Market Assessment for Organics Diversion through Reduction, Reuse and Recycling in NW Lower MI

2021 EGLE Market Development Grant

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Rotary Charities Resources for change.

EXECUTIVE SUMMARY

The goal of this project was to understand the generation, diversion, and current flow of organics within the 10-county region of northwest lower Michigan. The project was commissioned by SEEDS Ecology & Education Centers (SEEDS) and funded by two grants: 1) a 'seed' grant from Rotary Charities of Traverse City and 2) a Market Development grant from the Michigan Department of Environment, Great Lakes and Energy (EGLE).

This project sets the stage for increased diversion of organics from landfills by identifying value-added marketable opportunities. Project partners evaluated the local organics supply chain and the prevention, rescue & recovery, and recycling management options by engaging stakeholders representing the entire value chain: identifying existing sources and volumes of wasted and landfilled organics, processing and hauling capacity, and existing avenues for preventing food waste, recovering and adding value such as rescued foods for distribution to people or animals and small-scale decentralized and centralized composting operations.

The project team made up of SEEDS staff and volunteers, non-profit and public partners, and consultants accomplished the following activities:

- Conducted best management practice research through case studies and literature reviews.
- Evaluated prevention, rescue/recovery and recycling processing opportunities and applied feasibility of each option to each county in the region.
- Modeled centralized composting capital and operating costs.
- Modeled a preliminary collection and transportation plan.
- Projected GHG emission savings, value of carbon saved and green job generated.
- Identified actionable next steps that will support the organics circular economy and will inform and catalyze actionable diversion and processing here and throughout Michigan.

The background, methodology, and results of the assessment can be found the body of the report with supporting material in the appendices. In summary, this assessment includes:

First, using RRS waste characterization data calibrated with Michigan EGLE characterization data, the team calculated a regional generation rate of approximately 75,000 tons of yard and food waste annually, about 22,000 tons is commercial food waste, 18,500 tons is residential food waste, and 34,000 tons is yard waste (50:50 residential/commercial). It is assumed throughout this report that yard waste includes wood waste, but it is known that there is a gap in data collection around wood waste and much of the wood waste disposed and diverted goes unreported to the state.

Then, using information gathered from surveys on food donation, on-site composting, food waste to hog farms and centralized composting, along with the reported data to EGLE from registered sites, the currently diverted volumes of organics were calculated to be 7,750 tons per year.

Next, feasible prevention, recovery, and recycling opportunities were applied across all the counties based on key criteria (i.e., costs, ease of implantation, needs/challenges) informed by the case studies, literature reviews, and the results of surveys of generators, haulers, processors, and end users. This resulted in an estimated potential organics diversion by opportunity and by county, for a total of approximately 26,000 tons per year, or almost 35% diversion. This exceeds the State of Michigan's goal of 33% organics diversion (to meet the overall recycling goal of 45% statewide by 2025). The following table illustrates the diversion by opportunity, by county, and total.

ANNUAL TONS YARD AND FOOD WASTE								
			Estimated Potential Diversion					
COUNTY	Generation	Current Diversion*	Prevention	Rescue/ Recovery	Recycle**	Centralized Composting	Tons Diversion	Percent Diversion
Antrim County	6,149	41	81	39	345	935	1,400	22.8%
Benzie County	5,101	108	62	30	360	686	1,138	22.3%
Charlevoix County	6,687	1,286	91	44	387	1,415	1,937	29.0%
Emmet County	8,006	1,048	236	127	678	2,806	3,847	48.0%
Grand Traverse County	19,074	4,003	319	302	1,551	8,301	10,473	54.9%
Kalkaska County	5,114	14	61	30	229	721	1,041	20.4%
Leelanau County	5,850	751	76	36	447	861	1,420	24.3%
Manistee County	6,366	421	85	41	321	992	1,438	22.6%
Missaukee County	4,608	1	52	25	194	561	832	18.1%
Wexford County	8,035	77	115	56	547	1,789	2,507	31.2%
TOTAL	**74,989**	**7,750**	**1,179**	**729**	**5,060**	**19,066**	**26,034**	**34.7%**

*Current Diversion tonnage is estimated based on 2021 survey data and 2019 EGLE Waste Data System (WDS) of reported volumes to permitted composting sites.
**Recycle includes backyard composting, community composting and animal feed. The estimated diversion by sub-category is included in the appendix.

Next, costs and benefits to implement the diversion opportunities were estimated and are shown in the following table.

	Prevention	Rescue/ Recovery	Recycling	Centralized Composting**	Total Food Waste	Total Yard Waste + Food Waste
Total Tons Diverted	1,179	729	5,060	19,066	11,689	26,034
Total Annual Cost	$ 42,073	$ 51,381	$ 312,929	$ 3,322,824	$ 654,491	$ 3,729,206
Avoided Landfill Costs	$ (49,492)	$ (30,590)	$(212,358)	$ (800,213)	$(490,579)	$(1,092,654)
Saved Tons CO2e	(1,803.54)	(3,584.32)	(5,276)	(2,774)	(15,807.23)	(13,437.40)
Value* of Carbon Saved	$ 90,177	$ 179,216	$ 263,797	$ 139,458	$ 790,361	$ 672,648
Total Cost (Benefit)	$ (97,596)	$(158,425)	$(163,226)	$ 1,799,319	$(626,449)	$ 1,380,071
Total Cost (Benefit) per ton	$ (83)	$ (217)	$ (32)	$ 94	$ (54)	$ 53
# FTE	0.40	0.60	2.00	17.58		

* Social Value of Carbon (Yale 2021) = $50/ton
**6.6 jobs per 10,000 tpy (ILSR 2021) plus 4 FTE for hauling/collection

A range of diversion solutions were considered for this analysis. Although the largest quantity (slightly less than 75%) of material is shown to be diverted through centralized composting, the impacts of prevention, rescue/recovery, and other recycle options are proportionately most impactful. This study proposes that the focus of the leadership for these activities exist with SEEDS and its partners. Specifically, SEEDS should leverage its EcoCorps program with the appointment of an Organics Diversion Director. This Director, with the assistance of 2-3 EcoCorps members can provide critical extension-type technical and policy leadership services to implement and promote the organic diversion program throughout the 10-county region. The extension model is essential in nature in order to provide and promote a diverse set of organics recovery activities across the entire region.

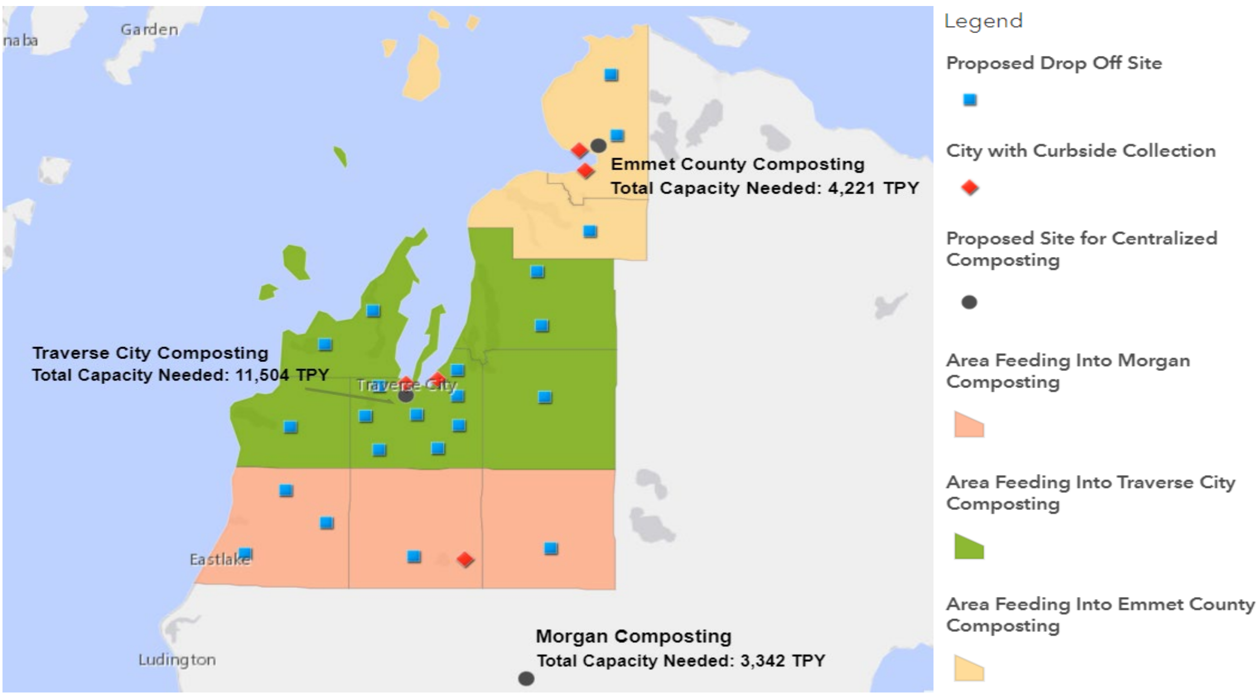
The development of one or two appropriately sized and centrally located aerated static pile facilities either on one of the yard debris processing sites or a standalone site is recommended. These facilities will provide recovery infrastructure for the residential, multi-family, commercial, and industrial sources of food waste. Additionally, organic materials generated in Manistee County, Missaukee County, and Wexford County can be most cost effectively transported and processed at Morgan Composting in Sears, Michigan.

In addition to the three centralized composting sites, curbside in the urban areas, and conveniently located drop-off/collection sites that feed either community composting sites or the centralized composting sites were considered. The design of the recommended collection system for the purposes of this report is preliminary and needs additional evaluation, discussions with haulers on service fees, equipment, pickup frequency, etc., detailed siting analysis for containers, and a robust education and outreach program.

The centralized composting sites identified in this report are used as examples because of their location close to regional centers of population and because their consideration enables the efficient use of existing infrastructure. The cost and collection modeling illustrated in the following map uses these sites as examples so that the project team could identify transportation distances and capital costs. However, as the organics program continues to grow and evolve over time, other centralized composting sites may be identified and developed instead or in addition to the sites illustrated in this report.

In response to the recovery goals set forth in the preceding tables, the total capacity needed by these projected facilities to manage organics through centralized composting is 4,221 tons at Emmet County Composting, 11,504 tons at a site in Traverse City, and 3,342 for Morgan Composting in Sears, Michigan. The identified flows of organic material were in each instance utilized to model the size and costs of the centralized composting facility upgrades as well as collection and transportation of the material supply.

The following map identifies the locations of both the existing pieces of the 10-county regional organics recovery and proposed locations for new additions to this infrastructure. The ArcGIS Online map link shown below the following figure allows the reader to access additional information that was used to develop this analysis including generators, existing composting sites, haulers, etc.



Map Link

The proposed drop off sites (blue squares) represent the number of drop off sites needed assuming all are the same size and material from the drop off sites could feed either community composting sites or the centralized composting sites. The exact locations and operations of the proposed drop off sites, or community composting sites, has not been determined in this phase of the study.

Cost modeling of the proposed centralized aerated static pile (ASP) facility upgrades in the Emmet and Traverse City regions were prepared using engineering estimates of the necessary capital site and equipment upgrades as well as operation requirements (labor, equipment, services). Revenue from material tip fees and finished compost sales were also identified in order to create a full financial assessment of the whole operation. For the sake of comparison, costs were determined on a per ton basis using standard amortization approaches and a discount rate to annualize capital costs. Collection and transfer costs are similarly evaluated and incorporate simple evaluations of the cost to move organics material from centralized collection sites and curbside in the urban centers to the composting facilities. The details of the model of proposed centralized aerated static pile (ASP) facilities can be found in the body of the report and the appendix.

Tools necessary fully implement the organic diversion plans laid out in this document are detailed in subsequent sections. In summary however, three approaches are suggested:

1. **Fees for Service –** As shown in the preliminary analysis. With the correct combination of tip fees paid for incoming material, sale of finished compost, and efficient operations, individual composting sites are capable of supporting themselves financially. Although, capital requirements for the site improvements and equipment upgrades at each of these sites are not insignificant a large portion of these costs could be offset by grants and zero interest loans, further reducing annual costs. In addition, some extension services contemplated for SEEDS are also partially or fully reimbursable by paid participants.
2. **Grant and Loan Funding –** SEEDS is already an active participant in a statewide circular economy initiative called NextCycle Michigan (NCMI). As a participant in this accelerator, SEEDS is benefiting from additional institutional support for its 10-county Organic Diversion Program and is being prepared for accessing planning and capital investments from the State of Michigan and other NCMI investors. These funds can be utilized for subsidy of backyard composting equipment, centralized composting site capital improvement, drop-off station development, and comprehensive education and promotional material development. Traditional lenders such as credit unions and local banks have proven willing to provide conventional financing tools for certain assets (e.g., trucks, building improvements) that can be conventionally underwritten. Local NGOs, charities, and individuals have already proven willing to provide donations to initiate this project and can be expected to continue their support.
3. **Local Unit of Government Funding –** The 10-county regional approach is powerful in its ability to mobilize for common goals and outcomes. Annual financial contributions from each of the participating counties to the SEEDS Organic Diversion Program will be critical. Likely, the fairest way to proceed would be to create an annual budget into which each county pays a sum proportional to its number of households. These funds could be used to support the extension type activities described previously.

Taken together, all of these sources of support create a powerful network of funders who can support a multi-county initiative of this sort. Collectively, these diverse opportunities for funding have development into an established system that is now described as Impact Investment. Impact Investment philosophies argue that there is a range of investment types (from traditional venture capital through banks to grants) all of which can play a role in financing ventures that might have multiple kinds of return (social, economic, and environmental).

The scope of this first assessment is necessarily limited by time and budget. But, as a conclusion to this initial survey and feasibility effort a series of next steps become evident. They include:

1. Continue to develop momentum of support through in-person and virtual forums to share successes and develop a serious of regionally appropriate best practices for food waste organics diversion.
2. Engage existing infrastructure (e.g., Keystone Site, Emmet County, Dairy-Doo/Morgan Composting, Food Rescue/Goodwill Industries of Northern Michigan, other private operators) to determine how these groups could individually and collectively leverage their resources to implement the diversion vision laid out in this document.

3. Leverage regional diversity and capability to identify and take advantage of unique circumstances (farmer engagement in animal feed, farm-to-table interest, organic agriculture demand for compost, citizen engagement in food rescue) to enable growth in organics diversion.
4. Advance SEEDS and its stakeholders to another level of leadership through active development of funding necessary to hire an Organics Diversion Director and staff the EcoCorps Team to enable immediate technical support and advance program momentum.
5. Identify and align with trends in organics recovery and circularity to further the goals of reduced methane emissions, feeding the hungry and building a policy environment that creates a long-term and sustainable plan for exemplary organics diversion in the 10-county region.
6. Develop a funding plan and solicit funds from the wide spectrum of investors (NCMI, EGLE, local charities/philanthropic organizations, impact investors, convention banks/credit unions) to obtain funds that are targeted for specific uses appropriate to those financial resources.

As part of this study, it has also become evident that further research and informational assets are likely required. Work can continue, most likely through the efforts of SEEDS and its stakeholders, to do things like seek further information from current operations, revise the findings of this feasibility analysis, build support and increase interested stakeholders, and overall popularize the ideas discussed here with local appointed and elected officials.

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BACKGROUND AND PURPOSE

GOALS AND OBJECTIVES

The project goal is to identify existing market forces that can be leveraged to catalyze increased organics diversion from the landfills of northwest lower Michigan by strategic investments in value-added processing of local organics. Rescuing organics from landfills presents numerous and cascading positive impacts improving the health, safety, and economy of Michigan residents. Transforming trash into treasure through the efficiency of cost savings and the economic impact of business-building is a key component in Michigan's transformation into a more resilient state.

As Michigan works to support recovery from the ongoing COVID-19 pandemic, and in light of future economic, social, and environmental hurdles that are sure to come, there has never been greater urgency to recover the wasted value of materials currently being landfilled. Waste organics in particular are key source materials for agricultural fertility, stormwater, and erosion management products, and for other economic, social, and environmental benefits. Our cultural appetite to explore connections between food, soil, and human health is at an all-time high and this had direct positive implications for increasing management of materials at the end of their useful life to the consumer. We can and will increasingly transform the wastes of one into valued inputs for another by connecting existing dots in more efficient ways that benefit and spur circular economies.

Because organics management in particular is best performed locally, due to transportation and spoilage considerations, green jobs growth in this sector has the potential to grow quickly and in a distributed manner through development of numerous small and medium-scale efforts. Further, the diversion of organic wastes will also improve the value of other recyclables, like paper, by improving source separations and keeping other recyclables clean. And finally, it is the wet, sloppy organics that help make handling solid waste dangerous – especially in terms of virus transmission and pest attraction. As we rebuild Michigan's disrupted economy, this is the moment to also transform it by investing in systems that close the loop on garbage, turning trash back into treasure.

This project's key objective is to identify clear, strategic next steps for the best practices management and processing of these specific organics based on local market and value-chain contexts, and to discover, analyze, and evaluate regional organics supply chain factors that influence and determine organics diversion and market drivers.

The project developed actionable next steps from a review of best practices and a detailed analysis of the current regional supply chain including quantified information and strategic direction informed by triple-bottom-line metrics for local and regional efforts that will result in increased rates of organics rescued to feed people, to feed animals, and to be processed into value-added beneficial end-products for landscaping, agricultural, stormwater / erosion control, and other markets as identified. The project gives a clear understanding of the current-state organics supply chain system and models the feasibility of multiple opportunities to increase organics diversion through community-based solutions. The value-chains and opportunities in northwest lower MI will also be a useful standard for comparison freely available to other communities engaged in similar work.

PROJECT PARTNERS

This Market Assessment was commissioned by SEEDS Ecology & Education Centers as a component of a bigger initiative to holistically understand and address organics waste streams in the 10 counties of northwest lower Michigan. Market analyses, data collection, evaluation, and facilitated interactive dialogue among key players required an intensive amount of professional time. From data design and collection to qualitative interviews and technical modeling, this effort was made possible through the time and effort of staff, volunteers, vendors, and partners. This Market Assessment was funded in large part by Rotary Charities of Traverse City and a Market Development grant from the Michigan Department of Environment, Great Lakes and Energy (EGLE).

Project partners were solicited particularly because of their leadership roles and their direct connections to individuals and networks along regional organics value-chains. Their expert time supported the project in significant ways to review progress and guide implementation. The project's Core Advisors were:

Michigan Recycling Coalition (MRC) - Project implementation leadership and guidance. Access to data resources and network of statewide stakeholders. Publishing BMPs online for public access.

Networks Northwest (NN) - Project implementation leadership and guidance. Access to mapping, planning, and economic data resources. Convenes a Materials Management Advisory Committee for the 10-counties and other local stakeholder groups.

Grand Traverse County Resource Recovery Department (GTC) - Project implementation leadership and guidance. Access to County data resources and network of stakeholders.

Emmet County Recycling - Project implementation leadership and guidance. Access to County data resources and network of stakeholders.

Manistee County Recycling - Project implementation leadership and guidance. Access to County data resources and network of stakeholders.

Bay Area Recycling for Charities (BARC) - Project implementation leadership and guidance. Access to business data and personal network of stakeholders.

SEEDS Ecology & Education Centers (SEEDS) - Project convener and fiduciary organization.

Other key partners included Grow Benzie, Food Rescue of Goodwill NMI, and numerous other businesses and individuals who provided data and information for this report.

Consultant, subcontracted partners were:
1. Resource Recycling Systems (RRS) – technical expertise, technical modeling, synthesis of data.
2. Iris Waste Diversion – technical expertise and qualitative data collection.
3. Good Impacts – communications coordination and qualitative data collection.

EXISTING CONDITIONS

NORTHWEST LOWER MICHIGAN ORGANICS OVERVIEW

The 2021 Gap Analysis Update[1] identified organics as the single largest component of municipal solid waste at 38% by weight. Organics comprise roughly more than one-third of both the municipal solid waste and recycling streams. Therefore, if the State of Michigan seeks to increase the overall recycling rate from its current 15% to 45% by 2025, the State will have to focus on organics recovery. This project aims to develop best practice management options of organics to increase organics diversion from the landfill, including food rescue and organic waste processing.

The ten counties in the northwest lower MI region have a 2019 estimated MSW landfill disposal of 241,585 tons per year, including 67,239 tons of organics going to the landfill. Organics diversion from the landfill was 5,833 tons, according to the EGLE WDS Database of reported volumes to permitted composting sites, with the majority of this being yard waste (93%). The average of the volumes reported to the Market Assessment project team during the surveying and from the 2019 EGLE WDS database is 5,752 tons currently diverted though centralized composting and another 2,998 tons are currently diverted through donation, backyard/onsite composting and to hog feed. Total estimated currently diverted is 7,750 tons per year.

As noted in the gap analysis, to increase Michigan's recycling rate to 45%, approximately 33% of the organics currently going to disposal will need to be captured for organics processing at compost or anaerobic digestion facilities. At a minimum, for this 10-county region, an additional 30,508 tons (50:50 residential to commercial) of organics need to be collected and processed to achieve the state organics diversion goal.

FOOD WASTE AS A PRIORITY

This study focuses on the feasibility of not only recycling of food waste through composting but includes prevention and rescue opportunities that play a role in the reduction of food waste overall and reducing the amount that will need to be collected and processed at a centralized compost site.

Northwest lower Michigan is fortunate to have established agencies, organizations, and businesses involved in food waste prevention, rescue, and recycling. In 2019, the Northwest Michigan Organic Diversion Advisory Group ("Advisory Group") was established to bring together a diverse set of organizations to help build a unified approach towards reducing food waste and leveraging it to benefit the region. The Advisory Group takes a wholistic approach to combat food waste by creating solutions geared towards preventing food waste, rescuing, and redistributing edible food, and recycling food through composting and other technologies.

FOOD WASTE PREVENTION

The region, specifically Emmet County, ran a residential food waste prevention educational campaign called *Give All Food A Future*. This foundation grant funded campaign targeted residential food waste reduction and provided a variety of tools and giveaways at Petoskey and Harbor Springs Farmer's markets and through presentations spanning from 2017- 2019. This is a replicable program focusing on starting small, helpful shopping tips, a under the kitchen sink compost caddy, a pledge form for residents to commit to reducing their food waste in a variety of ways. Gains and benefits accrued through prevention activities have not been easy to quantify and evaluate over time. Lately, progress has been made in developing

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[1] Source: 2021 Gap Analysis Update, NextCycle Michigan

better tools for measurement and efforts to quantify show that successful outcomes for food waste prevention incorporate both real quantitative reduction in food wasted as well to create a robust measurement environment that is sufficient to measure and communicate success.

FOOD RESCUE

Food Rescue, a program of Goodwill Industries of NW Michigan, receives roughly one million pounds (500 tons) of whole foods for distribution to nearly 50 regional food pantries and meal-serving sites. There is more demand for produce than the program can meet and there are more sources of produce that would be donated but for the barriers posed by the program's current capacity. Other local partners that manage food rescue, food donation and distribution include Cherry Capital Foods, Manna Food Project and the Little Traverse Bay Bands of Odawa Indians member food bank and their affiliate farm. While access to local data is limited, according to Feeding America estimates, at least 6 billion pounds of fresh produce goes either unharvested or unsold each year in the U.S. and about 20% of the fruits and vegetables the agricultural industry grows don't even make it off the farm. This number doesn't include food loss that occurs due to handling, storage, processing, or packaging issues. According to Healthy Harvest, demand for aesthetic perfection and homogeneity in produce makes whole-harvest selling impossible for farmers leaving 66,500 acres left unharvested annually because produce doesn't meet these arbitrary standards. As a diverse agricultural region, northwest Michigan stands to rescue significant produce to improve food access and supporting animal husbandry industries. Food rescue organizations not only have capacity barriers to collect and distribute edible food but have a challenge with managing food waste and should be included in food waste diversion as well as prevention efforts in the region.

RECYCLING (BACKYARD COMPOSTING, COMMUNITY COMPOSTING, ANIMAL FEED)

The rural and agricultural region of NW lower Michigan lends itself well to de-centralized food waste recycling due to the lack of curbside collection services, the high cost of transporting waste, the need for rich soil to grow food. There are a number of farms, restaurants/B&B's and food co-ops in the region that compost their organics onsite, there are a number of community farms that also offer community composting and there is a significant number of farms and haulers that collect food scraps for hogs. A large hauler (Organix out of Chicago) services the big box grocers in the region and take their food waste to farms for feed. Appendix M includes a case study on one food scraps to animal feed operation. Emmet County's Give All Food A Future campaign targets residential food waste reduction and provided a variety of tools and giveaways at Petoskey and Harbor Springs Farmer's markets such as under the kitchen sink compost caddy and conducting backyard composting workshops. Appendix K includes a case study on the Emmet County program.

YARD WASTE COLLECTION

In the State of Michigan, yard waste accounts for 9% of organics for potential recovery and 93% of currently recovered organics, demonstrating Michigan's success in the yard waste landfill ban to promote yard waste collection and diversion. In the 10-county region, yard waste accounts for about 65% of the overall diversion potential. There are numerous options for residential and commercial drop-off of yard waste (and wood waste) in the region. Table 1 below lists the 11 known (and surveyed) compost collection and processing sites in the region. To highlight a program, East Bay Township (Grand Traverse County) gives out a few passes each year to allow residents to take yard waste to the Traverse City Keystone site for free. Appendix K includes a case study on the Emmet County compost operation.

FOOD WASTE COLLECTION

The diversion of food waste from landfills is one of the top goals of this Market Assessment and the region will not meet its goals unless a collection program for food waste composting is in place. Emmet County operates a food waste collection program for commercial businesses in Petoskey and Harbor Springs. Following a successful pilot in 2015 the county continued to expand the program's offerings. It began as a back-of-house (food preparation, pre-consumer) food scrap only program and has matured to include more commercial establishments, zero waste events and some public collection points. Since the program's inception the county has recovered over 2 million lbs. of food scraps and processes it at the County owned and operated compost site. Carter's Compost (closed as of the publication of this report) and BARC in Grand Traverse County collect food waste from restaurants, institutions, and grocers for composting. Appendix K includes a case study on the Emmet County food waste collection program and another case study on Krull's Composting who processes food waste.

REGIONAL ORGANICS PROCESSING CAPACITY

There are currently seven small to medium EGLE-registered composting facilities in the 10-county region ranging from 50 to 3,000 tons per year, at least four very small un-registered facilities with less than 20 tons per year and one large, registered facility (upwards of 25,000 tons per year) just south of the region in Osceola County that accept materials from the region. The total estimated incoming volume of yard waste and food waste, based on the average of the volumes reported to the project team during the surveying and from the 2019 EGLE WDS database, is about 5,752 tons per year, and another 2,998 tons are currently diverted through donation, backyard/onsite composting and to hog feed. Total estimated currently diverted is 7,750 tons per year.

As discovered during the project's surveying process, five facilities in the 10-county region accept and process food scraps, and only one accepts BPI-certified foodservice packaging. All facilities accept and process some form of yard waste (mixed, leaves, brush) and two accept manure. The facility south of the region processes mostly manure and yard waste, but also accepts food waste and limited BPI-certified foodservice packaging.

Total known processing capacity (in acres) of the 11 facilities is about 70 acres, but only about 48 acres are currently used. Three facilities in particular, Emmet County, Traverse City's Keystone Site, and Krull's Composting are identified as potential expansion opportunities to receive and process more organics, as well as Morgan Composting directly south of the 10-county region.

Table 1 below displays the region's composting sites, their size, incoming volumes, and materials accepted as compiled by the project team as a result of the surveys. According to permits and current site capacity, the volumes of material processed at these sites could reach 10,000 tons per year using current windrow composting methods.

Table 1 Regional Organics Processing Sites

COMPOSTING SITE*	EGLE REGISTERED	TOTAL CAPACITY (ACRES)	USED ACREAGE	INCOMING VOLUME (CY) AS REPORTED IN SURVEY	INCOMING VOLUME (TONS) CALCULATED**	MATERIALS ACCEPTED
Tim Young's	No	10	unknown	75	19	Food waste, Wood waste, Food processing waste, horse manure, straw, unprinted cardboard
Carbon Farm LLC / 1801 Farm (also a hauler)	No	6	6	unknown	unknown	Food waste, Food processing waste for pigs
Grow Benzie	No	4	3	unknown	unknown	Yard waste
Carter's Compost (also bike powered hauler)	No	unknown	unknown	35	89	Food waste
Emmet County Composting Facility***	Yes	6	3	3458	880	BPI certified compostable, food waste, yard waste, brush, pallets, untreated wood for mulch
City of Charlevoix Composting Area	Yes	8	8	2500	480	Yard waste and wood waste
Boyne City-North Boyne Yard	Yes	3.5	3.5	unknown	780	Yard waste and wood waste
Traverse City Composting “Keystone Site”	Yes	21	13	12,000	2,552	Leaves and brush
Krull's Composting LLC	Yes	10	1.5	2,700	675	Food waste, yard waste, manure
Stewart's Excavating/City of Elk Rapids WWTP	Yes	unknown	unknown	200	29	Yard waste
City of Manistee Composting Facility	Yes	unknown	unknown	unknown	329	Yard waste
TOTAL (Municipal and Commercial)		**68.5**	**48**	**20,968**	**5,752**	

*Does not include Morgan Composting (Dairy Doo) which is just south of this 10-county region
**Average of survey reported (2021) converted tons versus EGLE WDS reported (2019). Conversions used: YW: 500 cy/lb; FW: 1000 cy/lb; used YW conversion if ratio of YW:FW unknown
***Emmet County volumes do not include wood waste.

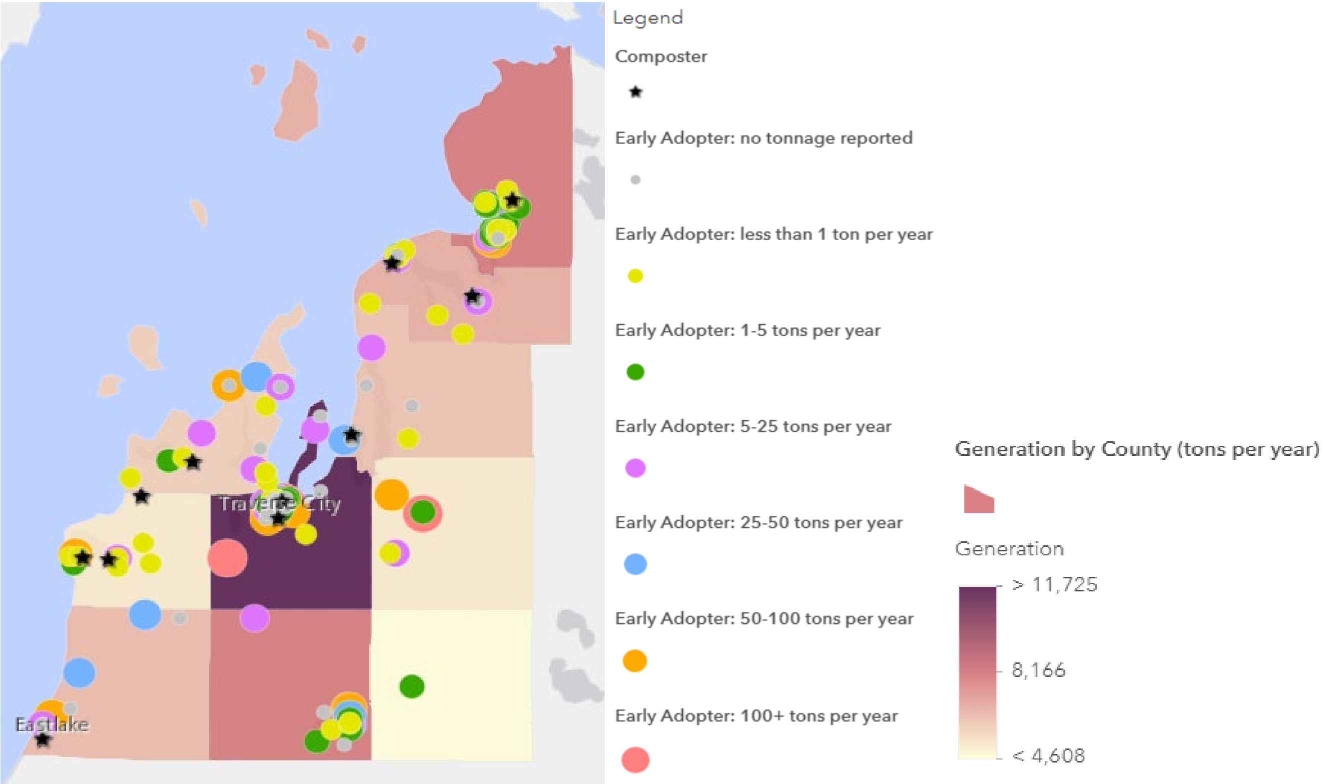
Hauling/Collection is through commercial contracts or residential drop-off. In addition,

- The City of Charlevoix and Traverse City offer seasonal curbside yard waste collection.
- Emmet County hauls 40-cy roll-off containers of yard waste (800 cy/year) from drop-off sites located in Petoskey and Resort Township.
- Emmet County hauls food waste (300 tons/year) from commercial businesses in Harbor Springs, Petoskey, Bay Harbor, Alanson, and Native Sovereign Nations- LTBB seasonally.
- BARC collects food waste and yard waste from commercial customers and takes to Krull’s.
- Carter’s collects food waste (about 7,000 gallons/year) via bike and trailer, seasonally.

- Carbon Farm collects food waste and yard waste (up to 1000 lbs./year) via trailer from farms and commercial businesses weekly, seasonally.

The map in Figure 1 below, created using ArcGIS Online that allows users to select desired layers and data sets, shows the ranges of organics generation by location and county-wide and also the early adopter organics material generators, haulers, and processors. Later in the report another version of this map will be shown that includes proposed processing sites and haulers with service ranges.

Figure 1 Regional Map of Generators, Haulers and Processers



Map Link

METHODOLOGY

The project team performed a baseline analysis obtained by collecting and synthesizing existing datasets, conducting literature and best practice reviews, and generating case studies combined with direct qualitative interaction, through formal surveys and informal discussions, with numerous stakeholders along the entire value-chain.

Qualitative dialogs served not only to populate the dataset and an interactive map of generators, haulers, existing and prospective processing locations, and end-use markets but also identified and cultivated relationships with strong advocates and critics.

The project team evaluated and modeled technical, financial, and environmental impacts of discovered opportunities. Key opportunities were modeled for detailed operational and capital needs and technical descriptions of recovery approaches appropriate for this region were prepared. The summary analysis supported by this grant will enable directional decision making about the preferred approach(es) and can be used to justify and enable focused future actions related to obtaining capital and operational startup funding.

CASE STUDY METHODOLOGY

RRS completed online research of several different options for case studies to highlight organics diversion efforts that are optimal examples of the diversion process and outlined key examples in the categories of aerated static pile (ASP), urban windrows, rural windrows, on-farm composting, food waste to animal feed, community composting, forced-air windrow composting, and backyard composting.

SURVEY METHODOLOGY

To discover sources and volumes of organics generated, understand the currently diverted volumes and potential for increasing the organics diversion rate in the Northwest region of lower MI, as well as determine the existing hauler and processing capacity and end use markets, a survey of representative sample of the various organics market segment was selected for surveying as described in Table 2. Due to availability of market segments and willingness of participants, not all market segments were able to meet the target number of interviews as noted in Table 2.

Table 2 Market Segments for Surveying

MARKET SEGMENT	DESCRIPTION	TARGET INTERVIEW BREAKDOWN	ACTUAL INTERVIEW BREAKDOWN
Generators	Areas that are creating organic waste including businesses, residents, restaurants, hotels, farms, etc.	160	194
Haulers	Those that are moving organic waste within the region	12	5
Preprocessor	Sorters, transfer stations, drop-off locations and food rescue organizations	10	2
Processor	Composters, anaerobic digesters and bio char facilities	24	13
Market Supplier	Landscapers and composters (Selling only)	20	4
End Market	Golf courses, parks, landscapers, engineers/landscape architects, road commission/construction and other users of finished compost	20	7

To determine the distribution of surveys within the commercial generator category RRS estimated high generators and likely early adopters. To estimate the organics generation RRS used a general estimate based on business type and number of employees from CalRecycle[2]. The generators were separated into easy to identify categories to determine the highest organics generators as shown in Table 3.

Table 3 Commercial Generator Categories

INDUSTRY	COMMON BUSINESSES	HIGH VOLUME	MEDIUM VOLUME	LOW VOLUME
Arts, Entertainment, & Recreation	Casinos, Parks, Golf Course	x		
Durable Wholesale & Trucking	Lumber yards			x
Education	Schools	x		
Hotels & Lodging	Hotels		x	
Manufacturing - Electronic Equipment				x
Manufacturing - Food & Nondurable Wholesale	Breweries, Wineries	x		
Manufacturing - All Other	Furniture, paper and wood manufacturing			x
Medical & Health	Hospitals	x		
Public Administration	Municipal buildings		x	
Restaurants	Restaurants, Bars, Cafes		x	
Retail Trade - Food & Beverage Stores	Grocery Stores	x		
Retail Trade - All Other	Flower Shops, other retail		x	
Services - Management, Administrative, Support, & Social	Landscapers, Food Rescue		x	
Services - Professional, Technical, & Financial	Barber/beauty shop, furniture repair, cemeteries			x
Services - Repair & Personal				x
Not Elsewhere Classified	Farms, Utilities	x		

These estimates are used strictly to highlight the high-volume generators in order to select which industry categories should be interviewed more and not for actual generation data. Using these numbers and the estimated number of employees in each business sector within each county from LexisNexus[3] it was determined that Grand Traverse County had the highest number of interviews while Missaukee County had the least. RRS used industry knowledge to estimate the minimum number of interviews the remaining market segments as shown in Table 2.

The surveys were completed by a variety of SEEDS project partners as well as self-reported by businesses. Each interviewee was asked questions specific to their business type as displayed in Appendix B.

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[2] Cascadia Consulting Group. 2015. "2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California."
[3] Online news & business research database tool. Accessed June 01, 2021. https://www.lexisnexis.com/en-us/professional/nexis/nexis.page.

VALUE CHAIN FEASIBILITY METHODOLOGY

Organics generation, rescue and recovery and recycling rates, diversion potential and feasibility of implementation of each option was identified and evaluated. To calculate organics generation rate, RRS used the estimated population of each county within the region along with per capita organics generation in Michigan specific to single-family, multi-family housing, and commercial sectors.

Current state generation and recovery rates were calculated by county, with the commercial sector rates informed by industry knowledge and localized by the survey results. Once generation for each county was estimated, RRS calculated the potential diversion for each county broken down into the solutions of prevention, rescue and recovery, small scale recycling, and centralized composting.

The range of solutions were evaluated by the project team for various criteria such as:

- Ease of Implementation
- Cost
- Diversion Impact
- Measurability
- Target Stakeholder/Waste Streams
- SEEDS' Potential Role/Feasibility
- Contingent Factors (needs/challenges)

The project team reviewed the criteria and determined key opportunities and the role of SEEDS and other project partners in implementing the solutions, as well as the possible needs and challenges of each. The outcome of this review can be found in the Results and Discussion section.

RRS also prepared a processing technology background summary and conducted a literature review of each of the solutions to give some examples of best practices and successes, and a deeper dive review for those who want to learn more about each solution. All of this was compiled into Processing Technology Options and Solution Options Matrix that can be found in Appendix F and Appendix D.

DEEPER ANALYSIS OF KEY OPPORTUNITIES METHODOLOGY

RRS further examined the most viable organics handling and value-add operations, as determined by value chain feasibility analysis, including siting, hauling impacts, equipment, and management requirements, and resulting triple-bottom-line impacts.

The project team evaluated and modeled technical, financial, and environmental impacts of key opportunities. Key opportunities were modeled for detailed operational needs, capital needs, and technical descriptions of recovery approaches appropriate for this region were prepared. The summary analysis supported by this grant will enable directional decision making about the preferred approach(es) and can be used to justify and enable focused future actions related to obtaining capital and operational startup funding.

RESULTS AND DISCUSSION

CASE STUDIES

Case studies were chosen to display the variety in methods and compost technologies that exist for repurposing organic waste in Michigan and throughout the US as described in Appendix M. The case studies showcase what the local community and surrounding neighborhoods are currently doing to manage organic waste. Despite the variety in operations, most interviewees shared a few common topics. First, education on contamination and impact of using compost was mentioned as an essential component to running a compost operation. Second, most operations obtained feedstocks from several different sources, such as residential curbside and drop-off, commercial haulers, and landscapers, in order to maintain consistent feedstock. Lastly, some operations created special blends or offered application services in order to supplement compost sales.

SURVEYS

SEEDS and their partners completed 225 interviews within the 10-county area of interest.

ORGANICS GENERATORS

Table 4 shows the breakdown of current reported activities of the generators as well as interest in becoming an early adopter of the organics collection program. 28% of generators surveyed that are not currently composting showed interest in the program. Educational outreach will help inform generators of the benefits of composting in order to generate further interest in the community.

Table 4 Organics Generator Survey Responses

LEVEL OF ORGANICS GENERATION	CURRENTLY COMPOSTING	NOT COMPOSTING	EARLY ADOPTER INTEREST
High	48	25	7
Medium	55	48	13
Low	10	8	3
Total	**113**	**81**	**23**

Table 5 shows the breakdown of current composters and non-composters by generator type. This illustrates that the biggest opportunities for organics collection lie in the Arts, Entertainment, Recreation category. This specific sector has high generation rates as well as a high level of interest in becoming an early adopter of food waste recovery, reuse, and recycling activities. The restaurant, bar, café, and retail trade categories make up the largest segment of the 10-county area for business generators. 8 out the 9 farms interviewed are currently composting through on-site methods; more farms could be considered for small-scale processing site or drop-off/pre-processing sites to reduce the amount going to centralized composting. Over half of the generators interviewed in these categories were already collecting compost while many of those not already composting showed little interest in starting the program. It is important to note that the survey team was able to self-select generators within the various categories, so the percentage of those already composting or interested in composting may be slightly skewed. These generator categories would be another strong target for educational outreach along with all educational facilities and medical buildings containing cafeterias as these can be high generators. A consideration to point out is that cafeterias under local control may be easier to implement a waste reduction or recycling program, while those subcontracted out to a corporate foodservice business (i.e., McLaren Northern Michigan Hospital, Petoskey Public Schools) may be need more time to approve and implement.

Table 5 Composting Activity by Generator Type

GENERATOR TYPE	LEVEL OF ORGANICS GENERATION	NUMBER OF GENERATORS CURRENTLY COMPOSTING	NUMBER OF GENERATORS NOT COMPOSTING	TOTAL NUMBER OF GENERATORS INTERVIEWED IN REGION	% CURRENTLY COMPOSTING	INTERESTED IN EARLY ADOPTER PROGRAM	% OF NON-COMPOSTERS INTERESTED IN EARLY ADOPTER PROGRAM
Arts, Entertainment, Recreation (e.g., Casino, Park, Golf Course)	High	4	4	8	50%	3	75%
Catering	Medium	1	0	1	100%	0	-
Correctional Facility	Medium	0	1	1	0%	0	0%
Distributor	High	0	1	1	0%	1	100%
Durable Wholesale (e.g., Lumber Yard)	Low	0	1	1	0%	0	0%
Education (e.g., School)	High	6	1	7	86%	1	100%
Environmental Non-profit	Medium	1	0	1	100%	0	-
Event Space	High	0	1	1	0%	0	0%
Farms	High	8	1	9	89%	0	0%
Food Distribution and Production	High	1	0	1	100%	0	-
Homeless Shelter	Medium	0	1	1	0%	0	0%
Hotel & Lodging	Medium	7	9	16	44%	1	11%
Household/Residential	Low	7	3	10	70%	3	100%
Manufacturing Food & Nondurable Wholesale (e.g., Brewery, Winery)	High	10	2	12	83%	0	0%
Manufacturing Other (e.g., Furniture, Paper, Wood Manufacturing)	Low	0	1	1	0%	0	0%
Medical & Health	High	3	4	7	43%	0	0%
Public Administration (e.g., Municipal Building)	Medium	7	3	10	70%	0	0%
Recycler and shredder	Low	0	1	1	0%	0	0%
Residential	Low	1	0	1	100%	0	-
Restaurant, Bar, Cafe	Medium	20	24	44	45%	9	38%
Retail Trade Food & Beverage (e.g., Grocery Store)	High	16	11	27	59%	2	18%
Retail Trade Other (e.g., Flower Shop)	Medium	10	7	17	59%	2	29%
Services - Administrative, Vendors,	Medium	9	3	12	75%	1	33%

Support (e.g., Food Rescue, Landscapers)							
Services - Repair & Personal (e.g., Barber, Furniture Repair)	Low	1	1	2	50%	0	0%
Utility	Low	0	1	1	0%	0	0%
Yoga Studio	Low	1	0	1	100%	0	-

ORGANICS PROCESSORS

The results of the composter and hauler surveys are summarized in Table 1 Regional Organics Processing Sites above. This data was used to further evaluate the existing composting sites' capacity to expand, current and future partners, and to identify gaps in the regional processing systems.

ORGANICS END-USE MARKETS AND SUPPLIERS

Four end market suppliers were surveyed, seven composters/suppliers, three landscape suppliers (two national brands). The key take-aways are:

- Compost is sold bagged (1) and bulk (all).
- Compost is sold to: landscapers (3), contractors (2), road projects (2), residents (4), farmers (2), municipalities (1), school gardens (1), community gardens (1), orchards (1) and vineyards (1).
- One supplier sells 800 cubic yards, another sells 3,000 bags per year.
- All but the small supplier can get enough product.
- Sale price is on average $9 per 1.5 cubic feet bag (range from $6 to $18 per bag); $5-$22 a cubic yard self-loaded, $30 a cubic yard loaded. One composter sells for $95/cy to specialty market of orchards and vineyards.

Seven end users were surveyed, one nursery, one tribal government and five farms, one who also produced their own compost. The nursery only uses sawdust. The key take-aways are:

- Compost is used for soil amendment/soil remediation/next to vines (5), landscaping (1).
- Compost is purchased either bulk or bagged from Dairy Doo (2), Traverse City, Emmet County, or Leelanau Road Commission.
- All responded that compost was readily available.
- Major concerns are #1 cost, #2 quality.
- Farms interviewed use anywhere between 60-200 cy/year and pay in the range of $5-$95/ton for compost.
- A high % of end users of compost in the region are farms.

The survey results are organized by county in order to evaluate the opportunities and gaps in collection, processing, and market segments. County-specific data and observations pertaining to key commercial organics generators, collection systems, system partners, and markets are in Appendix C. All of this information is considered in the value chain model to determine percent of organics likely to be prevented, rescued, and recycled, and discussed in detail in the next section.

VALUE CHAIN FEASIBILITY

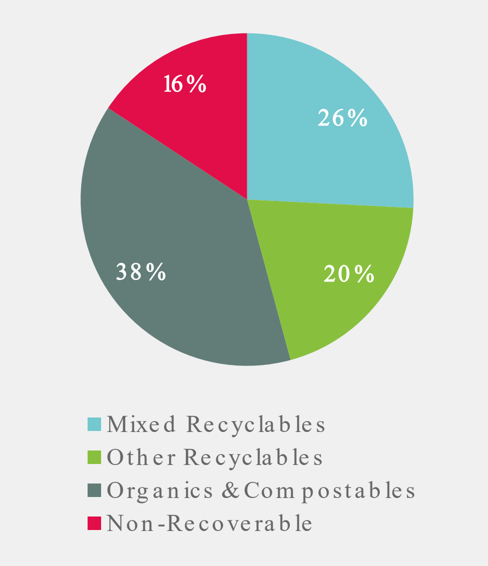
TYPES OF ORGANICS STREAMS AND RECOVERY SOLUTIONS

Organics Stream

Source separated organics (SSO) is often called "organics" but in actuality, the term "organic waste" includes a variety of compostable feedstocks, including yard debris, wood chips, brush, waste wood, manure, household organics[4] (HHO), and some wastepaper.

Leaves, grass, and brush (or yard debris) are the organic components of the waste stream most often considered for collection at the residential curb due to the Michigan yard waste landfill ban. Together with other organics such as food scraps and soiled paper, organics makes up a considerable percentage of the overall residential waste stream. Figure 2 shows the residential and commercial waste stream characteristics in Michigan. Organics makes up 38% of the municipal solid waste (MSW) stream. In the Appendix A, the reader will find more detail on the characteristics of organic waste, common considerations in designing the organics waste stream, frequent issues related to organics collection, composting, types of digestion systems, volume and capacity considerations, process economics, and prevention and recovery solutions for food waste.

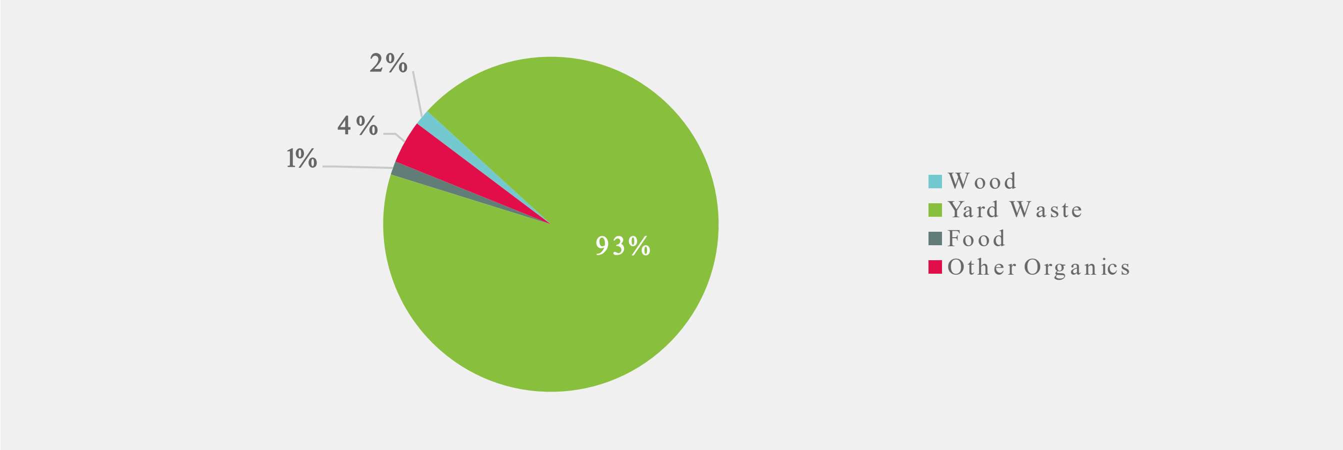
Figure 2 2019 Michigan Disposal Composition



As was found in the gap analysis, approximately 93% of composted organics is yard waste (Figure 3). This predominance of yard waste clearly reflects the existence of Michigan's yard waste disposal ban. This yard waste ban and the bottle bill are the only diversion from landfill policies in Michigan, further illuminating the need and effectiveness of policy levers, both state and local. The remaining composted material includes food (1%), other organics (4%), and wood waste (2%).

[4] Household Organics refers to food waste generated inside a residence.

Figure 3 Proportion of Organics Processed at Michigan Compost Facilities



Organics diversion from the landfill in the 10-county region is 5,833 tons, according to the EGLE WDS Database of reported volumes to permitted composting sites, with the majority of this being yard waste. The level of organics recovery in the region is much lower than the national recovery estimated by the US Environmental Protection Agency in 2014 (56%). Similarly, like the 2.8% of food scraps recovered nationally, the 10-county NW MI region collects only a tiny amount of this material at the current time.

The State of MI has an overall 45% recovery goal for all municipal solid waste (MSW) currently going to the landfill. For the 10-county region, this goal translates to a 33% organics recovery rate, or 30,508 tons. Additional organics recovery to meet regional and state goals requires a focus on food. As shown in Table 6, 46% of the estimated organics for potential recovery is food and currently food accounts for only 1% of the current organic's recovery in the state. In contrast, yard waste accounts for 9% of organics for potential recovery and 93% of currently recovered organics, demonstrating Michigan's success in the yard waste landfill ban to promote yard waste collection and diversion.[5]

Table 6 Additional Organics Recovery Needed in 10-County Region to Meet State Goals

MATERIAL	TONS OF ORGANICS RECOVERY TO MEET STATE GOALS	PERCENT OF ORGANICS RECOVERY TO MEET STATE GOALS
Food	14,034	46%
Wood	8,542	28%
Compostable/ Soiled and All Other Paper	5,186	17%
Yard Waste - General	2,746	9%
TOTAL	**30,508**	**100%**

[5] Source: 2021 Gap Analysis Update, NextCycle Michigan

Food waste is a subset of organic waste, which includes anything biodegradable that comes from plants or animals, such as yard trimmings and manure. Food waste includes unavoidable scraps, such as bones and rinds that retain beneficial value for reuse. It does not include waste from crop varieties specifically grown for fuel, animal feed, or other commercial uses. Further, recovery of residentially and commercially generated yard and woody waste materials are closely tied to food waste recovery efforts through both common infrastructure (curbside collection, yard waste composting facilities) and as needed constituents (e.g., bulking agents, carbon sources) to some recycling activities.

Consumer-facing businesses and homes represent over 80% of all food waste. Furthermore, home waste represents roughly two-thirds of total lost Economic Value, due to high volumes of waste, the higher cost of food sold at retail, and the high value of meat — a popular consumer purchase item.

Existing efforts already recover and recycle significant quantities of food in the region. These efforts, while not sufficient, represent commendable progress made by stakeholders to date and an opportunity to increase value further through more focus and attention on the issue.

The following solutions for increased diversion are organized by category (e.g., prevention, rescue/recovery, recycling/technology, recycling collection/policy). The full discussion of focus solutions, challenge solutions and stakeholder roles are included in the Solutions Recommendations in Appendix D. The areas of suggested focus and estimated diversion rates are informed by the proposed feasibility levels indicated in the Solutions Matrix in Appendix D.

Food Waste Prevention
Prevention is defined as stopping waste from occurring in the first place. On one hand, excellent prevention strategies will provide the region with the biggest bang for its buck. Food not produced, not transported, not warehoused, and not kept cold brings with it tremendous economic and environmental benefits.

Prevention solutions include:

- Educational Campaigns
- Waste Reduction Goals
- Waste Tracking and Analytics

Gains and benefits accrued through prevention activities have not been easy to quantify and evaluate over time. Lately, progress has been made in developing better tools for measurement and efforts to quantify show that successful outcomes for food waste prevention incorporate both real quantitative reduction in food wasted as well to create a robust measurement environment that is sufficient to measure and communicate success. Tools include the publicly available Conserve program offered by the National Restaurant Association, private solutions such as LeanPath, and internally built business tools.

Food Rescue & Recovery
Rescue/recovery is defined as redistributing food to people. Rescue/recovery also provides substantial benefit because it both provides resources to hungry people and in some instances, it avoids the production of additional food, thus providing significant social, economic, and environmental benefit in comparison to other solution types.

Rescue/Recovery solutions include:

- Food Donation
- Donation Liability Education
- Donation Transportation, Storage, & Handling
- Donation Matching Software
-

Although food recovery initiatives already exist throughout the region, opportunity remains to increase donations. Food recovery networks — including food banks, pantries, soup kitchens, shelters, and other agencies — already receive and distribute many pounds of rescued food each year. While prevention strategies can be implemented independently, recovery requires a systems approach with key success features: first, businesses need to be protected from liability related threats and understand how to safely handle recovered food, second, policy that assess financial incentives for individual and corporate donations need thorough understanding, and finally, appropriate infrastructure for transportation, processing, storage, and distribution are also needed.

Recycling/Processing Technology

Recycling is repurposing waste as energy, agricultural or other products and includes both small-scale solutions and centralized solutions. While good and useful activities to pursue, recycling/processing solution outcomes can only reap the benefits of methane generation prevention, soil enhancement, and conventional fertilizer displacement. Collectively, these benefits have lesser social, economic, and environmental benefits than prevention and rescue/recovery.

Recycling solutions include:

- Backyard Composting
- Community Composting
- Animal Feed
- Small-Scale Systems
    - Containerized Systems
    - Vermiculture
- Centralized Composting
    - Windrow Composting
    - Static Pile Composting
    - Aerated Static Pile (ASP)
    - In-Vessel Composting
- Anaerobic Digestion
- Co-Digestion
- Biochar

Once the opportunities for food waste diversion through prevention and recovery have been maximized significant organic materials remain and today most of these materials are sent to landfills where they incur disposal fees costing millions of dollars and rapidly create and release methane, one of the most potent greenhouse gasses.

Recycling technologies for organic, compostable materials have historically focused on the composting of lawn clippings and manure and been driven by bans or mandates to collect yard debris and lawn clippings in half of U.S. states. In many cases efforts to recycle food waste can be effectively combined with other, more established, organics recycling efforts.

Composting is typically the most cost-effective option for recycling food waste if the evaluation criteria is solely economic. While composting is a "natural" process, many technologies and engineered approaches are applied to processing food and other organic wastes into marketable compost. These range from low-tech windrowing to sophisticated, capital-intensive digester operations. Each of these techniques is designed to create an environment for reduction and stabilization of organic materials but vary in their applicability to source separated organics (SSO) recovery.

As a general overview, four technologies are reviewed in Table 7; each has its own advantages and disadvantages pertaining to the processing of food waste.

It should be noted that backyard composting and community composting can be an easier and inexpensive way for communities to generate enthusiasm about composting of residentially generated material. One of the most challenging aspects of starting a composting program and an essential component for success is getting residents to understand the value they personally receive from composting. An ideal means of demonstrating value is by providing incentives for residents to compost in their backyard or nearby community garden. Many cities in the U.S. promote composting by offering discounts or vouchers to purchase the equipment necessary to start. For example, the City of San Diego, California offers a year-round voucher program where residents can get one of three styles of bins at a discount. SEEDS and other organizations can promote backyard composting through its education programs and providing discounted kitchen counter-top collection bins and backyard composting bins, as Emmet County has since 2008 or as shared in the Henderson County case study in Appendix M. Emmet County also donates compost bins to community gardens and schools to help to create momentum in food scrap collection for schools, earth day zero waste events and even sales of Emmet County's compost to those community and school gardens. As identified in the survey process, many farms and some restaurants in the region already compost their organic materials on-site, thus reducing the costs and environmental impacts of hauling and processing off-site. These decentralized solutions should be encouraged through educational campaigns and incentives.

Evaluating the best long-term technology options for the region involves the consideration of:

- Feedstock volume,
- Biological engineering (aerobic versus anaerobic), and
- Access to end-markets.

A detailed discussion of composting technology options, volume and capacity considerations, process economics, prevention solutions, and recycling solutions are presented in Appendix F, including a literature review of small and large-scale technology solutions.

Table 7 Centralized Composting Processing Types

TECHNOLOGY	TYPE	DESCRIPTION	TIME TO FINISHED PRODUCT	APPLICABILITY TO SSO
Windrowing	Outdoor open air	Organic material is mixed and formed into long trapezoidal rows. Material is periodically turned and mixed.	3-9 months	Food waste must be adequately mixed with yard debris and bulking agents (wood chips) to balance the carbon-to-nitrogen ratio (C:N) and follow "best practices" for odor prevention.

Static Pile	Outdoor open air	Air is pumped into large pile to speed decomposition.	1-2 years	As above, need to balance the carbon-to-nitrogen ratio (C:N) and follow "best practices" for odor prevention.
Aerated Static Pile	Outdoor, indoor, or in-vessel system	Food waste is mixed with higher carbon-content materials and formed into long cylindrical rows and encased in a plastic bag "sleeve". Air is introduced into the bags.	4-6 months	Popular for animal manures and growing in application for additional high-nitrogen materials. As above, need to balance the carbon-to-nitrogen ratio (C:N) and follow "best practices" for odor prevention.
Anaerobic Digestion	Outdoor enclosed anaerobic	Organic material is typically mixed and warmed in a closed, airtight tank. Microorganisms break down or "digest" organic material without the presence of oxygen, typically for 6 weeks. Energy recovery from methane generation is common.	15-40 days	Household, industrial, institutional, and commercial organics (e.g., food waste) provide excellent nutrient sources in the digester. Not a solution for large amounts of yard waste.

Recycling/Collection and Policy
Centralized composting solutions require collection options. Even in the densest of urban settings, residential collection is sufficiently expensive that most communities seek to co-mingle residential food waste with existing (and higher volume) yard debris collections. However, collection of commercial, institutional, and industrial volumes with higher quantities can be cost-effective in urban communities. Finally, an established drop-off system can also enable organics collections for people wishing to self-transport materials. State and local policy plays a critical role to enable food residual diversion.

Recycling collection and policy solutions include:

- Community Compost Drop-Off
- Curbside Collection
- Pay-As-You-Throw (PAYT) Waste Collection Structure
- Local Policy

Organics Collection
Collecting one or more types of organic waste is an integral part of any composting system. Collection economics are important because collecting organics is generally more than twice the processing cost on a per ton basis.

The success of organic waste collection depends on several variables:

- Type/characteristics of organic waste to be collected,
- Type of collection container,
- Seasonal volume fluctuations,

- Available processing capability,
- Volume of material collected/economy of scale, and
- User convenience and participation.

Collection of SSO from residential and commercial sources, although still rare in the United States, is growing in popularity as more and more communities seek to increase their overall recovery levels. Canadian communities have had more experience and hence these programs provide important data and lessons learned. Downtown commercial districts with a dense clustering of restaurants provide an opportunity to collect food waste more efficiently than food waste for residential curbside. Still, SSO collection programs throughout North America vary considerably in terms of which wastes are allowed for collection. Basically, collection approaches fall into the following categories as listed in Table 8:

Table 8 Organics Collection Systems

COLLECTION SYSTEM	COST	PARTICIPATION/DIVERSION	TECHNICAL CHALLENGES
Food waste alone	(-) High costs per ton due to truck inefficiencies	(+) Allows wider range of processing options (anaerobic digestion)	(-) Winter freezing and summer "yuck" factors (can be somewhat alleviated by lining kitchen caddy with newspaper or brown paper bag)
Food waste plus yard debris (SSO)	(+) Lower cost per ton to collect	(+) Higher participation/diversion tonnage	(-) Seasonal nature of yard waste generation will create huge fluctuations in material flow
Addition of paper products	(+) Marginal costs of paper collection is low	(+) Higher diversion because there is a recovery options for non-recyclable fiber	(-) Increase potential for contamination at compost site and distraction from other recycling programs.
Co-collection with other streams	(+) Most cost-effective means of collection of food waste and kitchen non-recyclable paper because it uses the same vehicles as recycling program	(+) Easy to match with existing programs because they will be on the same day	(-) Truck modifications will be required in order to limit contamination to "clean" recyclables

Acceptable items in the food or "kitchen waste" category vary from program to program. Some programs accept only produce food scraps, some include meat, bones, and dairy, while other programs allow paperboard in addition to their collection of kitchen waste.

Food waste only collection programs for residential (also known as household organics, or HHO) are quite rare. Innovative collection schemes, ranging from bicycles to depreciated packer trucks have been used to provide residential users options for the collection of curbside residentially generated food waste. Typically, these limited collection programs generate insufficient material for economic collection. Other programs have shown that most successful programs find a means of co-collecting food waste with another larger volume material (e.g., SSO). In some cases, split packer trucks are used where one of the collection chambers is configured for municipal solid waste and the other for HHO. In other situations, particularly those where commingling seemed desirable, co-collection with yard debris provides an effective cost outcome as well as collecting from households in a downtown area on the same route with commercial food waste collection.

For commercial and industrial streams of organic waste more traditional approaches are usually employed. Specialize roll-off containers, packer trucks, and tanker trucks can all be used depending on the form and water content of the collected organic material. Any case, the means for collection of these organic streams and their development is highly dependent on the existence of sufficient processing infrastructure to enable acceptance of the collected organic material.

In addition, carbon based bulking agents are needed as part of the composting process. Bulking agents create spacing within the compost pile whereby oxygenated air can travel. This flow enables the composting to continue in an aerobic manner, without the odor and handling problems that can occur in circumstances where the composting process becomes anaerobic. In addition, woody materials can contribute needed carbon to the process to enable more effective breakdown of highly nitrogenous materials like food waste and grass. Where possible the addition of yard debris based bulking agent sources like tree trimmings or brush can be very useful in the processing environment.

Benefits of Co-Collection of HHO with Yard Waste

Many communities have implemented yard debris collection programs (frequently at the curbside) as part of an overall ethic of maximizing recovery or as part of outright landfill disposal bans. Over the course of the last thirty years, composting of yard debris in large scale environments has become relatively successful and commonplace. Although generation and disposal behavior of yard debris is not evenly distributed throughout the year, both private and public sector facilities have learned how to manage the fluctuations of yearly flow.

Three benefits derive from yard debris recycling. First, an awareness of the benefits of organics recycling and composting will begin to spread amongst residents and businesses from both the customer and the service provider perspective. Second, a collection and processing infrastructure will grow that will eventually create a portion of the recovery capability for HHO. Third, in residential circumstances the availability of routine, majority of the year and large-scale collection system creates a system that allows smaller volumes of HHO to "piggyback" on existing collection programs with little marginal cost impacts. Therefore, step one in the development of a composting program for the region should incorporate yard debris.

In addition, the physical characteristics of yard debris (relatively bulky and 50% moisture content or less) create a situation that facilitates the "bulking" of the wetter and "slimier" HHO stream. This characteristic is useful for both the collectors (in circumstances where HHO and yard debris streams can be combined into one container) and the processors who also benefit from being able to handle a more solid material. HHO alone at its collection point has a moisture content that ranges from 80 – 90%. Only the lightest handling will prevent this material from becoming a liquid sludge.

The greatest benefit of the co-collection of yard debris with HHO is economic. Throughout the year there simply isn't enough HHO material to justify a separate collection route. It is impossible for a conventional collection vehicle to stop at enough households in a day to fill its collection body. So, without the capability of co-collection of some other compatible materials the program costs would be prohibitive.

MODELING FOR FEASIBILITY IN NW LOWER MICHIGAN

Waste Generation, Characterization, and Recovery

The compilation and analysis of the waste generation and characterization determines the estimated volumes available for processing at a centralized composting site. Understanding the quantity and the make-up of the waste will inform the size and type of facilities required to process the material into a useful product. Additional variables that impact available volumes are participation and set-out rates in collection programs. Furthermore, consideration is also needed for activities surrounding waste prevention, rescue and onsite recycling which divert organic waste through decentralized activities such as backyard composting, food banks, and prevention of food waste through smarter purchasing and use of food.

Total Organics Generation

Using RRS waste characterization data calibrated with Michigan EGLE characterization data, Table 9 below shows the breakdown between single family residential food waste, commercial food waste, and yard waste. It is likely that yard waste designated as commercial is high because it is delivered by commercial landscapers in many cases generated at residential locations. Table 9 shows that there is approximately 75,000 tons of yard and food waste generation. Note: for purposes of this study, the yard waste portion includes wood waste.

Table 9 Organics Generation in NW Lower MI

FOOD WASTE GENERATION RATE	
	Tons/Year
Single Family Residential FW	14,833
Multi-Family Residential FW	3,774
Commercial FW	22,175
YARD WASTE GENERATION RATE	
	Tons/Year
Single Family Residential YW	16,353
Commercial YW	17,854
Total	34,208
GRAND TOTAL	**74,989**

Participation Rates

A key factor in driving higher diversion rates for organics recovery is the recycling participation rate. Participation rates define the engagement of residential homeowners, multi-family dwellers, and commercial building owners. Simply put, this rate measures the willingness of each of these participants to engage in the recovery behavior. We would expect a very successful food waste recovery program to achieve 60% participation from single family residence and 40% participation from multi family residence. Participation is easier to drive in commercial food recovery circumstances because generation per unit (collection quantities are greater at grocery stores, restaurants, schools, hospitals) tends to be higher. Finally, participation rates in yard waste recovery are the highest of all. The model assumes the participation rates do not vary between the 10 counties. A table showing estimated participation rates can be found in Appendix G.

Set Out Rates

For those system participants engaging in a curbside recovery program, set out measures their engagement on a week-to-week basis. Therefore, the following table measures only the activity of those actively participating in curbside recovery. Set out rates are used to modify participation rates in an effort to identify the total organics quantities available for recovery. Participants in high-performing programs put material out for collection on average only three-quarters of the time. Set out in single-family yard waste collection systems can be slightly higher. Also, the model assumes 1) a food waste and yard waste curbside program will only be initiated in the urban areas of Traverse City, Harbor Springs, and Petoskey, 2) a yard waste only curbside program will be initiated in Charlevoix and Cadillac, and 3) communities in other counties will collect food waste at commercial establishments. Tables showing estimated set-out rates can be found in Appendix G.

Total Recoverable Material

Before total volume of recoverable organics can be derived, application of an estimated percent of total diversion potential to each prevention, rescue/recovery and recycling solution opportunities in each county and then apply the set-out rates to the centralized composting solution is required.

Prevention, rescue/recovery, and recycling solutions were explored in depth by the project team as they sought to identify best solutions when tackling food waste reduction.

The range of solutions were evaluated by the project team for various criteria such as:

- Ease of Implementation
- Cost ($-$$$$)
- Diversion Impact (high, medium, low)
- Measurability (no, yes/how)
- Target Stakeholder/Waste Streams
    - residential consumers
    - commercial generators
    - food service operators
    - food rescue organizations
    - animal farms
    - local government, etc.
    - food waste, yard waste, etc.
- SEEDS' Potential Role/Feasibility
    - Information/Education
    - Promotion
    - Stakeholder education and networking
    - Secure funding, etc.
    - Leadership/Facilitation
- Contingent Factors (needs/challenges)
    - Funds/Costs
    - Feasibility study
    - Participation
    - Space/Land
    - Labor
    - Local policy
    - Balance carbon to nitrogen ratio (C:N)
    - Contaminants, etc.

The project team reviewed the criteria and determined key opportunities and the role of SEEDS and other project partners in implementing the solutions, as well as the possible needs and challenges of each. The Solution Matrix can be found in Appendix D and the full Solutions Recommendation can be found in Appendix E.

In summary, the project team derived the overall "vision for success" for each of the larger categories of solutions:

Prevention: The region seeks to accomplish the implementation of a world-class set of prevention approaches that create the opportunity for reduction of food waste by ~1.6% of total organics waste generation. With this reduction, comes additional profits for participating businesses (e.g. restaurants, caterers, grocery stores) and reduced costs of food for regional families and significant greenhouse gas emissions prevention.

Rescue/Recovery: The region seeks to establish, fund, publicize and implement an efficient food donation system that both diverts organic waste from landfills as well as provide food for community families facing hunger. It is estimated that ~1.0% of regional food waste can be diverted through Rescue/Recovery solutions.

Recycling: The region seeks to develop and fund a geographically disbursed, well operated composting infrastructure that can effectively accommodate a growing flow of organic material while continuing to recover currently delivered materials. ASP composting solutions will be evaluated where the population and generation densities warrant this centralized solution.

Where possible, onsite and neighborhood-scale solutions will be aggressively supported to enable self-management of organics by individual residents, institutions, and select commercial/agricultural options. Charismatic stories can illustrate closed loop strategies that show how food waste contributes to the production of more food (whether vegetables powered by compost or animals raised for meat that are fed food waste). SEEDS, in collaboration with other regional agencies and NGOs, needs to develop an "extension" expertise in the operation of onsite solutions. Overall, these activities can divert ~31.7% of the total organic available in the region.

Collection and Policy: The region seeks to create supportive and enabling policies for accomplishing best in class organic waste diversion. As part of this, support and funding for the development of an appropriately scaled collection infrastructure that provides access for the largest portion of the population will be essential.

Summary of Potential Diversion

Together, these prevention, rescue/recovery, recycling efforts are forecast to feasibly assist the region in a total recovery of ~35% of the regionally generated organic materials.

Based on the review of the survey data and determination of key opportunities, RRS applied an estimated percent of total diversion potential to each solution, county by county, and then applied the set-out rate assumptions to the centralized composting solution.

Table 10 shows the results of the analysis by county to derive a total volume of recoverable organics in the region. Table 10 shows that we would expect a medium level of recovery of organics to be 26,000 tons a year.

Table 10 Total Recoverable Materials by County

ANNUAL TONS YARD AND FOOD WASTE									
COUNTY	Generation	Current Diversion*	Estimated Potential Diversion						
			Prevention	Rescue/ Recovery	Recycle**	Centralized Composting	Tons Diversion	Percent Diversion
Antrim County	6,149	41	81	39	345	935	1,400	22.8%
Benzie County	5,101	108	62	30	360	686	1,138	22.3%
Charlevoix County	6,687	1,286	91	44	387	1,415	1,937	29.0%
Emmet County	8,006	1,048	236	127	678	2,806	3,847	48.0%
Grand Traverse County	19,074	4,003	319	302	1,551	8,301	10,473	54.9%
Kalkaska County	5,114	14	61	30	229	721	1,041	20.4%
Leelanau County	5,850	751	76	36	447	861	1,420	24.3%
Manistee County	6,366	421	85	41	321	992	1,438	22.6%
Missaukee County	4,608	1	52	25	194	561	832	18.1%
Wexford County	8,035	77	115	56	547	1,789	2,507	31.2%
TOTAL	**74,989**	7,750	**1,179**	**729**	**5,060**	**19,066**	**26,034**	**34.7%**

*Current Diversion tonnage is estimated based on 2021 survey data and 2019 EGLE Waste Data System (WDS) of reported volumes to permitted composting sites.
**Recycle includes backyard composting, community composting and animal feed. The estimated diversion by sub-category is included in the appendix.

Antrim, Benzie, Charlevoix, Kalkaska, Manistee, and Missaukee counties all currently have a relatively small amount of organics collection. These counties are unlikely to warrant centralized composting infrastructure due to the small level of in-county generation of organics and enthusiasm of the population. These counties are good candidates for increased education on backyard composing and food donations. It should be noted that some of the smaller areas of the region have a close proximity to the proposed larger composting facilities in Grand Traverse and Emmet counties.

LARGE COUNTY FACILITY	SMALL COUNTIES WITHIN PROXIMITY
Grand Traverse	Antrim, Benzie, Leelanau, Kalkaska
Emmet	Charlevoix

Emmet County has a well-established compost collection and processing infrastructure, these programs are a good candidate to use as a best practice demonstration, especially in the counties of Grand Traverse, Wexford, and parts of Leelanau. There is indication that development of a newer and larger composting facility with private sector operators could increase overall recovery by increasing processing capacity and encouraging greater participation. Grand Traverse County should continue to emphasize prevention related diversion activities while simultaneously focusing on increasing donation and animal feed diversions.

Leelanau County has a significant effort in organics recovery that engages farmers, onsite composting, and small-scale composting sites, which can be further developed and encouraged. Wexford County also has a significant effort in organics recovery that engage farmers and onsite composting, which should also be nurtured and further developed. For instance, there is a strong opportunity identified within the City of Cadillac for additional diversion from local restaurants. Wexford is a good county to increase education on connections with local composting facilities such as Morgan's Composting (Dairy Doo).

Table 11 shows each diversion category, what each category consists of, and the estimated potential diversion of organics (food waste and yard waste). The greatest potential for recovery lies with centralized composting, at 73.2% of the total diversion potential.

Table 11 Diversion Category Breakdown for Food Waste and Yard Waste

DIVERSION CATEGORY	DESCRIPTION	PERCENT DIVERTED FROM TOTAL GENERATION	PERCENT OF DIVERSION
Prevention	Consumer Education Campaigns, Waste Tracking & Analytics	1.6%	4.5%
Rescue / Recovery	Standardized Donation Regulation, Donation Matching Software, Donation Transportation, Donation Storage & Handling, Donation Liability Education	1.0%	2.8%
Recycle	Community Composting, Backyard Composting, Animal Feed	6.7%	19.4%
Centralized Composting	Municipally or privately managed composting	25.4%	73.2%

PREVENTION, RESCUE/RECOVERY AND SMALL-SCALE RECYCLING PROGRAM OPERATIONS

SEEDS is in a unique position to expand its operational support throughout the 10-county region through its EcoCorps program with an extension-type of service for food waste diversion activities. These activities should include: 1) education and outreach for food waste prevention and donation campaigns, 2) support for local policy, 3) managing the backyard composting portion of recycling with the addition of capital support (e.g., subsidized bins), 4) growing community composting sites, 5) training users and volunteers through regular annual trainings, and 6) providing ongoing field support and other extension activities.

SEEDS should seek startup support for these activities (e.g., bin purchases, educational/promotional material development, truck purchase) through grants or other one-time program support. Programming for a SEEDS manager position, supported by two to three EcoCorps members for use with extension activities and support for the entire 10-county regional organics initiative was also discussed and could be funded by ongoing operational contributions from the 10 participating counties with supplementary financing from local business, philanthropic, and non-profit groups. The following Table 12 shows the assumptions of SEEDS operational needs that were used to model these opportunities. The full table can be found in Appendix H. In addition to the annual operating costs, it is assumed a utility truck would be purchased as part of upfront capital for approximately $35,200.

Table 12 SEEDS Operating Cost Assumptions Summary

	ANNUAL COST	PREVENTION	RESCUE/ RECOVERY	RECYCLING - BACKYARD COMPOSTING	RECYCLING - ANIMAL FEED	RECYCLING - COMMUNITY COMPOSTING
Staffing	$ 178,904	10%	15%	25%	25%	25%
Education	$ 180,432	13%	13%	24%	25%	25%
Other	$ 7,260	10%	15%	25%	25%	25%
Truck Maintenance, etc.	$ 6,960					
Tools and Supplies	$ 300					

CENTRALIZED COMPOSTING SITING AND OPERATING CRITERIA

Both yard waste and food waste processing facilities have been the focus of lengthy siting and operating discussions in many communities. These discussions often involve the impacts (noise, odor, traffic, litter, etc.) that can accompany composting operations. Therefore, most states including Michigan have developed basic siting criteria for the location of composting facilities. These include:

- Setbacks from neighbors,
- Separation from groundwater and surface water,
- Access road requirements,
- On site storage limitations,
- Record keeping requirements,
- Limitations of volume per acre, and
- Hours of operations.

Composting siting considerations and a siting checklist template for evaluation of existing and new composting sites are provided in Appendix J.

Facility Regulations

There are local and state regulations when it comes to governing the development and operation of a composting site. These standards that include criteria that range from zoning and planning, water management, access roads, setbacks, odor and nuisance management, volumes of materials, and more. Effectively they require that site owners and operators undertake the following general steps in their facility development:

- Zoning consistency,
- Engineered site design with site stormwater management that prevents offsite runoff,
- Professional operational plans suited to the type and quantity of material to be composted,
- Active management plans and experience with preventative offsite emissions (odor, noise, dust, water), and
- Marketing plan for composted material.

A list of local permits and regulations as well as current State of Michigan EGLE compost site permit and regulations and a summary of proposed Part 115 compost site rules are provided in Appendix O.

Site Visits

RRS and Advisory Committee representatives visited several existing composting and collection sites in the region as part of this study to verify the data collected as part of the survey (Table 1) and to determine feasibility for drop-off/collection, pre-processing, and processing capacity as part of the regional organics strategy.

The two largest and most central composting sites, Emmet County Composting and Traverse City Composting Site "Keystone" were evaluated for current and future capacity and feasibility to meet the siting and permitting requirements. County and Traverse City representatives joined the site visits to share details on current operations, plans, and appetite for expansion, as well as possible challenges with the sites and local regulations.

Two smaller organics processing sites, Charlevoix Compost Site and Krull's Composting, were also visited to determine their feasibility in the regional strategy for pre-processing, collection/drop-off sites, or smaller processing sites.

Finally, the team toured two undeveloped sites, Glenn's Landfill and Historic Barns Park to evaluate the potential for public drop-off/collection sites.

The site visit observations and photos are in Appendix K. The following Table Table 13 is a summary of the key take-aways from the siting reviews:

Table 13 Site Review Summary

SITE	MATERIALS ACCEPTED	MATERIAL FLOW	SITE CONDITIONS	DEVELOPMENT OPPORTUNITY	OWNER/ OPERATOR STATUS	FUNDING
Emmet County Composting Facility	BPI certified compostable, food waste, yard waste, brush, pallets, untreated wood for mulch	Yard and food waste to windrows; woody materials to mulch (3x/year grinding)	Stable pad; **standing water;** supposed to drain to swales surrounding site; **overloaded with brush and wood (tub grinder on site to grind)**	Site at capacity currently with grinding operation; ASP system would help with site management and increased volumes	County owned and operated; **Possibility of outsourcing both food waste organic collection and compost site operations**	Limited County funds
City of Traverse City Composting "Keystone Site"	Leaves, brush, stumps	Leaves into windrows; stump grinding to Mid-Michigan for biofuel	Well drained; no retention; drains to river; no natural buffer from neighbors; built over closed landfill	Capacity to add food waste and more yard waste if site retention and groundwater are addressed with EGLE and if TC is on board with food waste; ASP system discussed	Joint City and County owned and operated	Mitigation effort could be funded through brownfield redevelopment funds
City of Charlevoix Composting Area	Yard waste and wood waste	Material is ground and moved into piles toward north edge	Relatively unimproved; standing water; Fully encircled by trees and is relatively accessible from the highway	Possible drop-off/collection site for pre-processing before going to Emmet County Composting Site	City owned and operated	

Krull's Composting LLC	Food waste, Yard waste, manure	Material into windrows; bagging finish product	Unimproved farm; well drained	Capacity to expand; possible drop-off/collection site	BARC delivers source separated food waste; Krull operates site	
Glenn's Landfill Site	N/A	N/A	Reasonably flat and wooded area adjacent and directly south of the landfill	Further exploration needed for drop-off/collection site	Glenn's Landfill	
Historic Barns Park (SEEDS Farm and Community Composting Area)	Vegetative waste from the community gardens and the Barns venue	BARC hauls food waste from special events; composted in static piles	Inefficient site access for public drop-off	Capacity for special event composting, pre-processing, and/or demonstration composting	SEEDS EcoCorps	SEEDS grants

The site visits were useful for exploring the idea of a centralized composting model using a site like the Traverse City site for a larger flow and Emmet County for a smaller flow with aerated static pile (ASP) technology. ASP processing technology would allow a reduced footprint with the ability to handle more volume of food waste. The next section of this report illustrates ASP model capital and operating costs as well as a feedstock transportation model, with benefits such as greenhouse gas (GHG) savings and local jobs opportunities.

The Charlevoix Compost Site and Krull's Composting could be used for drop-off/collection sites or smaller processing sites, with some site improvements to ensure storm and compost wash water management, public site access, and buffering operations from the neighbors. Glenn's Landfill site could be further evaluated for a public drop-off/collection site.

Historic Barns Park is best suited for continued processing of the SEEDS community farm vegetative waste, special event organics waste processing, and demonstration composting operated by the SEEDS EcoCorps program. The Historic Barns Park site could also be a location for pre-processing material from surrounding collection sites in the Traverse City area, assuming a partner like BARC can haul the material to the farm and from the farm to a larger centralized composting site. The SEEDS farm and community composting area demonstrated the power of the EcoCorps model and confirmed the notion that SEEDS is positioned to provide extension-like support for backyard (home) composting and onsite composting.

Next steps in site model development include:

- Determine feasibility of further site development at Keystone
    - Capacity for projected organics quantities,
    - Capital requirements for construction of a food waste capable composting operation,
    - Neighborhood features and barriers for composting,
    - Consultation with EGLE surface and groundwater specialists to determine regulatory appetite for using this site for food waste composting.
- Review of other sites options in the Traverse City area for centralized composting.
- Further refinement of the model to be undertaken as more direction is available from stakeholders.

- Further evaluation of privatized services (i.e., WeCare Organics, Morgan Composting) for the centralized composting sites as these large site operators have shown interest in expanding both their hauling and processing operations.
- Additional work needs to be accomplished on the organics marketing side to ensure valuable end products can be sold to local markets.
- Selection of public drop-off/collection sites (some with pre-processing capabilities like grinding) that will allow access for food waste and yard waste drop-off to urban and rural residents throughout the region.

DEEPER ANALYSIS OF KEY OPPORTUNITIES

CENTRALIZED COMPOSTING FACILITY RECOMMENDATIONS

In order to accomplish its organics recovery goals, SEEDS and its partners in the NW Lower MI region needs to initiate multidimensional prevention, rescue/recovery, onsite/decentralized recycling and centralized composting infrastructure investment. Centralized composting solutions will need to be developed to accommodate and manage around 73% of this recovery. Fundamentally, a choice will need to be made between higher tech and therefore more expensive solutions and lower tech and less expensive solutions. This section evaluates the opportunities for additional investment in organic recycling infrastructure and recommends a portfolio of facilities that would accomplish the most cost-effective recovery of organics in the region.

Centralized Composting Technology Options

See Appendix F for detailed technology solution descriptions.

Open Windrow Composting: Open windrow composting is the current method for most sites in the region. More than 10,000 tons per year may be currently composted by these facilities as shown in Table 1. Open windrow composting remains the most cost-effective means of managing traditional yard debris (grass clippings, leaves, garden pruning, and small brush) in the Midwest. When communities choose to have curbside residential food waste collected, food is most often deposited directly with yard debris in curb carts. Very few communities collect a single stream of residential food waste. Best practices show that the maximum fraction of food waste that is feasible to compost in an open windrow operation is between 10 and 15% of total volume. Fortunately, programs seldomly experience collection of single-family residential food waste at rates greater than 15%. But the overall quantity of yard debris makes the collection of residential food waste with yard debris the most logical means of implementing a residential food waste recovery program. Commercial food waste (including institutional sources) is most often collected source-separated in curb carts or front load dumpsters. Commercial food waste can add significant volumes to the mix and needs to be carefully considered in an open windrow composting system.

Aerated Static Pile Composting: Aerated static pile composting is most often used for materials with higher moisture content, greater opportunity for odor generation, and “messy” streams of organics. Streams of industrial and commercial food waste match this description and are often best managed using this more intensive, technological approach to composting. Simply put, if total food waste percentages exceed 15%, implementation of aerated static pile composting is necessary. Depending on incoming material make up, neighborhood geography, and the preference of the operator with either positive or negative aeration systems an ASP should be implemented. Usually negative aeration, sucking air from outside the pile into the pile, can be most effectively used to manage odors. Therefore, this would be the preferred approach to manage large streams of organic waste using this kind of facility. The region generates adequate volumes of brush that can be ground and added to the food waste, therefore additional bulking agent is not needed but it will need to be ground, so there is a cost.

Anaerobic Digestion Infrastructure: Anaerobic digestion (AD) systems, especially those of the low solids type, are quite useful for managing most industrial and some commercial streams of food waste. Often however, tip fees for this material are not competitive with composting operations, even those with more capital intensity like ASP facilities, and the volumes needed to justify AD systems is in the hundreds of thousand tons, not thousands as we have in this region.

Recommended Approach for Composting Infrastructure

As a general strategy, continued investments in an establishment of appropriate yard debris processing facilities are an important first step to developing the necessary infrastructure for the aggressive recovery of food waste organics. As indicated previously, this kind of facility will be capable of receiving residentially co-collected food waste in its yard debris stream, as well as multi-family residential, commercial, and industrial sources and processing it effectively in a safe and neighborly manner. The near-term strategy of establishing long-term and well-founded relationships with public and private sector operators of composting facilities enables the region to take the first step toward recovering a significant amount of residential food waste.

Strategically Sized and Located Centralized Composting Sites: The development of one or two appropriately sized and centrally located aerated static pile facilities either on one of the yard debris processing sites or a standalone site is recommended. These facilities will be developed to provide sufficient recovery infrastructure for the residential, multi-family, commercial, and industrial sources of food waste.

Additionally, it is being proposed in this strategy report that organic materials generated in Manistee County, Missaukee County, and Wexford County be transported and processed at a location convenient to that region such as an expansion of Morgan Composting activities in Sears, MI. Although Morgan Composting is outside of the 10-county region, use of the site and the relationship between Morgan and the Organics Advisory Committee is critical to the regional organics system plan because of the following:

- Proximity to Cadillac (the major city in Wexford County),
- Capacity to process more materials through the site,
- Ability to market their end-product to high-end users, and sell product back into the region,
- Morgan has large transfer trailers and can serve the regions' future drop-off/collection sites,
- Morgan has expressed interest in possibly operating another composting facility in the future, and
- Efficiency gained through the use of existing infrastructure.

Hub and Spoke Collection: In addition to the three centralized composting sites, conveniently located drop-off/collection sites that feed either community composting sites or the centralized composting sites should be sited in the region, especially in the more rural areas where curbside collection is not planned and distance to the centralized site would disincentivize composting. These sites can be part of a regional hub and spoke design. This system of collection (whether curbside or drop-off) is designed to target the organics streams remaining after diversion of streams through prevention and educational campaigns, rescue/recovery through food donations, animal feed at local farms, or recycled in backyard bins, small on-site systems, and at community gardens.

The centralized composting sites identified in this report are used as examples because of their location and existing infrastructure. The cost and collection modeling illustrated on the following pages uses these sites as examples so that we could identify transportation distances and capital costs, but as the organics program continues to grow and evolve, other centralized composting sites may be identified and developed instead or in addition to the sites illustrated in this report.

Table 14 below illustrates the yard waste and food waste generation projected recovery quantities by county and directed to one of three centralized composting sites to be processed. The composting sites identified here in this report are used as examples sites because it is important to note that the total capacity accounts for both the existing volumes from the 10-county region processed at the facilities and the new volumes projected for collection through the regional organics system.

Table 14 Processing Capacity Needed at Centralized Composting Facilities

REGIONAL SUMMARY BY COUNTY										
Annual Tons Yard and Food Waste										
County	Current Processing (YW)	Current Processing (FW)	New Capacity Needed (YW+FW)	Emmet Compost Facility (YW)	Emmet Compost Facility (FW)	Traverse City/GTC Compost Facility (YW)	Traverse City/GTC Compost Facility (FW)	Morgan Compost Facility (YW)	Morgan Compost Facility (FW)	Total Capacity Needed by Facility (YW+FW)
Charlevoix County	1,260		1,415	1,210	205					
Emmet County	741	139	2,806	1,977	828					**4,221**
Antrim County	29		935			753	182			
Benzie County	19		686			572	114			
Grand Traverse County	2,561		8,301			5,739	2,563			
Kalkaska County			721			574	146			
Leelanau County	675		861			701	160			**11,504**
Manistee County	329		992					790	202	
Missaukee County			561					487	75	
Wexford County			1,789					1,543	246	**3,342**
GRAND TOTAL	**5,613**	**139**	**19,066**	**3,187**	**1,033**	**8,338**	**3,166**	**2,820**	**522**	**19,066**

Table Color Coding:
Tons Hauled to Emmet County Composting
Tons Hauled to TC/GTC Composting Site
Tons Hauled to Morgan Composting

The total capacity needed by facility, 4,221 tons for Emmet County Composting, 11,504 tons for a site in Traverse City/GTC, and 3,342 for Morgan Composting, and the counties from which the volumes are generated from are the assumptions that were used to model the size and costs of the centralized composting facilities as well as the collection transportation model.

A combination of curbside collection in the urban areas (residential, commercial/institutional, and drop-off/collection sites) located in planned locations throughout the region to give maximum access to residents will be required to feed the centralized composting facility. The design of the recommended collection system for the purposes of this report is preliminary and needs additional evaluation, discussions with haulers on service fees, equipment, pickup frequency, etc., detailed siting analysis for containers, and a robust education and outreach program.

Table 15 below outlines a proposed transportation model. The largest urban centers would implement curbside organics collection for residential and commercial generators, while smaller communities close by might implement drop-off facilities to aggregate organic materials for easier collection by roll-off containers. The urban total tons per year takes into account the participation and set-out rates as described above. There are some large commercial/industrial generators that are located outside the urban centers, and those are not included here. Thus, these establishments may need to receive dumpsters for organic waste streams collection where clusters of these generators exist.

As shown in Table 15 below the drop-off sites would be serviced weekly and the hauls/week could be at one location or multiple locations; for example, the 2.4 hauls/week in Emmet County could be one location serviced 2 to 3 times per week or 2 to 3 locations serviced weekly. Curbside collection would occur weekly with each urban center implementing collection separately as part of its yard waste program. As the hauls/week show, Petoskey and Harbor Springs may be able to be combined into one truck run, or Traverse City and Acme Township may also be able to be combined to three total runs per week. The cost per ton per mile used are based on regional hauling and curbside costs as shown in notes below the table. The drop-off/transfer costs could be as little as $0.10/ton/mi with 22 or 40-ton loads of ground organics.

Table 15 Collection and Transportation Model Summary

Proposed Centralized Composting Site	Source	Curbside or Drop-off	Approx. Mileage (one way)	Urban Total YW+FW Tons/Yr	Balance of County Tons/Year	Hauls/ Year *	Hauls/ Week	Transport Cost/Year*	Cost/ Ton	Average Cost/ Ton
Emmet County Composting										**$129.86**
	Charlevoix County	Drop-off	24		155	16	0.3	$ 1,491	$ 9.60	
	Emmet County	Drop-off	5		1,560	156	3.0	$ 3,119	$ 1.62	
	Petoskey	Curbside	8	301		30	0.6	$ 372,604	$ 884.11	
	Harbor Springs	Curbside	5	65		7	0.1	$ 149,277	$1,633.96	
Traverse City/GTC Composting										**$110.11**
	Traverse City	Curbside	5	786		79	1.5	$ 831,919	$ 756.21	
	Acme Township	Curbside	9	228		23	0.4	$ 354,938	$1,110.77	
	Antrim County	Drop-off	45		906	91	1.7	$ 16,827	$ 18.00	
	Benzie County	Drop-off	40		667	67	1.3	$ 10,979	$ 16.00	
	GTC County	Drop-off	10		4,726	473	9.1	$ 18,905	$ 3.29	
	Kalkaska County	Drop-off	40		721	72	1.4	$ 11,529	$ 16.00	
	Leelanau County	Drop-off	40		186	19	0.4	$ 13,774	$ 16.00	
Morgan Composting										**$140.89**

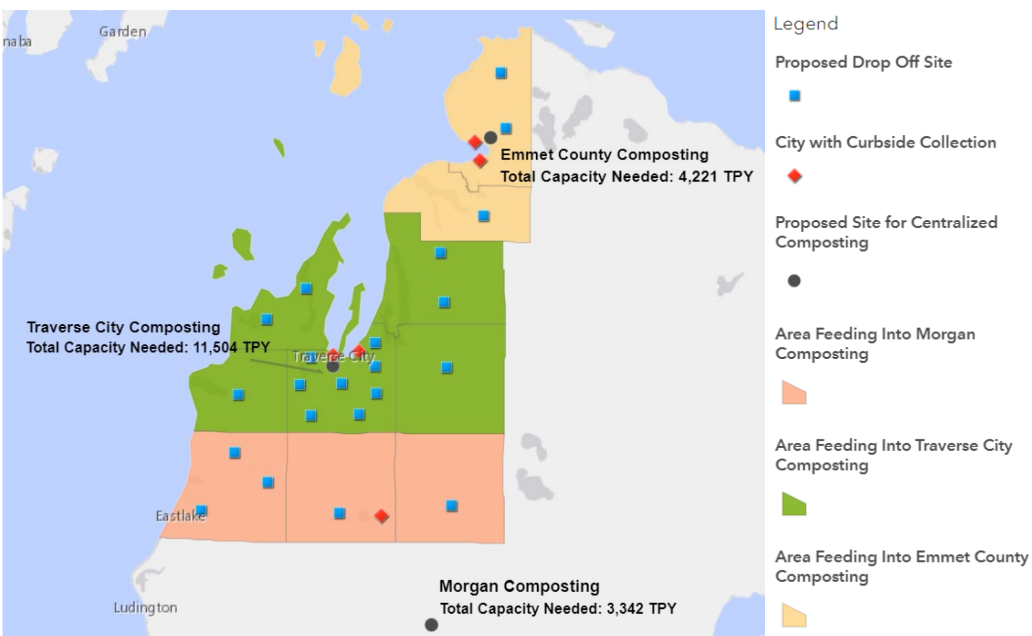
	Manistee County	Drop-off	32		1,789	179	3.4	$ 22,898	$ 12.80	
	Missaukee County	Drop-off	41		561	56	1.1	$ 9,205	$ 16.40	
	Wexford County	Drop-off	78		131	13	0.3	$ 5,767	$ 5.82	
	Cadillac	Curbside		531		53	1.0	$ 547,939	$ 736.76	

* $0.40/ton/mi for Drop-off and Transfer: assumes a 40-cy roll off of un-ground organics; 10-ton load;
* $9.98/ton/mi for Curbside/Direct Haul; $300/ton is typical of curbside collection; 10-ton load in 20-cy container

The map in Figure 4 below, created using ArcGIS Online that allows users to select desired layers and data sets, shows the proposed locations and estimated tonnage throughput of the recommended centralized composting sites as well as color-coding to identify the counties that will feed into each proposed site. The three black dots were selected purely because of existing activity and serve only as examples helping to illustrate solutions and costs. Also shown are the number of drop-off/collection sites in each county and the cities that are being proposed as curbside routes for residential and commercial organics. The proposed drop off sites (blue squares) represent the number of drop off sites needed assuming all are the same size and material from the drop off sites could feed either community composting sites or the centralized composting sites. The exact locations and operations of the proposed drop off sites, or community composting sites, has not been determined in this phase of the study.

Using the ArcGIS Online link, one can overlay the early adopters and large generators to see if they will feed into the proposed curbside routes, or if they will be expected to use the drop-off/collection sites (and may become the host of one of these sites), or if they will need a separate dumpster and pickup by a commercial hauler (note that separate pickups for commercial/industrial generators are not included in the modeled costs).

Figure 4 Map of Proposed Centralized Composting Sites and Collection Areas



Map Link

CENTRALIZED COMPOSTING FACILITY COSTS

Aerated Static Pile (ASP) Composting Facilities

Preliminary costs for the development and operation of ASP composting systems at Emmet County and in the Traverse City area, sized to receive a stream of organic materials at a medium level quantity shown in Table 18 and Table 20 below, have been developed. Again, these two sites have been identified as two possible centralized composting sites due to their central locations and existing infrastructure. Alternate sites may be identified as the project progresses toward implementation.

Emmet County Site

Key facility parameters for Emmet County ASP are summarized in Table 16. This shows that an area of under 1 acre, with 0.75 operators, with one new loader, will be able to process nearly 4,221 tons per year of yard waste and food waste. It is important to point out that the site development costs are minimal for this site (pond, maintenance shed, ASP asphalt pad and equipment) because the site is already developed with access, gatehouse, and operator amenities shared with the MRF/Transfer Station.

Table 16 ASP Facility Characteristics - Emmet County

ASP FACILITY CHARACTERISTICS	UNITS
Total Throughput (not including bulking) - Tons per year	4,221
Total Site Area - Acres	0.9
ASP Pad Acres	0.1
ASP Aeration Zones	2
Total Building Area – SF (maintenance shed)	600
Equipment – pieces (loader)	1
Staff – FTE (0.5 operator + 0.25 laborer)	0.75
Total Marketed Material - CY	6,753

Table 17 shows the operational costs and revenues associated with the ASP facility. For a total capital cost of approximately $432,400 the facility will incur annual operating costs of $130,600. Total expected revenues based on a sale price of $15 per cubic yard (cy) for compost and a tipping fee of $30 a ton for incoming materials approach almost $208,000. Overall, this type of facility will have a net revenue of approximately $6.27 per incoming ton of material. This analysis is a summary in nature and should be revisited to fully determine capital and operational costs at a later date before budget and capital costs are finalized. Compost sale price and tipping fee is based on best practices in the region. Specialty blends, bagged compost, and compost socks will sell for more. Tipping fees for yard waste/wood waste may be less depending on season and demand.

Table 17 ASP Facility Cost Summary – Emmet County

ASP FACILITY COST SUMMARY	UNITS
COSTS	
Total Facility Capital Cost	$ 432,400
Total Annual Operating Cost - Labor, Maintenance, Equipment ($)	$ 130,600
REVENUES	
Tipfees	$ 126,600
Compost Sales	$ 81,000
Total Annual Revenues	$ 207,700
Total Annualized Revenue (Loss) - ($/ton)	$ 6.27

Traverse City/Grand Traverse County (GTC) Site

Key facility parameters for Traverse City/GTC ASP are summarized in Table 18 using the existing Keystone site for the purposes of discussion. This shows that an area of 1.5 acres (not including access roads), with 2.5 staff (2 operators, 0.5 supervisor), with new rolling stock, will be able to process 11,504 tons per year of yard waste and food waste. Site development costs for this site are more than the Emmet County site (access road, fence gate, pond, receiving building, office trailer, maintenance shed, ASP pad (asphalt) and equipment) because the site is not fully developed.

Table 18 ASP Facility Characteristics – Traverse City/GTC Site

ASP FACILITY CHARACTERISTICS	UNITS
Total Throughput (not including bulking) - Tons per year	11,504
Total Site Area - Acres	1.5
ASP Pad Acres	0.3
ASP Aeration Zones	5.0
Total Building Area - SF (receiving building, maintenance shed, office trailer)	6,128
Equipment - pieces (loader, skid steer grinder/shredder, work truck)	4
Staff - FTE	2.5
Total Marketed Material - CY	36,812

Table 19 shows the operational costs and revenues associated with the ASP facility. For a total capital cost of approximately $2,075,700 the facility will incur annual operating costs of $464,500. Total expected revenues based on a sale price of $15 per cubic yard (cy) for compost and a tipping fee of $30 a ton for incoming materials approach almost $786,900. Overall, this type of facility will have a net of revenues of excess of costs of approximately $8.99 per incoming ton of material. This analysis is summary in nature and should be revisited to fully determine capital and operational costs at a later date before budget and capital costs are finalized. Compost sale price and tipping fee is based on best practices in the region. Specialty blends, bagged compost, and compost socks will sell for more. Tipping fees for yard waste/wood waste may be less depending on season and demand.

Table 19 ASP Facility Cost Summary - Traverse City/GTC Site

ASP FACILITY COST SUMMARY	UNITS
COSTS	
Total Facility Capital Cost	$ 2,075,700
Total Annual Operating Cost - Labor, Maintenance, Equipment ($)	$ 464,500
REVENUES	
Tipfees	$ 345,100
Compost Sales	$ 441,800
Total Annual Revenues	$ 786,900
Total Annualized Revenue (Loss) - ($/ton)	$ 8.99

MARKET DEVELOPMENT

The process of composting to recycle organic materials into a useful product is only one step in the total compost process. Without markets to sell finished compost products, composting would be relegated to serve as only a volume reduction tactic as part of the waste management system. Smart and sustainable programs are developed with the consideration of markets and potential customers during their development process. By addressing this in advance, owners of facilities will ensure marketability of their product before the first yard of material is produced.

Typically, there are enough local markets from this very diverse mixture of compost users, to absorb 100% of all composts produced, if proper education, marketing, training, and sales is used to sell the final product. Proper market development occurs starting with proper testing, education of compost use guidelines, and training of compost users to use the product effectively. Webinars, workshops, and classes are popular tools for market development along with print media, videos, and before – after photos.

Additional information about market development, market sectors, analysis of local market opportunities, and more are included in Appendix Q of this report.

FINANCING

Cities and other local units of government face a double dilemma when it comes to financing infrastructure. On one hand, the urban population is growing, causing an increase in demand for recovery services of all types. On the other hand, the traditional public sector general fund availability fails to keep up bills to keep up with current demand for service, much less the cost of new services like food waste collection and processing. The public sector ability to competently deliver these services is constrained with both resource and institutional limitations. It is often proposed that the solution lies in private sector participation. This kind of private sector participation is often characterized as "Public Private Partnership" or P3.

Compared to an open-source system, where residents seek their own solid waste and recycling service provider, privatization and public-private partnerships help establish a competitive process to acquire lower rates for services. Rates from service providers can be much lower with a larger quantity of customers are involved. While an open-source system gives residents more freedom to select their provider, the process is riskier since residents may not know the types of questions to ask to ensure the service they receive is cost-effective and meets their requirements. Local governments are the sole negotiators in the privatization or public-private partnership, and they help ensure all risks are vetted on behalf of the community. Further information about P3 structures are outlined in Appendix P of this report.

Funding Opportunities for 10-County NW Region

The State of Michigan, through EGLE grants and the NextCycle Michigan (NCMI) initiative, provide a unique opportunity to the 10-county region as they seek to move the organics diversion project toward implementation. Financing and organizational assets include the following:

- **NCMI Challenge Participation** – As a result of the efforts of SEEDS, the project is already participating in the NCMI FLOWS track which focuses on developing circular economies for recovery of food waste and organics. Participation in this challenge will enable SEEDS, as the leading entity in the 10-county initiative to gain further support in its efforts to implement this project through refinement of its business case, networking with other like-minded organizations, and structure exposure to a wide-range of potential project supporters.
- **EGLE Infrastructure Grants** – Funding for some of the capital costs of implementing the recommendations from this report can be funded through the EGLE infrastructure grant stream. In the past these grants have been available to fund up to $1.0M in hard infrastructure costs with a demonstrated project cash match of 20%. This category of grant is expected to continue into 2022 and beyond. Participants in the NCMI channels are expected to have at least informal priority for gaining these funds.
- **EGLE Market Development Grants** – The 10-county NW Region is funding this report in part through a Market Development Grant. Eight different grant categories are identified in the 2021 solicitation from EGLE, which are expected to continue into 2022. Of these, some categories of applicants can request up to $300,000 with matches ranging from 20 to 50 %. Again, explicit preference will be given to those applicants participating in NCMI.
- **Zero/Low Interest Loans** – Impact investors, such as Closed Loop Fund, have identified and committed substantial funding to support local units of government, non-profit agencies, and private corporations in their efforts to implement circular economy solutions in the development of recycling and recovery infrastructure. With local commitments for operational support, these sources of funds have proven their willingness to provide funding to Michigan initiatives.
- **Local Units of Government** – Support from the 10-counties, perhaps on a pro-rata basis, will be necessary to fund ongoing operations of the organics diversion project. One area of support that could move to the fore would be the development of an education and promotion fund that annually provides $3- $4/ household. This level of funding has been shown to be the minimum necessary investment to affect people's behavior positively toward recovery organics over the long term.
- **Local Philanthropies/Civic Organizations/Other NGOs** – Local entities often seek to "invest" in the betterment of their community. SEEDS is already supported by funding from a local Rotary chapter. Other sources of similar funding and network support are also available if suitable "development" activities are undertaken.

- **Credit Unions/Local Banks** – Debt financing of some infrastructure projects is feasible as well. Gaining this type of funding requires local loan officers to be willing to be creative about loan security and is often appropriate only for specific capital purchases like trucks, buildings, or lands against which security liens can be implemented.

Taken together, all of these sources of support create a powerful network of funders who can support a multi-county initiative of this sort. Collectively, these diverse opportunities for funding have development into an established system that is now described as Impact Investment. Impact Investment philosophies argue that there is a range of investment types (from traditional venture capital through banks to grants) all of which can play a role in financing ventures that might have multiple kinds of return (social, economic, and environmental). The challenge will be to develop necessary fabric of multiple solutions that allow each funder to play a unique role. As with all project finance activities, comfort is often gained when a variety of partners commit to a common vision.

ENVIRONMENTAL AND SOCIAL BENEFITS

The evaluation of environmental and social costs and benefits is useful for two reasons. First, it can be used to compare differing opportunities present in NW Lower Michigan – making apples and oranges easier to compare. Second, the analysis of the value-chains and opportunities present in NW Lower MI will be a useful standard for comparison freely available to other communities engaged in similar work.

Table 20 illustrates the tons and costs (benefits) of implementing each of the prevention, rescue/recovery, and decentralized recycling programs across the region using the operating assumptions identified in Table 12, along with the centralized composting costs (benefits). The centralized composting costs include collection and hauling costs. The full details of the costs (benefits) by solution category and sub-category (backyard composting, community composting, animal feed) as well as the three proposed centralized composting facilities and their associated collection/hauling costs are shown in Appendix I. Rescue/Recovery has the most beneficial social benefit on a per ton basis, and decentralized recycling has the biggest impact on social benefits based on the tonnage diverted. Centralized composting has an overall cost of $94/ton including collection and hauling. Food waste diversion has an overall benefit and total organics (yard waste and food waste) diversion has an overall cost due to the operating costs of centralized composting and collection. It is important to point out that the total annual cost does not. include tip fees or revenues from product sales. This could reduce the centralized composting annual costs by $600,000 to $750,000 in tip fees and compost sales, even more if compost is sold bagged or in compost socks for erosion control.

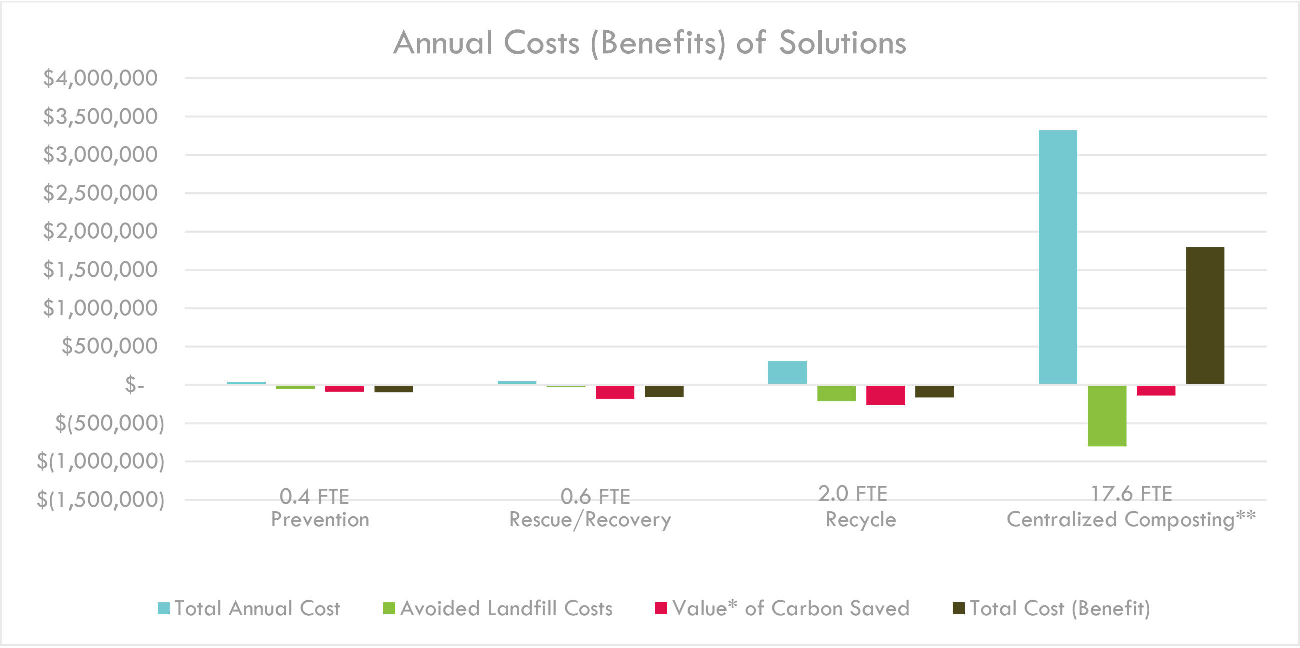
Table 20 Summary of Diverted Tons, Jobs, Costs (Benefits) for Solutions

	Prevention	Rescue/ Recovery	Recycling	Centralized Composting**	Total Food Waste	Total Yard Waste + Food Waste
Total Tons Diverted	1,179	729	5,060	19,066	11,689	26,034
Total Annual Cost	$ 42,073	$ 51,381	$ 312,929	$ 3,322,824	$ 654,491	$ 3,729,206
Avoided Landfill Costs	$ (49,492)	$ (30,590)	$(212,358)	$ (800,213)	$(490,579)	$(1,092,654)
Saved Tons CO2e	(1,803.54)	(3,584.32)	(5,276)	(2,774)	(15,807.23)	(13,437.40)
Value* of Carbon Saved	$ 90,177	$ 179,216	$ 263,797	$ 139,458	$ 790,361	$ 672,648
Total Cost (Benefit)	$ (97,596)	$(158,425)	$(163,226)	$ 1,799,319	$(626,449)	$ 1,380,071
Total Cost (Benefit) per ton	$ (83)	$ (217)	$ (32)	$ 94	$ (54)	$ 53
# FTE	0.40	0.60	2.00	17.58		

* Social Value of Carbon (Yale 2021) = $50/ton
**6.6 jobs per 10,000 tpy (ILSR 2021) plus 4 FTE for hauling/collection

Figure 5 illustrates the costs (benefits) of the solutions, with the annual operating costs of centralized composting outweighing the other solutions. These analyses show that prevention, rescue/recovery, and decentralized recycling of food waste (and yard waste where possible such as backyard and community composting) are beneficial from a cost and environmental perspective, without calculating in the impact of compost sales and the benefit to soils and water quality by applying compost to the land for landscaping, farming and sediment and erosion control.

Figure 5 Summary of Annual Costs (Benefits) of Solutions



NEXT STEPS

The 10-county NW Michigan Region has a unique opportunity to create a food waste organics recovery project that leverages its unique advantages and overcomes specific challenges. From this a series of next steps is proposed.

1. **Grass-Roots Momentum of Support** – Numerous examples of disparate organics recovery activities emerged from all around the region as the interviews were undertaken. These activities ranged from the unusually common use of animal feed as a recovery mechanism for spent grains/malt from brewing operations, to voluntary onsite composting activities at different restaurants and food preparation organizations, to typical community gardening efforts that incorporate composting into their operations. These activities, as enumerated in the interview results, show local interest in the kinds of activities that this initiative seeks to grow and nurture. *Next Steps – Create a virtual and in-person forum for sharing successes (and failures) in attempts to recover organics. Build a series of best practices from these successes so that others can learn without encountering as much failure and setback as experienced by the pioneers.*
2. **Power of Existing Infrastructure** – In diverse and unique ways, formal organics prevention, recovery, and recycling activities undertaken by Emmet County, Traverse City, Grand Traverse County, Grow Benzie, GoodWill of NW Michigan (Food Rescue) and Morgan Composting create an effective foundation from which to build a comprehensive region-wide organics recovery program. While all of these current activities will require upgrades in some regard, their experience and the experience of the public in using them is invaluable. *Next Steps – Engage more deeply with each of these entities (and others as appropriate) to ensure that these entities are completely integrated into plans moving forward. In addition, the project should build a series of best practices from these successes so that others can learn without encountering as much failure and setback as experienced by the pioneers. Seek to empower local small businesses (e.g., BARC, Krull) to continue to grow their efforts in support of an overall vision for organics recovery.*
3. **Collective Advantages of a Diverse Region** – The 10-county region is economically and politically diverse. On the basis of median household income one county of the region ranks 2^{nd} while another rank as low as 66^{th} out of the 83 Michigan counties. Appetite and the ability for the implementation of government programs likely varies widely as well. However, evidence from the interviews backs this up and suggests extremely strong regional interest. Consequently, solutions seeking to fully integrate each community into a program that best fits its needs and capabilities will be essential. Critical measures of success will include the development of real solutions that meet the needs for each community. For instance, curbside collection is likely politically and economically viable in more densely populated areas around Traverse City, Petoskey/Harbor Springs, and perhaps Cadillac. Yet, support for animal feed, backyard/onsite composting, and food waste reduction can have more universal appeal. *Next Steps – Work with the 10 counties both individually and collectively to further understand specific needs and appetites for services, ascertain commitments of support, and determine further background that will be necessary for securing participation.*
4. **SEEDS as a Planning and Operational Catalyst** – SEEDS and its partners will play an important role as both a catalyst for change and a key operational supporter of the system. The EcoCorps program currently operated by SEEDS, creates an opportunity for consistent and thorough "extension" support services for critical parts of the proposed initiative. For instance, SEEDS is especially well positioned to be the coordinating and responsible party for program promotion and education. Further, they can serve as the locus of technical support for home, onsite, and community composting efforts as well as best practices for animal feed operations. They are well

positioned to pursue policy initiatives throughout the region to support the range of best organics recovery practices like support and coordination for food rescue participants, curbside collection expansion, siting of drop-off facilities, facilitation for supporting private sector collection operations, funding conduit for infrastructure improvement, and education of public officials about the benefits of food waste diversion and recovery. *Next Steps – Take the steps necessary to fund a SEEDS Food Waste Diversion Director position starting in Q3 2022. Examine opportunities to expand EcoCorps services to fund the training and deployment of 2-3 individuals to support the Seeds Food Waste Diversion Director starting in 2023.*

5. **Global Attention to Organics Recovery and Circularity** – As evidenced by NextCycle Michigan (NCMI), EGLE's focus on grant funding for circular initiatives and national and international policy efforts focused on reduction of methane emissions in the face of climate change, the timing for this project is excellent. These trends seem to be accelerating, which means that the 10-county initiative will shortly prove to be a case study in success for other regions of Michigan if it succeeds in creating effective and efficient means of organics diversion. *Next Steps – Continue engagement with NCMI and EGLE to take advantage of funding and network support opportunities. Seek additional sources of funding and support (E.g., EDA, infrastructure, COVID relief) to support near and long-term goals.*
6. **Impact Investing Solutions** – As discussed previously, the range of funding opportunities to support this initiative is substantial. Efforts to update the business case for SEEDS and the 10-county region as part of the NCMI FLOWS track will be critical to this outcome. *Next Steps – Develop a capital and operational funding plan. As part of that, identify a "sources and uses" document that clearly shows what funding is being sought and how it will be used to further the overall goals. Explore funding opportunities that go beyond the usual non-profit opportunities like donations, campaigns, and grants. One example of this effort could include the development of brownfield funds for the improvement of the Traverse City Keystone Composting Facility. Similarly, perhaps tribal support for improvement of the Emmet County infrastructure might be available as well.*

The path toward successful Organics Diversion Program success requires stops along the way to gain stakeholder support from local units of government, cooperation, and coordination with local non-profit and for-profit businesses that seek to provide services as part of the program efforts, and careful attention to customer needs and desires. SEEDS and its collaborators are in a position to provide the circumstances and organizing motivation to bring these different stakeholders to the table in the productive way. As part of this effort, it would be well to remember some basic lessons of successful organics diversion efforts. Some of these basic lessons include the following:

- Organic materials, especially food, are comprised predominantly of water. Water is heavy and therefore expensive to transport. Therefore, minimizing transport distances will create circumstances more conducive to cost effective program development.
- Markets are essential for reuse and recycling activities. Slow but sure wins the race to productive relationships with food rescue operations, farmers interested in animal feed, and compost buyers.
- Clean streams of material make for happy markets. Educating customers about how they can contribute to cleaner compost and fresher rescued food will assist in making these diverted materials valuable.
- Attention to cleanliness (in collection vehicles, at drop off locations, during compost operations) will provide the public with a better image of organics diversion and limit health and safety complaints.
- Food waste diversion, recovery, reuse, and recycling is charismatic. More than other recycling activities, engagement with the local citizens is easier because everyone has to eat, many people participate in both ornamental and vegetable gardening, and their experiences with these activities make the actions necessary for organics diversion accessible and familiar. These are powerful motivators if they can be engaged.

APPENDICES

Appendix A: Types of Organics

SEASONAL GENERATION OF YARD DEBRIS

The amount of yard debris generated in the region varies by season. Up to 60 percent of yard clippings consist of grass and weeds are collected in the growing season from May through October. The overall amount of leaves can appear larger than grass as it arrives in a shorter time period (October – January). Brush from pruning and storm damage occurs primarily at two peak times (spring and fall). Moderate quantities of brush accumulate in the summer and winter months.

Changes in weather, landscape practices and population can alter yard debris volumes from year to year. In addition, the overall maturity and number of trees can have a dramatic effect on overall yard debris generation. To successfully handle fluctuations, collection routes must be sized to accommodate estimated peak capacity or additional collection capacity must be implemented to handle peak volumes.

Low yard waste generation presents difficulties in many SSO curbside collection programs. Without yard waste, organics generation is often too low to make collection during the winter economically feasible. Winter collection of food waste works without yard waste in situations where you have businesses and institutions whose "busy time of the year" is winter; ski hills, schools and restaurants generate notable amounts of SSO in the wintertime when collection service frequency drops. Furthermore, food waste alone in carts, which has a higher water content, is subject to freezing during the winter months. Ann Arbor, Michigan only collects once per month during January to March due to the low yard waste generation and asks residents to place food waste in certified compostable bags or wrap in newspaper. Further south, the City of Arlington, Virginia is testing out year-round yard waste collection for the first time in 2016. Fairfax, Virginia provides year-round yard waste collection to all residents, but only processes yard waste for composting from March 1 through December 24. With the exception of Christmas trees, between December 25 and the end of February, the small amount of yard waste generated is disposed of as trash.

GRASS

Grass is one of the main constituents of a typical urban yard debris stream. On average in a mature, treed city, grass can be as much as 40% of the entire yard debris stream. Its total quantity varies from season to season depending on seasonal weather variations. The quantity of material available for collection at the curbside is affected by household behavior in three main ways. First, many homeowners own "mulching" mowers that are designed to leave grass clippings on the lawn as they fall during mowing. Second, in the same manner homeowners who participate in backyard composting programs might collect their clippings but keep them for their own compost generations. Finally, homeowners that have their yard cut by grass cutting services generally require their contractors to remove whatever yard clippings are left on the lawn as part of their service. Therefore, households that fall into any of these three categories do not contribute substantially to the grass portion of the yard debris stream. However, the balance of households probably contributes fairly significantly to the yard debris stream requiring processing at a composting facility.

Reducing the amount of grass in the waste stream minimizes the odor potential. Grass collected in plastic bags may become odorous even before it is picked up at the curb. Kraft paper bags are suggested for curbside collected grasses as they reduce the odor potential and are compostable at the compost site. Paper bags also reduce separation required from plastic bags after processing, which is a major source of contamination. These measures create better circumstances at the composting facilities that are receiving these materials and should be encouraged. Overall, as a high nitrogen feedstock, grass is the least desirable of all yard debris streams. Therefore, any activity that enables the program to reduce this material creates a better environment for a successful composting system.

BRUSH

Management approaches for brush from community to community are inconsistent. Although brush is a small fraction of any program (5-10%) it creates some management difficulties. Some ban brush from collections entirely, others limit collections to certain diameter of stem (size of a thumb) and other provide curbside grinding services for larger limbs. The most effective programs focus on limiting this stream to diameters that are sufficient to manage in the collection vehicle without grinding at the curb. Then the commingled mass of yard debris is size reduced in preparation for composting at the site.

When collected in combination with HHO, brush may be desirable at the processing site. The woody component (in chipped form) helps the compost process by providing carbon for microbes and enhancing aeration. Where brush is collected, some form of chipping will be required. Woody materials do not break down at the same rate as grass and leaves unless its' surface area can be increased. An increased surface area makes the carbon in the wood much more available and consequently enables quicker decomposition. In circumstances where the brush is collected commingled with grass and/or leaves, typically the entire commingled mass of material will need to be run through a grinder to ensure the brush is properly chipped. The grinding requirement, especially when it includes grass, has a significant cost impact on the operational costs.

LEAVES

Leaves are the largest fraction of urban yard debris generation. Especially in cities like Columbus, OH that have a mature stock of deciduous trees, this stream can become quite overwhelming. Even the leaves that fall from the trees in the tree lawn (which in many cases are municipal responsibilities for management) can generate sufficient quantities of material to have negative effect on streets maintenance, storm sewers and sanitary sewers. Where the balance of a homeowner's leaves are pushed onto the street, the management difficulties can become quite extreme. Major public sector efforts have been undertaken in many communities to minimize the effect of leaves on the combined sewer systems or storm water systems and the promotion of fall cleanup and yard waste collection efforts can often be at odds with these priorities. Simply put, keeping the leaves out of the sewer can delay the expenditure of hundreds of millions of dollars in treatment facility capability. Communities where these issues are a concern have implemented cart-based leaf collection with additional material in compostable bags when they have yard waste and HHO cart based organics collection systems.

Leaves also have a high quantity of available carbon, which is essential for maintaining a good compost "recipe" with an appropriate carbon to nitrogen (C:N) ratio. They also provide significant bulking capability that enables the free flow of air that is necessary to provide the composting mass with aerobic break down conditions. Leaves do not require size reduction and can be immediately windrowed or piled up in preparation for composting. This is one of the critical material types from the overall yard debris stream that is desirable.

PAPER

Although not a yard debris material, non-recyclable paper is frequently targeted as part of a household generated organics program. This non-recyclable paper such as tissues and paper towels can add significantly to overall recovery if it is successfully targeted by an organics collection program. Non-recyclable household paper can have some challenging physical characteristics that are important to understand from a collection perspective.

Paper composts more slowly than other organic wastes and should be ground to increase surface area in order to make its carbon available. Paper mixed with higher moisture content materials (e.g., SSOs) alone takes on a “papier-mache” type texture that does not allow for the free flow of gases inhibiting efficient composting and can be responsible for creating odors during processing. As wet paper tends to clump, it is important to add bulking agents (wood chips or leaves) to maintain air space. Although paper is slow to compost, when mixed with high nitrogen wastes such as food, it can be managed successfully. Wax-coated boxes for carrying produce are not significant composting problems. Wax will compost and is not found in the finished material and some wax formulations have passed ASTM standards for BPI certified compostable. Some paperboard is coated with polyethylene to make it resistant to breakdown (such as frozen food containers) and should not be added to compost as it will not readily breakdown and may cause contamination issues.

Appendix B: Survey Questions

Composster and Pre-Processor	
What year did your facility open?	What is your acceptable level and type of contamination?
What size is your site?	If contamination of incoming load is too high, what do you do? (reject, move to disposal pile, etc.)
Total Usable Acreage	What separation technique does your facility use?
Total Used Acreage	Do you separate before or after active composting?
What is your overall design capacity?	Do you grind incoming material?
Capacity CY	If so, what type of material do you grind?
What technology do you use?	If so, what type of grinder do you use?
Permit status?	What is your timeframe for active composting?
Do you have any future site or expansion work planned?	What does your facility do with "overs" that do not compost in time?
What areas/ regions do you serve?	Is material cured in a secondary pile after active composting?
Material Source?	If so, how long is the curing process?
What type of organic waste are you producing?	What type of finished product do you produce?
How is material received?	How much do you produce in a year?
Do you accept compostable plastics at your facility?	Do you make custom soil blends or bag your product?
If YES, what, if any are the requirement (BPI-certified, ASTM, etc)?	Do you sell your product under a branded name and if so, what is it?

If YES, what material formats?	Do you have product certifications?
If YES, do you include compostable paper?	If so, which products?
If YES to paper: soiled only?	Who are your end markets for your various products? (landscapers, contractors, road projects, residents, farmers/ag, etc.)
If YES to paper: what formats?	(Optional) Would you provide names and contact info of your large customers?
What is your annual incoming material volumes by type?	What material handling fees do you have?
CY per year combined	If fees apply, please describe.
tons per year combined	How much do you charge for finished material by type?
tons per year combined	Can you provide names and contact info of your commercial customers and haulers?
tons per year YW	Do you provide education and/or feedback to your customers and haulers on acceptability, contamination, etc.?
tons per year FW	

Generator	**Hauler**
What type of organic waste are you producing?	What localities do you serve?
Do you currently compost or have a service for organic waste collection?	Where do you pick up organic material from?
Of that waste, what amount could be considered good for public consumption (e.g., "ugly" fruit)?	What type of organic material do you accept?
If YES, are compostable plastics accepted?	Do you accept compostable plastics at your facility?
If YES, what, if any are the requirement (BPI-certified, ASTM, etc.)?	If YES, what, if any are the requirement (BPI-certified, ASTM, etc.)?
If YES, what material formats?	If YES, what material formats?
If YES, do you include compostable paper?	If YES, do you include compostable paper?

If YES to paper: soiled only?	If YES to paper: soiled only?
If YES to paper: what formats?	If YES to paper: what formats?
How much organic waste do you produce in a week?	What is the annual organics material volume by type that you haul?
What unit is your measure/estimate?	Do you inspect the containers and reject collection if contamination is too high?
lbs per week	What is your acceptable level and type of contamination?
Conversion Possible?	What type of collection equipment do you use?
How do you currently dispose of your organic waste?	Where do you take your material?
How do you collect the material?	Please specify drop-off address.
Who transports the material?	Is this facility operated by your company, or another entity?
If curbside or dumpster, which hauler do you use?	If another entity, can you share their name and contact info?
If drop-off, what is the name and address of the facility?	Do you charge for container rental
How and what do you pay for disposal/hauling?	Do you charge for container rental?
Is there anything exciting about your business or organization not explicitly covered in this survey that you'd like us to know about?	If dropping off to an outside facility, What tipping fees do you pay?
Is there anyone else you would recommend that we reach out to?	Do you provide education and/or feedback to your customers and haulers on acceptability, contamination, etc.?
Of that waste, what amount could be considered good for public consumption (e.g., "ugly" fruit)?	What is your collection frequency?
	Do you provide the collection containers as part of your service offering? What type of containers are used for collection?

Market Supplier	**End User**
Type of Supplier	Type of End User
Do you currently sell compost, mulch, pellet or biochar products?	Do you currently use compost, mulch, pellet or biochar products?
If NOT, what barriers prevent you from selling these materials?	If YES, how do you use the product(s) you purchase?
If NOT, do you sell un-amended top soil, and how much per year? (in cubic yards)	If YES, where do you purchase the product(s) from and in what format? (bulk, bagged, other)
If so, do you make custom soil blends or bag your product?	If YES, what quality standards or characteristics do you require in the product(s) you purchase or use?
If so, do you sell your product under a branded name? If so, what is it?	If YES, how much product do you use or purchase annually?
If so, do you have product certifications?	If YES, are you able to get the amount of product that you need/want?
If so, which products?	If you're NOT able to get the amount you need, how much more product (in cubic yards) do you need/want?
If so, who do you sell to?	If you're NOT able to get the amount you need, what price point(s) are you looking for if you were to buy more?
If so, can you provide names and contact info of your large customers?	If you do not use organics products, what barriers prevent you from using these materials? (cost, availability, quality, awareness)
If so, approximately what volume (in cubic yards) do you sell per year?	On an annual basis, approximately what volume (in cubic yards) of compost, mulch, pellet, or biochar products are needed to meet your needs?
If so, are you able to get the amount of product that you need/want?	How much do you pay for finished product? (per ton or per bag?)
If NOT, how much more product (in cubic yards) do you need/want?	Do you provide feedback to your provider on product quality, contamination, etc.?
If NOT, at what price point(s)?	
Do you provide feedback to your provider on product quality, contamination, etc.?	
For how much do you sell finished products? Are they sold per ton or per bag?	

Appendix C: Survey Summaries by County

ANTRIM COUNTY
• 10.8 tpy directed collection/ onsite composting by Providence Farms
• ~1.04 tpy directed to backyard composting by Torch Lake B&B
Other Information (NAICS calculations)
• ~ 110 tons per year of food waste generated at Antrim Food stores
• ~ 240 tpy of food processing waste generated in Antrim
• ~ 665 tpy of food waste generated at bars and restaurants in Antrim
Conclusions
• Fairly small current recovery
• Unlikely to warrant centralized composting infrastructure both because of relatively small county generation AND disinterest among the population
• Suggest emphasis on developing onsite/back yard composting approaches
• Enhance food donation opportunities by clearly communicating options
• Recognize that proximity to GTC and its composting facility create an opportunity for selective FW collections within portions of Benzie

BENZIE COUNTY
• Stormcloud generates 75 tpy that goes to animal feed
• 1500 #/year picked up by farmer from St. Ambrose
Other Information (NAICS calculations)
• ~ 395 tons per year of food waste generated at Benzie Food stores
• ~ 265 tpy of food processing waste generated in Benzie
• ~ 480 tpy of food waste generated at bars and restaurants in Benzie
Conclusions
• Fairly small current recovery
• Unlikely to warrant centralized composting infrastructure both because of relatively small county generation AND disinterest among the population
• Suggest emphasis on developing onsite/back yard composting approaches
• Enhance food donation opportunities by clearly communicating options
• Recognize that proximity to GTC and its composting facility create an opportunity for selective FW collections within portions of Benzie

CHARLEVOIX COUNTY
• ~1.6 tpy directed collection Oleson's Food
• ~9.9 tpy directed to drop-off station by Upsy-Daisy Floral
• ~1.7 tpy directed to backyard composting by various entities
Other Information (NAICS calculations)
• ~ 855 tons per year of food waste generated at Charlevoix Food stores
• ~ 381 tpy of food processing waste generated in Charlevoix
• ~ 87 tpy of food waste generated at bars and restaurants in Charlevoix

Conclusions

- Fairly small current recovery
- Unlikely to warrant centralized composting infrastructure both because of relatively small county generation AND disinterest among the population
- Suggest emphasis on developing onsite/back yard composting approaches
- Enhance food donation opportunities by clearly communicating options
- Recognize that proximity to Emmet County and its composting facility create an opportunity for selective FW collections within Charlevoix

EMMET COUNTY

- 175 tpy directed to collection and the Composting facility
- No tons identified for backyard composting. There probably is some of that and it might be substantial.

Other Information (NAICS calculations)

- ~640 tons per year of food waste generated at Emmet Food stores
- ~38 tpy of food processing waste generated in Emmet
- ~1540 tpy of food waste generated at bars and restaurants in Emmet

Conclusions

- Emmet already has a well-established compost collection and processing infrastructure
- Its programs can be used as a model for implementation elsewhere, especially in GTC, Wexford, and parts of Leelanau Counties
- There is indication that development of a newer and larger site, possible with private sector operators might increase overall recovery.

GRAND TRAVERSE COUNTY

- 65.0 tpy directed collection/ onsite composting by Oryanna 10th
- 1.0 tpy directed collection by Oryanna Community Cooperative
- 2.9 tpy directed to collection by NW Michigan College
- 3.9 tpy directed to collection by Burrit's Fresh Markets
- 3.9 tpy directed to donation and reuse Cherry Capital Foods
- 35 tpy directed to collection/animal feed by Workshop Brewing (80% is BSG according to Brew.com 2012) - 28 tpy BSG animal feed - 7 tpy collection
- 65.0 tpy directed to animal feed by big box grocers
- 4.4 tpy from various small sources to backyard composting

Other Information (NAICS calculations)

- ~ 2,000 tons per year of food waste generated at GTC Food stores
- ~ 885 tpy of food processing waste generated in GTC
- ~ 4,200 tpy of food waste generated at bars and restaurants in GTC

Conclusions

- GTC/Traverse City is ideal location for a centralized composting site, possibly at the existing Keystone site
- Traverse City has momentum from local non-profits and progressive food establishments to expand the recovery here
- County the highest organics generated int eh region, so need to focus on efforts here

KALKASKA COUNTY
• ~13.9 tpy directed collection/ onsite composting by Cooper Ridge Farm
• ~ 0.5 tpy from Conservation District to collection
Other Information (NAICS calculations)
• ~ 140 tons per year of food waste generated at Kalkaska Food stores
• ~ 240tpy of food waste generated at bars and restaurants in Kalkaska
Conclusions
• Fairly small current recovery
• Unlikely to warrant centralized composting infrastructure both because of relatively small county generation AND disinterest among the population
• Suggest emphasis on developing onsite/back yard composting approaches
• Enhance food donation opportunities by clearly communicating options

LEELANAU COUNTY
• ~ 2.5 tpy split between drop-off and animal feed from La Bacasse
• ~32 directed to onsite composting by TLC Hydroponics
• ~2.4 tpy directed to backyard composting by four establishments
• ~7.0 tpy from four different food establishments currently take to food scraps to Oryana Co-Op, use BARC or use backyard composting
• ~40 tpy leaves and yardwaste directed to drop-offs (unknown, free drop-off location)
• ~0.3 tpy is directed to a drop-off and the small composting site from a private residence
Other Information (NAICS calculations)
• ~ 515 tons per year of food waste generated at Leelanau Food stores
• ~ 90 tpy of food processing waste generated in Leelanau
• ~ 520 tpy of food waste generated at bars and restaurants in Leelanau
Conclusions
• Significant effort already done on the organics recovery front
• ~ 2.5 tpy going to farmers
• ~ 35 tpy already been handled with onsite composting
• ~ 40 tpy YW being directed to small scale composting (undisclosed free sites)
• Recognize that proximity to GTC County and its composting facility create an opportunity for selective FW collections within Leelanau

MANISTEE COUNTY
• ~43.6 tpy from iron fish distiller to collection and composting
• ~48 tpy from The Glenwood to drop-off/collection and composting.
• ~5.4 tpy of possible material that could be delivered to drop-off or handled onsite.
Other Information (NAICS calculations)
• ~ 580 tpy of food waste generated at Manistee Food stores
• ~ 204 tpy of food waste generated at bars and restaurants in Manistee
Conclusions

- Fairly small current recovery
- Unlikely to warrant centralized composting infrastructure both because of relatively small county generation AND disinterest among the population
- Suggest emphasis on developing onsite/back yard composting approaches
- Enhance food donation opportunities by clearly communicating options

MISSAUKEE COUNTY

- ~1.0 tpy from 2 the Moon Bakery going to collection and composting

Other Information (NAICS calculations)

- ~ 293 tpy of food waste generated at Missaukee Food stores
- ~ 96 tpy of food waste generated at bars and restaurants in Missaukee

Conclusions

- Fairly small current recovery
- Unlikely to warrant centralized composting infrastructure both because of relatively small county generation AND disinterest among the population
- Suggest emphasis on developing onsite/back yard composting approaches
- Enhance food donation opportunities by clearly communicating options

WEXFORD COUNTY

- ~ 22 tpy Clam Lake Beer Co spent grain to farmer
- ~ 48 tpy Patty Cakes Restaurant and Bakery delivered to farmer
- ~33 tpy from Grahek's International (yard service) sent to onsite composting
- ~ 2 tpy Benson's Corner Greenhouse directed to onsite composting
- ~13 tpy from Harrietta Hills Trout Farm handled through onsite composting
- ~ 6.5 tpy RRR Meat Processing delivered to compost collection
- ~1.3 tpy Wiggins Trea Co handled onsite with backyard composting
- ~ 24 tpy could be collected from the Cadillac Grill
- ~ 37.4 tpy The Raven Social could be directed to composting

Other Information (NAICS calculations)

- ~ 261 tpy of food waste generated at Wexford Food stores
- ~ 960 tpy of food waste generated at bars and restaurants in Wexford
- ~ 17 tpy food waste generated by the food processing industry in Wexford (This is quite clearly wrong based on the Clam Lake Beer Co alone)

Conclusions

- Significant effort already done on the organics recovery front
- 70 tpy going to farmers
- ~24 tpy already been handled with onsite composting
- opportunity identified for an additional 62 tpy from local restaurants
- Good opportunity for education and connection with local composting facilities (Morgan) to push both more onsite composting as well

Appendix D: Solutions Matrix

(also provided as a separate PDF)

Category	Solution Description	Ease of Implementation (1 easy - 5 difficult)	Cost ($-$$$$)	Diversion Impact (high, medium, low)	Resources and Support Links	Brief Summary of Resource	Measurable?	Target Stakeholder/Waste Streams	SEEDS' Potential Role/Feasibility	Contingent Factors
Prevention										
	Educational Campaign - creating public awareness about food waste, the issue, the impacts, what individuals can do, call to action	3	$$	high	https://www.savethefood.com https://refed.com/downloads/ReFED_Report_2016.pdf	Save the Food provides household resources for planning meals, storing food, along with recipes to reduce food waste. ReFED is a collaboration of over 30 business, nonprofit, foundation, and government leaders committed to reducing food waste in the United States. ReFED seeks to unlock new philanthropic and investment capital, along with technology, business, and policy innovation, to achieve this goal, which will catalyze tens of thousands of new jobs, recover billions of meals annually	Yes. US-based campaigns have rarely tracked effectiveness, but studies in the UK and elsewhere have measured impacts by partnering with nonprofits.	Residential consumers and commercial generators	Information, promotion targetted to stakeholders Highly feasible across the region	Need funds for campaign materials, determine how to measure impact
	Promote Existing Resources to educate residential and commercial generators. - Take advantage of collateral produced by the Ad Council's Save the Food Campaign - Take advantage of collateral produced by the EPA's Food: Too Good to Waste campaign.	1	$	high	https://www.epa.gov/sustainable-management-food/food-too-good-waste-implementation-guide-and-toolkit https://furtherwithfood.org/	EPA Food: Too Good to Waste Implementation Guide provides insight into using community-based social marketing principles in order to reduce food waste. The accompanying toolkit provides techniques for individuals and families to reduce food waste through better shopping, cooking, and storing methods. Further with Food website, produced by The Center for Food Loss and Waste Solutions, has pre-developed resources available to target residential, institutional and commercial sectors and provides a compilation of sources on topics from public policy and reporting to food waste statistics from various authors, such as the US EPA, World Resources Institute (WRI), and the Food Waste Reduction Alliance (FWRA).	Yes	Residential consumers and commercial generators	Information, promotion targetted to stakeholders Highly feasible across the region	Need website for sharing resources, determine how to measure impact
	Waste Tracking & Analytics - Providing restaurants and prepared-food providers with data on wasteful practices to inform behavior and operational changes	2	$$	high	https://conserve.restaurant.org/Best-Practices/Reducing-Food-Waste. https://www.leanpath.com http://www.stopwaste.org/preventing-waste/smart-kitchen-initiative	Tools include the publically available Conserve program offered by the National Restaurant Association, private solutions such as LeanPath, and internally built business tools. One such is the Smart Kitchen Initiative works with medium to large food service operations in Alameda County, California to reduce pre-consumer food waste through tracking and staff training.	Yes	Food service operators	Funding (subsidizing software for food service operators), Labor (provide training) Feasible, but requires commercial "buy-in"	Funding and/or partnerships with software companies need to be in place to offer waste tracking software at a discounted rate
	Set Waste Reduction Goals	1	$	medium	https://www.usda.gov/media/press-releases/2015/09/16/usda-and-epa-join-private-sector-charitable-organizations-set	The EPA goal of 50% reduction of food waste in the US by 2030 demonstrated the importance of reducing food waste and created momentum for the U.S. Food Waste Challenge, produced by the EPA, whereby best practices and guidance reference documents were compiled.	Yes	all	Create consortium and adopt goals Highly feasible across the region	Assessment to determine feasible goals based on current waste generation and diversion efforts
Rescue / Recovery										
	Food Donation Guide - Resource to help businesses understand why and how to donate food easily. Smaller donations (under 50 pounds) are expensive.	2	$	medium	https://www.co.washington.or.us/hhs/swr/recycleatwork/upload/food-donation-flyer-2_2014.pdf.	This resource provides motivation (cost reductions, community benefits, and zero liability) and tips (storing food, types of food) for businesses who could donate surplus food to food rescue organizations.	Yes (although would require self-reporting, and tracking of data)	Businesses	Information, promotion, stakeholder education and networking, Highly feasible but requires leadership from SEEDS.	Funding for materials, standardization of one or more apps for food donation matching
	Donation Transportation, Storage & Handling - providing small-scale transportation infrastructure for local recovery, expanding temperature-controlled food distribution infrastructure/labor	4	$$$	high	http://www.borderlandsproducerescue.org/	Borderlands Produce Rescue collects produce from farms that would otherwise landfill the products or leave them to rot. Borderlands distributes produce at various locations during the season for a flat fee per box. During the 2018-2019 season, they rescued 32 million pounds of fresh produce. They also offer perished produce for composting.	Yes (although would require self-reporting, and tracking of data)	Food rescue organizations, nonprofits	Funding (grants or low-cost loans for purchasing and servicing trucks), facilitation (connections between rural recovery groups, etc.), Feasibility dependent on catalytic leadership from industry supported by SEEDS or a similar organization.	Need funds, establish grant application process
	Business Food Donation Awareness and Training - tracking food waste and training kitchen staff on best food prep or organics recycling practices to reach goals of reducing waste and increasing donations.	3	$	low	https://www.bamco.com/press-releases/bon-appetit-management-company-named-usda-epa-list-u-s-food-loss-waste-2030-champions/	Bon Appetit, a full food-service management company, has instituted food waste-fighting efforts including: creating a handbook containing guidance on harvesting excess/late-harvest produce and how to get it to hunger organizations and creating a waste awareness campaign where waste is tracked and employees are trained on waste-free food prep, among other methods of food waste rescue and recycling.	No	Potential food donors (businesses, nonprofits, etc.)	Information, promotion, stakeholder education and networking, Highly feasible with leadership, but requires coordination with Waste Analytics & Tracking prevention efforts.	Understanding of donation liability laws

Category	Solution Description	Ease of Implementation (1 easy - 5 difficult)	Cost ($-$$$$)	Diversion Impact (high, medium, low)	Resources and Support Links	Brief Summary of Resource	Measurable?	Target Stakeholder/Waste Streams	SEEDS' Potential Role/Feasibility	Contingent Factors
	Donation Liability Education - educating potential food donors on donation liability laws, the Emerson Act, etc. Donors, gleaners, and nonprofit organizations must still comply with state and local health regulations.	3	$	low	https://www.usda.gov/sites/default/files/documents/usda-good-samaritan-faqs.pdf	Frequently Asked Questions about the Bill Emerson Good Samaritan Food Donation Act that establishes Federal protection from civil and criminal liability for persons involved in the donation and distribution of food and grocery products to needy individuals when certain criteria are met.	No	Potential food donors (businesses, nonprofits, etc.)	Information, promotion, stakeholder education and networking Highly feasible but requires leadership from SEEDS.	Support from legal authorities versed in Michigan Law
	Donation Matching Software/App - Using technology platforms to connect individual food donors with recipient organizations to reach smaller-scale food donations. App providing dynamic, real-time information about food available for donation to enhance the operational efficiency of food recovery partnerships between nonprofits and businesses with smaller-volume batches of edible food, such as cafes, restaurants, hotels, and other foodservice settings.	2	$	medium	https://foodtank.com/news/2019/01/theres-an-app-for-that-reducing-our-food-waste/ https://www.spoileralert.com/ https://www.gocopia.com/ https://www.foodcowboy.com/	This resource provides a summary of food donation apps available from industry. Spoiler Alert is an inventory management system used by consumer packaged goods companies to track expiration dates on foods by matching supply with demand. Copia is a tool used by restaurants, hotels, and hospitals, whereby the company requests a pickup of excess food and Copia takes it to a non-profit. Copia also tracks trends in excess food to reduce at the purchasing level. Food Cowboy connects food distributors, large events, or similar with local food donation organizations. Food Cowboy will help load food on trucks and transport to organizations in need.	Yes	Businesses, nonprofits	Promotion Feasible but requires consolidation of regional stakeholders behind a common platform	Feasable with support from SEEDS or other catalytic NGO to work with business community
Recycling/Technology										
	Centralized Composting									
	Windrow Composting or Static Pile Composting - Organic material is mixed and formed into long trapezoidal rows. Material is periodically turned and aerated.	2	$$$	high	https://dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/ANR%20Site%20Identification%20and%20Design.pdf	The Vermont Agency of Natural Resources Department of Environmental Conservation provides info on compost site identification and site design considerations, such as regulatory compliance, road access, compost storage, and leachate management.	Yes	Yard waste and food waste	Secure infrastructure funding; own and/or operate facility, Highly feasible with local unit of government support for planning, zoning, and regulatory oversight.	Conduct compost feasiblity study. Food waste must be adequately mixed with yard debris and bulking agents (wood chips) to balance the carbon-to-nitrogen ratio (C:N), manage moisture content and follow "best practices" for odor prevention.
	Aerated Static Pile (ASP) - covered or uncovered or in-vessel system that uses forced air to aid in composting. Food waste is mixed with higher carbon-content materials, and formed into long cylindrical rows, sometimes in concrete bunkers, and sometimes encased in a plastic bag "sleeve".	3	$$$	high	https://www.biocycle.net/design-considerations-in-aerated-static-pile-composting/	Craig Coker and Tom Gibson write for Biocycle on the basics of recipe development and aeration fundamentals in aerated static pile composting.	Yes	Animal manures and growing in application for additional high-nitrogen materials such as food waste	Secure infrastructure funding; own and/or operate facility, in circumstances where feedstock is > 15% of incoming mass, ASP provides better process control. Feasible with local unit of government support for planning, zoning, and regulatory oversight.	Conduct compost feasiblity study. Food waste must be adequately mixed with yard debris and bulking agents (wood chips) to balance the carbon-to-nitrogen ratio (C:N), manage moisture content and follow "best practices" for odor prevention.
	In-Vessel Composting - Large scale enclosed composting with minimal labor and expedited processing time	4	$$$	medium (50 or more tons per day, can installed in parallel)	https://drive.google.com/file/d/1xNj4BK_1SHr25sNTnN0OrQs0kMzM6wBl/view	Engineered Compost Systems manufactures in-vessel tunnels made from concrete cells with gasketed doors. All conditions are controlled, creating the ideal environment for composting.	Yes	Municipal and farm facilities for food waste mixed with animal bedding or wood chips. Bioplastics are generally not accepted.	Secure infrastructure funding; own and/or operate facility, Financially and sometimes technically infeasible	Food waste must be adequately mixed with bulking agents (bedding, wood chips) to balance the carbon-to-nitrogen ratio (C:N) and manage moisture content. Bioplastics are generally not accepted.
	Small Scale On-Site Systems									
	Containerized Composting - small scale in-vessel composting with minimal labor and expedited processing time	3	$$	low-medium (0.5-10 tons per day)	https://www.globalcomposting.solutions/how-hotrot-techonology-works https://www.globalcomposting.solutions/hotrot-3518-composting-unit/ https://www.compostingtechnology.com/in-vessel-composting-systems/earth-flow/earth-flow-intermodal/	Global Composting Solutions Ltd produces in-vessel composting units with what they call "Hotrot technology." After material is placed inside the vessel, it is mixed and moved from one end to the other over the course of 12 days. The vessel is aerated and insulated to create the proper conditions for composting. The Hotrot 3518 is capable of processing ... Green Mountain Technologies manufactures the Earth Flow™, an in-vessel composting system, which is suitable for processing and utilizing organics on-site. Their webpage discusses benefits and processing capabilities.	Yes	Parks and resorts, institutional or corporate campuses, restaurants/breweries	Secure infrastructure funding; provide operator training, Feasible but requires signficant capital expenditure per ton recovered.	Available space, capital funding, and trained operator
	Vermicomposting - Uses earth worms, Eisenia fetida and E. andrei, to break down organic matter (mostly food waste) in bins as small as 18 inches by 24 inches, but larger 10-20 cubic yards systems are available	2	$	low-medium	https://rodaleinstitute.org/science/articles/vermicomposting-for-beginners/	Rodale Institute: Vermicomposting uses particular species of earth worms to break down organic matter under aerobic conditions. Providing the proper kind of bin and food scraps is essential to harvesting the compost.	Yes	Food waste at schools, campuses, community gardens, residential homes	Secure infrastructure funding; provide operator training, Feasible but requires experienced operator and appropriate site. Attract additional partners through NextCycle.	Available space; labor. Bioplastics are generally not accepted.

Category	Solution Description	Ease of Implementation (1 easy - 5 difficult)	Cost ($-$$$$)	Diversion Impact (high, medium, low)	Resources and Support Links	Brief Summary of Resource	Measurable?	Target Stakeholder/Waste Streams	SEEDS' Potential Role/Feasibility	Contingent Factors
	Backyard Composting - encourage residents to build their own compost systems at home	2	$	low (Up to 500 pounds per family per year)	https://www.kauai.gov/Composting https://www.planetnatural.com/composting-101/indoor-composting/bokashi-composting/ https://lessismore.org/materials/70-home-composting/ https://www.ecotainer.ca/wp-content/uploads/2016/12/Rain-Barrels-Compost-Bins-Earth-Machine-Instructions.pdf	Bokashi home bucket system is probably one of the least expensive composting systems around. A commercial Bokashi Bucket consists of a five-pound plastic bin with a tight-fitting lid on top and a spigot near the bottom which allows for draining leachate. The Home Composting Handbook covers the basics of what to compost, how to compost, and using compost. The Earth Machine is another popular backyard compost bin.	Yes	Yard waste and food waste from residential homes	Information, promotion, labor (workshops, etc.), materials (eg. compost bins), Highly feasible with "extension support" from trained SEEDS Master Composters	Consider appropriateness/ necessity if pursuing other options for organics such as curbside collection
	Community Compost Drop off / Community Composting - residents can drop off food waste at local community gardens to be mixed with yard waste in limited and manageable amounts, where the compost is processed and used, typically in a static compost pile or small in-vessel system.	3	$	medium	https://www.compostingvermont.org/community-composting https://www.reclaimedorganics.org/ https://ilsr.org/composting/	Composting Vermont provides resources for starting a community compost program, from engaging the community to operations and best management practices. Reclaimed Organics is a bike-powered compost collection service for Manhattan residents and businesses. ILSR's Composting for Community Project supports distributed infrastructure and the growing community composting sector through meeting the need for training, guidance on best management practices, business models, and navigating legal and policy hurdles.	Yes	Residents	Facilitation, promotion, Highly feasible with community embrace and SEEDS catayltic support	Need community gardens established and their approval to accept residential food scraps
	Other									
	Animal Feed - Feeding food waste to animals after it is heat-treated and dehydrated and either mixed with dry feed or directly fed	1	$	medium	https://www.chlpi.org/wp-content/uploads/2013/12/Michigan-Animal-Feed-Fact-Sheet-Final.pdf https://www.epa.gov/sustainable-management-food/reduce-wasted-food-feeding-animals	MI Fact Sheet: A Guide that examines both Federal and Michigan state laws that regulate the use of food scraps in animal feed. EPA website: Guideline on law and success stories on safely feeding food waste to animals	Yes	Institutional and commercial organics	Education and promotion	Federal and MI laws to be followed for food safety and livestock safety
	Anaerobic Digestion - Organic material is typically mixed and warmed in a closed, airtight tank. Microorganisms break down or "digest" organic material without the presence of oxygen, typically for 6 weeks, creating biogas and digestate. Energy recovery from methane generation is common.	5	$$$$	high	https://www.rubicon.com/blog/anaerobic-digestion-food-waste/	Rubicon: This resource shows the inputs and outputs of the anaerobic digestion process, along with the different categories of systems that exist.	Yes	WWTP, dairy farms, businesses, Household, industrial, institutional, and commercial organics (e.g. food waste)	Secure infrastructure funding; own and/or operate facility, Financially infeasible accept in very specific situations (e.g. WWTP, highly attractive gas off-take pricing)	Conduct AD feasiblity study. Best configured for management of slurry based food wastes and consequently yard debris can cause problems. Digestate requires further stabilization (i.e composting) for final marketing.
	Co-Digestion - Solids from sewage sludge are already anaerobically digested at publicly owned treatment works (POTW) facilities and when there is excess capacity in the digester system, food waste can be added to generate more energy	5	$$$	high	https://www.ebmud.com/wastewater/recycling-water-and-energy/food-scraps-recycling/	East Bay Municipal Utility District: EBMUD's wastewater treatment plant at the base of the Bay Bridge in Oakland not only treats sewage, but takes discarded materials like food scraps from restaurants and supermarkets that usually go to the landfill and converts them into renewable energy.	Yes	WWTP, businesses, institutional, and commercial organics (e.g. food waste)	Secure infrastructure funding; partner with POTW Financially infeasible accept in very specific situations (e.g. POTW with exisitng digestor)	Conduct feasiblity study. Requires POTW with exisitng digestor or will to invest and build a digestor. Digestate requires further stabilization (i.e composting) for final marketing.
	Biochar - a material produced from burning biomass, typically woody material, in an oxygen-limited environment	5	$$$$	medium	https://biochar-us.org/pdf%20files/2IPBiocharProduction_v5.pdf https://www.biochar-international.org/wp-content/uploads/2018/04/Compost_biochar_IBI_final.pdf https://www.biochar-international.org/wp-content/uploads/2018/04/IBI%20Biochar%20Application%20Guidelines_web	1): US Biochar Initiative: history of biochar 2) International Biochar Initiative: benefits of biochar 3) International Biochar Initiative: using biochar	Yes	Wastewood; Biochar can be added as an amendment to compost to further benefit its impact on soils.	Information, promotion Financially and technically infeasible for large volume applications	Properly using biochar requires several considerations, from understanding general characteristics of the biochar, BMPs for storage, and what crops for which it will be used. Biochar is unproven on a large scale as a cost-effective management solution.
Recycling/Collection and Policy										
	Curbside Organics Collection - establish, require, and/or incentivize customers to use curbside collection	3	$ (residential co-collection with yard debris) $$ (SSO commercial collection) $$$$ (residential SSO collection)	medium	https://www.portland.gov/bps/garbage-recycling/residential-compost-tips https://www.nextcyclemichigan.com/ncmi-stories/emmetfoodscraps NYC, Austin, and 145+ other residential curbside collection programs collect organics from households.	Portland, OR: How to collect food scraps and yard debris, use optional liners, find tips and resources. Emmet County shares their story about how food waste collection is provided to downtown business.	Yes	Haulers, residential and commercial customers	Facilitation, promotion, feasibility varies depending on the flavor. Residential co-collection with YW and commercial SSO collection is highly feasible. Residential SSO collection not so much	Collection vehicle costs
	Local Policy - policies such as mandatory organics diversion, required compostability standards to prevent contamination, etc.	3	$	high	http://www.austintexas.gov/bizorganics https://refed.org	Austin, Texas has an ordinance that requires multi-family households and commercial entities to have access to organics recycling services. Refed: Roadmap to 2030: Reducing U.S. Food Waste by 50% looks at the entire food supply chain and identifies seven key action areas to help guide the food system's efforts over the next ten years.	Yes (although would require self-reporting, and tracking of data)	Local gov	Adopt and enforce policies Feasable with support from SEEDS or other catalytic NGO	Requires local unit political stakeholders to "champion" policy drive
	Incentivize a "Green Restaurant Association" consortium locally - where businesses can collaborate with each other around composting practices and take advantage of scale	2	$	high	http://www.dinegreenasheville.com/	DineGreen Asheville is a website that hosts Certified Green Restaurants®, a certification which requires composting food waste, among other sustainably-driven goals.	Yes	Restaurants	Facilitation, promotion Feasible with support from SEEDS or other catalytic NGO	Feasable with support from SEEDS or other catalytic NGO to work with business community
	PAYT waste collection structure to incentivize diversion. Present as a market-based solution.	4	$	medium	https://resource-recycling.com/recycling/2018/06/25/community-spotlight-economic-incentive-brings-high-diversion-for-colorado-city/	Loveland, Colorado, a community of 75,000 people, has utilized a PAYT system since 1993. Diversion, which includes traditional recyclables and yard debris collection, has exceeded 60% since 2009.	Yes	Local government, Residents	Adopt policies Feasible with grass roots political support from SEEDS or other catalytic	Political difficulties can arise with PAYT as it is often framed as a policy disproportionately impacting young/large families

Appendix E: Solutions Recommendations

Food waste is a subset of organic waste, which includes anything biodegradable that comes from plants or animals, such as yard trimmings and manure. Food waste includes unavoidable scraps, such as bones and rinds that retain beneficial value for reuse. It does not include waste from crop varieties specifically grown for fuel, animal feed, or other commercial uses. Further, recovery of residentially and commercially generated yard and woody waste materials are closely tied to food waste recovery efforts through both common infrastructure (curbside collection, yard waste composting facilities) and as needed constituents (e.g., bulking agents, carbon sources) to some recycling activities.

Consumer-facing businesses and homes represent over 80% of all food waste. Furthermore, home waste represents roughly two-thirds of total lost Economic Value, due to high volumes of waste, the higher cost of food sold at retail, and the high value of meat — a popular consumer purchase item.

Existing efforts already recover and recycle significant quantities of food in the region. These efforts, while not sufficient, represent commendable progress made by stakeholders to date and an opportunity to increase value further through more focus and attention on the issue.

In conjunction with the Solutions Matrix, the following recommendations are organized by Category (e.g., prevention, rescue/recovery, recycling/technology, recycling collection/policy). Areas of suggested focus are informed by the proposed feasibility levels indicated in the Solutions Matrix.

PREVENTION

On one hand, excellent prevention strategies will provide SEEDS with the biggest bang for its buck. Food not produced, not transported, not warehoused, and not kept cold brings with it tremendous economic and environmental benefits. But these gains and benefits have traditionally not been easy to quantify and evaluate over time. Successful outcomes for food waste prevention will incorporate both real quantitative reduction in food wasted as well as a means to create a robust measurement environment that is sufficient to measure and communicate success.

FOCUS SOLUTIONS

- *Educational Campaign/Enhancement of Existing Efforts* – Educational efforts targeting consumers help them make better use of leftovers and minimize spoilage by properly storing perishable foods. At the same time these consumers have a direct hand in reducing waste in and outside the home by creating the awareness necessary to demand that businesses operate more responsibly. These campaigns help to overcome apathy, emphasize importance, and create a long-term commitment to food waste prevention.
- *Waste Reduction Goals* – We can't manage something we don't measure. Creation of numerical goals, and the means/metrics to track, enables effective measurement and tracking of progress. Although a small step, creation of goals is simple, inexpensive, and ultimately a very powerful tool in creating a circumstance of success.

CHALLENGE SOLUTIONS

- *Waste Tracking & Analytics* – Once waste reduction goals have been created, rigorous measurement creates the opportunity for regular management and improvement. Where it is collected, rigorous data collection enables businesses to identify the volumes and types of food that are wasted during food preparation. This knowledge in turn builds the business case for investment in other recovery and prevention solutions. This can accomplish two corporate priorities: increased profit margins and data reporting to show external stakeholders a path to lower overall waste levels. Implementation and collaboration such that individual business decisions can be aggregated into a community profile requires cooperation and a willingness to engage in pre-competitive collaboration.

STAKEHOLDER ROLES

- *Non-Governmental Organizations* – NGO's like SEEDS play an important catalytic role in creating the momentum for social initiatives. Their role in food waste prevention and recovery fits nicely in this model as well as working collaboratively with other NGOs at the local, regional, state and national level that are also engaged in these issues.
- *Local Units of Government* – Similarly relevant units of government can amplify the messages created for these social initiatives and coordinate with message developers to insure consistency and "sign-off". Public funding could also be available to match efforts of the NGO and business sector as the parties move forward with a concerted food waste education initiative.
- *State Agencies* – State agencies are potential sources of funding for one-time support through grants in aid and in-kind support for food waste prevention efforts. In Michigan cooperation with the Recycle Racoons, Know it Before You Throw It Campaign, and other education initiatives could yield a message across the state that is consistent with regional efforts promoted by SEEDS.
- *Institutions (schools, hospitals, universities)* – With their captured clientele, customers, and staff, institutions are closed systems where engaging food organics diversion behavior can be simpler than in the broader public. Institutions are often excellent places to pilot approaches to recovery, institute best practices, and concentrate food waste sufficiently to enable cost effective collection and hauling.
- *Consumer-Facing Businesses* – Businesses, especially those with an established customer basis, can influence the behavior of these individuals through various education and promotion activities. Some, like food service establishments, are uniquely able to engage as influencers through their own participation in prevention, recovery and recycling activities.
- *Residents* – Residents play a key role in all of these initiatives, both as consumers of information and voters who seek social change that reflects their desires for the kind of community in which they wish to live.

VISION FOR SUCCESS – The Region seeks to accomplish the implementation of a world-class set of prevention approaches that create the opportunity for reduction of food waste by ~1.6% of total organics waste generation. With this reduction, comes additional profits for participating businesses (e.g. restaurants, caterers, grocery stores) and reduced costs of food for regional families.

RESCUE/RECOVERY

Although food recovery initiatives already exist throughout the region, opportunity remains to increase donations. Food recovery networks — including food banks, pantries, soup kitchens, shelters, and other agencies — already receive and distribute many pounds of rescued food each year. While prevention strategies can be implemented independently, recovery requires a systems approach with key success features: first, businesses need to be protected from liability related threats and understand how to safely handle recovered food, second, policy that assess financial incentives for individual and corporate donations need thorough understanding, and finally, appropriate infrastructure for transportation, processing, storage and distribution are also needed.

FOCUS SOLUTIONS

- *Food Donation Guide* – This resource will help businesses understand why and how to donate food easily. Smaller donations (under 50 pounds) are expensive.
- *Business Food Donation Awareness and Training* - tracking food waste and training kitchen staff on best food prep or organics recycling practices to reach goals of reducing waste and increasing donations.
- *Donation Liability Education* - educating potential food donors on donation liability laws, the Emerson Act, etc. Donors, gleaners, and nonprofit organizations must still comply with state and local health regulations.

CHALLENGE SOLUTIONS

- *Donation Transportation, Storage & Handling* - providing small-scale transportation infrastructure for local recovery, expanding temperature-controlled food distribution infrastructure/labor
- *Donation Matching Software/App* - Using technology platforms to connect individual food donors with recipient organizations to reach smaller-scale food donations. App providing dynamic, real-time information about food available for donation to enhance the operational efficiency of food recovery partnerships between nonprofits and businesses with smaller-volume batches of edible food, such as cafes, restaurants, hotels, and other foodservice settings.

STAKEHOLDER ROLES

- *Non-Governmental Organizations* – NGO's like SEEDS play important coordinating and motivating roles for catalyzing community focus on many aspects of food recovery. Donation is one area where an organizing entity like SEEDS can provide significant impetus to gain traction with all aspects of donation and reuse, including working with local food rescue organizations, coordinating and promoting their programs.
- *Local Units of Government* – Because donation is primarily an activity occurring within the business community, the role of local governments is primarily supportive. Support can come in many ways including funding for program education and promotion, zoning and planning support, and frequent vocal public support by elected leaders and senior staff.
- *State Agencies* – State agencies are potential sources of funding for program education and promotion. Supportive policy in the form of recovery goals and technical outreach that understands local and regional centers of expertise and information are areas where state agencies can provide important support and funding.
- *Institutions (schools, hospitals, universities)* – Institutional entities often prepare and serve large quantities of good in a variety of settings. As such they are prime targets for joining the network of donors of unused but still edible food. Similarly, they are also prime targets for both recycling and prevention.
- *Consumer-Facing Businesses* – Commercial establishments (groceries, restaurants, food processors) make up the bulk of the potential active participants in donation eco-system. To make their participation in regular donation "sticky" they need assurance that their efforts will be safely implemented (liability for spoilage is limited by the recipients of their donations) and reasonably

efficient and low cost. Most of these commercial establishments are low-margin businesses, which make them exceedingly sensitive to higher costs food waste management options.

- *Residents/Consumers* – Residents play a key role in all of these initiatives, both as consumers of information and voters who seek social change that reflects their desires for the kind of community in which they wish to live. For instance, publicly identifying commercial establishments that play a role in donation of excess food provides residents/customers with the ability to patronize those establishments.

VISION FOR SUCCESS – The Region seeks to establish, fund, publicize and implement an efficient food donation system that both diverts organic waste from landfills as well as provide food for community families facing hunger. Divert ~1.0% of regional food waste through Rescue/Recovery solutions.

RECYCLING/PROCESSING TECHNOLOGY

Once the opportunities for food waste -diversion through prevention and recovery have been maximized some scraps remain and today a majority of these materials end up in landfills where they incur disposal fees costing millions of dollars and rapidly create and release methane, one of the most potent greenhouse gasses.

Recycling technologies for organic, biodegradable materials have existed for decades. Historically, this organics recycling sector has focused on the composting of lawn clippings and manure, driven by bans or mandates to collect yard debris and lawn clippings in half of U.S. states. In many cases efforts to recycle food waste can be effectively combined with other, more established, organics recycling efforts.

FOCUS SOLUTIONS

- *Centralized Windrow Composting* – There are thousands of composting facilities nationwide that employ a combination of windrows predominantly for yard debris. Some food waste can be accommodated in these facilities as long as it remains less than 10 – 15% of the total material by volume as a best practice for odor and vermin management. Foundational infrastructure in the form of centralized composting facilities located near the region's major larger communities of Traverse City, Petoskey/Harbor Springs, and Cadillac create a good starting point for greater recycling of organic materials. But initial reviews suggest that expansion and capital improvements to these facilities will likely be required.
- *Backyard Composting* – Many communities have successfully established home composting programs that can cost effectively manage residential food scraps for homes with sufficient outdoor space to allow management of 1-2 CY piles of food and yard debris scraps. Although substantial education and promotion investment is required to successfully implement a community-based backyard composting program, the operational and capital costs are tiny in comparison to the investments necessary for more centralized systems. In circumstances where curbside collection is not available, backyard composting is often one of the only feasible solutions for residential food scrap composting.
- *Community Compost Drop-Off/Community Composting* – This approach contemplates transporting food from homes by truck, car, bicycle or foot to small, community, or neighborhood-level compost facilities that manage small (less than 2 tons per year) quantities at locally established community facilities. This kind of operation is often co-located with community gardens.

- *Animal Feed* - Feeding food waste to animals after it is heat-treated and dehydrated and either mixed with dry feed or directly fed provides an important mechanism for beneficial reuse of a waste product. In some instances, unless farmers are close to the generation source, food waste might require dehydration. Successful programs match large producers with large farmers who have sophisticated means of matching nutritional qualities of the food waste with the balanced diet needs of individual animal species. It is important to follow Federal and Michigan state laws that regulate the use of food scraps in animal feed when exploring solutions.

CHALLENGE SOLUTIONS

- *ASP (Aerated Static Pile)* – ASP composting, is a higher tech, controlled approach to efficiently composting organic materials. Critically, one of the most important consequences of carefully managed airflow in the composting material is better control of odors. For this reason, once open windrow facilities exceed 10 – 15% by volume of food waste a technological upgrade to ASP is often required. It is likely that some regional investment in this approach to organic recycling will be required if the region is to successfully accomplish its overall food waste reduction goals. Finally, a major lever of success is ensuring final product quality by limiting incoming contamination in the recovery food waste streams.
- *Containerized Composting* - Parks and resorts, institutional or corporate campuses, restaurants/ breweries each of which for their own reasons seek small scale in-vessel composting with minimal labor and expedited processing time participate in recycling organics through containerized composting systems. Several vendors sell "turn-key" applications for this approach. Although not the least expensive capital and operating cost solution, this approach is often successfully implemented by organizations whose primary goal is control and assurance that its waste organic material will be successfully recycled.
- *Vermiculture* – Like containerized composting, the use of worms to consume food waste residuals has gained popularity with parks and resorts, institutional and corporate campuses and universities. They are best deployed where the "worm castings" can be used onsite as a high-quality soil amendment to fully "close the loop". As a system that is most often deployed using bins, this approach can often be volume limited, making it less useful for organizations with unpredictable or cyclic waste generation profiles.

STAKEHOLDER ROLES

- *Non-Governmental Organizations* – NGO's like SEEDS play important coordinating and motivating roles for catalyzing community focus on the development of recycling solutions. Other regional NGO's such as conservation districts and MSU Extension could partner with SEEDS for further support and regional involvement. They are ideally suited to playing an "extension" role in the popularizing and implementation of onsite technologies like containerized composting, vermiculture, and backyard composting. Their role in developing more capital-intensive centralized approaches can vary from site identification to the coalition-building necessary to achieve the economies of scale essential to the justification for capital expenditure.
- *Local Units of Government* – Local governments can play supportive roles for onsite technologies by ensuring its health, building, and planning enforcement bodies understand the benefits and best practices with organics recycling. Contributions like contractual requirements for delivery of organics collected within their boundaries stimulate the development of infrastructure quite

effectively. Others like site identification also play disproportionate roles in allowing recycling infrastructure to develop.

- *State Agencies* – State agencies are potential sources of funding for capital and marketplace development of new and existing facilities. Supportive policy in the form of recovery goals, technical outreach, education about uses of food waste as animal feed and recovery-oriented planning provide key environmental supports. Finally, an established permitting environment based on industry best practices creates a balance between private and public and environmental interests.
- *Institutions (schools, hospitals, universities)* – As organizations where food waste is concentrated, commitment to the delivery of aggregated streams of food waste at a tipfee, to centralized facilities, institutions can provide a "bankable" stream of income against which facility developers can borrow for capital investment in the underlying business.
- *Consumer-Facing Businesses* – Commercial establishments (groceries, restaurants, food processors) make up as similarly large portion of available food waste, creating important synergies for possible facility developers and operators. They will play a key role in helping to maintain high quality flows of organics by investing in education and enforcement to prevent contamination.
- *Residents/Consumers* – Residents play a key role developing the necessary momentum for a robust recycling program. They can also play a key role in helping to reduce the contamination that is often part of an aggressive food waste recycling program.

VISION FOR SUCCESS – The Region seeks to develop and fund a geographically disbursed, well operated centralized composting infrastructure that can effectively accommodate a growing flow of organic material while continuing to recover currently delivered materials. Due to the higher volume of food waste recovery that is planned and need for smaller processing footprints, an ASP composting solution will be evaluated. Where possible, onsite solutions will be aggressively supported to enable self-management of organics by individual residents, institutions, and select commercial/agricultural options. Charismatic stories can illustrate closed loop strategies that show how food waste contributes to the production of more food (whether vegetables powered by compost or animals raises for meat that are fed food waste). SEEDS, in collaboration with other regional agencies and NGOs, needs to develop an "extension" expertise in the operation of onsite solutions. Overall, these activities can divert ~31.7% of the total organic available in the region.

RECYCLING/COLLECTION AND POLICY

Centralized composting solutions require collection options. Even in the densest of urban settings, residential collection is sufficiently expensive that most communities seek to co-mingle residential food waste with existing (and higher volume) yard debris collections. However, collection of commercial, institutional and industrial volumes with higher quantities can be cost-effective in urban communities. Finally, an established drop-off system can also enable organics collections for people wishing to self-transport materials. State and local policy plays a critical role to enable food residual diversion.

FOCUS SOLUTIONS

- *Community Compost Drop-Off/Community Composting (ALSO A PROCESSING SOLUTION)* – This approach contemplates transporting food from homes by truck, car, bicycle or foot to small, community, or neighborhood-level compost facilities that manage small (less than 2 tons per year) quantities at locally established community facilities. This kind of operation is often co-located with community gardens.

- *Curbside Collection* – As described collection of single-family residential recycling is limited by the small individual quantities of material generated by each household and the countervailing need to make collection frequency sufficiently often to prevent generation of odors. Unless residential food waste can be co-collected with yard waste, there are few cost-effective solutions. With larger commercial, institutional, multi-family residential or industrial generators, a commercial collection using larger volume containers is more likely to be both technically and economically effective.

CHALLENGE SOLUTIONS

- *Local Policy* – Policies like mandatory organics diversion, compostability standards, and landfill bans are proven approaches to encourage organic diversion. Although not sufficient on their own, these policies create a policy eco-system that makes the development of an organic diversion system much more effective.
- *Green Restaurant Program* – Restaurant owners interface with food diversion programs at many different levels ranging from prevention (waste tracking & analytics), donations and recycling. But because the vast majority of restaurants are not part of large chains with corporate support functions available for food waste diversion, support needs to be developed elsewhere. In this case, local groups of restaurant managers and owners can gain support, knowledge of best practices, and community resources through development of green restaurant associations.
- *PAYT Waste Collection Structure* – One specific policy that has received significant attention over the years are Pay As You Throw waste collection arrangements. The PAYT economic concept hypothesizes that one means of incentivizing recovery options is to make waste disposal more expensive. Although, PAYT has been "proven" to be effective its ability to drive substantial additional diversion has been questionable. To best implement PAYT, it is clear that it needs to be accompanied by excellent and cost-effective diversion programs and consistent and effective messaging. In other words, like many solutions, by itself it won't move the needle.

STAKEHOLDER ROLES

- *Non-Governmental Organizations* – In perhaps their most significant contribution, NGO's like SEEDS are well positioned to articulate and advocate the benefits of supportive food waste diversion policies. They can also play catalytic roles in crystalizing community activity in support of collection programs as well.
- *Local Units of Government* – Governments play roles in passing legislation and making regulations that result from food diversion policy actions. These require both an understanding of community activity and best practices for food waste diversion. Individual policymaker and senior staff support can also be critical to the success of diversion goals.
- *State Agencies* – State agencies are potential sources of funding for collection programs. Supportive and consistent policy into which local regulations can fit also support recovery goals. And finally state funded technical outreach with supportive expertise is also a likely factor for eventual success.

- *Institutions (schools, hospitals, universities)* – Institutions provide the opportunity for R&D support (universities), demonstration projects (all), and eager participation that contributes to both overall recovery and creating momentum for the rest of the community.
- *Consumer-Facing Businesses* – Commercial establishments (groceries, restaurants, food processors) often participate in local chambers of commerce, some of which have been traditionally opposed to governmental mandates. Support for these policies within chamber discussions can be especially useful in gaining support or at least neutrality on these steps at the local chamber level.
- *Residents/Consumers* – As always, voter support from residents and consumers form the basis for proactive progressive policy and system development.

VISION FOR SUCCESS – The Region seeks to create supportive and enabling policies for accomplishing best in class food waste diversion. As part of this, support and funding for the development of an appropriately scaled collection infrastructure that provides access for the largest portion of the population will be essential.

Together, these prevention, rescue/recovery, recycling efforts will assist the region in a total recovery of ~34% of the regionally generated organic materials.

Appendix F: Types of Processing Technology Options

Composting technologies can be classified as in-vessel or outdoor based systems. An in-vessel based system degrades material biologically in an enclosed vessel. An outside based system allows the material to be exposed to the ambient environment where it is also biologically degraded. Both systems provide oxygen, generate sufficient temperatures, and allow water and carbon dioxide to escape from the composting material. All technologies for composting of recovered food waste must meet the Process to Further Reduce Pathogens (PFRP) to reduce issues with bacteria and pathogens in parent materials. Some composting systems use a combination of in-vessel and outdoor approaches to create a marketable end product. Following PFRP allows the end product to be free of diseases, insects and weed seeds. Enclosed static piles and the Ag-bag system are two examples of this kind of combination. The following technologies represent commercially available methods for digesting/composting organic wastes.

CENTRALIZED COMPOSTING

Windrow Composting

Windrowing is the simplest form of compost technology. It is used throughout the U.S. for composting organics such as yard debris and limited amounts of food waste. Windrows are simply triangular or trapezoidal shaped piles spaced far enough apart to navigate equipment between them. Windrowing is an effective and reliable compost technology for yard wastes and is the least expensive method to biologically treat organic wastes. However, windrow composting of large quantities of food waste has the potential to generate odors if "best practices" aren't employed.

Organic wastes are composted by arranging layers of size reduced organic wastes and brush chips/wood chips in a pile. The pile is called a windrow and is constructed in order to facilitate aerobic microbial activity by creating sufficient mass to both generate and maintain the heat necessary to promote microbial growth and material breakdown. Windrows are typically six to eight feet wide, and as long as possible within space constraints.

Once the windrow is established, machines turn and mix the windrow on a regular basis. Windrows can be turned by a front-end loader, but this turning approach is less efficient then using a windrow turning machine. Many windrow-turning machines are available to windrow compost and they vary considerably in size, capacity, style and price. Windrow turning machines typically vary in price between $100,000 and $750,000. Windrow composting can take as long as 6-12 months for finished product and the resulting product is typically sufficient for high value soil product use as long as incoming contamination is kept to a minimum.

Static Pile Composting

Static pile composting is similar to windrowing. Rather than aerating the feedstock mixture with a mechanical turning machine, the mixture is actively aerated by means of forcing or drawing air through the composting mass. Although most static piles are aerated with fans and blowers, simple passively aerated static piles can also be used efficiently to compost organic wastes. Oxygenation is accomplished in passively aerated static piles by increasing the amount of bulking agent in the compost mixture and by keeping compost piles smaller. This allows for the free flow of oxygen throughout the compost pile without fans or blowers. Passively aerated static piles are less expensive to maintain but take longer to complete the composting process; thus, a larger area (pad) for the storage of composting material is needed which in turn contributes to higher facility capital costs.

Aerated Static Pile (ASP) Composting

Aerated static pile (ASP) composting is the most cost efficient and simplest composting method for large volumes of food-based organic waste. It is especially suited for yard debris, food waste and livestock manure. ASP can be done indoors, outdoors in a windrow composting operation or totally enclosed in-vessel composting. It uses an aeration system to push and/or pull air through the composting mass. Inducing airflow into the organics pile helps to maintain aerobic conditions such as moisture level and temperature that are ideal for the microbial populations, allowing for maximized degradation efficiency and minimization of pathogens. Unlike windrow facilities that require turning of the pile, ASP does not because of the automated air flow produced through the pile, which reduces the operational costs of the facility. In addition, instrumented and process controlled airflow through the compost for aeration provides an added benefit of odor reduction, lowering the impact of the facility on surrounding neighbors. ASP composting takes between 4-6 months for finished product.

In-Vessel Composting

In-vessel composting uses equipment that encloses feedstock, thereby controlling conditions such as temperature, moisture content, and aeration. It is more compact than other forms of composting and expedites the composting process in as little as 10-21 days, plus 30 to 60 days for curing the product. In-vessel units vary in size, from being able to process 50 or more tons per day, allowing them to work well for kitchens and schools or larger campuses and farms. This approach to composting is capital intensive and less operationally complex than other approaches. This composting technology is often used in institutional settings (e.g. universities, schools, corporate campuses) where space is at a premium and capital is available.

SMALL SCALE ON-SITE SYSTEMS

Containerized Composting

Containerized composting has emerged as food waste diversion grew in popularity and need. Containerization enables operators to effectively manage process control, odor, moisture, vermin, and final product quality. It creates an increase in logistical flexibility. Containerized systems can be operated as standalone operations or scale with multiple installations to track effectively track collection growth. As onsite solutions, these systems often range in capacity from less than 0.5 tons per day to as much as 3.0 tons per day.

Although more costly than open air composting, the benefits of containerized systems appear to be gaining ground as more food waste projects are implemented. Many operations find permitting easier where state and provincial regulatory agencies call for control of these environmental factor control. The other trend that makes containerization more popular and useful is its ability to be deployed in a modular fashion. Containerized technology employs a variety of approaches including tunnel systems, positive aeration, and mechanical agitation many of which are reapplications of mechanical systems developed from farm silage management, mushroom growers, and other batch process industries.

Vermiculture

Vermiculture (sometimes referred to vermicomposting) is the process by which Eisenia fetida and Eisenia andrei, different species of earth worms, decompose food waste to produce vermicast, a nutrient-rich substance that can be used as a fertilizer. Vermiculture can be undertaken on a small-scale, using a wooden or plastic bin, or it can be done using windrows in a hoop house. In small-scale vermiculture, the bin should have holes for ventilation and be kept in a cool, dark space, like in a basement or under a kitchen sink. Approximately 1 pound of worms per square foot of bin surface area are needed. Worms should be fed produce scraps, with the exception of citrus and never be fed meat, dairy, or other fatty foods, and bioplastics are generally not accepted as the worms cannot digest these items. Worms can consume one-half to their full body weight in food per day. One method of harvesting the finished compost is to shine light on the surface of the bin for several hours, causing the worms to migrate to a bottom layer while the product on top is removed.

Backyard Composting or Community Composting

Backyard composting and community composting can be an easy and inexpensive means for municipalities to generate enthusiasm toward composting and to accomplish significant recovery of household organics without incurring significant operating and capital cost. One of the most challenging aspects of starting a composting program and an essential component for success is creating an environment where residents can understand the value they receive from composting. An ideal means of demonstrating value is by providing incentives for residents to compost in their backyard or nearby community garden. Many cities in the U.S. promote composting by offering discounts or vouchers to purchase the equipment necessary to start. For example, the City of San Diego, CA offers a year-round voucher program where residents can get one of three styles of bins at a discount. A significant differentiator for success is the support of residents as they employ this approach for managing their organic material streams.

OTHER

Anaerobic Digestion

Anaerobic digestion (AD) is a natural process in which organic materials are broken down by microorganisms in the absence of oxygen. AD treatment systems have been used for decades as a way to stabilize municipal solids and as a form of treatment for high-strength organic waste. A benefit of AD processes, as compared with aerobic processes, is the production of methane-rich biogas which is readily captured. The biogas can be utilized to offset heat or electricity demands and can result in an additional revenue source. In addition to biogas, the end-product of the AD process is a digested, stabilized material called digestate, which has nutrient value and can be applied as a low analysis fertilizer after stabilization or composted in a windrow or aerated static pile. When evaluating AD systems for feasibility it is critical to consider the end uses and/or management of the biogas and digestate end products.

AD requires a few key conditions, including an environment without oxygen, optimum temperatures (which vary depending on the specific process), and the proper nutrients. Based on samples collected by Eureka Recycling, residential source-separated organics (SSO) has a carbon to nitrogen (C:N) ratio ranging between 24.6 and 32.7, which is consistent with the optimum range for digestion between 20 and 3021. The commercial SSO characterization showed more variable and lower C:N ratios ranging from 9.2 to 22.9. Given the long detention times in anaerobic systems (on the order of 15 days), the fluctuations in the C:N ratios is expected to equilibrate in the AD reactor. AD systems are not well equipped to digest or accept yard waste, especially brush and woody material. Woody waste contains high amounts of lignin, a compound anaerobe, and are unable to efficiently degrade.

AD processes are typically classified as wet digestion (or low solids) and dry digestion (high solids). While the solids concentration threshold between the wet digestion and dry digestion varies from reference to reference, generally wet digestion systems have solids concentrations of 10-15% or less. The wet and dry

AD systems involve different treatment components, but generally, the biogas quality and quantity produced is similar. However, material management within the systems differ greatly because wet systems allow the digesting mass to be pumped, while the dry substrate needs to be handled using bucket loaders and the like. The description of the AD alternatives includes more information about wet and dry AD systems; however, primary differences between the two systems are summarized below.

- The two systems require different energy inputs. Wet digestion processes require more energy input, using up to 50% of the energy generated, whereas dry digestion processes use only 20 to 30% of the energy generated.
- Wet systems have been in use for decades for treatment of municipal biosolids. Dry systems are newer and there are limited U.S. installations.
- Wet systems require the input of water or another wet waste stream. Dry systems, depending on the waste characteristics, may require the input of a bulking material (grass, brush, or woody) to increase the solids concentration and allow percolation of liquid.
- Dry systems require more costly conveyance equipment because standard pumps cannot be used.
- Wet systems require larger storage and heating equipment.

Although popular in Europe and initially frequently utilized for North American on-farm installations, high solid digesters have had difficulty achieving their predicted gas yields using SSO. A number of operators and observers who have focused on SSO digestion in the field at larger volumes find that the combination of operational cost, input requirements, and energy production are not consistent with low solid digestion. Organics can be digested in 4-6 weeks, with digestate management requiring at least another 8-10 weeks for complete stabilization.

Co-Digestion

Solids from sewage sludge are already anaerobically digested at publicly owned treatment works (POTW) facilities. There, they generate methane and a solid residual as part of the standard secondary treatment process. The methane gas is used as a source of energy (often for plant operations) and the solid residual (biosolids) can be composted to produce a soil amendment or in many cases directly land applied at appropriate agronomic rates on nearby farmland. Where there is excess capacity in the digester system, food waste can be added to generate more energy. In California alone there are almost 140 POTW facilities that utilize anaerobic digesters, with an estimated excess capacity of 15-30%. An excess capacity at a POTW facility can occur when utility districts overestimate development or when large industries leave the area. For example, East Bay Municipal Utility District's (EBMUD) main treatment plant has an excess capacity because canneries that previously resided in the Bay Area relocated resulting in the facility receiving less wastewater than estimated when it was constructed.

Overall, co-digestion at POTW facilities works well because in many cases the anaerobic digesters already exist and are under-utilized and operational expertise is already in place. In addition, facilities are located in urban areas thus facilitating lower transportation costs and the pre-digestion of food waste can reduce the overall odor production during the composting phase. However, POTW managers and engineers can be reluctant to accept food waste because its characteristics can differ from their usual wastewater inputs.

Biochar

Biochar is a material produced from burning biomass, typically woody material, in an oxygen-limited environment such as in small or larger-scape pyrolysis ovens that can also generate heat and power. Smaller units can be used in a residential setting and larger units are more practical for large farms or district heating needs. Smaller stoves can be converted to mobile units and taken to the biomass source saving on transportation costs when large amounts of bio-mass are available periodically but not regularly in a specific location. Larger industrial-sized units can handle tons of biomass on a daily basis. They can produce electricity as well as biochar, bio-oils, and syngas in large quantities. These stationary units depend on a steady, sustainable supply of biomass, so need to be located where they can take advantage of reasonable haul distances for feedstocks.

Biochar is beneficial as a soil amendment, in some cases it has been shown to retain nutrients in soils, control odor, inhibit growth of molds, and soil increase aeration. It can be added at the beginning of the compost process to reduce GHG emissions, odor, and ammonia loss, or it can be incorporated with the finished product. The amount of biochar added at the beginning of the compost process depends on bulk density and carbon to nitrogen ratio of compost feedstocks. Properly using biochar requires several considerations, from understanding general characteristics of the biochar, BMPs for storage, and what crops for which it will be used. It's production and use has not grown appreciably in the time since it gained more notoriety in the 1990's as an enhancement in the organics recovery and soil marketplace. It's benefits to soil remain significant and uncontroversial, however its production, using pyrolysis is difficult to replicate and to reconcile with high costs and production requirements.

Appendix G: 10-County Aggregate of Generation and Diversion Rates

(Current Generation and Potential Diversion all in Tons/Year)

FOOD AND YARD WASTE DIVERSION

GENERATION

Food Waste	Tons/Year
SF Residential FW	14,833
MF Residential FW	3,774
Commercial FW	22,175
Yard Waste	Tons/Year
SF Residential YW	16,353
Commercial YW	17,854
Total	34,208
GRAND TOTAL	**74,989**

DIVERSION

	Low	Med	High
Prevention	0.88%	1.57%	2.34%
Rescue/Recovery	0.58%	0.97%	1.46%
Recycle (Onsite)	4.91%	6.75%	8.44%
Recycle (Centralized)	16.78%	25.43%	34.60%
Total	**23.15%**	**34.72%**	**46.84%**

PROCESSING OPTIONS

	Low	Medium	High
Residential YW (+Res FW)	3,089	5,623	7,516
Commercial FW + MF FW	9,494	13,443	18,434
Total	**12,583**	**19,066**	**25,949**

Windrow Facility Input -> ASP
ASP/Digester Input

PREVENTION

Consumer Education Campaigns			
8.2%	Low	Med	High
SF Residential FW	266	532	798
MF Residential FW	68	102	136
Commercial FW	-	-	-
Waste Tracking & Analytics			
4.3%	Low	Med	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	327	546	818
GRAND TOTAL (Tons)	661	1,179	1,752
GRAND TOTAL (%)	0.88%	1.57%	2.34%

RESCUE/RECOVERY

Standardized Donation Regulation			
1.5%	Low	Medium	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	141	235	352
Donation Matching Software			
1.1%	Low	Medium	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	125	209	313
Donation Transportation			
0.8%	Low	Medium	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	62	104	156
Donation Storage & Handling			
0.8%	Low	Medium	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	62	104	156
Donation Liability Education			
0.4%	Low	Medium	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	47	78	117
GRAND TOTAL (Tons)	437	729	1,093
GRAND TOTAL (%)	0.58%	0.97%	1.46%

RECYCLE

Home Composting			
SF Residential YW	Low	Medium	High
SF Residential FW & YW	1,661	2,305	2,857
MF Residential FW & YW	-	-	-
Commercial FW & YW	1,049	1,278	1,424
Community Composting			
SF Residential YW	Low	Medium	High
SF Residential FW & YW	264	376	473
MF Residential FW & YW	17	26	34
Commercial FW & YW	158	192	215
Animal Feed			
0.4%	Low	Medium	High
SF Residential FW	-	-	-
MF Residential FW	-	-	-
Commercial FW	530	883	1,325
GRAND TOTAL (Tons)	3,680	5,060	6,328
GRAND TOTAL (%)	4.91%	6.75%	8.44%

CENTRALIZED COMPOSTING

Tons Collected Food Waste			
	Low	Medium	High
SF Residential FW	362	1,086	2,036
MF Residential FW	116	260	434
Commercial FW	1,301	3,375	7,038
Tons Collected Yard Waste			
	Low	Medium	High
SF Residential YW	2,727	4,537	5,479
MF Residential YW	-	-	-
Commercial YW	8,077	9,808	10,962
Tons Collected Total			
	Low	Medium	High
SF Residential FW & YW	3,089	5,623	7,516
MF Residential FW & YW	116	260	434
Commercial FW & YW	9,378	13,183	18,000
GRAND TOTAL (tons)	**12,583**	**19,066**	**25,949**
GRAND TOTAL (%)	16.78%	25.43%	34.60%
Processing Options			
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Total	**12,583**	**19,066**	**25,949**
GRAND TOTAL (%)	16.78%	25.43%	34.60%
RECYCLE/CENTRALIZED	21.69%	32.17%	43.04%

FOOD WASTE PARTICIPATION RATE			
	Low	Med	High
SF Residential FW	20%	40%	60%
MF Residential FW	20%	30%	40%
Commercial FW	30%	50%	75%
YARD WASTE PARTICIPATION RATE			
	Low	Med	High
SF Residential YW	70%	85%	95%
MF Residential YW	Included in Commercial Estimates		
Commercial YW	70%	85%	95%

SET OUT RATE – URBAN AREAS			
Food Waste Set Out Rate			
	Low	Med	High
SF Residential FW	40%	60%	75%
MF Residential FW	40%	60%	75%
Commercial FW	40%	60%	75%
Yard Waste Set Out Rate			
SF Residential YW	55%	75%	80%
MF Residential YW	Included in Commercial Estimates		
Commercial YW	Not Applicable		

SET OUT RATE – COMMERCIAL ONLY ESTABLISHMENTS			
Food Waste Set Out Rate			
	Low	Med	High
SF Residential FW	0.0%	0.0%	0.0%
MF Residential FW	0.0%	0.0%	0.0%
Commercial FW	15.0%	25.0%	40.0%
Yard Waste Set Out Rate			
SF Residential YW	0.0%	0.0%	0.0%
MF Residential YW	Included in Commercial Estimates		
Commercial YW	Not Applicable		

PREVENTION			
Consumer Education Campaigns			
8.2%	Low	Med	High
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Tons Collected Total			
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GRAND TOTAL (tons)	**12,583**	**19,066**	**25,949**
GRAND TOTAL (%)	16.78%	25.43%	34.60%
Processing Options			
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Total	**12,583**	**19,066**	**25,949**
GRAND TOTAL (%)	16.78%	25.43%	34.60%
RECYCLE/CENTRALIZED TOTAL	21.69%	32.17%	43.04%

Appendix H: SEEDS Operating Costs Assumptions

	Total Cost	Cost per Unit	# Units	Prevention	Rescue/ Recovery	Backyard Composting	Community Composting	Animal Feed
Staffing	**$ 178,904**			10%	15%	25%	25%	25%
Manager	**$ 80,000**	$80,000	1	$ 8,000	$ 12,000	$ 20,000	$ 20,000	$ 20,000
Conservation Corp	**$ 59,904**	$19,968	3	$ 5,990	$ 8,986	$ 14,976	$ 14,976	$ 14,976
Daily Expenses for CC @ $150/day	**$ 39,000**	$ 150	260	$ 3,900	$ 5,850	$ 9,750	$ 9,750	$ 9,750
Education	**$ 180,432**			13%	13%	24%	25%	25%
Education & Promotion*	**$ 153,432**	$ 1.50	102,288	$ 19,946	$ 19,946	$ 36,824	$ 38,358	$ 38,358
Training Seminar Costs	**$ 20,000**	$ 2,500	8			$ 10,000	$ 10,000	
Master Composter Course	**$ 7,000**	$ 875	8			$ 3,500	$ 3,500	
Class per person	$ 50	$ 50	8			4	4	
Hotel per person (4 nights)	$ 100	$ 400	8					
Per Diem per person (5 days)	$ 75	$ 375	8					
Transportation per person	$ 50	$ 50	8					
Other	**$ 7,260**							
Tools and Supplies	**$ 300**							
Truck Maintenance, etc.	**$ 6,960**							
Assumptions								
Landfill Tip Fee ($/ton)**	$ 41.97							
Utility Truck (upfront capital)	$ 35,200							
Total Households	102,288							

*Social media, traditional media, printing and educational materials ($1.50 per HH)
**Average MI Landfill Tip Fee (EREF 2018)

Appendix I: Solutions Cost (Benefit) Summary

	Total Tons Diverted	Total Annual Cost	Avoided Landfill Costs	CO2e Costs per ton			Saved Tons CO2e	Value* of Carbon Saved	Total Costs	Jobs
				Total lb CO2e/ ton	Landfill lb CO2e/ ton	Netlb CO2e/ ton			Total Cost (Benefit)	# FTE
Prevention										
Total Prevention	1,179	$42,073	$(49,492)	-1,259.98	1,798.91	-3,058.89	(1,803.54)	$90,177	$(97,596)	0.40
Rescue/Recovery										
Total Rescue /Recovery	729	$51,381	$(30,590)	-8,036.47	1,798.91	-9,835.37	(3,584.32)	$179,216	$(158,425)	0.60
Recycling										
Backyard Composting - FW	3,583	$116,131	$(150,379)	-296.03	1,798.91	-2,094.94	(3,753.09)	$187,654	$(221,903)	
Community Composting	593	$105,149	$(24,908)	-296.03	1,798.91	-2,094.94	(621.65)	$31,083	$49,158	
Animal Feed	883	$91,649	$(37,071)	-241.70	1,798.91	-2,040.61	(901.20)	$45,060	$9,518	
Total Recycle	5,060	$312,929	$(212,358)				(5,276)	$263,797	$(163,226)	2.00
Centralized Composting										
Emmet County- ASP Composting - YW	3,187	$136,848	$(133,776)	-110.13	-440.53	330.40	526.56	$(26,328)	$29,399	1.00
Emmet County- ASP Composting - FW	1,033	$ 44,360	$(43,364)	-380.07	1,798.91	-2,178.97	(1,125.68)	$56,284	$(55,288)	

Emmet County - Centralized Hauling		$526,491						$40	$526,451	
Grand Traverse County- ASP Composting - YW	8,338	$495,400	$(349,951)	-110.13	-440.53	330.40	1,377.45	$(68,872)	$214,321	3.00
Grand Traverse County- ASP Composting - FW	3,166	$188,090	$(132,867)	-380.07	1,798.91	-2,178.97	(3,449.06)	$172,453	$(117,230)	
Grand Traverse County - Centralized Hauling		$1,247,249						$439	$1,246,810	
Morgan- Windrow Composting - YW	2,820	$84,594	$(118,347)	-110.13	-440.53	330.40	465.82	$(23,291)	$(10,462)	1.00
Morgan- Windrow Composting - FW	522	$15,659	$(21,908)	-380.07	1,798.91	-2,178.97	(568.69)	$28,435	$(34,683)	
Morgan - Centralized Hauling		$584,133						$299	$583,834	12.58
Total Centralized Composting	19,066	$3,322,824	$(800,213)				(2,774)	$ 139,458	$1,799,319	17.58
GRAND TOTAL FOOD WASTE RECOVERY	**11,689**	**$654,491**	**$(490,579)**		**$67.62**	**per ton**	**(15,807.23)**	**$790,361**	**$(626,449)**	
GRAND TOTAL ORGANICS RECOVERY (INCL. YW)	**26,034**	**$3,729,206**	**$(1,092,654)**		**$25.84**	**per ton**	**(13,437.40)**	**$672,648**	**$1,380,071**	

* Social Value of Carbon (Yale 2021) = $50/ton
**6.6 jobs per 10,000 tpy (ILSR 2021) plus 4 FTE for hauling/collection

Appendix J: Composting Siting Consideration and Siting Review Checklist

Centralized Composting Siting Considerations

As the region looks to develop and expand current composting infrastructure, there are some required siting and design criteria regarding setbacks, water management, and nuisance control that must be adhered to. These are:

- Not in a 100-year floodplain
- Minimum 200 feet from a body of water, including a lake, stream, or wetland
- 2000 feet from a type I or a type IIA water supply well
- 800 feet from a type IIB or type II water supply well
- Drainage conveyance structure that is capable of conveying leachate or storm water runoff to retention pond without overflow or percolation
- Diversion channels to direct runoff and promote sedimentation removal
- Retention pond at sites larger than 5 acres or those with high water tables
- Retention pond that can contain a 25-year, 24-hour rain event
- Restrict/control rate of runoff to reduce quantity and increase quality of runoff
- 4 feet above groundwater
- 100 feet from a property line
- Minimum 300 feet from a residence
- If within 500 feet of a residence, visual obstruction from a fence of at least 8 feet in height and 75% screening or an earthed berm that offers equal obstruction is required
- 500 feet from sensitive receptors (church or other house of worship, hospital, nursing home, licensed day care center, or school, other than a home school)
- If located within 10,000 feet of any airport runway used by turbojet aircraft or 5000 feet of an airport runway used by only piston-type aircraft the facility must be designed and operated so that the facility does not pose a bird hazard to aircraft

Other considerations that must be evaluated include perimeter buffers, soil type and permeability, pad design and slope, site access/roads, prevailing wind direction, size, material flow through site and site structures.

Appendix K: Site Visit Observations

Emmet County Composting Site

Wednesday November 17, 2021. JD Lindeberg of RRS met with Andi Tolzdorf and Lindsey Walker of Emmet County (by phone). They provided updated information on both the flow of food waste and wood and brush to the site.

Andi indicated an appetite for the possible outsourcing of both food waste organic collection and compost site operations due to the possible need to reduce their overall costs. Clearly this limits the opportunity for additional programming and capital improvements at the composting facility.

The composting facility is located to the south of the County transfer station/MRF atop a closed and capped landfill. This facility was built in 2004 and is permitted with EGLE. A portion (2 acres) is devoted to the composting of collected yard waste and food waste, while another portion (1 acre) is devoted to processing incoming brush and logs collected from within the county.

A 30-minute tour of the composting facility provided insight into its current operational status. The facility was overloaded with brush and wood, newly delivered leaves from the current season, and compost piles in various states of decomposition. The site itself was suffering from the impact of recent rainstorms, shown by the evidence of mud and standing water in most portions of the site. Recent arrangements with Deering Tree Service from Leelanau County had resulted in the delivery of a tub grinder and loading conveyor to the site in preparation for cleanup operations that would begin as early as next week.

Andi also told me that she plans to have the loader operator smooth and regrade the side to the extent possible after the grinding and consolidation of piles has occurred. I observed that most of the mud and is likely to be a layer of compost on top of a relatively stable pad. If this material were removed routinely, the amount of standing water and mud would be dramatically reduced.

Andi continued to discuss that there is no specific person responsible for the composting operation. The site would be cleaner and the total time for decomposition would lesser if more attention were paid to operations.

Traverse City Keystone Composting Site

On the morning of November 18, 2021, a wide variety of stakeholders gathered to tour the Traverse City/Grand Traverse County organics recovery facility site. The site tour was led by TC Streets Superintendent Mark Jones. Joining JD Lindeberg on the tour were Sarna Salzman (SEEDS Executive Director), Nick Beadleston (Good Impact), Jennifer Flynn (SEEDS EcoCorps Program Director), Dan Buron (CEO of Goodwill of Traverse City), Taylor Moore (Food Rescue Coordinator, Goodwill of Traverse City), Mac McClelland (Brownfield Consultant) Andi Tolzdorf (Emmet County Director of Solid Waste) and David Schaffer (GTC Resource Recovery Manager).

This ~17.0-acre composting site has been in operations along the Boardman River in Garfield Township since the 1980's. The primary material it currently accepts is Traverse City- street collected leaves. A much smaller fraction of material is delivered by private landscape contractors. The overwhelming fraction of the composting material on the site seems to be leaf organics.

The site was observed to be approximately two thirds involved with operations. One section toward the north and west, estimated to be approximate two to three acres in size, remains empty at this time of year. TC staff indicated that if leaf delivery continues and that this would shortly be filled. If leaf fall doesn't completely finish this fall and spring season street cleanup with fill the site later.

The site was observed to be relatively well drained. A few areas of standing water were observed, but the overall fraction of water surface in comparison to site area was small (less than ~5%). Regrading efforts using sand surfacing toward the back of the site were observed. Staff explained that this area experienced subsequent erosion and the grading was needed in order to prevent flow of compost water into the river channel.

Current layout of the windrows is across the gradient. Street staff indicated that this new approach to windrow layout was an attempt to soak up more precipitation as it flows across the site toward the river. Operationally, TC staff believe that insufficient moisture is slowing decomposition onsite.

No stormwater retention is available on site, causing site runoff to drain primarily into the Boardman River drainage. Most likely, EGLE staff will eventually impose requirements for managing stormwater at this facility.

Several aspects of site utilization seem to be inefficient. Incoming leaf windows are being formed as the material arrives, a reasonably efficient approach to manage the logistics of on-site material. However, it would be possible as well to accumulate all of the leaves in a large pile, using less footprint, until those leaves were needed for windrowing. As observed earlier, there are large open spaces around the site. Little attempt is being made to carefully layout and monitor windows, which probably leads to inefficient break down and process control. Finally, stormwater management is likely to become an issue in the event of heavy rainstorm or lengthy period of wet weather.

Site ownership and control is split between Grand Traverse County and Traverse City. The site entry and gate house are owned and staffed by the County. Similarly, the County takes responsibility for stump and wood waste delivery and management. As part of this they take responsibility for the grinding of this material, much of which is then used as part of the composting process. In addition, some of the wood waste is directly to Mid-Michigan Recycling for use as fuel.

The Keystone site represents an interesting and potentially useful site for the 10-county regional organics strategy centralized composting. Although the current operators (Traverse City Streets Division) aren't eager to change the composting operation to incorporate food. However, County staff was more open to the opportunity and was actively willing to discuss the option.

If Keystone is identified as a destination for food waste the underlying landfill should be capped and mitigated. The mitigation effort could be funded through brownfield redevelopment efforts. Recommendations from Michael McClelland who joined the site visit suggested that the brownfield redevelopment process would be possible, but the City should first make a decision about its willingness to entertain food waste composting at this site.

To make this determination, it would be necessary to do some detailed planning to evaluate a number of factors related to the site including:

- Capacity for projected organics quantities,
- Capital requirements for construction of a food waste capable composting operation,
- Neighborhood features and barriers for composting,
- Consultation with EGLE surface and groundwater specialists to determine regulatory appetite for using this site for food waste composting.

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LEAF COMPOSTING FACILITY
NO DUMPING ALLOWED
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Charlevoix County Composting Area (Brush ad Stump Grinding)

The Charlevoix site is located to the south of US31 on the way out of town toward Elk Rapids. It is located adjacent to an active quarry or borrow pit to the east. The site itself (8 acres) is fully encircled by trees and is relatively accessible from the highway. It is secured by a gate with a lock.

The site is relatively unimproved and at the time of the inspection considerable standing water was in evidence. While onsite, a loader was observed moving piles of ground wood away from the standing water, toward the northern edge of the site. Much of this material appeared to have recently been ground. A smaller pile near the middle of the site appeared to remain unprocessed, but also appeared to be made up on a large fraction of dirt, possibly making it impossible to process in a tub grinder or shredder.

This site would need considerable improvements for composting and is best to be utilized for a drop-off collection site.

Krull's Composting

Krull's Composting is located on farmland near the intersection of S. Nash Road and Maple City Road in the middle of Leelanau County. This operation composts only farm (manure) and source separated food waste mixed with some yard waste using a tractor mounted windrow turner and watering wagon.

Bay Area Recycling for Charities (BARC) was observed depositing source separated food waste collected from Traverse City food waste collection participants. A variety of food waste was delivered in the individual bags including produce waste from grocery stores, floral waste, and other old and decaying fruits and vegetables. The organic material was deposited in windrows by the driver for what he indicated would be subsequent passes with the windrow turner.

A small, stationary shaker screen was observed in the field near the windrows. This screen was clearly used for screening the finished compost in preparation for bagging. A simple bagging unit was observed near the shaker screen that is either now used or intended for future use in producing retail quality material.

Discussions with Mr. Krull were not held because he was not present during the site tour. However, the BARC driver, Alex Campbell, was available to explain the process and answer questions about the composting and food waste collection program.

Glenn’s Landfill Site

A drive by site visit was undertaken to a possible composting site that was located adjacent and directly south of the property surrounding Glenn’s Landfill. The site location was observed to be reasonably flat, wooded, and rural. No information about exact size, opportunities for constructing access roads, surface water features or natural barriers between the operational area and surrounding homes could be ascertained.

Historic Barns Park

Late morning on November 18, 202,1 a site visit was undertaken at Historic Barns Park. The primary purpose of this site visit was to see the SEEDS operations and their farm. A tour of the SEEDS carpentry shop and garage area showed the wide range of activities of the SEEDS EcoCorps. SEEDS EcoCorps members have the opportunity to work on projects that range from light carpentry to trail making, to farming with numerous other activities as well.

The historic barns in the name of the park, refers to the two barns that were once part of the working farm that fed the patients and employees of the former Traverse City State Hospital. The hospital has been redeveloped as the Traverse City Commons and the 56-acre park to its south remains an important asset to the Commons and the rest of the community.

The tour of the SEEDS Farm and Community Composting Area demonstrated the power of the EcoCorps model and confirmed the notion that SEEDS is positioned to provide extension like support for backyard (home) Composting and Onsite Composting. Perhaps this work can be done as one of the SEEDS EcoCorps portfolio projects.

Part of the visit to the Historic Barns Park enabled evaluation of the SEEDS Community Farm as a potential food waste drop-off location and community composting site. Currently, the farm site is at the northwest end of the two -acre strip of land adjacent to the TART recreation trail. It is located between the trail and the adjacent street (Silver Lake Road) and has inefficient site access (only along the trail). Taken together this space would be a poor drop off location for outside food waste generators. It could provide demonstration composting facilities, especially if it were combined with management of vegetative waste from the community gardens and the Barns venue.


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SEEDS Farm
seeds

Appendix L: Compost Facility Cost Details

ASP FACILITY COST DETAILS – EMMET COUNTY COMPOSTING	UNITS
COSTS	
Equipment Capital ($)	$ 170,000
Site Development, ASP System and Building Capital ($)	$ 238,546
Contingency ($)	$ 23,855
Total Annualized Cost of Capital ($/ton) - a	$ 11.09
Annual Operating Cost - Labor ($)	$ 42,900
Annual Operating Cost - Maintenance ($)	$ 17,500
Annual Operating Cost - Equipment ($)	$ 70,209
Total Operating Cost ($/ton) - b	$ 30.95
Waste Disposal ($/ton) - c	$ 0.90
REVENUES	
Tipping Fee ($/ton) - d	$ 30.00
Compost Sales ($/ton) - e	$ 19.20
Total Annualized Revenue (Loss) - ($/ton) =(d+e)-a-b-c	**$ 6.27**

ASP FACILITY COST DETAILS – TRAVERSE CITY/GTC SITE	UNITS
COSTS	
Equipment Capital ($)	$ 600,000
Site Development, ASP System and Building Capital ($)	$ 1,093,093
General Conditions, Contingency	$ 382,583
Total Annualized Cost of Capital ($/ton) - a	$ 18.14
Annual Operating Cost - Labor ($)	$ 156,000
Annual Operating Cost - Maintenance ($)	$ 56,500
Annual Operating Cost - Equipment ($)	$ 252,004
Total Operating Cost ($/ton) - b	$ 40.38
Waste Disposal ($/ton) - c	$ 0.90
REVENUES	
Tipping Fee ($/ton) - d	$ 30.00
Compost Sales ($/ton) - e	$ 38.40
Total Annualized Revenue (Loss) - ($/ton) =(d+e)-a-b-c	**$ 8.99**

Appendix M: Case Studies

Case studies were chosen to display the variety in methods and compost technologies that exist for repurposing organic waste in Michigan and throughout the US. The case studies showcase what the local community and surrounding neighborhoods are currently doing to manage organic waste. Despite the variety in operations, most interviewees shared a few common topics. First, education on contamination and impact of using compost was mentioned as an essential component to running a compost operation. Second, most operations obtained feedstocks from several different sources, such as residential curbside and drop-off, commercial haulers, and landscapers, in order to maintain consistent feedstock. Lastly, some operations created special blends, bagged finished product, or offered application services in order to supplement compost sales.

ASP COMPOSTING

OCRRA AMBOY, CAMILLUS, NY

6296 Airport Rd, Syracuse, NY 13209

Type of system:	Aerated Static Pile, food waste bulked with yard waste
Total site size:	13 acres
Number of people served:	460,000 + people
Staff:	3 operators
Hours of operation:	April 1 to November 30: Monday through Saturday, 7:30 AM – 4:00 PM December 1 to March 31: Monday through Friday, 7:30 AM – 4:00 PM
Equipment on site:	Two bucket loaders, a skid steer, two shredders, and a trommel screen.
Throughput time:	3 to 4 months
Throughput total volume:	about 6,600 tons food waste, 36,000 cy of yard waste
Total permitted capacity:	Up to 9,600 tons of food waste per year
Material Source(s):	Residential, commercial, institutional, manufacturing
Collection Method:	Residential drop-off, commercial collection
Size of windrows/piles:	8 concrete bays, 20 ft x 100 ft
Processing building size:	50 x 100 square feet
Average sales price of product sold:	Residential Fees: • Compost by the Trunk Load 1/2" Screened: $10/trunk • Bulk General Compost 1/2" Screened: $15/cu. yd. • Bulk Premium Compost 1/4" Screened: $20/cu. yd. • Mulch by the Trunk Load Double Ground: $5/trunk (3,000 cy in 2018) • Bulk Wood Mulch Double Ground: $12.50/cu. yd. Commercial Fees: • Double Ground Wood Mulch: $12.50/cu. yd. • 1/2" Screened Compost: $15/cu. yd. • 1/4" Screened Compost: $20/cu. yd. Bagged compost (1 cu. ft. bags): $5 each or 5 for $20
Total volume sold per year:	About 3,000 cy of mulch
Funding mechanism:	Unknown
Local permitting/zoning requirements:	Subject to state permitting but not local because of public authority status

BACKGROUND

OCRRA's Amboy compost site, located just south of Syracuse, NY, in Camillus, NY, was originally a yard waste processing site. After a waste audit revealed that 20% of the county's waste stream was food, OCRRA began investigating food scrap composting. It was in 2008 that OCRRA members went to a conference in Pennsylvania where they met Peter Moon of O2 Compost and conducted a pilot food waste composting program using aerated static pile. By 2013, the site was developed into a permanent food waste composting site with 8 concrete bays for aerated static pile composting, permitted to accept up to 9,600 tons of food waste per year. The site is partially paved with remainder of drivable areas using millings for driving surfaces. There is a leachate collection tank, as well as 2 retaining ponds for storm water management.

OPPORTUNITIES AND RISKS

The Amboy compost site is open year-round to residents and commercial entities alike. Residents can purchase drop off passes to drop off unlimited trips of yard waste and food waste. Commercial entities pay by the load for yard waste/woody matter, or for food waste, by the ton using the scales on site.

Food waste arrives typically from waste haulers that either specialize in food waste hauling or have a food waste hauling part of their business. This food waste comes from institutions and schools primarily, as well as grocery stores. OCRRA also receives significant quantities of food waste from commercial food manufacturers. The site has no dedicated de-packaging capabilities and has used human labor for depackaging, along with experimental use of a shredder for depackaging.

Challenges arise in maintaining steady feedstock from food processors because of the incurred transportation fees. Odors have previously been an issue, but OCRRA has adjusted the food waste mix and oxygen levels to reduce odors. They also provide education to the community to not only reduce contamination for incoming material but to market their compost products.

416 LONGSHORE DRIVE, ANN ARBOR, MI 48105

THE SOLUTION

Food waste is mixed at a volume ratio of 3 parts bulking agent/yard waste to 1-part food waste. This is very close to 1:1 by weight. Thus, OCRRA accepts significant quantities wood waste, including trees, brush, and yard waste in addition to food waste. About 3,000 cy of mulch was sold this year from this inflow. Each bay is prepared with a cushion of wood chips as a bottom layer to assist with collection of draining liquids from food waste that has not yet absorbed and increase aeration throughout the bunker as air is pumped in through the pipes.

Near the site entrance, the office trailer and scale accommodate incoming loads with accurate tonnages for proper processing. The processing building is a fabric temporary structure (50 x 100) allowing processing out of the elements. Poured concrete walls provide the building sides and base, allowing bucket loaders to efficiently move material. Finished product is stored until screened, then staged for sale. OCRRA has USCC Seal of Testing Approval (STA) certified compost products and sells to agricultural and residential customers, as well as 30 different retailers. The site also has adequate room for ready to mix bulking agent for incoming food waste. A metal building 60 feet by 100 feet houses equipment and the shop. Currently, the Amboy site is staffed with 3 operators who operate two bucket loaders, a skid steer, two shredders, and a trommel screen.

FOOD SCRAP COLLECTION AND WINDROW COMPOSTING

SPURT INDUSTRIES, WIXOM, MI

2041 Charm Road, Wixom, MI 48393

Type of system:	Windrow
Total site size:	14 acres
Areas serviced:	Southeast, Central, and Southwest Michigan
Staff:	5 to 6 people
Hours of operation:	7am – 5pm Monday through Friday
Equipment on site:	Wheel loaders, bulldozer, trommel screens, slow-speed shredder, excavator
Throughput time:	1 year from time material is received to the time it is sold
Throughput total volume:	75,000 CY, with <1% food waste and minimal compostable packaging
Total possible/permitted capacity (cubic yards):	Unknown
Material Source:	Residential, Commercial, Institutional
Collection Method:	Curbside collection, drop-off (yard waste)
Size of windrows/piles:	unknown
Processing building size:	none
Average sales price of product sold:	$10/CY to $22/CY depending on amount purchased and if delivery is included
Total volume sold per year:	25,000 CY produced each year
Funding mechanism:	Tipping fees and product sales
Local permitting/zoning requirements:	Registered with EGLE

BACKGROUND

Spurt Industries has been operating since 1995, with the start of the Michigan yard waste ban. The third owner, Bill Whitley, purchased the operation in 2016 and has since focused on creating a high quality compost product. Located in a western suburb of Metro Detroit, Spurt Industries operates on 14 acres and processes 75,000 cubic yards of material per year using a turned windrow system.

OPPORTUNITIES AND RISKS

Purchased with no compost background, Whitley was challenged by the steep learning curve but motivated by the desire to positively impact the environment. He referenced sources from Biocycle online in addition to networking at conferences to improve the product. In order to maintain efficiency of operations and a high quality product, contamination is a big focus. Plastic film and glass are the most severe contaminants in potential feedstock, and there is a constant dialogue with commercial haulers and landscapers who deliver material. Whitley found that connecting the dots of low-contamination-in, high-quality-out is most effective with landscapers since they frequently purchase compost from Spurt as well.

Since Whitley prioritized processing food waste, he became a partner in the company My Green Michigan, a food scrap management and hauling company. Originally, My Green Michigan serviced southern lower Michigan and took material to Hammond Farms in the Lansing area, but now the food scraps picked up from the Detroit area goes to Spurt. Providing the food scrap carts and hauling services to their customers allows My Green Michigan to educate on the importance of minimizing contamination before it reaches the compost site.

THE SOLUTION

Roughly 25,000 cubic yards of product is produced annually from residential and commercial collection, landscapers, residential drop-off, and tree service business sources. Incoming material includes yard waste, BPI certified food service packaging, and food waste, which makes up 1% of the total incoming feedstock. To maintain a high quality product, incoming material is not ground up, such that contaminants can be more easily removed at the end. The two primary products offered are a USCC Seal of Testing Approval (STA) certified compost product as well as Spurt Dirt, which is a topsoil-compost blend.

FOOD SCRAP COLLECTION AND WINDROW COMPOSTING (RURAL)

EMMET COUNTY, MI

7363 Pleasantview Road, Harbor Springs, MI 49740

Type of system:	Passive windrows
Total site size:	6 acres
Areas serviced:	Petoskey and Harbor Springs
Staff:	1 part-time
Hours of operation:	8 a.m. to 4 p.m. weekdays, 8 a.m. to 3 p.m. Saturdays
Equipment on site:	Bucket loader
Throughput time:	9-12 months active composting, 2-4 weeks curing
Throughput total volume:	YW: 3,183 CY; FW: 278 CY (incoming)
Total possible/permitted capacity (cubic yards):	5,000 CY
Material Source:	Commercial, municipal (YW only), residential, institutional
Collection Method:	County-hauled, commercial-hauled, self-hauled
Size of windrows/piles:	14 ft x 100 ft
Processing building size:	none
Average sales price of product sold:	Residential Fees: • Compost, self-loaded: $20/CY • Compost, County-loaded: $30/CY • $10/CY less during fall sale (Oct-Dec) Commercial Fees: • Compost, minimum 20 CY: $20/CY
Total volume sold per year:	1,300 CY were screened/produced in 2020
Funding mechanism:	Emmet County Department of Public Works trash tipping fees
Local permitting/zoning requirements:	Yes, registered through EGLE since 2005

https://www.nextcyclemichigan.com/ncmi-stories/emmetfoodscraps

BACKGROUND

Emmet County is a rural county in Northern Michigan. The population ebbs and flows with the season, following the trail of tourists seeking Petoskey stones along the shores of the Little Traverse Bay or making fresh tracks on the cross-country ski trail. While the population is modest, its recycling program is anything but.

The program's parent department, the Emmet County Department of Public Works (DPW) does not rely on tax dollars, instead funding its operations entirely from sales of recyclables and trash tip fees. The recycling program recovers 60 different materials. 28 day-to-day recyclables are collected via the county's 13 drop off sites and their curbside collection service, the later serving 60% of the county's households under contracts with local townships and municipalities. Another 32 materials are collected for recycling at the county's Pleasantview Road Drop-off Center, for example mattresses, batteries, and tires. Over 80% of county households use the county recycling program.

OPPORTUNITIES AND RISKS

The county developed a yard waste composting site in 2005. Yard waste is commonly recycled in Michigan due to a 1995 landfill ban on the material. At the time of implementing the yard waste program, food scrap composting was out of reach, with uncertainty regarding how best to move forward, and whether residential or commercial organics streams would be best suited for a pilot project to explore community engagement.

In 2015 the county initiated a feasibility study, led by RRS, to develop a business case analysis for several iterations of a food scrap recycling program, and specifically helped to design a pilot project to demonstrate community interest and develop programmatic and operational capabilities. The study looked at very specific factors, including the number of trucks needed, capital expenditure, and staffing requirements. It concluded that the program should start with a focus on commercial generators and grow from there. It was determined that the best way to introduce this program was to test it through a pilot program before rolling it out full scale.

THE SOLUTION

Following a successful pilot in 2015 the county continued to expand the program's offerings. It began as a back-of-house (food preparation, pre-consumer) food scrap only program and has matured to include more commercial establishments, zero waste events and some public collection points.

The county offers twice-weekly collection in 64-gallon carts. While the service was provided at no charge in the program's first year, they now charge businesses per-cart per-pickup to make the program financially viable. Events are pre-certified to include acceptable compostable foodservice packaging (FSP). Compostable bag liners were successfully added across the program as well. In 2019 over 560,000 lbs of food scraps were recovered from commercial customers, nearly 25,000 lbs from public drop off sites, over 6,500 lbs from carts at local farmer's markets and over 4,000 lbs from "zero waste" community events. Since the program's inception the county has recovered over 2 million lbs of food scraps.

The material recovered through the program is processed at the County owned and operated compost site that produces commercially marketed compost. The carbon rich yard waste combined with nitrogen rich food scraps makes for a desirable blend. The site utilizes engineered compost pads on just under five acres of land and is managed with one key piece of equipment – a front loader.

ON-FARM COMPOSTING OF MANURE AND FOOD WASTE

KRULL'S COMPOSTING LLC, MAPLE CITY, MI

857 W. Burdickville Road, Maple City, MI 49664

Type of system:	Windrows
Total site size:	10 acres
Communities served:	Counties: Manistee, Antrim, Benzie, Leelanau; Traverse City
Staff:	BARC brings in food waste and delivers finished compost. Barry Krull manages the compost piles.
Hours of operation:	No standard hours
Equipment on site:	PTO-mounted turner, tractor, and an application spreader
Throughput time:	3 months
Throughput total volume:	2,700 CY (incoming feedstock), 1,500 CY (outgoing finished material)
Total possible/permitted capacity (cubic yards):	10,000 CY
Material Source:	Commercial yard waste; manure from farms; food waste from hospitals, schools, grocery stores, restaurants, and residential.
Collection Method:	Drop off (residential), BARC collects food waste with dump truck
Size of windrows/piles:	unknown
Processing building size:	none
Average sales price of product sold:	$125 per CY, with increasing discounts if purchasing 3 or more CY (NOTE: this sales price may include application and/or bagging)
Total volume sold per year:	2019: 300 CY, 2020: 609.4 CY (source: EGLE)
Funding mechanism:	Tipping fees and sales of compost
Local permitting/zoning requirements:	Yes, registered through EGLE since 2019

BACKGROUND

Barry Krull, owner and operator of Krull's Composting LLC has been making compost for over 30 years. His passion started as a hobby and he knew that during retirement he wanted to help provide people with compost products that improved the environment. Over the years, he experimented with different blends and the timing process for adding various feedstocks. In 2018, his composting operation began selling bagged material produced at a roadside stand on his 10-acre farm where he lives.

OPPORTUNITIES AND RISKS

Krull's Composting serves customers in Manistee, Antrim, Leelanau, and Benzie counties in addition to Traverse City. They do not have large trucks for material distribution but want to be able to help local farmers first. Currently, Krull's is in the process of creating special blends to be sold at a manufacturer of greenhouses.

They take in food waste from grocery stores, restaurants, schools, and their residential drop-off, so contamination can be an issue. Since the mix incorporates clay, screening is difficult, so unwanted material is removed by hand before composting begins.

Currently, they produce approximately 1,500 cubic yards of finished product per year but could increase production to 10,000 cubic yards given their current space.

THE SOLUTION

Barry, along with four other workers, help with processing material, bagging finished product, mowing the lawn, and other essential processes to maintain the operation. The blends utilize multiple type of feedstocks, including biochar, clay, manure, yard waste, and food waste, the later of which is brought in by dump truck by Alex Campbell from Bay Area Recycling for Charities (BARC). Along with producing multiple kinds of compost products, Krull's Composting offers compost application services where the compost tea blend is popular with orchards and vineyards.

Part of Krull's mission is to educate customers on how high-quality compost can impact their garden or lawn. Since they offer a residential food waste drop-off program, it gives customers the opportunity to tour the site and learn how Krull's humus-rich products can better maintain nutrients in soils.

FOOD WASTE TO HOG FARM

AMERICAN SPOON, PETOSKEY FACILITY, MI

308 Butler Street, Saugatuck, MI 49453

BACKGROUND

American Spoon is a Michigan-based, artisanal, small-batch manufacturer of fruit preserves and condiments. They opened in 1982 by Justin Rashid and produce 79 different products.

OPPORTUNITIES AND RISKS

In 2015, owner Justin Rashid decided it was time to find a use for the thousands of pounds of food scraps that the kitchen produced each year. He reached out to Lindsey Walker, Recycling Outreach for Emmet County, asking if there were any hog farms that could utilize the scraps. This connection allowed American Spoon to begin repurposing their food scraps and create a more sustainable production process.

THE SOLUTION

Since 2015, the American Spoon processing facility in Petoskey, Michigan has worked with a couple different hog farms to use their food scraps for feed and composted their food scraps at the Emmet County compost facility during a transition period when the hog farm they were using shut down. The process began with American Spoon training staff on what material can and cannot be placed into the 55-gallon storage drums. The full drums would then be placed into a refrigerator for up to four weeks, depending on the type of product scrap. Also, products that are unlikely to sell by their expiration date are repurposed as hog feed.

Currently, they work with Serendipity Farms in Wolverine, Michigan. The farm collects food scraps from American Spoon approximately once a week, loading the drums onto a trailer. They collect the food scraps free-of-charge since it's a mutually beneficial relationship. The hog farms have been able to take almost all the food scraps produced, and, one year, 18,000 pounds were diverted to hog feed. This picture is of happy hogs eating peach scraps.

Recently, Emmet County Recycling connected American Spoon with another hog farmer, Seth Strong from Levering. American Spoon had 25 drums of peach skins, pits and juice to dispose of that Serendipity Farms was not interested in. Also, the Emmet County compost facility couldn't take it because of its high liquid content and inability to service the 55-gallon drums. So, the collection of said food waste was an obstacle. Not only is Seth Strong able to feed his pigs with the food scraps, but he is also able to use it as bear bait

- baiting bears using day-olds from bakeries, grocery stores, candy manufacturers etc. is common in these parts. One could argue that it does not count toward feeding animals in accordance to the EPA food recovery hierarchy as a highest and best use, or does it?

THE CHALLENGES

The most challenging aspect of diverting food scraps to hog feed has been coordinating pickups based on American Spoon's production rate and the hog farms' needs. American Spoon may produce too much product or not provide enough notice for the hog farm, or the hog farm has constraints on which days they can collect food scraps. It does help to have a second farmer to work with to keep the food scraps moving toward diversion.

COMMUNITY COMPOSTING

GROWNYC, NY

New York City, NY

BACKGROUND

Funded by the Department of Sanitation for New York City, GrowNYC was created in 1970 and has come to manage the environmental concerns for the city. They have managed the residential food scrap compost drop-off in New York City since 2011. The motivation to start the progarm came from the desire to reduce waste and turn it into a resource.

OPPORTUNITIES AND RISKS

The program accepts yard and food wastes, though dairy and meat, as well as compostables are excluded. GrowNYC recognizes that convenience is at the forefront of ensuring consumers compost, so they are always growing by looking for new sites to host a drop-off or feedback on areas that would benefit from a drop-off site.

THE SOLUTION

Throughout all five boroughs of New York City, there are multiple drop-off locations, which consumers can find via an online map at www.makecompost.nyc. There are two types of locations for drop off: 1) greenmarkets where consumers purchase produce and 2) community gardens which account for 600 of the drop-off locations. Most organics are processed locally at community gardens, along with a few other local partners.

https://www.grownyc.org/about
https://www.grownyc.org/compost
https://www.makecompost.nyc/dropoff
https://www.makecompost.nyc/gapinthemap
https://www1.nyc.gov/assets/dsny/site/services/food-scraps-and-yard-waste-page/nyc-food-scrap-drop-off-locations

BACKYARD COMPOSTING

HENDERSON COUNTY, NC

1 Historic Courthouse Square, Hendersonville, NC 28792

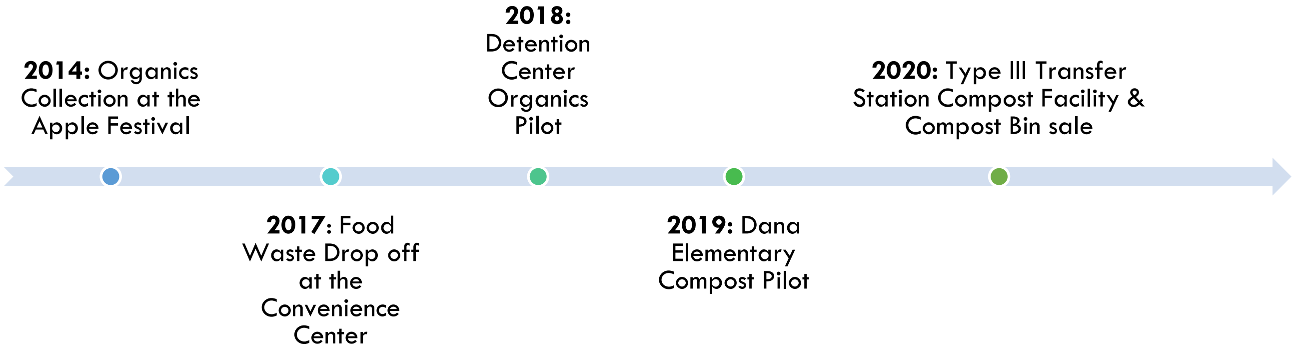
Type of system:	Residential Backyard Composting
Number of bins sold:	365
Compost bin price	$25.00
Number of volunteers recruited	10
Number of volunteers that completed the study	6
Study Duration	May – July 2021

BACKGROUND

Henderson County, located in Western North Carolina, has a total estimated population of 117,417 people as of 2019. The County also includes five additional incorporated local government entities. The Henderson County Solid Waste Division operates as a self-supporting enterprise fund, separate from the general fund and property taxes. The County maintains a closed landfill and operates two facilities: a regional Transfer Station and residential Convenience Center. In 2020, Henderson County Solid Waste transferred 72,445 tons of Municipal Solid Waste (MSW) and 38,032 tons of Construction and Demolition (C&D) debris to the Upstate Regional Landfill (Republic Services) in Enoree, South Carolina. **On average, about 15 – 30 tractor trailers are sent to South Carolina per day**. Since 2014, Henderson County has piloted a variety of organics programs in the area (see Figure 1) including special events, schools, backyard compost workshops and the first food waste drop-off program in Western North Carolina.

In 2020, staff researched local backyard compost resources and discovered that backyard compost bins were not financially or physically accessible in the community. Out of six local hardware stores in the County, only one had a compost bin in stock, for over $120.00. In order to increase access and empower residents to compost at home, the County began a discounted backyard compost bin program with support from the North Carolina Department of Environmental Quality (NCDEQ) and the Unisted States Department of Agriculture (USDA). In conjunction with a compost bin sale, staff decided to study the impacts of backyard composting on Transfer Station operations via a volunteer program to determine potential cost savings.

Figure 1: Henderson County Solid Waste Organics Programs



Below describes the logistics, challenges, and successes from the first compsot bin sale and findings from the volunteer study.

METHODOLOGY

COMPOST BIN SALE

Henderson County staff organized an online pre-sale in March and April 2021 with four pick-up locations in May. Due to the volume of customers already at the Transfer Station, staff decided to test multiple off-site pickup locations at three farmers markets and one community event. The type of compost bin sold, the The Earth Machine, was selected based on recommendations from the North Carolina Extension Solid Waste Specialist, Rhonda Sherman, and performance at the North Carolina State University's compost lab. Two proposals for bins were received and selected based on the lowest price. The compost bin company hosted the website for the sale and included bins, aerators, rodent screens and collection pails. The sale was advertised on the County's website and a local marketing firm was hired to promote the pre-sale via Google and Facebook ads. Over those two months, 365 compost bins were sold during the pre-sale.

Figure 2: Volunteer Instructions

Volunteer program

Ten volunteers were selected to help study the local impacts of backyard composting and were given The Earth Machine compost bin, luggage scale, collection pail, study instructions (see figure 2), and resources. The volunteers committed to providing at least four weeks of data in exchange for the free compost bin. They were also invited to a virtual training on the basics of backyard composting and details about the study. Out of the ten volunteers, six submitted at least four weeks of data, one submitted two weeks, and two did not participate.

OPPORTUNITIES AND RISKS

Henderson County staff experienced multiple challenges during the first sale. First, staff decided to subsidize the bins for residents. The wholesale price was $49.95, but the bins were sold for $25.00. The goal was to sell at least 150 compost bins and provide $3,750 in County funds to stay within budget. Due to the success of the marketing campaign and underestimate of residential interest, the goal was exceeded by 215 bins, causing the County to almost surpass a North Carolina local government procurement threshold of $5,000. If the threshold had been surpassed, the original procurement method would have been invalid and a different procurement method would have been required.

Secondly, staff experienced delivery delays due to COVID-19 and the transportation of the bins to each pick-up location was harder than expected. The original plan was to load the bins on the County's box truck with the skid steer. Unfortunately, the stacked bins were too tall and had to be loaded on their side by hand. It was also challenging unloading the bins at the event. Finally, two of the volunteers that participated did not finish because their HOA regulations.

THE SOLUTION

For the next sale, staff will advertise a certain number of bins at $25.00 and then all other sold after that limit will be $49.95 to cover the cost. Secondly, staff will consider renting a moving van with a taller clearance so that the pallets can be easily loaded, as well as ensure all farmer market locations are at the end of the line to distribute the bins directly out of the truck. Staff is also considering eliminating the off-site pick-up locations and just host at the Transfer Station. However, the amount of traffic at the Transfer Station and limited staff capacity is still a major concern for the compost bin sale. Staff are exploring other County property for the bins to be stored and distributed. Finally, staff is considering purchasing a bulk number of bins to sell throughout the year instead of hosting a seasonal event. For the next volunteer study, staff will ask each volunteer to obtain permission from their HOA before giving them the materials.

THE BENEFITS

Although there were challenges, the first compost bin sale was an overall success. The off-site pick-up locations required more labor but provided a great location to provide outreach safely. The first pick-up was during the first annual Environmental, Agriculture and Compost Fair, where eight orgnaizations, including the Cooperative Extension, Bee City Hendersonville, and North Carolina State Parks, tabled alongside the County. 188 Henderson County reisdents attented the event to pick up their compost bins and also had the opportunutiy to learn about pollinators, wildlife, and gardening in regards to composting. The farmers markets were also great locations to hand out the County's new compost brochure, Cooeprative Extension compost publications, and gather over 80 contacts for a waitlist for the next sale.

Finally, the data from the volunteer study proves the program was worth the effort. **According to the volunteers, the average Henderson County resident generates about 3.48 pounds of compostable material per week that can be processed at home**. This equates to about 167 pounds/year/resident. According to this estimate, the 2021 compost bin sale will divert an estimated 30.5 tons (60,969 lbs) of material from the landfill each year. **The average cost to haul and dispose MSW and C&D to South Carolina ranges from $35 - 40/ton, therefore, the 2021 Spring sale saved the County about $1,143 in disposal costs.** If all of the 117,417 residents composted in their backayrd, the County could save about $3,581,218 annually in hauling and disposal to South Carolina. This number also excludes the other material that can be composted at a large-scale compost facility.

Appendix N: Composting Facility Regulations

Facility Regulations

Local and state regulations govern the development and operation of composting sites. These standards include criteria that range from zoning and planning, water management, access roads, setbacks, odor and nuisance management, volumes of materials, and more. Effectively they require that site owners and operators undertake the following general steps in their facility development:

- Zoning consistency,
- Engineered site design with site stormwater management that prevents offsite runoff,
- Professional operational plans suited to the type and quantity of material to be composted,
- Active management plans and experience with prevention offsite emissions (odor, noise, dust, water), and
- Marketing plan for composted material.

Local Unit of Government regulations will involve Zoning/Planning Commission approval for site design that could require signoff by a licensed professional, compatibility with the surrounding community, and sometimes an operating permit. Local regulations will also require review of site plans with the Drain Commission for stormwater runoff, construction erosion control and wetlands protection: review of road load restrictions and local traffic with Michigan Department of Transportation and/or local Road Commission; review of odor and noise control and mitigation and facility operations by the County Health Department. All operations should comply with federal and state worker safety regulations such as MIOSHA and OSHA to protect operators and prevent injuries.

At the state level, Section 21 of Part 115 regulates the composting of yard clippings[6] under the following conditions:

- Composted at the property where they came from.
- Temporarily accumulated - section 11521(2)[7]
- Composted at a farm - section 11521(3)[8]
- Composted at a registered composting facility - section 11521 (4)
- Composted and used at a licensed solid waste landfill
- Composted at a processing plant
- Composted at a site with no more than 200 cubic yards of yard clippings
- Anaerobic digesters
- Disposed of at a landfill or incinerator if diseased, infested or are invasive

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[6] According to Section 11506(14), "Yard clippings" means leaves, grass clippings, vegetable or other garden debris, shrubbery, or brush or tree trimmings, less than 4 feet in length and 2 inches in diameter, that can be converted to compost humus. Yard clippings do not include stumps, agricultural wastes, animal waste, roots, sewage sludge, or garbage.

[7] Temporary accumulation = no nuisance, no other compostable materials, not more than 1,000 cu yds. And only for 30 days (Director can approve longer time).

[8] On Farm = follow GAAMPS. 1 or more of following apply:
-only yard clippings generated on farm are composted
-not more than 5,000 cu yds of yard clippings on farm
-if more than 5,000 cu yds of yard clippings = all of following must be met:
-accepting yard clippings to manage waste material generated by the farm
-not taking money for the yard clippings
-farm registers with MDARD

The following composting regulations are in place through the Department of Environment, Great Lakes and Energy (EGLE) for composting of yard clippings:

- On Farm Composting - A farm may accept up to 5,000 cubic yards of yard clippings and does not need to register with EGLE or MDARD. A farm may accept over 5,000 cubic yards and be registered with MDARD if: 1) the yard clippings are used to manage on-farm generated wastes, and 2) the farm operation does not accept monetary or other valuable consideration for accepting the material. Farms that produce a finished product that is sold to a person are considered to be commercial operations that do not have nuisance protection under the Right to Farm Act.
- Registered Composting Facilities – a registered composting facility must:
    - Register with EGLE (Registration Form and $600; registration lasts 3 years
    - Comply with location restrictions
    - Not be in violation or create a site of environmental contamination
    - Not have more than 5,000 cubic yards of material on any acre of property
    - Not speculatively accumulate material [9]
    - Produce finished compost with not more than 1%, by weight, of foreign matter
    - Debag plastic bags by the end of each business day
    - Prevent the pooling of water
    - Properly manage storm water runoff
    - Not attract or harbor rodents or other vectors
    - Maintain records

The proposed amendments to Part 115 rules clarify and improve requirements for composting facilities that include increased EGLE oversight and enforcement with general permits, inspections, site plan, operating and training requirements, strengthen the Right to Farm regulations and GAAMPs for composting on farms, make it easier for local units of government to site and expand composting facilities and provide funding for oversight, education, and outreach. The proposed rules further classify composting facilities into on-farm, exempt, small, medium, and large operations with more clarification on volumes allowed and permits required at the state level. A summary chart of the proposed classifications can be found in the next Appendix section.

[9] (l) "Speculative accumulation" means the storage of material intended for recycling or reuse at a site for a period of over 1 year, or for low-hazard industrial waste accumulated at the site of generation, a period of 3 years. A material is not accumulated speculatively, however, if the person who accumulates it can show that the material can be recycled into marketable raw materials or new products and that, during the period, the amount of material that is recycled or that is transferred to a different site for recycling equals not less than 75%, by weight or volume, of the amount of material that was accumulated at the beginning of the period.

Appendix O: Proposed Part 115 Rules Composting Facility Classifications

Material Category Descriptions:

Yard Waste: garden waste, grass, leaves, wood waste, branches
Class 1 Compostable: food, compostable foodservice products, manure, food processing residuals
Class 2 Compostable: mixed waste, biosolids, others by approval

LOCATION/TYPE	WHAT MATERIAL	VOLUME LIMITS	CONDITIONS
Where material is generated • Home • School/Hospital/Prison • Commercial businesses • Industrial site • Community garden	Yard waste Class 1 Compostable, minus manure	No limit	Don't create a nuisance Don't cause a discharge to groundwater or surface water Comply with local zoning Do not need MMP approval/exempt
Regardless of generation source • Urban Farm in cities pop >100K	All compostable materials allowed by local ordinance	As defined in local ordinance	Don't create a nuisance Don't cause a discharge to groundwater or surface water As defined in the local ordinance (can include commercial sale of compost) Note: Administrative exemption to GAAMPS
Regardless of generation source • Farm • Urban Farm in cities pop <100K	All compostable materials	Up to 5000 cubic yards or agronomic rates under a nutrient management plan	Follows GAAMPS If the farm sells finished compost, then will need to comply with MMP approval Applies to Urban farms in cities population <100K
Generated off-site from Composting Facility • Municipal composting facility • Exempt commercial composting facility	Yard waste Garden waste Class 1 Compostable	Less than 200 cubic yards	Don't create a nuisance Don't cause a discharge to groundwater or surface water Comply with local zoning Do not need MMP approval/exempt

Generated off-site from Composting Facility • Small composting facility	Yard Waste Class 1 Compostable, minus manure	200 cubic yards or more and less than 1,000 cubic yards of yard waste; up to 5% by volume Class 1 compostable materials minus manure	Don't create a nuisance Don't cause a discharge to groundwater or surface water Notify EGLE Report volumes on a yearly basis Requires MMP approval
Generated off-site from Composting Facility • Medium composting facility	Yard Waste Class 1 Compostable	1,000 cubic yards or more of yard waste and less than 10,000 cy of yard waste; up to 10% Class 1 compostable	Don't create a nuisance Don't cause a discharge to groundwater or surface water Register with EGLE Report volumes on a yearly basis Requires MMP approval
Large Compost facility	Yard Waste Class 1 Compostable General Use Compost	Greater than 10,000 cubic yards. No restriction on Class 1 compostable, but meet C:N ratio requirements as specified in General Permit	General Permit Financial Assurance Water Quality – Ground, Surface, Contact Testing and Reporting
Large Compost facility	Yard Waste Class 1 Compostable Class 2 Compostable Restricted Use Compost	Greater than 10,000 cubic yards of material. No restriction on Class 1 compostable but meet C:N ratio requirements. Class 2 compostable as specified in Permit	Site Specific Permit Financial Assurance Water Quality- Ground, Surface, Contact Testing and Reporting

Appendix P: “Public Private Partnership” or P3 Funding Structure

Public Roles in P3
Although constrained financially as a result of general fund limitations, the public sector has significant contributions to the P3 relationship. They include:

- Presumed role in the delivery of recycling and waste disposal,
- Capability to provide real estate sites for facilities at lower or no cost,
- Availability of policy levers to deliver some raw materials to selected collectors and processors,
- Capacity for least expensive capital finance (millage, bond issue), and
- Discretion for facility site/location.

Private Roles in P3
In circumstances that enable multi-year contract with monthly assured revenue sources, the private sector can contribute significantly to the P3 relationship as well. Its contributions include:

- Specialized experience and capability for top rate collection and processing contracts,
- Ability to integrate “merchant” activities as an ancillary, and possibly cost reducing feature in contracts with the public entity,
- Specialized financial arrangements (internal capital, leasing arrangements) that enable less expensive financing, quicker procurement of capital goods (trucks, and equipment, building), and better knowledge and access to newer technologies and practices.
- Large scale marketplace clout that enables bundled commodity sales, frequent purchaser benefits, and other efficiencies derived from regional or national operations,
- Lower cost, more experienced, and frequently more flexible workforces, and
- Marketplace responsiveness appropriate to the dynamic nature of commodity businesses.

The challenge for policymakers is to determine the best balance for a successful P3 relationship. That balance often varies because of community based cultural conditions, financial limitations or opportunities, and local political preferences. Therefore, the overlap in responsibilities for financing, contractual oversight, and ongoing maintenance and repairs varies depending on the specific contractual relationships developed for the actual P3 relationship. In general, however, public entities excel at finding land, directing material flow, and sometimes providing lower-cost financing. On the flipside private sector entities most often excel at hiring and managing staff, managing, and delivering capital projects, managing specialized operations, and engaging in the day-to-day marketplace activities of buying and selling.

There are additional benefits in pursuing a P3 model. Sometimes it is possible to use these arrangements to promote healthy competition among service providers. One example of this kind of healthy competition is the use of the franchise agreements for waste and recyclable collection. In cities that are sufficiently large, it is often possible to engage several collectors the Recyclables and solid waste to provide the same services in different parts of the city. This enables the public agency, in the event of service provider failure or contractual noncompliance to create redundant service capability if the new service provider is required on a timely basis. Used properly this can increase resilience within the entire recovery system.

FINANCING SOURCES FOR FACILITY CAPITALIZATION			
Source	**Advantages**	**Disadvantages**	**Contacts**
Public - Solid Waste Management Fees	• Public support creates a mandate for development • Costs are equally distributed	• Costs may not be equitably divided between system users • Public approval is difficult to get	• County or District Solid Waste Coordinators • BPW, City or County Councils
Public - District Tax Levies	• Can be used in conjunction with bond issue • Predictable stream of revenue	• Allocation of tax is not based on facility usage • Reduces the leverage of consumer choice • Require a tax increase	• County or District Solid Waste Coordinators • BPW, City or County Councils
Public - Bond Financing	• Bonds issued by City, state or districts are tax exempt • Extremely secure and predictable financing means	• Bond payments need to be regular • Repayment often requires "put or pay" contracts	• Bond counsel to cities, states, or districts • Small business assistance agencies
Private - Lease Financing	• Easier to qualify • Equipment can be its own security • Lease can be arranged quickly	• Limited to "lease-able" equipment • High financing costs	• Equipment manufacturers and representatives • Credit agencies • Small business assistance agencies
Public - Agency Funds	• No cost of funds • Expenditures can be planned in budget cycle • Sometime capital reserves can be tapped	• Major facilities could take years to fully fund • Inaccessible to private sector • Threatened by budget cutbacks	• City Manager, County Executive, and Solid Waste Coordinators
Public - Grants and Loans	• Low or no cost funding • Provide good seed for other sources	• Uncertainty of funding • Timing of grants is usually longer • Elaborate rules for grants limit fund uses	• State, Commerce, and EPA officials • State legislators • Solid waste consultants

Private - Equity and Bank Financing	• Unlimited and immediate funds for attractive projects • Management assistance from financiers • Reduces tax burden	• Financing is risk-averse • Management interference from financiers	• Local bankers • Venture capitalists • Private investor services • Small business assistance agencies

OPERATING COSTS: REVENUE SOURCES			
Source	**Advantages**	**Disadvantages**	**Contacts**
Public/Private - Facility Tipping Fees	• Common, well understood means of collecting revenue • Can easily be used to create incentives for recovery • Differential tip fees are a fair way to allocate costs	• Fluctuations in markets may tip fees to rise and fall • In the absence of flow control, revenues are unpredictable •	• County solid waste coordinators and planners • State and EPA regulators
Collection (Subscription) Fees	• Common, well understood means of collecting revenue • Can easily be used to create incentives for recovery	• Costs more to administrate • When fees are poorly applied, costs of composting can be misrepresented	• Local solid waste haulers
Public - Landfill Surcharges	• Can be contractually negotiated as part of permit or support process • Effective means of capturing future year benefits	• Illegal for public sector to impose on private landfills • Steadily increasing rates of landfill diversion reduces revenue stream	• Privately owned landfills • Publicly owned landfills
Public/Private - Material Sales	• Revenues are proportional to size of facility • Strengthening markets bode well for economic strength of facilities	• Lack of market awareness reduces current sales • Strength of market varies regionally	• State and national EPA, Departments of Agriculture Natural Resources, and Commerce • Land grant universities • Composting Council • Soil and Bark Producers Assoc. • National Recycling Coalition, • National Solid Waste Management Assoc.

Appendix Q: Developing Markets for Finished Material

The process of composting to recycle organic materials into a useful product is only one step in the total compost process. Without markets to sell finished compost products, composting would be relegated to serve as only a volume reduction tactic as part of the waste management systems. Smart and sustainable programs are developed with the considering markets and potential customers during their development process. By addressing this in advance, owners of facilities will ensure marketability of their product before the first yard of material is produced. SEEDS has the opportunity to support the marketability of compost in the region through supportive policies and standard operating procedures where quality compost is integrated into projects and existing elements of the community.

The Finished Product

All composts are not created equally. To ensure quality control for compost products, the United States Composting Council (USCC) runs a program called the Seal of Testing Assurance (STA) https://compostingcouncil.org/seal-of-testing-assurance/ . The program has been instrumental in helping create a level playing field for compost products to be marketed. The program focuses on regular testing, using test methods from a Certified Laboratory, and providing directions for use for that product. The manual for test methods, the Test Methods for Examination of Compost and Composting (TMECC) keeps the lab practices the same for all Certified labs enrolled. The manual itself is a step-by-step guidebook for labs to use proper practices in all areas of compost testing and is over 1,000 pages long. It is available here: https://compostingcouncil.org/tmecc/ . This program ensures that the same compost products tested in Michigan labs will have results like those tested in other states, if the same methods are used at each independent lab. The program is used by a large part of the industry voluntarily, however, the specifications that are currently being used in many states are starting to require composts to be STA certified. Michigan encourages it and will at least require the same level of testing for large composting facilities. This requirement provides a checks and balances system help compost purchasers understand that quality control is being monitored on a professional level from experts in the industry.

Market Development for proposed composting program including comingled food waste and yard waste will make the following assumptions:

- The product produced (compost) will achieve an STA rating of acceptable use compost for general purposes in landscaping, gardening, and general growth of plants.
- Test data for the compost will comprise roughly a 1-1-1 N-P-K analysis, 50% Organic matter, soluble salts <5 mmohs, weigh approximately 800-1200 lb/cubic yard, and have particle size of ½" or less.
- The composting process will follow industry recognized guidelines for meeting PFRP and creating a finished, mature compost. For more information on these guidelines, visit https://compostingcouncil.org/ This organization is an international group that focuses on the standardization of compost and composting.

These criteria are common goals for many facilities currently marketing similar products, including those analyzed in our facility review. The site design and production information contained herein also uses similar criteria to arrive at total cost estimates for producing this type of product.

Markets vs. Market Sectors

Market development is often confused when people use certain terms to describe the actual market. To be clear, the market is a geographic region with various 'market sectors' which reside within that geography. By adding up all the market sectors, one arrives at the total market in terms of its ability to purchase or use compost. Typically, this market number is an annual usage rate based on repeat customers, uses, etc. However, there are some market sectors where the use of compost will occur only once, like in new lawn establishment for a housing project. This annual amount is used to contemplate market development options. The rotation of new home building is like a home gardener that may use compost in their same garden every year. The purpose of understanding market sectors is so that when market development efforts are executed, targets, and needs to get compost into those market sectors effectively is understood.

Market Sectors

Market development is focused on market sectors which can be specifically identified by NAICS code classification. It is important to remember that simple calculations can be created to better understand future demand in any geographical area, by using these NAICS codes to arrive at total number of possible 'customers' within that market sector and use an estimate multiplier of annual use of compost. Each use for compost is a subset of that market sector. Using compost for planting shrubs may be a common use across many market sectors. As educational development begins, marketers need to review promotional programs to consider, and target those programs to all market sectors that might use compost in that manner. See Matrix inset below.

				Use							Total Compost Used Per Year (CY)						
	Golf Courses	Gardens - growers - retail	Erosion control	Topdressing	Construction	Bed Prep	Wildflowers	Band Application	Liner Beds	Lawn Estab.	Tree Planting	Container Mix	Golf Course Blends	Mulch	Topsoils	Resale Products	**TOTAL**
	DOT																0
	Nurseries																0
	Landscapers					3000											3000
	Construction jobs direct																0
	Topsoil Blenders																0
Market Sector	Golf Courses					1000											1000
	Retail Home depot																0
	Retail direct																0
	Parks & Recreation					500											500
	Grounds Maintenance					1000											1000
	Municipalities					250											250
	DOE																0
	Strip Mines																0
	Landfill Cover																0
	Erosion control																0
	TOTAL	0	0	0	0	5750	0	0	0	0	0	0	0	0	0	0	5750

(Tyler, 1996).

Although there is no data in the Michigan about average use of compost for each of these NAICS codes, or each particular use of compost, the market surveys the team conducted for this project and the surveys that the Michigan Organics Council conducted this year on compost end-markets for the Landscape for the Lakes Campaign do provide some insight. These Michigan data points coupled with experiences in other markets could give a reasonable estimate. By multiplying the annual use estimate by the total number of potential customers, each Market Sector arrives at an estimated annual use amount (if 100% of the contacts were to purchase the compost at the estimated amount).

These are key take-aways from the end-market surveys

- NW Lower MI (SEEDS project):
  - Seven end users were surveyed: one nursery, one tribal government and five farms, one who also produced their own compost. The nursery only uses sawdust.
  - Compost is used for soil amendment/soil remediation/next to vines (5), landscaping (1).
  - Farms interviewed use anywhere between 60-200 cy/year, and pay in the range of $5-$95/ton for compost.
- Statewide (MOC Landscape for the Lakes Campaign):
  - 5 Landscapers doing GSI (3) and Erosion Control (2)
  - 1 Large Retailer using compost for Commercial End Use
  - 1 Coalition of Local Governments doing watershed permitting/implementation of best practices
  - 1 Municipality/engineer doing maintenance
  - Primary project types:
    - #1 Landscaping
    - #2 Infrastructure Development
    - #3 Turf
    - #4 Road Projects
    - #5 Agriculture
    - Other: Stream restoration, community planning, outreach and education, green roofs
  - How much acreage do projects cover annually?
    - 10+ acres (2)
    - 5 to 10 miles of road per year in maintenance
    - 1,000 acres
    - 600 acres
  - Did not get a sense of what they pay for compost product

The process to conduct a full market assessment and estimate use is straightforward. A market assessment would simply contact each respective market sector and inquire about average annual compost use. Results from those inquiries would be used to build assumptions about average compost use for that sector. Then the results are multiplied by the number of contacts from the NAICS code to arrive at a total annual estimated compost use. All market sectors are added together to arrive at the marketplace total (Tyler, 1996).

This was a lofty goal for both these projects, but even for the SEEDS project, we broke down commercial organics generators by NAICS code and targeted 20 end market suppliers and 20 end market users to survey and we only contacted a hand from each and collected very limited data. A full assessment example would apply an annual usage of compost to each NAICS codes for the region. This calculation is possible with each market sector which will arrive at a total possible market available based on participation percentage assumptions. The exercise is meant to determine in any given geographic area how much compost could be used if generated locally.

The example matrix shows how understanding the number of contacts and the targets results in market development for a particular use. The matrix shows 'bed prep' as one of the uses, across multiple market sectors. The number inside the box is a goal for the annual use from customers in that sector. Note the total bed prep goal for the year for the entire market is the total, or 5,750 cubic yards. Market development would include putting together a brochure or other marketing materials describing using compost for bed preparation prior to planting and distributed to those market sector listings to educate them and make them aware of the opportunity. In addition, seminars, field days or online media might be used to show how to use compost in this way for bed prep.

Typically, there are enough local markets from this very diverse mixture of compost users, to absorb 100% of all composts produced, if proper education, marketing, training and sales is used to sell the final product. Proper market development occurs starting with proper testing, education of compost use guidelines, and training of compost users to use the product effectively. Webinars, workshops, and classes are popular tools for market development along with print media, videos, and before – after photos. The Michigan Organics Council Landscape for the Lakes campaign is developing end market use guidelines and training materials to educate and promote the use and benefits of compost for Michigan and its Great Lakes, similar to the Soils for Salmon project in the Pacific NW. Guidelines for green stormwater infrastructure, erosion control, and landscaping are being developed for local Michigan markets. Regional and national best practices and guidelines are also being made available, including the Strive for Five [% organic matter in soil], via a newly developed webpage on the michiganrecycles.org website. Check the link soon for resources.

Market sectors include landscapers, topsoil blenders, garden centers, nurseries, golf courses, mulch manufacturers, general contractors, erosion control contractors, athletic fields, urban gardens, parks and recreation departments, and schools and municipal complexes. One sector that is missing from the list and matrix provided is farms/agriculture, a major market in the NW Lower MI. Retail operations like Home Depot, Walmart, Lowes, Menards, etc., all carry organic products in bagged goods, and some bulk as well, some of which contain compost alone or as an additive to various planting blends. Market sectors are part of the discussion that follows, but they are detailed into ***internal*** market sectors and ***external*** market sectors. Internal market sectors are those that SEEDS and their partners may be able to easily influence due to its authoritative position and enforce compost use specifications for some applications.

This process creates new market sectors where compost is not currently being used as much as the External market sectors. External market sectors are those that are in most major markets and addressed by marketing personnel to sell the compost produced at the facility, often without specifications or assistance by any public agency. All these market sectors use compost in similar ways and are discussed in more detail below.

Environmental Applications Using Compost - Low Impact Development Projects

Low impact development has been a popular discussion for the last several years due to failing infrastructures on stormwater management. The continued increase in impervious surfaces (pavement, increased rooftop footprints) within major metro areas has caused a burden on existing underground conveyance systems for stormwater. In other words, the pipes in the ground never got increased in size when the stormwater going to those pipes has dramatically increased over the last 20 years. In response to this, many cities have adopted the use of low impact development to help reduce the use of these systems. Low impact development can reduce or eliminate discharge from new sites, thereby reducing the need to rely on existing stormwater systems in place. Where capacity is already an issue, this is now a widely adopted practice, and involves the use of locally made compost to achieve low impact development design criteria.

Note the numerous references to water quality based on the local use of compost. The USCC_CCREF has produced two landmark publications citing high level research indicating the environmental impacts of using compost may in fact be worth more than compost itself. *The Soil & Water Connection* details specific environmental benefits of using compost in soils and impacting groundwater, stormwater, and erosion control. *The Compost & Climate Connection* details links between sustainability and carbon sequestration by using compost. Both can be found at: www.compostfoundation.org/education/publications

The Sustainable Site (Tyler, 2010) outlines various designs, specifications and CAD drawings for low impact development that use compost for slowing down water, filtering water, and helping reduce the impact of stormwater. Designs like green living walls allow for reduced heat island effect within a city while providing water filtration as water passes over and through the compost contained in the green wall. Progressive cities like Atlanta have adopted many of these principles and require this practice within permits for construction and permits for occupancy. Some of those rules can be found here:

https://www.atlantawatershed.org/greeninfrastructure/

https://www.atlantawatershed.org/stormwaterordinance/

In other examples, 'Soils for Salmon' was one of the first programs of this kind. The greater Seattle area is well known for deep, organic topsoil. A long history of erosion from construction led to salmon spawning areas filling in with sediment, rendering their habitat unfit for proper egg deposition and growth. As more areas were cleared for construction, the soils that are put back into the areas after construction were comparably shallow, with less organic matter, rendering them less capable of holding and filtering water and they eroded much more.

As a rule, the more organic matter a soil has, the less it will erode. To respond to this, Seattle came up with this program, which requires a minimum organic matter content in topsoil which in turn created far less erosion of the newly placed soil, nearly eliminating the sediment deposition in the salmon beds. This requirement has created a solid long-term market for locally made compost and has been documented to help existing salmon populations halt the decline they experienced from excess sediment accumulation in the previous 20 years from erosion of soil on construction projects. http://soilsforsalmon.org/

In both cases, the cities simply changed the specification and enforced it as a mandatory part of compliance. From a market development standpoint, this is perhaps one of the most cost-effective actions that SEEDS can do in the future to ensure compost is marketed locally. The stories of the benefits of compost need to be documented and shared – this will ensure a strong end market for the future.

Other similar environmental applications that are within this internal market sector are compost filter socks, compost sock sediment traps, compost berms, compost blankets, compost swales, lining of retention ponds using compost, and compost used within brownfield areas on contaminated soils which are toxic to plant growth.

It is generally better for a city to make progressive, aggressive goals towards sustainability and adopt available existing public specifications for these applications within this market sector and issue requirements that they be met for all projects. The result long term will be on increase in sustainability, reduction of reliance on current stormwater infrastructure, creation of a market for compost that shows direct environmental benefit and cleaner water.

Urban and Community Gardens

Urban garden programs within the market area produce food in tough areas and sometimes provide food options in areas where availability to fresh food is scarce. Compost is used in this market sector as a soil amendment at a rate of about 1-2" tilled into 5-6" of soil. The results are much more robust soil, capable of holding more water, nutrients, and reducing leaching of nutrients or other items like fertilizer. In addition to urban gardens, the SEEDS market area is home to some high end certified organic farms. The use of compost as an approved USDA organic input for many participating farms.

Among urban gardens there are also master gardener programs throughout the market area. These programs certify master gardeners so they can teach how to be successful in growing vegetables, flowers, and other garden plants. Much of their success if from the use of compost. Michigan State University has progressive programs in master gardening and has an active outreach program from the extension service that has been successful.

Parks and Recreation, Athletic Fields, Golf Courses, Schools, Municipal Facility Grounds

Parks, schools, recreational areas, athletic fields, golf courses and municipal facilities include many options to use compost. Many of these locations have flower beds, where compost is often used at a rate of 1-2" tilled to a depth of 5" for creation of new beds. In addition, most if not all these flower beds use a 2" layer of mulch, created from some organic source, each season as an annual top-dress. Lawn areas in parks are often considered for topdressing of compost at a rate of ¼-1/2" per year sometimes which aerating with a core aeration device. This process is commonly used by all major golf courses on greens for relieving compaction, however, the mix for that application is only 30% finely screened compost and 70% sand.

Athletic fields use topdressing in the same manner, after core aeration, and compost is applied using a drag system to get the compost to end up in the newly formed aeration holes. This process breaks up clay, improves drainage, reduces compaction, and increases the soils' ability to infiltrate, drain, retain more water and nutrients. In general turf response for all these applications is robust, leading to a thicker, healthier lawn. One side benefit to using compost with turf applications is that compost is somewhat disease suppressive. Natural born diseases that are common in turf are reduced with the use of regular compost applications, reducing the need for additional chemical applications of fungicides or pesticides. (Tyler, 1996). Some links for more information about sports fields are available at http://crpdsports.org/facilities/outdoor . In addition, the parks listings can be found at https://www.metroparks.net/parks-and-trails/ .

School programs have been common and popular outreach efforts for successful marketing programs across the country. Celebration of Earth Day at schools using compost is always a popular event with children of all ages. Some curricula have been developed to assist teachers with materials to use for standard lessons with children to teach them the recycling and composting story. Since children are our next generation, it makes sense to invest in education in this market sector because it normally ends up involving the parents along the way, or if not, the message still seems to make it back home in some form. The National Gardening Association, cooperating with USCC-CCREF created a popular program entitled ‘A Garden for Every Child’ http://heea.org/resource/about.aspx?s=89979.0.0.89929 .In addition, these programs are especially popular either on Earth Day or Compost Awareness Day sponsored by the USCC: https://www.compostfoundation.org/ICAW/ICAW-Home

EXTERNAL MARKETS

Topsoil Blenders

Topsoil blenders have emerged over the last 50 years to supply quality blended topsoil in place of soils that used to be hauled from river bottoms, lowland organic soils or other quality harvest locations for good quality topsoil. Since most of those locations for supply are gone, due to urban development and current day restrictions on harvesting soils, topsoil blenders have emerged in most major metro areas across the US to provide soils for construction, landscaping, and general-purpose growth for a multitude of market sectors. Typical soils blended include 30-50% by volume of good quality compost, 20-40% sand, and 20-40% topsoil obtained from construction projects where topsoil is displaced when large buildings are constructed, and it does not meet compaction requirements for construction projects. This displaced topsoil, once moved, piled, and relocated loses its valuable structure, organic matter, mycobacterial life and requires the addition of compost or it will not perform anywhere near what it was prior to removal. (Tyler, 1996).

Since the generation of these ‘urban soils’ from displacing topsoil from construction allows a base material to be used, sand and compost blended to this base allows for a high-quality man-made soil to be used. Volumes used by typical soil blenders can be significant in Michigan as some contracts for Michigan DOT require a ‘state spec’ soil which must meet various criteria in order to be considered acceptable to produce vegetative cover that will achieve 70% or greater growth within one year. These projects are often on road expansions, lane expansions, after completion, where revegetation is a requirement and they can require 10-200,000 cubic yards annually. SEEDS (and the MOC/MRC as a partner) may be in position to positively influence these specifications to require that compost used in any blend for these applications shall use the product produced by the region, or equivalent.

Nurseries

Nurseries use compost in both container growing operations and in field growing operations. Container growing operations use compost as part of their potting mix at rates of 10-50% of total material by volume. Benefits of using compost for containers include better water holding capacity, improved nutrient holding capacity which reduces leaching of nutrients, and a good cost benefit compared to imported products like peat moss or pine bark.

There is ample documented research from major universities indicating the use of compost in containers reduces plant pathogens significantly thereby reducing pesticide application requirements. The Michigan Nursery and Landscape Association offers annual meetings with opportunities to provide education to members on the benefits of using compost.

Land applications for nurseries is normally focused on liner beds, or other crops grown in rows. Application rates are typically 1-2” tilled into a 5-6” soil depth. Sometimes these applications are only done in the growing area where the row is, so no compost is wasted by applying to the ‘roadways’ in between rows. In addition, mulching of plants is often possible while in rows, to reduce evaporation, increase water holding capacity and decrease soils temperatures.

Landscapers

In the above example, we used landscapers as the NAICS code example on how to calculate total available market use for compost in a given geographic area. Landscapers use compost in many ways, including as a soil amendment for new beds, as a mulch on existing beds, in large potting containers as a mix, for planting trees, shrubs, perennial and annuals. Compost has shown to increase annuals by 50% and perennials by 35% when used at typical application rates established by the industry (Tyler, 1996).

Since landscapers need to use some type of soil to plant new plants, they either must purchase a manufactured soil from a topsoil blender or make their own soil on site by getting compost, tilling into existing soil, and adding any other items that help them achieve their goal to create soil on site fitting the plant requirements. Thirty years ago, many landscapers commonly used peat moss, hardwood fines or other organic sources, but today compost is a leading ingredient to much of their success. The Michigan Landscapers Association has several statewide members that offer an opportunity to educate about the benefits of using compost at their monthly or yearly meetings.

Mulch Manufacturing

There are existing mulch manufacturing companies within the SEEDS footprint currently producing many types of mulch from many types of recycled materials. These include composted yard trimmings, ground wood waste from tree clearing operations, hardwood bark mulch, pine bark mulch, colored mulch from processing of waste wood and pallets which is ground into mulch, then died with a color of red, black, brown or natural. These facilities are often massive in size and consume large quantities of organic inputs in order to keep up with demand of outputs needed in the local environment from most of the market sectors described.

Most commercial properties have a maintenance staff that uses mulch each year to keep the grounds and property looking clean, manicured, and professional. Mulch companies can consume large quantities of compost, and often also produce topsoil blends. Although there is no local association for this market sector in Michigan, there is a national association which thoroughly covers the industry in depth http://www.mulchandsoilcouncil.org/ .

Garden Centers

Garden centers are essential supply houses for residential and small commercial operations that carry bulk and bagged products including compost, mulch, planting mix and other endless assortment of products. Home Depot and other big box stores also started carrying these items perhaps 20 years ago, and the local garden centers have become less essential due to this influence. As market forces continue to change, residents still typically go to local small garden centers for expert advice, exclusive offerings and sometimes things like bulk compost that big box stores do not carry. 30 years ago, a survey of garden centers indicated that very few had heard about compost let alone did not carry it. Today it is common to see some type of compost either bulk or in bags at every single location.

Many of the small garden centers have been forced out of business by the big box stores like Home Depot and Lowes, but a national association still represents the remaining independent locations at https://www.gardencentersofamerica.com/ .

Erosion Control

Using compost for erosion control has become one of the most popular and benefits driven market sector for compost. There are direct, undeniable benefits of using compost for erosion control that outperform traditional erosion control products like silt fence and straw blanket (Tyler, 2010). Compost filter sock in many locations has replaced silt fence. Compost blankets have replaced straw and coconut blankets. But these products are still viewed by many engineers as 'new' even though they have been available for over 15 years now.

As new engineers learn about the benefits of using compost for erosion control, training and educating them for these specifications has been a challenge. One of the most important things that SEEDS and their partners can do in market development efforts is to require that construction project use these tools that will be made available through the Michigan Organics Council.

Several uses for compost are detailed in specifications in this manual and if required by Michigan it will increase locally available markets for compost while reducing pollutants getting into the public waterways via construction site runoff.

Private commercial resources are also available from companies who base their business on erosion control. One example is Filtrexx International www.filtrexx.com. This site has an immense amount of information including specifications from USDA, USEPA, NRCS, USACE and other states which specify the use of compost in erosion control designs. Research about the efficacy is also included on this site which is the bulk of research that has been done within the industry for using compost for erosion control. The acceptance of all federal and state agencies has made it more common for local cities to adopt these specifications towards an efficient, effective, affordable, more sustainable environmental footprint.

Department of Transportation

The Michigan Department of Transportation has a manual which details various activities for DOT projects. Ideally, DOT would use compost blankets for roadside and road shoulder applications to replace straw blankets. These applications have proven to be more effective, erode less, retain more water, reduce impact on stormwater infrastructure and increase vegetation establishment (Tyler, 2010). However, since most of DOT construction is strictly driven on price, compost use is not as common as cheaper alternatives. A few applications using composted products should be listed in their manual like compost filter sock, so promotional efforts and driving specification use and enforcement should be easier.

Compost filter sock is mesh material filled with coarse composted material, which filters water more effectively than silt fence and is starting to become more widely adopted because the performance and price points both are appealing to contractors. Using compost in this manner can add up to a significant amount, when we consider county wide applications. For 12" diameter filter sock, which replaces traditional silt fence on projects, every 27 linear feet uses one cubic yard. There are literally hundreds of thousands of feet of silt fence used in the region annually, and replacement of these by driving specifications for compost use creates a significant market for composted product annually.

Tools for Market Development

Basic market development for compost products starts with testing of the finished product. Reviewing the finished product test results and comparing to other alternatives in the market are important steps to better understanding the value equation to offer potential customers. Once a basic understanding the test results is obtained, educating the marketplace about proper compost use follows. Market development occurs when feedback from the market is used to fine tune the compost to fit what their requirements demand. Product development follows, as the changing of the final product, to whatever extent is possible, is completed. Finally, the process is completed with sales strategies to promote and create awareness around the new offering. The short title for this process is called TEMPS which stands for Testing, Education, Market Development, Product Development and Sales (Tyler, 1996).

Since the assumptions made here are that the compost produced would meet minimum quality criteria established by well-known trade associations, much of this process is perhaps already done via existing contracts, existing offerings and historical understanding and habits of using compost locally. However, consideration for new outreach and education activities should center around the recycling impact of composting food waste and the impact of environmental applications of compost, which have not been common in the market area to date. These promotional/education/awareness efforts would be considered new compared to historical activities from existing contracts for yard waste composting.

One of the highest value market development opportunities for SEEDS is to adopt specifications for these environmental applications and enforce them. Following other progressive cities like Atlanta and Seattle can pay huge dividends within sister agencies managing stormwater.

There are plenty of available web-based programs, publications, and information about using compost. Getting that information into the proper hands to people can make educated decisions about compost use has always been a challenge. But today, the awareness about compost use is more common, people understand the basic benefits of using compost, and include compost in projects more and more.

Printed Information and References

Winning the Organics Game: The Compost Marketers Handbook; Tyler, 1996:
https://ashs.org/store/ViewProduct.aspx?id=2468706&hhSearchTerms=%2522winning+and+organics+and+game%2522
The Sustainable Site; Tyler, 2010:
http://sustainable-site.org/

Web Based Educational Information, Resources, Conference Programs

There are many sites that indicate how compost should be used. Classroom programs are available via USCC, BioCycle, Waste 360, and many others listed as links below. The examples used in this report are derived from printed references listed above, but here are a few more links for information resources about compost:
https://compostingcouncil.org/compost-use-instructions/
https://compostingcouncil.org/
https://www.biocycle.net/
https://www.waste360.com/

https://www.iecaonline.com/
https://www.foresteruniversity.com/content/Default.aspx
http://compostingvermont.org/the-connection-between-healthy-soil-clean-water/
https://www.compostfoundation.org/Education/Publications