Envisioning a Decentralized Compost System for Detroit

A Framework for Community-Scale Composting

TAUBMAN COLLEGE OF ARCHITECTURE AND URBAN PLANNING
UNIVERSITY OF MICHIGAN
MAY 2020

ENVISIONING A DECENTRALIZED COMPOST SYSTEM FOR DETROIT

Capstone Project - Dept. of Urban and Regional Planning
A. Alfred Taubman College of Architecture and Urban Planning
University of Michigan

Capstone Project, May 2020
Master of Urban and Regional Planning
Taubman College of Architecture and Urban Planning
University of Michigan, Ann Arbor, MI

TEAM MEMBERS:

Sean Burnett
David DeBoskey
Michael Friese
Emily Korman
Megan Rigney
Anikka Van Eyl
Keerthana Vidyasagar
Meixin Yuan

INSTRUCTORS:

Lesli Hoey and Eric Dueweke

ENVISIONING A DECENTRALIZED COMPOST SYSTEM FOR DETROIT

A Framework for Community-Scale Composting

This project explores the context for establishing a citywide decentralized community-scale composting system in Detroit using three sites, in three different districts, under present and proposed policy.

ACKNOWLEDGEMENTS

WE WOULD LIKE TO ACKNOWLEDGE OUR CLIENTS:

FoodPLUS|Detroit, and Detroit Future City.

OUR STUDY SITES:

Oakland Avenue Urban Farm, Georgia Street Community Collective, and Sherwood Forest.

OUR INTERVIEWEES:

We would also like to thank and acknowledge the many people who volunteered their time and expertise to speak with us and aided in the creation of this project.

OUR COLLEGE:

Last but not least, we would also like to thank our faculty advisors Lesli Hoey and Eric Dueweke as well as the University of Michigan and Taubman College of Architecture and Urban Planning.

CONTENTS

PART I
INTRODUCTION

02 Purpose
04 Mission & Goals
05 Project Team
06 Methods

PART II
WHAT IS COMPOST?

10 Introduction
12 What is compost?
17 The Power of Community Composting

PART III
DETROIT CONTEXT

26 People, Place & Compost Capacity
44 Physical Infrastrucure & Environment
66 Policy Analysis for Composting
80 Compost Market & Community

PART IV
STUDY SITES

102 How to plan a site?
120 Georgia Street Community Collective
134 Oakland Avenue Urban Farm
152 Sherwood Forest

PART V
LOOKING FORWARD

180 Recommendations
194 Conclusion

PART VI
APPENDICES

200 What can go in compost?
201 Compost Site Inspection Checklist
205 Process to further Reduce Pathogens
206 Estimates of Materials and Equipment

PURPOSE 02

MISSION & GOALS 04

PROJECT TEAM 05

METHODS 06

PART I

INTRODUCTION

INTRODUCTION

PURPOSE

Can compost be a mechanism for creating more sustainable and resilient communities? This is the central question guiding this project, the result of a partnership between University of Michigan students and FoodPLUS|Detroit. As part of a capstone course, the culmination of a Masters in Urban and Regional Planning program, our team set out to identify opportunities, recognize challenges, and create recommendations to help guide planners, policy-makers, and community members from Detroit and beyond looking to reduce waste and create more sustainable and resilient communities. A capstone course is a semester-long student-led, instructor-guided collaborative planning experience addressing real-world problems for a real-world client.[1] The aim of a capstone is to mimic a professional work experience while being conducted as a learning experience.

MISSION & GOALS

This project builds upon current efforts by FoodPLUS|Detroit to facilitate the development of compost-based solutions in the City of Detroit, and ultimately to create a more sustainable, resilient city and citizenry. We explored the context for establishing a citywide decentralized composting network in Detroit using three community-scale study sites, in three different districts, under present and proposed policy. Our goals included, but were not limited to:

- Developing ideas that promote the environmental benefits of compost and its use as a soil-based solution
- Using existing data to assess the potential volume of food waste in Detroit and the capacity and number of operations required to divert food waste from landfills
- Exploring the feasibility and economic impact of community-based and small-scale composting operations
- Generating guidelines for locations and management of a decentralized citywide composting system
- Assessing the markets for compost products (e.g., for green infrastructure that can support stormwater management, soil amendments for landscaping of new developments, tree planting, and gardens/farms, etc.)
- Identifying dynamics that could foster adoption or resistance for scaled-up composting systems, as well as best practices for educating and mobilizing the public around household-level and community-based composting systems
- Researching academic, government, and media sources to identify innovative policies and practices for citywide organic waste management systems

Ultimately, as our recommendations demonstrate, Detroit's social infrastructure, land use characteristics and the overall need for compost make it an ideal place to initiate and expand upon the growing number of small composting operations. The recently approved Detroit Sustainability Agenda demonstrates that Detroiters are eager to make their city greener and more resilient,[2] including strategies that can expand composting. If state, county, and city regulations aligned, Detroit could become a leading model for community-based composting operations, showcasing to other counties in Michigan the creative and productive possibilities that can emerge from efforts to divert waste from landfills, and demonstrating to communities across the US the environmental, livelihood and social resiliency that can emanate from something as seemingly simple and overlooked as compost.

PROJECT TEAM

FoodPLUS|Detroit

The mission of FoodPLUS|Detroit is to facilitate and accelerate a more sustainable metropolitan food system.[3] By engaging in innovation, research, experimentation, and learning, the organization endeavors to help create a system that is socially just, resource-efficient, economically prosperous, and globally connected. FoodPLUS is a local partnership of businesses, non-profit organizations, and government leaders who envision a healthy and accessible metropolitan food system.

Project Role: FoodPLUS|Detroit assisted the team's efforts by contributing heavily to the project advisory committee as well as supplementing research efforts and facilitating the establishment of relationships with grassroots food networks.

DETROIT FUTURE CITY

Detroit Future City's (DFC) mission is the advancement of the quality of life for all Detroiters.[4] By partnering with residents, public and private stakeholders, and utilizing data-driven strategies DFC seeks to promote the utilization of land use and sustainability, community, and economic development as tools to ensure equitable improvement in the quality of life within Detroit City.

Project Role: Detroit Future City provided funding support and staff expertise.

ADVISORY BOARD

Charles Cross
University of Detroit Mercy, School of Architecture, Detroit Collaborative Design Center

Pier Davis
Detroit Future City, Land Use

Bruce Evans
Buildings Safety and Engineering Department - Zoning, City of Detroit

Matt Flechter
Environment, Great Lakes, and Energy, Recycling and Marketing Development

Erma Leaphart
Sierra Club Detroit, Great Lakes Program

Kathryn Lynch Underwood
Detroit City Planning Commission

Whitney Smith
Office of Sustainability, City of Detroit

Renee V. Wallace
FoodPLUS|Detroit

METHODS

This project used a mixed-methods approach, following three distinct phases:

RESEARCH

We began this process with our first phase, research, to learn from community-scale composting best practices and understand the Detroit landscape. We carried out a literature review, document review, and researched best practices from composting sites and cities around the nation. In addition, the project team visited the three study sites: Georgia Street Community Collective, Oakland Avenue Urban Farm, and the neighborhood of Sherwood Forest, to meet with key informants and make observations. Lastly, we conducted 26 semi-structured interviews with leaders in composting from across the nation, including the Institute for Local Self-Reliance, existing community-scale composting sites, and Detroiters that have already been composting for many years. We also interviewed community and municipal leaders in Detroit including the City of Detroit's Office of Sustainability, Planning and Development Department, and Buildings, Safety Engineering and Environmental Department (BSEED).

ANALYSIS

We then shifted to our second phase: analysis. We utilized city-wide spatial data from secondary sources and drew on methods and tools from peer reviewed literature, books on composting, and the U.S. Environmental Protection Agency's Waste Reduction Model (WARM) Tool. We built multiple scenarios to estimate Detroit's food scrap generation, capture, and processing potential using Geographic Information System (GIS) mapping. We conducted this same analysis based on the unique considerations of our three study sites. From this, we designed community-scale composting systems customized for each site.

PROPOSAL

In the final phase – proposal – we developed strategies and recommendations that encompassed the most urgent and actionable steps towards a decentralized, community-scale composting system.

ENDNOTES

1. Taubman College of Architecture and Urban and Regional Planning. (n.d.). Exit Project. 2. Taubman College of Architecture and Urban and Regional Planning. University of Michigan. https://taubmancollege.umich.edu/

2. Office of Sustainability. (2019). *Detroit Sustainability Action Agenda*. https://detroitmi.gov/sites/detroitmi.localhost/files/2019-06/Detroit-Sustainability-Action-Agenda-Web.pdf

3. Food PLUS Detroit (n.d.) *Food PLUS Detroit: Identify, Vision and Mission*. https://foodplusdetroit.org/mission/

4. Detroit Future City (n.d.) *Detroit Future City: Mission*. https://detroitfuturecity.com/mission/

PHOTO CREDITS

Part I Introduction cover page image by Anikka Van Eyl, 2020.

INTRODUCTION 10

WHAT IS COMPOST? 12

THE POWER OF COMMUNITY COMPOSTING 17

PART II

WHAT IS COMPOST?

WHAT IS COMPOST?

INTRODUCTION

In the United States, food scraps are almost always sent to the landfill. More than 40 million tons of food waste was generated in 2017, while only 6% was successfully diverted from landfills, and combustion facilities.[1] Composting has the power to divert food scraps and other organic materials from landfills, preventing associated greenhouse gas emissions, pollution, and high capital costs.

In this portion of our report, we detail what composting entails and the range of scales at which composting can be carried out, from home composting to large-scale centralized composting with community-scale composting centered in the middle. We then further expand upon community-scale composting and its many benefits.

WHAT IS COMPOST?

As one community composter explained, "compost is how nature recycles."[2] Compost is a dark, crumbly, earthy-smelling substance filled with rich organic soil matter.[3] It is produced by decomposition, a natural process of breaking down organic materials. Microorganisms, such as bacteria, are the primary workers of decomposition. Organic material such as tree branches or twigs, leaves, and food scraps are all commonly used materials in composting. Gardners commonly call compost "black gold" because of its many beneficial uses as a soil amendment.[4]

TYPES OF COMPOSTING

There are two main and commonly practiced types of composting: *passive* and *active*.[5] *Passive,* or cold, composting involves less attention, which means less frequent turning and watering of the pile. The process takes a long time (as long as a year) and does not create an internal temperature high enough to kill all the pathogens or weeds. *Active,* or hot, composting (also referred to as *thermophilic composting*) involves much more turning and watering. Turning is an agricultural term to describe the process of switching compost material from outside the pile to the inside. All material should be heated in the middle. Giving more attention to the pile enables higher temperatures or thermophilic conditions. Figure 1. illustrates temperature levels where particular bacteria thrive the most. Psychrophilic bacteria (not shown) are most active between 0°F- 50°F, mesophilic bacteria are most active from 50°F- 105°F, and thermophilic bacteria are most active from 105°F - 160°F.[6] Oxidation occurs faster in the thermophilic stage, which is part of why this process is much shorter.[7] The temperature ranges might vary a little depending on information sources, but as long as it heats up to around 131°F, the process will work.[8] In the last phase, the curing stage, decomposing rates slow down, turning is less important and compost becomes mature and ready for use.

The exact timing of this process depends on the carbon to nitrogen ratio recipe and the frequency of turning.[9] When temperatures exceed thermophilic conditions, bacterial activity decreases, and stabilization slows down.[10] According to David Buckel, a former master composter at New York City's Red Hook Community farm, compost site coordinator for the NYC Compost Project and collaborator with the Institute of Local Self-Reliance, composters should turn three or four times a week.[11] Specific site conditions may dictate turning rate.

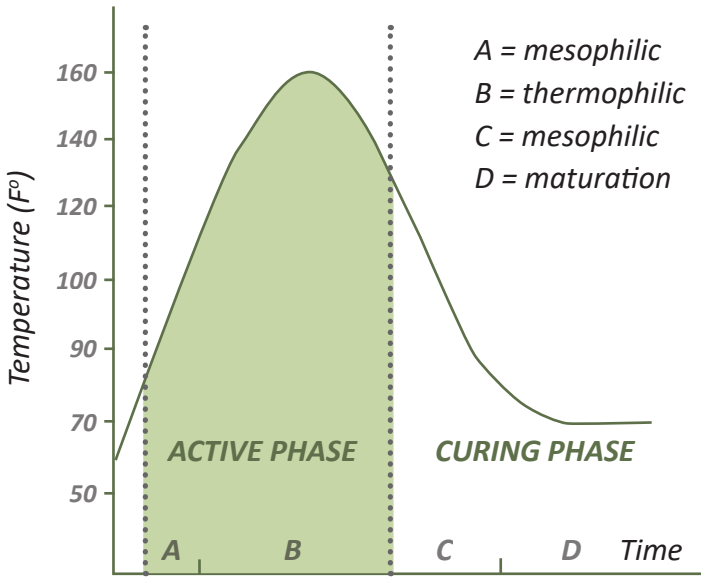


Figure 1. The three temperature stages of aerobic composting (Modified figure adapted from Cooperband, 2002)

HOW COMPOST IS MADE

The composting process has four main ingredients: organic matter, moisture, oxygen, and bacteria. Anything natural that was alive is organic matter.[12] When used for compost, organic matter should be a mix of brown organic matter (twigs, leaves, wood chips and shavings, most paper, straw, wood, yard, and garden trimmings) and green organic material (raw vegetable and fruit scraps, coffee grounds, lawn and garden clippings). Brown materials produce carbon, whereas green components produce nitrogen.

What makes decomposing and the composting processes work is bacteria and other microorganisms.[13] Bacteria use the added organic material, water, and oxygen to break down plant matter into compost.[14] The decomposing process releases heat in the center of the compost pile.

Moisture is necessary for microbes to live.[15] But if there is too little water in the production process, the decomposition will be slow as microbes can not thrive. But, on the other hand, too much water can drown the microbes requiring remediation by adding more brown material. A compost pile that has the right amount of water feels like a wrung-out sponge in your hand and has a moisture content of 45 to 60%.[16]

Composting is an aerobic process (Figure 2), meaning it requires oxygen.[17] If oxygen levels are too low (below 10%) the decomposing microbes will die or go dormant. The compost pile is then anaerobic and can start to smell. Regular airflow within a compost pile gives energy to microbes. Oxygen supports the work of bacteria during decomposition.[18] Oxygen is created when the pile is turned.

To ensure adequate oxygen, compost piles should have air in them.[19] A way to measure porosity, or how much air space is in compost material, is bulk density.

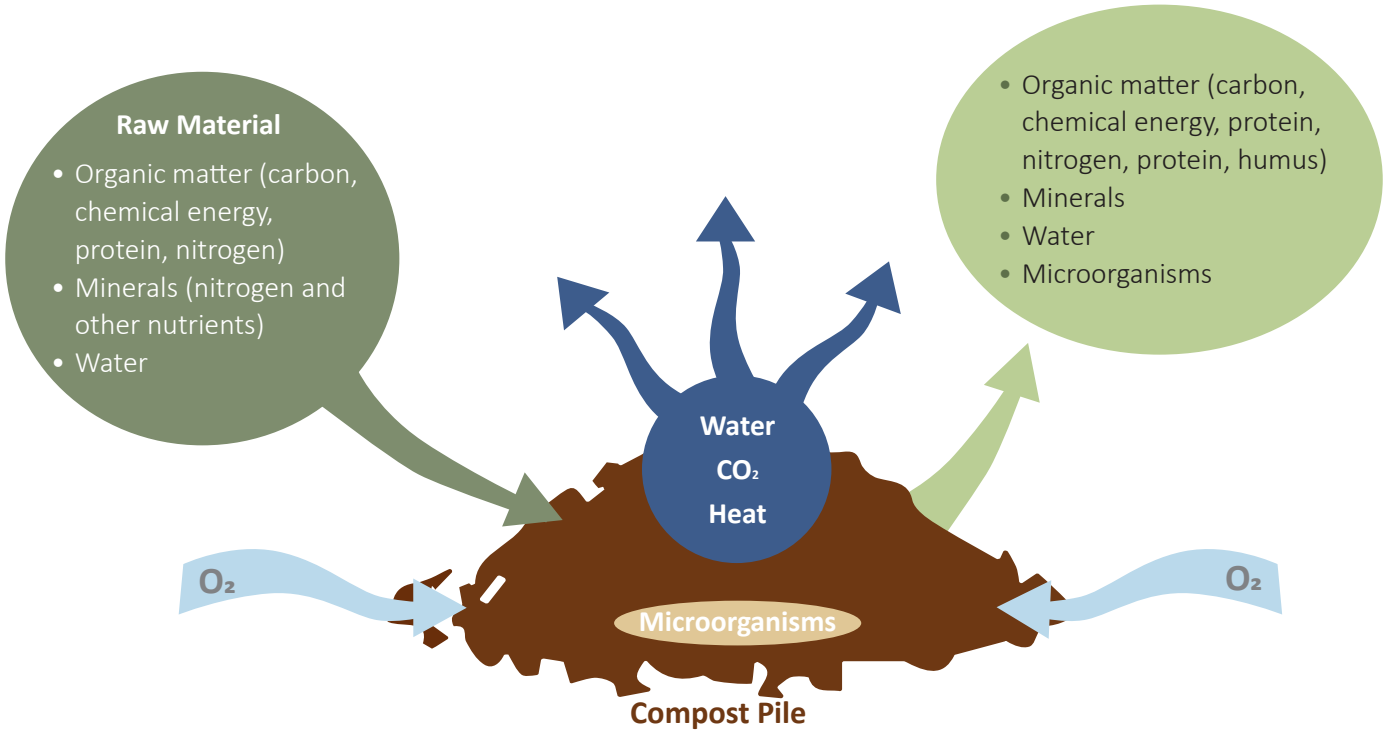


Figure 2. Aerobic composting process (Illustration adapted from OrganicGardenInfo.com)

A compost pile can not be a dense and thick mound. Certain brown materials, such as wood chips, act as bulking agents, which increase porosity, giving room within the compost for air to flow in and out.

In aerobic composting, microorganisms eat the organic matter consuming nutrients such as nitrogen, and carbon.[20] Carbon primarily serves as a source of energy for the organisms, with two-thirds respired as carbon dioxide (CO_2). The other third combines with nitrogen within the living cells.

Typically more carbon than nitrogen is needed, but if there is an excess of carbon over nitrogen (C:N ratio) in decomposing organic materials, biological activity diminishes. It will also require several cycles of organisms to burn most of the carbon. The remaining organisms use the stored nitrogen and carbon from microbes that recently died to make new cells while the excess carbon converts to CO_2; this reduces the carbon amount, and the nitrogen gets recycled. When there is an adequate C:N ratio, nitrogen is released as ammonia, and some ammonia may oxidize, or have oxygen added, to turn into nitrate. Other essential nutrients typically found in compostable materials include phosphorus, potash, and others. Aerobic conditions give off no odors, whereas anaerobic conditions, which is composting without oxygen, gives off smells.

COMPOSTING AT ANY SCALE

The compost process can occur at multiple scales, from small-scale home composting, to large-scale centralized composting and finally, community-scaled, decentralized composting, the focus of our project.

Home Composting

Home composting requires the least amount of space, usually taking place in an individual's backyard.[21] Typically carried out in a container or tumbler, home composting is often ignited by an individual's passion for food scrap diversion or desire to produce compost for their garden.[22] Sometimes home composting systems involve neighbors, but usually these systems are limited in their capacity or scope to expand, and remain small-scale.

Centralized Composting

On the other hand, at the largest scale of compost production, food scraps, yard waste, and other organic matter are sent to a large-scale centralized

Figure 3. Manual compost turning (Watts, 2009)

Figure 4. Smith & Hawkin three-level home composting bins (Womack, 2007)

composting facility, operated by a municipality or third-party commercial merchant composter.[23] Historically these systems focused primarily on yard waste and sewage, but now many are expanding to incorporate food scraps into their existing systems.[24] Centralized composting facilities have expansive capacity to process organic matter, far outpacing small- or community-scale operations, with great potential to positively impact the environment.[25] However, contributing communities usually see little direct benefit from the organic matter they divert as centralized facilities are often located far outside of the communities serviced for collection, missing potential opportunity for financial revenue as result of local resource recovery.[26,27]

Community-Scale, Decentralized Composting

Community-scale decentralized composting systems are motivated by residents' growing awareness of the amount of food waste and the potential for

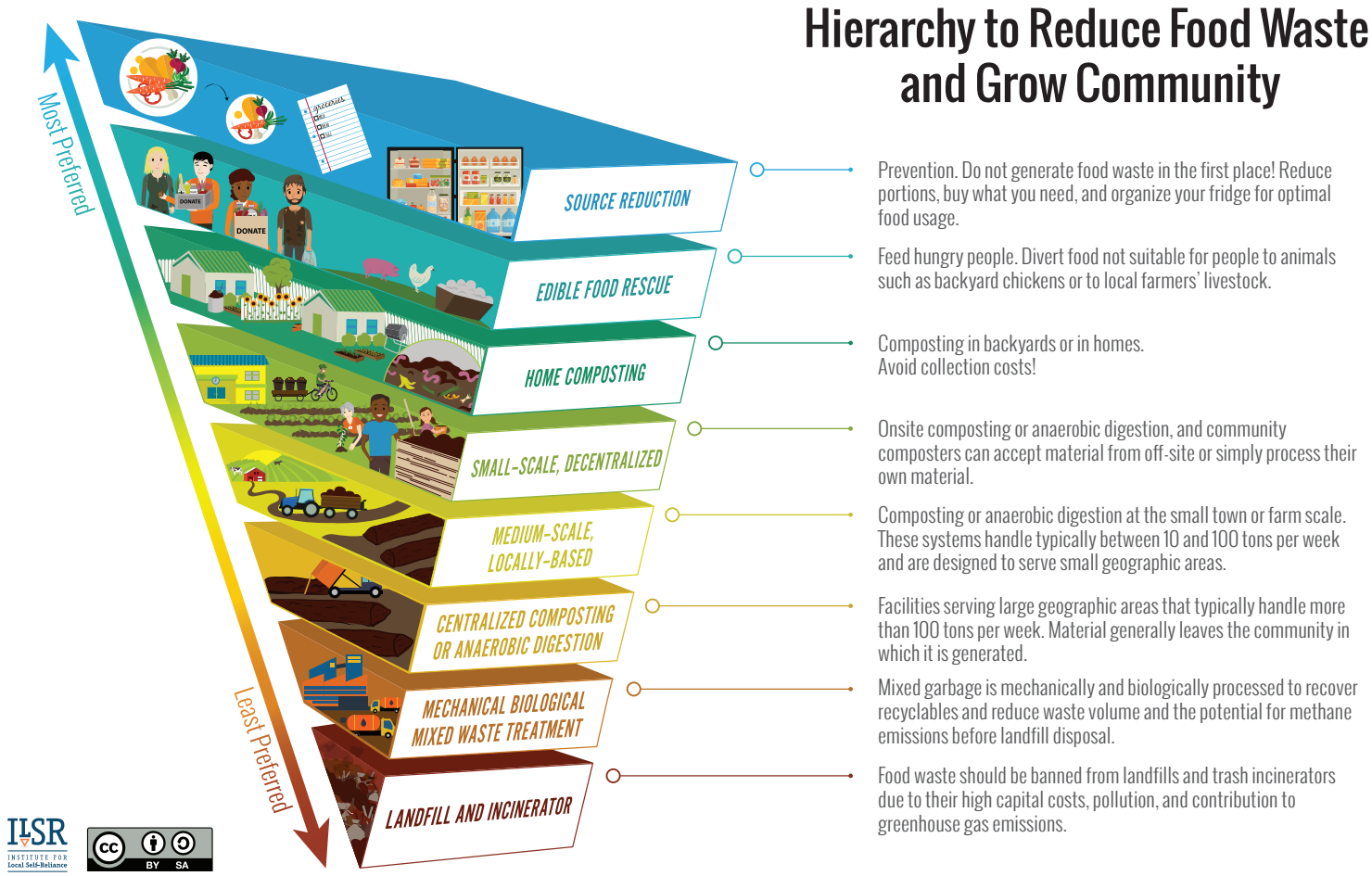


Figure 5. ILSR Hierarchy to reduced food waste and grow community
*Institute for Local Self-Reliance (www.ilsr.org ILSR) is a national nonprofit organization working to strengthen local economies, and redirect waste into local recycling, composting, and reuse industries. This image is reprinted here with permission.

resource recovery.[28] These models, often based within the community, capture the organic materials of a specific population, neighborhood, or community.[29] Community-scale systems typically operate below 500 cubic yards of compost, sourcing material from households, community gardens, and local businesses.[30] The methods of finished compost distribution vary – some give it away for free while others sell their black gold for profit. All community-scale systems share in that they benefit the community in many ways, such as reducing pollution, reducing waste, creating jobs, improving local soils, and many more.

The Highfields Center for Composting and the Institute for Local Self-Reliance developed the following set of Core Community Composting Principles displayed in the following box.[31]

CORE COMMUNITY COMPOSTING PRINCIPLES

- **Resources recovered**
  Waste is reduced; food scraps and other organic materials are diverted from disposal and composted.
- **Locally based and closed loop**
  Organic materials are community assets, and are generated and recycled into compost within the same neighborhood or community.
- **Organic materials returned to soils**
  Compost is used to enhance local soils, support local food production, and conserve natural ecology by improving soil structure and maintaining nutrients, carbon, and soilicroorganisms.
- **Community-scaled and diverse**
  Composting infrastructure is diverse, distributed, and sustainable; systems are scaled to meet the needs of a self-defined community.
- **Community engaged, empowered, and educated**
  Compost programming engages and educates the community in food systems thinking, resource stewardship, or community sustainability, while providing solutions that empower individuals, businesses, and institutions to capture organic waste and retain it as a community resource.
- **Community supported**
  Aligns with community goals (such as healthy soils and healthy people) and is supported by the community it serves. The reverse is true too. A community composting program supports community social, economic, and environmental well-being.

THE POWER OF COMMUNITY COMPOSTING

While there are many reasons to engage in home or centralized composting, community composting has the widest range of benefits. Composting at the community-scale captures a sweet spot of being small enough to maximize individually-sized benefits while positively impacting large populations and landscapes. Here are some of the main benefits for the environment, the local economy and the local community.

ENVIRONMENT

Composting has several environmental benefits. It contributes to healthier food, more fertile soil, and better water quality. The use of compost also helps reduce greenhouse gas (GHG) emissions and mitigating symptoms of climate change. Organic matter in the compost makes it a vital component for carbon sequestration and controlling the balance of soil nutrients. It also increases the water-holding capacity of the soil and acts as a biofilter for stormwater. Hence, the applications of compost have the potential of protecting source water and restoring watershed balance. [32,33]

LOCAL ECONOMY

Create Employment Opportunities

Compost processes are more labor intensive than other waste removal jobs and thus provide more employment opportunities. A 2013 comparative study conducted by the Institute for Local Self-Reliance (ILSR) found that composting operations in Maryland sustain more total jobs than the state's three trash incinerators combined, which handle double the amount of tonnage.[34] Additionally, for every one million tons of organic materials composted (with the resulting compost used in-state), nearly 1,400 full-time jobs can be supported – about 1,200 more than landfill and incinerator operations. While more research is needed across states with different policies, the study conducted by ILSR in Maryland indicates that if composting systems expanded in other states, the job opportunities in the waste-removal sector would likely to increase.

Save Money in Landfill Tipping Fees

Landfills across the United States are slowly reaching their capacity. With more limited service supply available, landfill tipping fees are slowly creeping up. In 2017 the average cost per ton of landfill municipal solid waste was $50.30 and is forecasted to increase 6 percent to $53.53 per ton by 2021.[35] The State of Michigan experienced a $4 increase in municipal solid waste landfill tipping fees between 2016, $41, to 2017, $45.[36,37] With landfill operations becoming increasingly expensive, municipal governments would be wise to consider alternative waste removal services.

Conversely, the average landfill tipping fee in Michigan is 36 cents per ton, comparatively much cheaper than tipping fees in neighboring states of Indiana, 60 cents; Illinois, $2.00; Ohio, $4.75; and Wisconsin, $13 per ton. Michigan State policies ought to increase the tipping fee per ton to incentivize composting over the expansion and use of landfills.[38] Composting is more than a waste-removal service, it creates economic value out of products deemed as waste.

In the State of Michigan, food waste accounts for nearly 14% of all municipal solid waste, with each person producing approximately 258 lbs of food

scraps per year.[39] Households participating in a backyard or community composting program, divert their food waste from the waste stream, thereby decreasing the amount of waste the municipally-managed program must transport, house, and process. This helps minimize strain on the centralized waste management organizations and facilities by reducing the cost of waste transport that communities pay for in fees and "prolonging the lifespan" of landfill facilities.[40]

Recover Resources

Instead of being thrown into a landfill, left to slowly decompose over years of time and taking up valuable land space, food scraps and organic materials can be combined to turn into compost within months. As we detail in other sections, finished compost has several purposes, including construction tubing for public works projects, landscaping, and planting beds to increase the soil's richness to promote plant growth.[41]

LOCAL COMMUNITY

Outside the environmental and economic benefits of composting, community-driven composting has numerous social benefits for entire neighborhoods and local governments.

Strengthen community collaboration and social resilience

By nature, community composting systems depend on support from local residents and businesses to function. In the course of working together, residents foster important relationships with one another, building social networks that support each other's wellbeing. Additionally, by depending on local businesses and community partners for knowledge, services, and resources, these systems foster a closed loop economy, where money circulates within the community rather than being lost to outside parties.[42]

Enhance educational opportunities

Compost demonstration sites, after-school programs, community gardens, and public workshops build communal knowledge about compostable materials and self-reliance for composting, as well as build an advocacy base to support composting operations.[43] Local schools, nonprofits, and other community groups can also partner with community compost managers to create educational programming that supplements ongoing school curricula.

Foster Local Leadership and Advocates

Residents passionate about composting who actively participate in their community's system have specialized knowledge and experience that few others in their community have.[44] These "compost champions" are well-positioned to influence municipal policy, laws, and regulations around composting, and shape them in a way that optimizes their wellbeing.

CONCLUSION

This report details these benefits in-depth and illustrates many local and national examples for further support. Within Detroit, we aim to highlight that the ground is already fertile for a community-scale composting system.

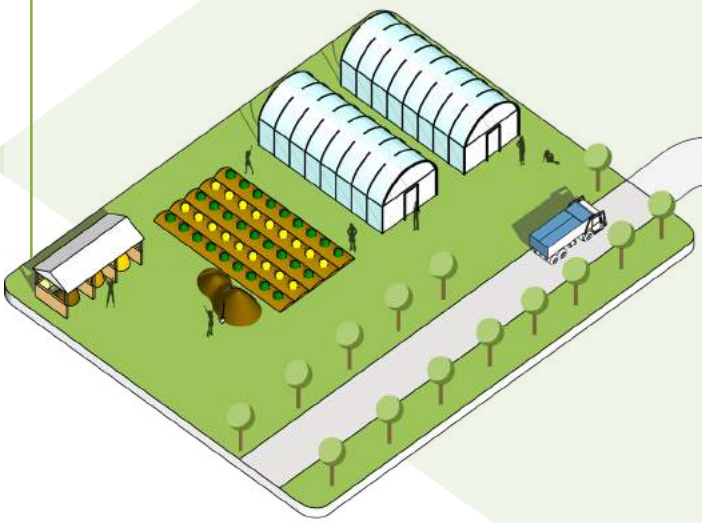
ENVIRONMENTAL BENEFITS OF COMMUNITY COMPOST

Enhance Carbon Sequestration

Compost helps capture CO_2 and other greenhouse gas, which helps remediate climate change

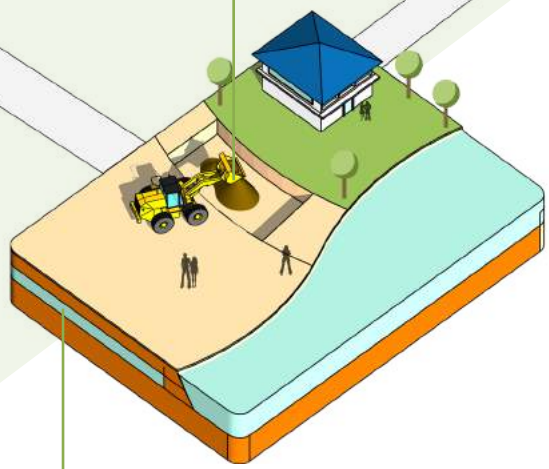
Use Compost as Fertilizer

Rich in organic nutrients, compost can substitute traditional fertilizers and serve community gardens



Remediate Soil

Compost helps to balance the nutrients in the soil and make it more fertile



Compost can improve soil's stormwater retention ability, thereby improving water quality

Improve Water Quality

ECONOMIC BENEFITS OF COMMUNITY COMPOST

Save Landfill Cost

Compost saves landfill tipping fees and other costs by diverting food scraps from the solid waste system

Recover Resources

Food scraps can be processed into compost and sold for local uses such as landscaping

Create Employment Opportunities

Compost operations create employment opportunities for local communities

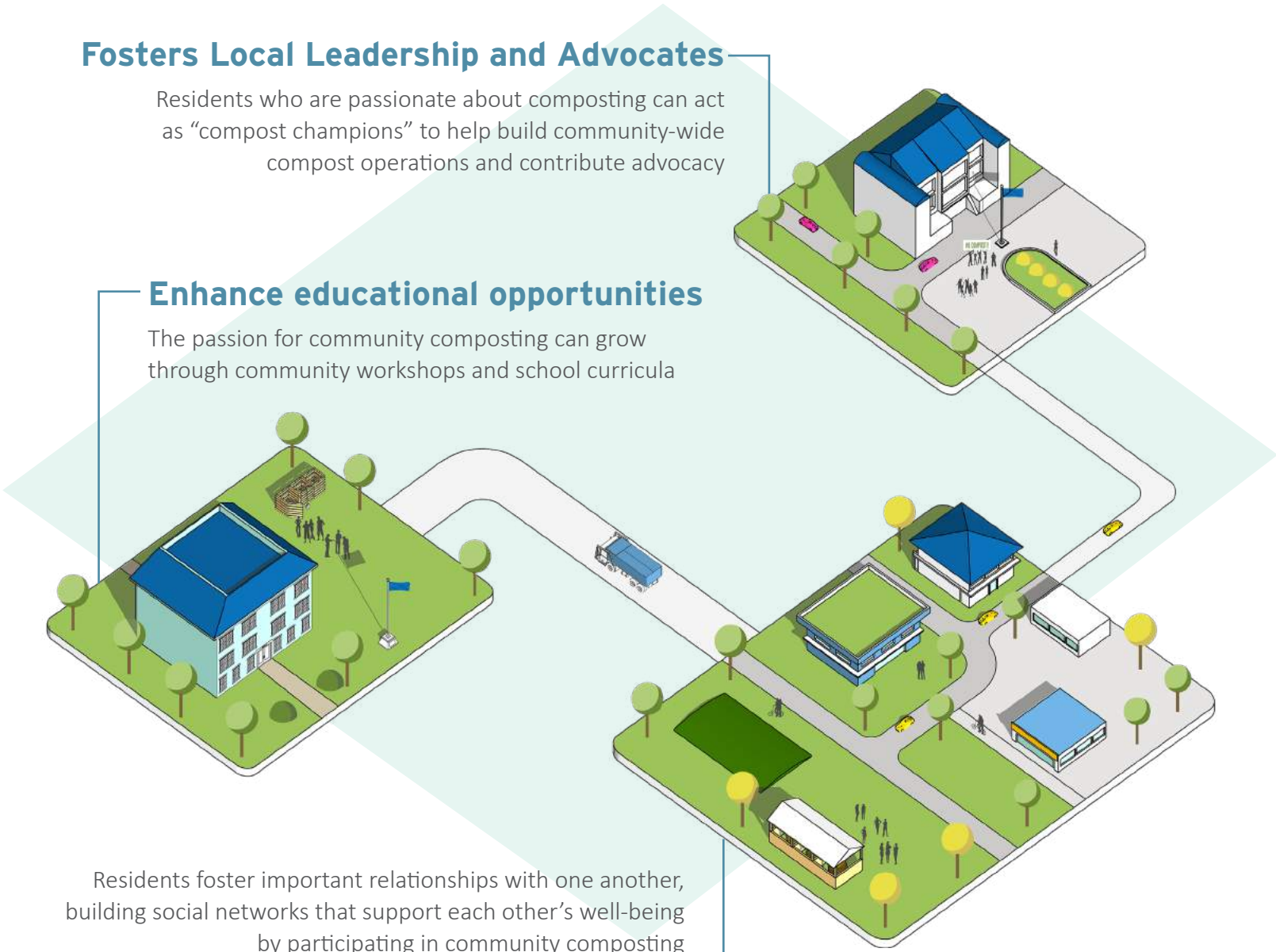
COMMUNITY BENEFITS OF COMMUNITY COMPOST

Fosters Local Leadership and Advocates

Residents who are passionate about composting can act as "compost champions" to help build community-wide compost operations and contribute advocacy

Enhance educational opportunities

The passion for community composting can grow through community workshops and school curricula



Residents foster important relationships with one another, building social networks that support each other's well-being by participating in community composting

Strengthen Community Collaboration and Social Resilience

ENDNOTES

1. US EPA, O. (2016, May 23). *Wasted Food Programs and Resources Across the United States* [Overviews and Factsheets]. US EPA. https://www.epa.gov/sustainable-management-food/wasted-food-programs-and-resources-across-united-states

2. Levi Gardner of Urban Roots, Grand Rapids, MI, personal communication, March 17, 2020.

3. Bilsens Brolis, L. and Platt, B. (2019) Community Composting Done Right: A Guide to Best Management Practices. Institute of Local Self-Reliance. (pp. 9). https://ilsr.org/wp-content/uploads/2019/03/Compost-BMP-v1.pdf

4. *Composting in the Home Garden—Common Questions.* (n.d.) https://web.extension.illinois.edu/compost/process.cfm

5. (Composting in the Home Garden—Common Questions, n d)

6. Graves, R., Hattemer, G. Stettler, D. (2000). *USDA Environmental Engineering National Engineering Handbook*, Chapter 2 Composting.https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_022229.pdf

7. University of Texas A&M Extension. (2009). Chapter 1, *The Decomposition Process*. https://aggie-horticulture.tamu.edu/earthkind/landscape/dont-bag-it/chapter-1-the-decomposition-process/

8. (Bilsens Brolis, L. & Platt, B., 2019, pp. 10)

9. (Bilsens Brolis, L. & Platt, B., 2019, pp. 13)

10. Cooperband, L. (n.d.). *The Art and Science of Composting*. University of Wisconsin-Madison, Center for Integrated Agricultural Systems. https://www.cias.wisc.edu/wp-content/uploads/2008/07/artofcompost.pdf

11. Buckel, D. (2017). Guidelines for Urban Community Composting. *BioCycle*. (pp. 5). https://ilsr.org/wp-content/uploads/2017/05/Guidelines-for-Urban-Community-Composting.pdf

12. (Bilsens Brolis, L. & Platt, B., 2019, pp. 10)

13. (Composting in the Home Garden—Common Questions. n.d.)

14. (Bilsens Brolis, L. & Platt, B., 2019, pp. 10)

15. (*Composting in the Home Garden—Common Questions*. n.d.)

16. (Bilsens Brolis, L. & Platt, B., 2019, pp. 10)

17. (Bilsens Brolis, L. & Platt, B., 2019, pp. 12)

18. (*Composting in the Home Garden—Common Questions*. n.d.)

19. (Bilsens Brolis, L. & Platt, B., 2019, pp. 12)

20. (University of Texas A&M Extension, 2009)

21. Platt, B., Goldstein, N., & Coker, C. (2014). *State of Composting in the US: What, Why, Where, & How* .Institute for Local Self-Reliance.(pp. 5). https://ilsr.org/wp-content/uploads/2014/07/state-of-composting-in-us.pdf

22. Platt, B., & Fagundes, C. (2018). *Yes! In My Backyard: Composting Guide for Local Government*. Institute for Local Self-Reliance.

23. (Platt, et al., 2014, pp. 7-8)

24. (Platt, et al., 2014, pp. 7-8)

25. (Platt, et al., 2014, pp. 7-8)

26. (Platt, et al., 2014, pp. 7-8)

27. Platt, B. (2017, April 4). *Hierarchy to Reduce Food Waste & Grow Community*. Institute for Local Self-Reliance. https://ilsr.org/food-waste-hierarchy/

28. McSweeney, J. (2019). *Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and Solving Our Waste Crisis* (pp. 6). Chelsea Green Publishing.

29. (Platt, et al., 2014, pp. 5)

30. (Platt, et al., 2014, pp. 5)

31. Platt, B., McSweeney, J., & Davis, J. (2014). *Growing Local Fertility: A Guide to Community Composting* (pp. 7). Institute for Local Self-Reliance.

32. (Platt, et. al., 2014, pp. 10)

33. Stumo-Langer, N. (2017, April). *Posters: Compost Impacts More Than You Think*. Institute for Local Self-Reliance. https://ilsr.org/compost-impacts-posters/

34. Platt, Bell, and Harsh. (2013). *Pay Dirt Composting in Maryland to Reduce Waste, Create Jobs, and Protect the Bay*. Institute for Local Self-Reliance.

35. Galantino, C. (2018, June). *No end in sight to us landfill cost increases — Pacific region to experience highest growth*. Solid Waste Environmental Excellence Protocol. https://nrra.net/sweep/no-end-in-sight-to-us-landfill-cost-increases-pacific-region-to-experience-highest-growth/

36. Environmental Research and Educational Foundation. (2017). *Analysis of msw landfill tipping fees 2017*. https://erefdn.

org/wp-content/uploads/2017/12/EREF-MSWLF-Tip-Fees-2017.pdf

37. (Environmental Research and Educational Foundation, 2017)

38. Sinclair, M. (2018, December). Gov. Snyder still hopes to tip the scales in his favor to increase tipping fees. *Frost and Sinclair Broadcast Group*. https://upnorthlive.com/news/local/gov-snyder-still-hopes-to-tip-the-scales-in-his-favor-to-increase-tipping-fees-12-11-2018

39. Schoonmaker, D., Lowen, A., Isely, P., & Kneisel, A. (2016). *Michigan municipal solid waste characterization and valuation: Opportunities for economic and environmental impact*. West Michigan Sustainable Business Forum; Grand Valley State University, 2016.

40. Silke, D., Müller C., Kubrom T., Mehari S., Zurbrügg C., & Kytzia S. (2006). *Decentralised composting - Assessment of viability through combined material flow analysis and cost accounting*. Digital Object Repository at Eawag. https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/Decentralized_Composting/Drescher_Mueller_2006.pdf

42. Brown, M.R., Chesbro, B., Danzinger, J. (2017, June). *Compost use for landscape and environmental enhancement*. California Integrated Waste Management Report. https://www.waterboards.ca.gov/rwqcb8/resources/docs/compost_use_for_landscape_and_environmental_2007.pdf

43. (Platt, et. al., 2014, pp. 44-46)

44. Refed. (n.d.) Community Composting. https://www.refed.com/solutions/community-composting/

45. (Platt, et. al., 2014, pp. 10)

PHOTO CREDITS

Part II cover page image on Visual Hunt, CC0 1.0, https://visualhunt.com/photo2/151550/

Figure 3. by skrubtudse, CC BY-NC-SA 2.0, https://search.creativecommons.org/photos/49f21057-5cc2-47f2-ba9c-ac875014cf07

Figure 4. by Mark Smith- originally posted to Flickr as Granton Vineyard Tasmania biodynamic composting 2010, CC BY 2.0,

https://commons.wikimedia.org/w/index.php?curid=10705996

PEOPLE, PLACE & COMPOST CAPACITY 26

PHYSICAL INFRASTRUCTURE & ENVIRONMENT 44

POLICY ANALYSIS FOR COMPOSTING 66

COMPOST MARKET & COMMUNITY 80

PART III

DETROIT
CITYWIDE CONTEXT

PEOPLE, PLACE, & COMPOST CAPACITY

HISTORY OF COMPOSTING IN DETROIT AND BEYOND

Composting as a waste management and soil replenishment technique is not a new phenomenon – rather, it extends back several millennia. Pre-Colombian Amazonian civilizations 7,000 years ago composted biowaste, fecal matter, and charcoal to produce the "anthropogenic black soil" known as *Terra Preta do Indio*, as a way to enrich the region's infertile soils.[1] One millennium later, Sumerian cities used outdoor stone waste pits to collect urban organic waste, applying it to farms.[2] During the thirteenth century, the Knights Templar in Spain and Southern France developed techniques to create different types of compost that could be applied to various crops to replenish their depleted soils.[3] Yet significant advances in modern composting were not made until the twentieth century when scientists began experimenting with organic material inputs, aeration, moisture, and storage techniques to evaluate finished compost as a fertilizer.[4]

In Detroit, composting has long been part of the food sovereignty and community agriculture movement, though perhaps not always as the primary focus. During economic downturns, World Wars, and other social upheavals, Detroit's leaders instituted local food production programs aimed at combating ongoing food shortages. These programs, which include Mayor Pingree's 1890 Potato Patch Initiative and Mayor Young's Farm-A-Lot program in the 1970s, helped embed urban agriculture and community gardens as a community empowerment strategy for Detroit residents.[5] While these programs emphasized food production by supplying participants with seeds, fertilizer, and technical assistance, they did not necessarily push residents to compost.[6] Over time,

organizations, businesses, and networks like the Detroit Black Community Food Security Network and Keep Growing Detroit have formed to support community gardens and urban farms. Some of these entities have begun composting as a way to fulfill their own need for compost or fertilizer.

In the past decade as climate change, food insecurity, and environmental justice have become more pressing issues to the public, compost has emerged as a focus for individuals and environmentally conscious organizations. In this time, new businesses have formed with missions focused on reducing food scraps, individuals' carbon footprint, and remediating environmental contamination. In conjunction with these new businesses developing in Detroit, City leaders passed the Urban Agriculture Ordinance in 2013 to recognize composting, farmers' markets and stands, garden centers, greenhouses, urban farms, and other types of agriculture "as legitimate land uses in the City and set standards for them."[7] This recognition signals a willingness by city leaders to allow larger-scale composting operations.

AVAILABLE LAND

During the first half of the twentieth century, Detroit's population steadily increased, reaching a peak of 1.8 million residents in 1950.[10] However, in the seventy years since this peak, every decennial census has recorded a decrease in Detroit's population, falling by over 57% to 772,419 residents in 2010.[11] During this decline, the City's residential vacancy rate increased, and vacant structures and lots began to dot Detroit's geography. Today, about 24 square miles—roughly 17% of the City's total land area—is considered vacant.[t,12] As a result, Detroit has an abundance of vacant land that can be repurposed for new uses like composting. The Detroit Land Bank Authority, the public authority charged with returning "the City's blighted and vacant properties to productive use," partners with community groups to establish urban gardening, green space projects, lot beautification, and community garden programs (see Box, *The Detroit Land Bank Authority*).[13,14]

DETROIT FUTURE CITY'S FUTURE LAND VISION

Detroit Future City's 2012 future land vision (DFC) articulates the organization's vision for the City. Their proposal suggests that underutilized land is put back into productive use by residents in a way that enables healthier communities, creates more open space and recreational resources, and rehabilitates Detroit's natural environment.[15] DFC envisioned

THE DETROIT LAND BANK AUTHORITY

The Detroit Land Bank Authority is a public authority charged with returning vacant and blighted properties across the City to productive use through homeownership and land purchasing programs. As of October 2019, the Land Bank owns 40,488 vacant land properties across the City.[8] As of October 2019, the Authority is in possession of 26,212 side lots for sale across the City.[9]

[t] Here, "vacant" refers to only "structure-free" parcels or lots where buildings were previously removed. This definition does not include abandoned schoolyards, unmaintained parkland, or abandoned right-of-ways (Gallagher, J 2019).

a “Food Network and Productive Landscapes” cartography that would link different employment districts and community assets, fostering connections between different industries, small-scale urban gardens, farmers markets, large scale urban farms, composting centers, and public spaces.[16] This vision, grounded in feedback from Detroiters through community workshops and surveys, sets the stage for composting advocacy, as this activity would help link different aspects of the local food systems movement throughout the City.

Figure 1. Harvest and planting at Earthworks Urban Farm (Sam Beebe, 2012).

DETROIT'S CITYWIDE COMPOSTING POTENTIAL

According to the State of Michigan's 2015 solid waste characterization study, food scraps accounted for 14% of the State's Municipal Solid Waste (MSW) by weight (Table 1).[17] This study indicates an average of 258.1 pounds of food scraps per person in Michigan in 2015. Based on this information and the population of Detroit, our team estimated the total food scraps or food waste generated in 2017.[18] With a total of 88,382 tons of food scraps, there is no doubt that Detroit has enough organic waste sources to feed a decentralized community-scale composting system. Several essential questions must be answered to explore the full potential of a decentralized community-scale composting system in Detroit:

- How much compost can be captured from residential, commercial and institutional food scraps?
- What would be the projected economic, environmental, and social impacts of diverting a particular volume of food scraps into a composting system?
- Will a citywide decentralized composting system be able to effectively process all the food scraps it captures?

Table 1. Organic Waste in Michigan, 2015

Category	Value
Michigan Population	9,925,568
Total Municipal Waste Volume (tons)	9,439,000
Overall Organic Waste Rate	35.17%
Overall Food Scraps Rate	13.57%
Food Scrap Quantity, per person	258 lbs/person/year

Note: The citywide food scraps generation is estimated based on per person food scrap generation data and Detroit's 2017 total population of 679,865. (Data sources noted with superscripts are listed in the section's Endnotes)

To answer these questions, we researched other cities' experience in food scraps capture, consulted James Mcsweeny's book: *Community-Scale Composting Systems*, utilized Environmental Protection Agency's (EPA) Waste Reduction Model (WARM), and collected Detroit's data from reliable sources. The data, experience, and methods, combined with our understanding of Detroit's specific context, allowed us to build scenarios and models to provide a quantitative reference to these questions. This analysis can serve as a starting point for envisioning the potential of a citywide composting system of Detroit.

ESTIMATING ANNUAL FOOD WASTE CAPTURE & GENERATION

Residential food waste capture at the citywide & census tract level

For our initial analysis we compared Detroit with Minneapolis and New York City (NYC). Minneapolis and NYC both initiated citywide residential composting programs around 2015 and 2017, established zero waste goals, and launched similar approaches to achieve a citywide composting system. In the early stages of their programs, both cities initially gauged buy-in from the citizenry by creating several pilot compost drop-off sites. After

FIGURE 2. CITYWIDE FOOD SCRAP GENERATION

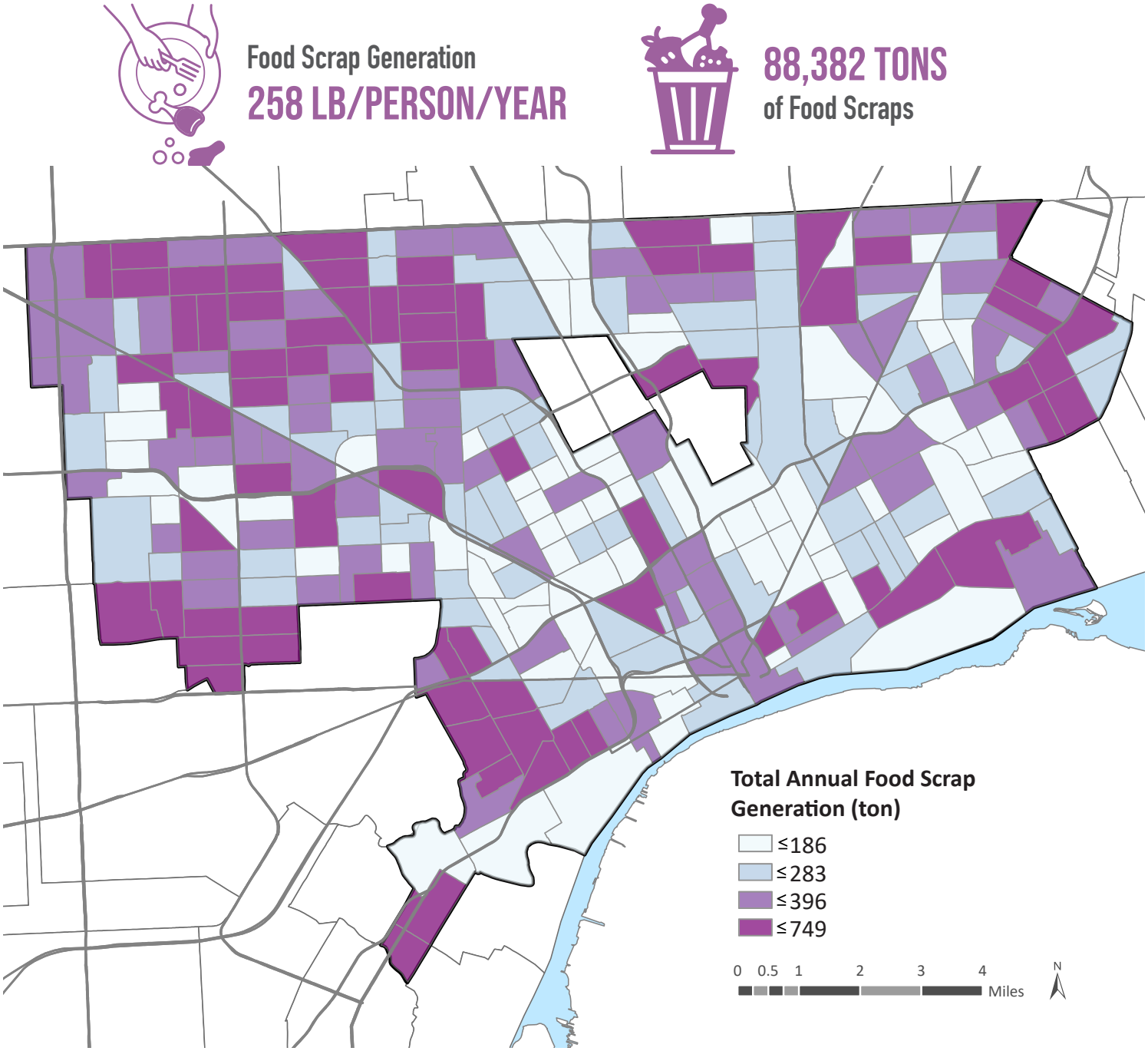


Figure 2. Citywide Food Scrap Generation. Data Sources: American Community Survey, 2013-2017 5-Year Estimate, 2016 Michigan Solid Waste Characterization Report.

Table 2. Residential Food Scrap Capture Comparison

	City of Minneapolis	New York City	City of Detroit	State of Michigan
Residential Food Scrap Rate	15% (2015)[a]	21% (2017)[d]	--	17% (2015)[h]
Compost Participation Rate	43% (2016)[b]	69% in three pilot boroughs (2016)[e]	2-10% **	--
Food Waste Capture Quantity	4 lbs/HH/week (2016)[b]	6-13 lbs/HH/week (2016)[e]	3-4 lbs/HH/ week **	--
Recycling Participation Rate	> 44% (2016)[c]	> 95% (2005)[f]	11% (2016)[g]	--
Recycling Rate	--	--	--	15% (2015)[h]

*** Numbers assumed based on participation rate of recycling rate being relevant to composting rate*
-- Data not available
(Data sources noted with superscripts are listed in the section's Endnotes)

buy-in had been established, their next step sought to expand these composting efforts citywide. In Minneapolis, the City provides curbside compost pick up for households who enroll in the program.[19] In NYC, the city expanded compost drop-off sites to all five boroughs.[20] Zero waste goals are often multi-faceted, with initiatives like recycling and composting programs being expanded simultaneously. When analyzing the data from the two cities we found that the participation rate of compost is comparable to that of recycling. Having recognized these two cities as precedents that can inspire Detroit's composting system, we built two residential compost participation scenarios – low estimate and high estimate – based on Michigan's and Detroit's context (see *Table 2*).

The low estimate assumes that only 2% of households in Detroit would participate in a compost program, and that they can contribute an average of 3 pounds of suitable compost materials every week per year. The high estimate assumes that 10% of households will take part in the program and contribute 4 pounds of composting material per week on average. According to our calculations, at the lowest estimation, 403 tons of food scraps will be captured from residential sources. With higher participation and contribution, Detroit can capture 2,688 tons of food scraps annually.

Annual Residential Food Waste Capture = NUMBER OF HOUSEHOLDS * PERCENT PARTICIPATION * AMOUNT PER WEEK * 52 WEEKS PER YEAR / 2000 LBS PER TON

Figure 3. James McSweeney and Brenda Platt, Micro-Composting: A Guide to Small Scale and On-Site Food Scrap Composting Systems (Washington, DC. Institute for Local Self-Resilience, forthcoming), courtesy of the Institute of Local Self-Resilience.

FIGURE 4. POTENTIAL RESIDENTIAL FOOD SCRAP CAPTURE

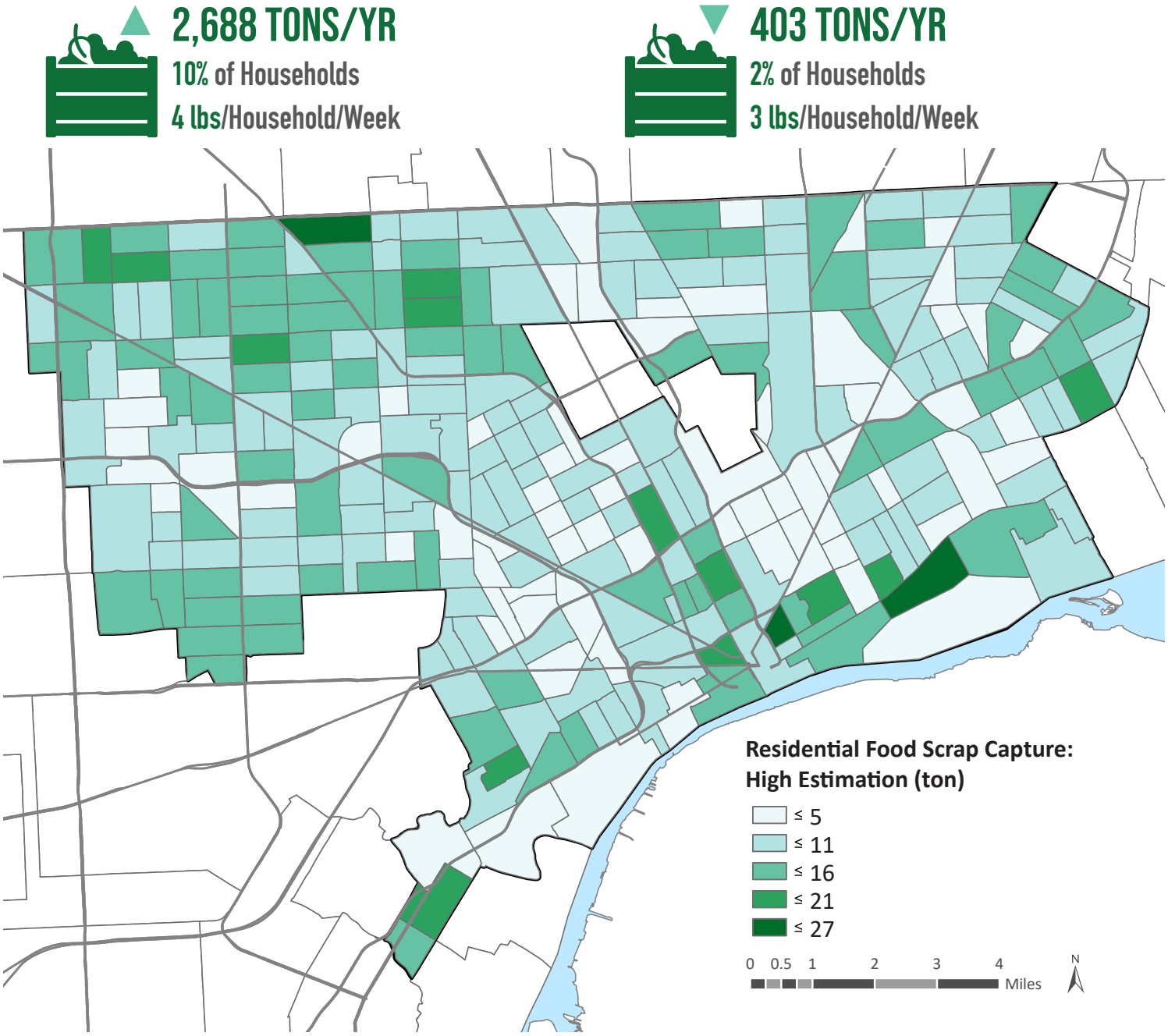


Figure 4. Residential Food Scrap Capture. Data Sources: American Community Survey, 2013-2017 5-Year Estimate; 2016 Michigan Solid Waste Characterization Report.

Commercial & Institutional Food Waste Generation & Capture

According to McSweeny's guidelines we can estimate commercial and institutional food scrap generation using calculations listed in Table 3. Combining and geocoding data from Detroit Open Data Portal, U.S. Census Bureau, Data Driven Detroit, and other web-based sources, we gained a basic understanding of the amount and spatial distribution of non-residential food scrap generation.[21] Using the available data, we estimated the food scrap generation of:

- Schools based on student enrollment in each census tract;
- Hospitals based on available beds; and
- Correction facilities based on the number of beds.[22, 23]

Additionally, we also analyzed the minimum amount of annual food scraps from grocery stores and restaurants.[24, 25] We did this by assuming the minimum full-time employee for grocery stores is one employee and restaurants is two employees. The number of full-time employees is considered as an indication of the size of stores/restaurants. Admittedly, most restaurants and grocery stores exceed this size. However, without more detailed data of stores and restaurants to justify other assumptions, we believe that assessing the minimum food waste volume is more appropriate. Since there is no accurate location data for every restaurant, we used Detroit's restaurant inspection data to get the total count of restaurants. The restaurant food waste generation is, therefore, not included in the map.

In all, Detroit can generate approximately 19,433 tons of food scraps from commercial and institutional sources every year. (See *Figure 5*) Our analysis also reveals that restaurants are the major contributors of citywide commercial food scraps, even when utilizing conservative assumptions to conduct the estimation. Restaurants alone can generate five times the food scraps of other commercial and institutional food scrap sources. Schools – including primary, secondary, and colleges—are the second-largest food scrap generators, with a total amount of 1,788 tons of annual food scraps (assuming schools operate 36 weeks a year).

Based on this estimation, we created high and low food scrap capture volume scenarios to set a baseline to analyze the potential environmental impact of compost. The low estimate assumes 15% of the food scraps of these categories would be captured appropriately, and the high estimate assumes the capture rate to be 30%.

FIGURE 5. COMMERCIAL & INSTITUTIONAL FOOD SCRAP CAPTURE VOLUME BY CATEGORY (TONS)

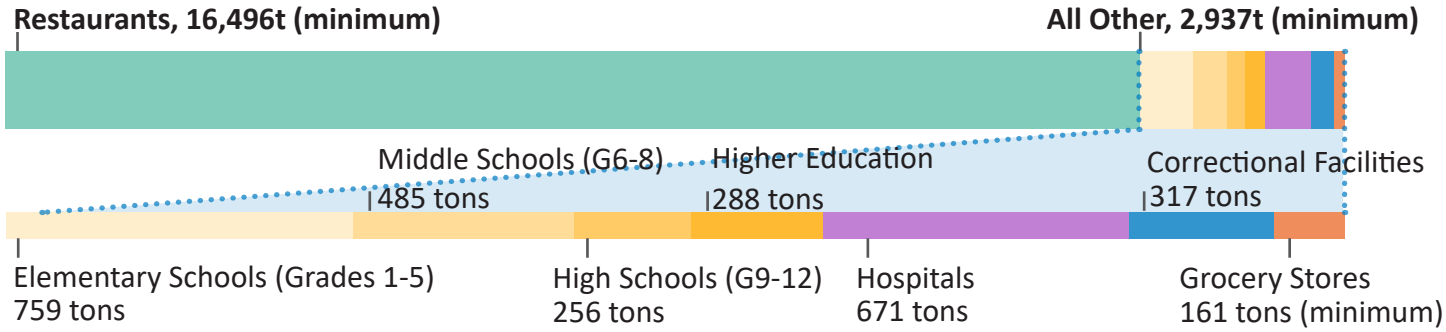


FIGURE 6. COMMERCIAL & INSTITUTIONAL FOOD SCRAP CAPTURE

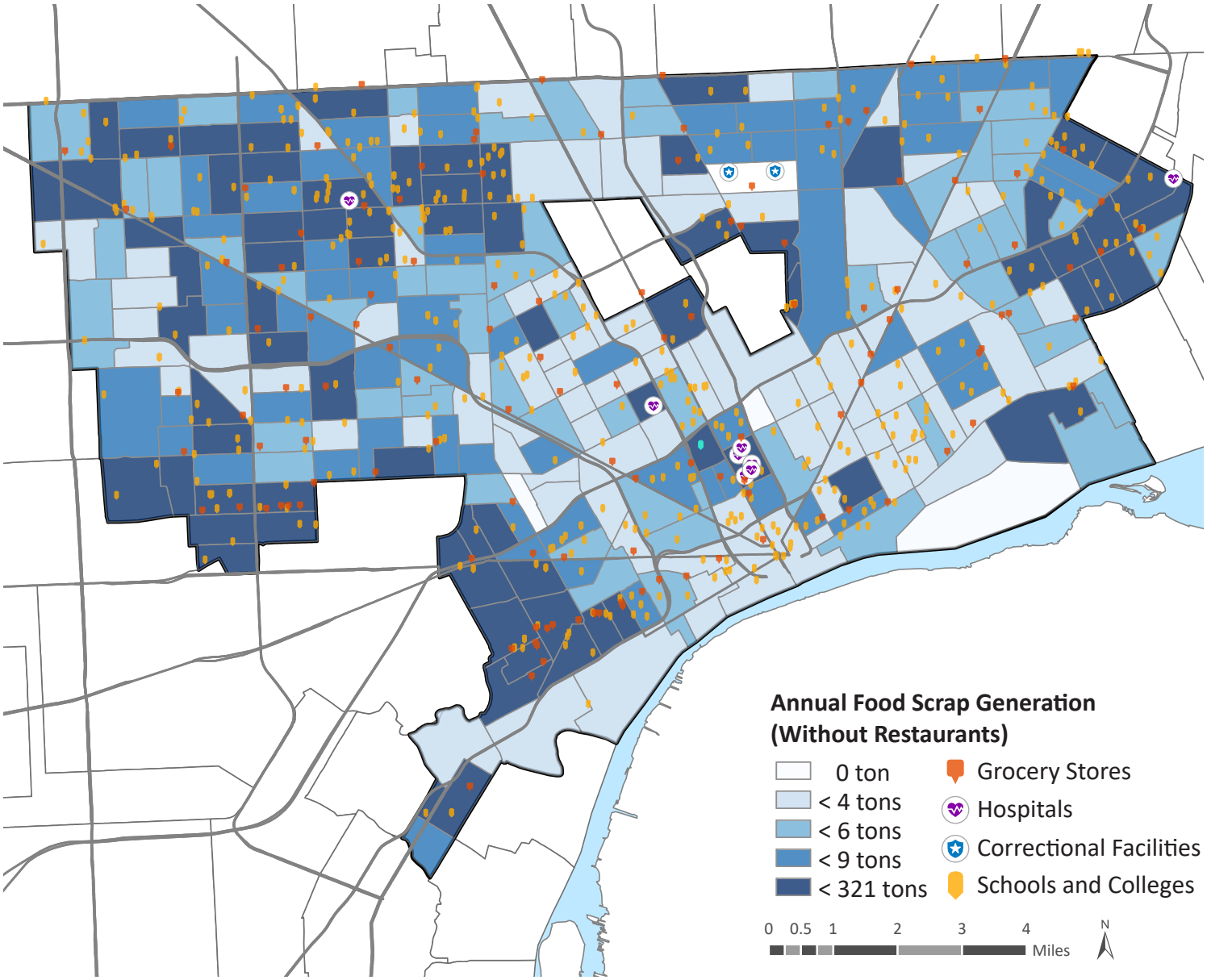


Figure 6. Commercial & Institutional Food Scrap Capture. Data Sources: American Community Survey, 2013-2017 5-Year Estimate, Detroit Open Data Portal (Hospitals, 2019, All Schools, 2018-2019, Restaurant Inspections, 2020), Data Driven Detroit (Grocery Stores,2015), Google Maps (Geocoded Correctional Facilities, 2020)

Table 3. Commercial & Institutional Food Waste Generation

Generator Type	Metric	Generative Factor to get to Tons per Week
Elementary School	Number of students	(# of students) * 1.13 / 2000[a]
Middle School	Number of students	(# of students) * 0.73 / 2000[a]
High School	Number of students	(# of students) * 0.35 / 2000[a]
College	Number of students	(# of students) * 1.13 / 2000[a]
Correctional Facilities	Number of beds	(# of beds) * 10.5 / 2000[b]
Hospitals	Number of beds	(# of beds) * 10.5 / 2000[b]
Restaurants & Cafeterias	Number of full-time employees	(# of employees) * 28.8 / 2000[c]
Grocery Stores	Number of full-time employees	(# of employees) * 57.7 / 2000[c]

a. Very accurate;
b. Based on two actual generators;
c. Have not validated.
Note: Table adapted from James McSweeney and Brenda Platt, Micro-Composting: A Guide to Small Scale and On-Site Food Scrap Composting Systems (Washington, DC. Institute for Local Self-Resilience, forthcoming), courtesy of the Institute of Local Self-Resilience.

AN INTRODUCTION TO EPAs WARM TOOL

The US Environmental Protection Agency (EPA) WARM Tool stands for "Waste Reductio Model". As the EPA notes, "WARM is a tool that calculates and totals the GHG emissions, energy savings and economic impacts of baseline and alternative waste management practices, including source reduction, recycling, combustion, composting, anaerobic digestion and landfilling."[26] It can be used by planners, policy-makers, researchers, and organizations to investigate the impacts of waste management decisions. The model quantifies five categories of impacts enticed by solid waste management practices including:

- Metric tons of carbon dioxide equivalent (MTCO2E)
- Energy units (million British Thermal Unit- BTU)
- Labor hours
- Wages ($)
- Taxes ($)

The most recent version of WARM (v.15) was updated in May 2019 and it is available at https://www.epa.gov/warm/

ESTIMATING THE IMPACTS OF A COMMUNITY COMPOSTING SYSTEM

QUANTIFYING THE IMPACTS

To understand the environmental, economic, and social impact of a potential composting system, we applied the Waste Reduction Model (WARM, version 15) developed by US EPA (see call out box, *An Introduction to Warm*) and cited Pai *et.al.*'s methods in estimating the cost avoidance of a decentralized composting system.[27, 28]

Table 4. Impact assessment methods of decentralized community composting

Impact	Assumptions	Tools / Calculations
Carbon emission reductions	Transportation Distance: • Compost: 3 miles • Landfill: 20 miles	U.S. EPA WARM Model
Disposal cost avoidance	Only used tipping fees ($30/ton). Transportation costs were ignored due to high variability and relatively small compared to tipping fees.	W * L, where: • W = the weight of food waste diverted • L = landfill tipping fee
Fertilizer cost avoidance	1 metric ton of food waste = 2.4 m^3 of finished compost[a] Price of compost[b]: $0-35 / m^3	W * V * P, where: • W = the weight of food waste diverted • V = Volume conversion of food waste to compost • P = Price of compost
The Social Cost of Carbon	A $50/metric ton of CO2 in 2017 dollars for the social cost in 2020.[e]	Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866

Note: Method adapted from Pai, S., Ai, N., & Zheng, J. (2019). Decentralized community composting feasibility analysis for residential food waste: A Chicago case study. Sustainable Cities and Society, 50, 101683. https://doi.org/10.1016/j.scs.2019.101683

(Data sources noted with superscripts are listed in the section's Endnotes)

ENVIRONMENTAL, ECONOMIC & SOCIAL IMPACTS

Legend

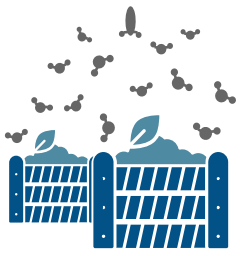
↑ "High Estimate"

↓ "Low Estimate"

↑ **8,518 TONS** PER YEAR

↓ **3,318 TONS** PER YEAR

Annual Residential, Commercial, & Institutional Food Scrap Capture



↑ **6,767 TONS** PER YEAR

↓ **2,635 TONS** PER YEAR

Reduction in Annual Carbon Emissions

↑ **$307,050** PER YEAR

↓ **$11,960** PER YEAR

Social Costs Saved from Reduced Carbon Emissions

↑ **$99,540** PER YEAR

↓ **$255,540** PER YEAR

Tipping Fees Avoided

↑ **$253,375** PER YEAR

↓ **$650,465** PER YEAR

Fertilizer Costs Saved

ESTIMATING CAPACITY OF A DECENTRALIZED COMPOSTING SYSTEM

The City's large volume of vacant parcels is a unique opportunity for Detroit to practice composting. To analyze the potential of the City's food scrap processing capacity, we considered the Detroit Land Bank Authority (DLBA) owned parcels with on-site structures that have been demolished as potential sites for composting operations. Based on DLBA-owned property, Detroit parcels, and residential demolition data, 16,607 parcels with an average size of 4,428 ft2 met our criteria.[29, 30, 31] We took the average site as a standard unit of composting sites and created a base scenario for this estimation. If we assume 40% of the site is utilized for processing (60% of the space left for curing, staging, best management practices' facilities, transportation, etc.), then each unit site can accommodate at most 8 windrows with a total volume of 391 cubic yards (CY). With low- to medium-intensity operations (i.e, with a once per week turning frequency, medium-level training requirements, etc.), food scraps need at least 90 days to be fully processed, stabilized and finished. Therefore, one unit site is assumed to be able to process 362 tons of food scraps annually.

According to our unit composting site capacity estimations, we built two scenarios for the analysis. Under the low-estimation scenario, Detroit could process 3,751 tons of food scrap employing 4% of the area of vacant parcels. In the high-estimation scenario, Detroit could process 9,377 tons of organic material with medium-intensity composting operations utilizing 10% of land of vacant parcels.

In addition, it is important to note that the large number of community gardens and market gardens can also serve as potential composting sites. The processing capacity of each site could be even higher if more attention were to be given to best management practices. If Detroit aggregates residential, commercial, and institutional food waste capture, Detroit can divert 3,318 to 8,218 tons of food waste to composting operations annually with our relatively conservative estimations. By comparing the current Detroit composting potential with the amount of food waste that could be diverted, it is evident that Detroit has adequate capacity to process its locally generated food waste. Considering other resources stated earlier, we are positive that the City has higher composting potential than we estimated.

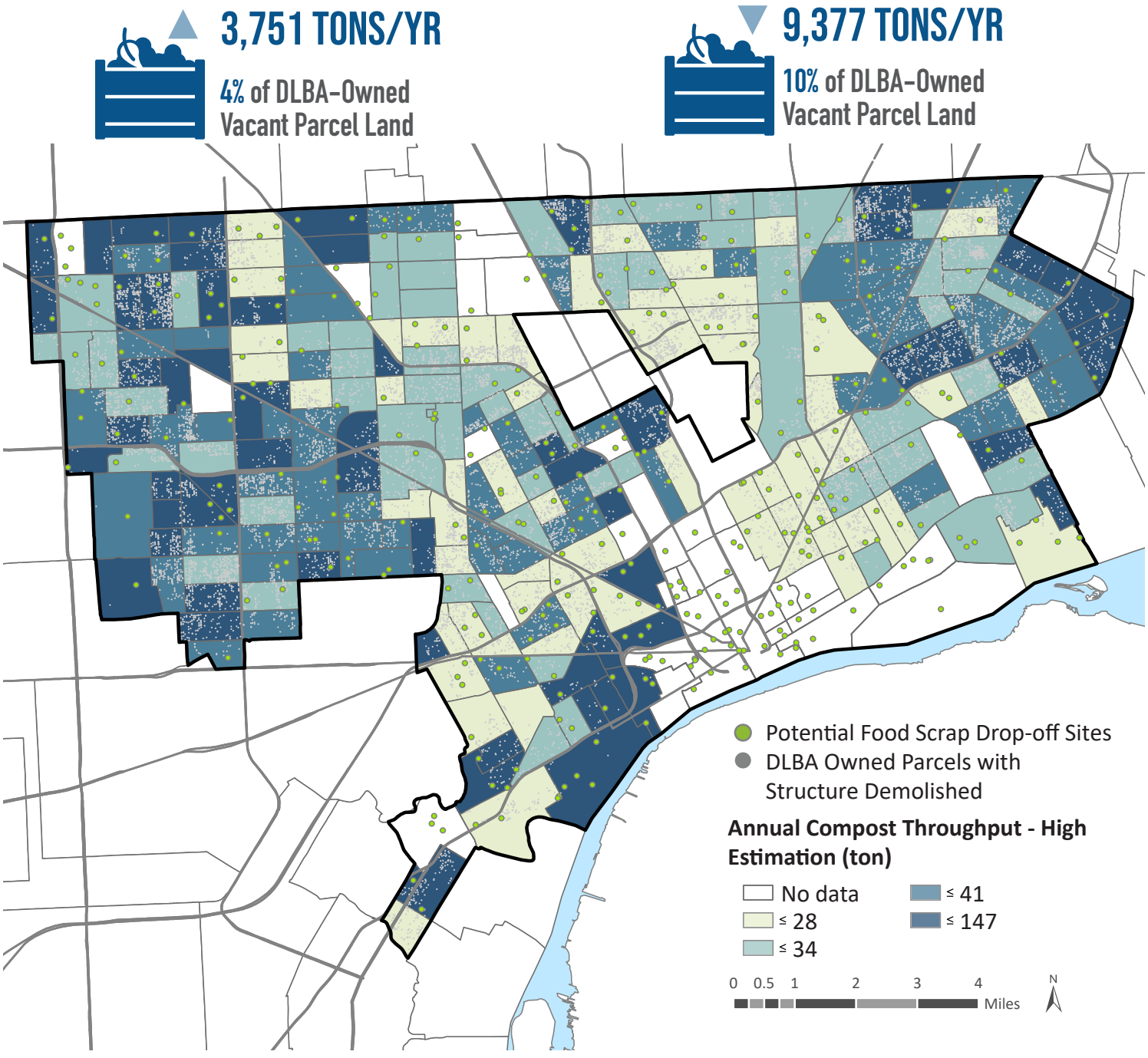
Table 5. Unit Composting Site Capacity Estimates

Category	Value
Average Size of a Parcel	4,428 ft^2
Processing Area (40% of the site)	1,771 ft^2
Average size of a windrow**	73 cubic yards
Number of windrows the site can accommodate	8
Potential Processing Windrow Volume	391 cubic yards
Annual throughput (90-day processing period)	362 tons/year

** The average size of windrow is calculated based on: ⅔ x 11' (width) x 20' (length) x 9' (height). If the site utilizes a loader to deal with food scraps and compost, the windrow's height can be up to 12'

One cubic yard of food waste is roughly equivalent to 463 lbs.[32]

FIGURE 7. CITYWIDE FOOD SCRAP PROCESSING POTENTIAL



Data Sources: Detroit Open Data Portal (DLBA Owned Properties, 2020, All Schools, 2018-2019, Completed Residential Demolitions, 2020). SEMCOG (Parks, 2020)

LIMITATIONS OF OUR MODEL

Although the People, Place, and Composting section of this report offers an initial estimation of food scrap generation, capture, impact, and the city-wide processing capacity, it is essential to recognize that most of these scenarios are based on assumptions. During the process of quantifying Detroit's composting potential, our primary challenge was the lack of local level empirical data. More grounded estimations could be made if site-specific data were available about household food scrap generation, interest in participating in composting, and current rates of capture and processing. More solid data and estimates will be beneficial for the City to evaluate the benefits and cost of composting operations and help organizations to strengthen their advocacy and make the case for funding. Looking forward, the City, non-profit organizations, community organizations, and composting sites all have a part to contribute to data collection. For the City, it is important to investigate solid waste data in greater detail at the local level. For organizations, surveys regarding the resident's willingness to contribute food scrap will provide critical knowledge that informs the building of composting sites. For community composting sites, keeping track of how much food scrap they collect, how much materials they process, and how much compost they yield based on their management practices is critical for their future operations.

Figure 8. A typical Compost Windrow. (Wikipedia Commons)

ENDNOTES

1. De Gisi, S., Petta, L., & Wendland, C. (2014). History and Technology of Terra Preta Sanitation. *Sustainability*, 6(3), 1328–1345. p. 1330. https://doi.org/10.3390/su6031328

2. Diaz, L. F. & de Bertoldi, M. (2007). Chapter 2 History of composting. In L. F. Diaz, M. de Bertoldi, W. Bidlingmaier, & E. Stentiford (Eds.), *Waste Management Series* (Vol. 8, pp. 7–24). p. 7. https://doi.org/10.1016/S1478-7482(07)80005-4.

3. (Diaz, L. F. & de Bertoldi, M., 2007, p. 8)

4. (Diaz, L. F. & de Bertoldi, M., 2007, p. 1)

5. Pothukuchi, Kameshwari. 2015. "Five Decades of Community Food Planning in Detroit: City and Grassroots, Growth and Equity." *Journal of Planning Education and Research* 35(4):419–34. p. 423

6. (Pothukuchi, 2015)

7. Taylor, D. E., & Ard, K. J. (2015). Research Article: Food Availability and the Food Desert Frame in Detroit: An Overview of the City's Food System. *Environmental Practice*, 17(2), 102–133. p. 126. https://doi.org/10.1017/S1466046614000544

8. Detroit GO DATA. (2019). DLBA Owned Properties. [Map] https://data.detroitmi.gov/datasets/dlba-owned-properties

9. (Detroit GO DATA, 2019)

10. Metzger, K. (2010, October 14). *A Contemporary View of the Detroit Region's History and Demographics*. https://datadrivendetroit.org/files/D3P/LDXXXII_10.pdf

11. (Metzger, K, 2010)

12. Gallagher, J. (2019, October 26). *Social media is arguing about how much vacant land is in Detroit—And the number matters*. Detroit Free Press. https://www.freep.com/story/money/business/john-gallagher/2019/10/26/detroit-vacant-land/4056467002/

13. Detroit Land Bank Authority. (n.d.). *Who We Are*. Retrieved April 3, 2020, from https://buildingdetroit.org/overview/

14. Detroit Land Bank Authority. (n.d.). *Community Partnership*. Retrieved April 3, 2020, from https://buildingdetroit.org/community-partnership/

15. Detroit Future City. (2012). 2012 *Detroit Strategic Framework* Plan (p. 216). Detroit Future City.

16. (Detroit Future City, 2012, p. 296)

17. *Economic impact potential and characterization of municipal solid waste in Michigan 2016.* (2016). West Michigan Sustainable Business Forum. https://www.michigan.gov/documents/deq/480236-14_WMSBF_waste_characterization_report_521920_7.PDF

18. U.S. Census Bureau. (2018). ACS 2017 5-Year Estimate. Age by Sex.

19. City of Minneapolis. (2019). Composting—*City of Minneapolis*. http://www.minneapolismn.gov/sustainability/homegrown/WCMS1P-130101

20. DSNY- Drop-off Composting. (n.d.). Retrieved April 23, 2020, from https://www1.nyc.gov/assets/dsny/site/services/food-scraps-and-yard-waste-page/nyc-food-scrap-drop-off-locations

21. McSweeney, J. (2019). *Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and Solving Our Waste Crisis.* p320- 321.

22. U.S. Census Bureau. (2018). ACS 2017 5-Year Estimate. School Enrollment.

23. *Hospitals*. (2019). [Map]. City of Detroit Open Data Portal. https://data.detroitmi.gov/.

24. *Grocery Stores*. (2015). [Map]. Data Driven Detroit. https://portal.datadrivendetroit.org/datasets/4726274b9bde451ebe679127e50c75ef_0

25. *Restaurant Inspections*. (2020). [Data set]. City of Detroit Open Data Portal. https://data.detroitmi.gov/

26. US EPA. (2016, January 7). *Waste Reduction Model (WARM)* [Collections and Lists]. Retrieved from https://www.epa.gov/warm

27. US EPA. (2016). *Versions of the Waste Reduction Model (WARM)* [Collections and Lists]. Retrieved from https://www.epa.gov/warm/versions-waste-reduction-model-warm

28. Pai, S., Ai, N., & Zheng, J. (2019). Decentralized community composting feasibility analysis for residential food waste: A Chicago case study. *Sustainable Cities and Society*, 50, 101683. https://doi.org/10.1016/j.scs.2019.101683

29. Detroit Land Bank Authority. (2020). *DLBA Owned Properties 0* [Map]. City of Detroit Open Data Portal. https://data.detroitmi.gov/

30. *Parcels*. (2020). [Map]. City of Detroit Open Data Portal. https://data.detroitmi.gov/datasets/completed-residential-demolitions?geometry=-83.622,42.264,-82.578,42.442

31. *Completed Residential Demolitions.* (2020). [Map]. City of Detroit Open Data Portal. https://data.detroitmi.gov/

32. *Volume-to-Weight Conversion Factors*. (2016). U.S. EPA Office of Resource Conservation and Recovery. Retrieved from https://www.epa.gov/sites/production/files/2016-04/documents/volume_to_weight_conversion_factors_memorandum_04192016_508fnl.pdf

TABLE CREDITS

Data Source for Table 1.: Organic Waste in Michigan, 2015

Economic impact potential and characterization of municipal solid waste in Michigan 2016. (2016). West Michigan Sustainable Business Forum.

Data Sources for Table 2. Residential Food Scrap Capture Comparison

a. 2016 Minneapolis Residential Solid Waste Composition Analysis and Recycling Program Evaluation. (2016). Foth Infrastructure & Environment, LLC Together with MSW Consultants, Inc. & Louis Berger and Associates.

b. Minneapolis curbside composting yields high interest, less organic waste than expected. Star Tribune. Retrieved April 23, 2020, from https://www.startribune.com/minneapolis-curbside-composting-yields-high-interest-less-organic-waste-than-expected/434569713/.

c. 2016 Minneapolis Residential Solid Waste Composition Analysis and Recycling Program Evaluation. (2016). Foth Infrastructure & Environment, LLC Together with MSW Consultants, Inc. & Louis Berger and Associates.

d. 2017 NYC Residential, School, and NYCHA Waste Characterization Study. (2017). New York City Department of Sanitation.

e. 2015 NYC Organics Collection Report. (2015). New York City Department of Sanitation.

f. Lange, R. (2005). Recycling at Home: NYC Resident Attitudes, Awareness, and Behavior (p. 49). Bureau of Waste Prevention, Reuse and Recycling.

g. Ferretti, C. (n.d.). Detroit plans outreach to boost recycling participation. Detroit News. Retrieved April 23, 2020, from https://www.de- troitnews.com/story/news/local/detroit-city/2016/02/11/detroit-recycling-outreach-campaign/80254664/.

h. Economic impact potential and and characterization of municipal solid waste in Michigan 2016. (2016). West Michigan Sustainable Business Forum.

Data Sources for Table 4. Impact assessment methods of decentralized community composting.

a. Komilis, D. P., & Ham, R. K. (2000). A Laboratory Method to Investigate Gaseous Emissions And Solids Decomposition During Composting Of Municipal Solid Wastes. Compost Science & Utilization, 8(3), 254–265. https://doi.org/10.1080/1065657X.2000.10701998

b. Bonhotal, J., & Harrison, E. (2004). Marketing Composts and Meeting Consumer Needs. Cornell Waste Management Institute. https://ecommons.cornell.edu/bitstream/handle/1813/2310/compostfs1.pdf?sequence=5.

c. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis—Under Executive Order 12866. (2010).

Interagency Working Group on Social Cost of Carbon.

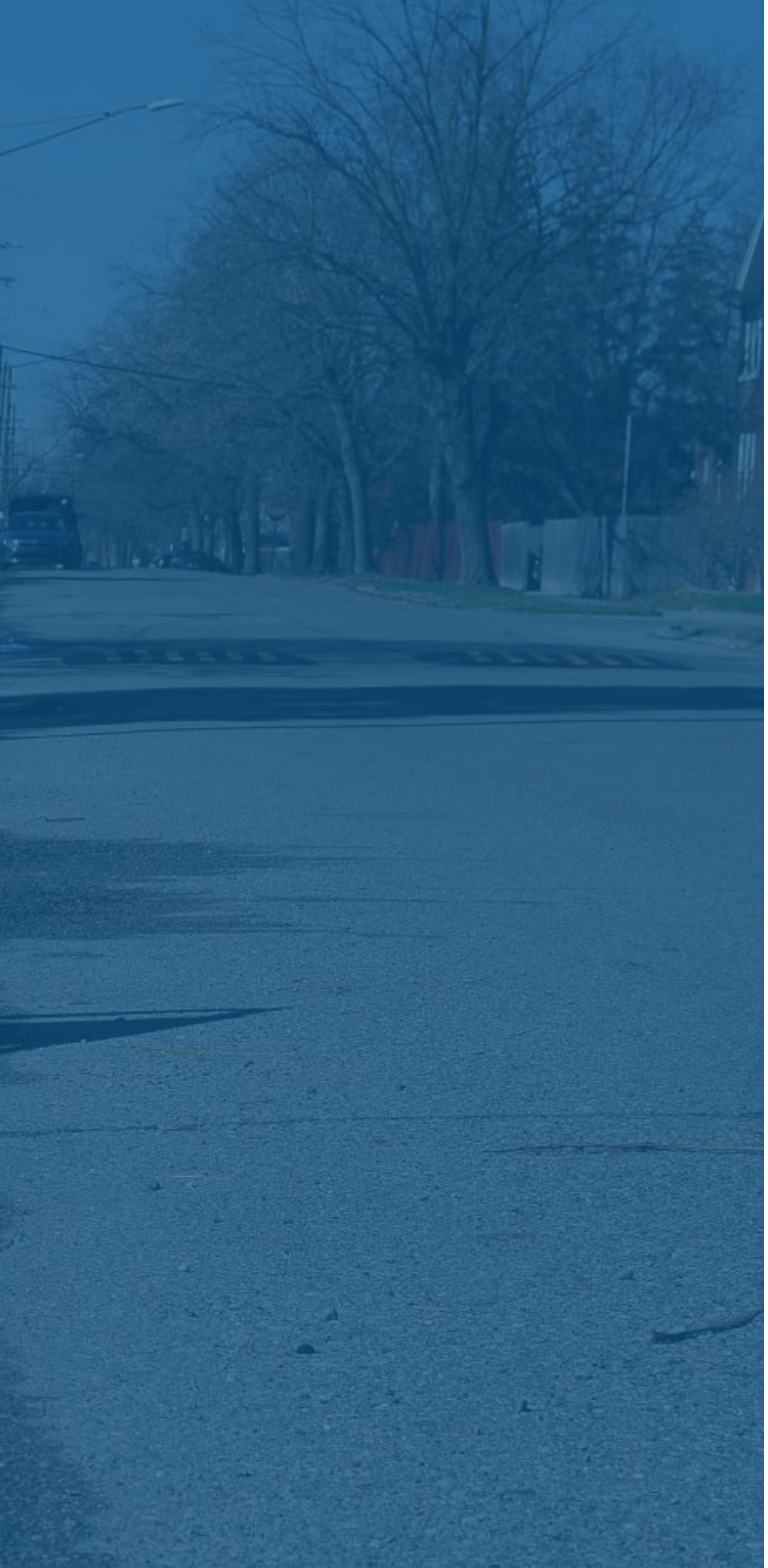
PHOTO CREDITS

Introduction Page Image by Alex S. MacLean. Accessed May 13 from https://www.nytimes.com/interactive/2014/12/07/opinion/sunday/exposures-detroit-by-air-alex-maclean.html

Figure 1. Found on Flickr. (2012, June 13). Sam Beebe. Accessed May 12 from: https://www.flickr.com/photos/sbeebe/7974741397

Figure 6. found on Wikipedia Commons. Accessed May 12 from: https://upload.wikimedia.org/wikipedia/commons/e/e5/Compost_site_germany.JPG

PHYSICAL INFRASTRUCTURE AND ENVIRONMENT



IT'S TIME FOR A RESOURCE REVOLUTION

Each year, an average of 30-40% of food grown in the world is never eaten. Landfills and trash incinerators receive 167 million tons of garbage each year. Over 50% of this garbage is considered compostable when factoring in food scraps, paper/paperboard, yard trimmings, and wood waste. This leads to large amounts of methane released into the atmosphere; as food scraps are among the primary offenders in the production of methane.[1]

Most cities have shifted to offering both garbage and recycling services, but composting is not yet widely established throughout all municipalities in the United States, particularly where tipping fees in landfills are low, disincentivizing the shift to composting services. At this time, Detroit does not offer any food scrap composting service, although it does provide yard waste collection services. As discussed earlier in our report, Michigan currently possesses one of the lowest tipping fees in the country, and thus there is little municipal incentive to shift to composting.

Research highlights a significant waste of divertable organic materials in Detroit, with an estimate of only 4% of residential municipal solid waste composted or recycled.[2] Just over 1% of all waste from eligible households is recycled despite increasing recycling participation rates, and significantly less is composted. These statistics include all of the food scraps generated by residents,

organizations, and businesses – estimates of 3,318-8,518 tons of organic material – which is a valuable resource that can be captured and utilized, even without a municipal centralized composting system *(see People, Place & Compost Capacity section).*

WHY NOW?

Despite currently low composting rates, Detroiters are eager to compost. The question that remains is, why now? The time is right as the City of Detroit recently released its Sustainability Action Agenda in 2019, defining an overarching goal to be a zero waste city, following years of advocacy, collaboration, and efforts led by residents and community partners. To firmly launch its efforts, the City established an Office of Sustainability in July 2019 after declaring that Detroit will become one of the greenest cities in the United States.[3]

Prior plans reiterated this goal to be zero waste and shift to a circular economy that recovers and benefits from resources, rather than wastes valuable resources. In 2013, stakeholders from 20 local, non-profit organizations committed to environmental justice came together to create the *Detroit Environmental Agenda.* Among its primary goals is *Zero Waste,* advocating to "Adopt a city waste management policy that prioritizes reduce, reuse and recycle – including diversion of food and construction/demolition waste."[4]

Four years later, Detroiters Working for Environmental Justice, working with many other non-profits, businesses, government officials, and more, published the *Detroit Climate Action Plan* in 2017.[5] This plan again rearticulated Detroiters' concerns and desires for an improved waste management system with their goal to "offer universal recycling and organic waste collection at home, work, businesses, and events."[6]

Building on this prior advocacy, Detroit's 2019 Sustainability Action Agenda strengthened this foundation using an extensive community engagement plan to uncover that 67% of residents thought it was "very important," and a combined total of 96% of residents thought it was "somewhat" or "very important" to have access to recycling, compost, and other waste reduction opportunities.[7] This desire to improve waste management has been voiced and fought for by residents, non-profit organizations, businesses, and the municipality alike. In response, one of the ten overarching goals in the Agenda is "*Reduce waste sent to landfills*" with five of the 43 action items listed under this section.[8]

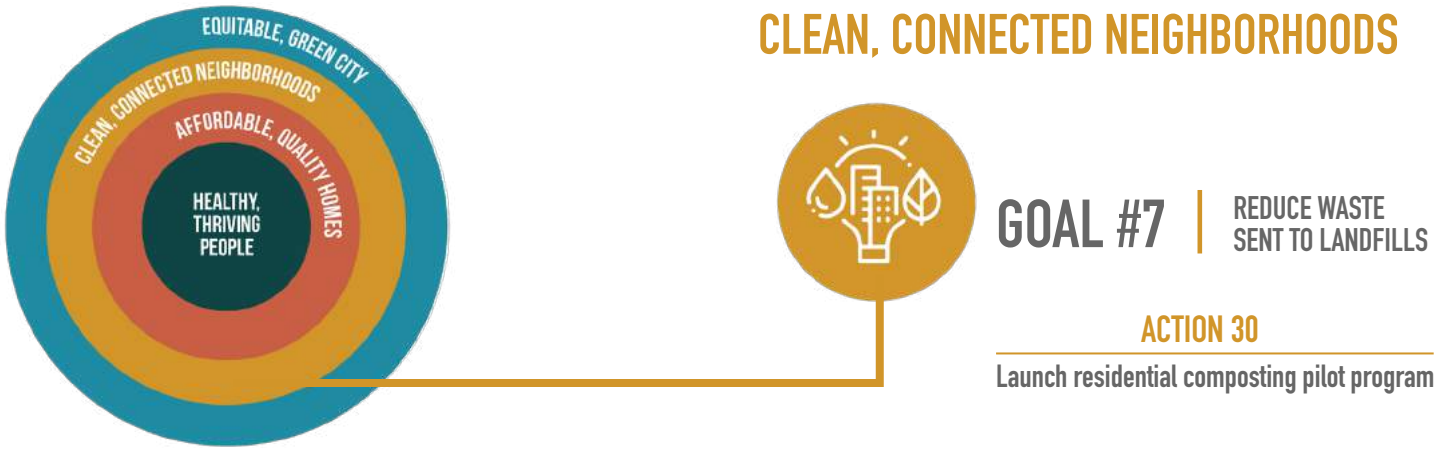


Figure 1. Aligning with Detroit's waste reduction goals (Detroit Sustainability Action Agenda, 2019)

TRANSFORMING THE WASTE MANAGEMENT LANDSCAPE

Growing interest in resource recovery is clearly stated across the municipality and residents alike. Detroit is already taking significant steps to reach its goal, but community-scale composting can both enhance and further enrich existing efforts while also still obtaining large-scale impacts. Detroit's waste management has already begun to transform in recent years. The waste system improved efficiency, streamlining its services, and the recycling system continues to expand to reach more Detroiters. With this, now lies the optimum time to expand the scope of resource recovery to include composting.

The City of Detroit is currently serviced by two waste disposal service providers: Green For Life (GFL) Environmental and Advanced Disposal, both contracted by the City's Department of Public Works.[9] Both providers provide refuse, recycling, bulk, and yard waste collection. Trash collection is offered weekly, while bulk, recycling, and yard waste services are collected biweekly on the same day (yard waste dependent on the season). Only in 2019 did waste management shift to a consistent same day pick up, streamlining waste management service in order to focus on expanding recycling services to more residents, in alignment with the City's commitment to zero waste in the Sustainability Action Agenda.[10] As Ron Brundidge, Director of the Department of Public Works, stated, "these changes are going to make collection more efficient for the vendors and provide a higher level of service for residents so we can do an even better job of keeping our city clean year-round."[11]

The City launched its curbside recycling program in select areas in 2011, expanding citywide in 2014. Today, any resident that lives in a single-family home or a home of up to four units can opt-in to participate in the voluntary recycling program.[12] In 2019, 27% of single-family households owned a bin, up from 9% in 2014.[13] Residents can receive a recycling bin one of three ways:

- Purchase a bin for $25 from their waste management provider[14]
- Attend a recycling workshop by Zero Waste Detroit or Green Living Science to receive a free recycling bin
- Play an online recycling educational game to receive a free recycling bin[15]

In order to improve resident recycling participation and knowledge, in January 2020, the City of Detroit, in partnership with Michigan Department of Environment, Great Lakes, and Energy (EGLE), launched *Know It Before You Throw It,* a widespread recycling campaign that aligned with Sustainability Action Agenda item #26, *Launch a citywide recycling campaign.*[16]

RESOURCE PARADIGM SHIFT

As demonstrated by the success of the recycling infrastructure, evidence has shown that low participation and waste diversion rates can increase over time with education, workshops, and advertising. The municipality has already expressed interest in expanding waste diversion to composting with action item #30, *Launch residential composting pilot program.* A future municipal curbside composting program could follow in line with the strengthening success of the recycling infrastructure by first starting with pilot areas before expanding citywide, offering incentives for composting, and providing online

educational opportunities to further engage and educate Detroiters. Overall, the City of Detroit is ready to compost and take on the next steps to reach their vision of becoming one of the greenest cities in the country.

ENVIRONMENTAL CONTEXT OF DETROIT

The City of Detroit currently faces a multitude of challenging environmental conditions, including degraded soil quality, a variety of soil and water contaminants, an excess of combined sewer overflows (CSOs), poor air quality, backyard and neighborhood flooding, and a large percentage of impervious surface throughout the city.[17,18,19] Many organizations, businesses, residents, and municipal departments continue to fight these challenges by building a network of green stormwater infrastructure projects, urban agriculture sites, and community-driven empowerment, in addition to taking other action. Below, we describe these environmental challenges in more detail and demonstrate how an expanded compost system can enhance associated actions to address them.

A major concern within the City of Detroit is its soil. Largely a result of the City's industrial legacy, degrading infrastructure and demolitions, the soil is often contaminated with coal, fly ash, cinders, mortar, and brick and glass.[20] Soil testing often reveals elevated pH levels and low organic carbon, nitrogen, and phosphorus. In addition, the soil in Detroit is typically a silty clay loam.[21] As per a study on urban soils in Wayne State University, the soil in urban areas in Wayne County is usually composed of both native soils as well as soils of anthropogenic nature. Anthropogenic soils are formed as a result of compacting soil under impervious surfaces and human action. These soils differ based on evidence of human habitation, industrial activity, and other land uses. Since urban soils are heterogenous, they suffer from the effects of increased impervious surfaces and result in degradation of soil quality through decreased microbial activity, decreased infiltration capacity, and elevated pH levels.[22] Due to the city's industrial past and frequency of demolition, the occurrence of anthrosediment is common.[23] Artificial sedimentation processes such as shifting soil for purposes of excavation, backfilling and compaction result in the formation of anthrosediment which is found widely in Detroit's soil owing to the City's proportion of vacant land.[24]

The City of Detroit currently operates on a combined sewer system, meaning that it carries both "wastewater from homes and businesses with stormwater during wet weather with a single pipe."[25] Approximately three million residents and thousands of businesses in Southeast Michigan use this system, sending their wastewater down the drain every day, leading to the Detroit Water Resource Recovery Facility, operated by the Great Lakes Water Authority.[26]

In times of wet weather, the combined sewer system collects stormwater in addition to the untreated sewage, and the dated infrastructure can exceed its capacity. When there is heavy rain, the volume passing through a single pipe can be 10 to 100 times more than on a typical dry day, exacerbating pressure on the system.[27] In total, 42% of Detroit is hard surface, heightening the risk for flooding.[28]

As a result, when it rains, stormwater overloads the combined sewer system, causing basement backups, street flooding, and polluted wastewater. In some areas of Detroit, a storm is necessary to cause flooding, while in others, much milder weather will invoke a similar response in part due to the amount of impervious surfaces.

Detroit is also expected to face an increase in precipitation and local temperatures as per a climatology study conducted by the Great Lakes Integrated Sciences and Assessments.[29] Precipitation has seen a drastic increase over the years, as has mean temperatures. Detroit hence faces increased risk, especially to low income households in urban areas, due to heat waves and temperature surges. Urban heat islands also deteriorate air quality as warmer temperatures increase ground level ozone. Increased heat also calls for more electricity that is produced by burning fossil fuels thereby polluting the air and causing respiratory diseases. A study of the impacts of climate change on vulnerable populations in Detroit states that decreasing greenhouse gas (GHG) emissions in Detroit will support climate justice efforts and "will ameliorate the existing environmental and health burdens".[30] Further, as per the 2012 GHG inventory for Detroit, emissions related to solid waste amounted to 275,578 tons of carbon dioxide equivalent.[31] Therefore, there is a pressing need to address the impacts of climate change on the City in the coming years and take sustainable steps towards equitably remedying the environment.

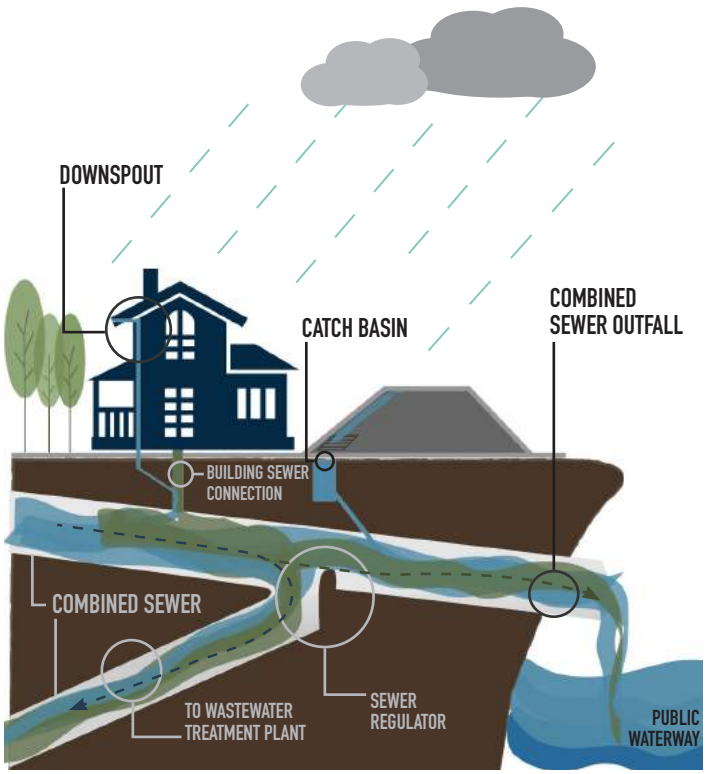


Figure 2. Working of Combined Sewerage Overflows (CSOs) during precipitation events (Illustration adopted from nyc.gov & civicgardencenter.org)

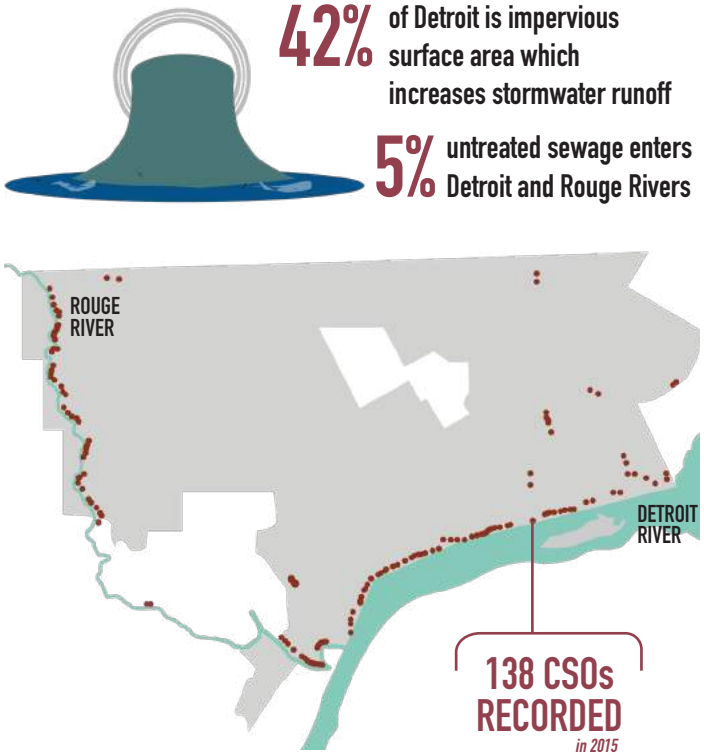


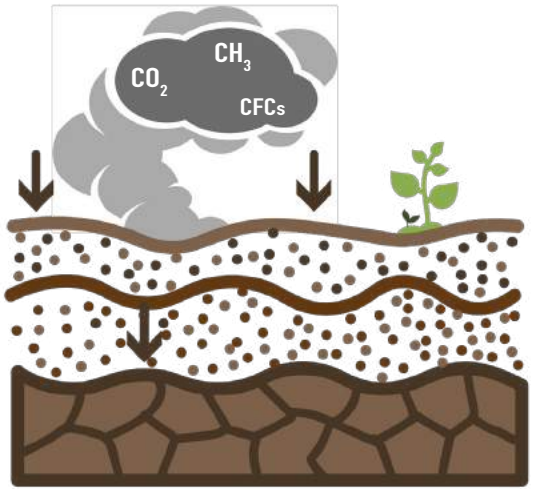
Figure 3. Illustration of Combined Sewer Overflows in Detroit (Data Driven Detroit, 2015; Detroit Future City, 2018)

ENVIRONMENTAL BENEFITS OF COMPOST

Compost can remedy degraded soil, water, and air systems. One of the most significant uses of compost is its ability to treat non-point source pollution, acting as both a filter and a sponge to manage stormwater and agricultural runoff.[32] Compost freezes and degrades pollutants, improving overall water quality. This reduces contamination with its ability to "bind heavy metals, pesticides, herbicides, and other contaminants, thus reducing their leachability and absorption by plants."[33] Amazingly, compost can filter out an astonishing 60-95% of urban stormwater pollutants when added to soil, along with many other benefits as seen in Figure 4.[34]

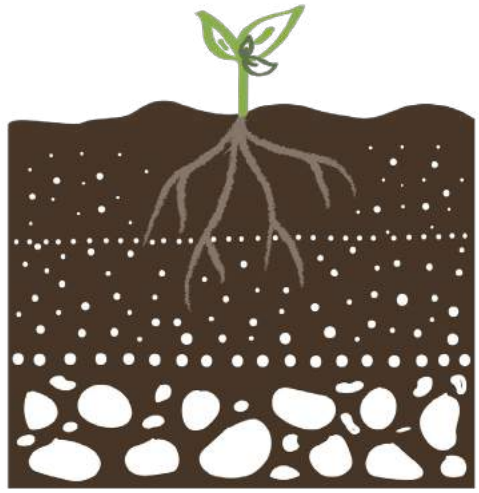
WATER

Impaired water quality means a greater dependence on water treatment, otherwise known as "grey infrastructure", in order to "convey, capture, contain, and treat water."[39] This results in a broken hydrological cycle at the watershed scale. When water systems are overloaded by increased runoff, it results in an inter-basin transfer, which further exacerbates the disruption of watersheds.[40] The role of compost in protecting source water comes from systems that are created to mimic natural infiltration and hydrological processes.[41] These include both soil and water



CARBON SEQUESTRATION

- Increases humus content
- Formation of soil aggregates
- Higher ability to store carbon
- Ability to decrease GHG emissions



IMPROVED SOIL HEALTH

- Increases organic matter content in the soil
- Increases microbial activity
- Better nutrient release for plants

Figure 4. Ways in which compost benefits the environment.

solutions, as they are closely linked in maintaining ecological balance. Blue-green stormwater infrastructure is considered an important method for urban stormwater systems, designed to improve water quality and protect source water.[42] The most common system used to mimic the water cycle is the process of bioremediation where contaminants are broken down by microorganisms present in compost, which consequently decreases leaching and transmission of toxic compounds into water sources. Other types of green infrastructure which play a role in ultimately protecting source water are described in the following sections. While considering compost's role in source water protection, it is beneficial to think about the connection between soil and water systems. Using compost for soil amendments and remediation processes eases the management of stormwater and aids in ecological balance.[43]

SOIL

Compost helps improve soil quality and has the potential of remediating soils that face contamination due to demolition activity, soil compaction, increased pH levels and lack of biodiversity.[35] Application of compost provides the soil with humus that stores water and adds organic matter to the soil. Organic matter increases the microbial activity in the soil and improves aeration, filtration capacity, and eases the extraction of nutrients for plants.[36] Organic matter also results in soil aggregates which have a high ability to store carbon. Nutrients needed for plant growth such as nitrogen, phosphorus, potassium, and sulfur are slowly released by compost into the soil, which decreases the chance of nutrient loss through stormwater runoff and increases infiltration capacity.[37]

Additionally, compost improves soil structure, porosity, and density to create a better root environment for plants and even has the ability to suppress certain soil-borne plant pathogens. By increasing the infiltration capacity and permeability, compost has the potential to reduce erosion. Compost also acts as a stormwater filter by binding heavy elements, pesticides, and other contaminants in the soil, thereby reducing their leachability and ability to contaminate stormwater runoff. The compost recipes for remediation processes vary based on the type of contaminant and the amount of soil to be treated.[38]

CLIMATE

Compost can play an important role in mitigating the effects of climate change. It has the ability to indirectly reduce GHG emissions and directly sequester carbon.[44,45] Methane is said to have 56 times the warming effect of carbon dioxide as it traps heat in the air almost 20 times that of carbon dioxide.[46,47] Diverting organic material from landfills decreases GHG emissions that would otherwise be released from decomposing organic materials at landfills. These organic materials, when converted to compost, are a valuable source of nutrients to soil and possess the ability to sequester carbon further decreasing greenhouse gasses in the air. The application of compost to soil enriches it with nutrients and organic humus-like compounds that enable the soil to store carbon in a stable humus form and decrease the release of carbon dioxide into the air.[48] Therefore, compost has the ability to reduce global climate change by diverting feedstocks, minimizing emissions from the composting process, sequestering carbon and improving soil health.[49]

OPPORTUNITIES FOR COMPOST USE IN DETROIT

Compost can not only improve the existing environmental conditions in Detroit, but it can also be used in many projects already underway, including stormwater management, demolition backfill, landscaping, soil remediation, urban agriculture, tree planting, and more.[50,51] For the past several years, Detroit grew exponentially in green stormwater infrastructure solutions and demolitions as it built capacity as well as completed landscaping, tree planting, and right of way improvement projects. All these projects have tremendous potential to utilize locally-sourced compost.

A mix of individual residents, community groups, non-profits, private businesses, and the municipality have all taken steps to address these existing environmental conditions. Each of these efforts, we argue, could benefit from access to compost.

STORMWATER MANAGEMENT

The Detroit Environmental Agenda, guided by the Detroit Water Agenda of 2012, aims to protect and restore the waterways that the city and communities depend on by reducing pollution from industries and stormwater runoff, including fertilizers and pesticides.[52,53] This can greatly impact stormwater management as increased runoff during high precipitation events causes the combined sewage system to overflow and discharge untreated water into the Rouge or Detroit Rivers.

Compost can be applied in a variety of ways to decrease surface runoff and increase soil infiltration capacity, specificifically by using one of the three compost best management practices (BMPs): compost blankets, compost filter socks, or compost

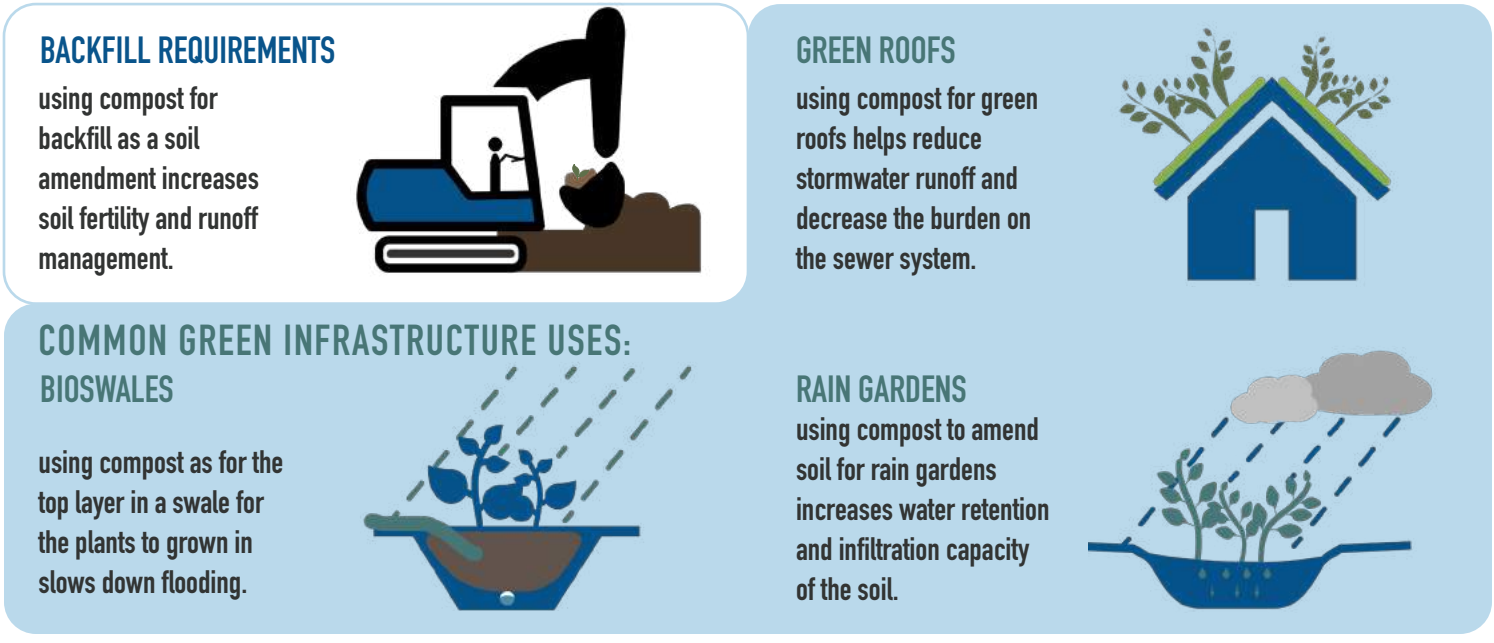


Figure 5. A few environmental uses of compost

filter berms.[54,55]

Compost blanket: A simple method of using a 1- to 2-inch loosely covered layer of compost applied directly on top of the soil. Compost blankets are usually applied in disturbed areas with sheet flow runoff (rather than concentrated) to reduce pollutant loads.[56]

Compost filter berm: A dike of compost placed perpendicular to runoff to retain sediment, control erosion and filter stormwater.[57] Compost filter berms are most effective at managing sheet flow runoff.[58]

Compost filter sock: A mesh tube filled with compost, placed perpendicular to runoff flow, that controls erosion and retains sediment during construction activities.[59,60] Compost filter socks are a type of contained compost filter berm and are used to reduce sediment from both sheet and concentrated flow.[61]

Compost blankets are a particularly common application for stormwater management. According to *The Soil & Water Connection*,

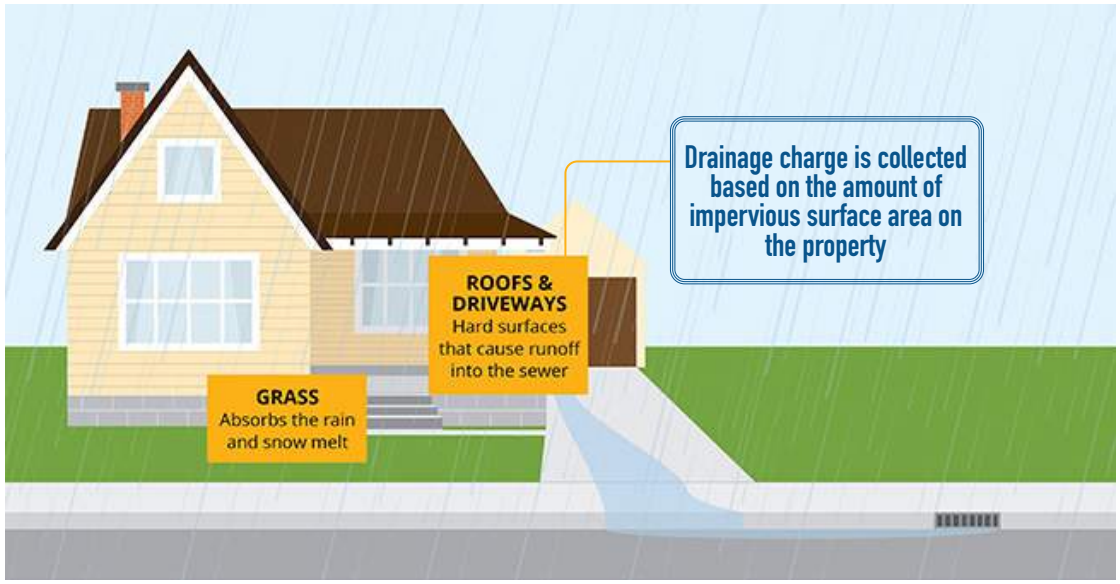
> Research in North Georgia has shown compost applied to the soil surface, in the form of a compost blanket, can absorb 80% of a 4-inch rainfall event, and in a similar study at the same location compost blanket applications absorbed 100% of a 3-inch rainfall event for some replications…A one-year university study conducted on construction site soils (disturbed, compacted sandy clay loam) evaluated the storm water and water quality effects of a 2-inch compost blanket relative to hydromulch on replicated field research plots. Compost blankets reduced runoff volume by 50%, peak runoff rate by 36%, total sediment loads by 80%, nitrate-nitrogen loads by 88%, and total and soluble phosphorus loads by 83%.[62]

These methods use compost to improve water quality by reducing the amount of stormwater that will enter water sources and provide water filtration to reduce pollutants.[63] Compost application can take place using a variety of methods but they are all particularly effective at managing stormwater, filtering pollutants, and improving infiltration from construction activities. Many of these applications can be directly applied to serve the needs of current projects in Detroit.

Drainage Charge

In recent years, the Detroit Water and Sewerage Department altered its methods of water service charge collection to now charge a monthly drainage fee to recover the cost of collecting, storing, and safely restoring combined sewage back to Detroit and Rouge Rivers based on the amount of impervious (hard) surfaces on properties that send stormwater to the combined sewer system.[64] This fee helps pay for infrastructure to reduce basement and street flooding and prevent future combined sewer overflows, where untreated sewage discharge enters the Detroit or Rouge Rivers, equating to about $150 million in annual operations and treatment costs.[65,66,67]

The drainage fee is charged to parcels based on the amount of impervious surface on the property and calculated by multiplying the impervious surface area (in acreage) by $602 then subtracting any green credits.[68,69] Green credits are a reduction in a property's drainage charge fee based on the use of green stormwater infrastructure (GSI) practices. Residential properties receive an automatic 25% Green Credit on their bill based on the assumption they have redirected their downspouts to run onto their lawn instead of directly into the sewer. Nonresidential customers can receive green credits to reduce their bills in exchange for the shared benefit of preventing excess stormwater from entering the combined sewer system by installing rain gardens or other similar green stormwater infrastructure projects. Five million dollars in funding are allocated each year to the Capital Partnership Program, which offers nonresidential customers the opportunity to receive up to a 50/50 match for green stormwater



HARD SURFACE (IMPERVIOUS ACRE)	PROJECTED DRAINAGE CHARGE
Less than 0.02	$0.00
0.02	$9.03
0.03	$13.55
0.04	$18.06
0.05	$22.58
0.06	$27.09
0.07	$31.61
0.08	$36.12
0.09	$40.64
0.1	$45.15
0.2	$90.30
0.3	$135.45
0.4	$180.60
0.5	$225.76

Figure 6. How the drainage fee works and charge per impervious acre (City of Detroit Stormwater Management and Drainage Charge)

infrastructure projects.[70]

Although the Detroit Water and Sewerage Department states it updated its drainage charge program to ensure city parcels are more equitably billed for their contribution of drainage costs, many residents complained about the increase in their bills since its implementation; thus stirring significant controversy.[71] Residents currently receive a 25% green credit, but are limited in options to further reduce their bills.[72] Using compost on a residential or nonresidential property can provide immense potential when used for stormwater management. By expanding the necessary guidelines to receive green credits, the application of compost can be offered as a low-cost, effective way to reduce one's impervious surface and green credits.

Green Stormwater Infrastructure

One solution used to address many environmental conditions in Detroit is GSIs where "using native plants and soil replicates natural systems to reduce runoff volume, remove pollutants, and cut down on flooding by absorbing, delaying, and filtering stormwater runoff before it enters the city's combined sewer."[73] Utilizing GSI is a more resilient solution and often a much cheaper solution than replacing aging gray infrastructure to absorb stormwater. To treat Detroit's combined sewer overflow (CSO) facilities and treating wet weather flows at the waste weather flows at the wastewater treatment plant costs $150 million annually.[74] The Detroit Water and Sewerage Department was required to invest more than $1 billion into combined sewer overflow facilities by federal and state regulations to prevent future untreated overflows into the Detroit and Rouge River.[75]

Although unable to overhaul the entire stormwater system infrastructure, the City invested millions of dollars into GSI projects as an alternate method to lower the incidences of CSOs.[76] In 2013, Detroit was permitted to use GSI as an approved stormwater solution.[77] The Detroit Water and Sewage Department has made significant strides to eliminating combined sewer overflows, having stopped 95% of the untreated combined sewage from entering the Detroit and Rouge Rivers.[78] Yet the 5% that remains

to be addressed is the more challenging CSOs – these require innovative alternative methods to help the City achieve Michigan's zero waste elimination standard for untreated sewer system discharges.[79]

Since 2013, a total of 203 green stormwater infrastructure projects have been recorded in the Detroit Stormwater Hub database by various public, private, and community stakeholders, managing in total over 630 acres and over 360 million of gallons annually.[80] (see *Figure 7*) Green stormwater infrastructure includes a wide range of systems, including rain gardens, bioswales, green roofs, rain harvesting, permeable pavement, some types of tree planting, and more.[81,82]

Recent years observed tremendous growth in GSI projects in part as a result of significant and successful education efforts that have presented GSI as a successful solution to deal with vacant land. This hard work paid off and is now heavily supported in the 2019 Sustainability Action Agenda.[83] Currently, work is underway to develop a Green Stormwater Infrastructure master plan, further emphasizing a variety of potential positive social, aesthetic, system, and ecosystem outcomes.[84]

In order to obtain green credits, many GSI projects have certain general standards to abide by, while some may already require specifically compost in these specifications.[85] Other mandates require

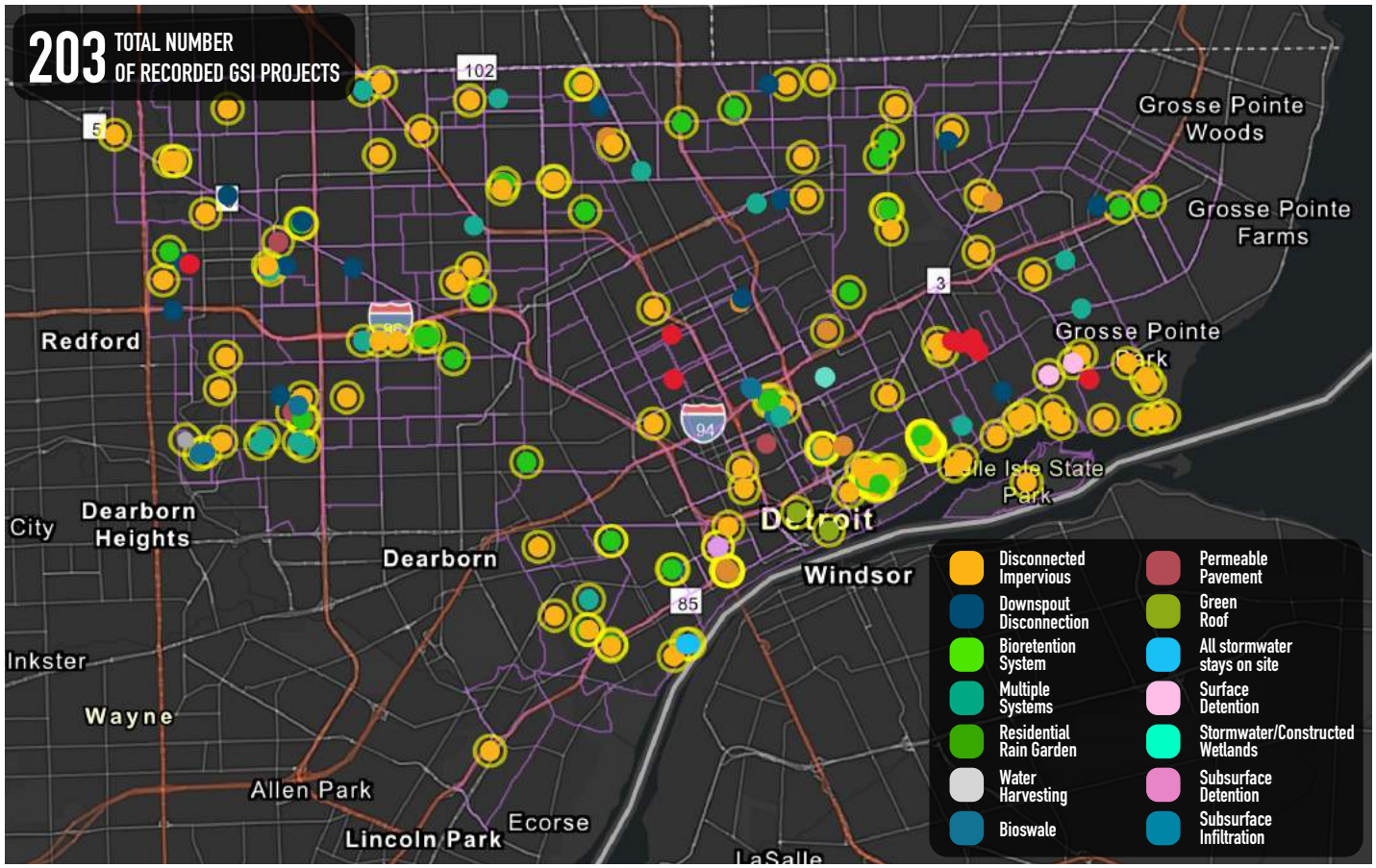


Figure 7. Green stormwater infrastructure projects in the City of Detroit (Detroit Stormwater Hub, 2020)

accountability for the amount of impervious surface but fail to address compost, and more specifically, fail to require local sourcing of compost – this presents an opportunity to require locally sourced compost.[86] Using compost can further improve absorption, enabling a parcel to hold up to five times its weight in water and thus, greatly reduce stormwater runoff. Most importantly, by using compost, it can spawn budding entrepreneurs and help close the loop of resource recovery within the City.

Rain Gardens

One type of green stormwater infrastructure that provides an immediate opportunity for a community-scale composting solution are rain gardens.[87]

> "Rain gardens are bioretention practices sized for smaller lots, like residences. They consist of a depressed area with an amended soil or soil filter media capable of infiltrating and filtering stormwater runoff and supporting vegetation."[88]

Friends of the Rouge and Sierra Club partner to host *Rain Gardens to the Rescue*, a program funded by the Erb Family Foundation that helps interested residents or businesses establish their first rain garden.[89] Participants receive help with the manual installation, obtain all necessary materials at no cost, and are taught both how to build one and how to teach others how to make them to share with their local community under a teach-the-teacher model.[90,91]

Through *Rain Gardens to the Rescue*, those with clay soil must replace 1 to 3 feet of topsoil with a mixture of 30% sharp sand, helping to loosen up the soil with its gritty texture, and 70% compost, providing a necessary ingredient to amend the soil to meet its intended purpose.[92] Currently, compost for the *Rain Gardens to the Rescue* program is sourced from Bushel Mart in Livonia, nearly 20 miles from downtown Detroit, and was stated to cost more than a previous distributor, which unfortunately closed.[93] According to members of Sierra Club and Friends of the Rouge, the program currently has funding to cover the cost of compost for rain gardens developed in this program, but this revenue is continuously lost outside the City.[94] *Rain Gardens to the Rescue* installed 70 rain gardens since 2015, treating over 47,000 gallons of rain water per rain event.[95] Compost sold in larger quantities at Bushel Mart goes for about $33-$36 a cubic yard, with a fee of $75 per delivery.[96] Assuming each rain garden has clay soil and requires the delivery of compost, about 163 yard^3 are needed (roughly 2 cubic yards of compost is needed for a 100 square foot rain garden at 12 inches deep), costing an estimated $9,400 - $9,800 of revenue that could be instead spent within city bounds.[97]

The City could incentivize or mandate all GSI projects to purchase from within Detroit, setting quality

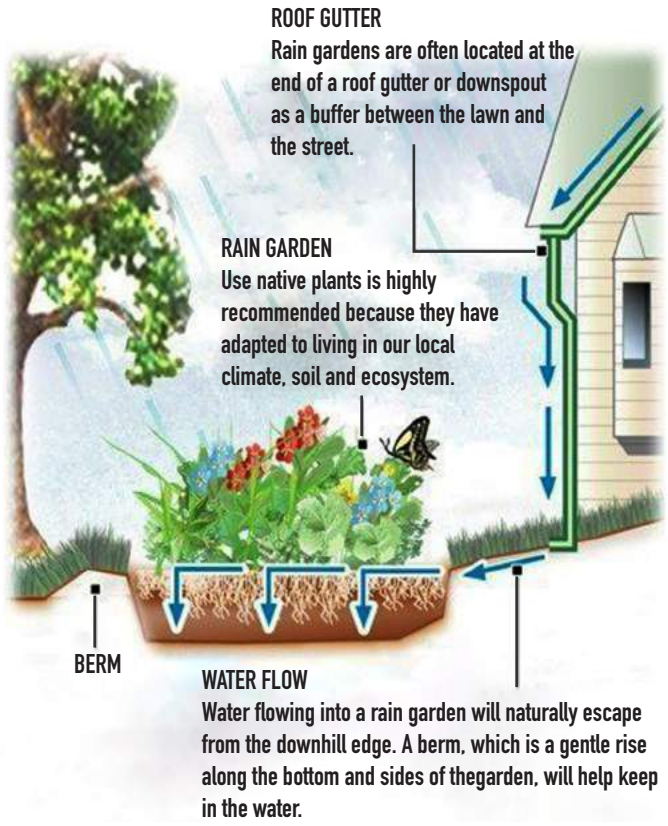


Figure 8. Working of a rain garden (Cuyahoga Water and Conservation District)

standards for community-scale compost processors to sell on the market. Doing this right away may be too costly or the amount of compost might not be initially sufficient to meet the entire demand; however, the volume of available compost would likely increase with time and costs may lower to become more reasonable or subsidized. By using incentives or mandates, innovative and budding entrepreneurs could be ensured of demand for compost, and thus, more may readily launch their own community-scale composting operations.

For example, one opportunity the City could incentivize or mandate the use of local compost is within the recently enacted Post-Construction Stormwater Ordinance of 2018.[98] This ordinance aims to hold property owners and developers accountable for creating and managing a significant amount of impervious surface.[99] By connecting this existing ordinance to eager entrepreneurs, everyone can benefit through the local processing of compost, the revenue that remains within Detroit, the managed stormwater, and the overall benefits of using compost for the community. The City has the power to connect budding producers with large, consistent buyers, removing risk for those entering the market.

MUNICIPAL INFRASTRUCTURE PROJECTS

The City of Detroit supports a variety of other projects currently in its work, including landscaping, tree plantings, new developments, right of way improvements, and more. Each of these pose a unique opportunity to use locally sourced compost. For example, the City aims to plant 1,000 trees a year – these plantings offer a rich opportunity to benefit from soil amendments with compost to help trees thrive in any soil condition. In addition, the City is working to establish development standards that align with the Sustainability Action Agenda #22, "Develop green building guidelines for new developments receiving City incentives."[100] One successful example of this is Washington State which developed Soils for Salmon, a set of standards for compost-based low impact development. These are now being implemented into the "Sustainable Sites Initiatives (SITES), a LEED equivalent national benchmark for sustainable site development."[101] Detroit could offer incentives or mandate that developers follow a similar set of standards regarding use of compost for any new development.

Another opportunity is to use compost in right of way improvement and street redesign projects. One example of this is the Texas Department of Transportation (TxDOT), the nation's single largest compost market due to it specifying the use of compost for highway maintenance projects.[102,103] TxDOT operates a total of 1.1 million acres of land and uses several hundred cubic yards of compost and mulch every year, using compost primarily for erosion control and vegetation establishment. Although Detroit is not quite the same size as Texas, the City can offer ample opportunity to use compost in similar projects, such as the I-94 Modernization Project, when partnered with stakeholders in the future. The municipality already displayed interest in a similar goal with the Sustainability Action Agenda action item #35, *Incorporate green stormwater infrastructure into street redesign and greenway projects.*[104] As detailed before, compost has immense potential when serving as a passive green stormwater infrastructure space. In order to properly implement this use, more research needs to explore the testing and specifications necessary for compost. Texas for example, "defines three grades of compost use and requires testing for particle size, organic matter, soluble salts, maturity, pH, time and temperature standards and EPA Part 503 testing for biosolids compost." Other systems use less rigorous methodologies for testing – the U.S. Composting Council, U.S. Environmental Protection Agency and BioCycle offer additional details to explore.[105,106]

Demolitions

Detroit contains tens of thousands of vacant structures and parcels that could be backfilled, and until recently, was carrying out about 25-50 demolitions a month.[107] The City hires various contractors to complete demolitions and backfills, and since the start of the Detroit Demolition Program in 2014, a total of 20,789 demolitions have been completed.[108] The City is working hard to clean up these lots and backfill these parcels with material, usually with a combination of crushed cement and topsoil.[109] These demolitions require the backfill of the parcels with clean soil, however, the definition of "clean" is unclear.[110,111] Most backfilling currently uses the existing soil from the site. In 2015, there was a reported $6,000 increase in the cost of a single demolition since 2013, up to $16,400.[112] Reasons for this large increase included the scarcity of uncontaminated dirt and higher trucking costs, among other things. Most pressing was the difficulty of obtaining clean backfill soil with contractors charging the municipality extraordinarily high prices for backfill material.[113] As a result, the state set limits for the cost a contractor could charge for dirt from $3,000 for larger houses, and $2,000-$2,500 for typical properties.[114] However, in 2019, some backfill sites were investigated for potential soil contamination, with further investigation into potential lead contamination.[115] These high prices and contaminated backfill in part points to the ongoing challenge to find a reliable source for backfill materials within the City bounds. Instead, contractors work with their preexisting relationships to procure backfill material outside of Detroit, losing potential economic gain inside the city with little oversight monitoring of quality or pricing.[116,117]

Most pressing was the difficulty of obtaining clean backfill soil.[118] Long-term, there lies tremendous opportunity to use compost as a topsoil amendment or applied as a compost blanket. By using compost in backfill projects, these parcels could serve as a passive green stormwater infrastructure space, providing better absorption and infiltration of stormwater and reducing its impact on the combined sewer system, in addition to countless other positive benefits for the environment.[119,120] Although this may initially be considered too expensive of a solution at first glance, one study found that:

> under a 3-inch/24-hour period storm, a typical 10-acre development with a compost blanket (i.e. a layer of loosely applied compost) would reduce runoff volume as compared to an impervious site and avoid $181,428 per year in water treatment costs. If the runoff was treated on-site with a stormwater management pond, the compost blanket application equates to a cost reduction of $697,800, avoiding the need for a larger pond to accommodate an increased volume of water.[121]

Similarly, one city government official we interviewed fully supported the use of compost in topsoil, stating, "[if we have a] large enough supply, [we] can just replace the topsoil for projects. Yes, it could be costly, but for [soil] remediation projects, [it] could be doable."[122] However, due to the current classification of compost in Detroit, compost cannot legally be used for backfill until its use is changed (see *Policy Analysis for Composting Section*). If implementing guidelines on compost for backfill use, there needs to be further research into the amount of compost necessary to fulfill demand, how community-scale compost operations could work with contractors to fulfill compost need, and the necessity for a large-scale centralized composting operation to meet any gap in supply.

EXPAND THE POWER OF COMPOST

Compost Tea

Additional measures can improve compost's capabilities to improve water and soil health by going beyond the typically standard compost recipe of 1 part carbon material to 3 parts nitrogen. An alternate recipe is *compost tea,* a liquid developed from compost by extracting the beneficial microorganisms using a brewing process.[123] Compost tea is then sprayed on soil to improve soil health, increase water retention, and strengthen soil structure, among other benefits. Many other recipes yield similarly positive results but may be used for different purposes.

Biochar

One particularly successful recipe uses biochar, also known as charcoal. Biochar, mixed with compost, enhances the ability to absorb and hold stormwater, reducing runoff.[124]

Minneapolis is a strong advocate of the use and creation of biochar, passing a resolution in June 2019 that recognizes biochar as a "climate action and resilience tool to benefit Minneapolis residents and our environment."[125] Biochar, or "terra preta," literally meaning "black earth" in portuguese, has the potential to sequester billions of tons of carbon dioxide a year as estimated by Project Drawdown, the climate change mitigation project that a group of more than 200 researchers worldwide developed to outline the most substantive list of solutions to global warming.[126,127] Biochar stabilizes carbon in the soil, decreasing carbon mineralization, while increasing the biological activity in the soil.[128] Specifically, when used in composting, biochar is beneficial because it:[129,130]

- Reduces greenhouse gas emissions
- Prevents loss nutrients in the compost material
- Promotes microbial activity which accelerates the composting process
- Reduces odor
- Reduces compost's ammonia losses
- Reduces bulk density
- Among many others

Even without biochar, compost has the remarkable ability to improve soil quality and clean water of contaminants, thus a crucial component to successfully addressing the existing environmental conditions.

ENSURE DEMAND FOR LOCAL COMPOST

Despite the many ways that compost could be applied to address environmental challenges facing Detroit, a gap exists in the availability of locally sourced compost. Currently, no compost processing system within the City can distribute compost widespread, in part because there has not been an explicit demand. Some cities have buy-in at the municipal level, where the local government actively seeks to generate a consistent market for compost.[131,132,133] With the significant amount that could be required by the City, the supply chain of compost would generate new jobs and economies.[134] The City is strategically positioned to encourage, incentivize or mandate the use of locally sourced compost in municipal operations, aligning with their overarching goals as declared in the 2019 Sustainability Action Agenda and stated mayoral and departmental priorities.[135]

By focusing on the areas where people are most susceptible to neighborhood-level flooding, compost can strategically be used first for the areas that need it the most as the production of compost ramps up to meet municipal demand. Changing legislation or offering incentives can be an effective first step to ending the import of compost into the city and thereby reducing the carbon footprint by miles traveled for resources while keeping economic activity within the city.

CONCLUSION

Compost has wide-reaching implications in its ability to protect the environment and as well as mitigate impacts of climate change. As noted before, food scraps that end up in landfills generate methane, a greenhouse gas that is 84x more potent than carbon dioxide in the short term (20 year period), and 28x more potent in the long term (100 year period). Yet if food scraps can be diverted from landfills, converted to compost, and then applied to the land, compost has the power to sequester carbon as a carbon sink instead.[136] When biochar is added, this rate of carbon sequestration significantly increases.

According to ReFED, a national nonprofit for food waste advocacy, community composting has the potential to divert up to 167,000 tons of food waste from landfills nationwide, with an estimated reduction in greenhouse gas emissions of 163,000 tons.[137] In Detroit alone, composting has the potential to divert an estimated 8,518 tons of food scraps from the landfill, reducing greenhouse gas emissions by an estimated 6,767 tons *(*see *Place and Context section for details).* To successfully apply community-scale composting as a solution to projects such as green stormwater infrastructure or backfill projects, there should be both market opportunities and municipal support to reach the highest resource recovery possible, while ensuring this work stays within the City of Detroit. Although estimates may vary, there is little doubt that there is significant potential for resource recovery using community-scale composting in the City of Detroit.

ENDNOTES

1. Frichmann, C. (2018, July 31). Food waste is a vastly overlooked driver of climate change. *The Washington Post*. https://www.washingtonpost.com/news/theworldpost/wp/2018/07/31/food-waste/

2. Office of Sustainability. (2019). *Detroit Sustainability Action Agenda*. https://detroitmi.gov/sites/detroitmi.localhost/files/2019-06/Detroit-Sustainability-Action-Agenda-Web.pdf

3. Wimberley, K. (2018, April 18). Detroit City Council Green Task Force to Recognize Residents and Businesses Focused on Sustainability April 21. *GreeningDetroit*. https://www.greeningdetroit.com/2018/04/18/detroit-city-council-green-task-force-to-recognize-residents-and-businesses-focused-on-sustainability-april-21/

4. *Detroit Environmental Agenda*. (2013). Detroit Environmental Agenda Steering Committee. http://detroitenv.org/wp-content/uploads/2016/07/DEA-Report.pdf

5. Detroiters Working for Environmental Justice. (2017). *Climate action plan*. https://detroitenvironmentaljustice.org/wp-content/uploads/2017/11/CAP_WEB.pdf

6. (Detroiters Working for Environmental Justice, 2017)

7. (Office of Sustainability, 2019)

8. (Office of Sustainability, 2019)

9. *Refuse Collection*. (n.d.). City of Detroit. Retrieved March 30, 2020, from https://detroitmi.gov/departments/department-public-works/refuse-collection

10. (Office of Sustainability, 2019)

11. Department of Public Works. (2019, May 23). *City announces improvements to bulk, yard waste collections, schedule changes for some residents*. City of Detroit. https://detroitmi.gov/news/city-announces-improvements-bulk-yard-waste-collections-schedule-changes-some-residents

12. Department of Public Works. (n.d.). *Recycling Information*. City of Detroit. Retrieved March 30, 2020, from https://detroitmi.gov/departments/department-public-works/refuse-collection/recycling-information

13. (Office of Sustainability, 2019)

14. (Department of Public Works, n.d.)

15. City of Detroit. (n.d.). *Recycling Challenge Educational Game*. Retrieved March 30, 2020, from https://detroitmi.gov/webapp/recycling-challenge-educational-game

16. *EGLE and National Nonprofit The Recycling Partnership Award More than $2M in Record-Setting Grants to Support Largest Expansion of Recycling in History of Detroit, Additional MI Communities*. (2020, January 6). The Recycling Partnership. https://recyclingpartnership.org/egle-and-national-nonprofit-the-recycling-partnership-award-more-than-2m-in-record-setting-grants-to-support-largest-expansion-of-recycling-in-history-of-detroit-additional-mi-communities/

17. Detroit Water and Sewerage Department. (n.d.). *Stormwater Management and Drainage Charge*. City of Detroit. Retrieved April 3, 2020, from https://detroitmi.gov/departments/water-and-sewerage-department/stormwater-management-and-drainage-charge

18. Ignaczak, N. (2016, December 12). *Digging deep: Detroiters work to clean up city's toxic soil*. Model D. https://www.modeldmedia.com/features/digging-deep-soil-121216.aspx

19. Wayne State University. (n.d.). *Urban Geology* [Collection of past and ongoing research carried out by Department of Geology at Wayne State University]. Urban Geology of Detroit. Retrieved April 18, 2020, from https://s.wayne.edu/urbangeology/urban-geology/

20. (Ignaczak, 2016)

21. *Official Series Description—DETROIT Series*. (2011, December). https://soilseries.sc.egov.usda.gov/OSD_Docs/D/DETROIT.html

22. (Wayne State University, n.d.)

23. (Ignaczak, 2016)

24. (Wayne State University, n.d.)

25. (Detroit Water and Sewerage Department, n.d.,a)

26. (Detroit Water and Sewerage Department, n.d.,a)

27. (Detroit Water and Sewerage Department, n.d.,a)

28. Land + Water Works. (2018). *Stormwater 101*. Land and Water Works. https://detroitfuturecity.com/wp-content/uploads/2018/03/Stormwater-101_PD_021918-1.pdf

29. (Detroiters Working for Environmental Justice, 2017)

30. (Detroiters Working for Environmental Justice, 2017)

31. Carson, J., Cooper J., Donahue M., Neale M., Ragland A. (2014). *City of Detroit Greenhouse Gas Inventory: An Analysis of Citywide and Municipal Emissions for 2011 and 2012*. Centre for Sustainability Systems, University of Michigan.

32. Bell, B., & Platt, B. (2014). *Building Healthy Soils with Compost to Protect Watersheds* (pp. 12). Institute for Local Self-Reliance.

33. (Bell & Platt, 2014)

34. Stumo-Langer, N. (2017, April 20). *Posters: Compost Impacts More Than You Think*. Institute for Local Self-Reliance. https://ilsr.org/compost-impacts-posters/

35. (Wayne State University, n.d.)

36. U.S. Composting Council, Research and Education Foundation. (1997). *The Soil & Water Connection*.

37. Biala, Johannes. (n.d.). *Organics Fact Sheet: Compost Use Mitigates Climate Change*. Compost Australia, The Organic Force. https://healthysoil.org/resources/documents/Compost_Use_Mitigates_Climate_Change.pdf

38. (U.S. Composting Council, 1997)

39. (U.S. Composting Council, 1997)

40. McFarland, A. R., Larsen, L., Yeshitela, K., Engida, A. N., & Love, N. G. (2019). Guide for using green infrastructure in urban environments for stormwater management. *Environmental Science: Water Research & Technology*, *5*(4), 643–659. https://doi.org/10.1039/C8EW00498F

41. Coker, C. (2006). Environmental remediation by composting. *ResearchGate*. https://www.researchgate.net/publication/292661824_Environmental_remediation_by_composting

42. Wagner, I., Krauze, K., & Zalewski, M. (2013). *Blue aspects of green infrastructure*. 12.

43. (Wagner et al, 2013)

44. Galchen, R. (2020, March 2). *How South Korea Is Composting Its Way to Sustainability*. The New Yorker. https://www.newyorker.com/magazine/2020/03/09/how-south-korea-is-composting-its-way-to-sustainability

45. AZoCleantech.Com. (2008, January 17). *Methane Gas—What is Methane Gas and Converting Landfill Gas into a Form of Renewable Energy*. https://www.azocleantech.com/article.aspx?ArticleID=31

46. (Galchen, 2020)

47. (AZoCleantech.Com, 2008)

48. (Biala, Johannes, n.d.)

49. U.S. Composting Council. (2008). *Greenhouse Gases and the Role of Composting: A Primer for Compost Producers.* https://www.sanjoseca.gov/home/showdocument?id=198

50. Malik Johnson of Detroit Buildings, Safety Engineering, Environmental Department, Detroit, MI, personal communication, March 17, 2020

51. Khalil Ligon of Detroit Planning and Development, Detroit, MI, personal communication, March 18, 2020

52. (*Detroit Environmental Agenda,* 2013)

53. Cockrel Jr., K. V. (2012). *Detroit Water Agenda 2012* (p. 39). Detroit City Council Green Task Force Water Subcommittee.

54. (Bell & Platt, 2014)

55. U.S. Environmental Protection Agency. (2016, July 21). *What are the compost BMPs?* U.S. Environmental Protection Agency. https://archive.epa.gov/region5/waste/solidwaste/compost/web/html/bmp.html

56. Archuleta, R., & Faucette, B. (2014). *Compost blankets for runoff and erosion control*. United States Department of Agriculture.

57. (U.S. Environmental Protection Agency, 2016)

58. Minnesota Pollution Control Agency. (2020, April 21). *Compost and stormwater management*. Minnesota Stormwater Manual. https://stormwater.pca.state.mn.us/index.php?title=Compost_and_stormwater_management

59. (U.S. Environmental Protection Agency, 2016)

60. Filtrexx Sustainable Technologies. (2020). *We are the inventors of the compost filter sock for sustainable management practices.* Filtrexx Sustainable Technologies. https://www.filtrexx.com/en

61. U.S. Environmental Protection Agency. (n.d.). *National Pollutant Discharge Elimination System (NPDES): Compost filter socks*. U.S. Environmental Protection Agency. https://www.filtrexx.com/application/files/2514/6196/0979/7.25_-_EPA_National_Menu_of_BMPs_-_Filter_Socks.pdf

62. (U.S. Composting Council, Research and Education Foundation, 1997)

63. (Minnesota Pollution Control Agency, 2020)

64. Detroit Water and Sewerage Department. (2020). *Drainage Charge*. City of Detroit. https://detroitmi.gov/departments/water-and-sewerage-department/stormwater-management-and-drainage-charge/drainage-charge

65. (Detroit Water and Sewerage Department, 2020)

66. Erma Leaphart of Sierra Club, Detroit, MI, personal communication, March 27, 2020

67. Detroit Water and Sewerage Department. (2019). *Seven Myths about Detroit Drainage Charge*. https://detroitmi.gov/sites/detroitmi.localhost/files/2019-08/Drainage%20Myths%20and%20Facts%20-%20Updated%20July%202019.pdf

68. (Detroit Water and Sewerage Department, 2020)

69. (Detroit Water and Sewerage Department, 2020)

70. (Detroit Water and Sewerage Department, 2020)

71. Horan, J., & Stateside Staff. (2019, February 8). *Detroit's controversial drainage fee and Michigan's struggles to fund stormwater infrastructure*. Michigan Radio. https://www.michiganradio.org/post/detroit-s-controversial-drainage-fee-and-michigan-s-struggles-fund-stormwater-infrastructure

72. (Detroit Water and Sewerage Department, 2020)

73. Detroit Water and Sewerage Department. (2020, April 20). *Green Stormwater Infrastructure Projects in Detroit*. Detroit Stormwater Hub. https://detroitstormwater.org/projects

74. (Detroit Water and Sewerage Department, 2020)

75. (Detroit Water and Sewerage Department, 2020)

76. Detroit Water and Sewerage Department. (n.d.). *Green Infrastructure Projects*. City of Detroit. Retrieved April 21, 2020, from https://detroitmi.gov/departments/water-and-sewerage-department/stormwater-management-and-drainage-charge/green-infrastructure-projects

77. (Detroit Water and Sewerage Department, n.d.)

78. Great Lakes Water Authority. (2020). *Our Combined Sewer Overflow Operations*. Great Lakes Water Authority. https://www.glwater.org/cso/

79. (Great Lakes Water Authority, 2020)

80. (Detroit Water and Sewerage Department, 2020)

81. (Detroit Water and Sewerage Department, 2020)

82. (Detroit Water and Sewerage Department, 2020)

83. (Office of Sustainability, 2019)

84. (Khalil Ligon, personal communication, March 18, 2020)

85. (Khalil Ligon, personal communication, March 18, 2020)

86. (Malik Johnson, personal communication, March 17, 2020)

87. Friends of the Rouge. (2018, April 10). *Rain Gardens to the Rescue*. Friends of the Rouge. https://therouge.org/rain-gardens-to-the-rescue/

88. (Detroit Water and Sewerage Department, 2020)

89. (Friends of the Rouge, 2018)

90. (Erma Leaphart, personal communication, March 27, 2020)

91. (Friends of the Rouge, 2018)

92. Sierra Club, Friends of the Rouge, & I Love Great Lakes. (n.d.). *Step-by-Step Guide to Planning and Planting Rain Gardens in Detroit*. Retrieved April 22, 2020, from https://vault.sierraclub.org/greatlakes/downloads/RainGardenGuide.pdf

93. (Erma Leaphart, personal communication, March 27, 2020)

94. (Erma Leaphart, personal communication, March 27, 2020)

95. (Friends of the Rouge, 2018)

96. (Erma Leaphart, personal communication, March 27, 2020)

97. (Sierra Club, et al, n.d.)

98. Detroit Water and Sewerage Department. (2018). *Fact Sheet—Post-Construction Stormwater Ordinance*. City of Detroit. https://detroitmi.gov/sites/detroitmi.localhost/files/2018-11/DWSD%20Fact%20Sheet%20-%20Post-Construction%20Stormwater%20Ordinance%20-%2011052018.pdf

99. (Detroit Water and Sewerage Department, 2018)

100. (Office of Sustainability, 2019)

101. (Bell & Platt, 2014)

102. Batjiaka, R. (2016, October 24). *Compost use by state DOTs*. BioCycle. https://www.biocycle.net/2016/10/24/compost-use-state-dots/

103. (Bell & Platt, 2014)

104. (Office of Sustainability, 2019)

105. U.S. Composting Council. (2015). *Innovative Uses of Compost by State DOTs*. U.S. Environmental Protection Agency. https://www.epa.gov/sites/production/files/2015-11/documents/highwy3a.pdf

106. (Batjiaka, 2016)

107. Detroit Building Authority. (n.d.). *Detroit Demolition Program*. City of Detroit. Retrieved March 1, 2020, from https://detroitmi.gov/departments/detroit-building-authority/detroit-demolition-program

108. (Detroit Building Authority, n.d.)

109. Stafford, K. (2019, February 11). *Was contaminated dirt used to fill Detroit demolition holes? Feds ask*. Detroit Free Press. https://www.freep.com/story/news/investigations/2019/02/11/detroit-land-bank-federal-demolition-dirt-probe-sites-across-detroit/2796355002/

110. Michael Roman-John Koschielniak of University of Michigan, Ann Arbor, MI, personal communication, April 16, 2020

111. (Stafford, 2019)

112. Whitaker, D. (2015). *Soil Stockpiles Final Report to City Council*. City of Detroit Legislative Policy Division. https://detroitmi.gov/sites/detroitmi.localhost/files/migrated_docs/legislative-policy-reports/2015%20Report%20to%20Council/Soil%20Stockpiles%20Final%20Report%20to%20CC.pdf

113. (Whitaker, 2015)

114. Ferretti, C. (2019, September 24). *Contractors named own price for Detroit demolition dirt, emails show*. The Detroit News. https://www.detroitnews.com/story/news/local/

detroit-city/2019/09/24/contractors-named-own-price-detroit-demolition-dirt-emails-show/1990005001/

115. (Stafford, 2019)

116. (Whitaker, 2015)

117. (Ferretti, 2019)

118. (Whitaker, 2015)

119. (Erma Leaphart, personal communication, March 27, 2020)

120. Faucette, B. (2012, October 25). Compost In The Green Infrastructure Tool Box. *BioCycle*. https://www.biocycle.net/2012/10/25/compost-in-the-green-infrastructure-tool-box/

121. (Faucette, 2012)

122. (Malik Johnson, personal communication, March 17, 2020)

123. Jacques, O. F. (2017, March 22). *How to Make Compost Tea*. Old Farmer's Almanac. https://www.almanac.com/content/how-make-compost-tea

124. Benny Erez of ECO City Farms, Washington, DC, personal Communication, March 27, 2020

125. Minneapolis Health Department. (2020, March 20). *Biochar*. Minneapolismn.Gov. http://www.minneapolismn.gov/environment/biochar

126. *Biochar Production*. (2020, February 7). Project Drawdown. https://drawdown.org/solutions/biochar-production

127. (Benny Erez, personal communication, March 27, 2020)

128. Hoffman-Krull, K. (2019, April 12). What's Biochar? How to Stabilize Carbon in Your Soil. *Rodale Institute*. https://rodaleinstitute.org/blog/whats-biochar-how-to-stabilize-carbon-in-your-soil/

129. Spears, S. (2018, May 16). *What is Biochar?* Regeneration International. https://regenerationinternational.org/2018/05/16/what-is-biochar/

130. (Hoffman-Krull, 2019)

131. (Malik Johnson, personal communication, March 17, 2020)

132. (Bell & Platt, 2014)

133. (Batjiaka, 2016)

134. (Office of Sustainability, 2019)

135. (Office of Sustainability, 2019)

136. (Stumo-Langer, 2017)

137. ReFED. (2016). *A Roadmap to Reduce U.S. Food Waste by 20 Percent*. ReFED.

138. (Detroit Water and Sewerage Department, 2020)

139. (Detroit Water and Sewerage Department, 2020)

PHOTO CREDITS

Introduction page image by Brian Alnutt. Found on https://planetdetroit.substack.com/p/flooding-and-covid-19-loom-over-detroits

Figure 2. House icon by Ahan Brahma. Found on https://thenounproject.com/icon/949294/

Figure 5. Icons inspired by Iowa Department of Agriculture and Land Stewardship. Found on https://www.cleanwateriowa.org/bioswale

POLICY ANALYSIS FOR COMPOSTING

ZONING AND LAND-USE IMPLICATIONS OF COMPOSTING

Zoning and land-use policies have a significant impact on communities' ability to compost. While planning and visioning are essential aspects of enabling an active composting program, having a proper regulatory structure at the state and local levels is integral. Successful regulations recognize the importance of encouraging individuals, private sector, urban farms, community groups, and nonprofits to compost and to utilize best practices to maximize the benefits of composting while minimizing any negative externalities.

Zoning and associated regulations directly impact composting by expressly providing where composting takes place within the community as well as what procedures composters must follow to compost. A well-written zoning ordinance is essential in providing clarity to composters as well as mitigating any potential nuisances (such as odor or unwanted wildlife).

We examine below the existing regulations at the state, county, and city levels that currently shape community-scaled composting as well as consider how zoning and regulations could shift to support a more enabling environment. Furthermore, this section gives some examples of how other jurisdictions around the country have successfully dealt with compost. We selected the drawn upon cases based on their unique or innovative solutions to potentially "wicked" policy problems associated with solid waste management.

COMPOSTING AT THE STATE LEVEL

At the state level in Michigan, composting operations must be aware of a number of regulations. The National Resources and Environmental Protection Act (NREPA) is the main law that governs composting and composting facilities within the state. Under NREPA we found the most relevant section to be Part 115: Solid Waste Management. Other sections of NREPA that have less direct, but still noteworthy implications on composting operations are Part 85: Fertilizers, Part 303: Wetlands Protection, Part 31: Water Resources Protection, Part 55: Air Pollution Control, and Part 24 Biosolids Rule of Part 31: Land-Application of Biosolids.

PART 115

For the purposes of Detroit and the three pilot sites chosen for this project the most relevant state-level regulations are contained within Part 115 and Part 85.

The State of Michigan's current regulations regarding composting can be found in Act 212 of 2007, which amends Part 115, Solid Waste Management, of the NREPA, 1994 PA 451 (NREPA). Facilities composting organic materials other than "yard clippings" do not need to register with the State. Composting facilities that handle 200 cubic yards or less of "yard clippings" also do not have to register under the Act. Furthermore, food scraps can be added to a compost pile without a processing permit so long as the food scraps are a source-separated material. Current regulations do not require any permits or approval from the Material Management Divisions (MMD) of site or source-separated compostable material (site or source separated material is raw compostable product that has been hand sorted for quality).[1]

Source separated materials include wood, paper products, garbage, yard clippings, or any other material approved by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) that is separated at the source of generation for the purpose of conversion into raw materials or new products. A site-separated material is a material that is separated from solid waste for the purpose of conversion into raw materials or new products at a location other than the point of generation. For purposes of determining site and source separated material, compost is considered a wholly new product from raw materials.[2] Therefore, with the exception of yard clippings, compostable material separated from other solid waste with the express purpose of creating compost is not regulated under Part 115.

In summary, the State of Michigan currently does not regulate the composting of "site or source-separated material". Further, the composting of yard clippings is regulated unless the facility handles 200 cubic yards or less of yard clippings and the compositing of the yard clippings does not cause a nuisance. As it currently stands, Part 115 does not adequately address composting within the State. Part 115 regulates facilities processing small amounts of yard clippings, which prevents wider adoption of composting. Concurrently, Part 115 does not regulate the composting of "site" and "source separated" material regardless of size. This language has the potential to create nuisances damaging to communities and thereby also contributing to the prevention of wider adoption of composting due to the stigma unregulated facilities could bring to composting. In an effort to address both of the above concerns various state actors have come together in an attempt to amend Part 115. The proposed amendments to Part 115 will be addressed below.

PART 85

The State of Michigan's current regulations regarding fertilizers can be found in Part 85 of NREPA. An important aspect of Part 85 is that it preempts any local ordinance except under narrow conditions. Part 85 implicates composting operations that are currently selling or plan to sell compost. Compost can be considered either a "soil conditioner" or a "fertilizer." The distinction between the two hinges on whether individuals selling the compost make claims about the products' nutrient value. For example, if a product claimed to improve the nutrient composition of soil (i.e. adding more nitrogen), it would then be a fertilizer. Whereas if a product which claims it improves soil properties; (i.e. exchange capacity, soil pH, water holding capacity, or soil compaction), it would be a soil conditioner.[3] If claims are made about a product's nutrient value, then it is considered a "fertilizer" under Part 85 and is subject to licensing, registration, and labeling requirements. If no claims are made about the composts' nutrient content, it is considered a "soil conditioner" and is subject to registration and less stringent labeling requirements.[4]

The costs associated with a product being considered a fertilizer are greater than those associated with being a soil conditioner. Due to the increasing overhead costs of marketing a compost product as a fertilizer, local composters must carefully consider the claims they are making about the product. Furthermore, those selling compost should become intimately familiar with Part 85 as violations of this regulation carry fines ranging from $1,000 (for a violation or attempted violation) to $25,000 (for malicious violations) and potential criminal liability in the form of a misdemeanor punishable by up to 90 days in jail.[5, 6]

PART 303

The authority for the state to regulate wetlands is contained within Part 303 of NREPA. Part 303 governs and reviews permits for activities proposed in regulated wetlands including dredging, filling, draining surface water, or constructing, operating or maintaining any use or development in a wetland. If a composter wanted to conduct operations in a regulated wetland, they would first have to obtain a permit from EGLE. None of the pilot sites in this project are on regulated wetlands.[7]

PART 31

Part 31 of NREPA regulates wastewater discharge into the waters of the state. The two sections of Part 31, which implicate the discharge of compost wastewater are Section 324.3109(1) and Section 324.3112(1). Section 324.3109(1) prohibits any direct or indirect discharge of a substance into the waters of the state which could injure or damage public health, safety, or welfare. It also prohibits the discharge of any substance which could harm the value of land, its recreational capacity, or injure plants and wildlife. Section 324.3112(1) prohibits discharge of wastewater into waters of the state unless a valid permit from EGLE is obtained.[8]

In summary, controlling run-off from compost piles is essential for all levels of composting facilities. Therefore, unless a community composter wants to go through the permitting process to allow discharge into waters of the state, site conditions must be carefully controlled to prevent wastewater from the composting operation being discharged.

Part 24: Biosolids Rule of Part 31

Biosolids are the solid remnants of wastewater that have been treated at wastewater treatment plants. These solids contain plant nutrients and can be added to soil as fertilizer of soil amendments. None of the current study sites for this project utilize biosolids, however biosolids could potentially be added to composting operations. However, under the proposed amendments to Part 115 of NREPA biosolids would

be considered a Class 2 material and therefore a "Restricted Use Compost."[9] Therefore, using biosolids would subject community-based composters to state oversight. The regulations surrounding the use of biosolids can be found in Part 24 Biosolids Rule of Part 31 of NREPA.[10]

PART 55

Part 55 of NREPA deals with air pollution, specifically the emissions of specific contaminants into the atmosphere. Emitting criteria pollutants above certain thresholds requires a permit from EGLE. Community composting projects (including the three pilot sites being referenced in this project) are unlikely to emit criteria contaminants at the level that would require permitting. However, it is important to be generally aware of Part 55 in case operations continue to grow beyond relatively small community-based operations.

PROPOSED STATE AMENDMENTS TO PART 115

EGLE is currently in the process of proposing a comprehensive overhaul of Part 115 of NREPA. The proposed legislation makes several changes to how compost will be regulated throughout the state. The main takeaways from the proposed legislation that will affect community decentralized composting including the following:

Compostable material will be broken up by class. The proposed amendment creates 2 classes of material.

- **Class 1 includes:** Yard waste, wood, food scraps, paper products, manure or animal products, compostable products, dead animals unless infectious or subject to certain restrictions, spent grain from breweries, paunch, food processing residuals, other material approved by the department, and a mix of the above.
- **Class 2 includes:** Mixed municipal solid waste, biosolids, State of Federal controlled substances, and all other compostable material not listed or approved as a Class 1 material.
- **Source-separated material** will be regulated. Food scraps and yard clippings are included in the same class, as is animal waste such as manure.
- **The amount of compostable material** allowed before having to be registered and regulated with the state will be 500 cubic yards. This is both an increase in the amount of compostable material an operation can handle (regarding yard clippings, which was previously 200 cubic yards) and a decrease in the amount of compostable material allowed (regarding source-separated material, including food scraps, which was not regulated at all under the original regulation).[11]

The proposed amendments are meant to encourage greater adoption of composting while also minimizing issues created from large unregulated facilities that deal in composting source-separated materials.

THE PROBLEM WITH LANDFILL TIPPING FEES

While not directly related to composting policy within the state, landfill tipping fees do have a large impact on composting in Michigan. Currently, Michigan has one of the lowest tipping fees in the nation and the lowest in the Great Lakes basin.[12] Low tipping fees encourage dumping in landfills as any alternative will cost more money. In our interviews with state level policy makers they indicated low tipping fees as a barrier to the wider adoption of composting.[13]

LEARNING FROM OHIO COMPOSTING REGULATIONS

Ohio has a clear and thought out compost policy at the state level and also offers guidance to local jurisdictions on how to encourage composting through zoning while still minimizing potential

nuisances. The Ohio Environmental Protection Agency has established administrative rules for facilities that compost solid waste. Those rules state what types of waste can be composted and where that compost can be used. In 2018, Ohio amended their statewide regulations to make it easier for community gardens and urban farms to compost.[14]

Ohio EPA crafted a composting exclusion (much the same way Michigan has done and will potentially expand upon in the proposed amendment of Part 115). Under this exclusion, Ohio will not regulate "any person composting yard waste, agricultural waste, animal waste, food scraps, bulking agents, and additives within an aggregate area not greater than five hundred square feet on any premises in a manner that noise, dust, and odors do not constitute a nuisance or health hazard and does not cause or contribute to surface or groundwater pollution."[15] If a community garden or urban farm composts on an area greater than 500 square feet they must comply with Ohio EPA regulations.[16]

Michigan's proposed amendments to Part 115 closely mirror Ohio EPA's composting policies. Both divide waste material into classes which informs which regulatory bucket a facility is subject to depending on the material they handle, and both are mindful of wanting to encourage smaller community based composting operations. The most significant difference between the two from a local community composting perspective is that they differ in the size an operation can reach before they are regulated by the state. Both Michigan's current policy and the proposed amendment to Part 115 allow for composting operations to reach greater sizes before they are regulated by the state.

NREPA Natural Resources and Environmental Protection Act

PART 31
Water Resources Protection

PART 85
Fertilizer

PART 55
Air Pollution Control

PART 24
Land Application of Biosolids

PART 115
Solid Waste

PART 303
Wetlands protection

Figure 1. Michigan State lesgislation (National Resources and Environmental Protection Act, 1994 PA 451, 1995).

COMPOSTING AT THE COUNTY LEVEL

The Wayne County Solid Waste Ordinance is meant to supplement provisions of Part 115 of NREPA. Compost is defined in the ordinance as "the process by which biological decomposition of solid waste is carried out under controlled aerobic conditions and which stabilizes the organic fraction into a material that can easily and safely be stored, handled and used in an environmentally acceptable manner. The presence of insignificant and anaerobic zones within the composting material will not cause the process to be classified as other than composting." The ordinance defines Composting Facility as a "facility where composting of yard clippings or compostable material occurs using composting technology. Composting technology may include physical turning, windrowing, aeration, or other mechanical handling of organic matter." The ordinance defines Yard Clippings as "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."[17] Wayne County's solid waste ordinance regulates composting facilities that meet state requirements for facilities that need to be regulated.[18] However, as written, the county would have the ability to regulate all composting facilities regardless of size.

Section 235 of the ordinance establishes the requirements and procedures for operating composting facilities within the county. Section 235.6 deals specifically with composting facilities, however composting facilities must comply with the rest of section 235 as well as section 200 and 210. Section 235.6 contains the following provisions:

- "The site shall be graded at a minimum 1 percent slope to minimize ponding of water, maintain flow in the direction of drainage collection ditches, and direct flow away from the composting material.
- The working areas of the site shall be compacted, graded and/or ditched to prevent contaminants from exiting the site via surface water or groundwater.
- Roll-off boxes, or similar waste containers, containing wastes not suitable for composting, shall be moved off site on a weekly basis, or more often as necessary to prevent nuisance conditions.
- The operator shall provide adequate size and quantity of equipment on site and shall provide for its routine operational maintenance.
- Finished compost shall be kept clearly separated from incoming yard clippings and unfinished compost for proper delineation of materials.
- Access shall be limited to times when a responsible individual is on duty. A notice stating the days and hours of operation shall be conspicuously posted at the entrance to the facility.
- Any leachate generated during mixing or composting shall be:
    - Collected and reintroduced into the compost pile;
    - Directed to a sanitary sewer if a permit is obtained from the sewer agency;
    - Directed to a storm sewer or natural water course if an NPDES permit is obtained;
    - Transported by a liquid industrial waste hauler who is properly licensed under the Michigan

Liquid Waste Haulers Act; or

- Handled in any other manner approved by the Division.

- A site-specific written plan shall be developed and followed for the operation of the composting facility, and shall include temperature and moisture contents of the compost piles.
- A contingency abatement plan shall be developed to provide for a malfunctioning operation. The plan shall, at a minimum, specify all of the following:
  - Identification of supervisory personnel responsible for putting the abatement plan into action;
  - Mechanism by which an offending odor source, contaminant runoff, or other malfunction will be eliminated;
  - Method by which new incoming material will be halted or handled; and
  - Criteria and method by which routine operations will be recommended."[19]

As stated above, the county regulation only serves to supplement Part 115 of NREPA and therefore does not contain any prescriptions about what can or cannot be composted. However this does not necessarily need to be the case as other counties in the country do take on a more active regulatory role.

LEARNING FROM ALAMEDA COUNTY, CA

Alameda County, located in northern California, takes a more active role in solid waste regulation, including compost. Alameda County effectively forces composting to occur within its jurisdiction as the Alameda County Waste Management Authority Plant Debris and Landfill Ban Ordinance 2008-01 requires the separation of all plant debris from garbage. The law applies to:

- Commercial and Institutional (e.g. colleges, hospitals, park districts, golf courses) customers subscribing to four or more cubic yards of weekly solid waste collection service.
- Landscapers and gardeners.
- Municipalities.[20]

The plant debris ban extends to all cities and unincorporated areas in the county. Through regulations such as the plant debris ban and its partnership with agencies dedicated to waste reduction, Alameda County has reduced the amount of waste it sends to landfills by 75%.[21]

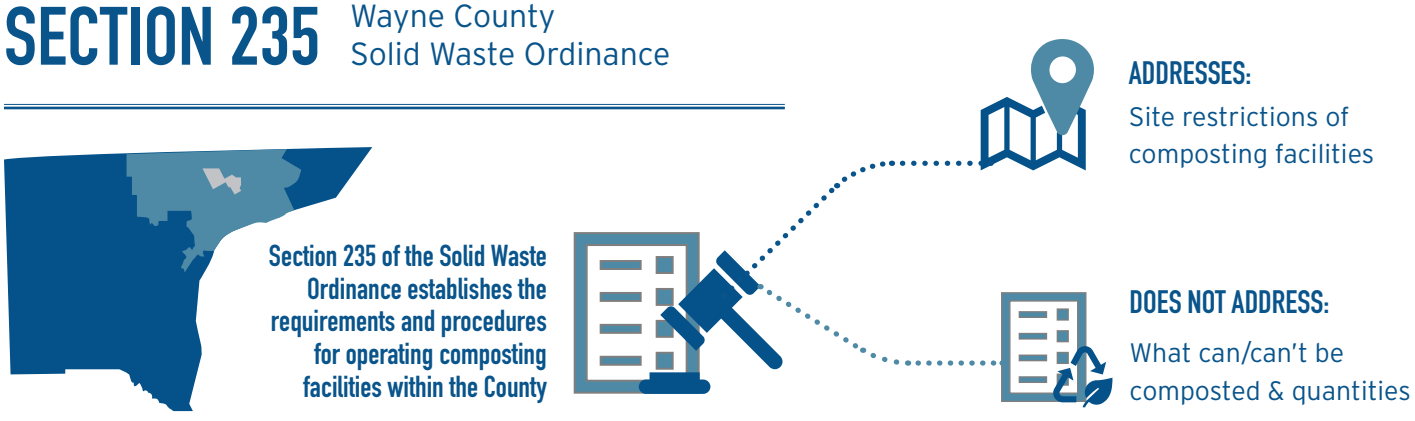


Figure 2. Section 235 of Wayne County legislation (Wayne County Solid Waste Ordinance, No. 2004-787, 2004)

COMPOSTING AT THE CITY LEVEL

Detroit deals with composting in its municipal code's zoning ordinance. The Code defines compost as a "Relatively stable decomposed organic matter for use in agricultural and other growing practices, usually consisting of materials such as grass, leaves, yard waste, worms, and also including raw and uncooked kitchen food scraps, but specifically excluding bones, meat, fat, grease, oil, raw manure, and milk products."[22] The current definition of compost does not match with the definitions given for the classification of material in the proposed amendments to Part 115 *(See Proposed Amendment to Part 115 section).*

The difference in definition could result in confusion from community-based composters who are determining what is and is not allowed to include in their compost piles. In the current code compost is considered a waste-related use and, therefore, can only be done, as of right, in industrial zoned areas.[23] The Code also allows compost as an accessory use in an urban garden or farm, but, due to its classification as an accessory use, composters cannot accept materials that were not generated on their own property, and cannot sell or allow the compost generated on their property to be used elsewhere.[24]

The Code also gives guidance for how a composting operation site needs to be laid out. The Code states that compost "must be located as close as is practicable to the rear crop setback (five (5) feet from the property line) and at least twenty (20) feet from the nearest principal residential structure."[25]

Currently, the Code does not adequately deal with compost and does not allow decentralized composting as it defines the manufacture/production of compost as a waste-related use rather than an agricultural-related use, which severely limits the areas of the city such sites could exist. Under the current Code each of our pilot sites would be forbidden from conducting a composting operation as none are in industrial-zoned areas.

Enforcement of municipal codes, whether zoning, health, or otherwise can be a monumental challenge for local governments. Careful pre-meditated allocation of resources is often essential for maximizing services, which has led to the prevalence of "complaint-driven enforcement" models in most municipal structures. This model relies on digital constituent services like 311 or ClickFix in order to efficiently deploy inspectors or other city service providers. In the case of compost, there are numerous reasons why city and state enforcement would be important. Failure to abide by zoning regulations, physical construction guidelines, or proper upkeep techniques can lead to undesirable impacts on nearby

City of Detroit Zoning Code

Section 61-16-131 of the current code defines compost as a waste-related use

Figure 3. Current definition of composting as per City legislation (Detroit Zoning Code, § 61-16-131, 2012)

properties. By integrating compost specific services into these digital service platforms, municipalities can effectively apply complaint-driven enforcement practices to burgeoning urban composting programs.

LEARNING FROM THE CITY OF CHICAGO

In 2015 Chicago amended its compost ordinance to allow community gardens and urban farms to accept and compost food scraps and other organic waste that was generated off-site.[26] The ordinance has different requirements depending on whether a site is a community garden or urban farm. For gardens to accept off-site compostable material they have to register with the city. The registration for community gardens is free. Gardens who accept off-site compostable material are considered Tier 2 garden compost operations and have to submit to the following requirements:

- Storing waste in containers at the end of the day if it is not immediately incorporated into the composting system.
- Registration of the garden by April 1 each year at Chicago Urban Agriculture Mapping Project (CUAMP) website.
- Record-keeping of the inputs into the compost pile as well as turning and other upkeep.
- Following best practices to minimize odor and pests. The Chicago Ordinance specifically lays out composting standards that must be followed in section 7-28-715.
- Composting operation can be no larger than 10 cubic yards (or 25 cubic yards with permission of Streets and Sanitation).[27]

If a site is an urban farm they can either follow the same requirements as a community garden, or submit to additional requirements if they want to compost on a larger scale. Urban farm composting permits have the following requirements:

- Must get a permit from the city ($300/3 years).
- Can take any type of organic waste as the permit allows.
- Operation can be no larger than 2% of the property.
- No tipping fee is allowed (A hauler can be paid to pick up material, but a farm cannot be paid to accept material).
- Can sell finished compost, but must comply with all applicable performance standards and testing procedures for end-product compost produced by compost facilities.
- There is a 150 foot setback from residential properties required and also a record-keeping requirement.
- All waste must be processed or contained in a covered steel or rigid plastic container by the end of the day, whether generated on-site or off-site.[28]

The Chicago ordinance is a good example of how a city can encourage compost, by making it legal and allowing it to be sold, while also minimizing nuisances. Decentralized composting in Chicago, by having this regulatory structure in place, has the potential to divert 27% of residential food scraps.[29] Having proper policy in place will allow the City of Chicago to divert a significant portion of their waste from landfills. Given that Chicago is more dense, the Detroit ordinance can allow for larger community composting operations within the city, potentially diverting a larger portion of food scraps.

CONCLUSION

LESSONS LEARNED FROM INTERVIEWS

To complement our review of state, county and local regulations affecting compost operations and our comparison with case srudies, we also conducted interviews with several people from various levels of government. These interviews aided in our understanding of compost policy at the state, county, and city level. The interviews also helped inform the policy recommendations shown below. The policymakers that we spoke to emphasized several key policy measures that should be pursued including: Coordinating between levels of government, including best management practices in regulations (specifically laying out what materials and in what volumes should be present on the site, isolation distances from residences, and appropriate barriers to mitigate odors, run-off, and visual nuisances), and ensuring compost operators and inspectors receive baseline training.

STATE - LEVEL RECOMMENDATIONS

On a statewide level there are several recommended action steps that can be taken.

- Communicate with municipal officials at county and city levels when finalizing the amendments to Part 115 to ensure that the regulations at the county and city levels do not contradict state regulations.[30]
- Propose model ordinances communities can adopt (as Ohio EPA does).[31]
- Work to match definitions of composting and composting material/categories across state, county, and city-level ordinances.[32]
- Increase landfill tipping fees to make composting more financially feasible and competitive.
- Implement state-level training that county and city inspectors can attend in order to have consistent enforcement across jurisdictions.[33]
- Team up with county and city officials and community leaders to educate citizens on the benefits of compost and problems associated with relying too heavily on landfills.[34]

COUNTY - LEVEL RECOMMENDATIONS

There are several considerations Wayne County should keep in mind when evaluating and drafting a new solid waste ordinance:

- Wayne County should continue to work closely with the state regarding the language of the proposed amendments to Part 115. This way Wayne County can ensure that state-level legislation will be able to function in tandem with future revisions to the county's solid waste ordinance.
- When the county amends its solid waste ordinance, it should comport its definitions with that of Part 115 of NREPA. This could be as simple as including a paragraph in an amended ordinance which states that Wayne County adopts the same definition and classes for compostable material. While it may be legally redundant, as the county will enforce state requirements, it will serve to avoid confusion from would be composters who are determining what regulations they need to

follow. Making the various levels of regulation as simple for people to understand as possible will avoid discouraging potential community composters.

- The county should consider taking a more active role in encouraging compost, such as banning specific compostable material from landfills located in the county.

CITY - LEVEL RECOMMENDATIONS

Based on our research, we have the following recommendations for the City of Detroit.

- Change the classification of compost from a waste-related use to an agriculture-related use, which would allow for composting to be done throughout the city.[35] This would not limit the actual use of the finished compost, rather it is a use classification which would allow composting to be carried out in more areas of the city than currently allowed. Furthermore, the use classification would not restrict composting to only urban farms or gardens; as stated previously the use classification dictates only where composting operations can be located.
- Match the definition of compost and the classification of compostable material with the proposed amendments to Part 115.[36] This recommendation is similar to the recommendation we gave to Wayne County regarding matching their definitions with the state.
- Determine appropriate isolation distances of the composting site to residential properties.[37,38] While the Code does already contain setback requirements *(See Composting at the City Level)*, these requirements were made with the understanding that composting could only be done in industrial areas or as an accessory use to urban farms and gardens. When expanding the legality of composting, Detroit should re-evaluate appropriate isolation distances for compost considering its more widespread use.
- Determine the amount of compostable material a site can utilize at any given time (this can either be based on a percentage of the overall property size or a predetermined amount).
- Require a barrier (e.g. wall, fence, natural fence) around the compost piles to reduce visual nuisance, and unwanted wildlife (See *Best Management Practices* Section).

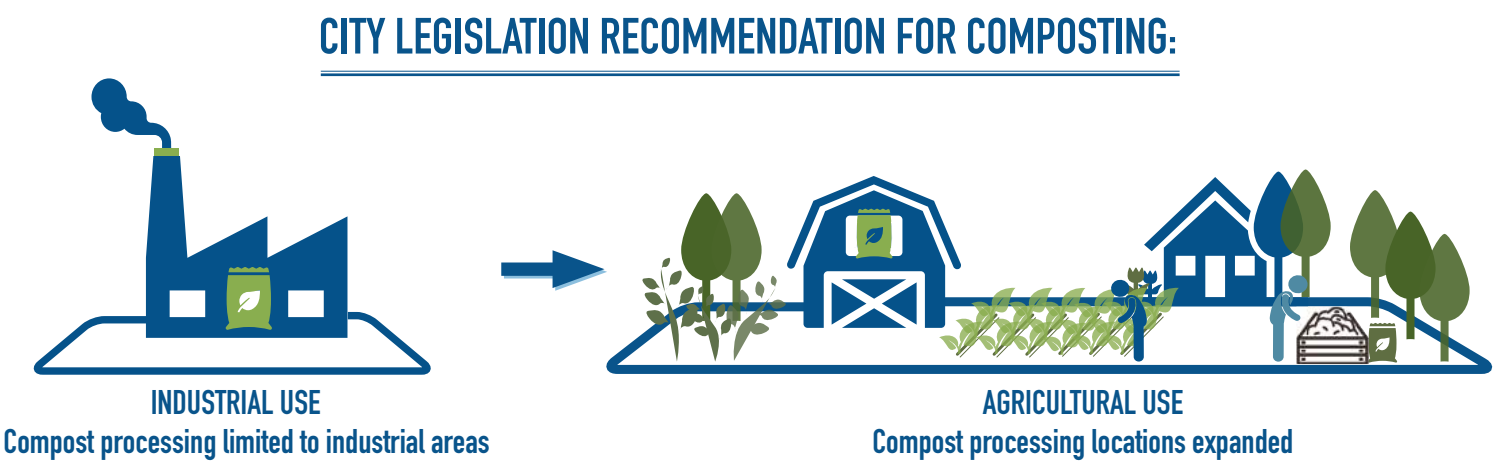


Figure 4. Recommendation for City of Detroit Legislation

- Require registration (either free or a nominal fee) with the city so that the city can ensure compliance and track waste reduction.
- Allow for compost to be sold so long as it follows state requirements.
- Consider requiring that each site have enough carbon on the site to rectify any odors coming from excess nitrogen.[39]
- Require compost site operators to attend training in best practices.[40]
- Ensure inspectors are knowledgeable about best practices for compost and urban agriculture.[41]

ENDNOTES

1. National Resources and Environmental Protection Act, 1994 PA 451, Solid Waste Act part 115, Mich. Stat. § 324 (1995) http://www.legislature.mi.gov/(S(f1kcdsu5vqlqzzh0d1fbxtvg))/mileg.aspx?page=GetObject&objectname=mcl-451-1994-II-3-115

2. (Solid Waste Act part 115, § 324)

3. National Resources and Environmental Protection Act, 1994 PA 451, Fertilizers Act part 85, Mich. Stat. § 324 (1995) http://www.legislature.mi.gov/(S(m1sr40lruvgq5uwkjamxyn4z))/mileg.aspx?page=getObject&objectName=mcl-451-1994-II-2-85

4. (Fertilizers Act part 85, § 324)

5. (Fertilizers Act part 85, § 324.8520(2))

6. (Fertilizers Act part 85, § 324.8520(6))

7. National Resources and Environmental Protection Act, 1994 PA 451, Wetlands Protections Act part 303, Mich Stat. § 324 (2013) http://www.legislature.mi.gov/(S(wucxstqzvrrhe5juk2j3opur))/mileg.aspx?page=getObject&objectName=mcl-451-1994-III-1-INLAND-WATERS-303

8. National Resources and Environmental Protection Act, 1994 PA 451, Water Resources Protection Act part 31, Mich Stat. § 324 (1995) http://www.legislature.mi.gov/(S(gvolauiqk2wpmdigflhube44))/mileg.aspx?page=getObject&objectName=mcl-451-1994-II-1-31

9. Draft Bill to Amend National Resources and Environmental Protection Act, Solid Waste Act Part 115 of NREPA, § 324.11505(7) (2019) https://www.michigan.gov/documents/egle/egle-mmd-swra-2019part115amendmentsdraft1_661852_7.pdf

10. National Resources and Environmental Protection Act, 1994 PA 451, Water Resources Protection Act part 31, Biosolids Rule part 24, Mich. Admin. R. 323 (1999) https://www.michigan.gov/egle/0,9429,7-135-3313_71618_3682_3683_3720-9615--,00.html

11. (Draft Bill to Amend Solid Waste Act Part 115, § 324)

12. Li, R. (2018, December). *Michigan Governor's recycling plans fall short as term expires*. Retrieved from WASTEDIVE. https://www.wastedive.com/news/tip-fee-increase-michigan-governor-rick-snyder/543197/

13. Matt Flechter of the Michigan Department of the Environment, Great Lakes, and Energy, Lansing, MI, personal communication, January 15, 2020.

14. Ohio Environmental Protection Agency Division of Materials and Waste Management. (2018, November). *Urban Agriculture, Composting and Zoning*.(pp. 3). Columbus: OH: Author.

15. Ohio Administrative Code, Rule 3745-560-001 (D)(2) (2018) http://codes.ohio.gov/oac/3745-560.

16. (Ohio Environmental Protection Agency Division of Materials and Waste Management, 4)

17. Wayne County Solid Waste Ordinance, No. 2004-787 (2004) https://www.waynecounty.com/departments/environmental/landresources/solid-waste-technical.aspx

18. Patrick Cullen of Environmental Services, Wayne County, MI,

personal communication, March 4, 2020.

19. (Wayne County Solid Waste Ordinance, No. 2004-787)

20. Alameda County Waste Management Act Plant Debris and Landfill Ban, No. 2008-01 (2008) http://www.recyclingrulesac.org/docs/Landfill-Ban-WMA-Ordinance2008-01.pdf

21. Alameda County. (2019). Sustainability. Retrieved from Alameda County website: https://www.acgov.org/sustain/what/recycling/index.htm

22. Detroit Zoning Code, § 61-16-53 (2012) https://detroitmi.gov/Portals/0/docs/cpc/pdf/Urban%20Ag%20Ordinance.pdf

23. (Detroit Zoning Code, § 61-16-131)

24. (Detroit Zoning Code, § 61-16-412)

25. (Detroit Zoning Code, § 61-16-338)

26. Advocates for Urban Agriculture. (2018). *Compost Ordinance Overview and FAQ Sheet*. Retrieved from https://auachicago.org/wp-content/uploads/2018/07/Compost-Ordinance-Overview.pdf

27. Chicago Municipal Code, § 7-28-715 (2015) https://www.chicago.gov/content/dam/city/depts/doe/general/RecyclingAndWasteMgmt_PDFs/Composting/Ordinance92607_3.pdf

28. (Chicago Municipal Code, § 7-28-715)

29. Pai, S., Ai, N., Zheng, J. (2019). Decentralized Community Composting Feasibility Analysis for Residential Food Waste: A Chicago Case Study, *Sustainable Cities and Society*, 50, doi:10.1016/j.scs.2019101683.

30. Suerth, L. (2016). Urban Agriculture: Composting. In A. Morales, J.C. Dawson (Eds.), *Cities of Farmers: Urban Agricultural Practices and Processes* (pp. 97-98). Iowa City, IA: University of Iowa Press.

31. Ohio Environmental Protection Agency Division of Materials and Waste Management. (2018, November). *Urban Agriculture, Composting and Zoning*. Columbus: OH: Author.

32. (Suerth, 97-98)

33. Malik Johnson of the Buildings, Safety Engineering and Environmental Department, Detroit, MI, personal communication, March 17, 2020.

34. Aaron Hiday of the Michigan Department of the Environment, Great Lakes, and Energy, Lansing, MI, personal communication, March 5, 2020.

35. (Suerth, 98)

36. (Suerth, 97-98)

37. (A. Hiday, personal communication, March 5, 2020)

38. (P. Cullen, personal communication, March 4, 2020)

39. (A. Hiday, personal communication, March 5, 2020)

40. (M. Johnson, personal communication, March 17, 2020)

41. (M. Johnson, personal communication, March 17, 2020

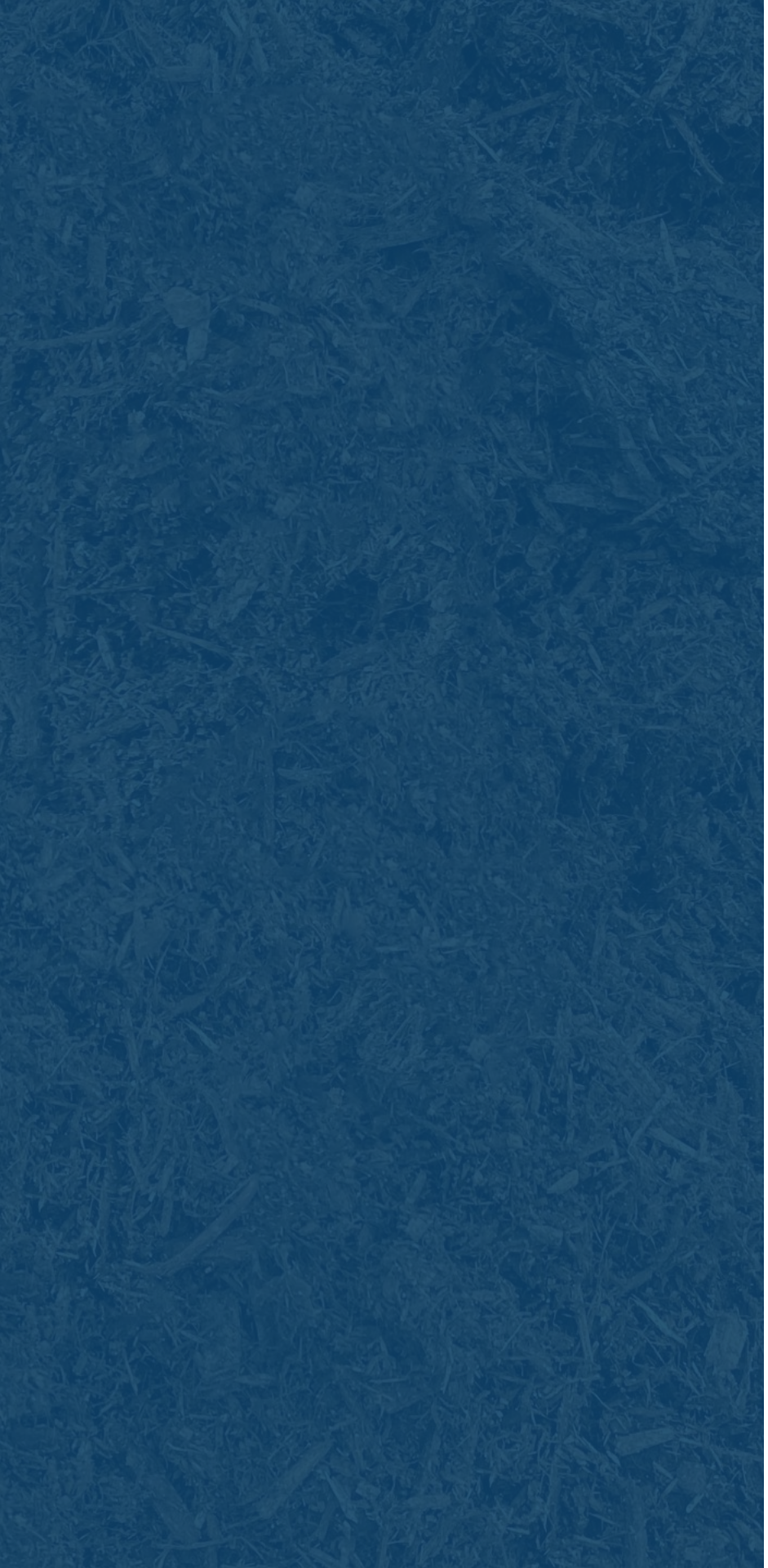
PHOTO CREDITS

Part II Policy Analysis for Composting cover page image from Google Earth Pro, 2020

Figure 4. Compost bin icon by Grégory Montigny. Found on https://thenounproject.com/search/?q=compost&i=1974965

COMPOST MARKET & COMMUNITY

STEPS TOWARDS A CLOSED-LOOP SYSTEM



INTRODUCTION

While composting organizations are often motivated by environmental goals and desires to cultivate community, they are aware that to sustain their missions, they must leverage compost as a revenue source to survive financially.

This section starts with an overview of the types of compost products and compost by-products that can be sold, the industries and target populations that could be interested in purchasing these products, and market strategies for these products. We then offer a spatial market analysis of potential compost buyers and sellers specific to the Detroit area, discuss the nuances of pricing compost, and outline financial considerations for a compost operation. We end by illustrating the power of compost in uniting communities, local partnerships, and strengthening communities – even as it helps to sustain organizations financially.

COMPOST PRODUCTS, BUYERS, AND MARKETING

COMPOST PRODUCTS

Compost and compost by-products are sold within a growing market, especially as climate change, environmental degradation, and waste management increasingly become chief concerns of governments and organizations worldwide.[1] Compost can be sold as a soil amendment, topsoil, potting mix, mulch, compost tea, and more. A soil amendment is any substance added to soil altering the chemical or physical characteristics of the soil.[2] Compost can be mixed into the soil, forming a cover from sun exposure and giving the soil beneficial nutrients and better water storage capability.[3] Potting mix is a combination of natural ingredients, of which compost is a predominant one, and provides a nutrient boost to plants.[4] Mulch is a layer of composted wood chips, yard waste, straw, cardboard, or newspaper and works to increase water absorption while limiting soil erosion and degradation.[5] Compost tea was previously defined and shown its value in the previous section, *Physical Infrastructure and the Environment.*

POTENTIAL BUYERS

A variety of industries and target populations use compost or compost by-products. Retail landscaping and gardening industries; state, county, and municipal government departments; construction companies; and the agricultural industry are some but not all of the industries that have practical applications for compost. Community residents, local professional landscapers or gardeners and the growing cannabis industry are others (see *Table 1*).[6, 7] For example, a Parks and Recreation Department may use compost for building stormwater and green infrastructure for a municipal park.[8] A landscaper may use compost for a topsoil amendment.[9] And a farmer or community gardener may apply compost to soil replacing synthetic fertilizer, improving the soil's ability to hold water and transforming toxic soil into opportunities to grow food.[10]

MARKETING STRATEGIES

Market research is required to determine the types of compost products your composting operation could sell and the specific buyers to target. As the U.S. Small Business Administration says, "you can't be successful selling in or to a market you don't understand." A marketing firm can formally do market research, or you can do it informally by asking and surveying.[11] If you have the means, a survey or questionnaire are great ways to provide valuable baseline research data. The U.S. Small Business Administration recommends market research done within a "Segmentation Targeting and Positioning (STP) and Stakeholder Analysis" model. The STP and Stakeholder Analysis model is further explained in Box 1.

One example of successful market research is with Rust Belt Riders, a food scrap collection service in Cleveland, Ohio, where they discovered that the local cannabis industry could buy and use a compost mixture that created suitable growing conditions for cannabis.[12] Rust Belt Riders expanded their compost community through a needed marketable product. The Cleveland cannabis community now knows who they are and their role in the community. Expanding compost production also creates new community ties that bring in additional revenue to community-based compost operations and support their environmental mission.

Regardless of the mix of target populations that make the most sense for a particular location and community compost operation, a multifaceted market strategy can ensure the successful selling of compost (see *Table 2*). Much like Rust Belt Riders did, building community relationships and advertising compost products via word of mouth is one of the most successful strategies for selling compost.[13, 14, 15]

Table 1. Example Target Populations and Associated Marketing Benefits and Challenges

Target Population	Benefits	Challenges
Community residents looking to garden or do home landscaping	• Easy to reach • If environmentally-conscious can be incredibly supportive and helpful	• May not understand what compost is and how it is used, therefore it is important to pair marketing efforts with educational awareness[16]
Landscapers or professional gardeners	• Greater profit opportunity	• Requires equipment to deliver large amounts of compost to landscaper or professional gardeners, unless they can pick up the compost • Requires there to be a large surplus of compost to sell[17] • These companies may have a compost source already
Cannabis industry	• Marijuana requires rich soil • Recreational marijuana was legalized in Michigan in late 2019, as was home cultivation, stimulating a major economic growth opportunity	• Requires establishing relationships with a specific audience
Community gardens and urban farms	• Detroit has a strong urban agriculture movement	• May already have their own compost production

THE STP & STAKEHOLDER ANALYSIS MODEL

1. **"Segmentation**
   Separating customers into categories to determine what segment is best for the business offerings. Customers can be separated by demographics such as gender, age, income, education levels, location, beliefs, spending habits, and so on.

2. **Target Markets Identification**
   Identify who uses your product and whether your product/service fits a definable segment or segments of the market. You might be able to target different segments with different products, or one product may have a primary target market and a secondary target market. If your product/service does not fit a definable segment of the market, you might reevaluate your product or service to determine whether it can be tailored to match a specific target market.

3. **Positioning**
   Decide how to position your business through effective messaging: Say the right things about your product to the right people in a way they understand. A best practice is to draft a 'segmentation profile' for your ideal customer, including name, age, occupation, likes, dislikes, etc. This personalizes your target market and helps you create compelling messaging.

4. **Stakeholder Analysis**
   A stakeholder is anyone affected by what your business does and the health of your business. It is important to identify which stakeholders are the most important to you, your values, and the health of your business because you cannot meet all of the diverse needs of all stakeholders. Keep these prioritized stakeholders in mind when making day-to-day and long-term strategic decisions."[18]

Table 2. Common Marketing Strategies and their Benefits and Challenges.

Market Strategy	Benefits	Challenges
Word of Mouth	• Accessible • Wide-reaching • Can spread quickly • Cost-effective	• Success is partially determined by network size • Quality and quantity of established relationships • Connections to key influencers in the community • Negative reviews spread just as fast as good reviews
Flyers	• Can reach non-member populations by posting in a variety of public spaces	• Printing costs • Physical labor of distributing flyers at various locations
Local Newspaper Ad	• Reaches a variety of age demographics • Widespread in the community	• Printing Costs • Coordinating Efforts with local newspapers
Website	• Easy to update • Low cost	• Physical labor of updating website • Primarily reaches those who already know of the farm • Needs to be easy to find on the site • Requires maintenance • Requires knowledge of web design • Negative reviews spread just as fast
Social Media	• Accessible • Wide-reaching	• Time intensive • Staff intensive • Reaches specific audiences, those with smart phones and those with the particular social media outlets
At Farm Location (i.e. advertising via signs, pamphlets, or verbally)	• Convenient for farm staff	• Primarily reaches those who already know of the farm • You must be at the farm to see it

METRO-DETROIT COMPOST MARKET ASSESSMENT

The Metro-Detroit region has great potential as a market for community-scaled compost. The City of Detroit, for instance, has several potential bulk purchasers of compost: Parks and Recreation, Public Works, Horticulture, and Forestry. Outside of municipal departments' private construction, landscaping, and gardening industries also use compost daily, and should be considered potential purchasers. Wayne County is interested in buying large amounts of compost for their county-level landscaping and land-use projects.[19] On smaller scales, urban farms and gardens, residential gardens, school gardens, and non-profit organizations are potential compost purchasers. In 2013, the Detroit Water and Sewage Department (DWSD) purchased compost for the implementation of the Green Stormwater Infrastructure Plan for the Upper Rouge Tributary Area.[20] The plan invested $15 million in green stormwater infrastructure to reduce 2.8 million gallons of stormwater flow. By 2029, DWSD plans to invest a total of $50 million towards the project.[21] Based on the previous discussion in the *Physical Infrastructure and Environment* section, it is likely that the compost already used for this project came from outside the City. This example is one out of many illustrating Detroit's desire to buy compost, some of which we believe community composting operations could provide.

To assess a portion of the more visible, institutionalized compost market in metro Detroit, we searched websites to identify current institutional compost buyers and sellers. We defined a compost seller as a firm that listed compost as a product they sold. Thirty-two compost sellers were identified in the Metro-Detroit area, a mix of nurseries, gardening, and landscaping firms. A firm was considered a potential compost buyer if they were a landscaping firm, garden center, or farm that did not list compost as a product they produced and/or sold. There are likely many more potential buyers than were noted above, as well as likely sellers that did not emerge in our research. Thirty-five firms in Detroit met the criteria as potential compost consumers; twenty-three of which are landscaping firms, two garden centers, and nine farms.

When considered in relation to two of our study sites – Oakland Avenue Urban Farm and Georgia Street Community Collective – where composting operations are already under way or slated to begin (see *Section IV* to learn more about each site), approximately 70% of the firms identified as consumers of compost are located within a 8.5 mile radius, or within a 10 minute drive with a 50 mph speed limit, (see *Figure 1*). In comparison, approximately 30% of firms identified as sellers of compost were within this same radius (see *Figure 1*). Landscaping firms that sell compost may be bigger firms that require larger land parcels than can be found in the City of Detroit, or they may cater to the Metro-Detroit region rather than the City of Detroit. The spatial mismatch signifies that there is a market opportunity for Oakland Avenue Urban Farm and Georgia Street Community Collective, and other community-based compost operations that may arise to sell compost to the nearby consumer firms within the City of Detroit. In short, the locally produced compost and close spatial distance offers a market advantage.

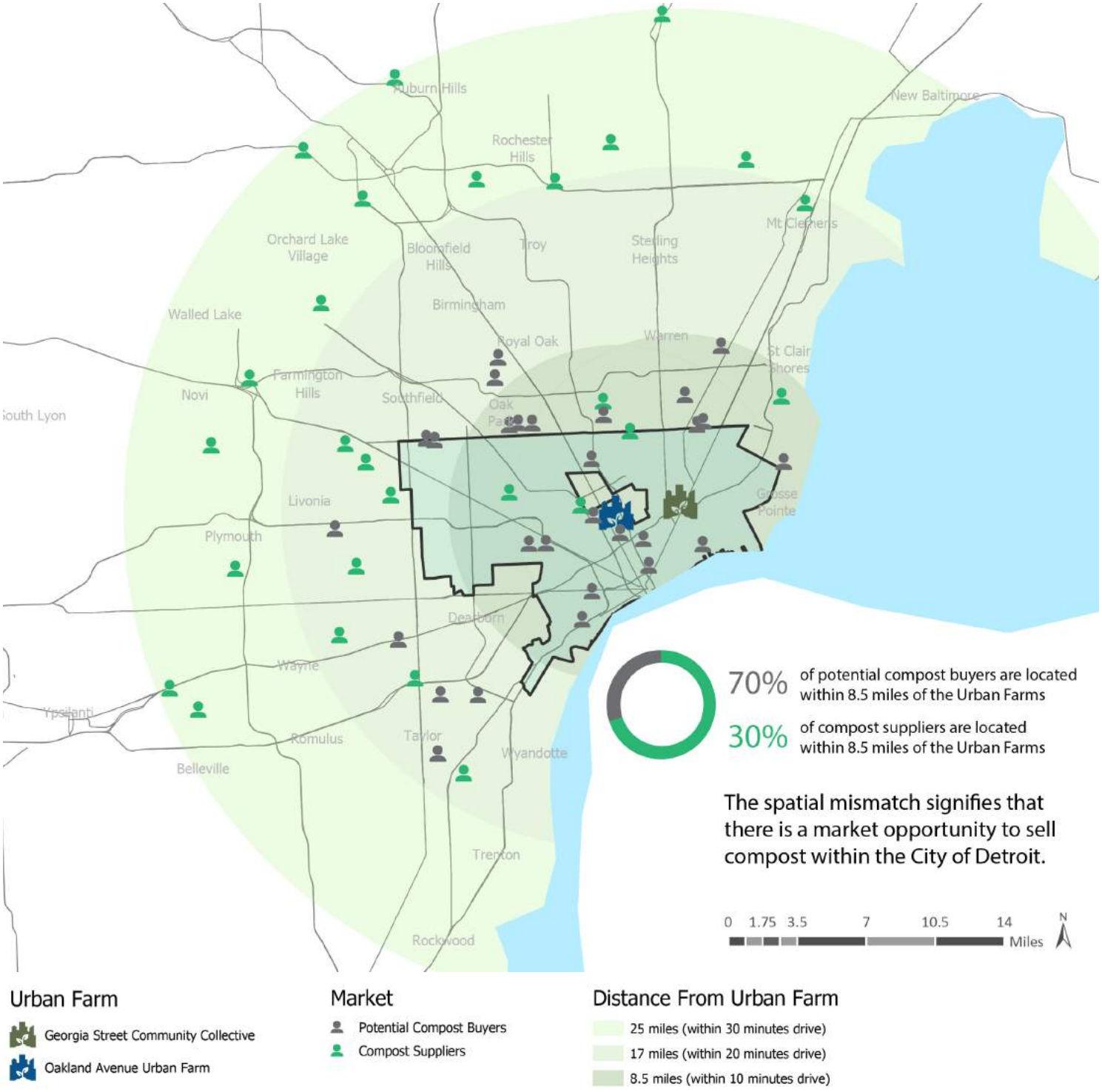


Figure 1. Compost Suppliers and Likely Institutional Buyers in Metro-Detroit

PROFITABILITY ESTIMATES OF COMPOST

HOW TO PRICE COMPOST

Pricing compost depends on the quality of the compost, the nutrient content, feedstock material, and quantity of compost sold.[22] Setting a price for compost should be both profitable and market competitive. For example, compost with manure on average sells at a lower price point than compost that is mostly plant-based material.[23] Manure is valued lower than plant-based compost as it contains extra nitrogen compared to the amount of carbon it has, a ratio that harms the microbial health of the soil.[24]

On a national level, a general estimated asking price for locally produced compost is $15 to $35 per cubic yard.[25, 26] However, this is a national average and varies greatly depending on the market of compost in the specific local context, including the demand and willingness to pay.

There are three methods for determining a pricing scheme for compost. First, conduct a market analysis to determine who is selling compost and for how much. For example, Brett Bloom of Dirt Wain examined the prices of organizations, including big box stores like Home Depot.[27] While locally produced compost is of higher quality and can be sold at a higher cost, if it is significantly more expensive than compost sold at nearby big box stores, people may not be as willing to purchase it. Asking urban farms in the area what price point they are selling compost at is a useful metric of setting a price. Dirt Wain asks for $50 for a cubic yard and $185 for 3 cubic yards, a price that is higher than the national average, but that is comparatively cheaper than big box stores and similar organizations selling compost in Fort Wayne, Indiana.[28]

The second method is to determine how you want to sell your compost. Compost sold as a boutique item can typically sell for more than compost sold at big box stores. One midwestern composting company, for instance, sells compost for $15 per ounce, or $240 per pound or $600 per cubic yard, as a boutique item. Selling compost as a boutique item, complete with ornate packing and logo, can market to an audience with disposable income who may be willing to pay more for environmental reasons, or to support local businesses.[29]

The third step is to understand that compost has real value and follows the principle of supply and demand; the more demand for the product, the higher the price. If selling compost as a stand-alone product is difficult, transitioning to selling compost as a product mixed with other materials, such as potting mix, can help sales and overall financial stability. Rust Belt Riders sold compost for two years but realized that a small decentralized system struggles to survive by selling compost as a pure product and transitioned to selling potting mix.[30] A bag of potting mix is 1/50th the volume to what you can charge per yard for compost. Therefore, 25 cubic yards of compost turns into 75 cubic yards sold of potting mix.

Additionally, Rust Belt Riders has observed a willingness to pay higher prices for products that include compost as an ingredient with other nutrients over compost as a standalone product. For example, the organization's potting mix is mainly composed of processed compost, with added amendments that act as bulking agents – such as coconut, river sand, or perlite – that help the soil perform in a different way from mulch or compost. As it is a commodity, they sell potting mix at a 75% margin rather than at cost, as

they were for compost as a stand-alone product. This generates more revenue and provides more financial stability to the organization, leading directly to greater opportunities for expansion.

PRICING COMPOST IN THE DETROIT MARKET

To determine the price of locally produced compost sold by national firms and firms within the City of Detroit, we carried out an analysis through sources we could access via websites (see *Table 3*). Waste360, a national news and waste analysis organization, found that landscapers buy compost at an average price of $9 per cubic yard while nurseries buy compost at an average price of $12 per cubic yard.[31] Currently, urban farms in the City of Detroit sell bags of compost between $1 to $8 per pound.[32]

Table 3. Comparing Prices of Compost Products Across Scales

Price Per Pound	Price Per Cubic Yard	Type	Geographic Region
$0.45	$15	Average	National[44]
$0.12	$35	Average	National[45]
$8	Firm does not sell at this scale	Small-Sized Urban Farm	Detroit
$1.00	$30	Mid-Size Urban Farm	Detroit[46]

EXPANSION CONSIDERATIONS

When community composting operations consider expanding, among the variety of factors that arise during the process, there are two critical considerations: how much additional compost can be produced and the upfront investment needed to expand.

Calculating the estimated amount of compost required for on-farm production is useful in determining how much compost can be sold per additional compost produced (see *Table 4*).

In addition to considering how much more compost can be produced, compost production increases could mean new costs to buy new machinery, land, and additional labor. For a small composting operation, financial costs can often be a great hindrance towards expansion.

Land and vehicle acquisition are arguably two of the greatest start-up and expansion costs. Applying for grants, finding more affordable options or building partnerships may be some ways to overcome the cost hurdle. For vehicles, if a composting operation is looking to switch to or add a pick-up service, a bike-based pick-up program can keep costs low.[33, 34] Once the pick-up route expands beyond the confines of the neighborhood or if the participating households are sparsely distributed throughout the city, however, a truck might make pick-ups easier, particularly during winter months.

Table 4. Application Rate of Compost (McSweeney, 2019)[47]

Spread Depth	Application Rate (Tons per Acre)	Yards per Acre								
		50'	100'	500'	1,000'	5,000'	10,000'	20,000'	½ Acre	1 Acre
⅛"	8.4	0.02	0.04	0.19	0.39	1.93	3.86	7.72	8.4	16.81
¼"	16.81	0.04	0.08	0.39	0.77	3.86	7.72	15.43	16.81	33.61
½"	33.61	0.08	0.15	0.77	1.54	7.72	15.43	30.86	33.61	67.22
¾"	50.42	0.12	0.23	1.16	2.31	11.57	23.15	46.3	50.42	100.83
1"	67.22	0.15	0.31	1.54	3.09	15.43	30.86	61.73	67.22	134.44
1½"	100.83	0.23	0.46	2.31	4.63	23.15	46.3	92.59	100.83	201.67
2"	134.44	0.31	0.62	3.09	6.17	30.86	61.73	123.46	134.44	268.89
3"	201.67	0.46	0.93	4.63	9.26	46.3	92.59	185.19	201.67	403.33

Acquiring affordable land can be more challenging, and where partnerships may play a valuable role. As Brett Bloom of Dirt Wain stated, "the initial investment of 50 thousand dollars to 100 thousand dollars for land is discouraging, relationships play an important part in urban activism."[35] Bloom received land valued at $5,000 donated by a community member who cared deeply for Dirt Wain's efforts. The average revenue for Dirt Wain is $200-300 per month, therefore, minimizing costs and receiving donations wherever possible is important for financial health.[36] A second strategy for overcoming the land cost expenditure is to rent land. Rust Belt Riders of Cleveland, Ohio rents parts of land on urban farms and picked an inexpensive vacant warehouse to be the main headquarters and composting storage facility.[37] Renting multiple pieces of land also works to increase the total amount of compost they can process as an organization, as each site is limited to the size allowed via the ordinance. Another strategy for saving costs is minimizing vehicle expenses, as Midtown Composting does by strategically planning vehicle trips to maximize gas and labor.[38]

Other financial expenses of either starting or expanding an operation may include machinery, marketing, education, start up kits for participants of the residential compost pick-up programs, and composting facility structures.[39] It is important to note here that the proposed three-bay system designed for Oakland Ave Urban Farm and Georgia Street Community Collection (see *Section IV*) can be very expensive and may pose a barrier to compost facility implementation. However, there are alternative cost-effective strategies that do not break the bank. Levi Gardner from Urban Roots, a community farm, market and education center in Grand Rapids, MI recommends that "without guaranteed funding or municipal support, beginning with outdoor windrows can be a reasonable approach that minimizes infrastructure cost, increases ease of use and access, and can expedite getting the process of the ground."[40] Additionally, Gardner noted that he has helped collaborate on community pilot sites "with less than $2,000 of equipment – the investment is in the personnel to manage, guide, and educate the public on the process."

Many compost operations evolve out of farms and gardens, where finding a consistent labor force and

generating enough capital to pay employees is a common concern. Most, if not all, of the sites and interviews featured in this report have started with or still have only one or two people on staff who receive a wage or salary. For example, Urban Roots had only enough financial capital to compensate the founder, Levi Gardner, for the first six months of the organization's operation.[41] Similarly, Brett Bloom is currently the only paid person of his organization, Dirt Wain.[42] The rest of Dirt Wain's labor force are volunteers, as are a majority of the laborers at Urban Roots.[43]

Finally, other recurring annual costs may include fuel, insurance, miscellaneous costs, and any loan payments. Conversely, recurring annual revenues may include collection fees and profits from selling compost. In the *Appendix* is a table of cost estimates of compost system materials and equipment, that could provide useful guidance to the costs of starting a compost business. Table 5. illustrates a pro forma for a sample composting facility located in a neighborhood that has 10,000 households. The food scrap donation program participation is 1,000 households, a 10% neighborhood participation rate.

ROOTING REVENUE IN COMMUNITY RESILIENCE

While finances are important to a site's sustainability, ensuring that a community compost system is economically viable quite often is rooted in efforts to ensure community well-being and local resilience, and relies upon numerous partnerships.

In an interview with Levi Gardner, he stated how, "compost is a subversive act taken by local communities. When neighborhoods reclaim their soil, and when they grow food in that soil, they take back the power to decide what to do with their local resources."[48] This power sends ripples through other parts of their economy, bringing awareness to how the community can be self-sufficient and more resilient. California provides us with a few examples of local collaborative resilience. The first example of this local community resilience is with the Green Restaurants Alliance Sacramento (GRAS) in Sacramento.[49] GRAS partners with local restaurants to collect food scraps and other post-consumer organic waste. The program aims to promote sustainable waste management and landfill diversion. Partnering restaurants receive quarterly estimates of what they individually diverted from landfills. GRAS engages in other sustainable activities as well, such as recycling wine corks by donating them to youth art centers, promoting zero waste events in Sacramento, and training restaurant staff and school children about compost management in the kitchen and cafeteria, respectively. Nine local farms and gardens process GRAS' compost. The primary motivation for many composting organizations and community collaborations like GRAS is to achieve environmental sustainability and empower local communities, but they are accomplishing this mission while also ensuring the organization's financial sustainability.

Financially viable community composting operations can also collaboratively occur without formal partnerships. For this example, we go to Los Angeles, where two composting organizations seem to find separate niches and complement each other without any formal partnership. Los Angeles County's Public Works Department educates interested backyard composters with workshops where at the end, they offer students the chance to purchase reduced

Table 5. Pro Forma Table for a Sample Composting Facility

	Description	Unit Type	Units	$/Unit	Total
Start-Up (Year 0)	Residential Drop-Off Program				
	Residential Starter Kits	Kit	1000	$9.00	$9,000.00
	Residential Drop-Off Signs	Sign	10	$50.00	$500.00
	Trailer	Vehicle	1	$1,000.00	$1,000.00
	Compost Site				
	Compost Bin Construction	Weekly Hours of Labor	5	$10.00	$50.00
	Compost Loader			$2,750.00	$0.00
	Land Aquistion	Land	1	$1,000.00	$1,000.00
	Outreach and Promotion				
	Flyers	Flyer	100	$1.00	$99.96
	Local Newspaper Ad	Advertisment	5	$200.00	$1,000.00
	Digital Content (Social Media and Website)	Weekly Hours of Labor	10	$10.00	$100.00
	Education				
	Educational Workshops	Weekly Hours of Labor	5	$10.00	$50.00
	Description	**Unit Type**	**Units**	**$/Unit**	**Total**
Annual Income	Collection Fees				
	3.5 gallon bucket, Every Other Week Pick-up	Per Month Cost	167	$12.31	$2,055.77
	5 gallon bucket, Every Other Week Pick-up	Per Month Cost	166	$16.15	$2,680.90
	3.5 gallon bucket, Weekly Pick-up	Per Month Cost	167	$20.52	$3,426.84
	5 gallon bucket, Weekly Pick-up	Per Month Cost	167	$24.84	$4,148.28
	3.5 gallon buckets, Weekly Pick-up	Per Month Cost	166	$41.04	$6,812.64
	5 gallon buckets, Weekly Pick-up	Per Month Cost	167	$49.68	$8,296.56
	Compost				
	Profits from Selling Produced Compost	Pounds of Compost	5000	$0.50	$2,500
	Description	**Unit Type**	**Units**	**$/Unit**	**Total**
Annual Expenses	Residential Drop-Off Program				
	Gas for Collection Truck	Gallons/Tank	100	$0.15	$15.00
	Labor for Collection	Weekly Hours of Labor	30	$10.00	$300.00
	New Participant Starter Kit	Kit	100	$9.00	$900.00
	Residential Drop-off Management	Weekly Hours of Labor	15	$10.00	$150.00
	Outreach and Promotion				
	Ongoing Education and Outreach & Promotion	Weekly Hours of Labor	15	$221.00	$3,314.99
	Compost Site				
	Hay Bales	Bale	15	$2.50	$37.50
	Wood Shaving Bales	Bale	12	5.5	66
	Employee Salary	Salary	2	30000	60000
	Property Tax	Tax	1	$3,380.00	

	Price Source	Notes
	(ILSR, April 2014)	
	(ILSR, April 2014)	
	(Tractor Supply Compnay, n.d.)	
	Assumption	
	(Tractor House, n.d.)	
	Assumption	Based off of Listings on Detroit Land Bank
	(Staples, n.d.)	
	(Kobliski, 2006)	
	Assumption	
	Assumption	

	Price Source	Notes
		Equally Distributed Among the 1,000 Participating Households
	(L. Gardner, March 17, 2020)	
	(L. Gardner, March 17, 2020)	
	(L. Gardner, March 17, 2020)	
	(L. Gardner, March 17, 2020)	
	(L. Gardner, March 17, 2020)	
	(L. Gardner, March 17, 2020)	
	(O_2Compost, n.d.)	National Average Cost per Pound of Locally Produced Compost

	Price Source	Notes
	Assumption	
	Assumption	
	(ILSR, April 2014)	
	Assumption	Weekly and As Needed Communication
	(ILSR, April 2014)	Compost Material
	(ILSR, April 2014)	Compost Material
	Assumption	
	Assumption	Based on Detroit Tax Rate

	Description	Value
Sample Neighborhood	Households	10,000
	Participating Households (10% Participation Rate)	1,000

	Description	Total
Totals	Start-Up Year 0 Cost	$12,799.96
	Residential Pick-Up Service (Collection Fees)	$27,420.99
	Profits from Selling Compost	$329,051.88
	Annual Income	$356,472.87
	Annual Expenses	$64,783.49
	Total Revenue (Year 0)	$278,889.42
	Total Revenue (Beyond Year 0)	$291,689.38

	Citations
Price Sources	Institute for Local Self-Reliance. (April 2014). Guide to Community Composting (pp. 90).
	Kobliski, K. (2006, January 17). *Newspaper Ads*. Entrepreneur. https://www.entrepreneur.com/article/83096
	Levi Gardener of Urban Roots in Grand Rapids, MI, Personal Communication, March 17, 2020.
	O2Compost. (n.d.). The Economics of Composting. https://www.o2compost.com/the-economics-of-composting.aspx
	Staples (n.d.). *Same Day Custom Flyers*. https://www.staples.com/services/printing/same-day-services/flyers/
	Tractor House. (n.d.). https://www.machinerypete.com/listings/tractors/40-99-hp/kubota/mx5200
	Tractor Supply Company. (n.d.). https://www.tractorsupply.com/tsc/search/trailer

priced compost bins.[50] L.A. County sells these bins at a profit loss. Simultaneously, LA Compost, a private organization, describes its mission as a place where "we cultivate places for people to engage with each other through compost access and soil education."[51] They complement L.A. County's work by providing a network of pick-up and drop hubs throughout the area where anyone can bring their bins full of compost to drop off. The co-op offers a social network of compost experts, where people who purchase compost ask Master Composters questions and problem-solve their own composting practices. Master Composters are members of a nation-wide training program that focuses on best management practices in composting.[52] The program trains people how to teach and train others on compost best management practices. These two compost organizations, either by design or by chance, seem to complement one another, together helping to scale up a robust community-wide composting system.

Another way community composting operations that incorporate a revenue-generating element can help to build a community of composters is to find more equitable ways for more people to benefit from composting. Compost Pedallers, of Austin, Texas, for instance, had a food scrap collection service that charged $4 per month. However, they had a program in which an individual could purchase another household's pick-up service.[53] This helps those who cannot afford the cost to still participate in the collection service, and it benefits the entire community as it means more food scraps are diverted from the landfill and put to a more valuable use. Compost Pedallers was so successful, it helped grow the popularity of composting to the point where the City of Austin adopted a curbside pick-up composting system. In a similar manner of spreading the benefit of composting, Tim Campbell of Midtown Composting in Detroit donates 15 cubic yards of compost to all of his residential household participants in early April, a time when they are starting their gardens and in need of fertilizer.[54]

Finally, another example of an economically viable community composting operation that has community as its anchor is Urban Roots. They are much more than a compost production site; they foster community by offering classes and a local market geared to connecting people of all ages to soil and the table. As an organization, they are "dedicated not only to urban agriculture for the sake of growing food, but also as a place to engage in the fundamental act of what it means to be a human being." Through "honest and rich collaborations throughout [their] neighborhood and [Grand Rapids], [Urban Roots] believe[s their] work can simultaneously be a platform for healthy food access, experiential learning, economic development, ecological stewardship, community revitalization, and social empowerment."[55] Gardner described his site's compost operation as "less than 5% of the energy that we have. As an organization, the finished product is significantly less of our storytelling than it is waste diversion and soil amendments for our urban farm and other urban gardens."[56] Compost provides the community with jobs, local sources of income and economic self-sufficiency, keeps money local, and improves the local natural environment, which enhances the economy and improves the quality of life for all.[57, 58]

Much like Urban Roots, other community-based compost operations similarly align their local economy, environment, and society. Compost is an opportunity to create a strong foundation of what makes a community a "community." Whether it's in Los Angeles, Sacramento, Austin, Detroit or Grand Rapids, local community collaboration is at the heart of community composting efforts, including those that are financially viable. Composting empowers local actors to decide on their own what is trash, what has value, and what can be reused, putting local sustainability leaders in the driver seat as they build a closed loop economy.

THINKING CREATIVELY ABOUT EXPANDING

Beyond expanding into new products or new market populations, compost operations can utilize their creativity to find new ways to engage their community while increasing revenue. Rust Belt Riders, for example, offers an additional service to their educational programming and compost products: zero waste catering services.[59] While this service is less about compost and more generally about waste management, it does not deviate from Rust Belt Riders' mission: "Feeding People, Not Landfills."[60] Educational outreach and residential curbside pick-up are two other common approaches community composting operations use to expand their revenue streams.

EXPAND COMMUNITY EDUCATION & OUTREACH

Education is a great step for expanding a potential revenue stream while achieving a resilient and robust community. Offering educational opportunities around composting creates a community of knowledgeable and practicing composters who compost, while maximizing soil recovery and building a closed-loop economy. For example, Rust Belt Riders hosts educational workshops on "seed starting, horticulture, small business management and financing, climate change and economics, supply chains, and composting."[61] Compost education might be the most frequently offered class, but compost operations can offer community workshops or courses in a variety of subjects, some of which can offer knowledge specific to regional and local conditions. An example of a specific course which considers regional and local conditions can be found within L.A. County's Public Works Department. The Department offers a garden education class where, in addition to learning about composting and grass recycling, they learn about water-wise gardening, and fire-wise gardening.[62] Water-wise and Fire-wise gardening are specific garden knowledge bases that are more critical to know in drought- and fire-prone climates.

Los Angeles isn't the only city succeeding in educational outreach. Many Michigan-based composting organizations are providing a diversity of methods to raise local knowledge about composting. Keep Growing Detroit, a community-based composting organization dedicated to creating "a food-sovereign Detroit," offers online instructional guides and garden planning manuals, as well as, hosts classes on beekeeping, rainwater collection, seed starting and tree pruning.[63] Detroit-based Earthworks Urban Farm holds gardening classes and educational programming for youth throughout the year.[64] Urban Roots of Grand Rapids offers a general gardening class, teaches a container and small growing space gardening class, and a local food cooking class, which instructs people how to use food according to what's available locally during different seasons.[65]

Common educational classes taught in a variety of places around the United States include jam making, pickling, cheesemaking, and beekeeping. Another example of unique education outreach is in New York City, with Common Ground Compost, where they offer specific training for Kitchen Staff in restaurants.[66] Restaurants are a large contributor to food waste in the United States, making educational training on how to repurpose food scraps extremely beneficial for the company and its surrounding community.[67] The examples listed in this section are only a few of the many ways organizations across the United States are creatively engaging with and educating local communities.

PICK-UP AND COLLECT FOOD SCRAPS

Curbside collection of food scraps is another revenue source that helps to make a composting operation economically viable, while simultaneously deepening ties to the community. A curbside pick-up service is a widespread and profitable service many compost organizations offer. For many sites, curbside pick-up fees are their primary source of income and compost feedstock. A curbside pick-up can expand the reach of "community" beyond the close neighborhood boundaries with each additional participating resident and business, and help promote the compost operation to a larger geographical area through word-of-mouth marketing.

Pick-up service marketing and pricing structures are very important to plan out as they can be complicated, especially if they involve a diversity of container sizes and pick-up frequencies for participants to choose from. While important to inform with market research and plan out prior to implementation, the operational structure can be adjusted with trial and error. An example pricing structure is that of Urban Roots' residential and business curbside pick-up service in Box 2 on the next page.

Beyond a detailed pricing scheme, this structure brings up the question of the containers customers will use to put their food scraps in, such as bins, buckets, or other containers.[68] Compost operations can ask customers to use their own containers, they can sell customers bins in bulk and distribute them to customers, or they can work with a community partner to obtain buckets.[69] One challenge of having customers use their own container is that it makes weighing the amount of incoming food scraps and green material difficult.[70] In this case, it is helpful to standardize containers to simplify measurements.

Ultimately, despite adding some additional logistics, curbside compost pick-up is a widely popular and successful way of creating a revenue stream for community composting operations, and a missed opportunity if the demand is there and a composting operation has the desire to expand.[71] We discuss additional ways of considering how to build up a curbside composting operation in the next section on *Sherwood Forest (Section IV).*

CONCLUSION

As demonstrated by nationwide examples, community composting organizations find numerous ways to make revenue: from selling pure compost and other soil mixtures, to offering unique educational opportunities and expanding their food scrap donation base with curbside composting systems.

Ultimately, organizations that engage in composting can simultaneously contribute to a closed-loop economy by diverting waste from local landfills and pursuing environmental and community goals even as they generate revenue to keep their mission afloat.

URBAN ROOTS: YOUR COMPOST PICK-UP SERVICE

"For a small monthly fee, you can help support the soil fertility at Urban Roots, participate in a city-wide effort to capture organic wastes, and cut down on your contribution to filling up sanitary landfills! For an additional $5 or $10 a month, you can join our Kombit Community.
All 'Certified Compostable' products are accepted.
Bucket options:

- (1) 3.5-gallon bucket, $12.31/month (Every Other Week Pick-up)
- (1) 5-gallon bucket, $16.15/month (Every Other Week Pick-up)
- (1) 3.5-gallon bucket, $20.52/month (Weekly Pick-up, a good size for 1-3 people who cook semi-regularly)
- (1) 5-gallon bucket, $24.84/month (Weekly, 4-6 people)
- (2) 3.5-gallon buckets, $41.04/month (Weekly, 7-9 people)
- (2) 5-gallon buckets, $49.68/month (Weekly, 10+ people)

Note: bucket size is dependent on how much you cook. If you cook with fresh vegetables often, you may need to move up a size"[72]

(Source: Urban Roots, 2020)

ENDNOTES

1. Insights, F. M. (2019, March 27). *Compost Turning Machine Market to Grow US$ 150 Million by 2028 – Future Market Insights*. GlobeNewswire NewsRoom. http://www.globenewswire.com/news-release/2019/03/27/1774011/0/en/Compost-Turning-Machine-Market-to-Grow-US-150-Million-by-2028-Future-Market-Insights.html

2. Pennsylvania Department of Agriculture. (n.d.). *Soil and Plant Amendments*. State of Pennsylvania https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/agronomic-products/SoilPlantAmendment/Pages/default.aspx

3. Michigan State University Extension. (n.d.) *The shocking truth about topsoil*. Michigan State University Extension. https://www.canr.msu.edu/news/the_shocking_truth_about_topsoil

4. Cleveland Van Cecil (n.d.). *Information on Planting Mix Vs. Potting Soil*. Garden Guides. https://www.gardenguides.com/130631-information-planting-mix-vs-potting-soil.html

5. California Department of Resources Recycling and Recovery (2019, October 29). *Compost and Mulch*. https://www.calrecycle.ca.gov/Organics/CompostMulch/CompostIs/

6. Tyler, R. (1997, January 1). *The price is right: How to sell your compost*. Waste360. https://www.waste360.com/mag/waste_price_right_sell

7. Mark Covington of Georgia Street Community Collective, Detroit, MI, personal communication, February 16, 2020

8. City of Philadelphia. (n.d.) Fairmount Park Organic Recycling Center Compost Recommended Specific Directions and Compost Use. https://www.phila.gov/media/20171115162327/Compost_Use_Direction_Sheet.pdf

9. Barrington, K. (2018, December 18). *Difference Between Garden Soil and Top Soil*. https://homeguides.sfgate.com/difference-between-garden-soil-top-soil-31708.html

10. US EPA. (1997, October) *Innovative Uses of Compost: Erosion Control, Turf Remediation, and Landscaping* https://www.epa.gov/sites/production/files/2015-08/documents/erosion.pdf

11. Small Business Administration (n.d.) Marketing 101: A Guide to Winning Customers. Marketing 101: A Guide to Winning Customers. Retrieved March 29, 2020, from https://www.sba.gov/course/marketing-101-guide-winning-customers/#course-transcript

12. Daniel Brown of Rust Belt Riders, Cleveland, Ohio, personal communication, March 17, 2020

13. Brett Bloom of Dirt Wain, Fort Wayne, IN, personal communication, March 17, 2020

14. (Tim Campbell, personal communication, March 26, 2020)

15. (Daniel Brown, personal communication, March 17, 2020)

16. (Brett Bloom, personal communication, March 17, 2020)

17. Tim Campbell of Midtown Composting, Detroit, MI, personal communication, March 26, 2020

18. (Small Business Administration, n.d.)

19. Patrick Cullen of Wayne County, Detroit, MI, personal communication, March 4, 2020

20. City of Detroit Water and Sewerage Department. (2014, August 1). *Green Infrastructure Plan for the Upper Rouge Tunnel Area*. Detroit Water and Sewerage Department (pp. 6). Tetra Tech. https://detroitmi.gov/sites/detroitmi.localhost/files/2018-05/dwsd_gi_upper_rouge_tunnel_area_08-01-2014.pdf

21. City of Detroit (n.d.) *Green Infrastructure Projects*. https://detroitmi.gov/departments/water-and-sewerage-department/stormwater-management-and-drainage-charge/green-infrastructure-projects

22. (Tyler, 1997)

23. Improve Net. (n.d.). *Compost Cost Guide*. https://www.improvenet.com/r/costs-and-prices/composting

24. Adams, Ann. (2017, August 22). *What's better for soil health - Compost or manure?* Holistic Management. https://holisticmanagement.org/blog/whats-better-soil-health-compost-manure/

25. O2Compost. (n.d.). *The Economics of Composting*. https://www.o2compost.com/the-economics-of-composting.aspx

26. Faucette B., Governo J., and Graffagnini B. (2004, April 1). *Doing the dirty work*. Waste 360. https://www.waste360.com/composting-and-organic-waste/doing-dirty-work

27. (Brett Bloom, personal communication, March 17, 2020)

28. (Brett Bloom, personal communication, March 17, 2020)

29. Levi Gardner of Urban Roots, Grand Rapids, MI, personal communication, March 17, 2020.

30. (Daniel Brown, personal communication, March 17, 2020)

31. (Faucette, et. al., 2004)

32. (Tim Campbell, personal communication, March 26, 2020)

33. AARP. (2017, July 12). *How Bicycling Can Save You Big*

Money. AARP.com. Retrieved May 3, 2020, form,https://www.aarp.org/money/budgeting-saving/info-2017/save-money-bike-commuting.html

34. Chandler-Isackson, K. (2015, December 4). *Bike-Powered Compost Collection*. Mother Earth News. Retrieved May 3, 2020, from, https://www.motherearthnews.com/nature-and-environment/bike-powered-compost-collection-zbcz1512

35. (Brett Bloom, personal communication, March 17, 2020)

36. (Brett Bloom, personal communication, March 17, 2020)

37. (Daniel Brown, personal communication, March 17, 2020)

38. (Tim Campbell, personal communication, March 26, 2020)

39. Platt, B., McSweeney, J., & Davis, J. (2014). Growing Local Fertility: *A Guide to Community Composting. Pg. 10. Institute for Local Self-Reliance and Highfields Center for Composting*. https://www.texasenvironment.org/wp-content/uploads/2015/04/Growing-Local-Fertility-ISLR-July-2014.pdf

40. (Levi Gardner, personal communication, March 17, 2020)

41. (Levi Gardner, personal communication, March 17, 2020)

42. (Brett Bloom, personal communication, March 17, 2020)

43. Urban Roots. (n.d.). *About Urban Roots*. Retrieved April 21, 2020, from https://www.urbanrootsgr.org

44. (O2Compost, n.d.)

45. (Faucette, et. al., 2004)

46. Midtown Composting (n.d.). Finished compost products. https://midtowncomposting.com/product/

47. McSweeney, J. (2019). Chapter Fourteen: Compost End Uses and Markets. In *Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and Solving Our Waste Crisis* (pp. 388). Chelsea Green Publishing.

48. (Levi Gardner, personal communication, March 17, 2020)

49. *ReSoil Sacramento / GRAS. (n.d.) Growing a Regenerative Food Community in the Farm-to-Fork Capital*. Retrieved March, 28, 2020, from https://grasacramento.org/

50. Los Angeles County Department of Public Works (n.d.). Smart gardening—Water Conservation. Retrieved April 5, 2020, from https://dpw.lacounty.gov/epd/sg/gen_info.cfm

51. LA Compost. (n.d.). LA Compost. Retrieved April, 5, 2020, from https://www.lacompost.org

52. New Mexico State University. (n.d). *Bernalillo County Extension Master Composters*. New Mexico State University College of Agricultural, Consumer, and Environmental Science Retrieved April, 30, 2020, from, https://bernalilloextension.nmsu.edu/mastercomposter/what-is-a-master-compost.html

53. Gan, V. (n.d.). *City Lab: This Austin Startup Picks Up Your Compost by Bike*. CityLab. http://www.citylab.com/navigator/2015/12/austins-compost-pedallers-pick-up-your-food-scraps-by-bike/419871/

54. (Tim Campbell, personal communication, March 26, 2020)

55. (Urban Roots, n.d.)

56. (Levi Gardner, personal communication, March 17, 2020)

57. Platt, Bell, and Harsh (2013) *Pay Dirt Composting in Maryland to Reduce Waste, Create Jobs, and Protect the Bay*. https://ilsr.org/wp-content/uploads/2013/05/Pay-Dirt-Report.pdf

58. (Platt, et. al, 2014)

59. Rust Belt Riders. (n.d). *Zero Waste Event Services*. Rust Belt Riders. Retrieved April 7, 2020, from https://www.rustbeltriders.com/zero-waste-event-services

60. Rust Belt Riders (n.d). *Rust Belt Riders: Feed People, Not Landfills.* Rust Belt Riders. Retrieved April, 7, 2020, from https://www.rustbeltriders.com

61. (Daniel Brown, personal communication, March 17, 2020)

62. (Los Angeles County Department of Public Works, n.d.)

63. Keep Growing Detroit. (n.d). Education series. Keep Growing Detroit. Retrieved April 28, 2020, from http://detroitagriculture.net/our-work/adult-education-programs/

64. Earthworks Urban Farm. (n.d). Youth Education. Earthworks Urban Farm. Retrieved April 28, 2020, from https://www.cskdetroit.org/earthworks/programs/youth_education/

65. Urban Roots. (n.d.) Make and Take Cooking. Urban Roots. https://www.urbanrootsgr.org/make-and-take-cooking

66. Common Ground Compost. (n.d.). NYC Recycling & Restaurant Composting | NYC Compost Consultants. Retrieved March 15, 2020, from http://commongroundcompost.com/services/

67. Food Marketing Institute et al. (2014) *Analysis of U.S. Food Waste Among Food Manufacturers, Retailers, and Restaurants*. http://www.foodwastealliance.org/wp-content/uploads/2014/11/FWRA_BSR_Tier3_FINAL.pdf

68. Platt, B., & Fagundes, C. (2018). *Yes! In My Backyard: Composting Guide for Local Government. Institute for Local Self-Reliance.* (pp. 9). https://ilsr.org/wp-content/uploads/2018/06/Yes-In-My-Backyard-Full-Report-v2.pdf

69. City of Minneapolis.(2020, April) *Residential Organics Recycling*. City of Minneapolis. Retrieved April 28, 2020, from http://minneapolismn.gov/solid-waste/organics/index.htm

70. (Platt, B., & Fagundes, C., 2018, pp. 18)

71. (Platt, B., & Fagundes, C., 2018, pp. 9)

72. Urban Roots (2020) Urban Roots: YOUR Compost. Urban Roots. Retrieved March 26, 2020, from https://www.urbanrootsgr.org/yourcompost

HOW TO PLAN A SITE 102

GEORGIA STREET COMMUNITY COLLECTIVE 120

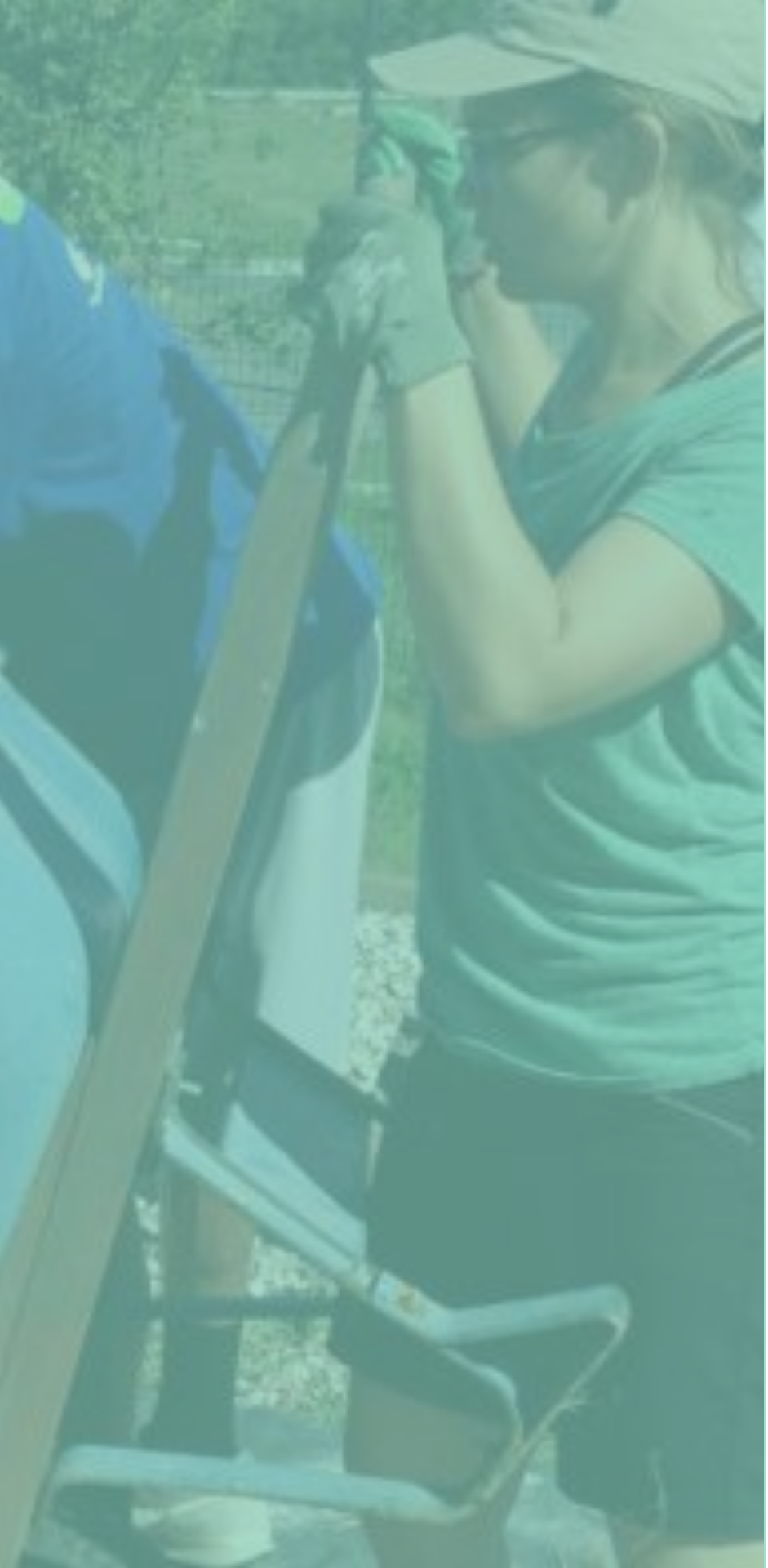
OAKLAND AVENUE URBAN FARM 134

SHERWOOD FOREST 152

PART IV

STUDY SITES

HOW TO PLAN A SITE



CURRENT STATE OF COMPOSTING

Community-scale composting already exists in the City of Detroit–but what does it look like in practice and what can we learn from these efforts? In places where such an operation does not yet exist but residents or urban farms have expressed interest in community-scale composting, what could this look like? And for both the new and experienced composters, how could we learn and apply best practices to grow a successful community compost system citywide?

While Southeastern Michigan possesses a small number of industrial composters, there is still ample room within the market for decentralized programs. Although there are a few composting facilities in this region, only a small subset of these accept food scraps.

Additionally, there are dozens of organizations within Detroit that are either actively involved with composting or work in a “compost-adjacent” sector such as urban agriculture, community gardens, food accessibility, environmental sustainability, or environmental education. With missions that accompany composting and waste management efforts, these organizations can be early “compost champions” and support advocacy efforts to encourage composting across the City.

Composting is not new to Detroit–there are residents and organizations that have been actively composting for several decades (see *Why Community-Scale Composting in Detroit?*). Some of the most well known community-scale composters include Detroit

Dirt, Brother Nature Produce, Earthworks, and Midtown Composting, among others.

As previously described in *Physical Infrastructure and Environment*, compost can have many uses such as green stormwater infrastructure, urban agriculture, and landscaping. Compost is already used for many projects within Detroit. However, currently, nearly all compost used in Detroit is sourced from outside the City's limits. If decentralized programs were able to meet demand, much of that revenue could be instead captured by local communities, as detailed in *Compost Market and Community*. Working to fill this gap in the current market can be a strategic and advantageous goal for Detroit.

In this section, we offer guidelines for how to site new composting operations, as well as useful best management practices. Then we explore three study sites in greater detail, applying these best practices as they work to develop or expand their own community-scale composting systems.

Figure 1. A labeled compost pile (Woods, 2008).

SUITABLE CONDITIONS

When identifying a compost processing site, there are important environmental, physical, infrastructure, and regulatory requirements that must be accounted for in both its location and design. Residents' preferences and travel behaviors must also be taken into account while designing a compost program. Further, planners should be careful to incorporate regulatory requirements, which can vary by municipality.

HOW TO PICK A SITE

Choosing a compost site requires considering the environmental, infrastructure, and physical conditions in order to produce the desired amount of compost successfully and efficiently. Before selecting a site, planners should answer questions such as:

- Are there environmental hazards, e.g. significant slope, floodplain, environmental contamination, previous materials, that could make compost processes more time consuming and resource-intensive?[1]
- Does the zoning ordinance of the location permit composting? Are there restrictions or specifications of legality in operations?[2]
- What is the cost of land? Is funding available? Are there available partnerships to share the cost?[3]
- What are the physical space measurements of the site? Is it large enough for the desired capacity?[4]

While many compost operations are integrated into non-profit and educational programs, a compost site that intends to sell compost is often more engaged with the surrounding community and must be in tune with market conditions. We detail these market conditions further in the section *Compost Market and Community,* but here we suggest that selecting a suitable site requires asking additional community-related considerations:

- What is the community's attitude towards sustainability efforts? Are there specific attitudes about composting or food waste reduction that could be leveraged to create community support for your operation?[5]
- What is the population and income of the surrounding community? Would there be a large enough population to make your operation profitable or could there be a large cost barrier to purchasing compost? Alternatively, would other, surrounding markets be sufficient to support a for-profit operation?[6]
- Is there nearby commercial and public infrastructure that could be potential operational partners or compost purchasers?[7]
- What is the saturation of the compost market in the area? Are you able to provide a unique service to the community?[8]

Figure 2 illustrates a checklist of best practices that should be used when identifying a site.

WHAT ABOUT THE NEIGHBORHOOD CONTEXT?

Site Considerations

When considering where to locate a site, the context of the neighborhood should also be taken into account. As detailed in the following pages, traffic, noise, runoff, safety, equity, and engagement can greatly affect where a site might be best set up for success.

ENVIRONMENTAL

- Site must be placed at least 300 ft away from surface water
- 200 feet from wetlands
- 500 feet from active wells
- Surface water should be avoided, including any floodplains
- Processing site must be placed at least 3 feet away from bedrock

REGULATORY

- The compost processing site must be smaller than 500 cubic yards (proposed regulation)
- Locate near rear of property with 5 ft rear setback
- If the site falls within a special zoning district, it must adhere to all additional zoning regulations

COMMUNITY PREFERENCES

- Close proximity to community space to encourage community involvement
- Ideally located within 1/4 mile of food scrap generators (based on estimated willingness to travel)

SITE PLACEMENT

- Site should be located at least 3 feet from any building foundations, sidewalks, or concrete slabs
- Site should be placed at least 2 ft away from any exterior walls, fences, or shrubs
- Ideally ground slope of 2- 5% for processing
- Ideally have access to water and electricity
- Processing site should be located on pavement or another impervious surface
- Site should be at least 20 ft away from nearest residence or business
- Site should ideally be 500 feet from sensitive receptors (churches, schools, nursing homes, hospitals, etc.)

Figure 2. The above Site Criteria Checklist offers a checklist of best practices that should be used to identify a potential compost processing site (Taylor & Ard, 2015; McSweeney, 2019; Michigan Recycling Coalition, 2015)

- **Traffic.** Adjacency to main arterial roads can increase the functional service area of a program as well as limit the congestion effects on residential streets. Ample space is also needed for vehicles performing pick-up or drop-offs to park off-street and turn around. Finally, to limit the negative impacts on municipal infrastructure, compost programs should take care to avoid allowing vehicles to track waste material into the public right-of-way.
- **Noise.** Some residents may worry that a composting operation in their neighborhood will cause loud noises. Although community-scale composting can occasionally involve machinery during typical workday hours (dependent on the scale), community composing is relatively quiet. The loudest noise may come from sites that host community groups for composter training or educational workshops. To assuage concerns or avoid nuisance complaints, compost managers can engage neighbors when planning a site to ensure everyone understands the level of noise that might occur from community engagement or potential machinery.
- **Water Management (Runoff).** Compost managers must also consider how to prevent pools of water.[9] Not only do bodies of water create anaerobic conditions and smells–they also weaken the surface they accumulate on. If water is underneath or nearby the compost, it can eventually damage the infrastructure and diminish the amount of compost. Water needs to quickly drain away from the compost. As such, gravel is a good surface for a compost pile. When planning windrows, place windrows along a slope so runoff flows down in one direction, making it is easy to monitor and clean up. If a pool of water cannot be drained, treat anaerobic pools with pulverized limestone, which can be bought at a home and garden store. Because compost runoff can contain toxic pollutants and metals, water should be directed to filtering infrastructure like bioswales or rain gardens before it leaves the site so the leachate can be cleaned.
- **General Safety Concerns.** Organic composting, if unregulated, can present certain undesirable risks to urban environments. Concerns about safety as they pertain to aggregation of flammable materials, as well as possible negative health impacts are valid if programs do not abide by structure standards or best management practices. Implementing common-sense regulatory standards that involve properly established property setbacks, utilizing non-flammable material in compost pile constructions, and careful definition and education regarding what materials are acceptable for composting can effectively mitigate risk.
- **Who's in the Neighborhood?** A vital component to locating a site is the question, *who are the people in the surrounding community*? Unlike large-scale centralized composting operations, community-scale composting sites typically engage the residents and businesses in the neighborhood, using their food scraps to process into compost. To be an equitable community-scale composting operation, the surrounding residents must benefit from compost production. Residents, despite their ability to pay, should be offered the opportunity to actively participate in the community composting system by contributing their food scraps, helping with compost processing, or receiving finished compost. Ability to pay often limits participation–planning a site with an equity lens first requires one to understand and plan for who is already there.
- **Community Engagement.** Neighborhood residents and the public should approve of the compost operation. Initially, public buy-in may be lacking because people are often concerned about

the smell, rats, and aesthetic associated with a compost site and pile. To counteract this reaction, educational elements must be incorporated into the site before and during operation. Parties, community discussions, and fundraisers are all events that can help build community trust and buy-in.

Because of compost's reputation, people might be hesitant about the site's existence in their neighborhood. This makes it important to demonstrate compost's value to the community and listen to neighbors' concerns. The neighborhood is a valuable compost feedstock source, as every house can contribute to your compost. Some of your labor force might come from the neighborhood too. I

Partnerships and community collaboration often start within the neighborhood. The Institute for Local Self-Reliance's *Best Management Practices* handbook explains how having "an engaged local community can be an invaluable source of support for your project, be it with labor, resources, or advocacy."[10] Similarly, without proper management, compost sites easily become places of nuisances that require police and/or site inspectors to mitigate. Develop good relationships with police officers and city inspectors by inviting them onto the site and demonstrating what you're doing. This can help mitigate nuisance complaints too.

SITE DESIGN

Composters should not overburden existing infrastructure.[11] Well-designed sites can mitigate bad odors and rodents, keep costs low, and determine the longevity of the operation. Sites should have enough space and capacity for three operational components:[12]

1. **Receiving/Staging:** where inputs are collected and filtered. Ideally should take 20-30% of the site.
2. **Processing:** where composting physically happens. Ideally should take up 55-65% of the site.
3. **Curing/Storage**: where final decomposition occurs. Ideally should take up 10-20% of the site.

The sizes of these three components will vary based on input frequency. Other considerations include how to design for year-round composting, and site conditions will dictate the composting method (windrows, bins, piles, tumblers, etc.). In addition to some of the conditions expressed above, others to consider include:[13]

- Surrounding land uses
- Wind direction
- Proximity to customers if selling
- Minimum travel and materials handling
- Firm surface to support vehicles under varying weather conditions
- Opportunity for expansion
- Cost of space and utilities

If city regulations require specific setbacks that cannot be met, another design consideration is to create a buffer to mitigate the odor and visual impacts of compost.[14] Well-designed sites account for capacity needs, projected volumes, equipment and infrastructure necessary, material processing activities, and an understanding of the space required to do everything before implementation. In general, if there is no prior planning, odor can arise. Sites can generally handle 5,000 cubic yards per acre of compost, but some sites can process larger volumes if they turn the piles more frequently.

If space permits, the site should be planned to:

- Minimize system delays, backtracking, and material handling
- Separate material piles/storage to create efficient C:N ratios
- Be easy to maintain and clean-up

If site operators can dictate the portion of inputs, they should choose mostly leaves and grass with some wood chips and food to have ideal C:N ratios and efficiently process compost. Table 1 lists the desired percentages of incoming inputs, recommended timelines for when to receive and hold on to material, advice on potential mixing materials for C:N ratios in the processing stage, and the ideal C:N ratios for finished compost.

TACKLING EDUCATION & BEST MANAGEMENT PRACTICES

In addition to suitability conditions and site design ideas, there are three specific concerns people unfamiliar with composting may raise when they are encouraged to compost or when a composting site is proposed for their neighborhood. Renee Wallace from FoodPLUS | Detroit refers to these inevitable questions raised as "the what abouts." As she says, people will ask: "What about rats? What about the smell? What about the way it looks - the aesthetics?" These are all valid concerns that many people associate with compost. So, what about them? The answers are in this next section.

Figure 3. A sample certified compost sticker to be placed on inspected compost or composting facilities to help ensure quality of compost and legitimacy for neighbors

In general, humans' brains latch on to negative attributes of a concept much more easily than the positive attributes–compost is no different. Compost has the unfortunate reputation of being smelly and swarming with rats. This reputation limits its widespread application and deprives many people of its benefits. While compost can sometimes smell and attract rats, such occurrences are most often a product of mismanagement. Levi Gardner of Urban Roots Community Farm said it best:

> Smell is a product of poor recipes, which only happens when there's anaerobic decomposition but if there's aerobic decomposition there's no smell. It smells like soil... If the piles are managed, pests don't want to eat apple cores that are immediately about to be incinerated. That's the thing: *it's all about management.*[15]

If management is key to avoiding smelly and rat-infested compost, education is key to transforming a negative reputation into a positive one that recognizes compost as environmentally-friendly, community-building, and profitable. Next we detail below the role that education plays in spreading good management practices, and then offer guidance on some of the key ways to avoid rats (and other animals), smells and unsightly compost operations.

Teaching Best Management Practices

Backyard composting is often people's only exposure to compost. However if a homeowner does not receive proper education on how to manage their compost pile and food scrap bucket, their compost will smell and attract rats. Because of the smaller volume, composting at the household level can more easily cause smells and attract rats–nuisances less likely to occur in a higher-volume, community compost system. Mr. Gardner explained why during

our interview:

> The problem [with] backyard composting [is that] most people don't know the recipe, they aren't creating enough feedstocks and so they are never getting to those temperatures–which means pests are going to be an issue. So the municipal codes are written around backyard composting and lack of literacy of how to do it. But medium-scale composting like what we're doing works, it works really well….It's all about management. If you manage it well, it has to be someone who you've pissed off to take you to task….it's all about your appropriations of your browns and your carbon sources, your turning and your building management and having a mass capacity so that you're getting enough to get those max temperatures. You'd really have to have a yard [of compost] or so to start, which according to our estimates is not even that much: 15-20 households. If you have that many, and its regular food stuffs per week, you'd have the heat that you'd need.[16]

To change backyard composting, municipal ordinances must reflect the proper compost management so that everyday consumers and interested compost buyers can learn the best ways to manage compost. It is through Urban Roots' medium-scaled, community compost operation–where "compost-educated" people are managing the compost–that the problems of pests and smells disappear. Until municipal ordinances facilitate proper backyard compost management and there is widespread public education on proper compost management, an effective way to break down compost's "what about" reputation is through the community-scale model. Moreover, to thrive, community compost does not require contributions from every household. As Mr. Gardner says, only "15-20 households" are needed to generate enough compost to operate.

If Detroit were to create a community composting

Table 1. Material Handling Needs

	% of Incoming Materials	Staging/Receiving Requirements	Processing Requirements	Curing/Storage Requirements
Leaves	50 - 60%	Accumulate in Fall for Spring	Incorporate gradually with grass	As finished compost at 3:1 or 4:1 volume reduction
Grass	30 - 40%	Accumulate for 1-2 days	Incorporate gradually with leaves	As finished compost (see above)
Wood Chips/ Brush	0 - 15%	Accumulate until grinding can occur	Grind separately from grass or leaves	As finished compost (see above)
Food Scraps	0 - 5%	Accumulate for 1-2 days	Incorporate quickly with leaves	Incorporate quickly with leaves

Guidelines for how to handle different types of materials in compost (Michigan Recycling Coalition, 2015).

network, interested practitioners must practice good management. In an interview with Aaron Hiday, the Compost Program Coordinator at the Michigan Department of Environment, Great Lakes, and Energy, he highlighted the importance of following proper management, proclaiming:

> You've got to have compost educated people running the sites. Compost is one of those things that can go south very, very quickly and stink to high heavens. I've seen sites get out of hand so quickly, and they are people who have good intentions but they just get way in over their head.[17]

As Mr. Hiday stresses, a lot of things can go wrong quickly when composting. And, without knowing the proper management techniques, composting can end badly for anyone and any community. Charles Cross, a resident of Sherwood Forest, recognized this hurdle as a factor that may inhibit a community compost network from working in his neighborhood. During an interview, Mr. Cross predicted that residents will argue the worst case scenario, that composting "is going to smell bad" and attract raccoons to their property. Mr. Cross understands, however, that "with proper management all [concerns] can be addressed."[18]

In our research and interviews we learned about some of these good management techniques. The following discussion of the proper management techniques is not an exhaustive list, nor should it act as formal education. Interested composters should use this guide as an introduction and inspiration to seek out formal educational opportunities. The following section provides expert advice on general composting best practices, followed by rat and odor management practices.

General Site Management

We recommend starting composting on a small scale.[19, 20] With all the potential problems that could plague a community composting site, by starting small, the stakes are low. Furthermore, a small operation gives composters expertise, experience troubleshooting problems and confidence. When designing a site, according to the Michigan Recycling Coalition (MRC), it's critical to have access to water, electricity and a sewage system.[21] Water is needed to manage odors. Electricity and a sewage system are necessary for accommodating structures used for site operators, staff, volunteers and visitors. Depending on the site, secure fencing and a lockable gate might be helpful to "limit liability from illegal dumping, contamination, vandalism, theft, and injury to unsupervised visitors."[22] Ensure that all tools, materials and anything else has a secure storage place when not in use. Site organization and cleanliness is important to maintain the site.

As discussed in the section *People, Place, and Compost Capacity*, site management can also be improved through regular data tracking and recordkeeping. According to the Institute for Local Self-Reliance (ILSR), "collecting data helps composters learn about the systems and materials that work best at making compost."[23] It also helps if a site wants to expand operations because it gives composters precise measurements needed for compost expansion given a particular processing size. Moreover, frequent monitoring and observation of moisture, temperature, density, and smell is important to ensure proper management and avoiding the what abouts. However, precisely measuring some of these factors might require buying thermometers and other instruments.

Finally, visual barriers can reduce the visual bias some people experience when seeing something messy or dirty, causing them to pre-judge and tell their noses that, "yes, this will be smelly." In an interview with Malik Johnson, Environmental Specialist within the City of Detroit's Buildings, Safety Engineering and Environmental Department, we learned that in the

GENERAL BEST MANAGEMENT PRACTICES

- **Start composting on a small-scale.** Composting properly takes practice and experience before increasing production. The stakes are low.
- **Be a good neighbor.** People might be resistant to compost in their neighborhood. Show them you mean no harm. Listen if they have concerns. Some neighbors might want to help or learn.
- **Follow the law.** Running a compost operation is a lot easier when you follow all proper regulatory and zoning measures.
- **Have a plan before breaking ground (for site, labor, finances, cleanliness).** A composting operation is a business; even if profit is not the goal, the operation can get out of hand if poorly organized.
- **Have access to water and other relevant utilities.** Water, electricity, and a sewage system are all essential to proper management and operation.
- **Have enough storage for tools, bins, and other equipment.** Proper management means having a place to put everything. Cleanliness is vital.
- **Seal and lock all storage bins or containers.** Ensure the site is not vulnerable to intruders (of all kinds).
- **Track materials coming in and out of the site.** This helps to keep things in order and know how the future of your site will look and what you will need.
- **Monitor active compost frequently: temperature, moisture content, density, and smell.** Proper management requires checking and more checking. These conditions can change frequently within a day.
- **Use visual barriers like a fence around the site.** This barrier can also be a part of a rat management strategy. This alleviates potential aesthetic concerns neighbors might have.

past, some city site inspectors gave blight tickets to urban farms.[24] Without knowing additional details, it is possible that some of those ticketed sites were not blighted, but needed proper maintenance and management. What was considered "blight" could be an example of this visual bias. In line with MRC's Compost Operators Guidebook, the sites that choose to implement a barrier (such as a fence or structure), should make them "at least eight feet" in height.[25] This barrier can be the same barrier used to mitigate rats as long as one layer of the barrier is made out of ¼ inch hardware cloth.

Controlling Rats (and Other Animals)

A variety of animals such as raccoons, foxes, coyotes, and rats can be attracted to compost. The most common animals are rats. However, if a site manages their rat problem, they can manage the other animals. Rats are a public health risk that carry lots of diseases harmful to humans.[26] Compost sites are easy food and water sources for rats.

According to Michael Parsons, a Visiting Research Scholar at Fordham University, when searching for signs of rats on a site, look for rat sebums smears, which look like grease stains that come from naturally produced oils within rat hair, along walls or corners as rats repeatedly run in the same areas.[27] Rats have poor vision, so they use sebum smears to communicate with each other and give them a sense of where they are. Imagine where a rat could look for food and water, and where they could live. Rats tend to follow the same daily route and nest within a hundred feet of food.

Look for the presence of rat poop or urine.[28] Rats find food where there is improperly stored garbage, clutter, overgrown weeds and vegetation, any holes or openings bigger than an inch in structures or sidewalks.[29] Rats like to live where the soil meets the pavement and anywhere where humans don't have a clear line. Ivy plants or shrubs should be trimmed and maintained as they tend to keep rats hidden. Rat populations can grow exponentially and are difficult to displace once they find a home.[30] They are nocturnal animals that don't like to be out in the day. Many rats visible during the day is a sign of a rat infestation, as typically only 5% of rats are visible during the day.

David Buckel–a former master composter at New York City's Red Hook Community Farm, compost site coordinator for the NYC Compost Project and collaborator with ILSR–writes that tumblers are the most rat proof composting system.[31] All tumblers are the same (see *Figure 5)*. Bins, on the other hand, require structural modification and added security measures to make them rat proof. Rats still might burrow or make a home nearby because rats like warmth. Bins hold more compost than tumblers (see *Figure 6)*.

Windrows are the least rat proof system because they have no protective barriers (see *Figure 7)*.[32] This means it's critical to regularly turn them. Windrows must be sealed along the outside with a thick layer of browns or finished compost, when not being turned, to deter rats. There shouldn't be any visible crumb nor be visible food anywhere on site. Ensure windrows and all compost systems are surrounded by open space.

Rats burrow in piles or unsecured storage bins.[33] Destroy or move any piles. Clean the site and all structures regularly. Put the compost system in the middle of the site surrounded by open space because rats hate being in open space, exposed to predators. Compost structure should keep a two foot clearance between plants and exterior walls of the compost structure and maintain at least six feet of clearance between exterior walls and tree limbs/branches. Build a barrier around the site's perimeter too. Locate compost away from livestock.[34]

Parsons states three rat mitigation strategies to do simultaneously.[35] The first strategy is to minimize any

Figure 5. A sample compost tumbler (Santelli, 2008)

Figure 6. A sample compost bin (Holt, 2009)

Figure 7. A sample compost windrow (Jensen, 2011)

Figure 8. A sample compost bay system (Blizzard, n.d.)

aromatic smells, which means filtering out smelly inputs at the compost staging process. Second, block rats' communication by having a strong overpowering scent, be careful though, because that smell will attract rats once they discover that behind the overpowering scent is food. And then third, build a barrier, with ¼ inch hardware cloth, around the compost and site. But barriers aren't foolproof: a rat can chew through the barrier if it knows it leads to food and water. The compost system recommended in this report for two of the pilot sites is a bay system (see *Figure 8)*. This system is like a bin system but with one open side enabling easier access to turn by hand or machine. Rat management for a bay system is mostly the same except for increased vigilance in monitoring the open bay side and ensuring that the barriers are secure. A bay system leaves the compost pile vulnerable and open.

Controlling Odors

The three most common reasons for foul odors are insufficient amounts of compost turning, not enough compost blending, and mismanaged leachate.[36]

As previously discussed in the section *What is Compost?*, turning is a part of aerobic decomposition.[37] Aerobic decomposition is generated by keeping adequate air in the compost pile through the physical turning and use of bulking matter like wood chips that sustain air pockets. Adequate air within the compost piles helps control odor. Turning the pile also cultivates aerobic microbes which aid in the decomposition process.

Anaerobic conditions create smelly odors.[38] Aerobic conditions do not smell bad and start with microbes. Microbes need nitrogen for growth and carbon for energy. Most organic materials do not have the right amount of carbon and nitrogen for ideal aerobic conditions but using a variety of fresh green and dried brown items can help mitigate smells. Blending brown and green materials allows the microbes to mitigate

the smell.

Proper management means getting the correct Carbon to Nitrogen ratio (C:N) within your compost system.[39] Aim to have a C:N ratio that is 1 part green (nitrogen) to 3 parts brown (carbon). A "part" is whatever one uses to measure their materials. It could be one shovel full, one bucket or one wheelbarrow. Brown materials slowly decompose. Green materials quickly decompose and are "hot" supplying the compost pile with the necessary heat. High temperatures mean that the composting process is working most effectively.

Gather browns and greens when they are abundant.[40] In fall, browns are common, but greens are not. In the spring and summer, greens may be easy to gather unlike browns. Browns alone may need a year to decompose. Browns should be stockpiled and mixed with greens when greens arrive on site. Greens can NOT be stockpiled by themselves because they give off foul odors and/or attract flies and other pests.

Beyond general season availability of feedstock, greens, which commonly take the form of food scraps,

BEST RAT MANAGEMENT PRACTICES

- **Minimize smells**
- **Block rat communication by eliminating smells or masking them with hygienic fragrances as overpowering scents.** Hygienic scents are useful only when combined with other strategies, as it can backfire if rats get into compost.
- **Cover-up/eliminate food sources**
- **Build physical barriers.** Use ¼ inch hardware cloth as one line of defense. Rats can chew through wood.
- **Reduce or eliminate any bodies of water.** Rats need to drink to survive.
- **Clean the site regularly.** Clean up any mess or pile. Even a crumb. Clean up equipment and tools after use. Cover and secure bins/containers. Do not overfill containers or bins.
- **Filter/pre-sift food inputs.** Do not put in anything smelly or aromatic.
- **Turn the compost**. Turning gives compost airflow, reducing smell and evenly heats compost.
- **Destroy any rat burrows or any (non-compost) piles.** Rats need a depth of eight inches to create a burrow.
- **Design a site with open space buffers around the perimeter and compost system.** Rats do not enjoy being exposed to predators in the open.

are nearly always available. However, browns can be a limiting factor; it's not always clear where browns will be sourced from. Some sites will have easy access to browns (lots of foliage, trees or hay with livestock). Conversely, others might have to create partnerships or regularly purchase browns to ensure the site has enough brown material. This will impact how much food scraps and greens a site can handle, thus limiting your composting capacity.

When compost is in water, compost's natural air spaces fill up with water causing respiration to cease and aerobic microbes to die which omits the bad smell. It is best to also avoid compacting the compost because it creates anaerobic conditions as air leaves.[41] Certain smells can mean different things.[42] A rotten egg smell means there is too much moisture. A fishy smell means the compost is biologically unstable and won't compost efficiently. In the *Appendix*, there is a troubleshooting guide from ILSR to help site managers manage potential issues including types of smells.

Filter through materials before being integrated into the compost.[43] Bring in fresh food scraps, and other nitrogen-based inputs while avoiding fats, meat, dairy and fish. Fats, meat and dairy attract rodents, smell, interfere with the microbial activity and cause inefficient and slow decomposition. Despite these inefficiencies, fish, dairy and meat can still be composted but it tends to be easier at a larger composting site that has the machinery to handle it.

Another odor problem is when compost in a sealed container sits too long in the container before being emptied at a compost site.[44] As it waits to fill, the compost becomes anaerobic. And the longer it waits to be emptied, the more likely the compost will seep into the container, tainting the container with an odor. The smell also gets worse because of no air flow. A solution is consistent weekly compost pick-up or drop-off. Other strategies include mixing incoming inputs with nearly finished compost and with browns and freezing the compost.

If screening and filtering at the onset of feedstock arrival is not possible, the next best place is a storage bin where it awaits to be composted.[45] The longer it remains in the bin the more it is necessary to layer or cover the scraps with browns.

After food scraps enter the compost, it can still smell.[46] There could be an imbalance in the C:N ratio, in which adding either more greens or brown would remedy it. Or there might not be enough oxygen to flow through because of low porosities due to compost compaction. More bulking materials would need to be added. Alternatively, the compost may need more blending or turning. Blending determines the rate of decomposition as microbes need both nitrogen and carbon to break food scraps down. So both carbon and nitrogen need to be spread out - covering all the compost - to quickly decompose. Blending is the easiest way to spread compost.

For bins and windrows, blending can occur three different ways:

1. **Pre-blend:** mix before the material is placed in a bin or windrow. This often is the easiest.
2. **Per-blend:** mix while the material is in the bin or windrow requiring a process of repetitively layering greens then browns. Each layer added pushes air out of the lower ones.
3. **Post-Bend:** mix after when all the browns and greens have be repetitively layered on top of each other like lasagna and then a pitchfork blends the pile. This is the hardest and can bring smelly compost if not blended and sealed quickly.[47]

A tumbler requires little effort to receive necessary amounts of airflow.[48] Conversely, bins and windrows require lots of effort for airflow. A bay system would be easier to manage odors because it is easier to access. Turning the compost enables all the material to get adequate exposure time to the ideal temperatures. The desired temperature for each pile to reduce pathogen generation is 131-degree

Fahrenheit and its supposed stay there for 72 hours. Well managed sites turn their compost every three or four days. However, turning frequency is dependent on the site.

Leachate smells and is a sign the compost is too wet.[49] As opposed to systems that are directly on soil, if feasible, leachate is most easily managed when the compost is resting upon a hard and flat surface, like concrete, to easily see leachate along the surface. These systems can also catch the lost microbials and nutrients by placing unfinished compost where the leachate runs to. If not mounted on impermeable surfaces, leachate is difficult to see where it runs and odor seeps into the permeable surface below, and must be cleared out to eliminate the smell. Wood chips are the best alternative to concrete because they are easier to shovel than soil. Managing leachate in a tumbler requires finished compost placed underneath so it can collect the falling leachate.

While these best management practices (BMPs) are derived from expert advice, they are initial steps, ones we hope will motivate aspiring composters to obtain a formal compost management education to help their compost systems thrive. If you would like to know more basic proper management rules, please review the Appendix. The next section will highlight our three study sites: Georgia Street Community Collective, Oakland Ave Urban Farm, and the neighborhood of Sherwood Forest, where we will discuss community-scale composting at three different stages, and how these sites already or could utilize these BMPs.

BEST ODOR MANAGEMENT PRACTICES

- **Reduce or eliminate any bodies of water.** Stagnant water smells after a while.
- **Turn the compost.** This allows for air and evenly heats compost.
- **Filter/pre-sift food inputs** This helps avoid smelly food in compost.
- **Always store Browns on-site** Browns are harder to find but necessary.
- **Never store Greens on-site** Stored greens can start to smell.
- **Cover and blend food scraps immediately upon arrival to the compost site** To minimize anaerobic conditions starting.
- **Maintain the C:N ratio of 3:1 - 3 parts Carbon to 1 part Nitrogen** Keeping this balance minimizes smells.

ENDNOTES

1. Mark Covington of Georgia Street Community Collective, Detroit, MI, personal communication, February 16, 2020.

2. Daniel Brown of Rust Belt Riders, Cleveland, Ohio, personal communication, March 17, 2020.

3. Brett Bloom of Dirt Wain, Fort Wayne, IN, personal communication, March 17, 2020.

4. Tim Campbell of Midtown Composting, Detroit, MI, personal communication, March 26, 2020.

5. (Tim Campbell, personal communication, March 26, 2020)

6. (Daniel Brown, personal communication, March 17, 2020)

7. (Mark Covington, personal communication, February 16, 2020)

8. (Daniel Brown, personal communication, March 17, 2020)

9. Michigan Recycling Coalition. (2015). Compost Operator Guidebook: Best Management Practices for Commercial Scale Composting Operations. Ch. 4, pp. 1)

10. Bilsens Brolis, L and Platt, B. (2019) *Community Composting Best Management Practices* (pp. 17). Institute for Local Self-Reliance. https://ilsr.org/wp-content/uploads/2019/03/Compost-BMP-v1.pdf

11. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 2)

12. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 7)

13. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 11)

14. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 10)

15. Levi Gardner of Urban Roots, Grand Rapids, MI, personal communication, March 17, 2020.

16. (Levi Gardner, personal communication, March 17, 2020.)

17. Aaron Hiday of the State of Michigan Department of Environment, Great Lakes and Energy, Lansing, MI, personal communication, March 5, 2020

18. Charles Cross of Sherwood Forest Neighborhood, Detroit, MI, personal communication, February 13, 2020

19. Michael Parsons of Fordham University, New York City, NY, personal communication, March 11, 2020.

20. Buckel, D. (2017). *Guidelines for Urban Community Composting* (pp. 1). https://ilsr.org/wp-content/uploads/2017/05/Guidelines-for-Urban-Community-Composting.pdf

21. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 7)

22. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 8)

23. Platt, B., & Fagundes, C. (2018). *Yes! In My Backyard: Composting Guide for Local Government*. Institute for Local Self-Reliance https://ilsr.org/wp-content/uploads/2018/06/Yes-In-My-Backyard-Full-Report-v2.pdf

24. Malik Johnson of Department of Buildings, Safety Engineering, Environmental Department (BSEED), Detroit, MI, personal communication, March 17, 2020

25. (Michigan Recycling Coalition, 2015, Ch. 4, pp. 19.)

26. Center for Disease Control and Prevention. (2018). *Diseases directly transmitted by rodents*. https://www.cdc.gov/rodents/diseases/direct.html

27. (Michael Parsons, personal communication, March 11, 2020)

28. (Michael Parsons, personal communication, March 11, 2020)

29. Institute of Local Self-Reliance. (2017, June 5). *Successful Rat Prevention for Community-Scaled Composting Webinar.* [Video]. Youtube. https://youtu.be/QmiTuZraFHI

30. (Michael Parsons, personal communication, March 11, 2020)

31. (Buckel, 2017, pp. 6)

32. (Buckel, 2017, pp. 7)

33. (Institute of Local Self-Reliance, 2017)

34. (Michael Parsons, personal communication, March 11, 2020)

35. (Michael Parsons, personal communication, March 11, 2020)

36. (Buckel, 2017, pp. 4)

37. (Buckel, 2017, pp. 2)

38. US Composting Council. (n.d.). *What is composting?* U.S. Composting Council Fact Sheet. http://organiclifestyles.tamu.edu/compost/home_composting_faq.pdf

39. (Buckel, 2017, pp. 4)

40. (US Composting Council, n.d.)

41. (Buckel, 2017, pp. 4)

42. (Michigan Recycling Coalition, 2015, Ch. 2, pp. 5)

43. (Institute of Local Self-Reliance, 2017)

44. (Buckel, 2017, pp. 2)

45. (Buckel, 2017, pp. 3)

46. (Buckel, 2017, pp. 4)
47. (Buckel, 2017, pp. 4)
48. (Buckel, 2017, pp. 6)
49. (Buckel, 2017, pp. 5)

PHOTO CREDITS

Cover page image from Bilsens Brolis, L and Platt, B. (2019) *Community Composting Best Management Practices*. Institute for Local Self-Reliance. https://ilsr.org/wp-content/uploads/2019/03/Compost-BMP-v1.pdf

GEORGIA STREET COMMUNITY COLLECTIVE

WHY GEORGIA STREET COMMUNITY COLLECTIVE?

Started by Mark Covington in 2008, The Georgia Street Community Collective (GSCC) is located in a neighborhood near Harper and Gratiot Avenue. GSCC's mission initially was to address the neighborhood's litter and garbage, but today envisions a space for neighborhood revitalization, education, health, and well-being.[1] GCSS provides health through community gardens and teaches others how to start their own gardens. They have established and continue to maintain the GSCC community education center and library which provides youth a safe place to meet. According to their website, GSCC seeks to "rebuild and sustain their community one house, one block, and one neighborhood at a time."[2] GSCC also hosts a variety of community events throughout the year, many of which have been on-going for twelve years straight.[3]

GSCC has grown over time from three lots to comprise five lots containing a community center, orchard, and farming operation (including neighborhood composting). GSCC is also a space to educate and mentor the area's youth. Soon GSCC will obtain two more lots dedicated to composting, expanding their food waste reduction mission. The site will also contain a space where community members can drop off their compostable material.[4]

This section explains what makes GSCC unique and why we chose to include it as a study site. It then will describe the surrounding community, how GSCC engages this community, and GSCC's current composting activities. Then, the section will discuss GSCC's role with education and their marketing strategy. The last section will discuss the future of GSCC and the proposed compost site.

WHAT MAKES GSCC UNIQUE

GSCC represents a functioning community composting center that plans to grow and move forward. GSCC currently operates its composting operation at three levels. At one level, GSCC's composting operation serves as an educational center exposing the community to the practice. It does this through its status as a community garden and community center, having deep ties to the neighborhood and the local school. GSCC also serves as a community composting site, which can help reduce the area's waste output and close the loop by selling or donating the compost created. Finally, the site functions as an example of how urban farms can utilize composting to improve their operations by using the finished compost on their crops. We are focusing on GSCC because its three-level compost system is a replicable model for many future sites.

Figure 1. Georgia Street Community Collective's urban farm (Rigney, February 2020).

The GSCC is deeply embedded within the surrounding community, as Mark Covington's family has lived within the community for generations. Mark has leveraged his relationships and social connections both within and without the community to make GSCC a compostable material drop-off center, not only for the local community but also for larger institutional actors and other urban farms. This social embeddedness makes it an ideal space to grow community-based programs, including a composting operation. Furthermore, the surrounding neighborhood, particularly around GSCC's physical space, is not densely populated, which makes it an ideal location for a composting operation by minimizing potential nuisance complaints from neighbors.

Additionally, GSCC is on land that is free from environmental concerns. GSCC is not located on a flood plain or wetland and is far enough away from any direct sewer connections so that the threat of run-off from the composting site is significantly reduced. GSCC would also like to obtain a mechanical means to turn its composting piles, which would further increase its capacity, thereby diverting more waste and creating more compost for the benefit of the community and the farm itself.[5]

Figure 2. Community Garden at Georgia Street Community Collective (Rigney, 2020),

COMMUNITY OVERVIEW

According to American Community Survey (ACS) 2017 5-year estimate, there are approximately 26,811 residents, 9,946 households living within a three mile radius, or 10 minutes driving distance to GSCC. The average household income is $24,722, which is 21% lower than the average household income of Detroit in 2017.

CURRENT COMPOST OPERATIONS

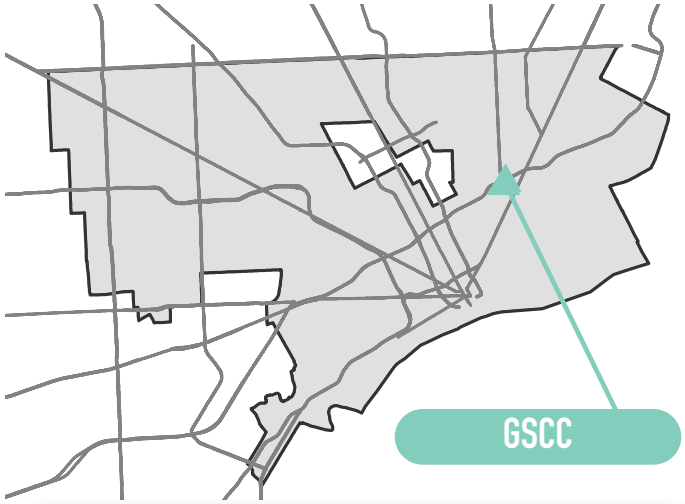
Current Compost Capacity

Currently, the GSCC is operating a three-pile composting operation, with a capacity of 3x3 cubic yards. The material for this current system was sourced through close collaboration with the local community (15 households who are donating compostable material including yard and food waste) and limited material from institutional actors. The community garden and surrounding land owned by GSCC itself is also a source of organic waste.

Compost Partners

GSCC has begun to work with various partners in their efforts to repurpose food waste, educate the community, and produce compost.

GSCC has secured a limited amount of material from Midtown Composting in the past and could receive material in greater amounts but this is dependent on changes to the current regulatory structure at the state and city level. At a city level, since GSCC is not located in an industrial zone, it currently can not compost any material beyond its own use. On a state level, GSCC's compost capacity expansion potential is limited upto 200 cubic yards. Proposed changes to both regulations would allow GSCC to compost for the community and would give it ample space to



THE SURROUNDING COMMUNITY

26,811
residents live within three miles of GSCC

9,946
households live in this area

$24,722
average household income

grow (see the *Policy Analysis for Composting* section for further discussion). The burgeoning partnership with Midtown Composting could also expand beyond simple material collection and delivery. Depending on regulations, Midtown Composting could also serve as a distributor of the finished compost produced by GSCC.[6]

Wayne State University is also becoming involved with GSCC's composting operation, but this partnership is also dependent on what the regulatory landscape becomes in the coming years. To date, Wayne State has only given a limited amount of compostable material and expressed interest in purchasing finishing compost. If state and city regulations allow GSCC to grow its operation, Wayne State will give more material to compost and will purchase finished compost from GSCC.[7]

GSCC has a limited partnership with AL Holmes Elementary, which is located within the same neighborhood. Currently, GSCC works with special education students aiding in their education by integrating them into the operations of the entire collective, including composting.[8] GSCC is talking with the Elementary school about potentially collecting food waste from the school.

Figure 3. Current compost processing site at Georgia Street Community Collective (Friese, 2020).

GSCC also worked with Michigan State University Community Extension until two years ago when funding was cut. Their partnership involved GSCC using the broader farm and composting operation to aid in math and science curriculum for students who were in grades three through eight. GSCC is interested in continuing that partnership or a partnership like it, as one of its main goals is community development through education.[9] The hope is that the more exposure youth get to sustainable practices, the more likely they are to apply them to their lives and their communities.

GSCC is also interested in educating the general public sometime in the future. GSCC would act as a community education and training hub within Detroit, educating the general public about composting and what types of products and food can go into compost bins. At the moment, though, GSCC does not know when such an educational role could take place due to limited organizational capacity.

GSCC is looking to leverage its current partnerships and create new ones. Given its ability to cultivate relationships with institutional actors, GSCC has a tremendous capacity to grow and become a leader beyond its immediate neighborhood borders. They are hopeful state and city regulations will be amended to aid in its mission of waste reduction, community empowerment, and education.

PROPOSED COMPOST OPERATION SYSTEM

Within the year, GSCC plans to buy two lots on the backside and east of the farm.[10] Each of these lots is 40 feet by 73 feet. The plan, assuming commercial composting production becomes legal, is to process composting for commercial composting for any interested partners and prospective buyers. GSCC is also looking into buying the necessary machinery needed to manage large quantities of compost. If compost doesn't become legal or they can not acquire the machinery then GSCC will convert the lots into goat grazing areas. Assuming composting is legal and they have the machines, GSCC then plans to buy the conjoining four lots north of the newly acquired two to use for future use. GSCC is also looking into the idea of purchasing nearby buildings to expand their community engagement capacity.

Figure 4. Location for future compost processing site at Georgia Street Community Collective (Friese, 2020).

Future development includes three compost drop off and pick-up stations, one for commercial partners and interested buyers, one for the community, and one for GSCC farm and site operation. The commercial station would be next to the two lots where the expanded compost operation is. The community station would be next to the community garden to make it accessible for the community. The third station, for GSCC's own use, would be located on the farm where the current compost pile is.[11]

RESIDENTIAL FOOD SCRAP CAPTURE POTENTIAL

16 tons/yr
2% of Households
3 lbs/Household/Week
Food Scrap Contribution

103 tons/yr
10% of Households
4 lbs/Household/Week
Food Scrap Contribution

FIGURE 5. POTENTIAL FOOD SCRAP CAPTURE

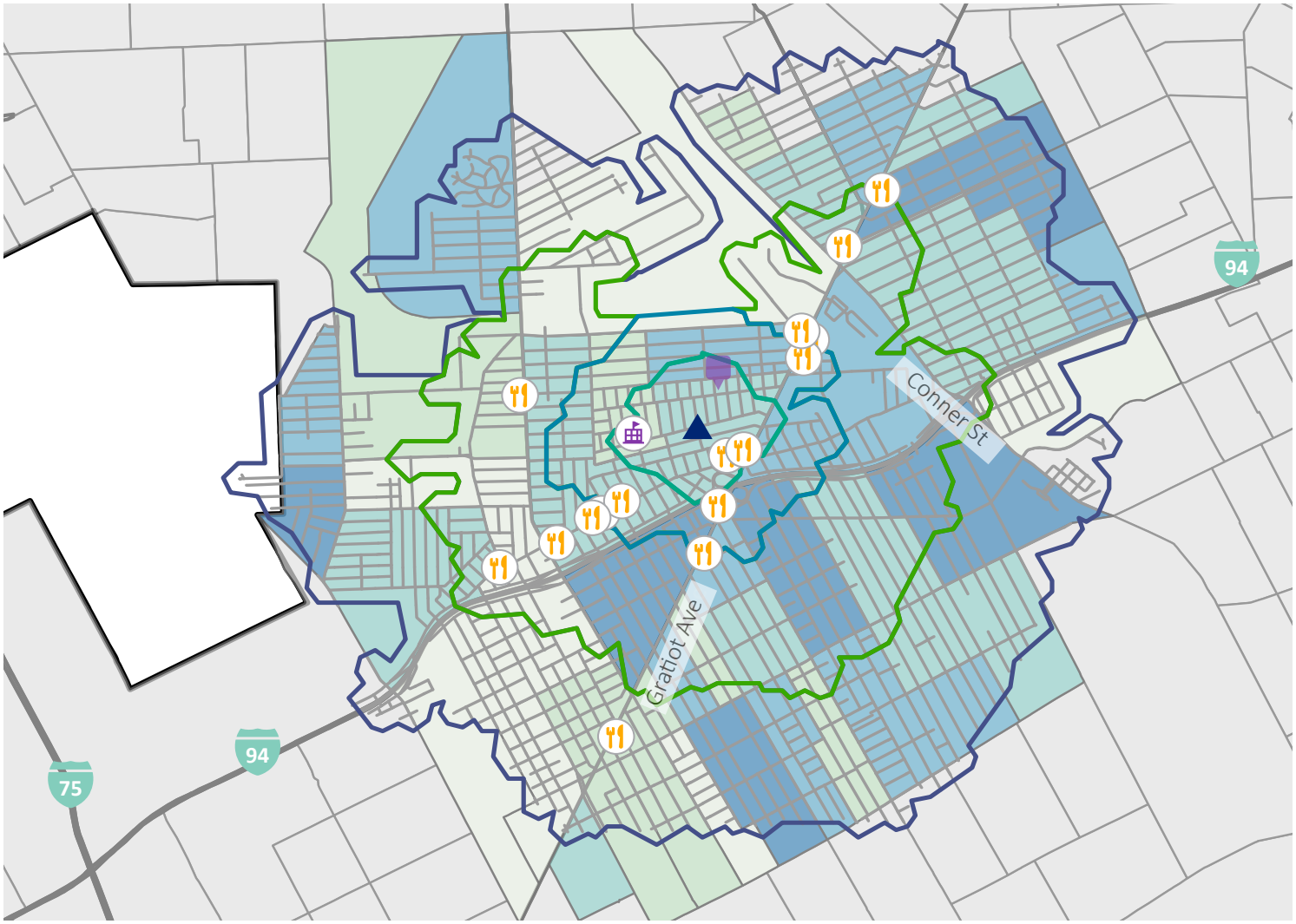


Figure 5. Potential Food Scrap Capture Within 3-Mile Drive Of Georgia Street Community Collective. Sources: American Community Survey 2017 5-year estimate, Locations Geocoded with Google Map [2020].

POTENTIAL ADDED COMPOST CAPACITY

Midtown Composting, Wayne State University, and AL Holmes Elementary are considering offering additional compostable material to support the expansion of the compost operation. The local community can also supply an abundant source of organic waste. The proposed food waste drop site, on the two new lots, can help capture residential food waste produced by the neighborhood. According to the scenarios of residential food waste capture (see *People, Place, and Compost* section), GSCC can capture 103 tons of food waste if 10% of households within 10 minutes driving distance participate in composting. As shown in Figure 5, we also identified 13 restaurants operating within a 10-minute drive of the site and a pasta factory near GSCC which could also contribute compostable material.

LABOR DEMAND FOR INCREASING OPERATION

Increasing composting operations will create greater labor demand. GSCC has access to a consistent volunteer force to help them with the community garden and compost management.[12] With strong community presence, GSCC can handle the proposed composting expansion, as described in the proposed concept design of the site.

PROPOSED CONCEPT DESIGN: A THREE-BAY SYSTEM

Figures 6 and 7 illustrate a potential site design of Georgia Street's compost site. The system is a three-bay system where compostable green material is dropped off from clients entering on the right gate and first put into the receiving/staging bay. Then from elsewhere on the farm, the corresponding brown material will be added to this receiving/staging bay. After which the compost will be transferred to the second bay by a loader where the active composting

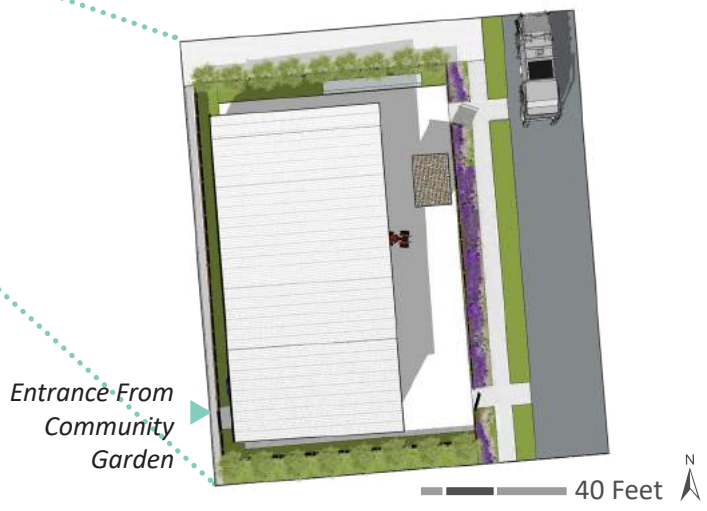


Figure 6. Conceptual master plan of future composting site and potential food scrap drop off location (Google Maps, 2020).

FIGURE 7. PROPOSED CONCEPT DESIGN

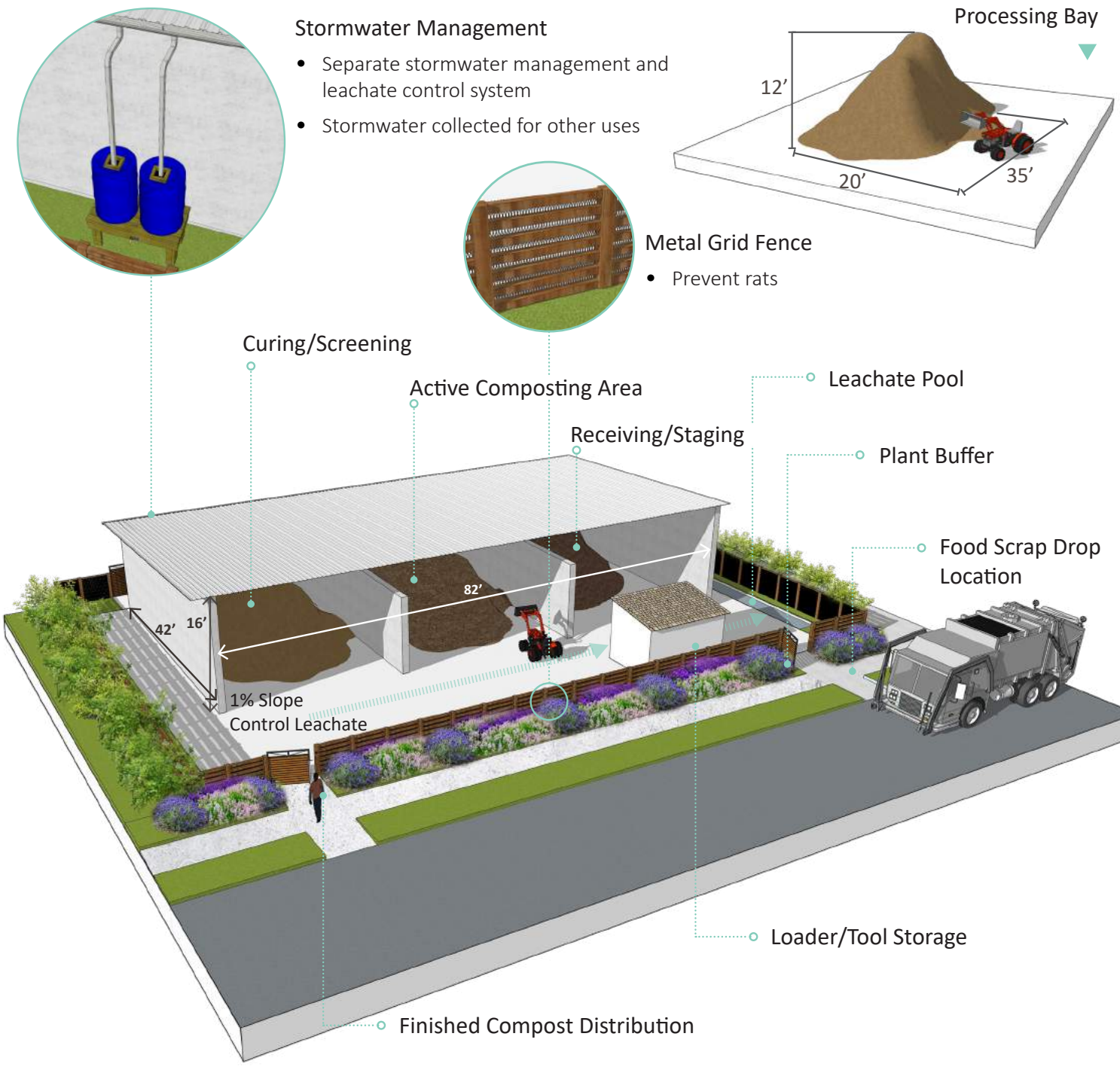


Figure 7. Future compost processing site design

stage will accelerate. Once the compost is mostly finished, the loader transfers it into the last bay on the left, the curing/screening bay, where it will begin the curing stage. Then the finished compost will be picked up by clients from the left gate. To mitigate rats entering the site, there is a hardware cloth fence wrapped all-around in addition to sacrificial scented plants around the outside. Surrounding the structure are open space buffers, which help mitigate rats by making them feel exposed and vulnerable to predators. Both the plants and the fence also address any aesthetic concerns. The plants also help to mitigate concerns of smells. Moreover, to manage leachate, the surface in which the compost piles lie upon is on a slope pointing down to a collection pool where any leachate will flow to. The structure's roof has a stormwater catchment system, collecting the rainwater into barrels to be used for farm irrigation. Near the barrels in the back is a gate that gives efficient access to other parts of the farm and community center. The loader can be securely sheltered in a shed near the fence when not in use. The shed also leaves space for tools.

COMPOST PROCESSING POTENTIAL

Volume of the Processing Bay: 207 CY

2/3 * (20W * 12H * 35L) = 5,600 ft^3 = **207 CY**
(207 * 463 lb/CY) / 2000 = **48 tons**

Annual Throughput: Vol * 4 = 192 tons

(Volume) * 4 = 192 tons
Assuming 90-day composting period

Annual Production: 58 – 77 tons

Shrinking factor: 30%-40%

COMPOST PROCESSING POTENTIAL ESTIMATION

According to the concept design, we estimated the potential processing capacity of the site. The volume of processing bay was estimated to be 207 cubic yards (CY), which contains around 48 tons of compostable materials. Assuming the materials requires 90 days to be processed into finished compost with low management efforts, GSCC could compost 192 tons of food and yard waste annually. With a 30% to 40% shrinking factor,[13] the site can yield 55-78 tons of finished compost every year. As indicated in the earlier discussion, GSCC has the potential to capture and process more materials with the existing community presence and future partnership.

COST EFFECTIVE ALTERNATIVE: START WITH WINDROWS

While this proposed site is designed for a bay system, we suggest that initial composting systems be windrows. A design like the one we recommend requires substantial funding or municipal support. GSCC has expressed their desire for this type of system and plans to engage with partners and apply for grants to obtain the necessary funds to build something similar to our design. For an aspiring composter with little money on-hand, windrows are relatively easy to build and maintain without spending excessive amounts. Moreover, windrows' relative low-cost enables more money to be spent on personnel and education, which are crucial for a small operations' success.

PROFIT POTENTIAL FOR COMPOST

With increasing compost production, GSCC hopes to sell finished compost if it can generate extra finished compost. Its partners such as Wayne State University could be potential purchasers; however GSCC has not started a formal conversation about selling with them. Local community members are also potential buyers. GSCC can catch their attention by word-of-mouth and social media marketing. For GSCC's production capacity, these two consumer groups along with the community garden's own demand, can adequately consume the compost produced by GSCC.

Although this is an excellent opportunity for GSCC to acquire more revenue, it is important to note that there are several barriers associated with selling compost. First, there are several legal barriers GSCC must overcome to sell compost. Zoned as single-family residential, the site can only produce compost for its own use. Selling legally would require a change in composting regulations as well as registration with the state as composting is defined as a soil conditioner (though depending on the claims made about the product compost could also be classified as a fertilizer and be subject to further regulatory control), which poses a difficulty for GSCC currently. In addition, as we discussed earlier, expanding compost production would require machine assistance. The purchase and maintenance cost is another barrier to make selling compost profitable.

BEST MANAGEMENT PRACTICES FOR ENVIRONMENTAL CONTEXT

While GSCC's environmental conditions are highly favorable for an expanded composting operation, the farm does occasionally flood as the site is not perfectly level which also can cause compost leachate to leak from the compost piles at times. However, it conveniently pools and stays on-site without flowing onto the sidewalks, and there is no nearby sewer drain.

GSCC is also alert to any foul smells the compost makes and is in close communication with the neighbors regarding the composting operation. If any smell becomes too odorous for the neighbors, they alert GSCC who quickly mitigates the smell. GSCC itself is also well suited to manage bad odors resulting from many years of farming experience. Mark Covington explained that GSCC maintains the ideal compost ratio recipe of carbon (e.g., leaves, livestock hay/straw, twigs and branches) to nitrogen (e.g., food stock, manure) to manage the smell.

GSCC, like any place, has some rat activity, but is confident it has taken measures to ensure the rats do not become a nuisance even after they expand production to the two lots. After expanding, GSCC intends on creating a barrier around the new production site.[14] In addition to physically keeping rats out, the barrier will be covered with a scent of lavender, or some other pleasant smell, to overpower foul smells, minimizing both rat attraction and neighbor complaints.[15] We recommend the barrier is made of a material akin to ¼ inch wire mesh to minimize chances of any rat breaking through. The barrier doubles as a visual barrier improving the aesthetics of the operation.[16]

Moreover, in addressing potential concerns over rats and odors with the planned compost expansion, GSCC is in the design stages of creating an environmentally sound site.[17] The details of the designs will have the compost sit upon a impermeable foundation, which will drain leachate into a container lessening GSCC's drainage fees. There will also be a cover over the compost serving as both part rainwater catchment system and part visual buffer from people walking by on the street. The cover will also have solar panels attached to minimize energy costs and improve

their environment footprint. They will implement an aerated tubing system underneath the piles giving the compost sufficient airflow to reduce any anaerobic conditions. Aerated piles cut down labor costs because there is less of a need to turn the piles. In addition to the fence around the lots, if all of these design plans come into fruition, the rats and smells should be minimized.

EXPANDING COMMUNITY IMPACT

GSCC has a strong vision for its future, focused on continuing to provide the community with services centering around education, health, leadership skills, establishing a safe place for youth, and rebuilding and sustaining the community. Seeking to maintain this mission, GSCC is in the process of deciding the best way to expand its services likely through the continued purchase of vacant lots and potentially the procurement of buildings adjacent to GSCC.[18] Through an increased footprint, GSCC will be able to provide additional services and spaces for the community to gather and learn.

Furthermore, increasing the amount of land owned, GSCC will also be able to expand its composting operation. This expansion will allow for greater utilization of institutional partners which will create more revenue for GSCC to develop further and offer more services. Expanding its composting operation will also result in more significant community benefits through waste diversion and the creation of a valuable product for community use.

LESSONS LEARNED

There are several lessons other groups looking to create similar community based composting programs can learn from GSCC:

- Focus on cultivating strong ties within the community where the composting operation will be located **by creating community-centered programs**. GSCC was able to accomplish this by involving the entire community in its revitalization efforts and by staying constantly engaged with all aspects of the community.
- **Communicate and educate** neighbors and fellow community members about the composting operation.
- Choose a composting location that **considers community density and isolation distances from primary residences** to eliminate nuisance complaints.
- Ensure that **individuals responsible for composting are knowledgeable about the best practices** of composting, thereby minimizing negative externalities.
- **Establish partnerships** with neighboring farms and larger institutions to source composting material and to create a customer base for the finished product.
- **Utilize word-of-mouth advertising based on existing relationships and visibility** within the community to both source compost material and sell the finished compost.

ENDNOTES

1. Jackman, M. (2009, May 27). *Food fighters*. Detroit Metro Times. https://www.metrotimes.com/detroit/food-fighters/Content?oid=2194966

2. Georgia Street Community Collective.(n.d.). Retrieved March 24, 2020, from http://www.georgiastreetcc.com/

3. (Georgia Street Community Collective, n.d.)

4. Mark Covington of Georgia Street Community Collective, Detroit, MI, personal communication, March 17, 2020

5. Mark Covington of Georgia Street Community Collective, Detroit, MI, personal communication, February 16, 2020

6. (Mark Covington, personal communication, March 17, 2020)

7. (Mark Covington, personal communication, March 17, 2020)

8. (Mark Covington, personal communication, March 17, 2020)

9. (Mark Covington, personal communication, February 16, 2020)

10. (Mark Covington, personal communication, February 16, 2020)

11. (Mark Covington, personal communication, February 16, 2020)

12. (Mark Covington, personal communication, March 17, 2020)

13. McSweeney, J. (2019). *Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and Solving Our Waste Crisis*. Chapter 7: Bin and Bay Composting Systems. p. 121.

14. (Mark Covington, personal communication, March 17, 2020)

15. (Mark Covington, personal communication, February 16, 2020)

16. (Mark Covington, personal communication, March 17, 2020)

17. Renee Wallace of Food PLUS Detroit, Detroit, MI, personal communication, March 23, 2020

18. (Mark Covington, personal communication, February 16, 2020)

19. (Mark Covington, personal communication, February 16, 2020)

PHOTO CREDITS

Georgia Street Community Collective cover page image from Megan Rigney, 2020.

Figure 1. Georgia Street Community Collective's urban farm. Megan Rigney, February 2020.

Figure 2. Community Garden at Georgia Street Community Collective. Rigney, 2020.

Figure 3. Current compost processing site at Georgia Street Community Collective. Michael Friese, 2020.

Figure 4. Location for future compost processing site at Georgia Street Community Collective. Friese, 2020.

Figure 5. Potential Food Scrap Capture Within 3-Mile Drive Of Georgia Street Community Collective. Data Sources: American Community Survey 2017 5-year estimate, Locations Geocoded with Google Map [2020].

Figure 6. Conceptual master plan of future composting site and potential food scrap drop off location. Basemap source: Google Maps, 2020.

Figure 7. Future compost processing site design. Meixin Yuan, 2020.

OAKLAND AVENUE URBAN FARM

WHY OAKLAND AVENUE URBAN FARM?

Established in 2009, the Oakland Avenue Urban Farm (further referred to as OAUF in this section), is a program of North End Christian Community Development Corporation. Run as a non-profit, OAUF is a community-based organization "dedicated to cultivating healthy foods, sustainable economies, and active cultural environments" in Detroit's North End.[1] Like many urban farm projects, compost plays an integral role in the growing process; soil contamination is always a potential concern, and compacted soil conditions can be notoriously difficult to grow to produce in. Currently, OAUF operates nine planting fields, with plans for steady growth. Each year for the last several years, the farm has purchased two additional, neighboring parcels. In 2019, this amounted to a 15% increase in size.[2] This constant growth is accompanied by increasing compost utilization in varying degrees.

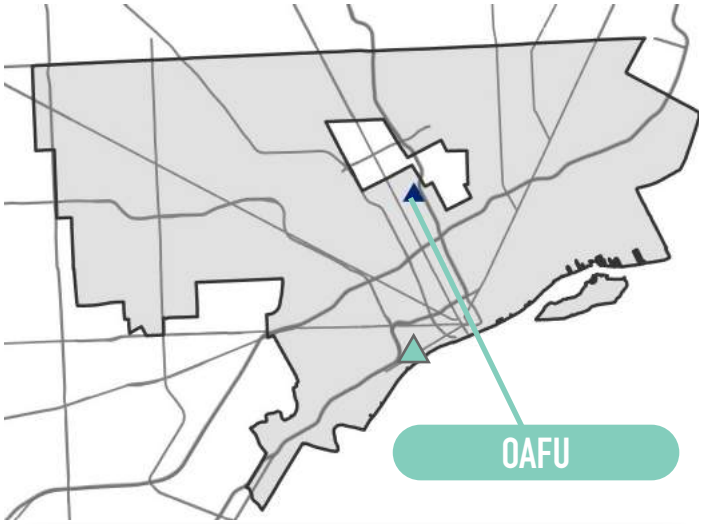
WHAT MAKES OAFU UNIQUE

OAUF currently operates as a compost distribution hub for the local agricultural organization Keep Growing Detroit. Members of the organization, who include other urban farmers and residents, can pick up compost for off-site utilization from the OAUF site. Accordingly, the development of a community-based composting program is of demonstrated importance. Increasing capacity and production output of compost both will contribute to growth yield for the farm as well as continue to support local gardening and agricultural networks. This section of the report will focus on outlining a variety of options and considerations that OAUF, and urban farms like it, should consider in their pursuit of establishing a self-operated, community-based composting program.

COMMUNITY OVERVIEW

The North End neighborhood consists of roughly 12,952 households, housing a population of 31,280 within its 3-mile radius.[3]

Figure 1. Greenhouse and community engagement board at OAFU (Rigney, 2020).



THE SURROUNDING COMMUNITY

31,280
residents live within three miles of OAFU

12,952
households live in this area

$27,830
average household income

PROPOSED COMPOST OPERATION SYSTEM

CURRENT COMPOST USE

The compost that OAUF currently sources from Keep Growing Detroit typically amounts to 30 to 40 cubic yards of compost, approximately seven times a year.[4] [4] This compost is primarily used for farm operations as some of their produce is grown entirely in compost beds. Since OAUF does not have an ongoing compost operation, we can assume that the amount of compost they currently purchase, minus a couple of yards a month that they give away for free as part of a program with Keep Growing Detroit, is the amount that they currently require to manage their nine fields of productive farmland. By this calculation, OAUF uses between 180 to 320 cubic yards of compost per annum for farm operations alone.

BEST MANAGEMENT PRACTICES

According to James McSweeney, key considerations in determining site designs and other operational and cost considerations for community-scale composting systems include the space and time required for the composting process, both of which also depend on the targeted scale and available labor.[5] Additionally, storage space is required for equipment, throughput, active composting phase, curing phase, screening and storing the finished product. Along with space for each of these phases of the composting process, space needs may vary depending on the time needed for each batch size to ensure access to composting material and avoid overcrowding of the site.[6] To maintain a successful composting site, we also considered access to water and runoff management in the site design. To save on start-up costs, farming tools for turning the compost and other auxiliary infrastructure requirements such as dumping trucks can be adjusted for based on the equipment that the farm already has access to.[7]

Figure 2. Team Members and Billy Hebron (OAUF owner) measure the future compost site area (Rigney, 2020).

Since this is OAUF's first composting system, we propose an implementation strategy that prioritizes scaling. By building a program that possesses a built-in capacity for growth, managers of the system can adapt to the future needs of the farm and the level of community engagement. Because of the learning curve involved with starting a compost operation, starting with a system for demonstration and education could prove useful. Not relying on mechanized composting processes- as we propose - has also been shown to build social capital, a core mission of OAFU.[8]Scaling the implementation of a composting facility system would also allow the farm to leverage existing community ties while including an educational component, as explained later in the "Expanding Community Engagement" portion. For these reasons, we propose that OAUF adopt a three-bay composting system. As we outlined in the *Compost Market and Community* section of this report, a three-bay system can be costly, but the Farm

could slowly build the compost production system and continuously add more bays as it scales up. A three-bay system also has the added benefits, as we noted, of not requiring mechanized turning and can serve as an educational demonstration site. More details of the design are in the following section.

Environmental Site Considerations

OAUF does not have significant issues concerning its environmental context and lies in an area that is not prone to flood hazards.[10] To better manage stormwater runoff in cases of high precipitation, the owners of the farm have set in place a stormwater management system custom-built with rocks that catch, filter, and store runoff, which is then pumped and used to water their crops.[11] This underground system is built on the western side of the farm within the section used to hold farmers' markets. The proposed composting site is located on the eastern side of the farm, facing Cameron Street. With the introduction of a composting operation, additional stormwater management would be required for the site in addition to managing leachate produced by composting. In a bay system, building a thick carbon base layer of 12 inches or more will decrease the likelihood of leachate stagnation on the compost pad and reduce odor.[12] Leachate can be collected and diverted from the bays and collected in a pool and treated or, most commonly used for adding moisture to a compost batch.[13] Other ways to manage leachate include runoff controls such as vegetative filter strips and sediment traps, using gravel beds, or utilizing “deep soil” techniques.[14] In our design, we propose having a 1% slope on the site to ensure that the leachate does not stagnate as well as a leachate pool to avoid filtration into the soil or water system.

COMPOST PICK-UP SITE

In line with OAUF’s mission to embed their work in the surrounding community, their composting process must also be reciprocal. Similar to what the Farm already does with the compost they receive from Keep Growing Detroit; Farm managers envision part of the finished compost product being available for free-pick up by neighboring residents as well as members of Keep Growing Detroit. Similar to planning a food scrap donation drop-off site, the compost pick-up site centers around coordinating location, schedule, and containers. A location that is more convenient for participants may be the food scrap donation site, but it may be more suitable for staff to put the site directly adjacent to the compost site. A consistent schedule is essential to make preparation and pick-up a regular habit for staff and participants. Containers for picking up the compost can be paper bags or reusable plastic containers.[9]

PROPOSED THREE-BAY COMPOST SYSTEM DESIGN

Figure 4 illustrates a potential three-bay system design proposal for OAUF's compost operation site. A hardware cloth fence wrapping around the entire site is designed to discourage rats from entering the site. The open space buffers around the site is a second strategy to discourage rats as the open space is likely to make them feel exposed and vulnerable to predators (see the section *Tackling Education and Best Management Practices*). The existing trees around the site will also play an essential role in the compost site. They help address any aesthetic concerns as well as help to mitigate concerns of smells. The surface of the compost operation site is at a 1% slope to control for leachate so that it will drain down into a collection pool.

Additionally, the structure's roof has a stormwater catchment system that will collect rainwater into the barrels to be used for farm irrigation. The loader can be securely sheltered in a tool shed near the fence when not in use. Near the barrels, in the back, is a

gate that gives efficient access to the primary site of Oakland Ave Farm. The proposed system operation is:

1. Food scrap material is put into a trench pile (not pictured in rendering)
2. Compostable green material, including ready food scraps, is dropped off into the screening/staging bin
3. Brown material that has been collected from the farm and/or purchased is added to the screening/staging bin
4. After the screening/staging phase, the compost will be transferred to the second bin, the active composting bin, by a loader
5. When the compost is finished in the active state, the loader will be used to move the compost pile to the last bin on the left, the curing bin, where it will begin the curing stage
6. Finished compost will be picked up by participants from the left-side gate

COMPOST PROCESSING POTENTIAL[15]

Volume of the Processing Bay: 148 CY

2/3 * (20W * 12H * 25L) = 4,000 ft^3 = 148 CY
(148 * 463 lb/CY) / 2000 = 34 tons

Annual Throughput: Vol * 4 = 136 tons

(Volume) * 4 = 136 tons
Assuming 90-day composting period

Annual Production: 82 – 95 tons

Shrinking factor: 30%-40%

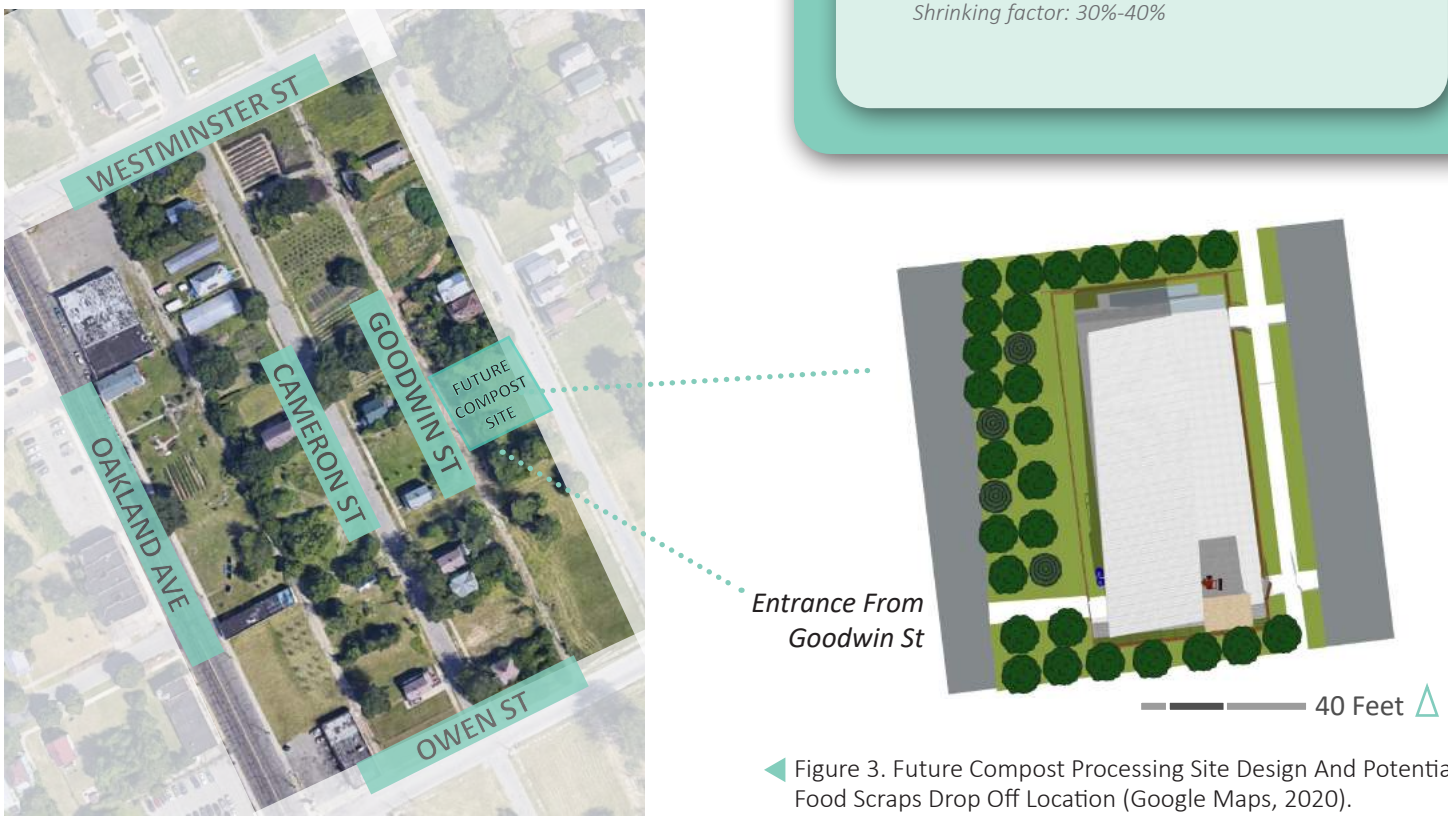


Figure 3. Future Compost Processing Site Design And Potential Food Scraps Drop Off Location (Google Maps, 2020).

FIGURE 4. PROPOSED CONCEPT DESIGN

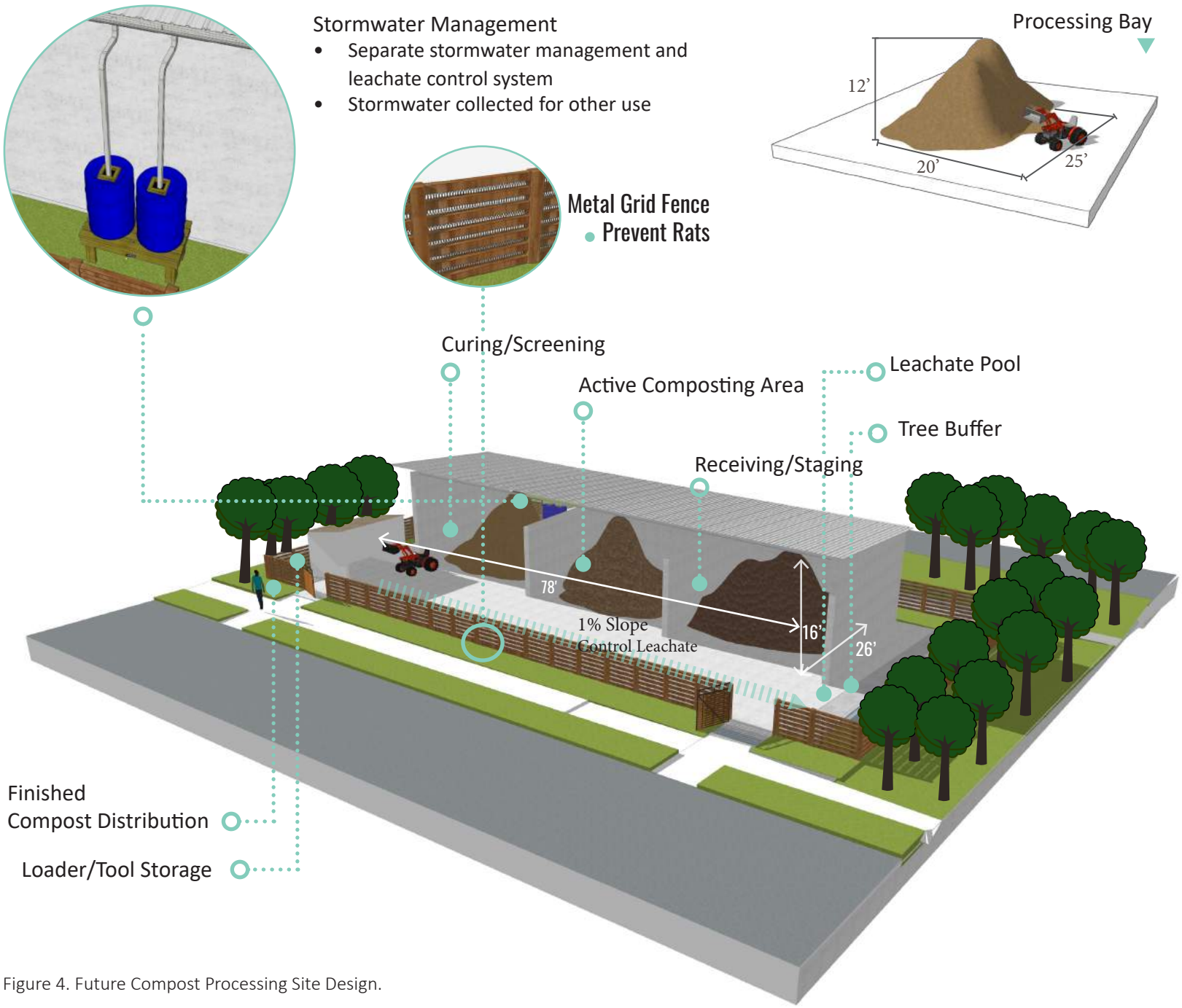
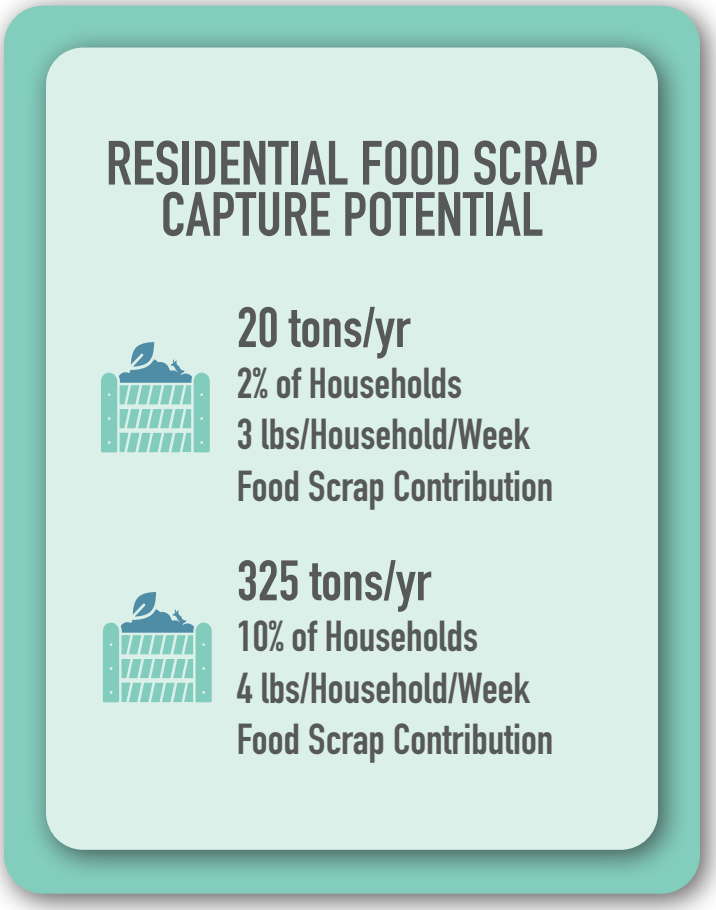


Figure 4. Future Compost Processing Site Design.

PROPOSED FOOD SCRAP DROP-OFF SITE

Food scraps are a significant component in the compost pile recipe. In initializing a composting program for Oakland Ave Urban Farm, we propose utilizing food scrap donations from a combination of local food generating sites within a 3-mile radius, including neighboring residents and area institutions such as schools and restaurants. For example, Oakland Ave Urban Farm could partner with Detroit International Academy and Maine Street Kitchen to utilize their food scraps for compost production. This partnership could be further beneficial if Oakland Ave Urban Farm sells or gives either the compost or fruits and vegetables grown in the compost to these food institutions.



There are currently 12,952 households within a 3-mile radius of Oakland Ave Urban Farm.[16] With 2% of households contributing 3 lbs/week of food scraps, the estimated total tonnage of annual residential food scraps captured is 20 tons. With an increased estimate of 10% of households contributing 4 lbs/week, the estimate increases to total tonnage of 135 tons annually.[17] When planning for additional contributions from community schools and restaurants, this tonnage would increase. Successful preparation for a food scrap drop-off site includes strategizing for the three major components of the drop-off process: location of the site, drop-off schedule, and collection containers.

LOCATION

Location planning requires balancing the convenience of the food scrap donation process for participants as well as making the collection process painless for staff. There are currently three possible food scrap drop-off site locations for Oakland Ave Urban Farm. The first is the farmers' market, held from 11 am to 3:30 pm every Saturday. The farmers' market provides a convenient place for neighbors to pick up fresh produce and drop-off food scraps. However, the market runs four months a year, from June to September. Further complicating things is the fact that the farmers' market is nearly 400 feet from the planned compost site.

The considerable distance could pose a logistical challenge if the intake of food scrap tonnage is high

FIGURE 5. POTENTIAL FOOD SCRAP CAPTURE

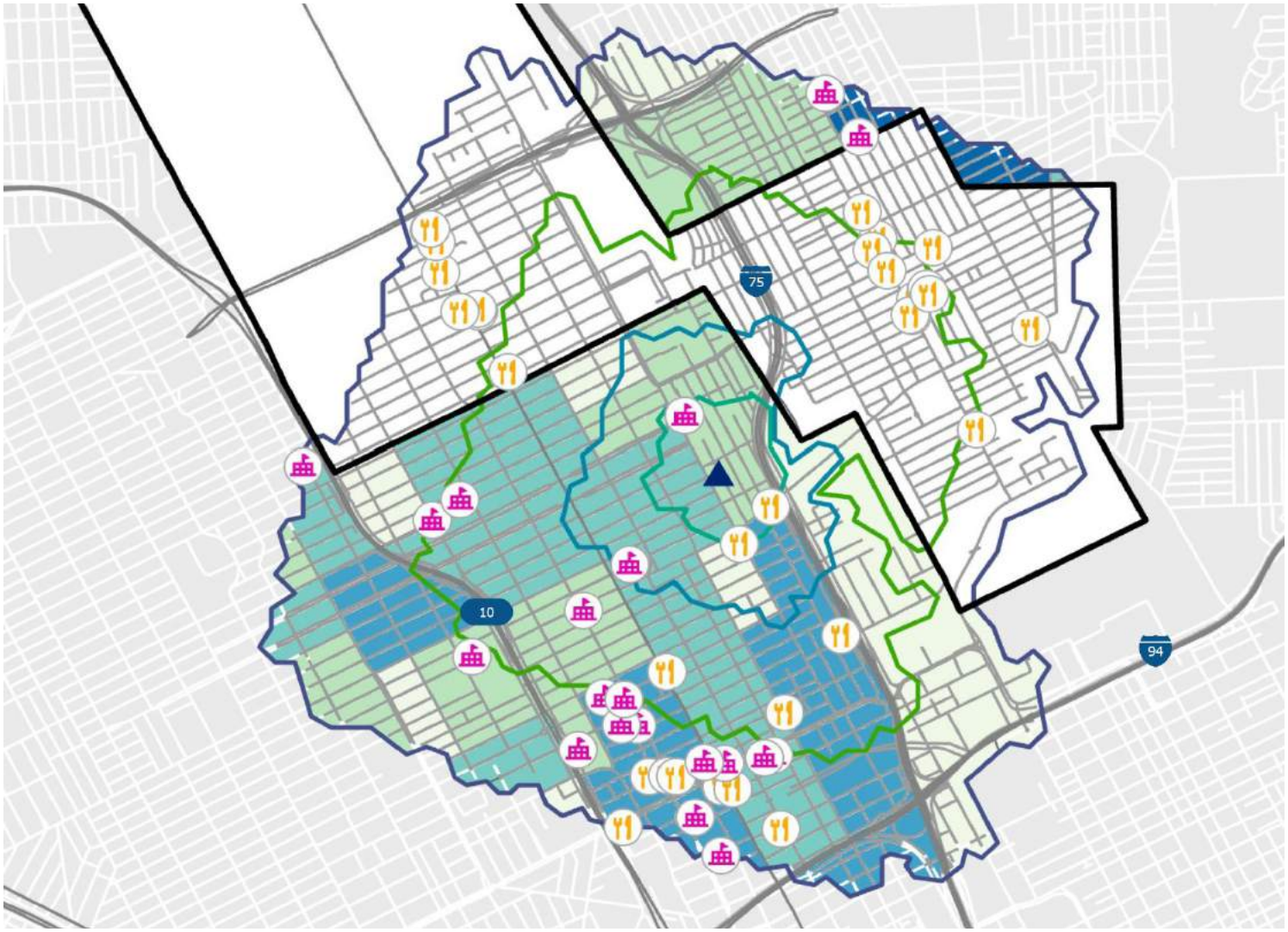


Figure 5. Potential Food Scrap Capture Within 3-Mile Drive of Oakland Avenue Urban Farm. Source: U.S. Census Bureau, American Community Survey. (2018). 2017 ACS 5-year estimate, Table DP05, City of Detroit, MI. Locations Geo-coded with Google Map (2020).

and requires several trips between the farmers' market to the location of the proposed compost site.

The second proposed site is adjacent to the proposed compost facility. This option represents the highest level of convenience for Oakland Ave Urban Farm staff as there would be no need to transport donated materials. However, the composting location could prove inconvenient for community members who are utilizing the service. The compost site is isolated from the rest of the farm out of necessity, which means participants would have to make an explicit trip to drop-off their food scraps.

A potentially more attractive option than either of these is the centrally located Community House and Farm Store. Currently, the building houses Oakland Ave Urban Farm's administrative offices while doubling as a commercial outlet that sells produce and farm goods. The advantages of this site are its closer proximity to the compost site at 350 feet, as well as the potential commercial benefits of combining drop-off with retail. Making the collection site easily accessible allows for those utilizing its service to build a routine that is critical for attaining sustainability (see Figure 10 for a potential design of this last drop-off site)..

SCHEDULE

Operating with a routine in mind is recommended to ensure food scrap drop-off participants can develop a habit of dropping off donations.[18] The capacity to accept weekend or nighttime drop-offs may provide more convenience for food scrap partners. Furthermore, coordinating drop-off times with other scheduled events on the farm could increase community participation rates. If Oakland Ave Urban Farm were to schedule drop-off times during Saturday farmers' markets, it would contribute to the attractiveness of dual-purpose trips, building upon the ability of the farm to engage with the surrounding community.

CASE STUDY 1:
URBAN ROOTS YOUR COMPOST GRAND RAPIDS, MI

As we noted in the section "Compost Market and Community: Steps Towards a Closed-Loop System," Urban Roots is an urban community farm established in 2013 in Grand Rapids MI that produces compost primarily utilizing leftover products obtained from their residential and small business food scrap donation program. Most of the food scraps are collected via weekly curbside pickup. Or, participants can drop-off food scraps at their convenience into a compost collection container located at the farm's headquarters, similar to the third location we propose for OAFU.[19] This image to the right is a snap-shot of a demonstration video for using the food scrap drop-off site.

Figure 6. Urban Roots Food Scrap Drop-Off Site (Urban Roots, 2020).

CONTAINERS

Residents who contribute to OAFU's drop-off system will either need to use their own containers or purchase them from Oakland Ave Urban Farm. Plastic food-grade containers are an affordable option and can cost as low as $5.05.[21]If the Farm chooses to provide containers, we suggest the farm supply enough buckets for each participant to have two per household. The benefit of this is that participants could drop-off full buckets while picking up clean ones. Having Oakland Ave Urban Farm staff clean buckets is a simple step that is often overlooked, yet contributes substantially to participation rates due to its reduction of participant labor.[22]

INTEGRATING FOOD SCRAPS INTO THE COMPOST PILE

Preparation

A bed of dry carbon materials should be prepared to create a carbon trough that is wide enough to retain the food scraps received.[20] The carbon trough is beneficial in that it:

- Assists in the blending process by spreading the food scraps thinly, layered on the bottom and top with the added feedstock
- Contains food scraps and liquids in a confined area
- Absorbs and balances out the moisture, nitrogen, and volatile compounds that cause odors and attracts pests

Blending

The recommended best practices for blending compost on a microscale environment of an urban farm such as OAUF are as follows:

1. Mix the compost pile with a loader, such as a tractor bucket, or by hand.

CASE STUDY 2:
CLOSE THE LOOP!
THE NORTH EAST KINGDOM (NEK)
NORTHEASTERN, VT

Established in 2006, Close the Loop! NEK is a small-scale, community-wide composting program in the North East Kingdom, VT. Funding for the program comes from individuals participating in the food scrap service and local private businesses. Close the Loop! NEK processes 400 tons of food scraps per year and produces 600-800 cubic yards of compost annually and operates seven drop-off locations. In the image below, a resident signs up for the food scrap drop-off program and receives a container, the cost of which is included in the food scrap drop-off program fee.[24]

Figure 7. NEK Participant Sign-Up Table (ISLR, 2014).

2. Following the compost pile recipe, account for any carbon-based material used in the trough or cover and spread the feedstock evenly over the compost pile.
3. Alternate dry and wet materials frequently and ensure that they are distributed across the pile well.
4. Create a layered lasagna compost pile with wet and dry materials alternating.
5. Mix feedstock every additional 18 to 24 inches of new material added to the pile.
6. Keep records of the blending date, recipe volumes, feedstock sources, and the batch name the blend went into.[23]

Figure 8. Current Compost Processing Site at OAFU (Google Earth, 2020).

FOOD SCRAP DROP-OFF SITE RENDERING

Figure 10 represents a design proposal for OAUF's food scrap drop-off operations. The board next to the food scrap drop-off bin has a place for community news, an instructional guide, and a list of items that can and can not be composted. The educational piece of the bin helps ensure that the food-scrap donation participants meet the standards set by the farm that can help ensure a healthy compost pile.

Figure 9. Current Compost Processing Site at OAFU (Daisy Creek Farms, 2018).

PROPOSED FOOD SCRAP DROP-OFF SITE DESIGN

Figure 10. Proposed Food Scrap Drop-Off Site Design (Rigney, 2020)

EXPANDING COMMUNITY ENGAGEMENT

As OAUF establishes its compost system and food scrap donation program, educational outreach and engagement are fundamental to the success of these programs. The best form of education incorporates as many media platforms as possible. Posting information on the website, flyers, signs at the food scrap drop-off station, and workshops are just a few types of educational methods that can be beneficial.

As many best-practice guides and case studies demonstrate (see the following case studies on Midtown Composting and Rust Belt Riders), education is an integral component of the community-based compost model, especially if the goal is to source food scraps and provide composting back to surrounding residents. Composting can be a foreign concept for some people. Informing participants of the value of both the raw and finished products can increase the likelihood of building a successful system.[25] By educating participants of what raw materials they can and cannot contribute to the compost system, managers can save time during the sorting process. Education can also assist with controlling for potential nuisances caused by the compost pile, such as odor and rodents. While compost piles can handle a broad spectrum of foods and materials, it is up to the farm to decide if they want to place limitations on specific food types for collection to control the pile more easily.

Table 1: Educational Method Types

Type[26]	Benefits	Challenges
Website	Widely Accessible	• Requires maintenance • Requires knowledge of web design • Some compost program participants may not have internet access
Flyers	Broad Distribution	• Printing costs • Labor involved in distributing
Signage	Offers Information Directly Next to Drop-off and Pick-up Areas	• Requires physical labor and materials
Workshops	Engaging	• Time intensive • Staff intensive

CASE STUDY 3:
MIDTOWN COMPOSTING
DETROIT, MI

Midtown Composting in Detroit believes in the power of multiple forms of education to reach a diversity of people, as individuals use a variety of platforms. In addition to handing out flyers, they maintain a significant Facebook presence. Possessing nearly 700 followers, Midtown Compost posts daily messages about local and national news relating to the environment, sustainability, composting, and top news coverage.[29] Midtown Composting also writes articles on composting and gardening and posts them to their website and Facebook. One such piece, titled "How Much of a Difference Compostable Packaging Can Make" makes a persuasive case for compostable materials.[30] Midtown Composting is not only educating to increase members' understanding of the food scrap donation process but also to create more informed citizens and sustainability advocates.[31]

CASE STUDY 4:
RUST BELT RIDERS
CLEVELAND, OH

Rust Belt Riders is a for-profit composting collection business operated out of Cleveland, OH, discussed in other sections of this report. Much like OAFU, they believe that involving the community is the key to being successful as a business and closing the loop. Food scrap donation program participants are educated prior to the membership start date and consistently throughout the membership period. Composting and food scrap donation workshops, phone calls, and distributing how-to literature pertaining to what can be donated is vital for their program's success. Additionally, Rust Belt Riders provides a diversity of workshops to members on topics such as seed starting; horticulture; small business management and financing; climate change; and economics, supply chains, and composting.[27] Rust Belt Riders also offers a robust FAQ section on their web-page about farm-related and food scrap donation-related service questions.[28]

LESSONS LEARNED

Oakland Ave Urban Farm can serve as a model to other community-based urban farms starting a compost facility.

Lessons learned from this site include:

- Utilize a **multi-pronged approach for education and outreach** to generate interest and ensure that participants in food-scrap drop-off programs are knowledgeable about what can and can not be composted
- Before breaking ground on a compost facility, **strategically plan it out** based on the environmental site conditions, space constraints, financial considerations, and organizational capacity
- **Choose a composting facility location that is not in the middle of the farm site** to avoid disruptions of other farm activities, and that is also far away from nearby residences to eliminate nuisance complaints
- Establish strategies to **source compost materials from area residents and nearby institutions**

Figure 11. Oakland Avenue Urban Farm Sign at the Farmers' Market Site Adjacent to Oakland Ave (Rigney, 2020).

ENDNOTES

1. Oakland Avenue Urban Farm. (n.d.). About. http://www.oaklandurbanfarm.org/about.html

2. Billy Hebron of Oakland Avenue Urban Farm, personal communication, February 20, 2020.

3. U.S. Census Bureau, American Community Survey. (2018). *2017 American Community Survey 5-Year Estimates, Table DP05, City of Detroit, MI.* https://data.census.gov/cedsci/table?hidePreview=true&g=1600000US2622000_0100000US&q=Detroit%20city,%20Michigan&table=DP05&tid=ACSDP5Y2017.DP05&lastDisplayedRow=93

4. (Billy Hebron, personal communication, February 20, 2020)

5. McSweeney, J. (2019). Introduction: Recycling Organics at the Community Scale. *In Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and Solving Our Waste Crisis.*

6. (McSweeney, J., 2019, Chapter 3: The Composting Process)

7. (McSweeney, J., 2019, Chapter 6: Compost Site Infrastructure and Equipment)

8. Platt, B., McSweeney, J., & Davis, J. (2014). *Growing Local Fertility: A Guide To Community Composting* (pp. 15). Institute for Local Self-Reliance and Highfields Center for Composting. https://www.texasenvironment.org/wp-content/uploads/2015/04/Growing-Local-Fertility-ISLR-July-2014.pdf

9. Mark Covington, Georgia Street Community Collective of Detroit, MI, personal communication, February 16, 2020.

10. FEMA. *FEMA Flood Map Service Center.* (n.d.). Accessed April 16, 2020, from https://msc.fema.gov/portal/search?AddressQuery=%209227%20Goodwin%20St%2C%20Detroit%2C%20MI%2048211#searchresultsanchor

11.. (Billy Hebron, personal communication, February 20, 2020)

12. (McSweeney, J., 2019, Chapter 7: Bin and Bay Composting Systems)

13. (McSweeney, J., 2019, Chapter 9: Aerated Static Pile Composting Systems)

14. Tom Richard. (n.d.). *Water Quality Protection–Cornell Composting.* Cornell Waste Management Institute. Retrieved April 25, 2020, from http://compost.css.cornell.edu/waterqual.html

15. (McSweeney, J., 2019 Chapter 7: Bin and Bay Composting Systems)

16. (U.S. Census Bureau, American Community Survey, 2018)

17. Korman, E. & Yuan, M. (see *People, Place, and Compost Capacity* section).

18. Levi Gardner of Urban Roots in Grand Rapids, MI, personal communication, March 17, 2020.

18. (McSweeney, J., 2019, Chapter 12: Food Scrap Generation and Collection)

19. Levi Gardner of Urban Roots in Grand Rapids, MI, personal communication, March 17, 2020.

20. (McSweeney, J., 2019, Chapter 13: Compost Site Management)

21. ULine. (n.d.). *Plastic pails and lids.* Accessed May 2, 2020 from https://www.uline.com/BL_8150/Plastic-Pails-and-Lids

22. (McSweeney, J., 2019, Chapter 12: Food Scrap Generation and Collection)

23. (McSweeney, J., 2019, Chapter 13: Compost Site Management)

24. (Platt, B., McSweeney, J., & Davis, J., 2014)

25. Tim Campbell of Midtown Composting in Detroit, MI, personal communication, March 12, 2020.

26. Platt, B. (May 2018). *Yes In My Backyard: A Home Composting Guide for Local Hovernment.* Institute for Local Self Reliance. https://ilsr.org/yimby-compost/

27. Daniel Brown of Rust Belt Riders in Cleveland, OH, Personal Communication, March 17, 2020.

28. Rust Belt Riders. (2020 March). *Residential services in Cleveland — FAQ page.* Accessed April 1, 2020 from: https://www.rustbeltriders.com/faq

29. (Tim Campbell, personal communication, March 12, 2020)

30. Midtown Composting. (2020, March 15). Blog. Accessed April 1, 2020 from: https://midtowncomposting.com/blog/

31. (Tim Campbell, personal communication, March 12, 2020)

PHOTO CREDITS

Oakland Avenue Urban Farm cover page image from Megan Rigney, 2020.

Figure 1. Greenhouse and community engagement board at

OAFU. Rigney, 2020.

Figure 2. Team Members and Billy Hebron (OAUF owner) measure the future compost site area. Rigney, 2020.

Figure 3. Future Compost Processing Site Design And Potential Food Scraps Drop Off Location. Google Maps, 2020.

Figure 4. Future Compost Processing Site Design. Rigney, 2020.

Figure 5. Potential Food Scrap Capture Within 3-Mile Drive of Oakland Avenue Urban Farm. Source: U.S. Census Bureau, American Community Survey. (2018). 2017 ACS 5-year estimate, Table DP05, City of Detroit, MI. Locations Geo-coded with Google Maps (2020).

Figure 6. Urban Roots Food Scrap Drop-Off Site. Posted on YOUR Compost. (2020, March 24). Urban Roots. Accessed March 25 from: https://www.urbanrootsgr.org/yourcompost

Figure 7. found in Platt, B., McSweeney, J., & Davis, J. (2014). Growing Local Fertility: A Guide To Community Composting (pp. 15). Institute for Local Self-Reliance and Highfields Center for Composting. https://www.texasenvironment.org/wp-content/uploads/2015/04/Growing-Local-Fertility-ISLR-July-2014.pdf

Figure 8. Current Compost Processing Site at OAFU. Google Earth, 2020.

Figure 9. Current Compost Processing Site at OAFU. Singh, J. [Daisy Creek Farms] (2018, July 9). Bury kitchen scraps directly in garden and this happens. YouTube. https://www.youtube.com/watch?v=uL-WRZUG0d8

Figure 10. Proposed Food Scrap Drop-Off Site Design. Rigney, 2020.

Figure 11. Oakland Avenue Urban Farm Sign at the Farmers' Market Site Adjacent to Oakland Ave. Rigney, 2020.

SHERWOOD FOREST

WHY SHERWOOD?

The third study site, Sherwood Forest–located in Northwest Detroit–presents a different set of challenges from both Georgia Street Community Collective and Oakland Avenue Urban Farm. Currently Sherwood Forest does not have a residential composting system in place, nor a clear idealized scenario of what such a system could look like. This is also a historic, relatively dense, and wealthier neighborhood compared to our other two study sites. We therefore saw an opportunity to look at Sherwood Forest through the lens of:

1. What it would take to locate and establish a compost operation from scratch; and
2. What it would take to destigmatize composting and challenge the narrative that community-scale composting can only occur in lower income and less dense neighborhoods.

Residents interviewed during this project expressed some skepticism over whether a community compost system would be accepted by residents due to potential preconceived notions about composting, the neighborhood's lack of vacant lots, and its limited amount of designated open space.[1, 2] However, as indicated in our report, these concerns are not insurmountable: they can be resolved through thoughtful design, use of best management practices, and attentive operations. And, with targeted "promotional" outreach at neighborhood gatherings, it may be possible to increase residents' interest in composting.[3]

The following proposed scenarios aim to highlight how community-scale composting

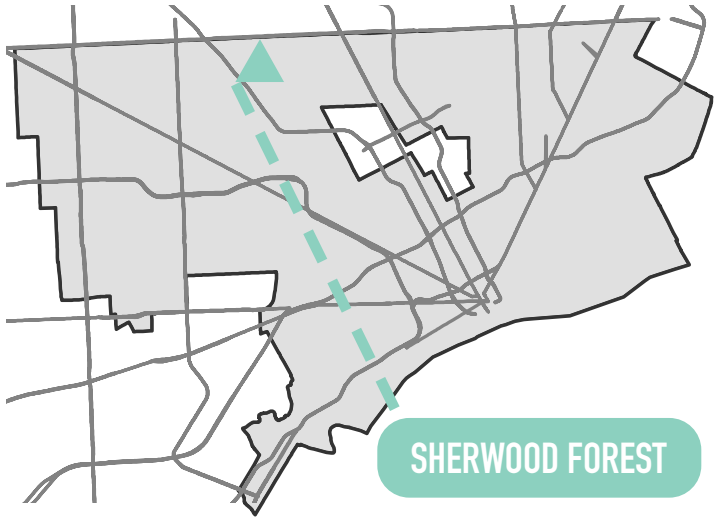
can take place anywhere as long as there is someone to champion and push for the system, and organizers design the system in a way that mitigates neighbors' concerns. Whether these proposals are implemented within the bounds of the Sherwood Forest, the surrounding areas, or some combination of locations in the City of Detroit, they work to rewrite the narrative as well as address typical community concerns such as rodents, odors, and aesthetics.

SITE CONTEXT

Sherwood Forest, a historic neighborhood home to over 1,200 residents, is located in northwest Detroit (Council District 5).[4, 5] Established in 1917, the neighborhood is bounded by Livernois, Seven Mile, Pembroke, and Parkside roads, with the majority of its housing built during the 1920s and 1930s.[6, 7] Nottinghamshire, England–the setting of the fictional Robin Hood tales–inspired the neighborhood's distinctively curved and winding roads.[8] In 2002, the Detroit Historic District Commission officially designated the neighborhood as a historic district in recognition of the community's efforts to maintain and preserve the neighborhood's historic character.

To help sustain the neighborhood's generally high property values, Sherwood Forest Historic District upholds a strict list of regulations. For example, the exterior of each house must be made of either brick, stone, or concrete over tile, while roofs are prohibited from being flat. The result of these strict aesthetic regulations have allowed the neighborhood to maintain its status as one of the most sought after residential neighborhoods in Detroit.[9, 10] Currently the median home value within the neighborhood stands at nearly $240,000, almost seven times the $35,000 average of the city's other properties.[11] Nearly 90% of Sherwood Forest residents are homeowners, indicating a much higher level of economic stability than some of the surrounding neighborhoods.

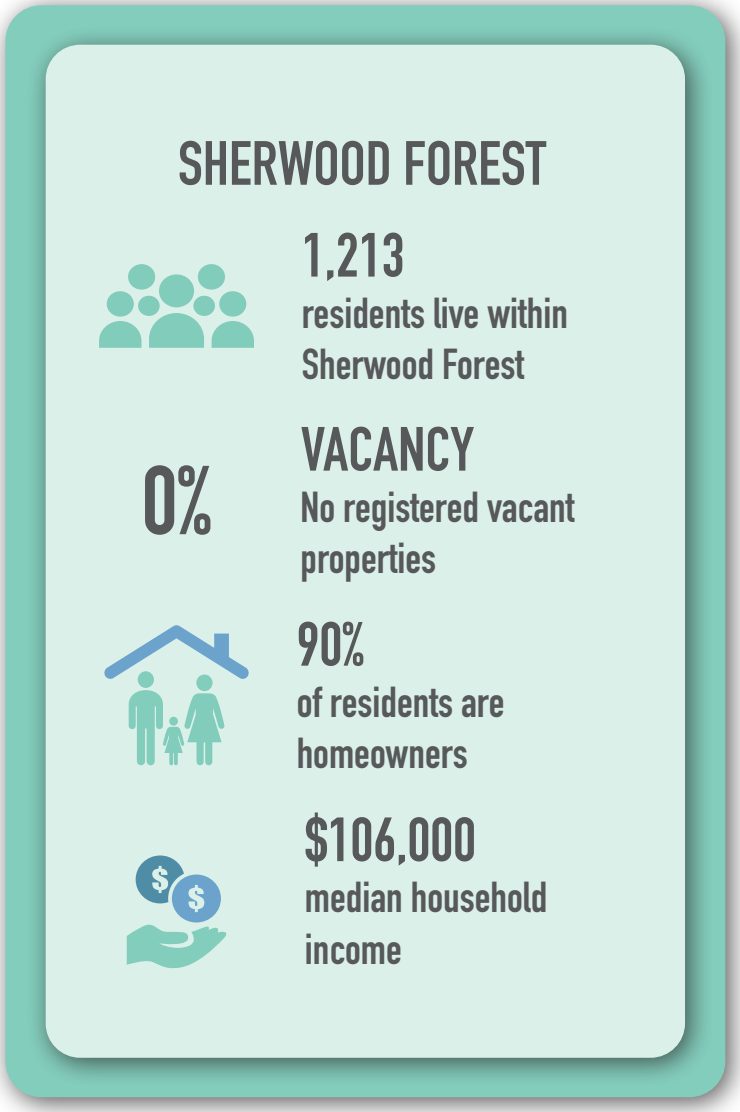
Sherwood Forest maintains an active and vibrant community partly through the efforts of its neighborhood association, Sherwood Forest Association. The Sherwood Forest Association, created in 1929, is a non-profit organization that monitors the general welfare of the neighborhood, responds directly to residents' concerns, maintains pocket parks, and enforces Historic District aesthetic guidelines.[12, 13, 14] The Association often partners with the City to provide neighborhood services such as snow removal and security patrol. They also contribute to the social health and connectivity of residents by creating welcome packets for new neighbors and organizing regular social events.



UNIQUE CONSIDERATIONS

Interviews with residents in Sherwood Forest highlighted several unique considerations that informed our proposed scenarios for the neighborhood:

- **High Density**. With about 435 homes within less than a quarter square mile and no registered vacant properties, there are very few open spaces available within the neighborhood that could hold a food waste collection site and/or a compost processing site.[15, 16, 17]



- **High Income.** Sherwood Forest's median household income, estimated at $106,000, is significantly higher than the rest of Detroit.[18] In part because of this, most residents pay the Sherwood Forest Association's optional $50 annual dues. This extra funding is utilized by the Association to pay for the additional neighborhood services it manages.[20] This demonstrated willingness to pay for additional services is a potential indicator that those residents interested in composting or sustainability efforts may be more willing to pay for food scrap collection services or to purchase finished locally produced compost for a higher cost than other neighborhoods in Detroit may be willing to afford.
- **Potential Food Scrap Generation.** Sherwood Forest, with a population of 1,213 residents and 48 businesses, has the potential to generate nearly 1 ton of food scraps each week.[21, 22] In only a quarter square mile, a community-scale composting system has enormous potential to capture food scraps in this limited area.[23]
- **Strong Community Network.** The Sherwood Forest Association is a vital organization within the community that both facilitates social services and strengthens community ties. The Association has frequent correspondence with the community as a whole through regular newsletters, a neighborhood Facebook group, and through its annual neighborhood-wide meeting. This means that they inhabit a critical position in the chain of resources, as members of the community can utilize these communication platforms to coordinate efforts.
- **Unknown Interest.** Currently, there are a handful of households in Sherwood Forest that either compost already or are interested in composting.[24, 25, 26] However, as described by our interviewees, composting is not on the broader community's radar. As part of its job

responding to residents' concerns, the Association sends neighborhood-wide surveys to gauge homeowners' top concerns and questions. As indicated in our interview with an Association Board Member, none of the three neighborhood-wide surveys conducted by the Association during the past decade raised compost as either an interest or concern for residents.[27] While this does not mean residents are disinterested in composting, it suggests that any system implemented may require persistent community outreach and advocacy efforts, driven by residents from within the neighborhood.

- **Limited Capacity.** The Sherwood Forest Association has limited capacity to act as a compost system manager as it is currently a stretched voluntary association and cannot take on additional responsibilities. As of March 2020, six of the Association's fifteen voluntary board seats are vacant, limiting the Association's capacity to orchestrate or oversee a new service.

WHAT COULD COMPOSTING LOOK LIKE?

Sherwood Forest poses a unique opportunity to demonstrate how community composting could be implemented in a denser, more affluent part of Detroit. Informed by other case studies, the broader literature and interviews we carried out with local stakeholders, our team developed three decentralized community-driven composting models that could be implemented in the neighborhood. We present each as a possible scenario one might imagine in the future, and then outline the specific aspects of each scenario, identifying the notable strengths and important considerations associated with each proposal.

While these scenarios were constructed for Sherwood Forest, all of them can be adjusted to suit other communities interested in developing similar community-scale composting systems.

Figure 1. A historic home in Sherwood Forest (Anikka Van Eyl, 2020)

PROPOSED COMPOST DEVELOPMENT

SCENARIO ONE:
THE HOME-BASED HUB

SCENARIO TWO:
THE COLLECTION ENTREPRENEUR

SCENARIO THREE:
THE COMMUNITY DROP OFF SITE(S)

SCENARIO #1: HOME-BASED HUB

IMAGINE THIS...

The Prichards, a young family of five who have lived in Sherwood Forest for a few years, decided to start composting in their backyard in early 2017 to reduce the amount of trash they produce each week. The Prichards have made it a new chore for their kids: once a day, someone empties their closed food scrap bucket into a small tumbler in their backyard. Early on in the project, the Prichards made it a household policy to exclude meat or fish from their food scrap bins. Mrs. Prichard occasionally throws some grass and leaves into the compost container after she's done mowing the lawn to make sure the compost doesn't start to smell and bother their neighbors. The Prichards' kids love talking about their backyard compost. As part of her middle school's science fair, their daughter Maise brought some of their completed compost to school to show her class how her family uses it in their garden and for their houseplants.

The Prichards' project inspired a few of their neighbors to start composting. The Rosens, a couple who live down the street, started their own backyard compost bin after seeing the success of the Prichards' initiative. Since they don't create much food scraps on their own, the Rosens convinced a few of their neighbors to contribute their own food scraps to the Rosen's pile. In exchange, the Rosens promised to give them some of the finished compost. As they continued their projects, many of the Prichards' and Rosens' neighbors asked for advice on how to start composting –however, very few have started their own piles due to fears of attracting of rodents. To share their knowledge with their neighbors, Mrs. Prichard and Mr. Rosen started hosting informal monthly workshops at their respective houses, where neighbors are welcome to stop by and ask composting questions.

OVERVIEW

The Rosens' idea to pool and share resources with neighbors as depicted in this scenario might be referred to as the "Home-Based Hub." This model is a flexible, relatively low-commitment community composting model where several households (referred to as "Compost Champions") interested in composting launch a system by dedicating space on their property for the collection of food waste from the surrounding neighbors.[28] Duties of the Compost Champions would include educating neighbors what kinds of food scraps can be added to their compost, as well as doing outreach in order to garner a larger community contribution to their composting system. This outreach could range from running informal workshops and composting demonstrations for their neighbors, to providing educational materials on best management practices for collecting food waste and how to avoid attracting rodents, bugs, and foul odors. Champions would work with their immediate neighbors to maximize input and output of their system.

This system builds and strengthens connections between neighbors participating in the system. Compost Champions become leaders in their community, gaining new specialized skills, knowledge, and experiences that can empower their neighbors to care for the environment. This system can help provide residents with a sense of ownership over composting, creating more composting advocates and facilitating the capture of social and economic capital associated with production models.

Figure 2. An example of how a Home-Based Hub could look in Sherwood Forest (rendering by Emily Korman, 2020; base image from Redfin.com, 2020).

KEY STRENGTHS

- **Few requirements are needed to start and maintain this system** outside of identifying–or the voluntary emergence of–Compost Champions interested in composting in their backyard.
- **Compost Champions become leaders in their community**, gaining new specialized skills, knowledge, and experiences that can empower other residents.
- **This model does not require outside financing.** Compost Champions can build their own compost bins or piles using materials they already have. Alternatively, they could opt to repurpose household containers to serve as compost receptacles, or purchase composting bins, which can cost anywhere between $50 and $550.[29, 30]
- The scale of the composting system is **as large or small as** the Compost Champion desires.
- **Increasing the size and yield of the system can be as easy as Compost Champions asking their neighbors to dump their food scraps in their yard a few times a week.** However, Champions need to monitor what food scrap materials their neighbors are contributing to ensure the organic materials stream is clean, enabling the creation of healthy compost.[31]
- By using home-based hubs, **residents can keep resources within the neighborhood and directly benefit from the finished product**. Compost Champions and their neighbors can share and use the finished compost for backyard gardens, landscaping, or neighborhood improvement projects.

KEY CONSIDERATIONS

- **This system needs Compost Champion–** neighbors that are passionate about composting, ready to spread the word and engage their neighbors. In many communities, champions for any number of issue areas emerge on their own. If an outside agency wanted to intentionally seed the growth of a compost system through a "Home-Based Hub" model, cultivating such champions might be a challenge if they do not already exist.
- **The size and scale of this system vary** depending on the number of households participating, what material volunteers choose to collect and compost, and the amount of space "donated" and its processing capacity.
- **There is no one overseeing this system.** The onus to ensure that participating neighbors are composting correctly is dependent upon Compost Champions.
- When designing their backyard systems, particularly in neighborhoods like Sherwood Forest, **Compost Champions would need to make sure they are adhering to the neighborhood's Historic District regulations**, and make sure the system does not violate any aesthetic code.
- **Private households are subject to state regulations and local zoning ordinances**, which may limit the amount of compost a household can hold on their property. Currently in Detroit, backyard compost systems are only allowed as accessory uses for urban gardens or farms and cannot accept off-site material (see the *Policy Analysis of Composting* chapter of this report for more information on this subject).[32]

HOME-BASED HUB CASE STUDY: WE GOT LEAVES

An example of an existing system similar to the "Home-Based Hub" model described here is the neighborhood composting system "We Got Leaves," in Shorewood, WI. Shorewood is the most densely populated village in Wisconsin with over 13,000 residents within 1.5 square miles.[33, 34,] This one-man operation initiative, led by Shorewood resident Joshua Liberatore, was created in 2012 as a way to divert coffee grounds and food waste from landfills, as well as prevent nutrient loading from fallen leaves from entering Lake Michigan and other waterways.[35] Early in its history, Liberatore hauled coffee grounds from local coffee shops via bicycle to community compost sites or his backyard composting system.[36] Without employees or volunteers, Liberatore processed 4 to 5 tons of compost per year by 2014.[37] Today, the initiative maintains three community compost sites at three schools, and offers free assistance to novice backyard composters starting their systems; advises experienced composters trying to expand their composting options or improve yields; and advocates for municipal composting programs, among other services.[38]

Figure 3. Atwater Community Garden offering a small composting operation to collect neighbor food scraps under We Got Leaves in Shorewood, Wisconsin (We Got Leaves, 2019).

SCENARIO #2: COLLECTION ENTREPRENEUR

IMAGINE THIS...

Every Wednesday, Sherwood residents line garbage bins at the end of their driveways for garbage pick up. On alternating weeks, the majority of the houses also tout blue recycling bins, the two bins neatly lining the winding roads, a simple routine everyone knows so well. At some houses, three containers dot the drives, the black and blue joined by an unassuming forest green 5-gallon bucket for compost. The buckets are closed shut with a tightly screwed on lid that protects the food scraps within from the elements and mischievous critters. Although Advanced Disposal, the contracted municipal waste management company, hauls trash and recyclables in trucks, a local microhauler collects the curbside food scraps by bicycle, starting with Sherwood Forest. Residents pay $20 a month for food scrap collection (about $5 / week), receiving a little green bucket, educational materials (including a magnet for the fridge!) and discounts on the finished compost created from their food scraps.

Residents are able to continue with their routines each week. The local microhauler simply bikes around the neighborhood and picks up their green buckets. The ability to meet residents where they are allows them to avoid making the process a further nuisance. Although initially only a handful of eager residents opted into the collection, after a couple of weeks, the blocks started to fill with little green buckets. Neighbors, excited by the project and motivated by the growth of neighborhood participation, soon join in. No household wants to feel like the only house on the block without that green bucket.

OVERVIEW

This weekly collection of food scraps as described illustrates one variant of the ”Collection Entrepreneur” model. This model of food scrap collection is operated by a microhauler, a food scrap collection entrepreneur that operates on a much smaller scale than a municipal, centralized hauler. In Sherwood Forest, food scrap collection could be operated by either: (1) an existing microhauler that services part(s) of Detroit, or (2) a new entrepreneur interested in establishing themselves in the composting business. Households are the first anticipated customers, but in many models, restaurants, churches, schools, and other local businesses also participate in food scrap collection following further expansion in the microhauler’s capacity.[40]

Collection entrepreneurs are often quite successful and financially sustainable–many earn profits while also still serving and benefiting the local community.[41] Some systems focus on only businesses, while others may focus on a mixture of residences, businesses, and other organizations alike.[42, 43, 44] Food scrap collection serviced by a collection entrepreneur are nearly always opt-in with residents or businesses electing to subscribe to the curbside collection by paying a small monthly fee.[45, 46, 47, 48] For example, Midtown Composting in Detroit charges $16 per

Figure 4. An example of a collection entrepeneur traveling house to house by bicycle to pick up compost containers (Van Eyl, 2020).

month for weekly collections plus a $5 sign-up fee.[49] The willingness to pay a fee is a critical factor to the success in any neighborhood. In Sherwood Forest, residents have already demonstrated a willingness to pay for additional services that beautify their community.[50] We believe many residents may choose to opt into this subscription service, particularly as more of their neighbors participate and community members become further educated on the benefits of composting.

In this type of a system, when neighbors opt into the curbside collection, they are typically provided with a 5-gallon composting bin.[51] On pick up days, each filled food scraps container are often exchanged with a clean one, although haulers can also just remove a compostable bag and leave behind the bucket. In this scenario, the collection entrepreneur washes residents' buckets each week, preventing any food from spoiling and mitigating any "what abouts"[52] that might concern nearby residents. In Sherwood Forest, one resident we interviewed explained that, any compost system that might be considered would have to be "tight" because "if someone [doesn't] put all their stuff in and there are two banana peels on the ground…. Those sort of things create a storm on our Facebook group. It can be like a runaway train, it would have to be a tidy system."[53]

Our research shows that microhaulers that support curbside collection can operate through a variety of means–a bike like the one described in the scenario above, or via electric bicycle or truck.[54] Utilizing traditional bicycles or electric bikes nearly eliminates environmental concerns that could arise transporting food scraps, while also providing a more community-based experience. In many cases, systems that primarily operate by bicycle also have a truck to use when the weather is problematic or they scale up.

Collection entrepreneurs, or microhaulers, serve as the middleman between food scrap generators and the compost production site.[55] Some microhaulers only service a defined geographic area or community-scale system to collect food scraps, while others may capture from a larger geographic area or several communities around town.[56] Once collected, food scraps usually are transported to a nearby composting site to be processed. Many haul to multiple compost processing operations, sometimes including a compost processing site they operate themselves, in addition to sometimes hauling to larger facilities, such as a wastewater treatment plant.[57]

Sometimes, the compost processing site is managed by a microhauler themselves, or in others, partnered with a dedicated compost processor. Once finished, the final product can be used on site, shared with Collection Entrepreneur subscribers or sold into the marketplace.[58, 59, 60]

KEY STRENGTHS

- Pick up curbside collection services are relatively **easy to establish and operate when serviced by a microhauler** as there are relatively few resources necessary to become established as a collection entrepreneur. Additionally, some existing microhaulers in Detroit could be interested to expand their scope if demand for their services increased by additional communities or local businesses.
- Curbside collection is considered to be a **more convenient option** for residents to participate in composting, reducing barriers of time, distance, and effort that often limit participation.
- **Microhaulers foster the already existing entrepreneurial spirit of Detroit.** A model like this aligns with the spirit and strength of the existing urban agriculture network.
- Microhaulers can readily access new customer segments, providing **opportunity to expand their business and revenue.** Outside of household residences, microhaulers can expand to pick up

from restaurants, libraries, schools, universities, churches, and other community centers.

- **Using local microhaulers allows Detroiters to take part in local compost production and benefit from the finished compost locally.** By keeping these resources within a community or a surrounding community, local residents can directly benefit from the finished compost, using it for green stormwater infrastructure projects, urban agriculture, landscaping, and more.
- **Food scrap density**–the density of potential food scrap generators like residents, businesses, or schools that are willing to pay for collection–**is a key component of a successful collection entrepreneur model.**[61] Sherwood Forest, a relatively dense neighborhood with high potential for willingness to pay, provides an excellent opportunity to develop a profitable model within a relatively small geographic area.

KEY CONSIDERATIONS

- **The location of the organics recycler dramatically impacts the profitability of a microhauler.**[62] The shorter the distance between the food scrap pick-up route to the compost processing site increases collection efficiency. Unlike Sherwood Forest, in less dense neighborhoods a microhauler may be less successful, particularly if they cannot get many households in close proximity to one another to sign up. For example, if a microhauler serviced one house on one block, another house three blocks over, and so on, the food scrap collection would both take a long time and likely not financially sustainable in the end, with the amount of fuel needed to service the route.
- In any collection entrepreneur model, the **legality of curbside collection models** that consolidate material for pick-up by another service must first be researched before launching a system in one's state.[63] This consideration does not apply in Michigan as there are no known legal restrictions.
- **Collection entrepreneurs typically rely on a collection fee paid by residents**, local businesses, or other participants. This requires a willingness and ability to pay for additional waste management services that often residents may not be ready or able to pay.

CASE STUDIES

Collection entrepreneurs and subscription collection models vary tremendously in their pricing and methodology. One case study explored in the *Compost Market and Community* chapter of this report is that of Rustbelt Riders in Cleveland, Ohio which charges $30-40 a month for pick up collection from one's residence.[64, 65] A very different model is that of the Compost Pedallers of Austin, Texas, as described on the following page.

Figure 5. An example of a food scrap collection bucket from Midtown Composting in Detroit, Michigan (Midtown Composting & Recycling, 2020)

COLLECTION ENTREPRENEUR CASE STUDY: COMPOST PEDALLERS

Although now dissolved, Compost Pedallers of Austin, Texas was a successful subscription-based residential and commercial food scrap collection service.[66] For only $4 a week, residential subscribers could sign up online and within a week receive a starter kit containing a 5-gallon collection bin and source separation educational materials indicating what was/was not compostable. Rather than sending the materials out of sight, food scraps were taken to the nearest "CompHost," which was anyone in Austin that had an interest in growing soil or food and possessed the ability to process a certain volume of organic material through composting. Subscribers were further motivated by a reward system. Each week, households' food scraps were weighed by Compost Pedallers and depending on the pounds collected, households earned points which could then be redeemed at local businesses or used to receive up to 25 pounds of compost.[67] In addition, subscribers who reduced the size of their garbage can could also save monthly on their utility bill from the City of Austin.[68] All food scraps were 100% transported by bikes, both traditional and electric, keeping the overall environmental impacts of the program as low as possible. Compost Pedallers was successful, generating such interest that in January 2019, it was absorbed by a municipality-led compost collection system.[69]

Figure 6. Compost Pedallers at work with their motto, "Burn calories not fossil fuels" (Compost Pedallers, BioCycle, 2015)

SCENARIO #3: COMMUNITY DROP OFF SITE

IMAGINE THIS...

It's Saturday morning again–a time for routine chores and walks around the neighborhood. Jaime takes the familiar stroll down to the storefronts along Livernois Avenue with her 10-year-old twins and wife, this week's food scraps in tow. The Livernois Community Food Scrap Drop Off Site is about half a mile away from their house on Canterbury Road, but Jaime and her wife love to use these weekend walks as family time, catching up with their kids as they go. Today, Jamie's friend Morganne and her son, Charlie, join the group on their walk. Morganne was the one to really Champion the Livernois Community site, working with a local business to set up a food scrap drop off site at an empty storefront on Livernois. In addition to dropping off her family's food scraps, Morganne is this week's Compost Attendant so it's her responsibility to monitor the collection bin to ensure it's not attracting rodents or creating foul odors.

During the months she spent advocating to establish the community drop-off site, Morganne recruited a few volunteers–now known as the "Compost Club"–to collectively share responsibility for maintaining the collection site, keeping it clean and tidy. Thanks to Morganne's management and the generous support of local business, the Compost Club has been running for about a year with a dozen volunteers . Approaching the storefront, Jaime and Morganne hand their food scraps to their kids to place in the large food scrap collection bin, careful to go around the cars entering the food scrap drop-off Drive-thru line. Morganne loves to tell people how excited Charlie was the first time he saw food scraps processing into compost at Palmer Park; now he insists on being the one to deposit their food scraps at the Livernois drop-off site every week.

OVERVIEW

The public food scrap collection bin illustrated in this scenario is one example of a ”Community Drop Off” model. In Community Drop Off systems, food scrap drop off locations are placed strategically in highly-frequented spaces such as schools, churches, local businesses, urban farms, or community gardens, offering a communal bin for interested residents to drop off their food scraps. Food scrap drop off sites are often placed in pedestrian-friendly communities, but, as demonstrated in this scenario, there could be opportunity to develop a drive-through drop off site in car-dependent cities like Detroit. Depending on resources and management, food scrap drop off sites can also operate as a network throughout a larger area, district, or city with multiple public strategically placed sites.[70, 71]

Community drop-off sites can be either fixed or mobile. A fixed drop off site is permanently placed in a specific location, like a park, community garden, or community center. In the case of Sherwood Forest, a fixed drop off site doesn’t have to be at Sherwood Park–rather, it could be placed at a local church, a storefront along Livernois Avenue, within an underutilized parking lot, at a nearby university, library, or school, or another community center.

Meanwhile, a mobile community drop off site is one that can be easily set up and broken down, and appear in different locations. Mobile sites offer an innovative solution to the many challenges of “what abouts” and land suitability for food scrap collection. In some community drop off systems, mobile drop off sites are located at specific public events or locations on a consistent schedule for a fixed amount of time to provide reliability and stability to the collection program.[72] These mobile sites may be monitored by an employee or volunteer to ensure the collection of clean organic material.[73]

In some systems using drop-off sites, food scraps are processed into compost directly on site; in others, food scraps are transferred to another location for compost processing. However, all community drop off models, regardless of how large or small they are, need to be actively managed by a group of volunteers or a specific organization to ensure the site remains clean, aesthetically-pleasing, and does not attract rats.[76, 77] For Sherwood Forest, the food scrap collection could be operated by a nonprofit organization like FoodPLUS | Detroit, an educational institution, a group of volunteers, or another community group with a volunteer base. The managing partner often provides oversight over the food scrap collection bin, maintaining the quality of collected food scraps and mitigating potential nuisances.[78] In cases where food scraps are transferred off site, a collection entrepreneur or urban farm often works with a community group, local business, or group of residents to organize the transfer of food scraps. In some cases, the managing organization distributes finished compost back to contributing participants for free, at a discounted price, or sometimes bundled in as part of a subscription service, while in others, the managing organization may use the finished compost themselves.

Figure 7. A compost station located within the Palmer Park Urban Garden, an educational garden within walking distance of Sherwood Forest (Korman, 2020).

COMPOST SUPERHERO

What if a mobile drop-off site was actually mobile? In the following narrative, we build upon the traditional mobile drop-off model, suggesting that a truck–similar to a traditional food truck–could be used as a mobile food scrap collection site that travels around the city to pick up food scraps at farmers markets, community events, schools, churches, and other sites across the City.

IMAGINE THIS...

Compost Superhero[74] is always on the move, collecting more food scraps from residents than ever before, energizing and educating residents of the possibilities of compost. Every Saturday during the summer, the residents of Sherwood Forest make their way to Sherwood Park for picnics and the occasional jazz concert,[75] with food scraps in hand–some in buckets, some in plastic bags; some by foot, some by car. Their first stop: the Compost Superhero, a truck that offers mobile food scrap drop off. As neighbors reach the truck, they wave hello to a familiar face: the friendly neighborhood Superhero, James, who arrives every week. Residents of all ages and experiences find joy in Compost Superhero as the truck buzzes around town collecting food scraps. The truck is vibrantly designed, painted with the help of children from the community to depict different uses of compost such as growing food and reducing waste. On the side of the truck sits a large bin where residents drop their food scraps off each week. Residents learned of Compost Superhero after a handful of people saw the truck at different farmers markets, community events, churches, and schools. After a while, residents requested that Compost Superhero make a stop in their neighborhood at their weekly picnics in Sherwood Park. Compost Superhero now pops up at community events and locations, which the public can track using ScrapHero Tracker, *the Compost Superhero's interactive online map. With Compost Superhero's consistent presence, adults and children alike are learning the power of compost for the environment, people, and the community.*

KEY STRENGTHS

- A community drop off site offers a **stable, consistent location for residents and surrounding businesses** to regularly bring their food scraps. Fixed sites often offer a flexible schedule for drop off times. Mobile sites offer adaptability to the location itself, while not requiring ownership or right of use for the land. This mobility offers additional flexibility in the variety of locations and ability to service events.
- One strength of the drop off site is its **potential to expand beyond only a food scrap collection site to potentially include education, compost demonstration, and compost processing opportunities**. Some fixed drop-off sites double as an educational space and demonstration site to help educate and inspire the surrounding community. Meanwhile mobile drop off sites provide flexible education and engagement that blend the different needs of farmers markets, schools, and any pop-up event or festival celebration.
- Community drop off sites need to be managed by a group of volunteers, a local community group or organization. Often this offers participants an opportunity to **develop stronger relationships within the community and foster curiosity and interest about composting**. In some systems, the management creates new green jobs within the community.[79, 80]

KEY CONSIDERATIONS

- As discussed by one of our interviewees, there may be **some initial resistance from neighboring businesses and residents** directly around a fixed food scrap collection site or compost processing site.[81] In the past when a local resident wanted to plant an apple orchard in Palmer Park, surrounding residents raised concerns that the apples would somehow attract rats.[82] It's important that site managers work with surrounding neighbors to foster community support for the operation, as well as reassure residents that the collection (and possible processing) site design will not attract rats, create foul odors, and other nuisances.[83]
- A major consideration of a community drop off site is **ensuring the quality of the food scrap collection**.[84] Without proper education, participants can taint the collection of food scraps, placing materials that cannot be processed in a community-scale compost site or materials that are more likely to cause odors or attract rodents. This is most apparent in fixed drop off sites placed in public spaces that are unmonitored with open access 24/7.[85] To ensure the quality of the organic material, some food scrap drop off sites using fixed times strongly encourage or require participants to freeze their food scraps, thus reducing odors and slowing the breakdown of food scraps.
- This system **relies on a willingness from participants** to separate their food scraps from mainstream trash and transport them to a distant location, which may feel cumbersome to some residents.
- If a community drop off site is mobile, organizers will need to determine their preferred transportation method by **considering the initial capital costs associated with the system**. It could be costly if a vehicle needs to be retrofitted. Some systems use a less costly cargo bike, but bikes may not be as efficient for collecting large amounts of food scraps from multiple drop off locations.
- If a compost processing site is not at the same location as a food scrap collection site, organizers need to figure out **how to transport food scraps between sites**, adding an additional layer of complexity to the system.

- Mobile sites usually require nearly continuous setup and tear down of drop off locations, which **can demand significant labor and time depending on the scale of the set up**. The system could employ multiple part-time or full-time staff members to service the operation, raising overhead costs, but also providing jobs. More exploration is needed to examine if this economic model is feasible.

CASE STUDY

One example of a successful drop off program is that of the food scrap collection sites at New York City's Greenmarkets run by GrowNYC. Although Detroit is very different from New York City in terms of its density and walkability, GrowNYC provides important lessons to strategically place community drop off sites in order to meet people where they already are.

COMMUNITY DROP OFF SITE CASE STUDY: GROWNYC'S GREENMARKET FOOD SCRAP DROP OFF

GrowNYC operates one of New York City's largest networks of community food scrap drop off sites, providing locations at subway stations and their "Greenmarket" farmers markets.[86] At the start of each Greenmarket, a GrowNYC staff member sets up a temporary food scrap collection site and then deconstructs it at the end of the day. Throughout the day, a staff member monitors the station, sorting through food scraps that residents drop off to ensure the correct "ingredients" are added. By doing so, staff members can control what organic materials are accepted, thereby keeping the organics recycling stream extremely clean. Residents can only bring vegan ingredients and eggshells, and many residents freeze their food scraps each week to drop it off at the market. In order to help educate residents on what materials can be composted at the Greenmarket sites, GrowNYC provides educational materials at their drop off sites.

Figure 8. GrowNYC food scrap drop off locations at green markets (GrowNYC, 2017)

LESSONS LEARNED

As our scenarios illustrate, the most important (and challenging) part of instituting any community-scale composting system is education. Interviewees in Sherwood Forest as well as municipal leaders and current composters in Detroit cited the importance of education when developing a collection or compost production system.[87, 88, 89, 90] As one of our local government interviewees stated, the goal is to "change the culture to a composting culture."[91] Education often begins with peer-to-peer knowledge exchange, where interested community members share by word of mouth the proper methods of food scrap collection and backyard composting or gather to learn from one another's compost experience.

As systems multiply and expand, it becomes increasingly important for compost site managers to follow best management practices to avoid potential "what abouts." This importance of well-maintained compost sites compounds as more residents grow interested in composting or start their own community-scale compost systems. In some cities, a community leader training and compost demonstration site provides a central location to offer comprehensive education for interested compost site managers. These centers can demonstrate different types of compost systems for residents to learn about, tour, and potentially replicate in their backyard. Often educational sites teach community members how to properly compost and start their small-scale projects through Master Composter programs. Other sites opt for the Neighborhood Soil Rebuilders Composter Training program as a way to go beyond the Master Composter program and train participants to engage and serve their communities under the overarching goals of "engagement, education, and empowerment."[93, 94, 95]

Figure 9. A neighborhood marker placed on the border of Sherwood Forest (Korman, 2020).

CONCLUSION

The previous section put forth three proposals for a community-scale compost system that could be implemented in Sherwood Forest. However, there are many other community composting systems that we did not detail but could still be implemented in this community or in other parts of Detroit. The following describes ten basic types of community-scale compost systems as captured by the report, *Growing Local Fertility: A Guide to Community Composting* by the Institute for Local Self-Reliance.[96]

- Community Gardens
- Farms (Rural and Urban)
- Schools
- Drop-Off Networks
- Collection Entrepeneurs
- On-site Composters
- Off-Site Composters
- Demonstration & Community Leader Training Sites
- Worker-Owned Cooperatives
- Home-based or Homestead Hubs

By examining the unique considerations of your community when planning a site, you can review which compost system might be right for you to ensure you and your community success.

Figure 10. A community event in Sherwood Forest celebrating the neighborhood's 100th Anniversary in 2017 (The Hub Detroit, 2017).

ENDNOTES

1. Maurice Telesford of Sherwood Forest Association, Detroit, MI, personal communication, March 5, 2020.

2. Charles Cross of Sherwood Forest, Detroit, MI personal communication, February 13, 2020.

3. (Maurice Telesford, personal communication, March 5, 2020)

4. *Sherwood Forest Historic District. (*n.d.). Detroit Historical Society. Retrieved April 2, 2020, from https://detroithistorical.org/learn/encyclopedia-of-detroit/sherwood-forest-historic-district

5. *Sherwood Forest Association.* (n.d.). Sherwood Forest Association. Retrieved March 31, 2020, from https://www.sherwoodforestdetroit.org/

6. (*Sherwood Forest Historic District*, n.d.)

7. (*Sherwood Forest Association*, n.d.)

8. (*Sherwood Forest Historic District*, n.d.)

9. Sarah Cross of Sherwood Forest, personal communication, February 23, 2020.

10. (*Sherwood Forest Historic District*, n.d.)

11. Runyan, R. (2019, June 2) https://detroit.curbed.com/2019/1/22/18192222/detroit-home-sale-prices-up-downtown-much-pricier-sales-than-neighborhoods

12. (Maurice Telesford, personal communication, March 5, 2020)

13. (*Sherwood Forest Association*, n.d.)

14. *About the Sherwood Forest Association*. (n.d.). Sherwood Forest Association. Retrieved April 3, 2020, from https://www.sherwoodforestdetroit.org/about/

15. *Vacant property registrations.* (2020). [Map]. City of Detroit. https://data.detroitmi.gov/datasets/vacant-property-registrations?geometry=-83.249%2C42.415%2C-83.034%2C42.459

16. (*Sherwood Forest Association*, n.d.)

17. Neighborhoods. (2020). [Map]. City of Detroit. https://data.detroitmi.gov/datasets/neighborhoods?geometry=-83.531,42.264,-82.670,42.442

18. U.S. Census Bureau (2017). *2013 - 2017 American Community Survey 5-year estimates.*

19. (Sarah Cross, personal communication, February 23, 2020)

20. (Maurice Telesford, personal communication, March 5, 2020)

21. U.S. Census Bureau (2017). *2013 - 2017 American Community Survey 5-year estimates.*

22. Figure calculated using formulas provided in McSweeney, J. (2019). *Community-scale composting systems: A comprehensive practical guide for closing the food system loop and solving our waste crisis* (pp. 320-321).

23. (Neighborhoods, 2020)

24. (Maurice Telesford, personal communication, March 5, 2020)

25. (Charles Cross, personal communication, February 13, 2020)

26. Sarah Cross, personal communication, February 23, 2020)

27. (Maurice Telesford, personal communication, March 5, 2020)

28. Platt, B., McSweeney, J., & Davis, J. (2014). *Growing Local Fertility: A Guide to Community Composting* (pp. 26-30). Institute for Local Self-Reliance.

29. Interstate Commission on the Potomac River Basin. (n.d.). *Build a compost bin*. Retrieved April 2, 2020, from https://www.potomacriver.org/resources/get-involved/water/build-a-compost-bin/

30. *The Economics of Composting*. (2018, August 20). SmartAsset. https://smartasset.com/mortgage/the-economics-of-composting

31. Linda Bilsens of Institute for Local Self-Reliance, Washington D.C., personal communication, March 10, 2020.

32. Detroit Zoning Code, Section 61-12-412.

33. Shorewood Business Improvement District. (n.d.). About Shorewood. Retrieved March 31, 2020, from https://www.shorewoodwi.com/about-shorewood/

34. (Platt, et. al., 2014, pp. 26-30)

35. (Platt, et. al., 2014, pp. 26-30)

36. (Platt, et. al., 2014, pp. 26-30)

37. (Platt, et. al., 2014, pp. 26-30)

38. *What We Do.* (n.d.). We Got Leaves. Retrieved April 3, 2020, from https://wegotleaves.wordpress.com/what-we-do/

39. McSweeney, J. (2019). *Community-scale composting systems: A comprehensive practical guide for closing the food system loop and solving our waste crisis.* Chelsea Green Publishing.

40. Tim Campbell of Midtown Composting, Detroit, MI, personal communication, March 26, 2020.

41. (Platt, et. al., 2014)

42. *Detroit Dirt.* (n.d.). Detroit Dirt. Retrieved April 18, 2020, from https://www.detroitdirt.org

43. (Tim Campbell, personal communication, March 26, 2020)

44. Gan, V. (2015, December). *This Austin startup picks up your compost by bike.* CityLab. http://www.citylab.com/navigator/2015/12/austins-compost-pedallers-pick-up-your-food-scraps-by-bike/419871/

45. (McSweeney, 2019)

46. Daniel Brown of Rust Belt Riders, Cleveland, OH, personal communication, March 17, 2020.

47. *Rust Belt Riders: Feed people, not landfills.* (n.d.). Rust Belt Riders. https://www.rustbeltriders.com

48. Lindell, C. (2016, September 23). *Home matters: Austin's Compost Pedallers takes out your food by bike*. Austin Statesman. https://www.statesman.com/news/20160923/home-matters-austins-compost-pedallers-takes-out-your-food-by-bike

49. *Midtown Composting & Recycling*. (n.d.). Midtown Composting & Recycling. Retrieved April 19, 2020, from https://midtowncomposting.com/

50. (Maurice Telesford, personal communication, March 5, 2020)

51. (*Rust Belt Riders: Feed people, not landfills*, n.d.)

52. "What Abouts" is a term coined by Renee Wallace of FoodPlus | Detroit to describe common concerns people have over composting practices.

53. (Maurice Telesford, personal communication, March 5, 2020)

54. (Lindell, 2016)

55. (McSweeney, 2019, pp. 28)

56. (Detroit Dirt, n.d.)

57. Platt, B., Goldstein, N., & Coker, C. (2014). *State of composting in the U.S.: What, why, where, & how.* Institute for Local Self-Reliance.

58. (Lindell, 2016)

59. (*Midtown Composting & Recycling*, n.d.)

60. (Rust Belt Riders: Feed People, Not Landfills, n.d.)

61. (McSweeney, 2019, pp. 28)

62. (McSweeney, 2019, pp. 28)

63. (McSweeney, 2019, pp. 29)

64. (Daniel Brown, personal communication, March 17, 2020)

65. (*Rust Belt Riders: Feed people, not landfills,* n.d.)

66. (Gan, 2015)

67. (Lindell, 2016)

68. (Lindell, 2016)

69. Gardner, L. (2019, February 12). *Private compost haulers are emptying landfills and changing minds – One bucket at a time.* Food Tank. https://foodtank.com/news/2019/02/compost-haulers-emptying-landfills/

70. (Platt, et. al., 2014, pp. 62)

71. GrowNYC. (n.d.). *GrowNYC Food Scrap Collection Schedule.* Retrieved March 3, 2020, from https://www.grownyc.org/compost/locations

72. (GrowNYC, n.d)

73. (GrowNYC, n.d)

74. The term "compost superhero" is a fictional character Renee Wallace dreamed up, that she shared with us following her interview with us in early March.

75. (*Sherwood Forest Association*, 2020)

76. (Platt, et. al., 2014, pp. 62)

77. Patrick Crouch of Earthworks Urban Farm, Detroit, MI, personal communication, March 27, 2020

78. (Patrick Crouch, personal communication, March 27, 2020)

79. (GrowNYC, n.d.)

80. David Hurd of Grow NYC, New York City, NY, personal communication, March 13, 2020

81. (Maurice Telesford, personal communication, March 5, 2020)

82. (Maurice Telesford, personal communication, March 5, 2020)

83. (Patrick Crouch, personal communication, March 27, 2020)

84. (Patrick Crouch, personal communication, March 27, 2020)

85. (Patrick Crouch, personal communication, March 27, 2020)

86. *Compost Food Scraps.* (n.d.). GrowNYC. Retrieved March 3, 2020, from https://www.grownyc.org/compost

87. Erma Leaphart of Sierra Club, Detroit, MI, personal communication, March 27, 2020

88. Khalil Ligon of Detroit Planning and Development, Detroit, MI, personal communication, March 18, 2020

89. Malik Johnson of Detroit Buildings, Safety Engineering, Environmental Department, Detroit, MI, personal communication, March 17, 2020

90. Benny Erez of ECO City Farms, Washington D.C., personal communication, March 27, 2020

91. (Malik Johnson, personal communication, March 17, 2020)

92. (Platt, et. al., 2014, pp. 27)

93. *Neighborhood Soil Rebuilders Composter Training Program.* (n.d.). Institute for Local Self-Reliance. https://ilsr.org/neighborhood-soil-rebuilders/

94. (Linda Bilsens, personal communication, March 10, 2020)

95. (Benny Erez, personal communication, March 27, 2020)

96. Platt, B., McSweeney, J., & Davis, J. (2014). *Growing Local Fertility: A Guide to Community Composting* (pp. 25-31). Institute for Local Self-Reliance.

PHOTO CREDITS

Cover page image from Anikka Van Eyl, 2020.

Figure 1. A historic home in Sherwood Forest. Anikka Van Eyl, 2020.

Figure 2. An example of how a Home-Based Hub could look in Sherwood Forest. Rendering by Emily Korman, 2020; base image from Redfin.com, 2020.

Figure 3. Atwater Community Garden offering a small composting operation to collect neighbor food scraps under We Got Leaves in Shorewood, Wisconsin. We Got Leaves, 2019.

Figure 4. An example of a collection entrepeneur traveling house to house by bicycle to pick up compost containers. Van Eyl, 2020).

Figure 5. An example of a food scrap collection bucket from Midtown Composting in Detroit, Michigan. Midtown Composting & Recycling, 2020.

Figure 6. Compost Pedallers at work with their motto, "Burn calories not fossil fuels." Compost Pedallers, BioCycle, 2015.

Figure 7. A compost station located within the Palmer Park Urban Garden, an educational garden within walking distance of Sherwood Forest. Korman, 2020.

Figure 8. GrowNYC food scrap drop off locations at green markets (GrowNYC, 2017)

Figure 9. A neighborhood marker placed on the border of Sherwood Forest (Korman, 2020).

Figure 10. A community event in Sherwood Forest celebrating the neighborhood's 100th Anniversary. Allen, E.B. (2017, August 10). "Celebrating a Century: Sherwood Forest turns 100." *The Hub Detroit.*. https://www.thehubdetroit.com/celebrating-century-sherwood-forest-turns-100/

RECOMMENDATIONS 180

CONCLUSION 194

PART V

LOOKING FORWARD

RECOMMENDATIONS

RECOMMENDATIONS

From our research, interviews, and discussions, our team has outlined several recommendations for how to implement decentralized community composting systems throughout Detroit. We've grouped our recommendations into three broad strategies: educate and engage, change policy, and build partnerships. Each strategy has specific action items for potential leaders and partners to undertake, as well as a general timescale ("short-", "mid-", or "long-term") indicating when actors should undertake it. Actions within each strategy are listed from more short-term to long-term actions. Additionally, each action item suggests potential partners that may be involved with implementing the action. Where appropriate, we specify a potential "lead" partner. A recommendation summary table and description of potential partners is provided at the end of this section.

STRATEGY #1
EDUCATE & ENGAGE

Community engagement and education are the foundation to the retainment and recovery of resources within the local community. As a result, community-scale composting can strengthen community ownership and empowerment.

ACTION #1 FIND COMPOST CHAMPIONS

● ○ ○

(1-2 YEARS)

Every community compost system needs an advocate - someone to start the system and encourage its growth.

POTENTIAL PARTNERS:

- Residents
- Community Organizations
- Block Clubs / Neighborhood Groups

FIND A PASSIONATE COMPOST CHAMPION

The first step to implementing any community-scale composting system requires a Compost Champion- a passionate individual, block club, or community organization who understands the community and is enthusiastic about composting. Compost Champions can be the most effective in championing a community-scale system and can provide localized public outreach, tailored to the neighborhood or community.

BUILD UPON EXISTING RESOURCES

Community gardens, urban farms, schools, churches, and more can serve as the seed to activate the system as long as there is a willing Compost Champion or group of committed individuals. By tying the compost system to an existing community resource, the compost system has additional stability that can help ensure the sustainability of the program.

SPREAD RESOURCES AND KNOWLEDGE

Compost Champions are already willing and excited to activate the system, making them an incredibly effective voice to reach a wide range of Detroiters. Working directly through existing community networks, Compost Champions can share knowledge with their neighbors, answer questions at community meetings, block parties, and other events. Some Champions may create their own educational materials to distribute or connect with community partners who already provide compost workshops to bring them to their own neighborhood.

ACTION #2 MAKE IT SIMPLE

● ○ ○

(1-2 YEARS)

From system guidelines to visual appearance, a community composting system must be as simple as possible to be embraced by residents.

POTENTIAL PARTNERS:

- Compost Champion(s)
- FoodPLUS | Detroit

DESIGN COMPOST BINS & COLLECTION SITES TO BE INTUITIVE

Compost pick-up bins and food scrap collection sites should be designed in a way that clearly indicates where food scraps is to be placed. This is particularly important when compost sites are near existing non-organic trash bins to ensure people don't mix waste streams.

OUTLINE THE "NEED-TO-KNOW" INFORMATION

Having simple guidelines for participants to reference on-hand can make it easier to ensure everyone is utilizing the compost system correctly. A one-page instruction pamphlet that is brief, coherent, and outlines what organic materials can and cannot be contributed to the system could convey this information well.

USE PARTICIPATORY MEASURES TO ASSESS INTEREST & HABITS

With information from neighborhood surveys, community asset maps, and other resources, system designers would have the information needed to create a system that integrates with participants' lifestyles. For example, if surveys indicate participants primarily commute via bus rather than personal car, it may make sense to place a community composting receptacle at the bus stop so residents can drop off their food scraps during their morning commute. These actions can help turn composting into a routine activity.

OFFER INCENTIVES TO ENCOURAGE PARTICIPATION

While the economic gains and job opportunities created by composting operations can be strong motivations, system organizers could offer residents, businesses, and institutions non-monetary incentives to encourage participation. For example, participants could be offered credits for contributing food scraps, and receive a mound of compost each season once they reach the credits.

PLACE FOOD SCRAP COLLECTION BINS IN POPULAR AREAS

Information collected from neighborhood surveys and other participatory measures can be used to identify the public places residents frequent most, such as schools, churches, bus stations, and parks. Based on data, place community food scrap collection bins in locations people frequently visit.

ACTION #3 CREATE SPACE FOR COMMUNITY

●●○
(2-5 YEARS)

Creating a physical space for community-scale composters to gather, learn, and support one another is an important component to building a knowledge base and supportive community around the system.

POTENTIAL LEAD:
- FoodPLUS | Detroit

POTENTIAL PARTNERS:
- Community-scale composting sites

OFFER ONGOING EDUCATIONAL PROGRAMMING

As the community system grows, community-scale composting site managers could share knowledge by offering workshops to explain the benefits of composting; host demonstration sites to engage new composters; teach decomposition science, and share composting best practice to interested residents. Schools, churches, libraries, and other community organizations could partner with composting sites to design and support these educational programs, opting to host them or running them as youth programs. Community composting sites could share best management practices and educational materials to limit bad actors that harm the overall reputation of composting within the City of Detroit.

DEVELOP COMMUNITY COMPOSTER TRAINING

Those interested in developing their own community-scale composting system could learn from an intensive, in-depth exploration of composting similar to the existing Neighborhood Soil Rebuilder's program or Master Composter programs. These educational programs would help ensure best management practices among composters while also offering an opportunity for individuals to launch their own system or deepen their knowledge.

ENABLE A PHYSICAL SPACE FOR THE COMMUNITY

Having a physical space where people can gather ignites creativity and allows for new social connections. Enabling this space- whether this means utilizing an existing organization's office or opening a new storefront space dedicated to community composting- allows residents and different community groups to come together to share composting knowledge and experiences. This space can offer opportunities for skilled composters and those new to the scene to learn and grow, strengthening the community-scale composting systems.

STRATEGY #2
CHANGE POLICY

Before community-scaled composting systems can flourish in Detroit, policy surrounding composting must be changed. Having a proper regulatory structure at the state and local levels is essential. Successful policy recognizes the importance of encouraging individuals, private sector actors, urban farms, community groups, and nonprofits to compost while balancing the need for best practices to maximize the benefits of composting while minimizing any negative externalities.

ACTION #1

● ○ ○

(1-2 YEARS)

ADVOCATE FOR LEG 115

To expand community-based composting in Michigan, the amendments to Part 115 of NREPA need to pass.

POTENTIAL LEAD: Sierra Club's State of Michigan Chapter
POTENTIAL PARTNERS: State of Michigan EGLE, Detroit Future City, FoodPLUS | Detroit

Advocate for the proposed amendments to Part 115 to help expand the reach of community-based composting. As stated previously in this report, the proposed amendments to Part 115 of Natural Resources and Environmental Protection Act (NREPA) do several things which would improve the state of composting in Michigan. To ensure its passage through the state legislature, it is imperative that parties interested in composting advocate on its behalf. For effective advocacy to occur community groups, public officials, and individual citizens need to actively lobby the state legislature.

ACTION #2

● ● ○

(2-5 YEARS)

EXPAND LEGALITY OF COMPOSTING

To encourage future community composting and to bring into compliance those who are already community-based composting, it is imperative to amend the Detroit Municipal Code.

POTENTIAL LEAD: Detroit City Planning and Development Department
POTENTIAL PARTNERS: FoodPLUS Detroit, Detroit Office of Sustainability

Currently, community composting is only legally allowed in industrially zoned areas or as an accessory use for urban gardens or urban farms. This severely limits the potential reach of community composting in Detroit. This recommendation can be achieved in several ways including: changing the classification of compost from a waste-related use to an agriculture-related use, which will allow community-scaled composting to be processed in the same location as urban gardens, urban farms, and other non-industrial sites; or by creating a separate composting ordinance, as was done with the Urban Agriculture Ordinance.

ACTION #3

● ● ●

(5+ YEARS)

INCLUDE BEST PRACTICES IN ORDINANCE

In order to control negative externalities and create transparent standards for both composters and city inspectors, any new ordinance or amendment must include administration standards and best management practices.

POTENTIAL LEAD: Sierra Club Great Lakes Program
POTENTIAL PARTNERS: State of Michigan EGLE, Detroit Future City, FoodPLUS Detroit

The ordinance ought to include standards that are clear, easy to follow, and not overly onerous on composters or city inspectors. We suggest that backyard composters not receiving external compostable material be exempted from the new ordinance or amendment.

STRATEGY #3
BUILD PARTNERSHIPS

Community-scale composting systems thrive on collaboration and partnership. By working together, compost leaders, municipal departments, and residents can share knowledge, identify opportunities to support the citywide composting system and help to ensure the demand of locally sourced compost.

ACTION #1 COLLECT DATA

● ○ ○

(1-2 YEARS)

To the best extent available, municipal departments, planners, and community partners should measure participation, organic material collection, revenue, expenses, compost processing speed, community involvement, policies, and initiatives.

POTENTIAL PARTNERS:

- FoodPLUS | Detroit,
- Urban Agriculture Organizations
- Individual Community Composting Operations

SET CLEAR DATA STANDARDS

Community partners can collaboratively establish data collection standards and collect data in order to support future initiatives and the potential expansion of a citywide decentralized composting system. It is important that data collection standards are simple and easy to capture.

USE DATA FOR ADVOCACY

Data on the growth and composition of the growing community composting movement in Detroit helps institutionalize knowledge and measure gains in sustainability efforts. This data can then be used as evidence to advocate at the municipal and state level to further support a citywide decentralized composting system.

LEAD THE NATION IN COMPOST DATA COLLECTION

Nationwide, data is largely lacking about composting operations, particularly community-scale or municipal-run programs. Detroit can lead data collection nationwide by establishing best practices and ease of data collection for community composting partners. More data is needed to better estimate diversion weights and the potential savings and environmental impacts for municipal governments.

ACTION #2 CREATE COMMUNITY LINKAGES

(3-5 YEARS)

Community organizations can connect and collaborate to enhance knowledge sharing and help identify opportunities for strengthening the city's decentralized compost system.

POTENTIAL LEAD:

- Detroit Future City

POTENTIAL PARTNERS:

- FoodPLUS | Detroit

ENSURE COLLABORATIVE RELATIONSHIPS

By collaborating and maintaining partnerships, this ensures the sustainability of the decentralized composting system rather than relying too heavily on any one partner or financial means.

EXCHANGE KNOWLEDGE

Different community composting sites could exchange best management practices and co-create educational materials to limit bad actors that harm the overall reputation of composting within the City of Detroit.

SHARE EVENTS

Partnerships can provide an opportunity to streamline workshops, events, and initiatives around the city to reduce efforts by various community partners but reach a larger number of residents with consistent messaging.

ACTION #3 ENSURE COMPOST DEMAND

(5+ YEARS)

The City of Detroit could encourage or mandate the use of locally sourced compost for municipal and community-led projects to support the growth of the composting industry by emphasizing use of compost in long range planning.

POTENTIAL LEAD:

- Office of Sustainability

POTENTIAL PARTNERS:

- Buildings, Safety Engineering, and Environmental Department (BSEED)
- Detroit Water and Sewerage Department
- Planning and Development Department

EMPHASIZE COMPOST USE IN CITY PROJECTS

Considering that the City could potentially use a significant amount of compost, increased demand could create jobs and its own economies, while also aligning with the City's overarching goals as declared in the 2019 Sustainability Action Agenda. The City could encourage the use of compost as a soil amendment, emphasizing locally sourced compost from the City of Detroit for future municipal or community green storm water infrastructure, right of way improvement, landscaping, and tree planting projects. As compost production capacity expands over the years, this could also include backfill for demolitions. The City could incentivize or mandate the use of a certain percentage of compost in these projects to encourage the expansion of the compost market, providing alternatives in the case that locally sourced compost is not readily available.

ENSURE QUALITY WITH BEST PRACTICES

A streamlined contracting process can establish systems to ensure compost quality by promoting best management practices.

RECOMMENDATION OVERVIEW

STRATEGY	ACTION	DESCRIPTION	TIMELINE
EDUCATE & ENGAGE	FIND COMPOST CHAMPIONS	Every community compost system needs an advocate–someone to start the system and encourage its growth.	●○○
	MAKE IT SIMPLE	From system design to guidelines to visual appearance, a community composting system must be as simple as possible to be embraced by residents.	●○○
	CREATE SPACE FOR COMMUNITY	Creating a physical space for community-scale composters to gather, learn, and support one another is an important component to building a knowledge base, and supportive community around the system.	●●○
CHANGE POLICY	ADVOCATE FOR LEG 115	To expand community-based composting in Michigan, the amendments to Part 115 of NREPA needs to pass.	●○○
	EXPAND LEGALITY OF COMPOSTING	To encourage future community composting and to bring into compliance those who are already composting at a community scale, it is imperative that the Detroit Municipal Code be amended.	●●○
	MANDATE BEST PRACTICES	In order to control negative externalities and create transparent standards for both composters and city inspectors, any new ordinance or amendment must include administration standards and best management practices.	●●●
BUILD PARTNERSHIPS	COLLECT DATA	To the best extent available, municipal departments, planners, and community partners should measure participation, organic material collection, revenue, expenses, compost processing speed, community involvement, policies, and initiatives.	●○○
	CREATE COMMUNITY LINKAGES	Community organizations can connect and collaborate to support the system's operations and help identify potential opportunities for system-level design.	●●○
	ENSURE COMPOST DEMAND	The City of Detroit could encourage or mandate the use of locally sourced compost for municipal and community-led projects to support the growth of the composting industry by emphasizing use of compost in long range planning.	●●●

IMPLEMENTATION PARTNERS

STATE OF MICHIGAN EGLE

The Department of Environment, Great Lakes, and Energy's mission is to protect Michigan's environment and public health and is a key author of the State of Michigan's ordinance that includes composting regulations.

CITY OF DETROIT DEPARTMENTS

City of Detroit Office of Sustainability; Buildings, Safety Engineering, and Environmental Department; Water and Sewerage Department; and Planning and Development Department; among others all have an important role to play in the development of a successful decentralized composting system.

DETROIT FUTURE CITY

Detroit Future City (DFC) is a nonprofit organization that plays a crucial role in Detroit as an independent think tank, policy advocate and innovation engine focused on the future of the city and the implementation of strategies that advance the recommendations laid out in the DFC Strategic Framework, which demonstrates the potential of expanding community-scaled composting.

SIERRA CLUB'S STATE OF MICHIGAN CHAPTER

The Sierra Club is an influential grassroots environmental organization in the United States and is committed to community-based composting.

FOODPLUS | DETROIT

FoodPLUS|Detroit is a local partnership network comprised of business, government, societal, cultural and community organizations and knowledge institutions. It plays a key role in advocating for community-composting in Detroit.

COMMUNITY OF DETROIT

Residents, block clubs, neighborhoods, community organizations committed to composting can serve as the seed to activate a decentralized composting system.

CONCLUSION

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it is the only thing that ever has."

– Margaret Mead

CONCLUSION

Looking forward, our recommendations and analysis suggests that there is tremendous opportunity to shift the narrative of waste management to resource recovery, while also engaging, empowering, and educating the community. We focused on decentralized, community-scale composting because of the numerous benefits that go beyond that of more individualized backyard or large-scale industrial composting: greener neighborhoods, healthier local soils, reduced stormwater runoff, more local jobs, and community empowerment.[1] Scaling up composting at the community level offers more opportunity for education and increased participation, while also building support for a potential city-wide food scrap collection program in the future.

As advocates consider ways to scale up composting in Detroit, we suggest a number of ways they might build on the research we outline in this report. First, this report will be most useful for considering strategies for expanding community-scaled composting; it does not represent an exhaustive look at all composting efforts at other scales–such as backyard and industrial composting–nor does it examine composting efforts in countries outside of the United States

Second, time limitations, in part due to the COVID-19 outbreak, constrained our ability to carry out more robust community engagement beyond the stakeholders we were able to engage with early on and those we could continue to interview over the phone. Ideally, we would have additionally held in-person

focus groups and design charrettes with nearby residents of Georgia Street Community Collective, Oakland Avenue Urban Farm, and Sherwood Forest. Such idea generation and neighborhood-specific strategy development is a recommended next step for Detroit partners to take in this effort.

Finally, this report offers initial estimates of food scraps generation, capture, impact, the citywide processing capacity, and partners who take on this effort. However, these estimates were calculated with base assumptions, and while they are an attempt to reflect real-life practices, actual numbers may deviate. Local level and site-specific empirical data was limited. As our recommendations suggest, a thorough and consistent data recording method would be beneficial for composting sites, community organizations, and municipal departments to strengthen their strategy and advocacy for the community composting movement in Detroit.

Detroit is already taking steps towards resource recovery and a closed-loop system, with its declaration in the 2019 Sustainability Action Agenda: "Goal #7–Reduce Waste Sent to Landfills."[2]

Surveys used to develop the Action Agenda showed that 96% of residents declared they want better access to recycling, compost, and other waste reduction opportunities.[3] This desire to improve waste management has been voiced and fought for by residents, non-profit organizations, businesses, and the municipality alike. However, with the unfolding uncertainty within the city's budget, it is critical to continue to advocate for the importance of waste diversion to ensure resources and support.[4] This budget uncertainty further signifies the opportunity and potential for community-scale composting, given the potential cost savings for municipal waste management systems and the potential for decentralized composting to engender closed loop systems.

We hope that this report identified opportunities, recognized barriers, and developed actionable recommendations that can help guide planners, policy-makers, and community members from Detroit and beyond looking to divert waste while strengthening community. Through the collaboration of the municipality, community organizations, and residents, Detroit can further its vision of becoming one of the greenest cities in the United States. Most importantly, as we illustrate in Detroit, we hope this report and its recommendations build on the growing body of knowledge that testifies to the power of compost in creating more sustainable and resilient communities.

ENDNOTES

1. Institute for Local Self-Reliance. (n.d.) *What is community composting?* https://ilsr.org/composting/what-is-community-composting/

2. Office of Sustainability. (2019). *Detroit Sustainability Action Agenda.* https://detroitmi.gov/sites/detroitmi.localhost/files/2019-06/Detroit-Sustainability-Action-Agenda-Web.pdf

3. (Office of Sustainability, 2019)

4. Carmody, S. (2020, April 14). Detroit's facing $348 million budget gap due to COVID-19; Mayor: "It is going to hurt.". *Michigan Radio NPR*. https://www.michiganradio.org/post/detroits-facing-348-million-budget-gap-due-covid-19-mayor-it-going-hurt

WHAT CAN GO IN COMPOST? 200

COMPOST SITE INSPECTION CHECKLIST 201

TROUBLESHOOTING FAQ 202

PROCESS TO FURTHER REDUCE PATHOGENS 205

COST ESTIMATES OF COMPOST SYSTEM MATERIALS & EQUIPMENT 206

PART VI

APPENDIX

WHAT CAN GO IN COMPOST?

YES! Greens Nitrogen - 1 PART	YES! Browns Carbon - 3 PARTS	NO! Not in my compost!
☑ Fruit and vegetable scraps and rinds ☑ Other food scraps including egg shells, coffee grounds (& filters), tea bags (no staples), and more ☑ Bread and grains ☑ Fruit Prunings ☑ Plants ☑ Grass clippings ☑ Uncooked food leftovers and spoiled/expired food - *requires immediate mixing with browns; often not accepted in community-scale composting to maintain BMPs* ☑ Manure of livestock (chicken, cow, pig, goat, rabbit, horse) - *currently NOT legal in Detroit but subject to change. Presents pathogen risk requiring a specific process*	✓ Leaves ✓ Shredded newspaper ✓ Paper - *NO colored or glossy paper* ✓ Tissues ✓ Cardboard - *small* ✓ Sawdust ✓ Woodchips - *untreated* ✓ Wood shavings - *untreated* ✓ Bark ✓ Twigs and branches - *small* ✓ Chopped brush ✓ Straw ✓ Horse and cow bedding ✓ Corn stalks ***Raising livestock in Detroit is currently not legal, but is subject to change.***	*Commercial or industrial facilities often accept the following but NOT in community compost sites* ✗ Meat or fish ✗ Dairy ✗ Fats/Oils/Grease ✗ Garden weeds ✗ Cooked food ✗ Certified Compostable Products (plant-based plastics) ✗ Bones ✗ Diseased plants ✗ Wood ash *NEVER in compost:* ✗ Fruit or vegetable stickers ✗ Plastic ✗ Metal ✗ Dog or cat feces ✗ Glossy or coated paper ✗ Condiment packages

Figure 1. Brief guide to acceptable materials at community-scale composting operations (U.S. Composting Council. (n.d.). https://www.compostingcouncil.org/; Bilsens Brolis, L and Platt, B. (2019) Community Composting Best Management Practices. Institute for Local Self-Reliance, pp. 17. https://ilsr.org/wp-content/uploads/2019/03/Compost-BMP-v1.pdf; Recology. (n.d.). Compost, recycle, & landfill. Recology. https://www.recology.com/recology-san-francisco/your-three-carts/; Support, E. W. (2018). Sheet mulching — aka lasagna composting — Builds soil, saves time. https://extension.oregonstate.edu/gardening/techniques/sheet-mulching-aka-lasagna-composting-builds-soil-saves-time)

COMPOST OPERATION INSPECTOR CHECKLIST

INSPECTION CHECKLIST FOR COMMUNITY-SCALE COMPOSTING OPERATIONS

NAME: _____

ADDRESS: _____

INSPECTOR NAME: _____ **DATE:** _____

COMPOST SITE

- ☑ Compost site is within legal site parameters
- ☑ Site is clean and well organized
- ☑ Site has a drainage pool
- ☑ Site has secure barrier(s), i.e. physical fence or structure
- ☑ Site has on-site storage
- ☑ Browns are stored on site
- ☑ Greens are not stored on site
- ☑ Storage bins or containers have seals and/or locks
- ☑ Documentation of materials that are coming in and out of the site
- ☑ Documentation of monitoring of active compost sites including temperature, moisture content, density & smell
- ☑ Presence of physical barrier to site

COMPOST PILES

- ☑ Food sources are covered
- ☑ No strong odor coming from the compost piles
- ☑ No non-compost piles
- ☑ No rat burrows

COMPOSTING PROCESS

- ☑ Food inputs are filtered/pre-sifted
- ☑ Compost site has been turned within the last two weeks

Figure 2. Proposed inspector checklist for community-scale compost operations (Bilsens Brolis & Platt, 2019; Michael Parsons of Fordham University, New York City, NY, personal communication, March 11, 2020.; Buckel, D. (2017). Guidelines for Urban Community Composting (pp. 1). https://ilsr.org/wp-content/uploads/2017/05/Guidelines-for-Urban-Community-Composting.pdf)

TROUBLESHOOTING FAQ

Composting System Condition	Possible Source or Reason	Other Clues	Recommended Remedy
Composting system fails to heat	Materials too dry	Cannot squeeze water from material	Add water or wet ingredients
	Materials too wet	Materials look or feel soggy; compost pile slumps; moisture content >60%	Add dry ingredients (leaves, straw, wood chips) and remix
	Not enough nitrogen, materials are slowly decomposing	Large amount of woody materials	Add high nitrogen ingredients; alter composting recipe
	Poor structure	Composting system pile settles quickly; few large particles; not excessively wet	Add wood chips, straw, build in dome shape
	Cold weather and small composting system pile size	Composting system pile size is less than 3.5 to 4 ft.	Enlarge or combine composting system piles; add highly degradable ingredients (fruit and veggie)
Temperature falls consistently over several days	Low oxygen; need for aeration	Temperature declines gradually rather than sharply	Turn or aerate composting system pile
	Low moisture	Cannot squeeze water from material	Add water
Uneven temperatures or varying odors in composting system pile	Poorly mixed materials	Visible differences in the composting system pile moisture and materials	Turn/remix composting system pile
	Uneven airflow	Poorly mixed materials	Remix composting system pile and build in dome shape
	Materials at different stages of maturity	Poorly mixed materials	None required
Gradually falling temperatures; composting system pile does not reheat after turning or aeration	Composting nearing completion	Approaching expected composting time period; adequate moisture available	None required
	Low moisture	Cannot squeeze water from materials	Add water and remix
Composting system pile overheating (temperature >150°F)	Insufficient aeration for heat removal	Composting system pile is moist	Turn composting system pile
	Moderate to low moisture; limited evaporative cooling	Composting pile feels damp but not excessively wet or dry	Add water; continue turning and aeration to control temperature

Composting System Condition	Possible Source or Reason	Other Clues	Recommended Remedy
Extremely high temperatures (>170°F) in composting system pile, curing pile, or storage materials	Pyrolysis or spontaneous combustion	Low moisture content; composting system pile interior looks or smells charred	Maintain proper moisture content; add water to charred or smoldering sections; breakdown pile and properly rebuild
High temperatures or odors in curing or finished compost storage pile	Compost is not stable	Short active composting period	Compost is not in curing stage, keep turning compost and tracking temperature and moisture
Ammonia odor coming from composting system pile	High nitrogen level	C:N ratio < 20:1	Add high-carbon materials
	Slowly available carbon source	Large woody particles; C:N ratio <30:1	Use another carbon material such as leaves or increase the carbon proportion
Rotten-egg or putrid odors coming from composting system pile	Anaerobic conditions	Low temperatures	Turn composting system pile
	Anaerobic conditions- materials too wet	Low temperatures	Add dry materials
	Anaerobic conditions- poor structure	Low temperatures	Add wood chips, straw, and rebuild in dome shape
	Anaerobic conditions- composting system pile is compacted	Low temperatures	Remix and rebuild in dome shape
	Anaerobic conditions- insufficient aeration	Low temperatures	Turn composting system pile to increase airflow rate
	Anaerobic conditions- pile too large	High temperatures	Break down composting system pile, remix with accurate recipe, and rebuild smaller pile
	Anaerobic conditions- airflow uneven	High temperatures	Break down composting system pile, remix with accurate recipe, and rebuild proper structure and size

Composting System Condition	Possible Source or Reason	Other Clues	Recommended Remedy
Odors generated only after turning	Odorous raw materials	High temperatures	Frequent turnings; add carbon to absorb and mitigate odors
	Insufficient aeration; anaerobic interior	Falling temperatures	Shorten time interval between turnings; add high-carbon materials, especially wood chips
Site-related odors (composting system pile not odorous)	Raw materials	Odor is characteristic of the raw material	Handle raw materials promptly with minimal storage
	Nutrient-rich puddles because of poor drainage	Standing puddles of water; ruts in ground surface or hardscape pad	Divert runoff properly; maintain pad surface
Fly or mosquito problems (Note: black soldier flies are usually not a problem)	Flies breeding in compost system pile	Fresh nitrogen materials exposed; flies hovering around composting system pile	Turn composting system pile every 2 to 3 days; cover with 6- to 12-inch layer of compost or carbon source
	Flies breeding in raw materials	Wet raw materials stored onsite longer than several days	Handle raw materials promptly; properly mix into composting system pile
	Mosquitoes breeding in stagnant water	Standing puddles of water; nutrient-rich receiving waters	Water effectively by showering compost pile while mixing; keep standing pools of water away from composting system pile
Finished compost contains clumps of materials and large particles; texture is not uniform	Poor mixing of materials or insufficient turning	Original raw materials discernable in compost	Screen/sift compost; improve initial mixing
	Airflow uneven	Wet clumps of compost	Screen/sift or shred/break compost into smaller bits; improve air distribution
	Raw materials contain large particles and non- degradable or slowly degradable materials	Large, often woody, particles in compost	Screen/sift compost; shred/break compost into smaller bits
	Active composting not complete	Curing pile heats or develops odors	Lengthen composting time or improve composting conditions.

Figure 3. Adapted from L. Bilsens Brolis, B. Platt, Community Composting Done Right: A Guide to Best Management Practices, Institute for Local Self-Reliance, 2019 (www.ilsr.org/composting-bmp-guide). Reprinted with permission.

PROCESS TO FURTHER REDUCE PATHOGENS

SPOTLIGHT - The Process to Further Reduce Pathogens (PFRP)

According to the U.S. Composting Council, because food residuals have high moisture content, and due to the system in which human foods are produced, they are at a high risk of containing human pathogens, fungi, and bacteria.[a] For this reason, it is of utmost importance that certain composting sites monitor temperatures and follow the Process to Further Reduce Pathogens (PFRP) time-temperature protocols. This includes sites processing animal manures and food scraps from more than one household, or producing compost for sale or food production.

Large-scale commercial-industrial food scrap composting sites are required to meet PFRP. While most small-scale composting systems are not, meeting PFRP will help assure that you are creating a final product that is safe to use for food production. Basically, PFRP means compost processing time and temperatures should be sufficient to kill most weed seeds, and reduce pathogens (such as E. coli or salmonella) and prevent vector attraction (unwanted critters).

To meet PFRP, material composted in enclosed systems must be maintained at a minimum average temperature of 131°F (55°C) or higher for three continuous days. Passively aerated and windrow style piles need to keep material at a minimum average temperature of 131°F (55°C) or higher for at least 15 days (they don't always need to be consecutive days, but check with your state regulators to be sure). During this period, there must be a minimum of five turnings with a minimum of three days between turnings.[b]

To render persistent weed and otherwise unwanted seeds inactive, such as tomato or pumpkin seeds, we further recommend 153°F as the target temperature to reach for at least three continuous days. It is important to note that everything in our pile must hit these temperatures – that means that these temperatures must be reached after new material has stopped being added. Although there will be instances where a pile may need to be reinvigorated with a boost of fresh nitrogen, remember that adding new material to your pile (particularly food scraps or manures) means that you must start the PFRP process anew.

▲ A composting pile in the active phase of decomposition. *Source: Institute for Local Self-Reliance.*

a Eva M. Christensen, *Best Management Practices (BMPs) for Incorporating Food Residuals Into Existing Yard Waste Composting Operations*, U.S. Composting Council (2009).

b Personal communication, Cary Oshins, US Composting Council, November 21, 2018. According to Cary, "you don't have to turn 5 times within 15 days; you have to turn 5 times with pile temps at or over 131 for at least 15 of those days." Also see the U.S. Composting Council Model Compost Rule Template, which provides a template for state regulators (available online at https://compostingcouncil.org/state-compost-regulations-map/). The template recommends that pathogen and vector attraction reduction compliance be achieved as follows:

i. Windrow composting: the compost material must be maintained at a minimum average temperature of 55°C or higher for 15 days or longer. During the period when the compost is maintained at 55°C or higher, there shall be a minimum of five turnings of the windrow with a minimum of 3 days between turnings. The 15 or more days at or above 55°C do not have to be continuous;

ii. Aerated static pile or in-vessel composting process: Material maintained at a minimum average temperature of 55°C or higher for three continuous days.

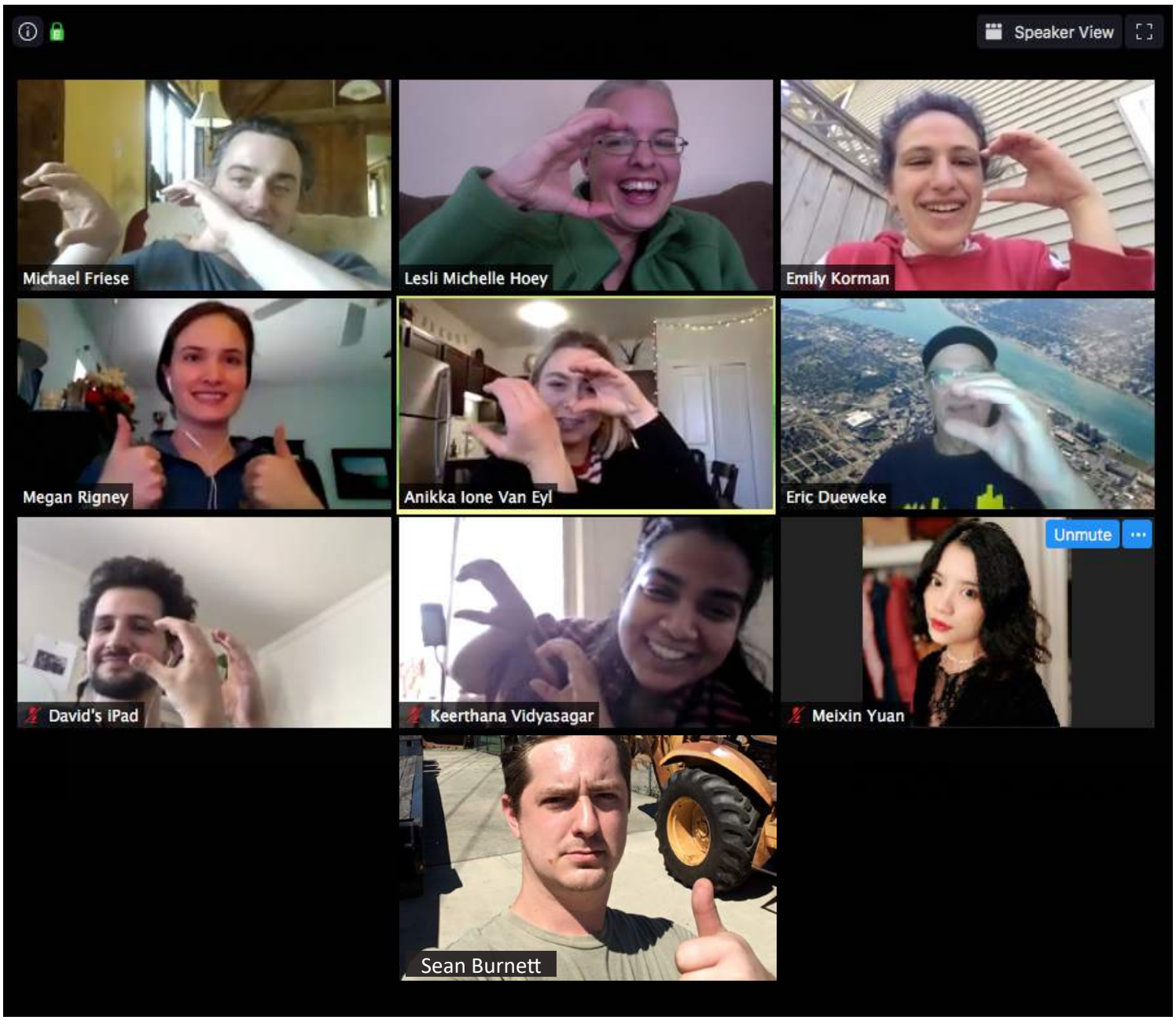
Figure 4. Source: L. Bilsens Brolis, B. Platt, Community Composting Done Right: A Guide to Best Management Practices, Institute for Local Self-Reliance, 2019 (www.ilsr.org/composting-bmp-guide). Reprinted with permission.

COST ESTIMATES OF COMPOST SYSTEM MATERIALS & EQUIPMENT

MATERIAL	ESTIMATED PRICE RANGE	NOTES
Residential 3-Bin Systems	$0-500	Free pallets make great composting bins. For demonstration bins, often aesthetics justify higher materials costs.
Residential Single Bins and Tumblers	$0-$500	Municipalities often sell discounted black plastic composters. The cheapest options are often wire cages. The largest capacity drum compost tumblers for residential applications are upwards of $400.00.
Prefabricated In-Vessel Composters	$15,000-$100,000	A wide variety of options exist (see Resources for link to CalRecycle technologies vendors website). Do research and talk to other operators of the system before you purchase.
Back Yard Compost Thermometers	$30.00	Typically 18". Respond slowly and will not last as long as commercial grade counterparts. Good for school applications where multiple are needed for students.
Commercial Quality Compost Probes w/ Handles	$75-200	Typically 3', although longer custom ones can be specially ordered. Handles will add years to its life! Quick read thermometers are a good investment when time is limited. Purchasing in bulk can cut the cost in half.
New/Used Loaders	$10,000-100,000	Huge price range depending on the size of the loader and whether it's new or used. If the equipment can serve multiple uses e.g. as a loader for turning piles as well as a tractor for field cultivation, costs will be spread across more of the operation.
Loader Operation	$25-$50/hour	It costs money in fuel, maintenance, and depreciation to operate a loader. For example, an 80 HP loader is accounted for at $35.00 per hour to run.
Small Self-Made Compost Screener	$0-200	Lots of simple designs and ideas on Google. Screening compost is not always necessary.
Commercial Compost Screener	$15,000-$100,000	Basic and used screeners can be found for under $50,000. Conveyors make screening more efficient. Make sure your loader and screener are compatible.
Compost Feedstocks (Raw Materials)	$0-15/cubic yard	Raw materials are free whenever possible and most composters get paid to accept & process food scraps. Certain materials may involve a hauling cost. High carbon materials such as bark and sawdust are the most expensive.
Feedstock & Compost Analysis	$30-$350	Basic analysis can be conducted by some universities for lower costs. US Compost Council Seal of Testing Assurance Lab tests start at around $40.00. Find Testing Protocols on the Highfields for Composting Center website (Feedstock Sampling Protocol).
Hand Tools (shovels, rakes, forks)	$15-$50	
Wheelbarrows	$50-$150	For carrying heavy loads, double-wheeled wheelbarrows are more stable.

Figure 5. Reprinted with permission from the Institute for Local Self-Reliance. Source: Brenda Platt, et al., Institute for Local Self-Reliance, Growing Local Fertility: A Guide to Community Composting, Table 7, page 89, available online at: ilsr.org/composting.

“C” IS FOR COMPOST!



– The Compost Capstone Team

Sean Burnett, David DeBoskey,
Michael Friese, Emily Korman,
Megan Rigney, Anikka Van Eyl,
Keerthana Vidyasagar and Meixin Yuan