Sustainability at WPI: Food Waste Management

An Interactive Qualifying Project
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Abstract

The goal of this IQP was to find a sustainable approach to improve Worcester Polytechnic Institute's food waste management. We explored the current disposal methods used by WPI’s food service provider and solutions implemented at other institutions. From our findings we concluded that the addition of composting to WPI's current system would divert more food and organic waste from its waste stream and function as a backup if the current system ever experiences difficulties.

Authorship

This report was written by Daniel Cammarata, Michael Cevallos, Camila Dias, and Augustine Kelty. Sections of this paper were drafted individually, however the final report was revised and edited in a combined effort.

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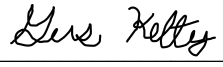

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Executive Summary

Problem

Here at Worcester Polytechnic Institute (WPI), food waste represents the second largest portion of trash by weight and the largest portion of trash that can be diverted away from landfills. Percentages of food waste in WPI's trash have been on the rise in recent years. This is cause for concern because this trend indicates that, at worst, food waste is increasing, or, at the very best, food waste is declining at a slower rate than other forms of waste (WPI Sustainability Report 2011, 2012, 2014, 2016).

To divert food waste, WPI currently has a mutually beneficial partnership with Tyde Brook Farm, a pig farm located in Holden, Massachusetts. The pig farm only collects pre-consumer food waste, and post-consumer from Morgan Hall. A representative from Tyde Brook Farm comes three to four times per week to collect the accumulated food waste. This arrangement only occurs during the academic year. In the summer all the food waste is disposed of in the trash.

A waste audit conducted in November of 2016 by the WPI Green Team reported that approximately 170 pounds of food waste were present in the garbage of the Campus Center, Gordon Library, and Daniels Hall (Table 1).

Table 1: WPI's Green Team 2016 Waste Audit Food Waste Results

Building	Percentage of Food in the Trash (%)*	Weight (lb)
Campus Center	23.1	124.0
Gordon Library	25.1	35.4
Daniels Hall	8.4	10.2
	*All data collected on November 9, 2016	**Total: 169.6 lbs**

Food waste was present at these locations because WPI does not have a system in place to capture post-consumer food waste from anywhere other than Morgan Dining Hall. Although the waste audit data only represents one day in three buildings, it indicates where improvements can be made in WPI's food waste removal system.

Goals

This IQP's goal was to recommend modifications to WPI's food waste management process; reducing the amount of food and other organic materials present in its trash stream. To accomplish this, we did the following:

1. Learn how WPI's current food system operates
2. Find out how other institutions solved the problem of food disposal
3. Construct a plan to improve WPI's food disposal system
4. Work with student organizations to implement, plan, raise awareness, and ensure a continued effort of reducing food waste

To gain information on WPI's existing food waste management infrastructure and process, we interviewed Elizabeth Tomaszewski, the Facilities System Manager and Associate Director of Sustainability and Joseph Kraskouskas, the Director of Dining Services. In addition to learning about the WPI establishment we also needed to gain an informed student perspective; to accomplish this, we interviewed the Green Team's President, Kyle Corry. The interviews enabled us to gather reliable information about WPI's food waste process initiatives, determine areas of improvements, and refine our goals.

To find out how other institutions solved their food waste problems we conducted off-campus interviews with Steven Bandarra, Sustainability Coordinator at Worcester State University, and Jenny Isler, Director of Sustainability at Clark University. At these locations, we toured their respective food waste disposal systems.

With the information we obtained, we formulated three different compost solutions: compacting, dehydrating, and in-vessel dry composting. The only data available to us regarding WPI's food waste was from a single waste audit, conducted on a single day, which is not representative of WPI's food waste disposal needs. As a result, we designed a pilot-program to gather the data necessary to select a solution.

We met with WPI's Director of Facilities, William Spratt, to inform him of the composting pilot-program and to request his feedback. We also introduced the Green Team to the topic of composting and explained the pilot-program. The purpose was to get the Green Team's support for the planned pilot-program.

Recommendations

We recommended implementing a pilot-program for composting in the Rubin Campus Center since it is a high traffic area and produces the most post-consumer food waste that ends up in regular trash (Table 1). The first goal of this pilot is to gather data on how much post-consumer food waste WPI regularly creates that is not diverted from the waste stream. The second aim of this pilot is to evaluate how well the WPI Community can sort organic waste. It also served to estimate how many Full-Time Equivalents (FTEs) are needed to operate this system. With this information, it will be possible to recommend a well-fitted solution for WPI.

The pilot will take place on the bottom floor of the Campus Center where the food court is located. Throughout this floor, bins labeled “Compost” will be distributed alongside recycling and trash bins. The Green Team’s role in this recommendation was to raise awareness of the new system on campus, through table sitting and social media, and to audit the compost bins to determine necessary changes in signage and positioning.

Concluding Remarks

By creating a pilot program for WPI, we are providing the university with the tools to craft the solution that best fits its needs. If WPI were to implement composting over summer and collect post-consumer food waste, it will ensure compliance with the Massachusetts food waste ban for the foreseeable future and safeguard against unforeseen disruptions in either food waste disposal system.

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Chapter 1: Introduction

Few people recognize the impact of their choices when disposing of leftover food. The lack of awareness has led to more than 38 million tons of food waste added to landfills every year (EPA, Reducing Food Waste at Home, 2017). Wasting so much food is both environmentally and socially irresponsible. The common misconception is that food in a landfill will decompose and will not cause any environmental harm. This assumption is incorrect because when food breaks down in a landfill, it produces methane, which is a greenhouse gas twenty times more potent than carbon dioxide. Additionally, food requires an immense amount of water and natural resources to produce. For example, growing a single almond, on average, uses 1.1 gallons of water (Mekonnen, Hoekstra, 2011). If food goes uneaten, the water and energy used to produce it are wasted as well. Food waste is a lost opportunity to feed hungry people; in the United States alone there are 48 million food insecure people (Feeding America, 2017). The United States Department of Agriculture defines food insecurity as not having enough food for an active, healthy lifestyle (USDA, 2017). If less food is wasted, then production would be better able to meet demand, and food insecurity would decrease.

Here at Worcester Polytechnic Institute (WPI), food waste represents the largest portion of trash that can be diverted away from landfills. Percentages of food waste in WPI's trash have been on the rise in recent years. This is a cause for concern because this trend indicates two possibilities: one, food waste is increasing or two, food waste is declining at a slower rate than other forms of waste (WPI Sustainability Report 2011, 2012, 2014, 2016).

As a goal outlined in the WPI Sustainability Plan, the university has aimed to reduce the waste that it disposes of in landfills or incinerators to 10% below the national per-capita average by 2018 (WPI Sustainability Plan, 2016). Redirecting the food waste would make a significant impact on WPI's waste disposal figures, and would be a major step towards achieving its sustainability goals.

With these facts in mind, this IQP explored the current disposal methods used by WPI's food service provider, Chartwells, and the solutions implemented at other institutions. Following, a feasibility study was performed on methods WPI could implement to reduce its food waste. Lastly, a final plan was suggested, for WPI to add composting to select dining locations on campus.

Chapter 2: Background

Organic waste is a constant concern, which has negative environmental and social implications. Presented in this chapter is an overview of organic waste and its regulations, WPI's current food waste management practices, and alternative methods to reduce food waste.

2.1 Food Wastage: Loss and Waste

Throughout the supply chain, from production to consumption, food can be either lost or wasted. Food loss is the quantity of food that becomes unusable before reaching the consumer; it is attributed to poor infrastructure and transportation, limited storage, and poor packaging or marketing (Lipinski et al., 2013). In contrast, food waste occurs when it is thrown away due to spoilage, careless handling, or overpreparation (Lipinski et al., 2013). Though loss is unavoidable throughout the supply chain, through proper preparation and planning, it can be controlled.

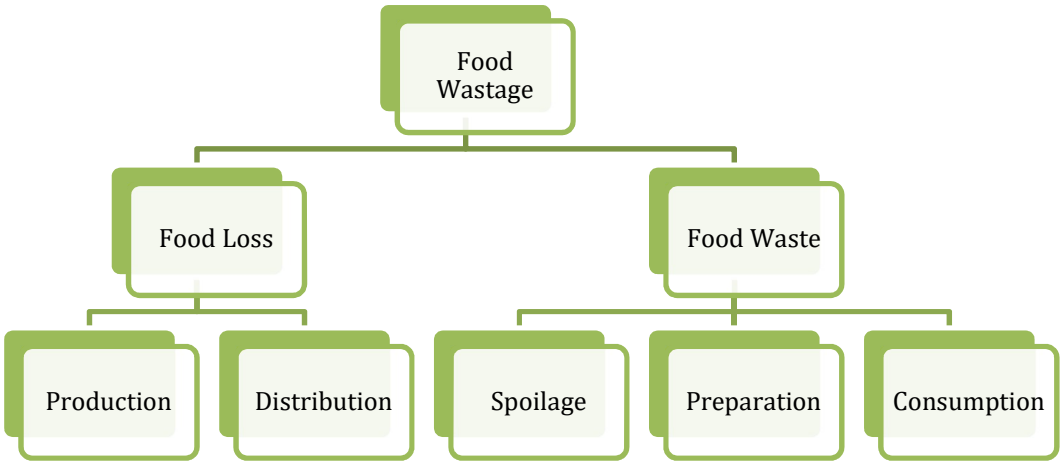

Figure 1: Food Wastage Supply Chain

Food wastage represents a missed opportunity to feed those who lack access to enough food. According to the Food and Agriculture Organization of the United Nations, 1.3 billion metric tons, or about one-third of all food produced for human consumption, is wasted globally (Food Loss and Food Waste, 2017). While tons of food are being wasted, 12.9% of the global population or 780 million people are suffering from hunger.

Food wastage has adverse consequences for the environment as it contributes to the depletion of natural resources like water. According to the United States Geological Survey

(USGS), in 2010 38% of "freshwater withdrawal" went to agriculture irrigation (Irrigation Water Use, 2016). The excess agricultural production needed to make up for wasted food results in greater water consumption. In addition to water, other natural resources are used to transport, store and prepare food. To put this in perspective, for every 100 heads of lettuce grown, only 67 (roughly two-thirds) will be eaten. The resources needed to transport and grow the remaining 33 heads of lettuce would have been wasted.

In addition to natural resource waste, food wastage also has a significant impact on methane emission. Per the EPA "Food waste is the second largest category of municipal solid waste (MSW) sent to landfills in the United States, accounting for approximately 18% of the waste stream" (Turning Food Waste into Energy at the East Bay Municipal Utility District, 2016). In landfills, organic waste decomposes in an anaerobic environment. This process releases methane, a greenhouse gas 21 times more potent than Carbon Dioxide (Turning Food Waste into Energy at the East Bay Municipal Utility District, 2016). In 2014, solid waste landfills accounted for 18.2% of human-related methane emissions, approximately one billion metric tons of methane yearly, the third largest source in the United States (Basic Information about Landfill Gas, 2015).

2.2 Waste Management Regulations in Massachusetts

In 2010, Massachusetts created a Master Plan to guide the state in reducing solid waste by 30% over the next ten years. According to this Plan, organic waste (food waste, leaves, and yard waste) makes up approximately 25% of all solid waste. However, only one tenth of this waste is diverted from landfills. Since the 1990s Massachusetts has banned the disposing of leaves and yard waste in municipal waste streams, however, no such regulation banning food waste existed until after the Solid Waste Master Plan was created (Massachusetts 2010-2020 Solid Waste Master Plan, 2013).

In October of 2014, Massachusetts instituted a ban on Commercial Organic Materials (COMs) from entering the waste stream (Commercial Food Waste Disposal Ban, 2017). COMs are any food or vegetative material that is produced in quantities greater than one ton per week (C.M.R 19). The ban makes it illegal for organizations to dispose of their food waste at a solid waste disposal facility, like a landfill. Instead, the waste must be composted, reduced, reused or recycled. WPI is already compliant with the existing regulations; however, it is still possible to decrease the amount of food in the waste stream.

2.3 WPI Current Waste Management Process and Rates

Currently at WPI, food waste is the second largest portion of trash (WPI Sustainability Plan, 2016). *Table 1* shows the proportion of food waste in three locations on campus. Two are food service locations, the Rubin Campus Center and the Gordon Library. One is a residential Hall, Daniels. Of note, buildings which serve food have triple the ratio of food waste in their trash when compared to locations that do not. This was the first audit to record the amount of food waste present in the trash. In previous years only trash and recycling were documented by the Green Team.

Table 1: WPI's Green Team 2016 Waste Audit Food Waste Results

Building	Percentage of Food in the Trash (%)*	Weight (lb)
Campus Center	23.1	124.0
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	*All data collected on November 9, 2016	**Total: 169.6 lbs**

WPI's food service provider currently sends food waste produced during meal preparation from its main dining facilities, Morgan Dining Hall, Campus Center and Goat's Head, to a pig farm. According to Elizabeth Tomaszewski, Associate Director of Sustainability at WPI, Morgan Dining generates 400 pounds of food waste a day; the Campus Center produces 100 lbs./day and the Goat's Head produces 50 lbs./day. A representative of the farm comes to WPI and takes the food at no cost. Researching WPI's current food disposal practices was a significant portion of this project, additional information can be found in Chapter 4: Results.

2.4 Methods of Reducing Food Waste

The EPA has developed the "Food Recovery Hierarchy"(***Figure 2***), a preference scale which ranks five methods for recovering food waste before it reaches landfills or incinerators, (Food Recovery Hierarchy, 2017). This section will elaborate on each tier of the Food Recovery Hierarchy.***Figure 2***), a preference scale which ranks five methods for recovering food waste before it reaches landfills or incinerators, (Food Recovery Hierarchy, 2017). This section will elaborate on each tier of the Food Recovery Hierarchy.

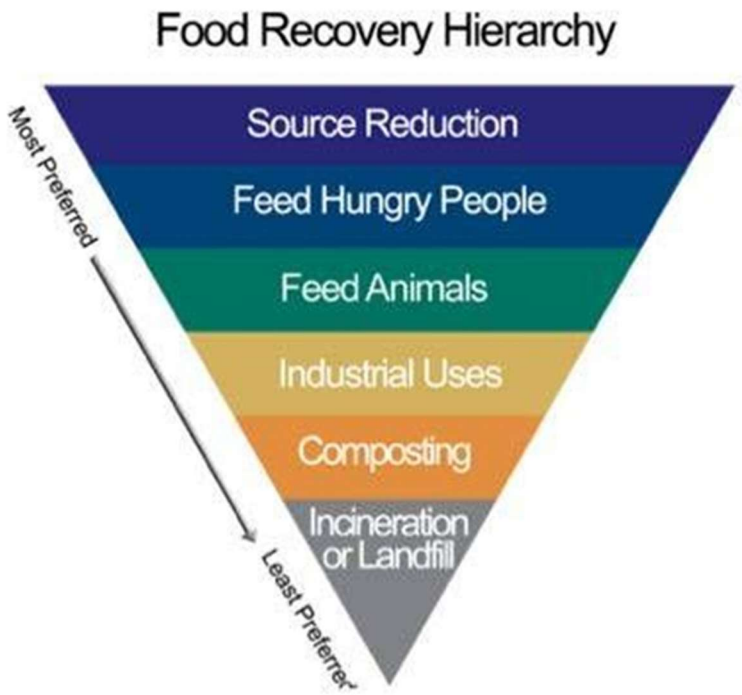

Figure 2: EPA's Food Recovery Hierarchy

2.4.1 Source Reduction

The primary and most efficient way of managing food waste is to prevent its generation. The EPA suggests a few methods individuals, businesses, and organizations can use to reduce food waste; they can change buying habits, modify food processes, and incorporate First-In First-Out (FIFO) practices (Food Recovery Hierarchy, 2017). If the total amount of food waste produced at the start of the hierarchy can be reduced, the effects propagate throughout the rest of the process resulting in an overall reduction of food waste.

In recent years, colleges across the United States have become increasingly conscious of food waste issues, and are implementing reduction and prevention programs. A growing reduction initiative among universities is the incorporation of trayless cafeterias, which limit the amount of food students take at once. Additionally, the mentality has shifted from “all you can eat” to “all you care to eat.” Trayless activities have proven to be effective and reduce up to 50% of food waste at colleges (More College Cafeterias Dump Food Trays, 2008). At WPI, the elimination of trays reduced the food thrown in trash bins by 40% (J. Kraskouskas, personal communication, March 21, 2017).

2.4.2 Feed Hungry People

Apart from source reduction, donating extra food to nonprofit organizations is the next best method for managing food waste. While Americans waste 38 million tons of food each year, 12.7% of the population does not know where their next meal is coming from (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016). One way of increasing food availability to those in need is donating edible food to shelters, charities, food banks and individuals. Food donations not only feed people but also reduce food waste in the environment.

Despite the benefits of donating food that would otherwise go to the trash, many restaurants, markets, and dining services do not donate in fear of liability issues. However, the Good Samaritan Food Donation Act protects donors and nonprofit organizations from civil and criminal liability. The law was signed by President Clinton in 1996, with the goal of encouraging food donations to nonprofit organizations. According to the act, organizations and individuals are only liable in case of negligence or wrongdoing (Good Samaritan Food Donation Act of 1996).

2.4.3 Feed Animals

When food is no longer edible, but still safe, it can be donated to farms to feed animals. Using food scrap as animal feedstock reduces the environmental impacts of food waste while saving farms and businesses money. Farms save money by purchasing less feedstock and businesses save money on waste disposals costs (Leftovers for Livestock, 2016). To protect the farms and animals, both the federal and the state governments regulate the use of food scrap as feedstock. Massachusetts prohibits feeding any garbage to ruminants as well as feeding scrap food collected by a town with more than 30,000 inhabitants to any animal, besides swine (Mass. Gen. Laws Ch. 270, § 9, 2016). Another Massachusetts regulation requires that any person wishing to feed food scraps to swine must have a permit, except for individuals who raise swine for personal use (Mass. Gen. Laws Ch. 129, § 14B, 2016). Regulations such as those in Massachusetts are in place to provide guidance and safety to farms and individuals interested in using food scrap as feedstock.

2.4.4 Industrial Uses

Industrial uses is the fourth step on the EPA's Food Recovery Hierarchy, which includes any process that converts uneaten food into industrial ingredients. Vegetable oil recycling is one example, which involves processing used cooking oil into biofuels. A second use, is to render the fats and oils present in organic waste into soaps, animal food stuffs, and cosmetics (Food Recovery Hierarchy, 2017).

2.4.5 Composting

Compost is a nutrient-rich dirt-like material made from decomposed organic matter and is used as a fertilizer to help plants grow bigger and healthier. The human-driven process through which compost is made is known as composting. It can take up to 2 years for composting to occur naturally, but by artificially creating the ideal composting conditions, the timeline can be reduced to 2 months (Moosey, 2017). Per the EPA, compost efficiency depends on nutrient balance (Types of Composting and Understanding the Process, 2016). Compost needs to have a proper mix of nitrogen-rich "greens" and carbon-rich "browns." Greens can include grass clippings, food scraps, and manure, while browns can include twigs, wood chips, and dry leaves. The general rule of thumb when it comes to composting is that if it was alive at one point, it can be composted. On a small scale like in a backyard meat, bones, or oils should not be composted because the odors could attract unwanted pests. When composting is done on an industrial level, the organic waste can be stored in pest-resistant vessels, or even indoors, to mitigate the risk of animals (Types of Composting and Understanding the Process, 2016).

2.4.6 Incineration and Landfill

The least ideal options are at the bottom of the food recovery pyramid and do not recover or take advantage of any of the unique properties of food waste. The combustion of food neither uses the nutrients like compost, nor renders the oils to be repurposed like industrial applications. Instead, it produces energy by burning the waste, which turns steam turbines. Though this process produces electricity, it is not an optimal solution. In an interview with Laura Haight, senior environmental associate at New York Public Interest Research Group, she stated that more energy is saved by reusing materials instead of destroying them (Pyper, 2011)

Sending food waste to landfills is less favorable than incineration because it can no longer be reclaimed for energy. Since 1976, the Resource Conservation and Recovery Act has required landfills to be lined with either clay and/or plastic (Palmer, 2011). Despite sealing efforts, leaks are a regular occurrence that expose local environments and groundwater to leachate. Leachate is a mixture of decomposing materials and heavy metals that pool at the bottom of landfills (Palmer, 2011).

2.5 Other Organic Wastes

Implementing a successful composting system allows additional organics to be diverted from landfills. The following sections elaborate on the different organic wastes that are present at institutions like WPI.

2.5.1 Compostable and Biodegradable Tableware

In recent years, biodegradable and compostable tableware options have become increasingly available to consumers. Products like cups, cutlery, and straws can be compostable if made from materials like corn or potato starch. Compostable tableware breaks down in a comparable amount of time as food waste provided it is disposed of at composting facilities (Biodegradable Products Institute, 2016). The use of these products provide the most benefit when composted, but are still favorable over plastics when disposed of in landfills.

2.5.2 Paper Products

Food is not the only organic waste present in landfills. The EPA estimates that paper products account for approximately 25% of landfill waste (EPA, 2016). The Massachusetts Executive Office of Energy and Environmental Affairs (EOEA) define reclaimable paper products to be magazines, newspapers, cardboard, and packaging materials. Items that have organic material such as pizza boxes, food containers, and toilet paper are also included in this number (EOEA, 2017).

There are three ways to properly dispose of paper waste: recycling, composting, and combustion. Recycling paper products allows them to be repurposed into new products, leading to a direct decrease in the amount of raw material needed to make new paper. If the product has been in contact with food and contains significant amounts of food residue, such as pizza boxes or frozen food containers, then the next best option is to compost it. Composting ensures that the paper will decompose in an aerobic environment, preventing methane emissions. If the product is unable to be composted, for instance if it was bleached, the final option is to use it as fuel for combustion. Combusting the paper produces a small amount of power and minimal pollution if emission control and capturing systems are in place (Elmore, 2012).

2.5.3 Yard Waste

Yard waste includes, but is not limited to, leaves, grass clippings, flowers, and weeds (Njue G., 2015). Even though it is an organic material, yard waste is not a significant source of waste in the trash stream or landfills. This is because in Massachusetts it is illegal to send green waste to landfills or combustion facilities. (C.M.R 19).

Yard waste cannot be dumped anywhere. Though it appears benign, yard refuse piled in excess can negatively affect the local environment. When piled, yard waste does not decompose naturally and can last for years due to the anaerobic environment in the heap's center. This pile produces heat, smothers native plants, and leads to soil erosion. If this occurs near a water source, the added heat can harm local aquatic wildlife (Lovejoy A., 2017).

Chapter 3: Methodology

This IQP's goal was to recommend modifications to WPI's food waste management process to reduce the amount of food and other organic materials present in its trash stream. To accomplish this, we created five objectives:

1. Conduct a literature review about food waste, and its solutions
2. Learn how WPI's current food system operates
3. Find out how other institutions solved the problem of food disposal
4. Construct a plan to improve WPI's food disposal system
5. Work with student organizations to implement, plan, raise awareness, and ensure a continued effort of reducing food waste

3.1 Literature Review

To accomplish the literature review, we first met with Laura Amy Robinson, a librarian at WPI. She showed us what tools were available to us, what constituted productive research, how credible sources could be identified, and what type of sources could be used in an IQP report. There were three main focuses for our research. First, we examined food waste, learning why it was an issue, how it harmed the environment, and what solutions existed to minimize it. Second, we looked at WPI's past IQPs and MQPs to learn what research had already been conducted on food waste at WPI and if any of the work was applicable to our IQP. Reading past reports also provided an outline and gave a clearer framework to our project. It was necessary to do this initial study so that we could ask food sustainability professionals informed questions.

3.2 On-campus Research: Interviews and Observations

All interviews followed a semi-structured format. We chose this format because while we knew specific questions to ask, we did not know if there was additional information we could gain from the interview. To conduct the interview, we specifically followed six steps:

1. Before meeting with the interviewee, we prepared an interview outline with questions we wanted to ask.
2. We emailed interviewees the outline ahead of time so they would know what to expect from the interview and could be prepared for our questions.
3. During the meeting, we first had them sign the IRB consent form. This form allowed us to include their interview and information in our report. It also informed them of their rights: they could make corrections, request for information to be omitted, or cancel the

meeting at any time.

4. We had one dedicated interviewer who asked questions and led most of the conversation and one note taker who recorded key information and asked clarifying questions. The remaining two people contributed where necessary.
5. After the interview was finished, we went through the taken notes and compiled them into a formal write-up.
6. The write-up was sent to the interviewee for their final review. This was needed because the interview had the potential to contain sensitive data. Edits were usually not needed, but when they did occur were only due to minor miscommunications during the interview.

To gain information on WPI's food waste management infrastructure and process, we interviewed Elizabeth Tomaszewski, the Facilities System Manager and Associate Director of Sustainability and Joseph Kraskouskas, the Director of Dining Services. In addition to learning about WPI's food waste infrastructure we also needed to gain an informed student perspective; to accomplish this we interviewed the Green Team's President, Kyle Corry. The interviews enabled us to gather reliable information about WPI's food waste process initiatives, determine areas of improvements, and refine our goals.

The first person we interviewed was Elizabeth Tomaszewski on February 17, 2017. The objective was to gain basic knowledge on WPI's food waste programs on campus and to gather contact information for individuals involved with food sustainability on and off campus. We asked for her insights on current food waste issues around campus, and what aspects she believed we should focus our project on (**Error! Reference source not found.**). The interview with Elizabeth Tomaszewski enabled us to create a baseline for our project. She connected us with Steven Bandarra, Sustainability Coordinator at Worcester State University, and Jenny Isler, Director of Sustainability at Clark University, whose interviews are described in the next section of the paper (3.3 Off-campus Research: Interviews and Observations).

The second on-campus interview was with WPI's Director of Dining Services, Joseph Kraskouskas, on March 21, 2017. The goal of the meeting was to gain a deeper understanding of Chartwells' food waste reduction initiatives and identify areas of possible improvements. We inquired about the effectiveness of the Chartwells Trim Trax program, Project Clean Plate, and the logistics of the pig farm agreement (**Error! Reference source not found.**). The interview with Joseph Kraskouskas enabled us to focus our project on post-consumer solutions and summer food waste pick-ups.

The next on-campus interview was with Kyle Corry, the WPI Green Team President, on March 28, 2017. The goal of our meeting was to learn about the Green Team's past efforts towards sustainability and to understand what role they could play in our project. We asked about the Gompei's Gears Bike Share program, which arose from a past IQP that the Green Team took over. Additionally, we inquired about Project Clean Plate, asking about how they recorded food waste, how effective last year's program was, and if there was data we could access (**Error! Reference source not found.**). The interview enabled us to plan for how the Green Team could help for future implementation.Appendix B: Interview Summaries). The interview enabled us to plan for how the Green Team could help for future implementation.

The final stage of learning about WPI food system was on March 28, 2017, when we toured Morgan Dining's kitchen. We saw the Trim Trax program in action and where the Tyde Brook Farm bins were located. We documented the tour with pictures.

3.3 Off-campus Research: Interviews and Observations

The purpose of the off-campus interviews was to learn how other campuses, subject to the same laws and regulations as WPI, solved their food waste issues. First, we met with Steven Bandarra, Sustainability Coordinator at Worcester State University (WSU), on March 24, 2017. Then, with Jenny Isler, Director of Sustainability at Clark University, on March 29, 2017. The interviews followed the semi-structured format presented earlier in section 3.2 On-campus Research: Interviews and Observations. The goal of the meetings was to learn the reasons they chose composting over alternative food waste disposal methods, what the barriers they faced during the transition, and how they overcame the obstacles. Additionally, we asked what food waste mitigation programs WSU and Clark partake in. The prepared interview questions can be found in **Error! Reference source not found.**, respectively. The interviews revealed additional avenues to dealing with food waste and demonstrated how food service providers operated at neighboring universities.

In addition to the interviews, we also toured both campuses. At WSU, we viewed their dish return setup where students dropped off their dirty plates and uneaten food. We took pictures of their grinder-pulper-dehydrator process and examined the resulting dehydrated food. At Clark, we viewed their dining hall's dish return and informally talked to three students about composting. We also visited a café and talked about Clark's waste system.

3.4 Analyze and Develop a Solution

From April 9 to April 20, 2017, we analyzed three potential food waste solutions for Worcester Polytechnic Institute (WPI). They were a compactor, a dehydrator-pulper, and an in-vessel composter.

On March 20, 2017, we conducted an over the phone interview with the Operations Manager at Common Ground Compost (CGC), Meredith Danberg-Ficarelli. CGC is a consulting, business to business, company which matches organizations and institutions with waste haulers. The services CGC provides were similar to the goals of this IQP; they evaluate an organization and provide tailored recommendations for improvement. We contacted her to learn about how CGC operates and what factors, like environmental or economic, they consider when comparing waste haulers (**Error! Reference source not found.**). This information guided us when we contacted waste hauling and composting companies.

During the week of April 9, 2017, we reached out to four hauling companies, Waste Management, Casella, and We Care Organics. We inquired about pricing data and how they handled organic waste. This data was to be used to create a recommendation for which company WPI's Facilities Department should pursue and would partially determine the solution employed. However, no companies responded to our inquiries in time. Therefore, we contacted other institutions that used the systems we analyzed and requested their historical price rates. Additional cost information was obtained from the Massachusetts On-Site Systems for Processing Food Waste report.

With the gathered pricing data from other institutions and online research, we analyzed how viable each solution would be and what considerations WPI should have. Additional information can be found in Chapter 5: Analysis.

3.5 Transition Solution to Student Organizations

The final phase of the project had two main goals: to propose the recommendation to Facilities and to hand the project over to the Green Team to manage. During the interviews, both Steven Bandarra and Jenny Isler stressed the importance of testing and iterating to a fitted solution. Their urging highlighted the necessity for a short-term action plan, during which experiments, tests, and observations can be performed to improve the program. Their recommendations, and the lack of pre-existing data on food waste drove us to recommend a pilot-program.

On April 24, 2017, we presented at the Green Team's general body meeting; this was a follow-up to our interview with Kyle Corry (3.2 On-campus Research: Interviews and Observations). We introduced the topic of composting, our project, and explained the pilot-program. At the end of the presentation, the Green Team members asked questions and provided feedback. The presentation's purpose was to get the Green Team's support for the planned pilot-program.

On April 25, 2017, we met with WPI's Director of Facilities, William Spratt. The goal of the meeting was to inform him of the composting pilot-program and to request his feedback. We asked him if WPI were to implement composting, how operational logistics would change. This includes any increase in labor and resources. We also requested additional pricing data on waste haulers, how the pricing is structured, and how much WPI pays for waste removal services (**Error! Reference source not found.**).

Chapter 4: Results

During our on and off campus interviews, our group identified three different phases in the food cycle: pre-consumer, post-consumer, and disposal.

4.1 Pre-Consumer Food Waste

Pre-consumer food waste is any food lost in preparation before it reaches the consumer. Loss can be due to spoilage, preparation procedures such as peeling, and mistakes such as overcooking. Our interviews identified two methods WPI uses to minimize pre-consumer waste: Trim Trax and the Food Recovery Network.

Trim Trax is a food waste reduction program developed by Compass Group, the parent company of Chartwells Dining. The goal of Trim Trax is to reduce the amount of food wasted during the meal preparation process (Implementing Waste Reduction Practices, 2010). As part of Trim Trax, kitchen staff place all food trimmings into clear 16-quart plastic containers. This allows the employees to have a visual reminder of how much and what type food is being wasted. When these bins are filled, the kitchen staff weigh, catalog, and dump the contents into designated trash barrels. Consistent record keeping allows kitchen staff to set a benchmark upon which they can improve. When the barrels are full, Chartwells employees empty the food scraps into 55-gallon drums marked for Tyde Brook Farm. The Trim Trax food waste process is illustrated in *Figure 3*. Three to four times per week, a representative from Tyde Brook Farm comes to WPI to collect the full drums and drop off empty ones (J. Kraskouskas, personal communication, March 21, 2017).

16-Quart Trim Trax Bin | 32-Gallon Trash Barrels | 55-Gallon Drums

Figure 3: Trim Trax Food Waste Process

A similar process is in place at Clark University where kitchen staff weighs and measures the amount of food wasted, and they have goals to minimize it. However, since Clark uses a compost system, they can also include napkins, and other organic waste in the waste stream (J. Isler, personal communication, March 29, 2017).

The second program we researched at WPI was the Food Recovery Network. Founded in 2011, the Food Recovery Network is a non-profit student-run organization that began with the aim of reducing waste and feeding people. The WPI chapter achieves this by collecting food from Morgan Dining Hall three to four times per week and donating it to a community center, Friendly House, located in Worcester. The food that is donated consists of the excess meals that were prepared by the kitchen and were deemed safe to consume according to kitchen guidelines (J. Kraskouskas, personal communication, March 21, 2017).

4.2 Post-Consumer Food Waste

Post-consumer waste is any waste that occurs after the final customer has received their product; it is harder to control because it requires compliance from the general population. We identified three different and complementary ways in which wasted food can be reduced: Project Clean Plate, food tray elimination, and the implementation of compost bins.

Project Clean Plate is a campaign promoted by the WPI Green Team. It seeks to raise awareness about the amount of food that students throw away, in an effort to encourage students to be more conscious of their portion control and waste less food. This is accomplished by students from the Green Team setting up a table near the disposal bins in Morgan Dining Hall; where the Green Team volunteers give raffle tickets to students that have no wasted food on their

plates. The raffles serve as positive reinforcement by offering the chance to win a prize at the end of the term. Since the start of the program at WPI in 2000, Chartwells has adopted this awareness campaign on a national level (J. Kraskouskas, personal communication, March 21, 2017).

The most successful initiative at WPI and at college campuses across the nation is the elimination of food trays at dining centers. Trayless dining limits the amount of food that students can pick up at one time. This mitigates the empty stomach effect where students pile more food on trays than they can eat in one meal (Foderaro, 2009). Both Project Clean Plate and the elimination of trays in dining halls created a substantial reduction in post-consumer food waste at WPI. Prior to program implementation, the average waste per meal was 0.55 pounds. Currently, the number is below 0.25 pounds (J. Kraskouskas, personal communication, March 21, 2017).

The final system researched was post-consumer compost collection. From interviews with the sustainability faculty of WSU and WPI, respectively Steven Bandera and Elizabeth Tomaszewski, we learned that having compost bins on campus might cause noticeable, repugnant odors. Therefore, these campuses decided to only collect pre-consumer food waste from the kitchens where odor can be controlled. However, Clark has developed an award-winning campus-wide compost collection system that manages to contain the odor.

From 2007 to 2012 the student-run organization, Clark Compost implemented the current campus-wide compost system. The frequent servicing of compost bins and the inclusion of paper products prevents pests and odors from becoming an issue on campus. Custodians frequently empty and clean the compost bins, eliminating the opportunity for odor build up. Jenny Isler, the Director of Sustainability at Clark, found adding paper products, such as used napkins and paper towels to be the biggest breakthrough for the success of the compost program. The paper products keep odors down by absorbing water and humidity present in the compost bins. The introduction of compostable, paper-based dining ware on campus has furthered the success of the program because the dining ware also absorbs liquids and moisture. Compost bins, such as the ones illustrated in *Figure 4* the science labs due to safety concerns. the science labs due to safety concerns. the science labs due to safety concerns. the science labs due to safety concerns. the science labs due to safety concerns.

Figure 4: Clark's Compost Bins

4.3 Storage and Destination

At Clark, all the waste captured by the compost bins is stored in a 17-ton capacity trash compactor. According to Jenny Isler, Waste Management picks up 12 tons of organic waste every two weeks during the academic year and tips to We Care Organics, an industrial composting center. During the summer, Clark produces half as much organic waste, so Waste Management comes half as often.

Worcester State University also composts but handles storage and disposal differently. To prevent smells and rodents from becoming a problem, the university processes their food waste and stores it as an inert substance. The food is first ground and pulped by a series of machines installed in the kitchen. The food is then sent to the dehydrator located in the building's trash room. The food processor accepts all forms of organic material, and can tolerate the presence of plastics, but will not break them down. The final material only has 10% its original volume. The amount of food that is collected before it is processed is approximately 4 tons every month, which ends up being stored in five 64-gallon trash toters that weigh up to 160 pounds each. Due to this Casella Waste management only picks up the waste approximately once every month.

Figure 5: WSU Food Waste Dehydration Process

Unlike Clark and WSU, WPI does not store any of its organic waste for as long of a time frame. The pre-consumer food from Morgan Dining, the Goat's Head, Campus Center and the Gordon Library is combined with the post-consumer food waste from the Morgan Dining and is picked up 3-4 times a week by a worker of Tyde Brook Farms, a pig farm. Since the waste is marked for livestock, compostable such as napkins and paper are not allowed in these containers. WPI sends approximately 8 tons of food to this farm every month. During the summer, this partnership is halted because the kitchen and students produce half as much food waste. The farm would have to come half as often to pick up full loads. In fear of the heat causing the waste to smell horrible, it is simply combined with the existing waste stream to be incinerated.

Chapter 5: Analysis

WPI currently has four initiatives in place to reduce food waste: Trim Trax, Project Clean Plate, Food Recovery Network and donation to the pig farm (Tyde Brook Farm). However, the pig farm donation currently lacks summer pick-ups and approximately half of post-consumer collection (Project Clean Plate, 2016) (Waste Audit, 2016). Summer pickups do not happen because the heat causes bacterial decomposers, which are responsible for the foul odor, to be 2.5-3 times as active when compared to cooler months. To prevent odors, a farm representative would need to collect twice as often, while WPI produces half as much food waste; meaning the farm would make twice the effort for half of the results. Post-consumer food waste, from locations other than Morgan Hall, are not suitable for the pig farm due to the lack of accountability and the high likelihood of contamination.

This chapter presents an analysis of three composting systems, a compactor, a dehydrator & pulper, and an in-vessel composter. Each option was analyzed with comparisons presented at the end. The criteria used to compare options were upfront costs, space constraints, odor risks, pick-up frequency, and versatility. The solutions were graded on a low-medium-high scale for easy comparison.

5.1 Compactor

One method of handling organic waste is to use industrial sized compactors. They have a broad range of sizes, depending on usage. The compactors researched for WPI ranged from 10 tons-20 tons. There are no specific compactors for organics; compactors are standalone systems that operate the same regardless of material input.

The greatest benefit of adding a compactor is its ability to store a large volume and variety of organic waste. Since the compactor does not process any material, it is versatile and can readily accept any organic waste such as paper towels and used napkins. Secondly, the compactor costs are low; it has no upfront investment and low operational expenses. The cost consists of a monthly rental fee, a per ton tipping charge, and a pick-up fee. At a similarly sized university the fees for these services were: $160/month for compactor rental, $60/ton for tipping, and $130 per pick-up. One last benefit of this system is that it operates nearly identicaly to the current trash and recycling collection system. Therefore it requires minimal additional workforce and training to run and maintain.

WPI's space constraints make a compactor's footprint its greatest drawback. The second drawback is the risk of foul odors. To mitigate this risk, paper towels and napkins, soiled by food or liquid, would be added to the compactor. Paper absorbs moisture in the compactor, inhibiting the growth of bacteria, and reducing the risk of fluid accumulation. To be clear, clean paper should be recycled, not composted because recycling gives the paper more utility over time. The least impactful drawback is the pickup frequency. The compactor would need to be emptied every two weeks to a month, but trash is already regularly picked up, so the change will not be significant.

Table 2: Analysis of Compactor

Type	Compactor
Upfront Cost	**None**
Maintenance Cost	**None**
Operational Cost	Low
Space Constraints	High
Odor Risk	Low
Pick-up Frequency	Medium
Versatility	High

5.2 Dehydrator & Pulper

The potential dehydration system has three parts: a grinder, a pulper, and a dehydrator. First is the grinder which, with the addition of water, process all the food into a slurry. The slurry goes into the pulper which operates similarly to a juicer, pulling most of the water out, producing a damp paste. The dehydrator uses dry air and heat from decomposition to remove the rest of the water from the paste. The dry material is then stored in 40-gallon to 50-gallon toters, until it is hauled away and processed at a composting facility. The dry material produced looks like compost, but is not, and will smell if it gets wet.

Figure 6: Pulper (left) and Dehydrator (right)

A dual dehydrator-pulper system has three benefits. The system shrinks volume by 85% to 90%, allowing for much less total storage space. It also kills most (80-95%) of the bacteria resulting in an inert, odorless substance. The decreased size and lack of foul smell (smells like dirt) significantly lower the needed pickup frequency to at most once a month (note: it also will process less material than the compactor). Some companies offer pilot programs or leasing and renting options, allowing WPI to test the equipment, lowering the commitment risks.

Dehydrators have three drawbacks. The first is that pulpers and dehydrators can be very expensive; their combined price ranges from $35,000 to $400,000, depending on size and features. Models fitting WPI's expected needs range from $35,000 to $50,000 and are designed small enough for indoor use. Additionally, all dehydrators require electricity and drainage, further limiting their placement. Expected electrical operational cost range from $50 to $140 per week. This system is designed primarily for food because other organic wastes like paper and compostable products are already dry and cannot be shrunk through dehydration.

Table 3: Analysis of Dehydrator-Pulper

Type	Dehydrator-Pulper
Upfront Cost	High
Maintenance Cost	Low
Operational Cost	Medium
Space Constraints	Low
Odor Risk	**None**
Pick-up Frequency	Low
Versatility	Medium

5.3 In-Vessel Dry Composter

In-vessel dry composting involves enclosing organic material and regulating its temperature, moisture, and aeration to produce compost. Similar to dehydrators; there are several types of in-vessel composters available for lease or purchase.

Figure 7: The Rocket In-Vessel Dry Composter

There are four benefits to an in-vessel composter. First, the electrical operating costs are low, ranging from $100 to $250 per month. Second, some models can shrink the material to 10% of its original volume. Third, in-vessel composters are closed systems and produce little to no odor. Finally, they accept any organic material but would require a particular ratio of green to brown matter to produce proper compost (2.4.5 Composting).

The biggest problem for WPI choosing an in-vessel composter is its main selling point; it produces compost. WPI does not have a constant demand for compost, requiring it to be stored until the spring. Facilities are already struggling with limited space and storing compost would only exacerbate the problem. Upfront purchasing costs are expensive, with units ranging from $20,000 to $65,000. All units require expensive enzymes and catalysts to function, adding to operation costs. Processing times are long, the shortest being 24 hours, while others can run for up to two weeks. Lastly, in-vessel composter requires specific ratios of green to brown matter, this must be managed and requires additional oversight to be successful.

Table 4: Analysis of In-Vessel Composter

Type	In-Vessel Composter
Upfront Cost	Medium
Maintenance Cost	Medium
Operational Cost	High
Space Constraints	Medium
Odor Risk	**None**
Pick-up Frequency	**None**
Versatility	Low

5.4 Comparison

Of the three composting alternatives, the compactor has the least upfront cost and lowest maintenance cost, making it the easy-entry option. The biggest obstacle to the compactor is space as it requires an additional compactor. The operational costs for the compactor are lower than both the dehydrator-pulper and in-vessel composter as it requires little energy and no supplementary materials. The dehydrator-pulper requires the least amount of space, the unit itself is small, and it shrinks the volume of the food waste substantially. The in-vessel composter and the dehydrator-pulper have the lowest odor risks because they both process the food waste into inert products, where the compactor is riskier because it relies on a high ratio of paper products. The compactor is the most versatile option as it can accept any organic waste a university would produce, where the Dehydrator mainly focus on food and the in-vessel composter requires a controlled ratio of "brown" to "green" matter.

Table 5: Analysis Comparison Chart

Type	Compactor	Dehydrator-Pulper	In-Vessel Composter
Upfront Cost	**None**	High	Medium
Maintenance Cost	**None**	Low	Medium
Operational Cost	Low	Medium	High
Space Constraints	High	Low	Medium
Odor Risk	Low	**None**	**None**
Pick-up Frequency	Medium	Low	**None**
Versatility	High	Medium	Low

Green = Favorable	Yellow = Adequate	Red = Unfavorable

Chapter 6: Recommendations

The following chapter discusses our recommendation for Worcester Polytechnic Institute (WPI) to test the feasibility of composting. The only data we have obtained on post-consumer food waste in locations other than Morgan Hall is the 2016 Green Team Waste Audit (Waste Audit 2016 Results, 2016). This data was collected on just one day, November 9, 2016, and does not depict an accurate model of the post-consumer food waste WPI creates on a regular basis. Nor is it comprehensive because it was only an audit of 3 of WPI's buildings. To gather more representative data, we are suggesting a pilot-program that will audit the post-consumer food waste in the Campus Center Food Court. This pilot has been developed to be run by the Green Team in the fall of 2017. The results of the pilot will indicate which of two possible solutions, adding composting as a supplement system or sorting more food waste to be collected by the pig farmer, will be the most viable for WPI.

6.1 Campus Center Compost Pilot

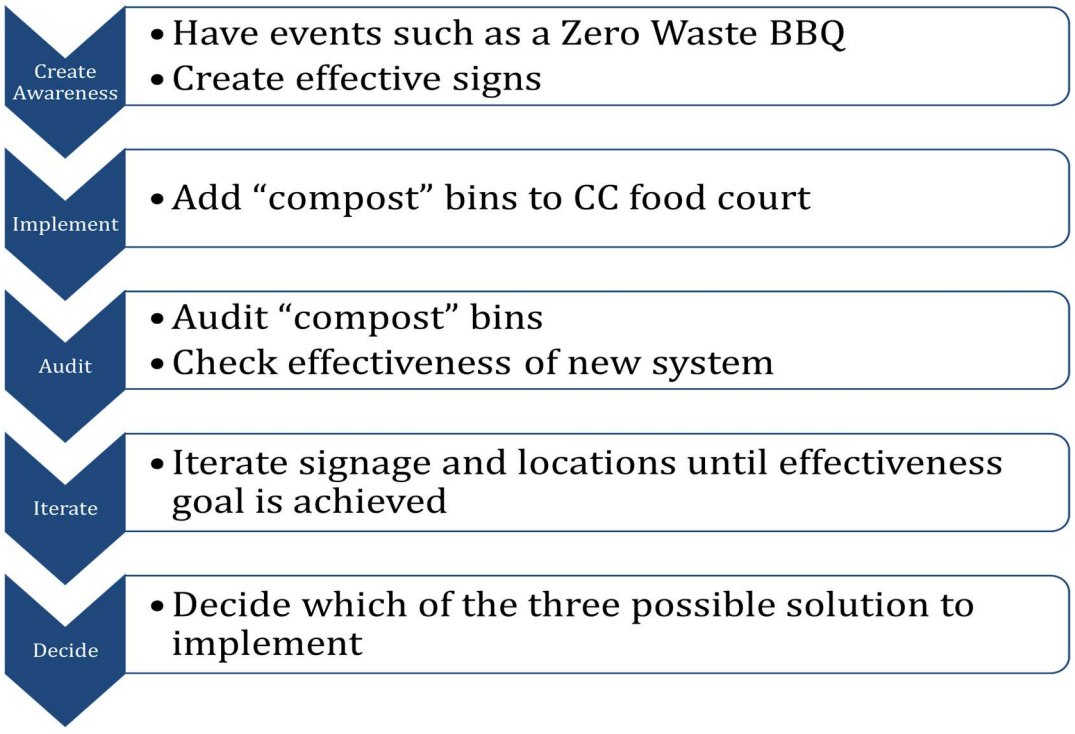

Figure 8: Pilot Composting Program

We recommend implementing a pilot-program for composting in the Rubin Campus Center since it is a high traffic area and produces the most post-consumer food waste that ends up in regular trash (*Table 1*). The goals of the pilot program are to:

- Gather data on how much post-consumer food waste WPI regularly creates that is not diverted from the waste stream
- Evaluate how well the WPI Community can sort organic waste
- Estimate how many Full-Time Equivalents employees (FTEs) Facilities will need to operate this system

With this information, it will be possible to recommend a well-fitted solution for WPI.

6.1.1 Methods of Pilot

The pilot will take place on the bottom floor of the Campus Center where the food court is located. Starting the pilot on only one floor will make it more manageable. Throughout this floor, bins labeled "Compost" will be distributed alongside recycling and trash bins. These compost bins will not only be for food waste but will also collect other organic wastes such as napkins and compostable containers. Each bin will have signage that indicates what materials can and cannot be composted. These signs can be text-based, image-based, or a combination of the two. In addition to signage, it is essential to monitor the separation of food scraps to prevent contamination. The simplest way to conduct this is by assigning volunteers from the Green Team to watch the bins during peak traffic hours. Having a person to monitor the food bins will prevent the WPI Community from throwing trash in the organic waste bins or vice versa.

We suggest that the Green Team coordinate with facilities to manage the organic waste collection. It is important to work with WPI's Facilities Department because custodians are the ones who collect and dispose of trash and recyclables. During the pilot WPI will not yet have a contract with a compost hauling company, so the post-consumer organic waste will either go to the regular trash compactor or the pig farm. The final destination depends on which of the following audit techniques is applied.

1. The Green Team audits the waste when the bins are full, recording the quantity food and paper products and calculating their ratios.
2. The waste is separated into two separate bins, one for food and the other for additional organic waste.

During the pilot, both audit strategies should be tested as they each simulate different scenarios. End of day sorting is good because it simulates how the compost will behave if the compactor solution is chosen, however, sorting the waste will be messy, and volunteers may be hard to find. Time of disposal sorting will be easier to collect data from, but will not accurately simulate the additional Facilities workload needed, and will not simulate how the bins may smell. We recommend the Green Team works with William Spratt, the Director of Facilities

Operations, and Terrance Pellerin, Associate Director of Buildings and Events, to coordinate labor, and decide which audit style best suits both parties. Working with facilities throughout this process is key to get the new system implemented since custodians will be the ones responsible for the organic waste collection after the pilot-program ends.

The pilot-program should take place for two to four weeks at the start of the fall semester in the hopes that a new system will be easy for students and faculty to adjust to at the onset of the academic year. Audits will be performed on a regular basis and in a similar fashion to the audits that the Green Team's annual waste audits. Depending on the results of audits and other problems that may arise such as foul odors, modifications such as bin placement and signage can be continually made to improve user behavior. This iterative process will continue until the target goal of low odor and adequate sorting is met. The results of the audits along with the corresponding final implementation will be used to determine what option WPI should pursue.

6.1.2 Composting Solutions

The final audit results will determine which solution is best applicable for WPI. When analyzing the scenarios for the most appropriate solution, there are three main considerations: first is odor, second is convenience, and third is cost effectiveness. The main goal is to have a system that does not create foul odors, is easy to manage, and is not an exorbitant expense for WPI to operate. Our group has researched five courses of action, with the direction depending on the results of the pilot program.

The first possible scenario is that the compost bin has a mix of food and other compostable items such as paper. If the amount of paper present is high enough to prevent odors, then it is recommended to implement the compactor system, similar to the one used by Clark University. This solution requires all the compostable items to be stored in a trash compactor until it is ready for pick-up. The compost waste needs to be hauled away regularly during the school year and at a less frequent rate during the summer months when production drops. The volume of waste and the contract will determine the frequency of pick-ups with the hauling company. More detailed information on compactor solution can be found in section 5.1 Compactor.

The next scenario that can occur is that despite having a mix of food and paper products, the bins produce bothersome odors. In this case, two options are available. The first is installing a dehydrator with a pulper and the second is purchasing an in-vessel dry composter. The first option, the dehydrator, is designed primarily to reduce food waste volume and produce an odorless material. Consequently, the odor free product can be hauled away less frequently,

potentially on a monthly basis. See section 5.2 Dehydrator & Pulper for detailed information on dehydrator systems. An alternative to the dehydrator is an in-vessel dry composter system. This solution differs greatly from all previous ones as it produces a final compost material and does not require pick-ups by a waste hauling company. While both of these options produce little to no odor, they have significant running and maintenance costs and require that WPI purchases new equipment. See section 5.3 In-Vessel Dry Composter.

The final scenario that might occur is that after several iterations of signage at the compost bin, audits show that contaminants are still highly present. In this case, it will be necessary to promote educational material and events on campus before continuing the analysis and implementation of a new system.

Figure 9: Composting Options Pros and Cons

6.1.3 Promotional Goals

We recommend that as the new disposal system is introduced to campus, a variety of social and educational outreach efforts are made to increase the adoption by the WPI Community. The Green Team will be a vital partner in achieving this goal. Not only will it be necessary to have students design flyers and table-sit to educate users, but events such as a Zero Waste Barbecues could prove beneficial. Highly visible, informative and attractive events such as a Zero Waste Barbecue will inform users on what is acceptable organic waste and have them practice sorting waste at the same time.

6.1.4 Continuing Implementation

If the pilot program is successful, then the next step would be for WPI to implement one of the solutions for the organic waste. Regardless of which option is chosen, the program should begin in the same place as the pilot, the bottom floor of the Campus Center. This will allow facilities to acquaint themselves with the proper procedures and solve any unforeseen obstacles before expanding the system. Ideally, the collection will expand slowly, floor by floor, building by building. Therefore, the next step after the pilot will add bins to the second level of the Campus Center. Once collection on that floor is perfected, compost bins should be added to the third floor, thus completing Campus Center as WPI's first composting building.

Next, a new location with substantial amounts of food waste, such as Gordon Library, should be selected to receive bins in the same manner as the Campus Center, starting on one highly trafficked floor and spreading to others. By following this procedure, the entire campus would eventually be equipped with composting. This would not be a quick process. Clark University took three years to place compost bins in nearly every building on campus. The implementation of a compost system in residence halls requires a significantly different and more complex implementation procedure than the one for regular buildings. Therefore, we recommend revisiting the topic of composting in residence halls with a second pilot-program and only after the composting system has been successful in buildings with dining locations.

6.1.5 Alternative scenario

In case composting in not a viable solution, we recommend that WPI still diverts post-consumer food waste from trash. An alternative solution is to combine the newly diverted food scraps with the existing food waste stream being sent to the pig farm. The first step will be to relabel compost bins as food collection bins. To ensure that the food bins have little to no contaminants, the WPI Community should still be educated on food waste sorting techniques. Although this is the simplest solution to implement, it has the smallest impact because it only solves the problem of post-consumer food waste during the school year. During the summer months, WPI will continue to send approximately half a ton of food every month into the trash stream because the additional food will still not be enough to warrant sending it to Tyde Brook Farm (J. Kraskouskas, personal communication, March 21, 2017).

6.2 Tableware Recommendation

If WPI adopts composting, we recommend a system wide switch from disposable plastic tableware to compostable alternatives, otherwise WPI should switch to reusable tableware. Much of the plastic tableware that is currently used on campus is non-recyclable due to food contamination and Waste Management's acceptance policies. Switching will be easy because WPI already uses some compostable tableware, a conversion will only require expanding the current purchases. One consideration to have when purchasing compostable tableware, is that all products should be thoroughly researched to ensure they are compatible with WPI's chosen system. Compatibility depends on decomposition difficulty and time. Implementing composting will enable the WPI Community to dispose of its compostable products the ideal way, rather than into a landfill or incinerator.

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Appendix A: Interview Questions

Interviewee: Liz Tomaszewski - Associate Director of Sustainability

Goal: The goal of this interview is to get basic information on WPI's food waste management process, and to validate our project topic during planning stage.

**This meeting was conducted during our PQP, before we had refined our interview techniques

Questions:

Q: It is our understanding that WPI send its food scrap to a pig farm. Can you tell us about this partnership? Which locations on campus this food waste diversion system is in place?

Q: Does Chartwells manage all the food on campus?

Q: Can you tell us about Chartwells food waste reduction initiatives programs?

Q: We plan to search and visit other colleges and explore their food waste diversion solutions. Which schools do you recommend us to start our research?

Q: Schools across the country are adopting composting as a solution to divert food waste from the waste stream. In your opinion, which is better, composting or pig farm donation?

Q: Do you think composting is a possible solution for WPI?

Q: In case composting is a recommended solution, how should we approach facilities and dining directors?

Q: How do you envision composting being managed? Would you hire an outside company to deal with it or some other solution?

Q: How hard would it be to switch from disposable clamshell containers in the Campus Center to compostable ones?
Q: Are there any other aspects of food waste we should look at?

Interviewee: Meredith Danberg-Ficarelli - Common Ground Compost

Goal: The goal of this interview is to expand our knowledge in the composting industry

Questions:

Q: What is your position and role at Common Ground Compost (CGC)?

Q: What are the standard food waste collection services composting companies such as the Common Ground Compost provide?

Q: Does Common Ground Compost work with any schools or colleges? If so, how big? What do they do with their waste? Reasons for not composting?

Q: What are your thoughts on compostable tableware? Good or bad?

Q: What type of questions do you ask a hauling company when assessing them for a school?

Q: Currently, WPI sends its food scrap to a pig farm. If the school decides to implement composting on campus, what would you suggest us to do to make the implementation process easier and smoother? What are the biggest challenges you believe WPI (or any campus) will face if composting is implemented?

Q: If we were to pursue composting from a company in the Worcester area, what considerations should we have? Is there anything we're not asking?

Q: Do you know of any people or companies we should talk to next?

Interviewee: Joseph Kraskouskas - WPI's Director of Dining Services

Goal: The goal of this interview is to have a better understanding of, WPI's food waste management process, WPI's initiatives in food reduction, and areas of possible improvements.

Questions:

Q: As Director of Dining Services, what is your role in ensuring food waste sustainability on campus?

Q: We researched that Chartwells partakes in a food waste reduction program called Trim Trax as part of its sustainability commitment. How is this program performed at WPI?

Q: Does WPI participate in any other food waste reduction initiatives besides Trim Trax?

Q: Can you tell us about WPI's food waste disposal partner(s)? Pig Farmer(s)? What are the partner(s)' logistics? (For instance: which types of food is acceptable, how often is the campus food waste collected, and how much of the food is collected, etc.).

Q: How about WPI's logistics? Where is the food waste stored? How is food waste collected and combined throughout different WPI's dining locations?

Q: WPI's Chartwells website mentions its 7 dining locations on campus, which are:

1. Morgan Hall – Pulse On Dining Marketplace
2. Rubin Campus Center Food Court- Profiles in Good Taste
3. Founders Hall- The Goat's Head Restaurant
4. Founders Hall- On The Go
5. Rubin Campus Center Food Court- Dunkin' Donuts
6. Gordon Library- 1970 Library Cafe
7. Higgins House- Faculty Dining Room.

How does Chartwells manage food waste throughout those locations? Are all of WPI's dining locations managed in the same manner? Who can we reach out to if we want to learn more about these locations specifically? Does Dunkin' Donuts participate in the same food waste programs as the Chartwells locations?

Q: Is there anybody else we can contact to learn more about campus wide food waste?

Q: What are the current food waste generation and diversion rates in pounds/tons?

Q: How do you define food waste? Are there any contaminants (Non-food waste like plastics, fruit stickers, etc.) found in the food bins? At what rate? Have there been any significant increases or decreases in the past, if so why?

Q: Is it possible to collect food waste from other WPI dining locations with the current disposal process?

Q: Has post-consumer food waste collection been considered in places like the campus center been (similar to what is done at Morgan Dining)? If so, what obstacles does it face?

Q: It is our understanding that Chartwells also provides food services to other institutions. Is

there an overall company policy on food waste disposal? If so, how is the WPI Chartwells different?

Q: Does Chartwells provide any training to its employees regarding these programs? If so, how frequent is the training? Can you tell us how the training is conducted?

Q: As a goal outlined in the WPI Sustainability Plan, the university is aiming to lessen the waste that it disposes of in landfills or incinerates to 10% national per capita average by 2018, which it is currently at 24%. Do you have any suggestion on how our IQP team could help WPI reach its waste reduction goal?

Q: For our project, one of the potential solutions we have been exploring is composting. Is there any way we can record the organic waste present at WPI's dining locations by auditing the trash? This would enable us to determine if composting is a viable option for WPI.

Q: Is there anything you feel that we should be asking you that we have not yet?

Interviewee: Jenny Isler - M.B.A., Director of Sustainability

Goal: Get information on Clark's current food waste reduction methods, any roadblocks they faced implementing, whom they are partnering with, and what catalyzed the fundamental shift on their campus to be more sustainable

Questions:

Q: As the director of sustainability at Clark, what is your role in ensuring sustainability in your campus?

Q: It is our understanding that Sodexo is Clark's food service provider. Do they have any food waste reduction/diversion programs in place?

Q: We researched that Clark composts on campus. Can you tell us about the compost management process?

Q: We were very impressed to learn that in 2013 Clark won MassRecycle 'Best Student Effort' among Massachusetts colleges and universities for its innovative and successful residential halls composting program. How was this program started? How is this process managed?

Q: Which food waste reduction program(s) does your campus participate in?

Q: When did your campus' food sustainability program(s) begin?

Q: What are the current food waste generation and diversion rates of Clark University?

Q: How successful have your food waste reduction program(s) been?

Q: What triggered the decision to select composting in place of other alternatives?

Q: Does your university use compostable disposable products such as eating ware and plates? If so, what kind (corn starch, potato starch, bamboo, etc.)?

Q: Can you tell us about your food waste compost partner(s)? What are your partner(s)' logistics?

Q: What kind of challenges did you run into when implementing the current food waste reduction initiative(s)?

Q: How does your institution manage meat and dairy waste?

Q: How did your school manage to motivate and encourage students and staff to reduce food waste?

Q: Any word of advice to other schools that might be interested in implementing food sustainability initiatives similar to yours?

Q: Is there anything you feel that we should be asking you that we have not yet?

Interviewee: Steven Bandarra-Sustainability Coordinator

Goal: Get information on Worcester University's current food waste reduction methods, any roadblocks they faced implementing, whom they are partnering with, and what catalyzed the fundamental shift on their campus to be more sustainable.

Questions:

Q: As the sustainability coordinator of sustainability at Worcester University, what is your role in ensuring sustainability in your campus?

Q: It is our understanding that Chartwells is Worcester University's food service provider. Do they have any food waste reduction/diversion programs in place?

Q: We researched that Worcester University composts on campus. Can you tell us about the compost management process?

Q: Which food waste reduction program(s) does your campus participate in?

Q: When did your campus' food sustainability program(s) begin?

Q: What are the current food waste generation and diversion rates of Worcester University?

Q: How successful have your food waste reduction program(s) been?

Q: What triggered the decision to select the food waste disposal system(s) in place over other alternatives?

Q: Does your university use compostable disposable products such as eating ware and plates? If so, what kind (corn starch, potato starch, bamboo, etc.)?

Q: What kind of challenges did you run into when implementing the current food waste reduction initiative(s)?

Q: How does your institution manage meat and dairy waste?

Q: How did your school manage to motivate and encourage students and staff to reduce food waste?

Q: Any word of advice to other schools that might be interested in implementing food sustainability initiatives similar to yours?

Q: Is there anything you feel that we should be asking you that we have not yet?

Interviewee: Kyle Corry - Student Green Team President

Goal: The goal of this interview is to gain an understanding of the Green Team's and other sustainability clubs' interest in compost and food waste management and how they can contribute to our efforts.

Questions:

Q: Can you give us a brief overview of what the Green Team does here at WPI?

Q: We understand the Green Team runs Project Clean Plate, can you tell us more about the results of the program this past year?

Q: How about the Waste Audit? What observations did you and the Green Team make (food waste in pounds)?

Q: We discovered that WPI sends its food waste to a pig farm. However, as you might have observed during the waste audit results, most of the post-consumer waste is not collected. Do you think having a composting system here on campus would help WPI divert more of its food waste from landfills? Why or why not?

Q: If WPI started composting some of its food waste, do you think the Green Team could play a role in making that system successful? If so, how?

Q: What do you think best motivates people to be sustainable?

Interviewee: William Spratt - WPI's Director of Facilities Operations

Goal: Gain facilities' perspective on our recommendation and composting as a whole

Questions:

Q: As Director of Facilities Operations, what is your role in ensuring food waste sustainability on campus?

Q: We know that WPI sends its pre-consumer food waste to Tyde Brook Farm. Can you tell us about the reliability of the current system? Do you think there is room for improvements?

Q: Can you tell us about the costs associated with hauling away the trash?

Q: Did WPI purchased "compactors/dumpsters" used to store the trash or are they rented? If rented, how much does it cost? Is it charged in a monthly basis?

Q: Does WPI gets charged any penalty fee for the food waste that goes to trash? If so, how much?

Q: Is there any environmental fee that WPI get charged by the weight of the trash?

Q: If composting is proven to be a feasible and valuable solution. Would WPI have enough space for an additional dumpster/compactor? If so, where could it be located?

Q: What are the labor constraints?

Appendix B: Interview Summaries

Interviewee: Elizabeth Tomaszewski

Position: Worcester Polytechnic Institute, Assistant Director of Sustainability

Interview Date: February 17, 2017 @ 12:00pm

Goal: The goal of this interview is to get basic information on WPI's food waste management process, and to validate our project topic during planning stage.

**This meeting was conducted during our PQP, before we had refined our interview techniques

Q: It is our understanding that WPI send its food scrap to a pig farm. Can you tell us about this partnership? Which locations on campus this food waste diversion system is in place?

A: Morgan Dining, and at least two other places (she was unsure which other two locations). Approximately 400 pounds per day from Morgan Dining and about 150 pounds from the other locations are sent to the pig farms in a daily basis. The 400, and 150 numbers are from food preparation waste and post-consumer waste from Morgan Hall.

Q: Can you tell us about Chartwells food waste reduction initiatives programs?

A: Joe, Chartwells' Dining Service Director, has a program in place called Trim Trax. The program has the goal to minimize food waste during meal preparation. One successful food waste reduction initiative implemented in the Morgan Dining Hall was the removal of the dining tray. This program has not only reduced food waste by roughly 40%, but has also helped reduced water usage because trays no longer had to be washed. Additionally, The Green Team has been helping reduce food waste with the Project Clean Plate. Liz recommend us to contact the Green Team to get the data gathered during Project Clean Plate.

Q: We plan to search and visit other colleges and explore their food waste diversion solutions. Which schools do you recommend us to start our research?

A: recommended us to contact Worcester State University, Clark University and UMASS Amherst. Worcester State composts their food and has the same food provider as WPI, Chartwells. Clark composts around campus and has a different food provider. UMASS Amherst has been number one in dining services for a couple of years.

Q: Schools across the country are adopting composting as a solution to divert food waste from the waste stream. In your opinion, which is better, composting or pig farm donation?

A: Liz stated that the answer is not cut and dry. The reality is, the pigs are happy. One issue she pointed out with compost is that some hauling companies do not take meat, while pigs do. WPI's relation with the farm is almost selfish as it is easy and it is free. The farm just comes and picks of the food. If we switched to composting, that meat waste would have to be considered.

Q: Where do you think composting could be implemented?

A: Jim McLaughlin, who oversees the campus center, is receptive to the idea of composting in the Campus Center. But no formal meetings have been accomplished to discuss the prospect.

One idea was to put some bins where the plastic utensils are, but there are concerns, such as the appearance and odor; the institution wants to be sure the campus looks and is clean at all times. It is imperative that no food is slopped outside of the bins and that it does not attract any bugs or pests.

Q: In case composting is a recommended solution, how should we approach facilities and dining directors?

A: Elizabeth Tomaszewski stressed that composting has not yet been tested at WPI due to odor and aesthetics concerns. She asked us to develop a plan to address odor mitigation and to consider if dining staff or facilities staff would be required to keep an eye on the system's cleanliness. She stressed the importance of the people behind the system.

Q: Does Chartwells manage all the food on campus?

A: Chartwells does manage all food on campus with the exception, of Dunkin Donuts. However, WPI's Dunkin Donuts franchise reports to Chartwells. During the November 2016 waste audit, there was a huge number of bagels in the waste.

Q: How do you envision composting being managed? Would WPI hire an outside company to manage it or compost on campus?

A: WPI is space constrained; it would be best if one of the empty lots could be used for composting. However, composting on campus might add a lot of human resources and thus be impractical. If composting is implemented WPI would probably work with an outside contractor.

Q: How hard would it be to switch from disposable clamshell containers in the Campus Center to compostable ones?

A: Elizabeth Tomaszewski believes switching from disposable clamshells to compostable alternative is a great idea. However, compostable containers may be costly. In fact, Facilities is trying to grow the idea of a reusable container rather than the concept of a compostable one. Ideally, the plastic clamshells should be eliminated entirely because WPI's waste hauler, Waste Management, does not recycle them since they are too flimsy.

Q: Are there any other aspects of food waste we should look at?

A: Food insecurity is a big issue. A lot of the food prepared for events goes directly to the pig farm, but it would help if Chartwells could donate the food to people instead of to the pigs.

Interviewee: Meredith Danberg-Ficarelli

Position: Common Ground Compost, Operations Manager

Interview Date: March 20, 2017 @ 9:30am

Goal: The goal of this interview is to expand our knowledge in the composting industry

Q: What is your position and role at Common Ground Compost (CGC)?

A: Meredith has been working with Common Ground Compost since October 2015 as an Operations Manager. Her position has a broad range of responsibilities. She initially started working at CGC to help Laura Rosenshine, the founder, to grow the compost business. The business began as a side project and has evolved drastically since then. When Meredith started working at CGC, there was no business plan, no pre-created models on how to run the business, no target client, and no marketing goals. Therefore, her initial task was to understand the current status quo of the operation and help build the business to make it financially stable. In addition to financial accounting and forensics, she also helped rebuild the company's website. Currently, she does a little of everything such as partnership development, and marketing.

Q: What is your background?

A: Meredith graduated from the University of Virginia in 2007, with a major in Anthropology and a minor in Fine Arts. After few internships and full-time jobs in diverse areas in New York, she went back to college in 2009 to get a Master's degree in Urban Policy Analysis and Management at New School University. She has accomplished some remarkable work in sustainability. She is the co-founder of F.E.R.N internationals, a non-profit enterprise that facilitates composting and recycling activities in food establishments, such as restaurants. She has also, worked at lower east side ecology center in Manhattan, one of seven organizations that is focused on recycling in New York City.

Q: What are the standard food waste services Common Ground Compost provides?

A: Common Ground Compost is a consulting company that helps schools, businesses, and residents to improve or design food waste composting solutions. Also, to serving as matchmaker between haulers and the NYC community, the company also provides education and training to each age and environment.

Q: Does Common Ground Compost consult with any schools or colleges? If so, how big? What do they do with their waste? Reasons for not composting?

A: CGC works with all kinds of business such as hotels, restaurants, schools, residents. In fact, Common Ground started the first composting with NYC's public schools. The company usually works with smaller schools, but they have consulted for larger colleges as well. All schools that Common Ground consults for compost their food waste. Meredith mentioned that it is almost impossible to achieve zero waste at colleges due to uninformed as well as unwilling to collaborate individuals. Colleges, especially large ones, receive many visitors throughout the year, who are unaware of the recycling initiatives and end up throwing food waste in the trash. Additionally, it is difficult to get all students on board, even with extensive student educational programs.

Q: Can you tell us about compostable tableware?

A: Meredith is not an advocate of Polylactic acid (PLA) products since it is a difficult to recycle product. In fact, PLA is not considered recyclable or compostable through many collection services. Another issue pointed out by Meredith is the difficulty for average consumers to differentiate PLA products from regular plastic ones. There are other alternatives such as bamboo and fiber base tableware. However, she said that compostable ware should go in the trash in case no compost stream is present.

Q: What type of questions do you ask a hauling company when assessing them for a school?

A: Meredith stressed that it is important to understand haulers' schedules, collection frequency, which products are accepted and which ones are not, the destination of organic waste, cost (by container or by weight), and transportation methods.

Some sample questions to ask are: Does the hauler have a mixed paper recycling stream? Do they retain the purity of recycled material? What transfer station do they take the recycling to? What Material Recovery Facility (MRF) do they take the trash to? What is accepted? What isn't accepted? Where does it go? Where does it end up? Commercial haulers usually partner with each other. Where do they all put the compost? How do they charge, is it by the container, weight, or cover? How much do they cost? By average? If the container isn't full, are they wasting money?

Q: If our school decides to implement composting on campus, what would you suggest we do to make the implementation process easier and smoother?

A: Meredith recommended that we look at this change from a facilities perspective. She also stated that it is important to gather information. Look at where food is generated first, whether that's a cafe, dining hall or apartment kitchen. Conducting an audit would be the best way to understand how much food is being wasted. Learning the source, generation rates, the number of covers (number of people served/meals served), talk to chef or kitchen staff to find how many of pounds of waste per person).
Audits can be done two ways:

1. Open all trash and sort by hand. Wear Tyvek, etc. Sort the trash bags and sort into recycling, trash, and compostable.
2. Start at the beginning of the day and have students help with sorting. Bucket A is used for compost, where Bucket B is used for trash. Once a bin is full you weigh it and tip it into a larger bin. At the end of the day compare the sorted Compost/Trash data to previous averages.

This information is essential to ensure that WPI partners with the right hauling and composting companies. Not all businesses accept the same types of waste; there is a frequent variation for meat, dairy, and paper products. Contamination levels are also a concern. For these reasons, we need to make sure WPI finds the best companies to fit its needs.

Q: What would be the biggest challenges of implementation?

A: One major problem we may face is spreading awareness and knowledge of the new system. This can be handled using conveniently located compost bins, visible and informative signage, and even a social media campaign.

Q: If we were to pursue composting from a company in the Worcester area, what considerations should we have? Is there anything we're not asking?

A: Per Meredith, the most important questions are: What waste can they accept? Where are does it all go? What are the allowable contamination rates compared to the current contamination rates at WPI? What happens if there are contaminants?

Q: Do you know of any people or companies we should talk to next?

A: Some recommendations Meredith made were reaching out to the City of Worcester which offers residential composting, and considering services provided the current waste hauler (Waste Management) and to try and set up a meeting. It is important that we gauge what the service profile is before letting them know we want the service. We should also take a tour of the compost site if possible. UMass Amherst has an excellent composting program that we could learn more about.

Considering onsite composting would be another option. Finding a grant or petitioning the school would help to get some decontamination machines on site. These machines would produce inert de-volumized material (50-80% reduction of volume). A few options are:

- Rocket Composter (requires woodchips)
- dehydrators (uses a lot of energy, but reduces the nutrient from heat)
- Microbe-based

All composting tech needs decontamination technologies. When looking at these technologies it is important to consider what volume they can accept.

Interviewee: Joseph Kraskouskas

Position: Worcester Polytechnic Institute, Director of Dining Services

Interview Data: 03/21/2017 @ 10:00 AM

Goal: The goal of this interview is to have a better understanding of WPI's food waste management process, WPI's initiatives in food reduction, and areas of possible improvements.

Q: As Director of Dining services, what is your role in food waste sustainability on campus?

A: Joe Kraskouskas ensures sustainability on campus by incentivizing staff to create as little waste as possible along the food production process, and educating WPI's community on food sustainability methods.

Q: We researched that Chartwells partakes in a food waste reduction program called Trim Trax as part of its sustainability commitment. How is this program performed at WPI?

A: Trim Trax is a Chartwells program designed to minimize waste during food preparation. The kitchen staff is asked to place the food waste generated during the prepping and cooking process in transparent buckets. The clear buckets allow the staff to see the amount of food that is being thrown away, promoting awareness of their food waste. The waste collected during Trim Trax is weighed and documented with the purpose of monitoring and improving the wastage process. Thus, Trim Trax helps WPI save money on food as well as decrease its waste.

Q: Does WPI participate in any other food waste reduction initiatives besides Trim Trax?

A: In addition to Trim Trax, there are two other programs in place to help WPI reduce its waste. The first is the Food Recovery Network, which is a donation program run by students. Safe uneaten food from Morgan Hall is collected in "hotel pans" (aluminum pans) and delivered to donation locations in Worcester such as Friendly House. This initiative is done 3 to 5 days a week. However, during finals or breaks, food donation usually goes on hiatus. The second initiative is Project Clean Plate, an awareness campaign where the goal is to change students' behavior regarding food waste. Students who return a clean plate at the end of their meal are rewarded with a raffle ticket and the potential to win a prize. This campaign was initiated by students at WPI and has been adopted by the entire Chartwells organization.

Q: Can you tell us about WPI's food waste disposal partner(s)? Pig Farmer(s)? What are the partner(s)' logistics? (For instance: which types of food is acceptable, how often is the campus food waste collected, etc.)

A: The partnership with the pig farmer started more than ten years ago, he comes 3 to 4 days a week to pick up the food waste. However, the collection process stops during the summer, from May to August, because food production is significantly reduced (classes are not in session). Additionally, the food scraps are stored outside and generate a foul odor in the summer heat. There is no charge involved in the pickup process; it is a mutually beneficial exchange between WPI and the pig farm. There are no restrictions on types of food accepted by the pig farm.

Q: How much waste is created during the summer?

A: During the summer Morgan Hall dining produces approximately half the waste as it does

during the school year. The amount generated varies widely by the week and hosted events.

Q: How about WPI's logistics? (Where the food waste is stored, how is food waste collected and combined throughout different WPI's dining locations, etc.)

A: Food waste for the pig farm is stored in eight 50-gallon drums located outside of three campus locations: five outside of Morgan Hall, two outside of the Campus Center and one outside of Founders' Hall. All pre-consumer waste from other dining locations, such as Gordon Library and Higgins House is transported to Campus Center drums at the end of each school day.

Q: What is Chartwells' relationship to the Dunkin' Donuts Location in the Campus Center and how do they handle their food waste?

A: Dunkin' Donuts is subcontracted by Chartwells. It is unknown what DD does with their food waste. They do not fall under Chartwells' policies for food waste management.

Q: Is there anybody else we can contact to learn more about campus-wide food waste?

A: Liz Tomaszewski

Q: What are the current food waste generation and diversion rates in pounds/tons?

A: Morgan Dining Hall produces 400 pounds of food waste per day, the Campus Center produces 100 pounds of waste per day, and Goat's Head Restaurant produces 50 pounds per day.

Q: How do you define food waste? Are there any contaminants (Non-food waste like plastics, fruit stickers, etc.) found in the food bins? At what rate?

A: Chartwells does not have a set definition for food waste. The number of contaminants present in the bins destined for the pig farm is unknown. However, there have been no complaints by the pig farmer in regards to contaminants found in the waste.

Q: Have you noticed student behavior changing during your time at WPI? To what do you attribute this change?

A: The amount of food thrown away by students has drastically decreased in the past few years. It used to be at a rate of 0.55 pounds of waste per student per meal. The most recent survey shows that number decreasing to below 0.25 pounds of waste per student per meal. Joe Kraskouskas said that the elimination of trays in Morgan Hall, the introduction of small dishes, and the implementation of the Project Clean Plate made a big difference in decreasing food waste per student.

Q: Has post-consumer food waste collection been considered in places like the Campus Center (similar to what is done at Morgan Dining)? If so, can you tell us about the obstacles you encountered?

A: The amount of post-consumer food waste produced in Goat's Head is much smaller since individual portions are given out. Therefore, it is not viable to consider such a system like the one in Morgan Dining in Goat's Head, and for that reason, food scraps are disposed of with the rest of the waste. There is the potential to have the staff that bus the tables sort food waste into a separate bin. A system like the one present in Morgan Hall was planned for the Campus Center,

but implementation proved to be infeasible because of the drastic structural changes that would have to be made.

Q: It is our understanding that Chartwells also provides food services to other institutions. Is there an overall company policy on food waste disposal? If so, how is the WPI's Chartwells different?

A: Every institution needs to comply with food waste laws. However, every Chartwells location manages food waste differently. The relationship with the pig farm is unique since most other campuses contract a hauler to collect and compost their food waste.

Q: Does Chartwells provide any training to its employees regarding these programs? If so, how frequent is the training? Can you tell us how the training is conducted?

A: Basic training is provided to kitchen staff. However, the message behind reducing food waste isn't taught.

Q: As a goal outlined in the WPI Sustainability Plan, the university is aiming to lessen the waste that it disposes of in landfills or incinerates to 10% national per capita average by 2018, which it is currently at 24%. Do you have any suggestion on how our IQP team could help WPI reach its waste reduction goal?

A: Joe Kraskouskas suggested us to consider possible methods to enable the donation of catering food. He also recommended our group search for potential solutions for collecting food waste during the summer.

Q: Is there anything you feel that we should be asking you that we have not yet?

A: No.

Interviewee: Steven Bandarra

Position: Worcester State University, Sustainability Coordinator

Interview Date: March 24, 2017 @ 1:30 PM

Goal: The goal of this interview is to gain an understanding of WSU's food waste management process and what we can learn from WSU to better our process at WPI

ABOUT INTERVIEWEE

Q: What does your position as WSU's Sustainability Coordinator entail?

A: Mr. Bandarra started working as WSU's Sustainability Coordinator in 2012. His primary task at WSU is to implement sustainability efforts to help WSU achieve its commitment to the American College and University President's Climate Commitment (ACUPCC). WSU committed to reducing its carbon footprint to zero by 2050, and to integrate sustainability into its curriculum.

COMPOST

Q: We researched that Worcester State University has a nationally recognized and successful composting system. When did your campus' compost program begin? To what do you attribute this success?

A: Worcester State University's current compost program started in 2012. Mr. Bandarra attributes collaboration, both with the school and hauling company, as the key to the success of the program. The waste disposal company that WSU currently employs is willing and supportive of the compost program enough to alter its practices to make the program successful.

Q: What triggered the decision to select composting over other alternatives such as sending food to pig farms?

A: WSU used to send food to a pig farmer but wanted a more reliable system. Unfortunately, the pig farm's collection cycle didn't always line up with the school's consistent production and would create odor and rotting issues. Therefore, WSU contracted with a compost hauler, creating the control and reliability needed for success.

WORCESTER STATE UNIVERSITY'S FOOD WASTE MANAGEMENT METHODS

Q: How does smell affect your food waste program?

A: The old program had the food in toters which the haulers picked up three times a week. For this scenario smell was a concern. However, smell is not an issue anymore since WSU added a dehydrator (Fall of 2014) to their food disposal stream. The dehydrator removes the water and compresses the food to 90% of its original volume. The dry compressed food waste is inert and smells slightly like coffee beans.

There haven't been any problems with the dehydrator itself, but establishing the proper placement was awkward. For a year after WSU acquired the dehydrator, it couldn't be used. The original installers incorrectly placed the machine in a room with ventilation leading to the rest of the building. While the odor was mild, it was still enough to cause the device to be unusable. Eventually, the machine was moved into an old trash room with ventilation only to the outside.

Q: Can you tell us more about the dehydration system?

A: WSU's dehydration system has three parts: a grinder, a pulper and the dehydrator itself. First is the grinder which, with the addition of water, process all the food into a slurry. The slurry goes into the pulper which operates similarly to a juicer; it pulls most of the water out, producing a damp paste. The dehydrator uses dry air and heat from decomposition to remove the rest of the water from the paste. The dehydrator also kills most (80-95%) of the bacteria.

Q: How does WSU manage post-consumer food waste?

A: WSU composts both pre and post-consumer food waste from its dining hall. Students place both their dishes and any leftover food onto a conveyor belt which goes back into the kitchen. From there, the kitchen staff sort the food waste into the proper receptacles. Having staff sort the waste instead of students ensures the reliability and accountability needed for composting. A constant issue faced by the staff is the presence of straws which routinely make it through sorting. Attempts have been made to mitigate the problem, such as removing straws from the dining area, but so far no solutions have stuck.

Q: Some composting companies do not compost meat and dairy waste due to pests and odor. How does Worcester State manage meat and dairy waste?

A: WSU's hauler accepts all kinds of food including meat and dairy (although dairy gets mostly washed out). Therefore, WSU dehydrates meat and dairy like normal.

Q: Can you tell us your food waste hauler(s) logistics?

A: Initially WSU's hauler had to collect waste three times a week. But after installing the dehydrator, the hauler now only collects once a month. While the dehydrator had a big upfront cost ($20,000), the school now saves money in collection fees since their hauler charges by container and number of pickups.

Q: How involved are the WSU students and faculty in composting food waste?

A: Faculty and students are not involved in the composting process since the dining hall kitchen staff sorts the food waste.

Q: Did your school manage to motivate and encourage students and staff to compost food waste? Did your school manage to motivate and encourage students and staff to compost food waste?

A: Most of the motivation and encouragement efforts are accomplished by the kitchen staff. Signage in the dining hall near the disposal station also helps raise awareness.

SCHOOL FOOD WASTE DIVERSION INITIATIVES OTHER THAN COMPOST

Q: Other than compost, what food waste reduction programs does your campus participate in?

A: One of the first food waste reduction/diversion initiatives WSU accomplished was the elimination of trays in its Dining Hall. This switch happened back in 2007 and caused the single greatest decrease in their food waste (20%). Without the trays, students take less food at a time, giving them more time to feel full. Tray elimination combats the issue where student's eyes were bigger than their stomachs. WSU also participates in Project Clean Plate which is a yearly program Chartwells runs in the Spring. The program works to raise awareness of food waste and educate students on why it is an issue of importance.

Q: It is our understanding that Chartwells is Worcester University's food provider. Can you tell us about the food waste reduction/diversion programs Chartwells has in place at your school?

A: WSU's Chartwells has the Trim Trax program in place, as well as the Project Clean Plate.

OTHERS

Q: Any word of advice to WPI and other schools that might be interested in implementing composting initiatives?

A: WPI should partner with a reliable hauler and find the best solution that fits our school's priorities.

Q: Is there anything you feel that we should be asking you that we have not yet?

A: No.

Interviewee: Kyle Corry

Position: Worcester Polytechnic Institute, Student Green Team President

Interview Date: March 28, 2017 @ 9:00 AM

Goal: The purpose of this interview is to gain an understanding of the Green Team's and other sustainability clubs' interest in compost and food waste management and how they can contribute to our efforts

Q: Can you give us a brief overview of what the Green Team does here at WPI?

A: The Green Team's work focuses on raising awareness of the environment and sustainability. They have organized events such as the annual Waste Audit, and E-Waste drive. In the Fall they also run Project Clean Plate which raises awareness about food waste. They are currently doing Recyclemania events as well. Since the start of D-Term 2016, the Green Team has managed almost all aspects of Gompei's Gears, which is the bike share program here at WPI. They also work with student organizations to help them and their members become more sustainable.

Q: Can you tell us more about what the Green Team does for Gompei's Gears? Since the Bike Share is a sustainability program brought to campus by an IQP, similar to our vision for our own project.

A: The Green Team manages almost all aspects of Gompei's Gears, such as maintenance, placement, and tracking (chasing down the people who rent a bike for too long, and ensuring it gets returned). Maintenance is a huge element; volunteers go out every weekend to tighten chains, fill tires and make sure the bikes are all in working condition. They also store the bikes during the winter months and return them to service when the weather clears up (early April). At the start of the program, the Green Team ran the kick-off event.

Q: How much use does the Bike Share program get?

A: The program gets used a huge amount, most of the time the bikes are checked out. The usage rate is why maintenance is such a constant effort, with chains wearing out, etc.

Q: Is Gompei's Gears taught during New Student Orientation (NSO)?

A: I don't think so. There was a small event at the beginning of the year and has been mentioned as an addition, but I don't believe that it is currently part of NSO.

Q: We understand the Green Team runs Project Clean Plate, can you tell us more about the results of the program this past year?

A: The results weren't all they were hoping for, they saw an initial decrease, but the numbers then went back up after running for a few days. No consistent decrease was observed. Kyle did hear a few stories of students who would yell at their friends for wasting too much food, which shows awareness and activism are increasing. However, he is unsure that Project Clean Plate was the cause of it.

Q: Can you tell us about how waste was measured during Project Clean Plate?

A: The Green Team volunteers were at Morgan Dining on Wednesdays from 5 pm to 8 pm. At the start of the time slot, Chartwells would place clean waste bins out. Then at the end, the volunteers would take the waste out and weigh them. The mass was used to indicate the production level of food waste. Chartwells didn't manage to do a control measurement for a time when the Green Team wasn't watching. The lack of a control measurement made it difficult to calculate the effectiveness of the program.

Q: How about the Waste Audit? What observations did you and the Green Team make?

A: Kyle noted that overall people at WPI are not good at recycling. He saw a lot of recyclable materials in trash bins, but also a lot of trash in the recycling bins. He was also disappointed by the significant amount of food present in both the recycling and trash streams.

Q: Can you tell us more about RecycleMania?

A: RecycleMania is a national competition between institutions where they compete in sustainability challenges. For the event, the Green Team has been table sitting and doing plastic bag collections. There is also some data that the Green Team collected which Kyle can send to us. The event has two weeks left, at which point data collection would be complete.

Q: What do you think best motivates people to be sustainable?

A: People seeing what their impact is; often people have the train of thought of "I'm just one person, what I do won't make an impact, and it won't matter if I don't do it." But if they saw the impact they caused they would be motivated to change.

Q: We discovered that WPI sends its food waste to a pig farm. However, as you might have observed during the waste audit results, most of the post-consumer waste is not collected. Do you think having a composting system here on campus would help WPI divert more of its food waste from landfills? Why or why not?

A: Kyle believes adding compost bins would help because people would see the compost bins and think "wow, I can put my food in there." And while not everyone will think that way it would still help provide a better choice for those that do. The compost bins would need to be next to the trash and recycling receptacles for greatest effectiveness. However, they don't need to be in all the buildings, just the ones with food would be required. He believes Joe Kraskouskas would be open to the program.

Q: Do you think compost is the best solution?

A: Kyle's opinion is that it's one of the best since then students could see a direct impact of what they did.

Q: If WPI started composting some of its food waste, do you think the Green Team could play a role in making that system successful? If so, how?

A: Yes, the Green Team would help. They do a lot of work with awareness and outreach, both of which are crucial for a project such as ours to succeed. The Green Team could help create a kick-

off event for a pilot program, as well as assist in adding a module to New Student Orientation (NSO) to indoctrinate incoming students to the program. Kyle was personally excited about helping the program and brought up how Gompei's Gears started as an IQP and has now morphed into a full-fledged program.

Interviewee: Jenny Isler

Position: Clark University, Director of Sustainability

Interview Date: March 29, 2017 @ 2:00 PM

Goal: Gain information on Clark's current food waste reduction methods, any roadblocks they faced implementing, whom they are partnering with, and what catalyzed the fundamental shift on their campus to be more sustainable

ABOUT INTERVIEWEE

Q: What does your position as Clark's Sustainability Director entail?

A: Ms. Isler is responsible for implementing sustainable practices at Clark and coordinating efforts among students, faculty, and staff.

"The mission of Sustainable Clark's Office of Sustainability is to cultivate a greener campus by facilitating collaboration between and among students, faculty, administrative departments, and staff. We offer resources to recognize system failures and help innovate solutions; empower the Clark community to collaborate on creating campus-based solutions & programs and serve as an integral partner in their implementation; and strive to build community awareness around social, economic and environmental issues."

COMPOST

Q: We researched that Clark University began composting food waste in 2007 and has won many awards. Can you tell us about the overall compost management process on campus? How was it started? (For Instance: Collection methods and storing means)

A: Clark's composting system began in 2007 and was primarily driven by student demand. Since the first pilot programs, composting at Clark has grown to the point where it is almost universal; it exists in all residence halls, dining locations, and academic buildings. The exception is laboratory space where hazardous materials are present.

Q: Can you tell us more about how the system works in the residence halls?

A: In residence halls, students have small composting bins in each kitchen and kitchenette. To prevent the containers from becoming malodorous, they are washed regularly and have rounded corners. The rounding prevents accumulation of organics in the edges. The Recycling Crew empties the small (2 gallon) kitchen bins daily into the larger (32 gallon) central compost bins on each floor. Hall resident can also sort and use the larger central bins. From there, custodians combine the contents of the larger compost bins with paper waste from the bathrooms. The combination is transported daily to the 17-ton organics compactor.

Q: How does composting work in your dining hall?

A: Clark's dining hall has a conveyor belt dish return at the exit where students place the dirty dish and all waste from their meal. From there, the dishes and food return to the kitchen where staff sort the waste. However, students don't have much post-consumer food waste. This is primarily because Clark is trayless. Additional benefits arise from student culture and serving style – staff add food to students' plates instead of students adding the food themselves.

Q: What are the current food waste generation and diversion rates of Clark University (lb/week)?

A: Clark generates 24 tons of compostable material every school month, they produce about half as much during the summer and winter break periods. Yearly totals vary from 200 to 220 tons of compostable waste.

Q: Odor and rotting are perhaps the most common problem associated with collecting and storing food waste, especially in the Summer. How does Clark manage odor and rotting issues?

A: Cleaning is paramount; all bins are regularly rinsed to be sure no smell accumulates. Their compactor is also power washed at every pickup. Ms. Isler also attributes the lack of smell to the large quantities of paper in their compost stream, which absorbs moisture and keeps the organic waste dry.

Q: Can you tell us your food waste hauler(s) logistics? (For Instance: haulers' schedules, collection frequency, which products are accepted and which ones are not, final destination of organic waste, does hauler charge by container or by weight, and transportation methods)

A: Waste Management (WM) hauls for Clark. WM accepts all forms of paper and organic material. After WM hauls the organic waste away, they transfer it to We Care Organics who composts it. The compostable materials are picked up twice a month during the school year and once a month during summer and winter breaks.

Q: How involved are the Clark University students and staff in composting food waste?

A: The student body is highly involved; in fact, students drove the change to compost. Clark Compost is a student organization, which formed in 2012 with members from the preexisting student Eco-Reps. Through a series of incremental and iterative pilot programs Clark Compost achieved their goal of having compost in all residence halls by 2014. By 2015 they achieved their final goal of compost bins in the Academic Commons and in academic buildings. Since then the group has not been active, but the club still has a president to keep it alive on campus.

All the students we encountered were aware of Clarks composting system and fully supported it.

One student we talked with said he doesn't waste food because of his grandmother, who grew up in the Great Depression, taught him the value of food and not to waste it.

Q: What triggered the decision to select composting over other alternatives such as sending food to pig farms?

A: Reliability, by going with composting Clark had greater control of the system. Ms. Isler also cited convenience, since dirty paper products can't be fed to pigs. The dirty paper towels, napkins, cups, etcetera, would then end up in a landfill or incinerator.

SCHOOL FOOD WASTE DIVERSION INITIATIVES OTHER THAN COMPOST

Q: It is our understanding that Sodexo is Clark's food service provider. Do they have any food waste reduction/diversion programs in place?

A: Sodexo has a program called Lean Path which is like Chartwell's Trim Trax program. In the program, kitchen staff takes all their food waste to their manager who measures and tracks it. The manager then instructs them what to do with the waste, such as composting it, using it for soup stock, or even reusing it in another dish. Spoilage is avoided by using "just in time buying", where Sodexo buys the food for a meal a few days in advance, Clark's freezer is incredibly small because of this. To further reduce spoilage production sheets are used which provide an accurate measure of how much food to prepare.

Q: Any word of advice to other schools that might be interested in implementing food sustainability initiatives similar to yours?

A: We should go slow and be sure all the administrative pieces are in place before doing anything. When ready we can create a pilot program, then stop, measure, and pilot again. The pilots keep people engaged, and ensure nothing is missed. Both parts help keep people on our side; "all it takes is one person not doing what they are supposed to for the entire program to fail." Lastly, we must work with the custodians and facilities staff, checking in with how much work we are adding or saving them. Check-ins enable us tweak the program and keep the strain on facilities minimized; we absolutely must have the custodians and facilities staff on our side for everything to work well.

Q: Is there anything you feel that we should be asking you that we have not yet?

A: No.

Interviewee: William Spratt

Position: WPI's Director of Facilities Operations

Interview Data: 04/25/2017 @ 9:30 AM

Goal: Gain facilities' perspective on our recommendation and composting as a whole

GENERAL QUESTIONS

Q: As Director of Facilities Operations, what does your position entail, and do you work with sustainability on campus?

A: As director of operations at Facilities William Spratt oversees the Custodians, Tradesmen (Maintenance), the power plant, Grounds, Customer Service, and the Events Group. He does not work directly with sustainability.

Q: We know that WPI sends its pre-consumer food waste to Tyde Brook Farm. Can you tell us about the reliability of the current system? Do you think there is room for improvements?

A: As the Operations Manager, William Spratt knows there is always room for improvements, but the pig farm agreement is very ideal. There is no contract with the pig farm; from the Facilities standpoint, it just happens. The agreement is not labor intensive and is a hands-off system, where the waste is stored in 55-gallon drums relatively fresh and only moved a short distance. A potential for improvement would be a backup plan which can take a fluctuating amount of food waste. William Spratt pointed us towards the Associate Director of Facilities at WPI, Terry Pellerin, who runs the custodial group, because he may have inputs on reliability.

HAULING/COST DATA

Q: Can you tell us about the costs associated with hauling away the trash?

A: For the 2017 fiscal year, the hauling and tipping budget is $241,870. Per ton the recycling tipping fee is $35 and trash tipping is $135. Labor is not included in the budget, and William Spratt stressed how labor is the greatest cost.

Q: Did WPI purchase "compactors/dumpsters" used to store the trash or are they rented? If rented, how much does it cost? Is it charged on a monthly basis?

A: We rent the compactors from waste management. He did not have the cost on hand.

Q: Does WPI get charged any penalty fee for the food waste that goes to trash? If so, how much?

A: There is no penalty. Only the ban on food waste disposal exceeding one ton per week.

LOGISTICS: SPACE AND LABOR CONSTRAINTS

Q: If composting is proven to be a feasible solution, would WPI have enough space for an additional dumpster/compactor, and where could it be located?

A: At WPI space constraints are extreme, especially because all work must be done behind the scenes. There are compactors behind the Campus Center, Morgan Hall and between Salisbury and Atwater Kent. The Salisbury/Atwater Kent location is not ideal because it is in the center of campus. At the moment there is not space readily available for an additional compactor, but if it was driven by an initiative something could be figured out. It would probably end up being placed behind the Campus Center, but this depends on its size.

Q: What are the labor constraints?

A: Labor is very expensive and by far the greatest cost to adding a composting program. The locations of disposal containers on campus sometimes force custodians to take trash four buildings over. With the pilot program data, an analysis will need to be done to see how much additional labor will be required, and how those needs can be met.

PILOT PROGRAM

In our search, we found three possible compost solutions for WPI:

1. Add paper to compost and implement a compactor
2. Add a dehydrator, which reduces food waste by 90%
3. Add an in-vessel dry composter, which produces compost ready material

All solutions were analyzed in relation convenience, cost and odor issues. However, due to the lack of data, we recommend a pilot to be run by the Green Team. The goal of the program is to measure food waste in the Campus Center and analyze which one of these solutions is feasible if any. The pilot program will consistent of "fake" compost bins, as the system will not be fully in place yet. After waste has been measured and solutions analyzed, the Green Team, using our analysis outline will recommend a solution to WPI.