Management of Waste at Worcester Polytechnic Institute

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An Interactive Qualifying Project

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Abstract

The purpose of this study was to examine waste sorting at WPI and analyze its process and efficiency. We compared WPI's method to other institutions, interviewed people responsible for implementing sustainability at WPI, inventoried waste receptacle areas to help the Facilities Department implement uniform bins, and surveyed students, faculty, staff, and custodians to see how they felt and what they knew about recycling. Finally, we analyzed our data to develop recommendations for changing and improving WPI waste sorting.

Executive Summary

Prior to August 2014, WPI utilized dual stream recycling, which is a type of source separation recycling set-up with one trash bin and two or three recycling bins to separate various recyclable materials (paper, glass, aluminum, etc.). In the fall of 2014, WPI changed to single stream recycling, which uses a single trash bin and a single recycling bin, eliminating the need to sort recyclables. Despite a projected increase in the recycling rate with the new single stream recycling system, there was a significant reduction in the campus recycling rate according to the 2013 and 2014 Student Green Team Waste Audits.

In the opinion of Elizabeth Tomaszewski, member of the WPI Sustainability Task Force and the WPI Facilities System Manager, one of the causes of the reduction in the recycling rate was a lack of communication to the campus about the shift from dual stream to single stream recycling. This communications problem was to be addressed at the time by the newly hired Director of Sustainability, however, she left only a few months into the year leaving the problem of motivating and educating students, staff, and faculty unchanged.

The goal of this project was to significantly increase recycling rates by improving the process of waste sorting on the WPI campus. Two of the members of our IQP team consistently see the impact of the lack recycling information as part of their jobs as part-time custodians at WPI. This gave our group more than one point of view in the path that waste takes, as both producers and collectors of waste, and further motivated the team to help WPI improve the campus recycle rates.

Our group utilized several different methods to collect the necessary data to reach our project goal. Our first step was to become familiar with the types of recycling programs available to any individual or corporation: single stream, dual stream, full source separation, and all-in-one, including the advantages and disadvantages of each. We also researched the laws and regulations, or lack of such, for all types of waste including food, recyclables, electronic, and universal waste. One important law regarding food waste is the Massachusetts Commercial Food Waste Ban, which requires that all institutions producing at least one ton of waste per week to divert all of the food waste from landfills.

With basic recycling information in mind, we researched other institutions that have successful recycling programs for ideas on how to improve the waste management system at WPI. In addition we explored why people do not recycle, including reasons such as recycling and trash bin availability and behavior.

We also met with the stakeholders in our project, including WPI's Associate Director of Buildings and Events, the Facilities Systems Manager, the Student Sustainability Coordinator and Green Team President, members of Residential Services, the co-chairman of WPI's Sustainability Task Force, and a representative from Chartwells Management (WPI's food

service provider). In addition, we toured WPI's waste and recycling hauler, Waste Management and met with a representative of the company.

To determine how much the community knows and/or cares about waste sorting, we surveyed four groups: custodians, students, faculty, and staff. We began by first surveying the custodians in order to determine if a recycling training occurs and if they are aware of the proper sorting of waste under single stream recycling. A similar survey was distributed to students, faculty, and staff to assess their knowledge.

Our team toured the entire WPI campus to photograph and inventory the types of trash and recycling bins and their locations. We documented whether or not each location contains at least one recycle bin to every waste bin and we made note of locations that needed an updated recycle bin, an updated trash bin, or a recycling poster. We also took pictures of every location we inventoried in order for the facilities department to know exactly where in each building an update is needed.

We compiled all of the survey results, meeting summaries and campus tour data and analyzed the information.

During our campus tours, we did not find even one ideal bin set-up, as modeled in Figure ES 1, on the WPI campus. This was confusing to us because in August of 2014, most of the recycling bins on campus were converted to single stream recycling bins by adding two holes for cans on a paper only bin to reflect the ability to combine different types of recyclables in one bin. This conversion should have made every set-up ideal.

Figure ES 1: A model of an ideal single stream set-up that our team created

We also found that custodians are provided with green bags to use in recycle bins to be able to easily distinguish trash from recyclables. Some of the recycling bins reflect single stream recycling while others don't. This is very misleading to the WPI community since the conversion to single stream should be emphasized especially through our recycling bins. Also, throughout our campus tours, we determined that a majority of the posters detailing recycling around campus are either wrong, not clear/attractive to read, or not within sight of a recycle bin. An ideal recycling poster is shown in Figure ES 2. By inventorying the types and number of bins in each location, our group came up with two scenario recommendations to submit to facilities. The purpose of each is to create a more uniform waste bin system on campus to ease confusion.

Figure ES 2: As a result of our research, this is what we consider to be an ideal poster

In our meeting with Mr. Terrence Pellerin, Associate Director of Buildings and Events, we discovered that although there are various types of training programs the custodians undergo yearly, there are no programs that specifically address recycling. We recommended adding a custodial training program in proper recyclable waste disposal.

Through our meeting with Joseph Kraskouskas, we found that Chartwells implements most of its food diversion in Morgan Dining Hall where food and paper products are separated in order to send food scraps to the local pig farmer. This separation of food, however, only takes place in Morgan Dining Hall; all other locations are not yet set-up to collect food waste from consumers (although they do separate food waste in the kitchen). As a group we feel that food separation should take place in all of their locations. Even if there is not much food waste generated, every bit counts when you consider the yearly amount of food diverted from the trash on campus.

The students, faculty, staff, and custodians were asked survey questions involving knowledge and behavior regarding single stream recycling and electronic waste disposal. Issues commonly noted were the lack of images on most posters, lack of knowledge regarding single stream recycling, and lack of knowledge regarding electronic waste disposal locations.

In addition to the recommendations stated above for better access to waste disposal bins, we developed a few additional recommendations focused on knowledge and training. These range from recommending that the new Director of Sustainability keep the WPI Sustainability webpage and social media up to date to updating recycling posters to both current standards and survey requests. In addition, we recommended initiatives to use more sustainable materials, such as Chartwells using compostable takeout materials.

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Chapter 1: Introduction

At WPI, the management of waste has been a continuing issue since the inception of a campus wide recycling program in the 1990's when a capstone project undertook the design of a program for paper recycling. This paper recycling program contrasted with the original program in which all waste had been disposed of in a trash bin only set-up. The implementation of the paper recycling system laid the groundwork for future programs that addressed other types of recyclables (glass, metal, and plastics) to be disposed of separately from trash (See Appendix G, Terrence Pellerin Stakeholder Meeting). WPI eventually settled on a dual stream recycling system, which uses a trash bin, a paper bin, and a combined plastic, metal, and glass bin.

Most recently, in the fall of 2014, WPI changed to single stream recycling, which uses a single trash bin and a single recycling bin. Despite a projected increase in the recycling rate with the new single stream system, there was a significant reduction in the campus recycling rate according to the 2013 and 2014 Student Green Team Waste Audits. In particular, the Green Team audits of Morgan Hall and Daniels Hall showed that the Morgan Hall recycling rate fell from 25.9% to 23.4% and the Daniels Hall rate fell from 30.6% to 23.6% (3rd Annual Waste Audit Report 2013 and Waste Audit Report-2014). In the opinion of Elizabeth Tomaszewski, a member of the WPI Sustainability Task Force and the WPI Facilities System Manager, one of the causes of the reduction in the recycling rate was a lack of communication to the campus about the shift from dual stream to single stream recycling.

Two of the members of our IQP team consistently see the impact of the lack recycling information as part of their jobs as part-time custodians at WPI. Problems they observe include improper sorting and disposal of waste, and lack of care about proper waste disposal amongst many people at WPI. This gave our group more than one point of view in the path that waste takes, as both producers and collectors of waste.

1.1 Project Statement

The goal of this project was to significantly increase recycling rates by improving the process of waste sorting on the WPI campus. Our team researched different methods of recycling, food waste disposal, and electronic waste disposal which gave us a solid foundation from which to investigate what is problematic at WPI. We gathered additional information specific to WPI through a series of meetings with personnel involved in waste disposal and sustainability, including Waste Management, the waste hauler of WPI. For our data collection we produced three separate surveys targeting students, faculty/staff, and custodians, to determine awareness and knowledge of proper waste sorting practices. In addition we took inventory of the waste bin set-ups in every building on campus, excluding Health Services, Salisbury Estates, and Greek life houses. This inventory involved photographing each waste bin set-up and

documenting the types of bins that were present, as well as posters in an excel spreadsheet. Finally, we analyzed our data in conjunction with our background research to formulate proposals for the improvement of the waste sorting system at WPI, which we pitched in a second series of stakeholder meetings.

1.2 Summary

Chapter 1 is an introduction, which provides a general overview of the problems and goals that our project encompasses. Background information imperative to understanding our project is found in Chapter 2. In Chapter 3, there is a detailed description of the methods we utilized to collect data for our project, including information about groups of people we surveyed and why each group was important. The results and analysis of our project are contained in Chapter 4, where the data collected is analyzed to form a basis for our initial proposals of improvement to the WPI waste management system. Finally, Chapter 5 is the recommendations chapter, where we propose our final recommended improvements to the WPI waste management system backed by the data and information we have collected. Included in the Appendix are summaries of our group's initial stakeholder meetings, survey questions, results, and graphs, summaries of our final proposal meetings, and a summary of our waste bin inventory. The full waste bin inventory information is uploaded as a separate excel spreadsheet to the WPI library website.

Chapter 2: Background

2.1 Introduction

Considering the diverse nature of a college campus, it often becomes difficult to meet everyone's needs. Our group had to account for this diversity as we investigated why students, faculty/staff, and custodians do not recycle. This is because there are people from all over the world with different views and customs on recycling. For example, Europeans call their recycling system "single stream" even though they sort between paper, plastic, and glass. There are other locations in the world where people have never heard of recycling and this may impact the recycling rates at WPI.

We first became familiar with the various types of recycling programs: single stream, dual stream, and all-in-one. We also researched the laws and regulations, or lack of such, for all types of waste including food, recyclables, electronic, and universal waste. With this knowledge in mind, we researched other institutions that have successful recycling programs and general reasons why people do not recycle. With the diversity of the WPI campus in mind, our group researched various methods of recycling which we hope will complement this diversity.

2.2 General Recycling Knowledge

2.2.1 Introduction to Recycling

There are various methods of recycling available to consumers. Recycling methods such as single stream, dual stream, complete source separation, and all-in-one, are used for reducing the amount of metal, plastic, glass, and paper/cardboard waste that would otherwise go to landfills. Each method has its own advantages and disadvantages, which will be described in the following sections.

2.2.2 Single Stream

Single stream recycling is a relatively new method of recycling that is gaining popularity. Single stream's major identifying feature is that all recyclables including metal, plastic, glass, and paper are placed into one recycling bin as shown in Figure 2.1. The recyclables are later separated by type at a recycling facility. At the Waste Management sorting center that we toured in Avon, Massachusetts, the separation is a combination of manual and machine processing.

Figure 2.1: Waste Management sorting system[1] *(Waste Management, 2011)*

Single stream recycling is often viewed as advantageous because it is convenient for clients. With this method, people do not have to distinguish between the various types of recyclables; they just have to be able to distinguish between what is waste and what is recyclable. Take a cardboard food container with an aluminum edge for instance. In a recycling method in which sorting amongst aluminum and cardboard is mandatory, many may be confused about how to properly dispose of this particular item. In this case, many may feel as though it would be easier to throw out the container in the trash rather than take the time to determine which recycling bin to use. Single stream is supposed to make this process easier because there is only one trash bin and one recycling bin.

The major issue with single stream recycling is the potential for contamination. As previously stated, in single stream recycling all of the recyclable materials are disposed of in a single waste receptacle and then sorted out at the recycling plant (Androutsopoulos, 2013). When food is disposed of in recycling containers, the food can contaminate all of the recyclables within the container as demonstrated in Figure 2.2. When oils from foods taint cardboard or paper in the recycling containers, the materials become non-recyclable. This is because oil is not soluble in water, and water is used in the recycling process to clean the paper. This results in paper with grease spots at the end of the recycling process.

[1] To see a video clip of single stream sorting at a Waste Management Facility, use the following URL: https://www.youtube.com/watch?v=_GP3JuiX5BY

Figure 2.2: Banana peel contaminating a recycle bin

Since plastics and metals are melted, any remaining food residue is burned off at the elevated temperatures. Therefore, food contamination is not a quality issue for recycled plastics and metals. However, it should be noted that it is common for recyclable waste to not be processed for several days—in some cases as long as a month. This can lead to food decay and unwanted attraction of insects and other animals. It is important that as much food residue is removed as possible because it is detrimental to a company's working and waste storage environment.

2.2.3 Dual Stream and Full Source Separation Recycling

The full separation of recyclables is a practice where each type of recyclable is disposed of in separate bins. For example, glass, paper, plastic, and metal are each disposed of in different containers. This method is rarely practiced for curbside pickup because there are so many different types of recyclables and it is not efficient to have one receptacle for each type of recyclable material. However, when recyclables are disposed of directly at the plant, full source separation recycling is practiced.

Dual stream recycling is a type of source separation recycling. Unlike full source separation recycling, dual stream recycling usually has two different recycling bins, in addition to a trash bin. In its most basic form, dual stream recycling involves the separation of paper and cardboard waste from plastic, glass, and metal waste. Basically, paper and cardboard are disposed of in their own receptacle and plastics, glass and metals in another. This situation is illustrated in Figure 2.3 where the third gray bin is for non-recyclable wastes. The main advantage of dual stream recycling is that it lowers the chance of paper contamination from food contaminated plastics and metals (Androutsopoulos, 2013).

Figure 2.3: Dual stream recycling. Here the green bin is for plastic, glass and aluminum, the blue bin is for paper, and the black bin is for trash.

The main disadvantage to dual stream over single stream is that it requires the waste producer to sort the different recyclable material and waste. This is usually inconvenient when compared to simply disposing of an item in a trash bin or a recycling bin. There is also confusion as to where to place items made of more than one type of material. For example, Figure 2.4 shows a biscuit container made of a paper product and aluminum. Under dual stream, consumers would have to decide whether to recycle this container in the paper and cardboard bin or in the aluminum bin, or even be forced to separate the item into various components.

Figure 2.4 shows a biscuit container that has both cardboard and aluminum on the edges (Flaky Buttery Crescent Rolls, 2011).

2.2.4 All in One (Trash + Recycling)

There is limited research regarding the all in one system of recycling. For this method, trash and recyclables are placed in the same container to be sorted at a waste plant. Currently, in a few areas such as Houston, Texas, there are proposals to create a plant that supports this type of waste disposal (One Bin for All).

2.2.5 Comparison

Table 2.1 demonstrates the advantages and disadvantages of the different types of recycling. It is noted that "each of these methods vary greatly, but the following strengths and weaknesses are generally agreed upon in the recycling community" (Emmet County Department of Public Works, 2015).

Table 2.1: Comparison of Recycling.

System	***Source Separated***	***Dual Stream***	***Single Stream***	***Dirty MRF[2]***
Materials collected and received by processing facility	*All separate (1 for trash, number of recycling varies)*	*Two groups (1 Trash, 2 recycling)*	*All recyclables together (1 trash, 1 recycling*	*In garbage (1 container)*
Convenience for residents/businesses	*Low*	*Medium-High*	*High*	*High*
Collection costs	*High*	*Moderate*	*Moderate-Low*	*Low*
Sorting equipment expense	*Low*	*Low-Moderate*	*High*	*Very High*
Worker exposure to biohazards	*Low*	*Low*	*Low-Medium*	*High*
Amount of recyclable material lost due to inaccurate sorting or contamination	*Low*	*Low*	*Medium*	*Very High*
Quality of resulting materials	*High*	*High*	*Medium-Low*	*Low*
Markets for resulting materials	*Strong*	*Strong*	*Medium -Weak*	*Weak-Marginal*
Market value of resulting materials	*High*	*High*	*Medium-Low*	*Very Low*
Preferred by waste haulers	*No*	*No*	*Yes*	*Yes*
Preferred by factories which buy recyclables	*Yes*	*Yes*	*No*	*No*

[2]*Materials Recovery Facility: a generic term for facilities that sort recyclables and prepare them for transportation to the factories which, in turn, will make them into new materials. (Emmet County Department of Public Works, 2015 [Materials collected and Received by Processing Facility edited for clarity]).*

2.2.6 TerraCycling

TerraCycling is a type of recycling where materials are changed directly into everyday items. The TerraCycle Company is privately owned company located in New Jersey and is able to use a wide variety of items such as: used drink pouches, candy wrappers, tape dispensers, pens, cosmetic/beauty supplies, and e-waste. An institution simply has to request to be a member of a TerraCycle program and then reach a minimum weight of recyclable products before shipping to the TerraCycle facility. Points are given to the institution based on the type and quantity of material sent in. The institution can then redeem these points for products, such as backpacks, binders and benches, created from the recycled and repurposed waste. Points also have a monetary value of $0.01 per point, which can be sent to a non-profit or school of each institution's choice (How TerraCycle Works).[3]

Figure 2.5: Terracycling allows people to collect items such as chip bags and pouches and ship the items to the TerraCycle facility where the items are repurposed to make miscellaneous items such as backpacks, bags, and pencil pouches.

2.2.7 E-Waste and Universal Waste

According to bostonelectronicwaste.com, e-waste is defined as:

> "Electronic waste, or e-waste, is a term for electronic products that have become unwanted, non-working or obsolete, and have essentially reached the end of their useful life."

This definition applies to items such as VCRs, DVD players, TVs, cell phones, fax machines, printers, telephones and any other electronic item no longer in use. Currently, the state of Massachusetts does not have a mandate prohibiting the disposal of most types of e-waste in the trash or recycle bins. They do, however, have a ban on the disposal of CRTs which was initiated in the year 2000. This ban applies to televisions and computer monitors with cathode ray tubes (Electronics Recycling| MassDEP). There are also programs in place to motivate

[3] For an institution that uses this method, see section 2.5.1

people to divert e-waste through mail-in/drop-off programs or donation programs (Electronics Recycling| MassDEP). Donation programs such as the "National Cristina Foundation" and "Goodwill Industries" accept some newer electronics such as computers and televisions for people with disabilities. Another program in place allows customers who own electronic devices to mail in or drop off their electronics at major retailers such as Best Buy, Apple, AT&T, Dell, HP, etc. The purpose of these programs is to divert toxins, such as lead and mercury, from landfills because they pose health risks and harm the environment.

There is also another type of electronic waste known as universal waste. These include electronics that are hazardous to people and the environment. Items that fall under this category are batteries, light bulbs, thermostats, and pesticides (San Bernardino County Fire Department).

Figure 2.6: Universal waste includes any type of batteries, light bulbs, computer parts, televisions, etc. (San Bernardino County Fire Department).

2.3 Relevant Waste Laws in Massachusetts

In the state of Massachusetts a law called the "1983 Bottle Bill" was enacted in hopes of motivating people to recycle their aluminum and plastic bottles. This bill is responsible for the CRV[4] deposit that customers pay for their bottled drinks. This has helped divert bottles from landfills for the past three decades (Guide to the 1983 Bottle Bill for Consumers | MassDEP). This bottle bill however does not include every type of bottle. In Massachusetts, water bottles are not able to be redeemed for a 5 cent return.

Since the 1990's, Massachusetts has established waste disposal bans for items such as hazardous, recyclable, and compostable waste material. As of October 1st, 2014, the state has also implemented a ban on commercial organic material. This means that any institution that produces more than one ton of food waste per week must divert it from landfills. Many institutions and businesses have started to deliver their food and organic material to off-site compost and anaerobic digestion facilities that repurpose the food waste. Pig farmers have also been sought to help haul their food waste away. While some institutions simply donate the food and satisfy the ban, others keep their waste by installing their own on-site technologies (Options for Complying with the Commercial Organics Waste Ban). Another option is to give it to

[4] Can Redemption Value

companies such as City Soil who composts the food waste and then sell it to farmers as a soil mixture as shown in Figure 2.7 (Ezell 2014).

Figure 2.7: City Soil using food waste to produce compost that can be used for gardens and farms (Massachusetts Food Waste Ban Gains Broad Acceptance).

2.4 Waste at WPI

2.4.1 Previous Methods of Recycling at WPI

Prior to August 2014, WPI utilized dual stream recycling which is a type of source separation recycling. For dual stream recycling, three or four different bins were placed in each residential hall and academic building; one for paper, one for aluminum and plastic, one for trash, and, in locations that produce a lot of cardboard waste, one for cardboard. Although there was a recycling program in place, it could have been more efficient.

WPI's Green Team holds yearly waste audits during which they evaluate how much of WPI's waste is recycled. Formulas are used to calculate the actual and potential rates for the WPI campus.

$$\text{ACTUAL RATE: } \frac{\text{Total Weight of Correctly Recycled Waste}}{\text{Total Weight of all Waste}} * 100 = \text{Recycling Rate of Building} \quad \text{(Eq. 2.1)}$$

$$\text{POTENTIAL RATE: } \frac{\text{Total Weight of all Recycling}}{\text{Total Weight of all Waste}} * 100 = \text{Potential Recycling Rate of Building} \quad \text{(Eq. 2.2)}$$

In November of 2013, the waste audit results yielded recycling rates in various buildings ranging from 25-31% with an overall average of 29.08%. The Green team then analyzed WPI's potential recycling rates, and concluded that, with proper disposal of waste and recycling, WPI is

capable of achieving 41-44% recycling rates among the multiple buildings analyzed (Bourke, 2013).

2.4.2 Current Methods for Recycling at WPI

In 2014, WPI converted to single stream recycling. This conversion was a result of input and encouragement from the Sustainability Task Force, the Green Team, and other influential people on campus. WPI hoped that by making different types of recyclables easier to dispose, more students, faculty, and staff would be willing to recycle.

However, when the Green team conducted its annual waste audit in November of 2014, recycling rates decreased significantly. In the various buildings analyzed, rates ranging from 4%-24% were recorded as opposed to the 25-31% range from the previous year. Using Equations 2.1 and 2.2, the Green team also calculated that these buildings had a potential of reaching a 35-50% recycling rate; a wider range in comparison to the 2013 results. Therefore, potential recycling rates increased, yet actual rates fell significantly (4th Annual Waste Audit Results, 2014).

The implementation of single stream did not improve recycling rates. We believe that it needs to be determined if students, staff, and faculty either don't know the difference between trash and recyclables or they don't care. This problem was set to be addressed by the newly hired Director of Sustainability. However, the Director of Sustainability left only a few months into the year leaving the problem of motivating and educating students, staff, and faculty unchanged.

2.4.3 WPI and Waste Management

WPI's waste and recycling hauler is the company Waste Management. They are the largest waste hauler and renewable energy provider in North America with goals of achieving zero waste. They have various locations across the United States and Canada which comprise different facilities such as landfills, recycling centers, and transfer stations. Waste Management has been WPI's waste and recycling hauler for about 30 years. The waste goes to the landfill facility in Millbury, Massachusetts and WPI's recycling goes to a facility in Avon, MA. Waste Management encouraged the transition to single stream recycling because they found that the simplicity of single stream boosted recycling across the United States and Canada by 30%. The Waste Management Company converted their dual stream plant in Avon to a single stream facility in 2009 (See Appendix G, Ed Conley stakeholder meeting summary).

Waste Management has signs which help distinguish what can be accepted in the single stream recycling containers, and the signs are placed in various locations around campus to promote single stream recycling. However, the signs do not address "gray areas" such as plastic food containers with food residue nor pizza boxes. This generates confusion amongst students, faculty, staff, and even custodians about proper waste sorting. Figure 2.8 is a typical sign produced by Waste Management (Waste Management, Inc., 2015). However, it should be noted that when our group met with Waste Management representatives and toured their facility we learned that small amounts of contamination are not considered an issue by this particular plant.

For example, pizza boxes are accepted as long as they are not "dripping" with oil, and yogurt containers can have small amounts of residue. However, waste procedures are strongly encouraged to clean out what they can. In addition, during our meeting we were told that dual stream, like single stream, can still have contamination issues when the food waste is disposed of in the paper container (See Appendix G, Ed Conley stakeholder meeting summary).

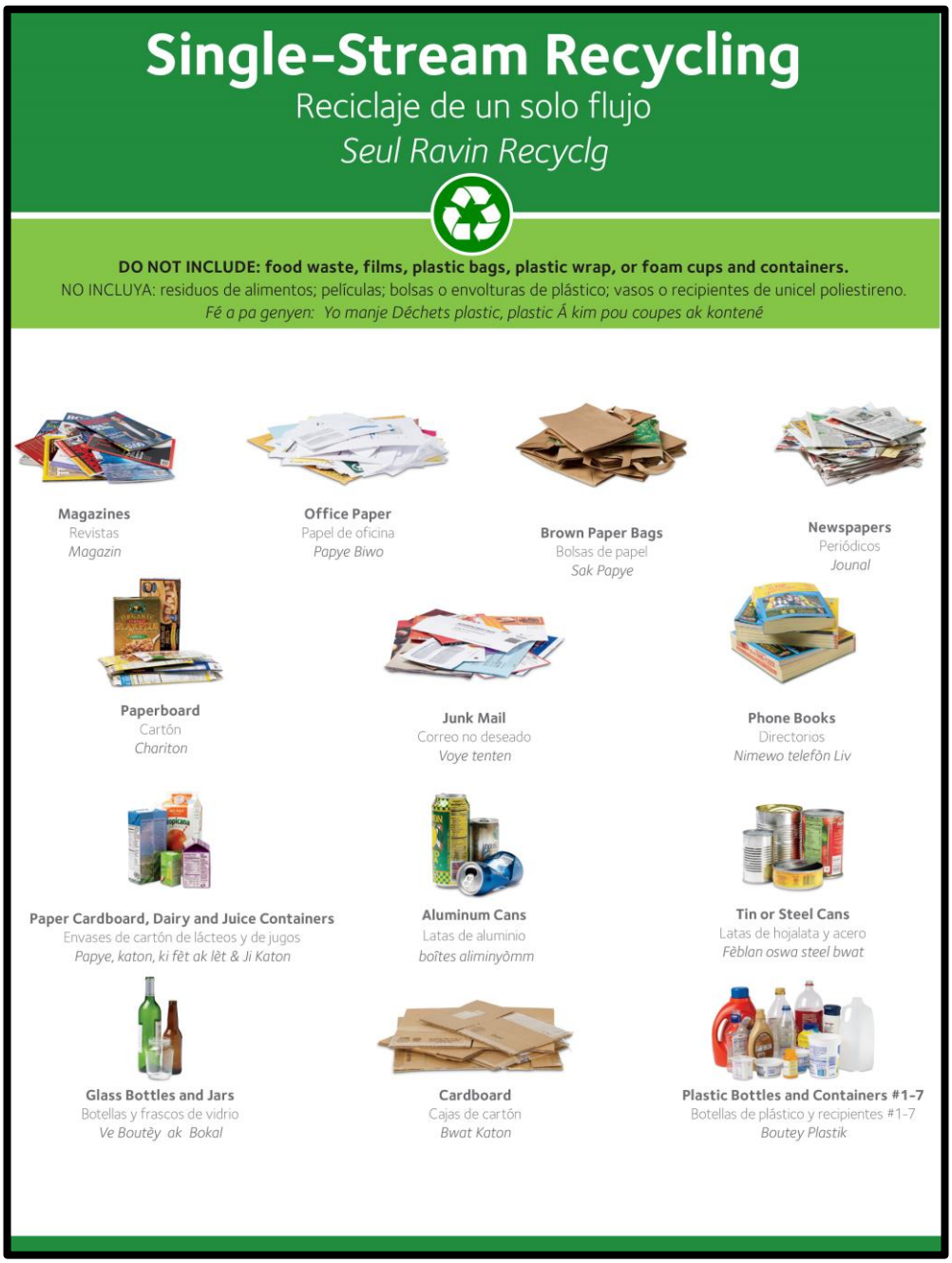


Figure 2.8: One of the most common signs distributed on the WPI campus describing what is accepted under single stream recycling (Waste Management, Inc., 2015).

2.4.4 WPI and the Institutional Recycling Network

The Institutional Recycling Network (IRN) is a program in which institutions pay to become a member. IRN is located in New Hampshire and they aim to help institutions reuse various materials. WPI has used IRN's services to remove electronic waste and old furniture since the late 1990's (Institutional Recycling Network, 2010). Although there are programs which dispose of e-waste for free, those programs often ship these products to third world countries causing health problems to those who live near the landfills. IRN has a strict policy that all electronic waste has to be dismantled in the United States. IRN also donates WPI's old furniture to areas that would benefit from it. For example, our team learned that in 2005 WPI made renovations and IRN came to remove the old furniture. IRN then proceeded to donate the used furniture to hurricane Katrina victims (See Appendix G, Terrence Pellerin stakeholder meeting summary).

2.4.5 WPI's Sustainability Task Force

The WPI Sustainability Task Force is a group of students and faculty that work together to promote sustainability at WPI. The task force is led by Jeff Solomon and John Orr as co-chairmen. As a group, this task force promotes sustainability through IQP and MQP projects, research, and courses. This task force is powered by volunteer efforts and are hoping that with the appointment of a Director of Sustainability, their ideas to enhance sustainability on campus will be better enforced (See Appendix G, John Orr stakeholder meeting summary). The position, Director of Sustainability, would replace the part-time Sustainability Coordinator with a full time paid position, providing the ability for someone to devote their full time to enhancing sustainability on campus.

2.4.6 Food Waste at WPI

WPI's food service provider, Chartwells, is in charge of the Goats Head Restaurant, Pulse on Dining (Morgan Commons), and the Rubin Campus Center Food Court. They have been utilizing different ways to divert food waste, predating the enactment of the Massachusetts Food Waste Mandate. Different programs such as Project Clean Plate, Trim Trax, and a partnership with a pig farmer for food waste disposal are some of the ways used to both divert and reduce food waste.

Project Clean Plate was first developed at WPI at the Pulse on Dining Marketplace in 1999 (The Towers · Project Clean Plate: Reducing Student Waste). This program had the dining hall stop using trays and switching all of their large-sized plates to a smaller size. The smaller size was in an attempt to lower the amount of wasted food by encouraging students to eat smaller portions at a time and go up for seconds if needed. Each of the plates held less and, without trays, there was no longer a convenient way of carrying several plates at one time. This discouraged taking excess quantities of food; the result was a 20-40% decrease in the amount of food waste produced.

Today, the majority of food waste produced by the dining establishments on the WPI campus is collected by a pig farmer. Both disposing of food waste into separate receptacles and the Trim Trax program are utilized in order to collect as much food waste as possible. Figure 2.9 is a representation of how food is separated for the pig farmer. The partnership with the pig farmer is mutually beneficial, without any charge for Chartwells or the farmer. Chartwells has their food waste diverted from landfills and put to good use, while the pig farmer has a steady supply of food to feed his livestock.[5]

Figure 2.9: How food is separated from other paper products for the pig farmer.

Trim Trax is a program where the food service workers place any and all food waste into a clear bucket. The significance behind this is to show the cumulative effect of small amounts of food. This program's goal is to have workers waste as little usable food as possible. For example, when cutting off the carrot top, cutting off a half inch of the carrot in the process versus a quarter inch does not seem like much at the time. However, the clear bucket shows the combined amount of waste.

[5] For more information and quantities see Appendix G for our stakeholder meeting with Joseph Kraskouskas

2.5 Why People Do Not Recycle

There are common factors that affect why people do not recycle: motivation, time consumption, availability of recycle bins, and confusion (Spencer, 2012). At WPI, determining which of these factors most impacts students, faculty, staff, and custodians has been an ongoing problem for the Facilities Department.

2.5.1 Motivation

In a case study conducted in Michigan, researchers studied grocery shoppers to determine the best practice for motivating consumers to reduce waste production. The people studied were divided into 4 groups: one received a pamphlet describing the environmental benefits of reducing waste; one received a pamphlet describing the economic benefits of reducing waste; one received a pamphlet with both environmental and economic benefits; and one did not receive a pamphlet at all. The results indicated that the pamphlet that depicted both the environmental and economic benefits yielded the most significant decrease in waste production by motivating people to more waste conscious (Promoting Source Reduction Behavior).

2.5.2 Time Consumption

The process of single stream recycling requires that a person rinse out or clean their items before disposing of it into a recycling bin. For a student, faculty, or staff not located near a sink area, this requires a walk to a bathroom or kitchen in order to rinse out a recyclable, and then a walk to the recycle bin to dispose of the recyclable. As a student at any institution, such a ritual is time consuming especially with a heavy workload. Even faculty and staff members may find the additional steps required for single stream time consuming.

2.5.3 Confusion

What often confuses the WPI community is that there are so many varieties of recycling bins and trash bins across campus. By simply walking around campus, our team discovered trash bins of different shapes and sizes as shown in Figure 2.10. We also noticed a variety of recycle bins, some of which were labeled “paper only”, “cans only”, “plastic, glass, aluminum, tin only”, or they did not have a label. In addition many bins were not located near an informative recycling poster.

Figure 2.10: Three of the various types of trash bins found around campus.

2.5.4 Availability of Recycle Bins

Although there are many places on campus that have recycle bins, there are still a few locations that lack bins. If there is no recycle bin in sight, even people willing to recycle are unable to do so. For example, in a trash can located on the second floor of 22 Schussler Street, a property WPI owns, we found over 30 recyclable items, likely because no recycle bin was nearby. This meant that students either had to go downstairs to the kitchen where a recycle bin is present to throw out their recyclables or take the easiest route and simply toss it in the trash as demonstrated in Figure 2.11. Thus, availability of recycling bins is necessary if we want to see an efficient and sustainable recycling program on our campus.

Figure 2.11: A mix of bottles, aluminum cans, and cardboard found in one trash bin that could have been recycled but weren't most likely due to a lack of recycling bin on the second floor.

2.5.5 Summary

Recycling is a task that can be quite simple but obstacles must be addressed in order to become successful on campus. Once students, faculty, and staff no longer feel they are wasting their time, have easier access to recycle bins, are motivated to recycle, and are not confused about the proper recycling, we believe recycling rates at WPI will improve.

2.6 Managing Waste at Other Institutions

Based on the 2014 RecycleMania Competition that takes place every year, our group reviewed some of the top winners. Universities across the country challenge themselves to divert their waste from landfills by proposing alternative solutions. They also use effective methods in promoting waste minimization on campus which is analyzed below.

2.6.1 Agnes Scott College

At Agnes Scott College, they have a very clear webpage about recycling that gives all the specifics of proper waste disposal. What helps their sustainability program is that their webpage includes a description of what colored bins to use for each type of waste as shown in Figure 2.12. They also provide a phone number you can call to ask about disposing of electronics and hazardous waste such as light bulbs and batteries. Another way that this college promotes sustainability is by taking part in TerraCycling. TerraCycling is a great program that allows the campus to divert additional waste from landfills and simultaneously buy products for the university (See section 2.2.6 for more information on TerraCycling).

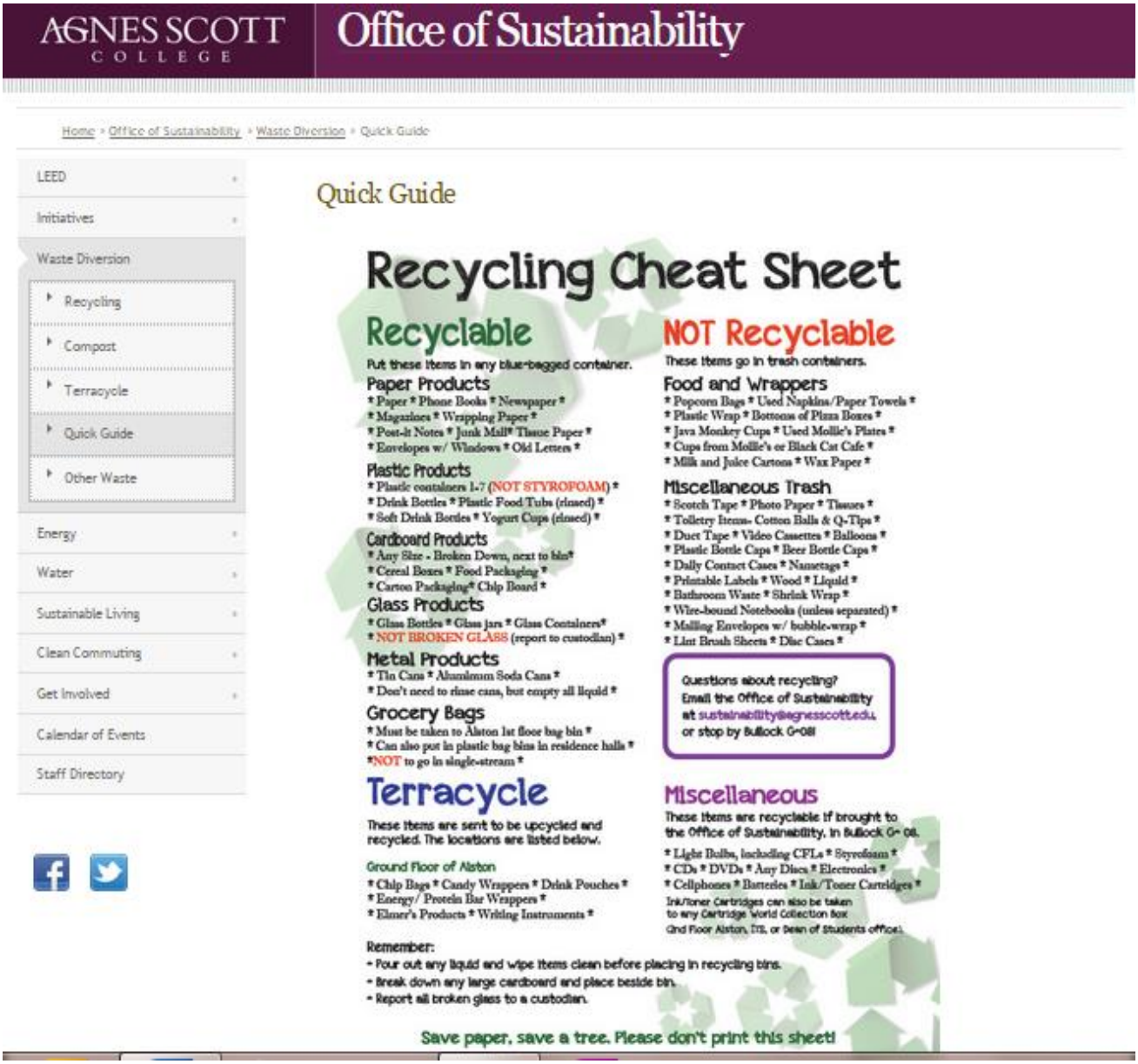


Figure 2.12: Agnes Scott College recycling webpage and its organization and clarity (Recycling at Agnes Scott).

2.6.2 Kalamazoo College

Kalamazoo College has a unique recycling method on their campus. Their recycling program is run by student workers under a supervisor. The student workers are responsible for picking up and sorting the recyclables. The recycling department also provides free bike rentals and has a room dedicated to school supplies that are found in the recycle bins or donated for other students to use. These items include sticky notes, pencils, highlighters, binders, dividers, mirrors, etc. They also provide an email address students can contact to request more recycling bins on campus if needed (Townsend, 2014).

2.6.3 Antioch University Seattle

Another exemplar university uses only compostable dishware for events held on their campus. One of their biggest successes came from removing all the trash bins from their campus to make the community think twice when disposing of their waste. Since their items were all compostable, nothing on campus needed to be placed in a trash bin. Plastic water bottle usage was also reduced by installing water bottle refillable stations around their campus. Refillable water bottle stations such as the one shown in Figure 2.13 were also added to the WPI campus in hopes of achieving a reduction in water bottles found in recycle bins (AUS Is the 2014 RecycleMania Grand Champion!-Antioch University Seattle).

Figure 2.13: A water bottle refill station installed to help decrease plastic water bottle disposal

2.6.4 Valencia University

Valencia University has signed the American College & University Presidents' Climate Commitment (ACUPCC). This is a commitment to reducing their carbon footprint and thus, has implemented many green programs to reduce their waste. This year at the RecycleMania competition, they won first place in "Waste Minimization". This is determined by the lowest overall amount of recyclables and trash per person. This means that on average each person in this university creates waste at a lower average in comparison to any other person at other colleges taking part in RecycleMania (Valencia Cleans Up in RecycleMania, 2012).

2.6.5 Food Waste at Clark University

Clark University has enacted many different programs involving electrical, trash, recycling, and food waste to help with sustainability and waste reduction (Sustainable Clark). One of the food waste programs at Clark is composting initiated in 2007 in the Higgins Cafeteria. This was the result of a 2-year-long student project. It became very successful, and within a few years several other eateries were following suit. In 2013, a student team, Clark Composts!, proposed adding compost bins to select resident halls (Sustainable Clark). Student

volunteers are utilized to remove the waste from these buildings on a regular basis to prevent large accumulations and the attraction of animals (See Appendix G, Elizabeth Tomaszewski stakeholder meeting).

All of the food waste collected is sent to We Care Environmental in Massachusetts. In fact, Clark's trash carrier charges less for organic material pick up than trash, which may contain banned materials (Goldman, 2015). Therefore by removing the food and organic wastes from the trash waste, the quantity of waste considered trash is lowered. Since the organic waste costs less to transport and the amount of trash waste is reduced, overall costs were lowered.

2.6.6 Summary

If WPI were to implement similar practices and educate the community about the importance of recycling, our campus too could be just as exemplar as the colleges and universities described. We know that many of these techniques would also help enhance the sustainability on campus along with saving money in the long run.

Chapter 3: Methodology

3.1 Overview

The goal of this project was to determine the most effective way to divert, sort, and recycle waste produced at WPI. In order to execute this goal, our team developed the following research questions;

1. What waste management programs have other colleges implemented and what are the levels of change that ensued as a result? What data exists for these other systems that would indicate a level of successful standard of compliance?
2. Are students, faculty, staff, and custodians knowledgeable about waste processing and what their role is in the process? How important is it to each individual student, faculty, and staff to properly sort their own waste? How can our team raise awareness about the importance of proper waste sorting?
3. What are the current systems in place at WPI for food, electronic, recyclable, and trash waste and how can they be improved?
4. What are the advantages and disadvantages of single stream recycling versus the previous method?
5. Where does each type of waste go when our waste hauler retrieves it and what is considered contamination for this waste hauler? Is there a way to inform the community on how to reduce contaminating recyclables?
6. What methods does WPI use to keep within the Massachusetts Commercial Food Waste Disposal Ban and other regulations? Can these methods be improved?
7. Are waste systems placed in appropriate locations and/or properly documented? Do these locations need to be updated to reflect the change to single stream recycling?

Below, we detail the methods we used to address these goal oriented research questions

3.2 Background Research

To help determine feasible solutions for a better sorting system at WPI, we researched previous efforts that were made on the WPI campus and how effective these methods have been. We also used RecycleMania.com to determine which colleges had the highest success of becoming a sustainable campus. We also reviewed any published, professional, or popular literature available that provided additional information on other existing sorting systems. Our group also researched waste disposal laws and how it impacts our current sorting methods.

3.3 Surveys

We surveyed multiple groups within the WPI community in order to obtain data on why recycling is not as effective as it could potentially be (see Appendix A through C). We created these surveys using an online survey maker called Qualtrics. We printed the custodial surveys in

order to give it to them during their daily meetings. Students, faculty, and staff received the surveys by email. Some questions common to all surveys were:

- Do you know what single stream recycling is?
- What would you do if you had an empty water bottle and no recycling bin in sight?
- Do you know where to dispose of electronics?

To determine how much the community knows and/or cares about waste sorting, we surveyed three groups in particular: custodians, students, faculty and staff. We began by first surveying the custodians in order to determine if a recycling training occurs and if they are aware of the proper sorting of waste under single stream recycling. The same assessment was modified and sent to both students and faculty to assess their knowledge.

3.4 Meetings with Stakeholders

Another method the team used to answer our research questions was to have in-person meetings with those involved with the sustainability efforts at WPI. In doing so, we were able to gather opinions and information from noteworthy sources necessary to determine areas of improvement. We scheduled meetings with several people, including WPI's Associate Director of Facilities, the Facilities Systems Manager, Student Sustainability Coordinator and Green Team President, Residential Services and the co-chairman of WPI's Sustainability Task Force. In addition, the team met with Chartwells Management and a Waste Management representative. These people were vital to our project because they have the power to put our suggestions in action and we were able to gain more insight on their attempts at improving sustainability on the WPI campus.

3.4.1 Associate Director of Facilities: Terrence Pellerin

Our team met with Terrence Pellerin on March 19, 2015 since he trains custodians in fields such as safely handling blood borne pathogens and proper chemical use. We asked questions such as why our campus turned to single stream recycling and if there were currently any custodial training programs about recycling. We also asked about alternative bin designs and about the possibility of placing a food waste bin in the campus center to divert more food from landfills.

3.4.2 Facilities Systems Manager: Elizabeth Tomaszewski

We met with Elizabeth Tomaszewski on March 20, 2015 because we believed she would be able to further explain what the proper waste bin set-up is supposed to look like, why there are areas that lack either a recycling poster and/or recycling bin, and if there are current plans to ensure WPI follows through with single stream recycling. We asked her questions regarding the difficulties she faced when aiding our campus' transition to single stream recycling and what our campus is doing to follow the Massachusetts Commercial Food Waste Ban.

3.4.3 Green Team President and Student Sustainability Representative: Mary Prescott

When we met with Mary Prescott on March 23, 2015, our group asked questions regarding the steps that have been taken to make the WPI campus more sustainable, including programs that have been initiated through the Green Team. We also asked for her opinion on the transition to single stream and if she had noticed any negative or positive aspects to this method of recycling.

3.4.4 WPI Residential Services: Ashley Merchant

We met with Ashley Merchant on March 23, 2015, in order to learn about contributions residential services made to making living on campus more sustainable. We also asked if, between the Community Advisor and the Residential Advisor, there is currently a mandatory program about proper waste sorting for residents in place.

3.4.5 Co-chairman of the WPI Sustainability Task Force: Professor John Orr

Our team met with John Orr on March 24, 2015 to discuss the projects the sustainability task force has undertaken. This added a faculty member's perspective on the importance placed on recycling as well as provided insight on the successes and failures of past attempts at managing waste at WPI. We asked about any difficulties the Sustainability Task Force faced reaching out to students, faculty, and staff.

3.4.6 Chartwells Management: Joseph Kraskouskas

Our group met with a representative from Chartwells management on March 25, 2015 to ask about the success rate of the current food waste sorting system. We also asked Chartwells about their arrangement with a local pig farmer who hauls away their food waste and about the programs Chartwells has in place to promote a more sustainable dining experience.

3.4.7 Waste Management Center: John Henry, Michelle Lee, and Ed Conley

In order to fully understand the process of waste sorting, we met with representatives from Waste Management on April 2, 2015, the company that handles WPI's waste and toured the plant where WPI's recycled waste is sent. We asked questions about whether the plant is capable of handling contaminated recyclables and about their success with transitioning to single stream.

3.5 Campus Tours

Our team toured the entire WPI campus to photograph and inventory the types of bins and their locations. We documented whether or not each location contains at least one recycle bin to every waste bin. During this walk through of the campus, we made note of locations that needed an updated recycle bin, an updated trash bin, or a recycling poster. We also took pictures

of every location we inventoried in order for the facilities department to know exactly where in each building an update is needed.

Chapter 4: Results and Analysis

4.1 Introduction

In this chapter, our group will discuss our findings from our surveys, meetings with stakeholders, and research. These results and analysis are separated by type of waste generated and the topics discussed are existing conditions, opportunities for improvement of the current conditions, and the ideal condition as detailed in Figure 4.1.

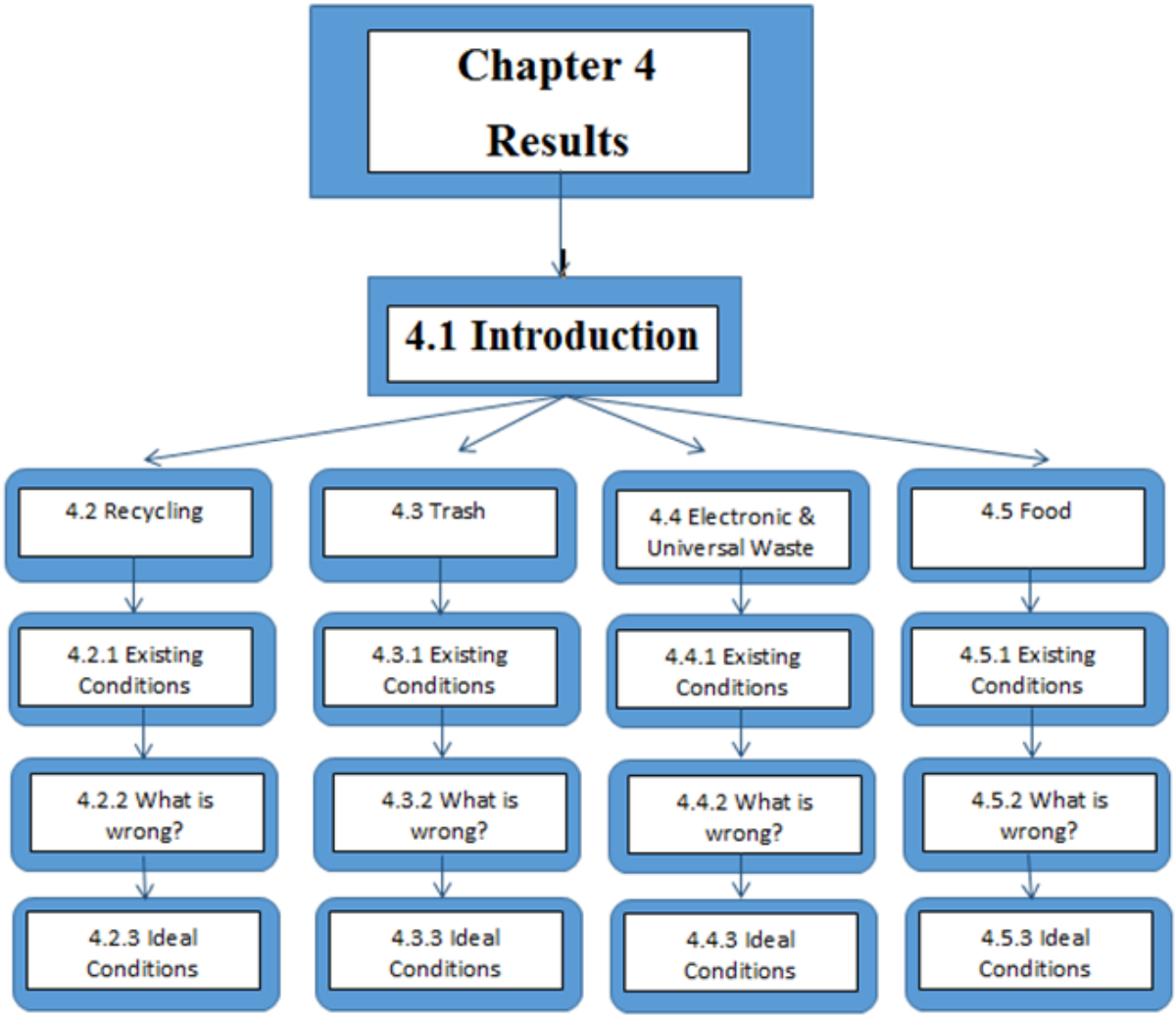


Figure 4.1: An organizational chart depicting the flow of discussion throughout this chapter.

4.2 Recycling

4.2.1 Existing Conditions

Since its implementation in the early 1990's, the Associate Director of Buildings and Events, Mr. Pellerin, has played a large role in managing the success of recycling on campus. In the late 1990's, WPI joined the Institution Recycling Network (IRN) and since then, unwanted

furniture has been diverted from landfills by sending them to areas in need. We also discovered from our interview with Mr. Pellerin that there are recycling bins in all academic and residential halls. In August of 2014, most recycling bins were converted to single stream recycling bins by adding two holes for cans on a paper only bin to reflect the ability to combine different types of recyclables in one bin as shown in Figure 4.2. Additionally, custodians are provided with green bags to use in recycle bins to be able to easily distinguish trash from recyclables.

Figure 4.2: Two variations of recycle bins reflecting the change from dual stream to single stream recycling; holes were added to the paper only bin to allow plastics, aluminum and paper to be recycled together.

On display near recycling bins, as well as other places on campus, are multiple versions of posters detailing what should and should not be recycled as shown in Figure 4.3.

Figure 4.3: A poster from our waste hauler Waste Management which details what can and can't be recycled as well as a fun fact across the top which details the importance of recycling.

In our meeting with Mr. Pellerin, we also discovered that although there are various types of training programs the custodians undergo yearly, there are no programs that specifically address recycling. However, 19 of the custodians surveyed reported attending a training program that discussed single stream recycling (See Appendix D, for the full custodial survey data). Either these custodians attended a training program about single stream recycling at a different institution, or the question was unclear and they misunderstood the meaning of a training program.

Students, faculty, and staff are responsible for sorting their own waste into the proper bin. The responsibility then falls on the custodians to remove and process the trash and recyclables separately. Custodians then take trash to a waste compactor and leave the recyclables near the compactor. A custodian who is responsible for the recycling on campus then brings all the recyclables down to Fuller Labs where it is dumped into the recyclables compactor. Once in the compactor, Waste Management hauls the recyclables to their sorting center in Avon, Massachusetts. There, the recyclables are sorted and any waste products are removed.

4.2.2 Opportunities for Improvement

Mr. Pellerin informed us that single stream recycling was implemented in August of 2014 with supporters of single stream promising a 20% increase in recycling rates specific to WPI. From the waste audit results and a meeting with the Facilities Systems Manager Mrs. Tomaszewski, our group discovered that even with the implementation of an easier recycling method, recycling rates fell from one year to the next, as detailed in Table 4.1. Mrs. Tomaszewski believes that recycling rates fell because single stream recycling was not advertised or explained. Our survey results confirm with 28% of faculty and 55% of students reporting that they are unaware of what single stream recycling means.

Table 4.1: 2013 Waste Audit results at WPI prior to single stream implementation compared to the 2014 Waste Audit results following the implementation of single stream (4th Annual Waste Audit Report, 2014)

Building	2013	2014
Rubin Campus Center	-not conducted-	20%
Gordon Library	-not conducted-	4%
Daniels Hall	30.62%	23.4%
Morgan Hall	25.93%	23.6%
Water Bottles	20.4 lbs	14.4 lbs

Through walkthroughs and work experience as temporary custodians, we discovered that some custodial closets either do not have green bags supplied or custodians do not use them, as seen in Figure 4.4. Mr. Pellerin informed us about custodial concerns regarding the durability of the green bags. These green bags are thinner than the clear bags seen in Figure 4.4 and are thus prone to ripping.

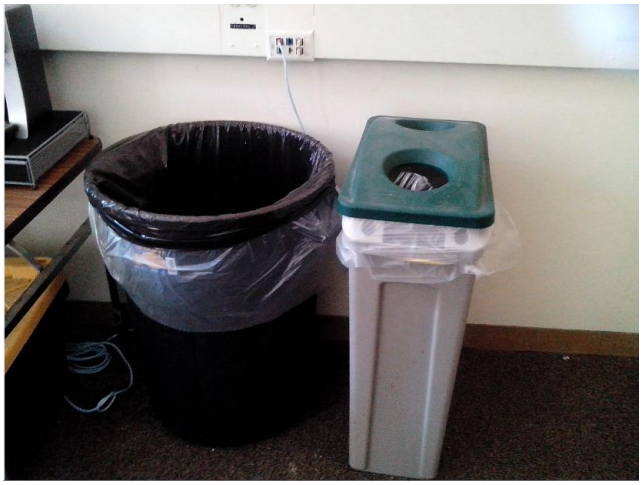


Figure 4.4: Both trash and recycle bins have clear bags. The recycle bin should have a green bag to distinguish the trash from recyclables.

Walking from building to building, our team found that there are multiple types of recycling bins around campus as shown in Figure 4.5. Some of these bins reflect single stream recycling while others do not. This is very misleading to the WPI community since the conversion to single stream should be emphasized especially through our recycling set-ups. By inventorying the types and number of bins in each location, our group determined that WPI would have to replace at least 300 recycle bin lids in order to complete the transition to single stream recycling.

Figure 4.5: Three of the multiple types of recycling bins found on campus. The recycle bin furthest to the left should have been eliminated with the implementation of single stream because it emphasizes sorting. The other two bins are correct under single stream recycling.

The data that we collected by inventorying the types and number of bins across campus confirmed that although there are many recycling bins on campus, many are not strategically placed such as near trash bins or in areas of high traffic. There are some large areas, both indoors and outdoors, where there are no recycle bins in sight as shown in Figure 4.6.

Figure 4.6: On the second floor of 22 Schussler St., a property owned by WPI, we found a recycling poster but no recycling bin.

Also, throughout our campus tours, we determined that a majority of the posters detailing recycling around campus are either wrong, not clear or attractive to read, or not within sight of a recycle bin as shown in Figure 4.7.

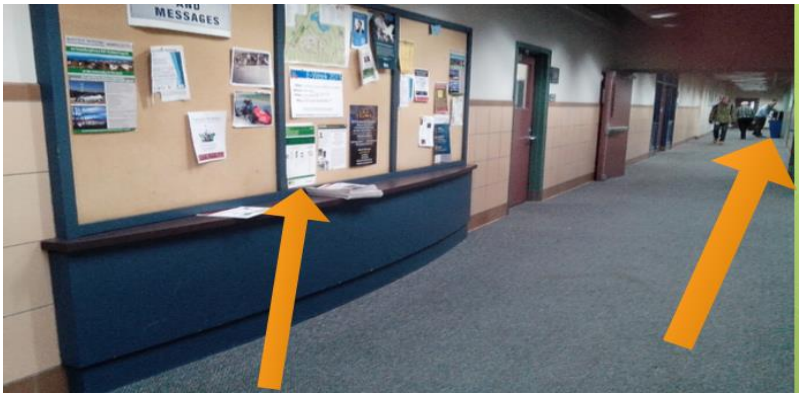


Figure 4.7: In Higgins Labs, a poster is located in one area of the hallway while the recycle bins are located on the opposite side of the hallway.

In some areas, posters detailing the proper way to sort waste under dual stream recycling are still posted as seen in Figure 4.8. The presence of the old poster can cause confusion for anyone attempting to practice proper waste disposal. In our survey we asked students, faculty, and staff if they were often confused as to which bin they should dispose their waste into. 33% of students and 20% of faculty and staff answered yes. Interestingly, these were lower percentages than the number of students and faculty/staff that stated that they did not know what single stream recycling is; 55% for students and 28% for faculty/staff. This implies that students and faculty/staff are practicing incorrect waste sorting, despite believing that they are correct. For the full list of survey information see the Appendices A through F.

In addition, through our survey results and meetings with stakeholders, we discovered that the WPI community prefers posters with more pictures instead of words. Of the students that took our survey, 36% stated that they would greatly prefer a poster with more pictures, and an additional 52% stated that they would somewhat prefer a poster with more pictures.

Figure 4.8: A poster detailing dual stream recycling right next to a poster for single stream in the Rubin Campus Center.

Also, our survey results indicated that 16.3% of the custodians surveyed did not know what single stream recycling was. This is especially concerning since the custodians should have seen the new single stream bin set-up in their own building. Another alarming fact is depicted in Figure 4.9. In our survey, we told custodians "It is rumored that inconvenience or confusion on what can or cannot be recycled causes some custodians to combine the trash with recyclable material and take it all out as trash." We then asked if they had ever done this, if they know of other custodians that have done this, or if they believe it never happens. We found that the rumor was generally true with 44% of custodians reporting that they combine trash and recycling to be disposed of together.

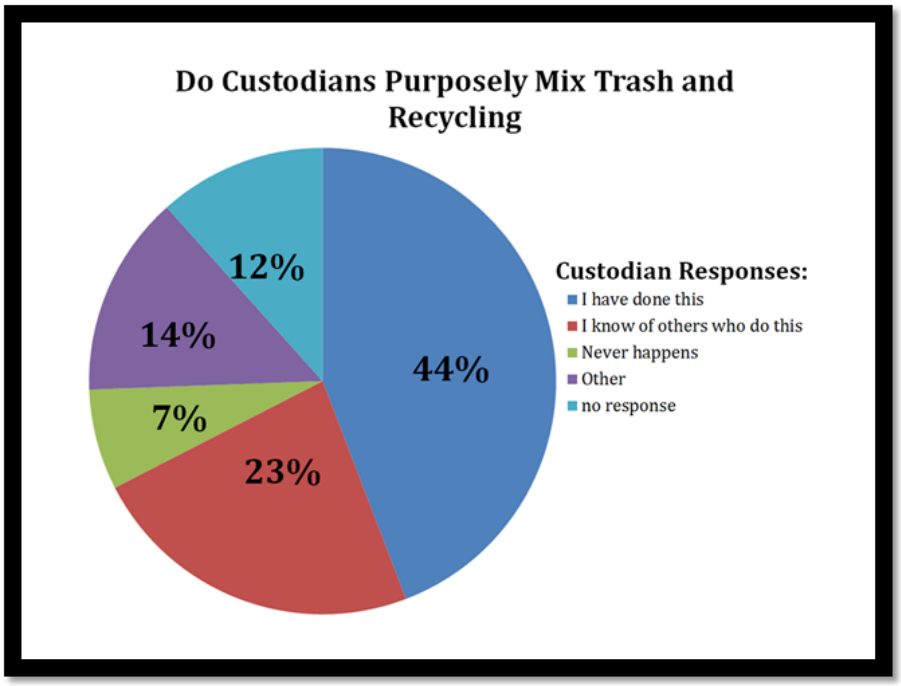


Figure 4.9: With 44% of custodians claiming they have combined trash and recyclables to be disposed of together and another 23% of custodians claiming they know of other custodians who do this, students, faculty, and staff may question why they bother to recycle.

When our group toured the Waste Management recycling center we learned that they prefer bags of recyclables to be untied because it is easier for the workers to dump out the materials inside which, in turn, allows for a higher rate of recycling from their machinery. The problem is that recyclables are sorted manually by workers. By the time the workers open a tied bag of recyclables, other non-recyclables manage to slip by on the sorting belt. Therefore, bagged recyclables are considered trash if the workers are unable to quickly open the bags.

4.2.3 Ideal Conditions

An ideal trash and recycling container set-up would consist of two bins; one for trash and one for single stream recycling as shown in Figure 4.10. The recycling bins would have the correct lid depicting our transition to single stream.

Figure 4.10: A one-to-one ratio of trash and recycle bins. This set-up minimizes the amount of recyclables that would otherwise be thrown into the trash bin.

Ideally, recycling poster would be placed at eye-level above recycling bin to serve as a guide. Even if these posters are not uniform in design, they must all describe the proper way of single stream recycling. It should not matter whether a single stream poster from 2014 or 2015 is up, so long as the content on the poster is consistent.

Using green bags for recycle bins would make it easier for custodians to distinguish between trash and recyclables which would reduce the chance of recyclables ending up in trash compactors. In order to address the concerns of the custodians as well as encourage the use of green bags, Mr. Pellerin mentioned that there are thicker green bags that can be purchased. In Figure 4.11, another ideal usage of green bags is displayed where the custodian places a white bag underneath the green recyclable bag to prevent leaking material from spilling directly into the recycling container.

Figure 4.11: The custodian placed a green bag on top of a clear bag. If the green bag rips, the clear one captures the leak and is removed as well. If the green bag does not rip, however, only the green bag is removed and the clear one is left.

Ideally, the facilities department would have a yearly training where someone who is an expert on single stream recycling can share information on the proper way of recycling and answer any questions custodians might have. This training can include a PowerPoint presentation or a short speech where the proper method of recycling is discussed and the importance of recycling. The consequences of not recycling would also be discussed to emphasize the importance being placed on recycling.

In addition, from our meeting with Mr. Pellerin as well as from our research about the practices of IRN, we believe that IRN is a great program for WPI to continue membership with. Rather than discard furniture into landfills, IRN redirects this waste to benefit areas suffering from poverty or natural disasters.

4.3 Trash

4.3.1 Existing Conditions

When inventorying the campus trash locations, our group began to notice that there was a lack of uniformity not only with recycling bins but with trash bins as well. Bins would vary from building to building and sometimes even from floor to floor. As seen in Figure 4.12, these bins vary in color, size, and shape.

Figure 4.12: Four of the various types of trash bins found all around campus.

Based on our interview with Mr. Pellerin, the types of bins around campus and their locations are not documented but he would be interested in obtaining this information. With this information, bins can be updated to become uniform across campus.

4.3.2 Opportunities for Improvement

With the lack of uniformity in bins, it is harder to educate students on proper disposal methods. Additionally, our team, through campus tours and personal custodial experience, noticed that when a trash bin with a push flap was placed next to an open top recycle bin, students would tend to toss their trash in the recycle bins as demonstrated in Figure 4.13. We

noticed that this problem occurs more frequently in locations with open top recycling bins and push to open trash bins.

Figure 4.13: The recycle bin (blue) is filled with trash such as tissues and the waste bin (brown) is filled with recyclables such as Gatorade bottles.

Additionally, having an up to date document with all the bins and their location is beneficial especially if the campus undergoes another recycling modification. Therefore, using an Excel spreadsheet, we documented bin locations and the types and amount of bins in each location. Our group also documented if the area contains a poster along with a comment box with our groups suggestions for a better set-up. See Appendix J for the Excel file containing the buildings inventoried the types and number of bins found in each building, and additional comments regarding the set-up.

4.3.3 Ideal Conditions

Along with educating students on proper waste sorting methods, we believe that the ideal WPI sustainability web page should be clear, to the point, and easy to navigate such as Agnes Scott College's sustainability webpage (See Section 2.6.1 of the background chapter for more information).

Our team also concluded that students, faculty, and staff must not like touching the dirty flaps on the trash bins. We discussed using other trash bins with open tops however Mr. Pellerin mentioned that it would conflict with fire codes. Mr. Pellerin informed us that Slim Jim trash bins fulfill the fire code requirement and make it easier to dispose of waste without having to open a flap as shown in Figure 4.14.

Figure 4.14: Slim Jim waste bins. The trash bin (black) has a flap open top which opens easier when trash is placed on top requiring less contact than other flap open trash bins.

4.4 Electronic & Universal Waste

4.4.1 Existing Conditions

Through our interview with Mr. Pellerin, we discovered that there are approximately 35 e-waste boxes around campus for battery and handheld device disposal. Many of these are located in the main offices of each building on campus. These boxes, provided by the IRN, are used to collect the most common universal and e-waste on campus. However, items such as light bulbs and other hazardous waste that can't fit in the box has to be called into the facilities department for pickup. The universal and e-waste are then taken to the Daniels Hall basement where these items are stored until they are picked up by ACB Services. On the loading dock of Fuller Labs there is yet another e-waste disposal center; this one primarily for larger electronics such as printers and televisions.

4.4.2 Opportunities for Improvement

Although there are approximately 35 different locations on campus for students, faculty, and staff to dispose of their batteries and old hand held devices, many members of the WPI community do not know where these bins are located as evidenced by Figure 4.15. Nor do many know that there is a space available to drop off large electronic devices or that the facilities department can be called to pick up e-waste. According to the results of our surveys, 78% of faculty/staff and 86% of students reported either that they weren’t aware of battery disposal bins on campus or knew of just one bin on campus. Another problem is that these battery disposal boxes do not have a number to call when the box needs to be emptied.

Figure 4.15: Batteries dumped into the trash may be a result of the lack of knowledge the WPI community has about the battery disposal bins around campus.

Another problem on campus is that the locations we have available to store e-waste and universal waste are not publicly advertised. Despite it not being well known, WPI pays to have electronic waste hauled away. The reason why locations of the large electronic waste drop offs, for items such as computer and printers, are not widely advertised is to prevent places such as the loading dock behind Fuller Labs from becoming dumping grounds for electronic waste items. For this reason, the facilities department only uses the loading dock behind Fuller Labs for electronic and universal waste found exclusively by custodians. When analyzing Worcester State's website, we found that they do not mention a location that students, faculty, and staff can dump their e-waste. Instead, they simply make note of their yearly e-waste drive (Worcester State University, 2014).

4.4.3 Ideal Conditions

Currently, a significant population of students, faculty, and staff do not know where to dispose of their e-waste. 35% of students surveyed and 21% of faculty surveyed reported tossing unnecessary electronics in the trash bin or recycle bin to be disposed of. Neither the trash nor the recycle bin is the correct location to dispose of electronic and universal waste. Furthermore, only 18.6% of custodians stated that the most common place they find student electronic waste is the proper electronic waste boxes. By educating the WPI community of these locations, we can reduce the number of e-waste and universal waste products that incorrectly end up in the trash and recycle bins. Ideally, an email would be sent out in the beginning of the year, plus additional times throughout the year, to inform the community of proper disposal methods. The locations of electronic disposals would also be clearly posted on the sustainability website. In addition, instructions for waste pickup when the box is full, such as a phone number to call, would be placed upon each of the battery and handheld electronic disposal bin.

While stressing proper disposal methods on campus is important, there are opportunities off campus that ideally would be stated on WPI's sustainability website. Along with information on WPI's yearly e-waste drive, the sustainability website would also include opportunities such as Worcester's Free Household Electronics Recycling Day held in the spring. Additionally, TerraCycling allows people to begin an e-waste brigade which is a way to dispose of electronics for free. A brigade is a program that collects and reuses items that are not easily recyclable. These brigades help to eliminate waste by reusing items such as diaper packaging, cigarettes, and snack bags that would otherwise be sent to a landfill.

4.5 Food

4.5.1 Existing Conditions

The separate collection of food waste is an issue at WPI, which is met by varying levels of success throughout the campus. One building in particular has a successful set-up which diverts the majority of food waste on campus. Chartwells implements most of its food diversion in Morgan Dining Hall where food and paper products are separated in order to send food scraps to the local pig farmer. This separation of food, however, only takes place in Morgan Dining Hall; all other locations are not yet set-up to collect food waste from consumers. However, in the food preparation areas in all dining halls food scraps are collected and given to the pig farmer through a program called Trim Trax[6].

Through our interview with Chartwells, our group found that Chartwells has thought about having a counter constructed in the Campus Center food court which would implement a compost bin. However, due to financial reasons, their project is still currently pending approval.

4.5.2 Opportunities for Improvement

Although Chartwells has three main areas where food is provided, only one of these areas diverts food waste. As a group we feel that food separation should take place in all of their locations. Even if there is not much food waste generated, every bit counts when you consider the yearly amount of food diverted from the trash on campus. Additionally, the Massachusetts Food Waste Ban requires that institutions that produce more than one ton of food divert it all from landfills. Thus, by allowing food to be disposed into a trash bin, Chartwells is inadvertently violating the mandate.

4.5.3 Ideal Conditions

Although we believe that it would be a great idea to implement a counter for food separation in the campus center, there is a much easier and inexpensive way of achieving the same goal. A clearly labeled food bin would be an ideal temporary solution to collecting food waste and is still a great permanent solution should the project proposal for a new counter get

[6] For more information on Trim Trax, see Appendix G: Stakeholder Meeting Summaries: Joseph Kraskouskas

declined. All that is needed is a common inexpensive trash can barrel with a sticker clearly defining the bin as food waste only. An example of a free solution is to use a trash bin that will fall into disuse following the widespread conversion to Slim Jim style waste bins and use it to collect food waste.

Chapter 5: Recommendations and Conclusions

The purpose of this chapter is to present the recommendations that our group developed for the improvement of waste management at WPI. We have organized our recommendations into those that can be accomplished in a short, mid-length, and long period of time.

Table 5.1: A table detailing our recommendations, their timelines, and responsible parties.

Recommendations and Responsible party	**Short-term** (accomplish by the start of fall 2015)	**Mid-term** (accomplish by 2015-2016)	**Long-term** (accomplish by 2019)
Use informative posters that contain more pictures and fewer words.(**Waste Management**)	✓		
The custodian responsible for picking up the recyclables around campus should make a slit in the bags prior to being dumped in the compactor.(**WPI Facilities Department**)	✓		
The facilities department should train the custodians annually on the proper disposal methods of single stream recycling as well as the importance of proper sorting. (**Terrance Pellerin**)	✓		
The facilities department should order new Slim Jim trash and recycling bins.(**Terrence Pellerin)**		✓	
The Facilities Department should purchase and place more outdoor recycling and trash bins for Fuller/Ellsworth apartments. (**Terrence Pellerin**)			✓
Waste Management should perform a waste audit at the end of the academic year, during March or April. (**Elizabeth Tomaszewski**)		✓	
Waste Management should be a guest speaker to discuss single stream recycling, as well as the importance of recycling. (**Elizabeth Tomaszewski**)		✓	
The WPI sustainability webpage needs to be updated. (**Director of Sustainability**)	✓		
The use social media to spread information on the importance of sustainability. (**Director of Sustainability**)		✓	
Send an informational email(s) providing an overview of single stream recycling and sustainability efforts to students, staff and faculty (**Director of Sustainability**)		✓	
Run a sustainability facts “slide” on the WPI TV channel (**Director of Sustainability**)			✓
The Student Green Team should place stickers reminding people to shut off the lights when nobody is in a room.(**Green Team President**)			✓
Chartwells should place a temporary trash bin in the Campus Center for additional food waste accumulation. (**Joseph Kraskouskas**)	✓		
Chartwells should use compostable materials (**Joseph Kraskouskas**)			✓
Further research should be done on eliminating the need for recycling and trash bags on campus **(WPI Sustainability Project Center)**			✓

5.1 Short Term Recommendations

The recommendations outlined in this subsection are expected to be accomplished before the beginning of the 2015-2016 school year.

Recommendation S1: Use informative posters that contain more pictures and fewer words.

These posters should reflect our university's conversion to single stream recycling. Our team recommends using Waste Management's most current recycling poster as shown in Figure 5.1. These posters can be requested at any time at no charge from Waste Management. We highly recommend placing these posters at eye-level on the wall above the bin. (For a complete list of locations, see the Appendix J Excel file link).

Figure 5.1: The 2014 Waste Management Single Stream Recycling Poster which summarizes items that can and cannot be placed in the recycle bin mainly through pictures rather than words.

Recommendation S2: The facilities department should train the custodians annually on the proper disposal methods of single stream recycling, the importance of proper sorting, and the consequences of improper sorting.

We have provided the facilities department with a short training PowerPoint which the facilities department can feel free to use or modify (see Appendix K for the custodial training program PowerPoint). As shown in Figure 5.2, the topics discussed in the custodial training program were proper procedures, the importance of recycling, and the consequences of not recycling. Our team also recommends that custodians use green bags in their recycle bins so that it becomes easier to distinguish recyclables from trash when bags are pulled and accumulated. We also hope that the facilities department considers implementing some sort of consequence for custodians found improperly disposing of waste.

Figure 5.2: The topics slide of our custodian training PowerPoint presentation.

Recommendation S3: Chartwells should place a temporary trash bin in the Campus Center for additional food waste accumulation.

The temporary trash bin should be clearly labeled to indicate that the bin is specifically for food waste. If the budget to have a sorting center for food waste (similar to the one in Morgan Hall) is approved, then the temporary bin can be removed. Otherwise, the bin can become a permanent one. Additionally, if food is not diverted in the Goats Head Restaurant after being picked up by the busboy, we recommend putting a bin for food waste in that dining facility as well. This would also help them to fully comply with the Massachusetts Food Waste Disposal Ban by diverting as much food as possible from landfills.

Recommendation S4: The custodian responsible for picking up the recyclables around campus should make a slit in the bags prior to being dumped in the compactor.

By making a slit in the recyclable bags, the recyclables would fall out of the bags once in the compactor. The bags would then be disposed of once at Waste Management but the recyclables would be processed rather than thrown away for being tied in a bag. This makes it easier for Waste Management once they receive these recyclables to efficiently sort them.

Recommendation S5: Update the WPI Sustainability webpage.

We believe that the internet and social media are very important tools to aid the spread of information in modern day society. The website should include information such as the locations of all electronic waste disposal boxes, details regarding what can and cannot be recycled under single stream recycling, and contact information for any questions and suggestions. Figure 5.3 shows Agnes Scott College's Sustainability webpage which has a clear set-up, has information on how to get involved, and also provides a link to the college's sustainability social media page. The sustainability webpage should also contain information on where e-waste and universal

disposal locations are on campus. This would make it easier for students, faculty, and staff to be able to locate a disposal location rather than incorrectly disposing of their waste in a trash or recycle bin. One option that would avoid the cost of hauling away e-waste would be to advertise free annual e-waste drives such as the ones WPI and the one that the City of Worcester provide. An alternative option would be for the Director of Sustainability to look into TerraCycling. TerraCycling allows people to join a brigade of their choice; one of which is e-waste. TerraCycling is a free program which would eliminate the current costs to haul e-waste.

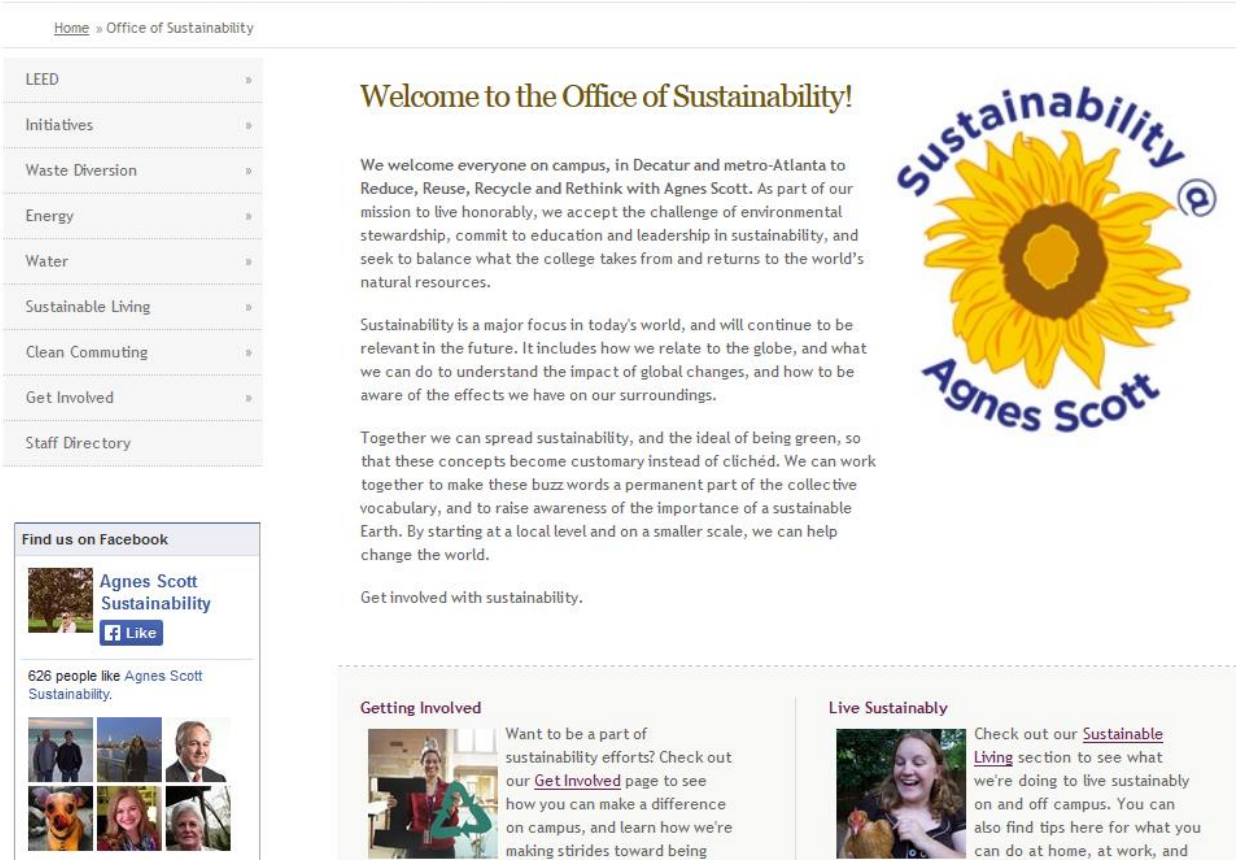


Figure 5.3: Agnes Scott College's sustainability page does a great job of classifying the types of waste (shown in the tabs on the left) and providing links to important pages.

5.2 Mid-term Recommendations

The recommendations outlined in this subsection are expected to be able to be accomplished by the end of the 2015-2016 school year assuming a Director of Sustainability is hired during the summer of 2015.

Recommendation M1: The Director of Sustainability should use social media to spread information on the importance of sustainability.

Mike Hamilton, the Assistant Director of Residential Services is very successful with efficient social media to market his department. A similar approach to sustainability through

social media can be made through the Director of Sustainability. We believe that through the use of social media, the Director of Sustainability may be able to reach out about to students and faculty who are frequent social media users by methods similar to that of Figure 5.4.

Figure 5.4: An example of a social media outreach, a hashtag.

Recommendation M2: Send an informational email or multiple emails providing an overview of single stream recycling and the importance of recycling and sustainability.

There should be an initial email about the proper way to dispose of waste at WPI sent to the students, faculty, and staff at the beginning of each academic year. Through our interviews, we found that the best person to send this email would be the Director of Sustainability when they are hired. However, if the new Director of Sustainability is not hired by the beginning of next school year, we believe that Elizabeth Tomaszewski, Facilities System Manager and member of the WPI Sustainability Task Force, should send out the email. This is because we believe Mrs. Tomaszewski has one of the most recognizable names from Facilities and the Sustainability Task Force so the email would be more likely to be acknowledged by its recipients. The person in charge of sending out the email could send additional emails either monthly or weekly providing tips to leading a more sustainable lifestyle at WPI such as bringing one's own mug to Dunkin rather than purchasing a drink and wasting a plastic cup every day. However, it should be noted that there are issues regarding sending "email blasts" to the student body. Therefore, the Director of Sustainability should discuss options for sending out the emails with the undergraduate Student Government Association (SGA), as the SGA is who monitors emails.

Recommendation M3: The facilities department should order new Slim Jim trash and recycling bins.

Through our research, we found that many people dislike the flaps that open inwards rather than downwards on current trash bins lids as they get sticky, and people do not want to touch it to throw out there waste. We first believed that simply removing the tops of the trash bins would fix this issue. However, after we were told that trash bins must have lids due to fire hazards, we decided that the Slim Jim type is a better alternative. The Slim Jims have a downward trajectory so the weight of waste pushes it through the lid, without somebody always needing to touch the flap. Also, having Slim Jim trash and recycling bins all around campus would create uniformity on campus which was a common concern in faculty, staff, and students

survey responses. An example of the acceptable bins for two of the scenarios we are submitting to the WPI Facilities Department is shown in Figures 5.5 and 5.6.

Scenario 1: Replace lids on current recycle bins and buy all Slim Jim trash bins with black push down lids

This scenario would update bins on campus to Slim Jim trash and recycle bins. Trash bins would have a black lid that swings downward. Acceptable trash and recycle bin set-ups include those pictured in Figure S1.1. A black colored bag would be used for trash bins and a green bag for recycle bins in order to minimize confusion among trash and recyclables during the removal process by custodians. Lastly, a Waste Management single stream recycling poster would be attached to every blue bin to help aid in proper recycling procedures.

Ideal condition:

Figure 5.5: Three acceptable waste set-ups and three acceptable recycle bin set-ups. The most important aspect is the lids to distinguish trash from recycle bins.

# of Slim Jim single stream recycling lids needed (300) * avg. cost each **(**$18) = $5,400
# of Slim Jim trash bin lids needed (372) * avg. cost of each ($31) = $11,532
# of Slim Jim bins needed (lids not included) (490) * avg. cost each ($49) =$24,010

Grand Total Estimated Price: $41,000 for lids & bins (Can be less if bought in bulk/ University company discount if any)

Scenario 2: Replace all trash bins with a black color Slim Jim bin and all recycling bins with a blue Slim Jim

This scenario involves updating every trash bin on campus to a black Slim Jim bin with a corresponding black lid that swings downward and for every recycle bin to be updated to a blue Slim Jim with a corresponding single stream blue lid as shown in Figure S2.1. A clear bag would be used for trash bins and a green bag for recycle bins in order to minimize confusion among trash and recyclables during the removal process by custodians. Lastly, a Waste Management single stream recycling poster would be attached to every blue bin to help aid in proper recycling procedures.

Ideal condition:

Figure 5.6: One acceptable waste set-up and one acceptable recycle bin set-up under scenario 2. The most important aspect is the bin colors to distinguish trash bins from recycle bins.

# of Slim Jim black trash bins needed: (374) * avg. price for each bin ($48) + avg. price for each black downward push lid ($31) *(374) = $29,546

# of Slim Jim recycle bins needed: (300) * avg. price for each bin ($48) + avg. price for each single stream lid ($18)* (300) =$19,800

Grand Total Estimated Price: $49,346 for black and blue Slim Jims with appropriate lids (Can be less if bought in bulk/ University company discount if any)

Recommendation M4: Waste Management should perform a waste audit at the end of the academic year, during March or April.

During our tour of the Waste Management facility in Avon, Massachusetts, we found that they perform free waste audits for their clients. The Waste Management waste audit should be performed at the end of the year in order to compare them to the results of the Green Team's annual waste audit held at the beginning of the year. This would also help measure a decline or incline in recycling efficiency throughout the year. When we discussed the possibility of utilizing both waste audits with Mrs. Tomaszewski, she stated she too would like to have both the Student Green Team and Waste Management perform their waste audits once during the fall semester, and once during the spring semester. Either Mrs. Tomaszewski, Mr. Pellerin, or the Director of Sustainability would be in charge of arranging the Waste Management waste audit. In addition, it is important for the person in charge to identify the frequency of the waste audits that Waste Management would be willing to perform for free.

Recommendation M5: Waste Management should be a guest speaker to discuss single stream recycling, as well as the importance of recycling.

When our team toured the Waste Management recycling facility, we were told that Waste Management is willing to give a talk at WPI. We believe that by working with members of the Student Green Team, students could gain insightful information about the recycling method used at WPI during New Student Orientation (NSO). The Director of Sustainability would be responsible for overseeing the set-up of the Waste Management talk, as its organization would take place before the beginning of the academic year.

5.3 Long Term Recommendations

The recommendations outlined in this subsection are expected to be able to be accomplished within two to three years (by 2019).

Recommendation L1: The Director of Sustainability should meet with the residential services department to discuss engaging resident advisers to promote sustainability on campus. An alternative would be to bring back the Eco-reps.

Our group hopes that the future Director of Sustainability will work with residential services to incorporate sustainability into dorm life to create a sustainable living condition. This would be helpful to teach students who do not attend New Student Orientation or need a refresher program about sustainability on campus. Examples of sustainability topics can include recycling, wasting less water, energy consumption, and heat usage.

Another alternative is to have the Director of Sustainability and the Green Team bring the Eco-Reps program back. By having Eco-Reps, the Director of Sustainability could bypass working with residential services and instead work with these Eco-Reps to promote sustainability

programs in residential halls. The Director of Sustainability should meet with Elizabeth Tomaszewski to discuss the Eco-Reps program as she was the originator of the program.

Recommendation L2: The Student Green Team should place stickers reminding people to shut off the lights when nobody is in a room.

The Student Green Team should work with the facilities department and residential services departments to produce and place labels on every residential hall light switch that does not currently have a sensor. We hope that this would help raise awareness about sustainability as well as lower the cost of electricity. In addition, we also hope that the stickers will be a temporary measure that will be replaced by motion sensors or other technology upgrades in all buildings. A simple example is shown in Figure 5.7, although more eye catching stickers should be developed if possible

Figure 5.7: An example of a sticker that can be placed near the light switches and doorways in rooms across the WPI campus.

Recommendation L3: Chartwells should use compostable materials

The Director of Sustainability should work with Chartwells to find usable compostable take-out materials in the Campus Center and the Goat's Head Restaurant. The compostable materials would help the WPI campus take steps toward a more sustainable dining experience by eliminating plastic take-out containers from landfills. However, it is key that the compostable materials are high quality (ex. spoons should not start to dissolve when exposed to hot liquids).

Recommendation L4: The facilities department should place outdoor recycling and trash bins for Fuller and Ellsworth apartments.

Currently, most students from these two residential locations combine their trash and recyclables to take it to the trash compactor across the street. By creating a recycling center outside the Ellsworth and Fuller apartments, we believe students would have better access to recycling bins thus increasing recycling rates.

Recommendation L5: Run a sustainability facts "slide" on the WPI TV channel

We recommend that the Student Green Team or the Director of Sustainability work with the ATC to implement sustainability fun facts like those in Figure 5.8 on the WPI Channel. This would allow televisions across campus to educate and raise awareness on the importance of recycling.

Figure 5.8: An example of the types of fun facts that can be shown on the WPI channel with hopes of motivating students to make better sustainable choices.

Recommendation for further study:

Currently the custodians at WPI utilize green bags to hold recyclable waste. However, as Waste Management considers all bagged waste to be trash, we recommended that the custodians responsible for collecting all of the recyclable waste make a slit in the bags to let the recyclables come loose once in the compactor. However, the bags themselves are still considered waste, whether they are disposed of at Waste Management's recycling facility or WPI. Therefore making slits in the bags only works as a temporary solution. The ideal solution is to remove bags from the recycling process, as their use is wasteful. Elimination of trash bags would also be helpful, because the bags are adding to the waste already being sent to landfills, or in WPI's case being burned at Waste Management's energy producing waste burning plant. Therefore we recommend that the WPI Sustainability Project Center look into reducing or eliminating the use of recycling and trash bags at WPI.

Appendices

Appendix A

Custodians Survey:

- As a custodian, I care about recycling.
    1. Strongly agree
    2. Agree
    3. Neutral
    4. Disagree
    5. Strongly disagree
- Did you receive, through any training programs, information on what can be recycled under single stream recycling?
    - yes
    - no
    - I don't know what single stream recycling is
- Which of the following items should **NOT** be placed in a recycling bin? (Check all that apply)
    - pizza boxes
    - used paper towels
    - used paper plates
    - empty cans, bottles, glass jars
    - clean plastic food containers
    - plastic food containers with food residue
    - plastic bags
    - gloves
    - cardboard boxes
    - candy wrappers
    - batteries
    - Styrofoam
    - clothing
- You are cleaning a room and you find an empty plastic water bottle. This room only has a trash bin. What do you do?
    - Hold on to the bottle until you find a recycle bin
    - Throw it out in the trash bin
    - Leave it on the ground/ at desk

- Do you know where to dispose of electronics discarded by students?
    - yes
    - no
    - depends on the type of electronic
        - If yes, Which building/s?: [Text here]
- Where do you most commonly find discarded electronic waste from students?
    - Trash bin
    - Recycling bin
    - Other
        - Text box

Appendix B

Student Survey:

- As a student, I care about recycling?
  1. Strongly agree
  2. Agree
  3. Neutral
  4. Disagree
  5. Strongly disagree
- Do you know what single stream recycling is?
  - Yes
  - No
- Which of the following items should **NOT** be placed in a recycling bin? (Check all that apply)
  - pizza boxes
  - used paper towels
  - used paper plates
  - empty cans, bottles, glass jars
  - clean plastic food containers
  - plastic food containers with food residue
  - plastic bags
  - cardboard boxes
  - candy wrappers
  - batteries
  - Styrofoam
  - clothing
  - Wet piece of paper on a rainy day
- You are in a classroom with only a trash bin. There is no recycle bin in sight. Class just ended and you need to throw out your empty plastic water bottle. What do you do?
  - Hold on to the bottle until you find a recycle bin
  - Reuse/refill bottle
  - Throw it out in the trash bin
  - Leave it on the ground/ at desk
- Are you often confused as to which bin your waste should be disposed of in?
  - Yes
  - No

- Were you aware that WPI uses single-stream recycling?
    - Yes
    - No
    - I don't know what single stream recycling is
- Did you receive information on what can be recycled under single stream recycling?
    - Yes
    - No
    - I do not know what single stream recycling is
- Are you aware that there are information sheets posted around campus detailing what can or can't be recycled?
    - Yes
    - No
- Where do you dispose of your unnecessary electronics? (Electronics refer to items such as light bulbs, phones, batteries, computer parts, etc.)
    - Trash bin
    - Recycling Bin
    - Off Campus
    - Other
- Do you know where there are electronics and battery disposal bins on campus?
    - No
    - yes; 1 location
    - yes; 2-4 locations
    - yes; more than 4 locations
- If yes- in which locations?
    - text box
- Do you think having an app that would allow you to search what items are recyclable would be helpful?
    - yes
    - no

Appendix C

Faculty/Administrator/Staff:

- As a member of the Faculty/Administrator/Staff, I care about recycling.
    1. Strongly agree
    2. Agree
    3. Neutral
    4. Disagree
    5. Strongly disagree
- Do you know what single stream recycling is?
    - Yes
    - No
- Which of the following items should **NOT** be placed in a recycling bin? (Check all that apply)
    - pizza boxes
    - used paper towels
    - used paper plates
    - empty cans, bottles, glass jars
    - clean plastic food containers
    - plastic food containers with food residue
    - plastic bags
    - cardboard boxes
    - candy wrappers
    - batteries
    - Styrofoam
    - clothing
- You are in an area with only a trash bin. Class just ended and you need to throw out your empty plastic water bottle. There is no recycle bin in sight. What do you do?
    - Hold on to the bottle until you find a recycle bin
    - Reuse/refill bottle
    - Throw it out in the trash bin
    - Leave it on the ground/ at desk
- Are you often confused as to which bin your waste should be disposed of in?
    - Yes
    - No
- Did you receive information on what can be recycled under single stream recycling?
    - Yes
    - No
    - I do not know what single stream recycling is

- Are you aware that there are information sheets posted around campus detailing what can or can't be recycled?
    - Yes
    - No
- Where do you dispose of your unnecessary electronics? (Electronics refer to items such as light bulbs, phones, batteries, computer parts, etc.)
    - Trash bin
    - Recycling Bin
    - Off Campus
    - Other
- Do you know where there are electronics and battery disposal bins on campus?
    - No
    - yes; 1 location
    - yes; 2-4 locations
    - yes; more than 4 locations
- If yes- in which locations?
    - text box
- Do you think having an app that would allow you to search what items are recyclable would be helpful?
    - yes
    - no

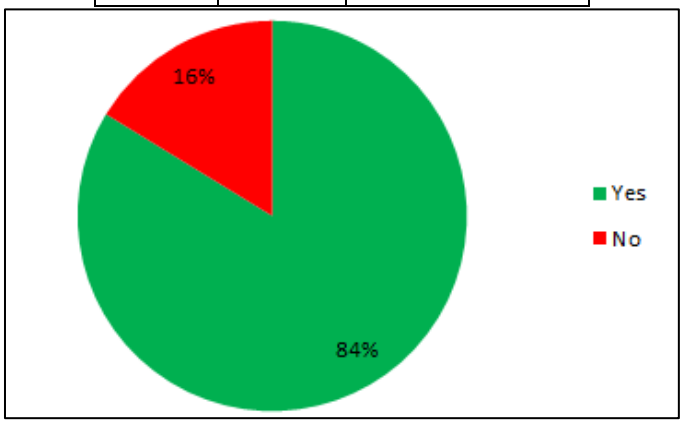
Appendix D

These are the responses to the surveys we gave to the custodians, faculty/staff, and students. For the detailed responses of open -ended survey questions, contact Professor Suzanne LePage and Professor Fred Looft.

Custodial Surveys

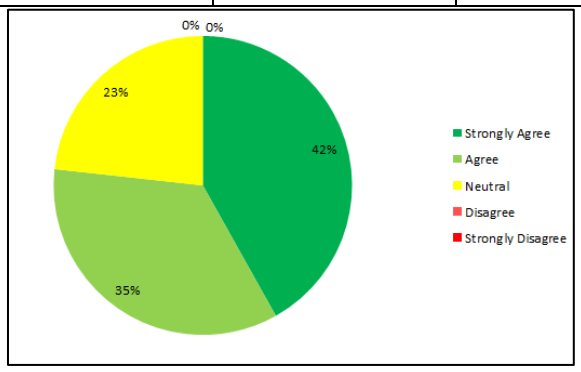
1: Do you know what single stream recycling is?

#	Answer	Response
1	Yes	36
2	No	7



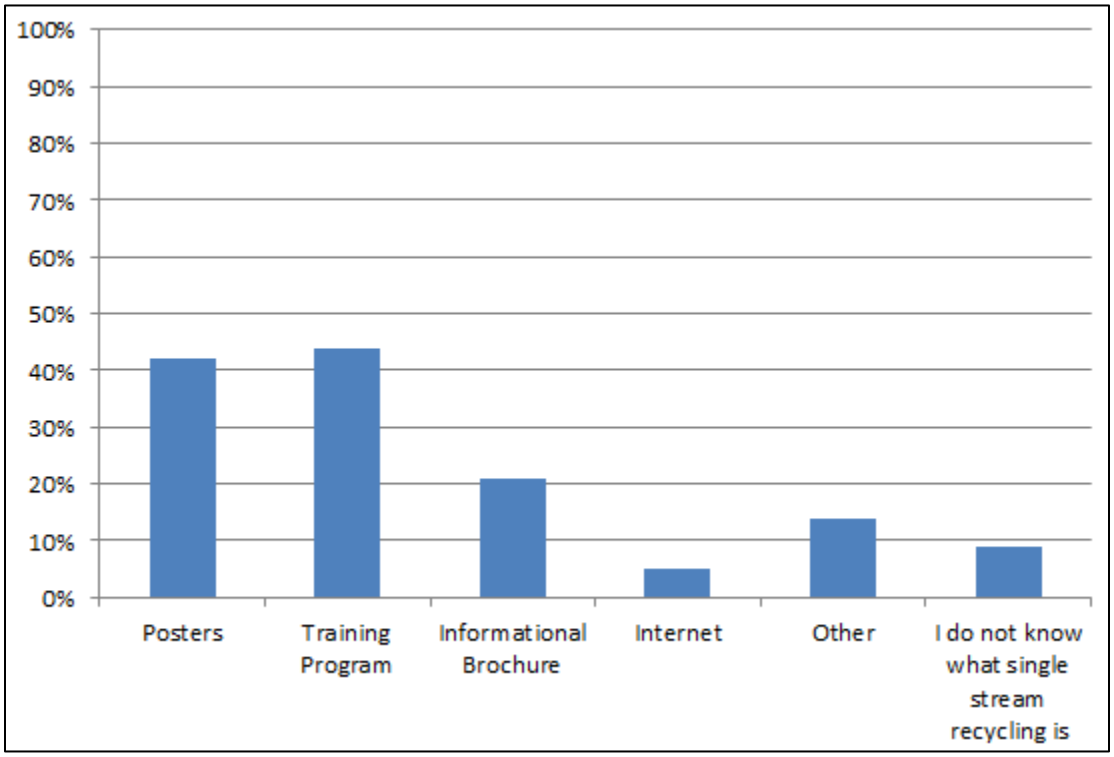
2: As a custodian, I care about recycling at WPI.

#	Answer	Response	Percentage
1	Strongly Agree	18	42%
2	Agree	15	35%
3	Neutral	10	23%
4	Disagree	0	0%
5	Strongly Disagree	0	0%
	Total	43	100%



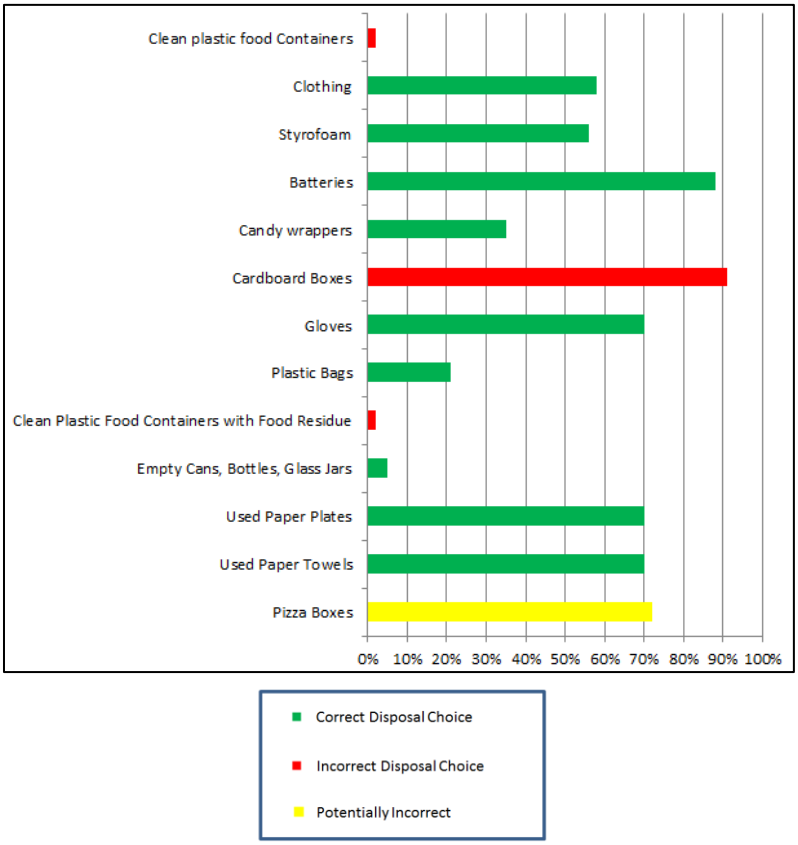
3. Did you receive information on what can be recycled under single stream recycling? How? (Circle all that apply?)

#	Answer	Response	Percentage
1	Posters	18	42%
2	Training Program	19	44%
3	Informational Brochure	9	21%
4	Internet	2	5%
5	Other	6	14%
6	I do not know what single stream recycling is	4	9%
	Total	43	100%



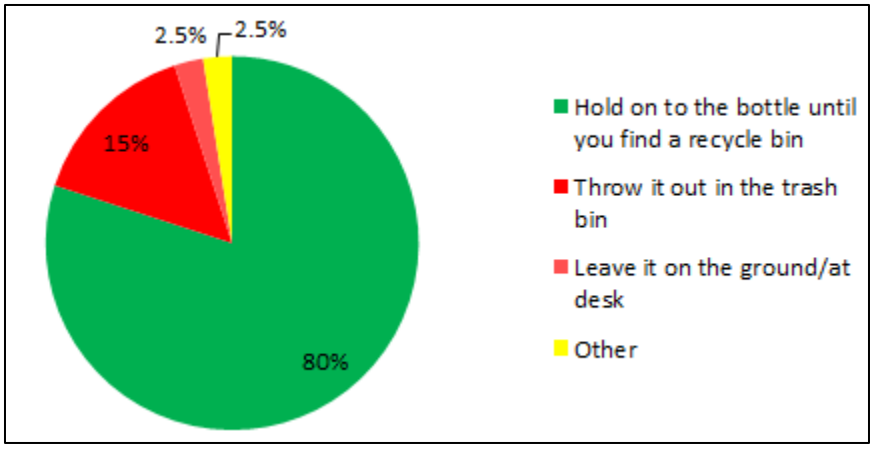
4. Which of these items should not be disposed of in a recycling bin?

#	Answer	Response	Percentage
1	Pizza Boxes	31	72%
2	Used Paper Towels	30	70%
3	Used Paper Plates	30	70%
4	Empty Cans, Bottles, Glass Jars	2	5%
5	Clean Plastic Food Containers with Food Residue	1	2%
6	Plastic Bags	9	21%
7	Gloves	30	70%
8	Cardboard Boxes	39	91%
9	Candy wrappers	15	35%
10	Batteries	38	88%
11	Styrofoam	24	56%
12	Clothing	25	58%
13	Clean plastic food containers	1	2%
	Total Individuals Responding	43	100%



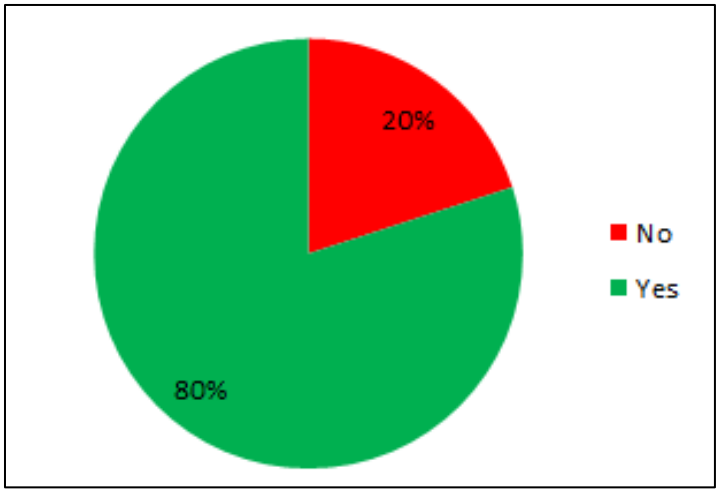
5. What would you do if you had an empty water bottle with no recycling bin in sight?

#	Answer	Responses	Percentage
1	Hold on to the bottle until you find a recycle bin	32	80%
2	Throw it out in the trash bin	6	15%
3	Leave it on the ground/at desk	1	2.5%
4	Other	1	2.5%
	No Response	3	
	Total	43	100%



6: Do you know where to dispose of electronics discarded by students?

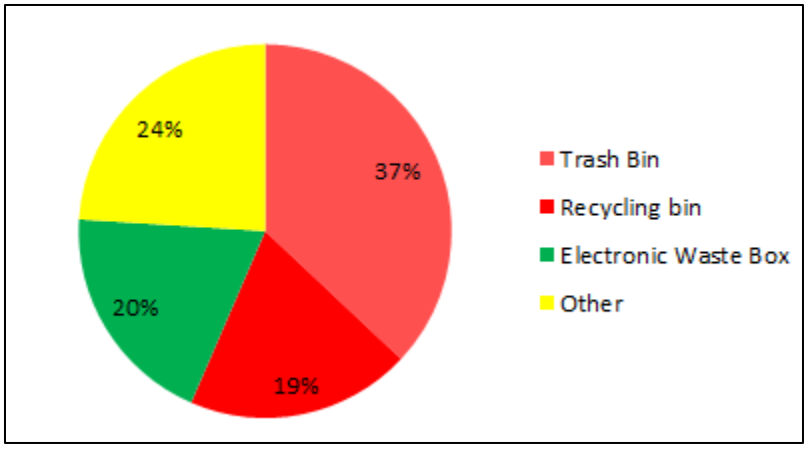
#	Answer	Response	Percentage
1	No	8	20%
2	Yes	32	80%
	No Response	3	
	Total	43	100%



7. Where do you most commonly find discarded electronic waste from students?

#	Answers	Response	Percentage
1	Trash Bin	15	37%
2	Recycling bin	8	19.5%
3	Electronic Waste Box	8	19.5%
4	Other	10	24%
	No response	2	
	Total	43	100%

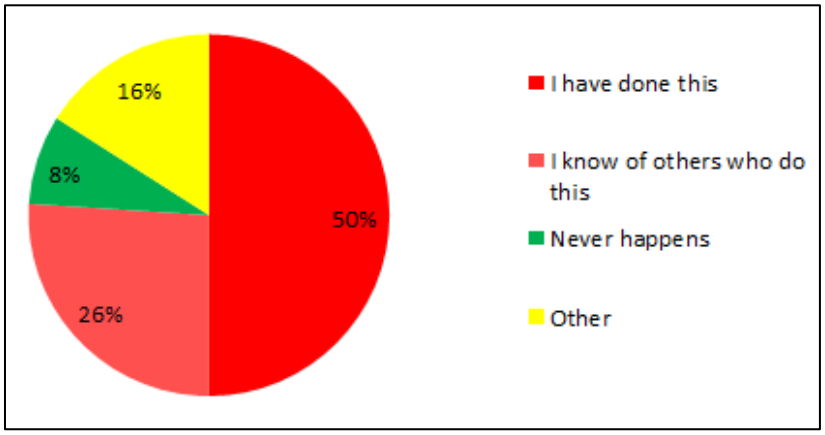
Comments can be found in the full version



8: It is rumored that inconvenience or confusion on what can or can't be recycled causes some custodians to combine the trash with recycle and take it all out as a trash.(Circle one)

#	Answer	Response	Percentage
1	I have done this	19	50%
2	I know of others who do this	10	26%
3	Never happens	3	8%
	Other	6	16%
	no response	5	

Comments can be found in the full version



9.) Do you have any further comments?

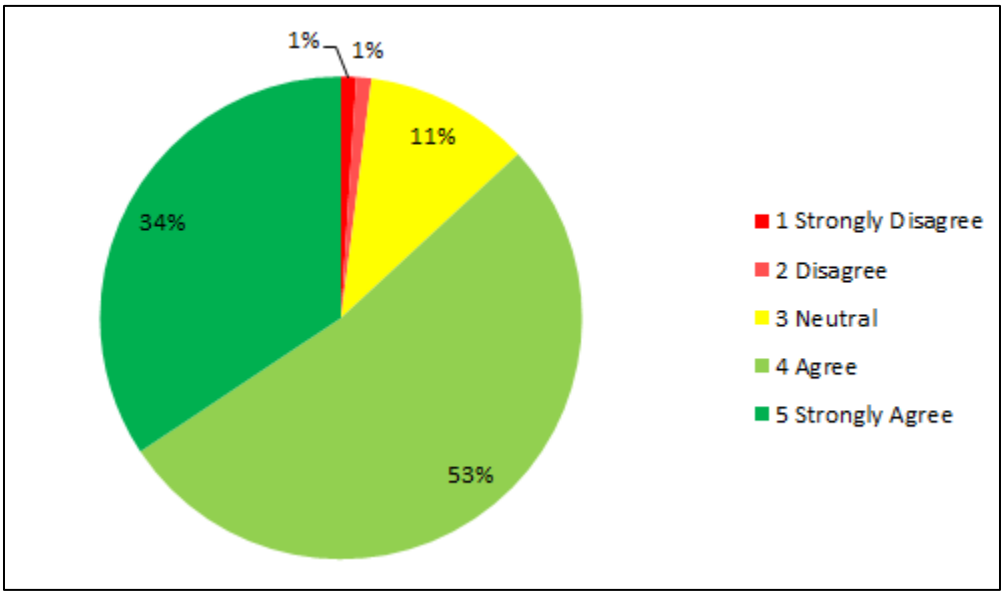
Comments:
Think before you dispose
Updated Posters
Don't spit in the containers
Go experience a Waste company to learn
No food or coffee grains in recycling bins
Hold people more accountable
Better organization
Educate everyone that steps on Campus
Repetition is mother of learning

Appendix E

Student Surveys

1. As a student, I care about recycling.

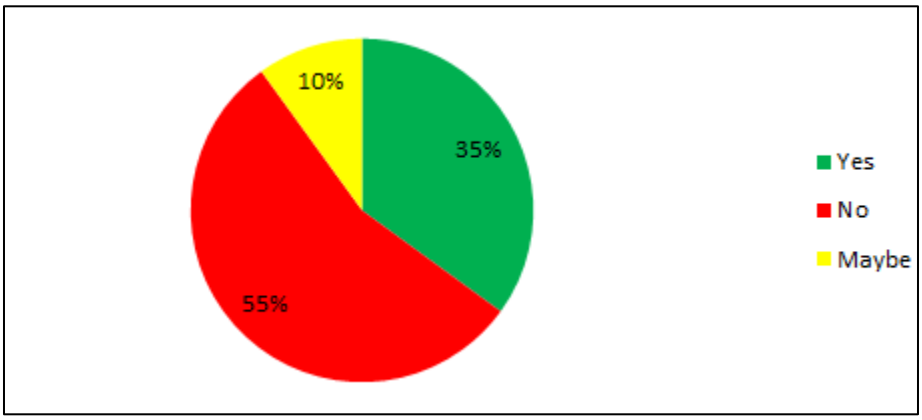
#	Answer	Response	%
1	Strongly Disagree	3	1%
2	Disagree	4	1%
3	Neutral	33	11%
4	Agree	151	52%
5	Strongly Agree	99	34%
	Total	290	100%



2. Do you know what single stream recycling is?

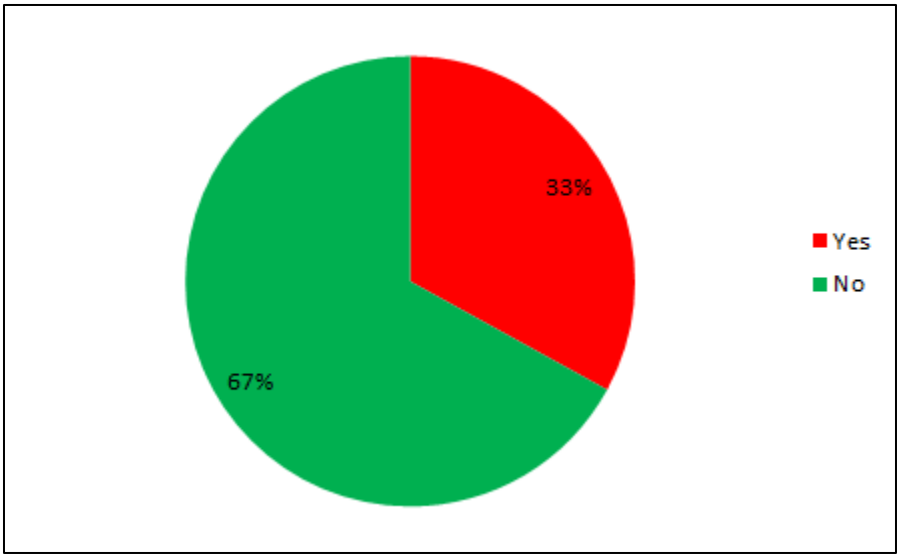
#	Answer	Response	%
1	Yes	102	35%
2	No	159	55%
3	Maybe	29	10%
	Total	290	100%

Comments can be found in the full version



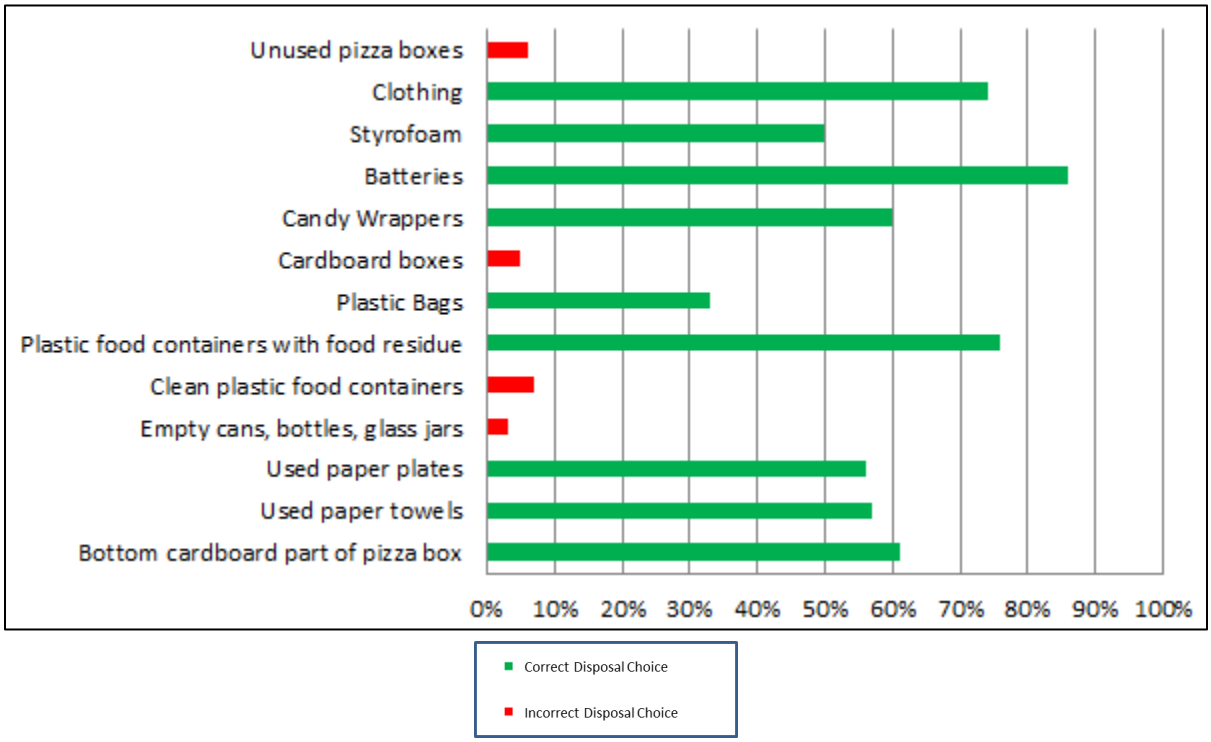
3. Are you often confused as to which bin your waste should be disposed of in?

#	Answer	Response	%
1	Yes	94	33%
2	No	195	67%
	Total	289	100%



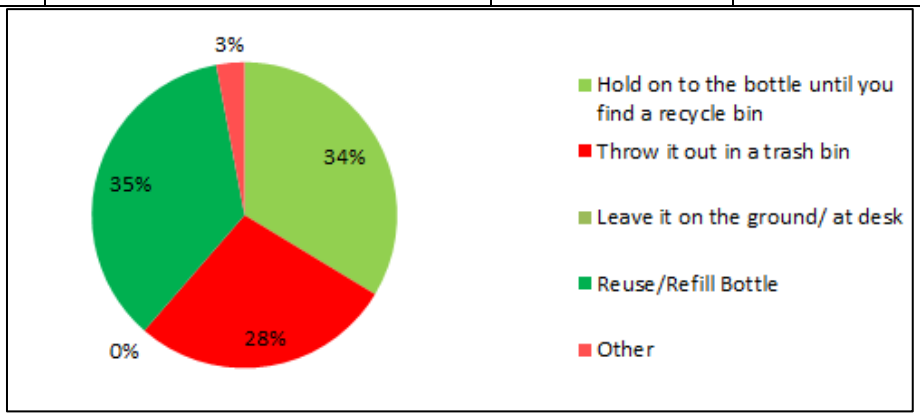
4. Which of the following items should NOT be placed in a single stream recycling bin at WPI? (Check all that apply)

#	Answer	Response	%
1	Bottom cardboard part of pizza box	172	61%
2	Used paper towels	161	57%
3	Used paper plates	156	56%
4	Empty cans, bottles, glass jars	9	3%
5	Clean plastic food containers	19	7%
6	Plastic food containers with food residue	213	76%
7	Plastic Bags	92	33%
8	Cardboard boxes	14	5%
9	Candy Wrappers	170	60%
10	Batteries	241	86%
11	Styrofoam	141	50%
12	Clothing	208	74%
13	Unused pizza boxes	18	6%



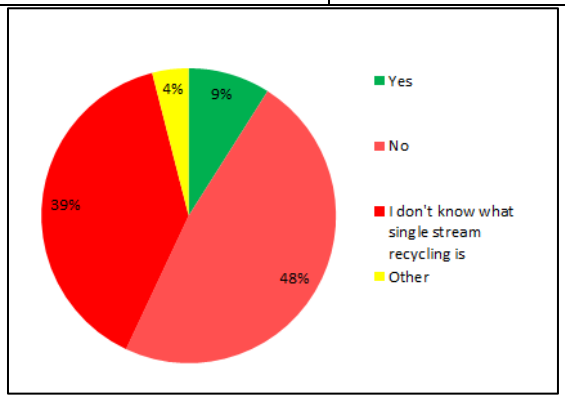
5. You are in a classroom with only a trash bin. There is no recycle bin in sight. Class just ended and you need to throw out your empty plastic water bottle. What do you do?

#	Answer	Response	%
1	Hold on to the bottle until you find a recycle bin	93	34%
2	Throw it out in a trash bin	76	28%
3	Leave it on the ground/ at desk	0	0%
4	Reuse/Refill Bottle	100	36%
7	Other	7	3%
	Total	276	100%



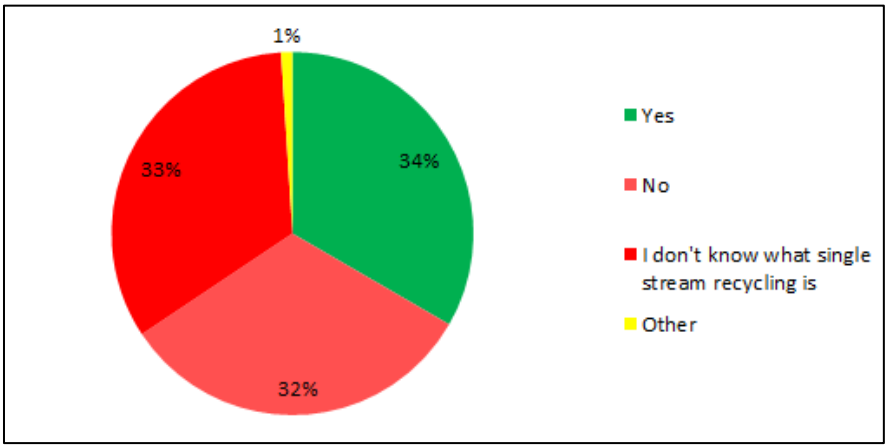
6. Did you receive information on what can be recycled under single stream recycling at WPI?

#	Answer	Response	%
1	Yes	25	9%
2	No	133	48%
3	I don't know what single stream recycling is	106	39%
4	Other	11	4%
	Total	275	100%



7. Were you aware that WPI uses single-stream recycling?

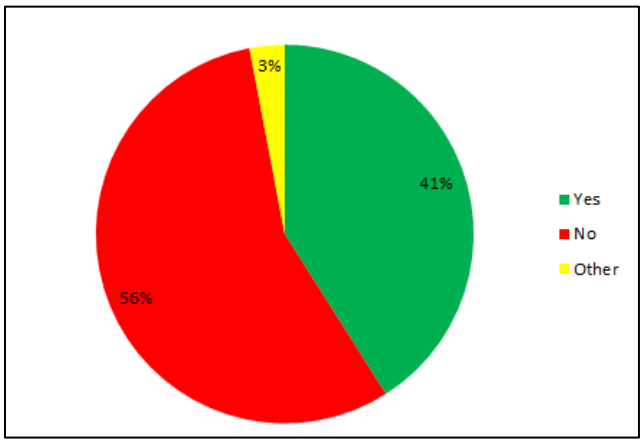
#	Answer	Response	%
1	Yes	91	33%
2	No	88	32%
3	I don't know what single stream recycling is	91	33%
4	Other	4	1%
	Total	274	100%



8. Are you aware that there are information sheets posted around campus detailing what can or cannot be recycled?

#	Answer	Response	%
1	Yes	113	41%
2	No	153	56%
3	Other	7	3%
	Total	273	100%

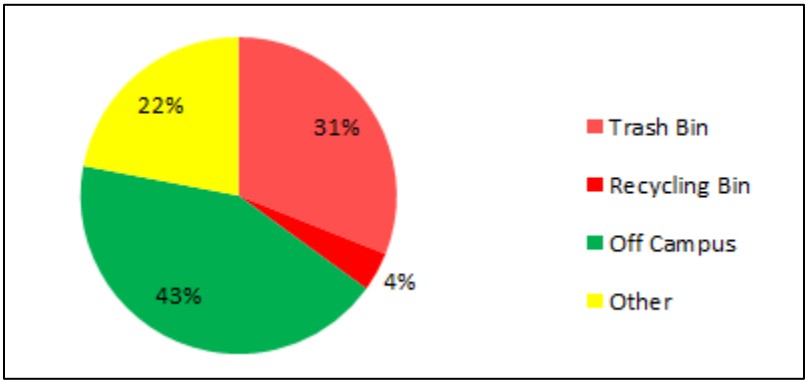
Comments can be found in the full version



9. Where do you dispose of your unnecessary electronics? (Electronics refer to items such as light bulbs, phones, batteries, computer parts, etc.)

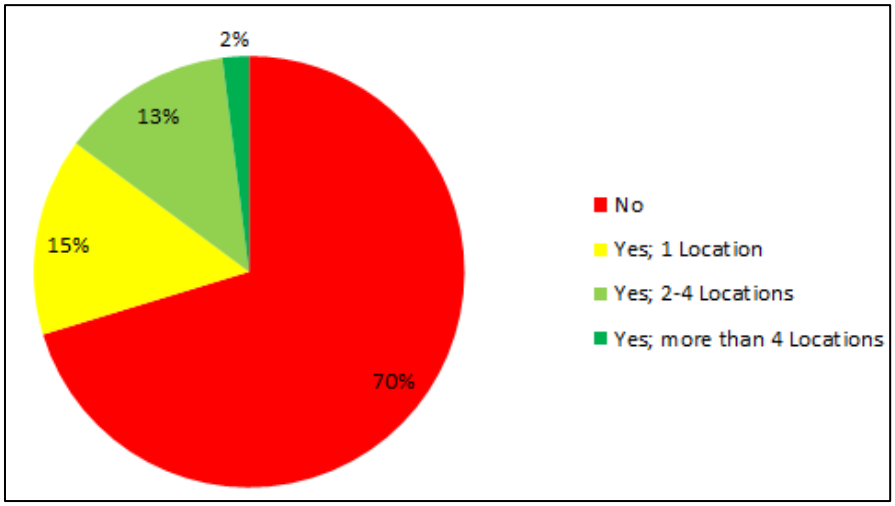
#	Answer	Response	%
1	Trash Bin	83	31%
2	Recycling Bin	12	4%
3	Off Campus	118	43%
4	Other	59	22%
	Total	272	100%

Comments can be found in the full version



10. Do you know where there are electronics and battery disposal bins on campus?

#	Answer	Response	%
1	No	193	71%
2	Yes; 1 Location	40	15%
3	Yes; 2-4 Locations	34	13%
4	Yes; more than 4 Locations	5	2%
	Total	272	100%



11. You answered that you knew where there are electronic/ battery disposals on campus. In which location(s)?

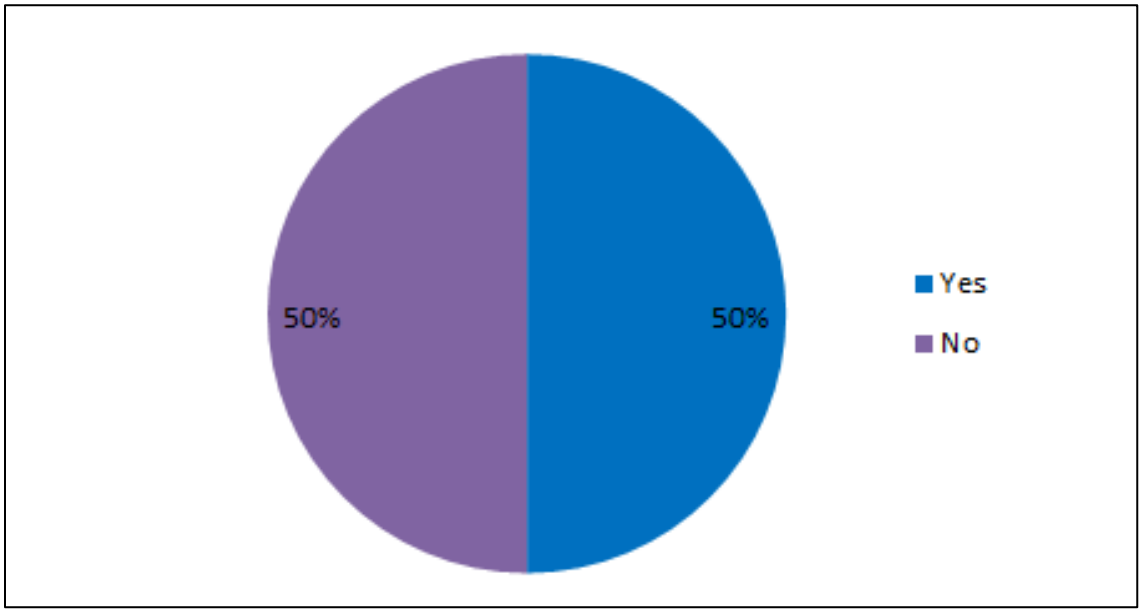
Full list of comments can be found in the full version

A Selection of Responses:
Harrington locker room and campus center
Washburn labs, campus center
Campus Center
Several in Fuller, Campus Center, Atwater Kent
Library
One is in Harrington by the locker room
Fuller labs, etc.
CC(2), HL 005, Fuller(2),
Campus center, IT office
Library and CC if I remember correctly
Daniels basement

Question 12: Do you think having an app that would allow you to search what items are recyclable would be helpful?

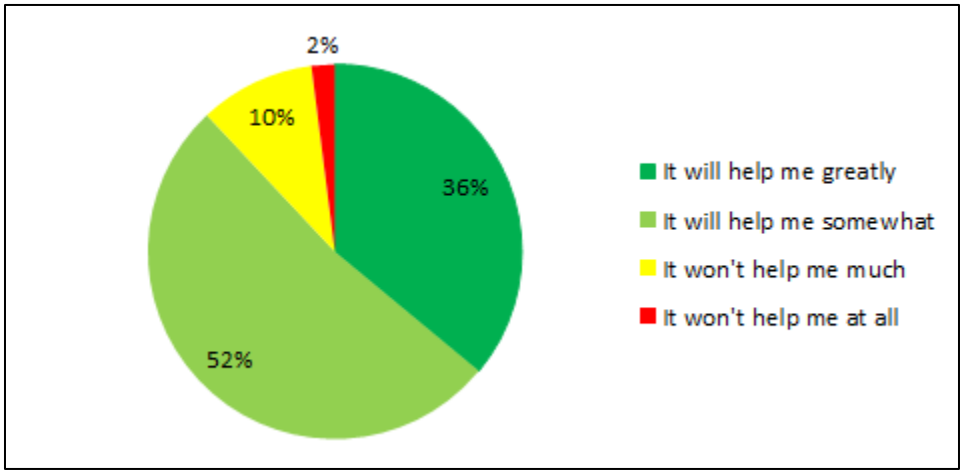
#	Answer	Response	%
1	Yes	134	50%
2	No	135	50%
	Total	269	100%

Comments can be found in the full version



13. Custodians at WPI took a similar survey. One of the comments recorded on several surveys was improving the posters describing what can and cannot be recycled, by adding more detail. Do you believe this would make it easier for you to sort waste at WPI?

#	Answer	Response	%
2	It will help me greatly	97	36%
4	It will help me somewhat	139	52%
5	It won't help me much	26	10%
6	It won't help me at all	6	2%
	Total	268	100%



14. Do you have any further comments?

Full comments can be found in the full version

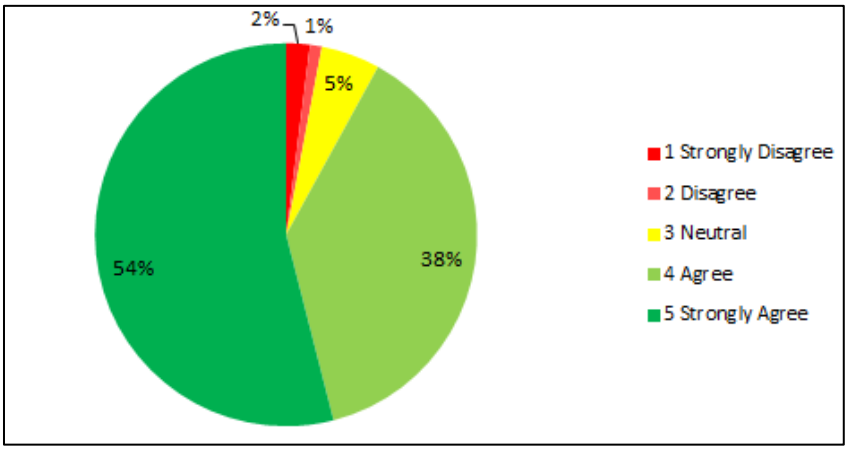
Comments:
Make the posters/flyers more visible because I have never seen one in 3 years
Establish bins with clearly marked labels that typical items people dispose on campus in each section of the campus
Honestly, I prefer multi stream recycling. I feel as though it makes the division of recycling easier and easier to remember
there are still signs around from before single stream and the single stream ones are inconsistent
Mark what can go into each bin on the bin and have all the bins in the same area
Invest on the campus sustainability first before worrying about other places around the world for projects.
If we're going to stick with single stream, bins/stickers that indicate that they only take one or types of recyclables need to be replaced by less misleading ones. BIG posters over recycling bins that indicate what is/isn't recyclable would be a huge improvement too, any posters that we have aren't obvious. Also, in the dining hall, there are only locations to dispose of food and paper waste that are near the exit. However, there are some trash and recyclable waste products that come from inside, and most students just throw them in the paper waste since the trash can is outside in the wedge. I'm not sure what happens with the paper waste (I hope it gets composted or something) but those cans certainly have other waste. Maybe having a trash bin NEAR the food/paper waste would be good, and having either a recyclable bin in the same place or instituting a program (not sure if this is plausible) where students were encouraged to leave dirty recyclables on their plates could be instituted, so they could be washed off by dining services to remove food waste and then recycled.
put the posters in a place where you have to read them to use the bin
If the posters saying what can and can't be recycled isn't next to recycling bins, can they be?
Complete uniformity between containers across buildings.
Single sort recycling is always a good plan, but that's more Worcester's business than WPI's
Put signs on the actual bins saying what you should put in them. Have more recycling cans.
I still don't know what single stream recycling is.
We should have a place to throw biodegradable products (like food waste)
There should be some sorts of posters hanging above the trash bins, recycle bins
single stream makes it more likely students will recycle things if they don't have to also sort them themselves
forum to ask what is recyclable and compile a list from the requests
We should have more electronics recycling station. We should make it known at orientation. We should make it known at some introductory class or with RAs so that all kids know and will REMEMBER. We also need to do the same for plastic bottles and other plastic items. I'm not too concerned about food recycling, because it is perishable. But toxic e waste and plastic needs to be managed better, especially since we're in a tech school (lots of e waste) and we have lots of social activities (lots of plastic waste)
There should be a way for people living off campus to bring bulk/huge amounts of recycling
QR codes on the recycling bins could be an easy way to promote sustainability by not printing out lots of posters
Put the posters on the recycling bins, then they would help

Appendix F

Faculty and Staff Survey

1. As a faculty/administrator/staff, I care about recycling.

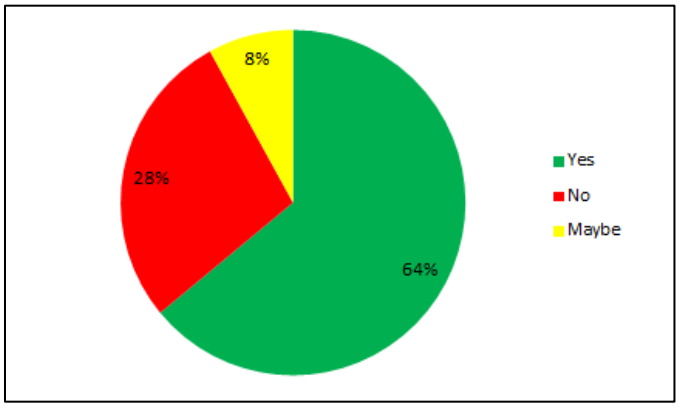
#	Answer	Response	%
1	Strongly Disagree	4	2%
2	Disagree	2	1%
3	Neutral	9	5%
4	Agree	69	38%
5	Strongly Agree	97	54%
	Total	181	100%



2. Do you know what single stream recycling is?

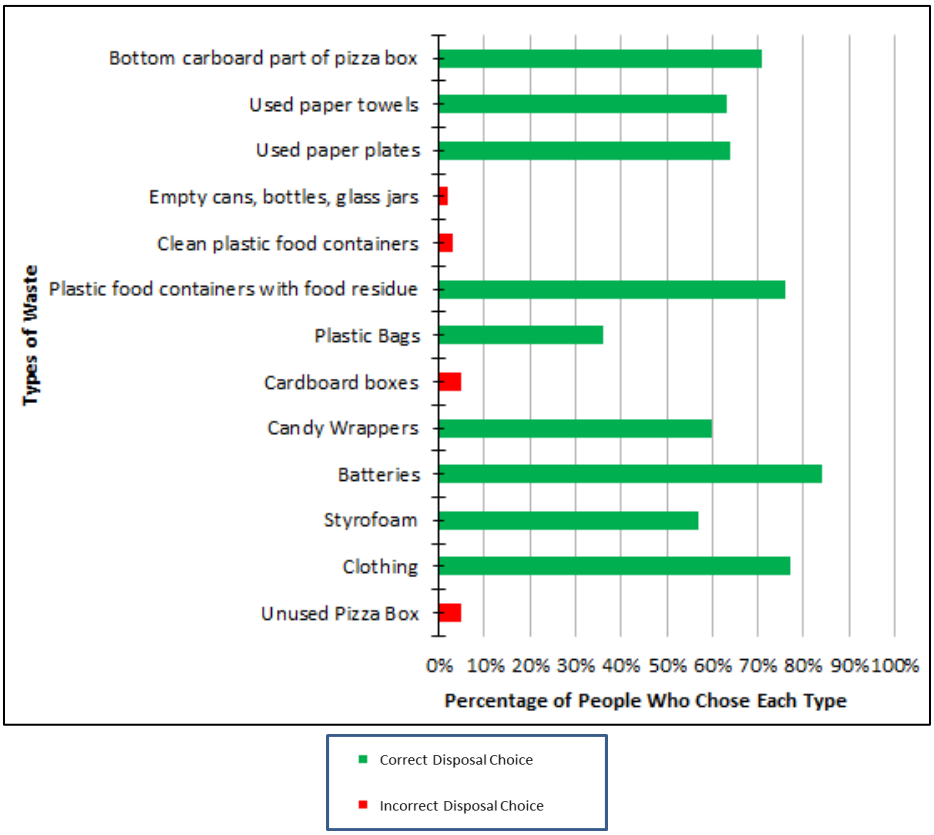
#	Answer	Response	%
1	Yes	116	64%
2	No	50	28%
3	Maybe	15	8%
	Total	181	100%

Comments are contained in the full version



3. Which of the following items should NOT be placed in a single stream recycling bin at WPI? (Check all that apply)

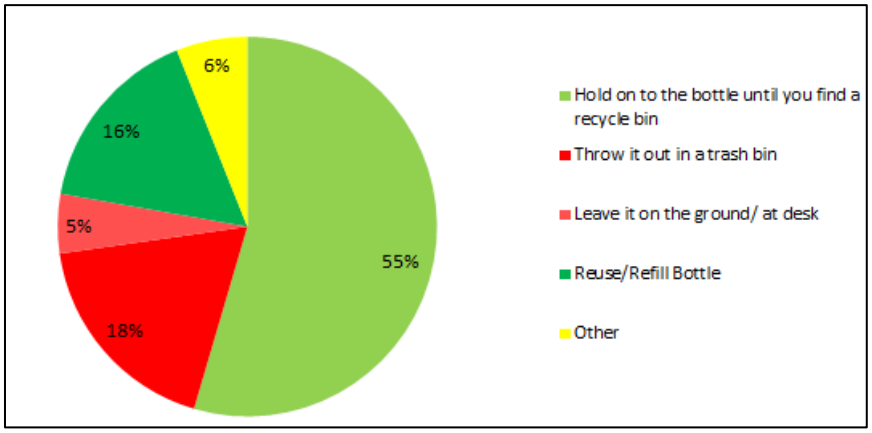
#	Answer	Response	%
1	Bottom cardboard part of pizza box	123	71%
2	Used paper towels	109	63%
3	Used paper plates	111	64%
4	Empty cans, bottles, glass jars	3	2%
5	Clean plastic food containers	5	3%
6	Plastic food containers with food residue	133	76%
7	Plastic Bags	63	36%
8	Cardboard boxes	9	5%
9	Candy Wrappers	105	60%
10	Batteries	146	84%
11	Styrofoam	99	57%
12	Clothing	134	77%
13	Unused Pizza Box	9	5%



4. You are in an area with only a trash bin. There is no recycle bin in sight and you need to throw out your empty plastic water bottle. What do you do?

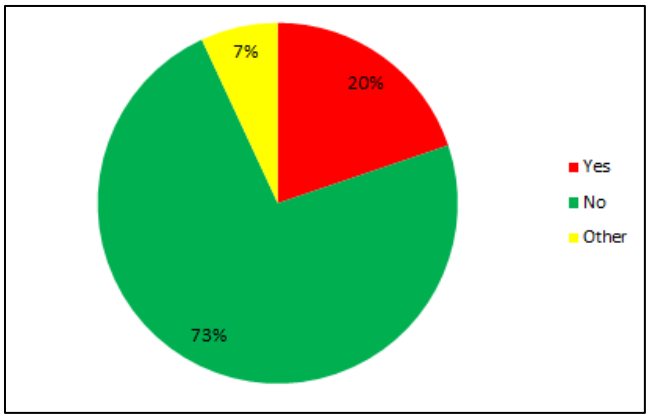
#	Answer	Response	%
1	Hold on to the bottle until you find a recycle bin	94	54%
2	Throw it out in a trash bin	32	18%
3	Leave it on the ground/ at desk	9	5%
4	Reuse/Refill Bottle	28	16%
7	Other	11	6%
	Total	174	100%

Comments can be found in the full version



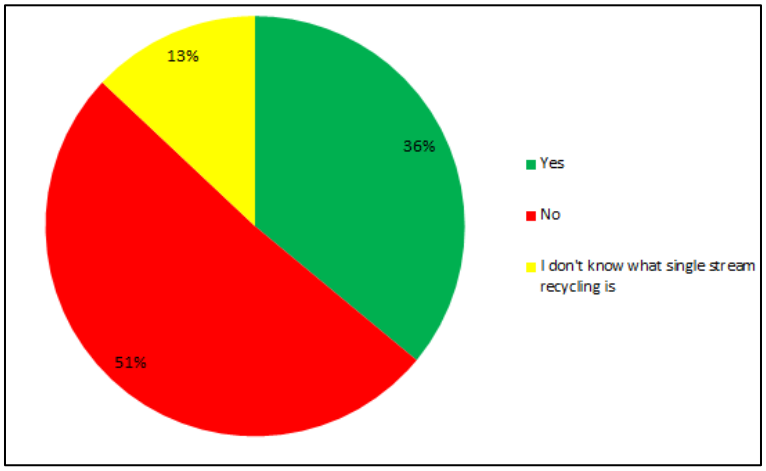
5. Are you often confused as to which bin your waste should be disposed of in?

#	Answer	Response	%
1	Yes	34	20%
2	No	128	74%
3	Other	12	7%
	Total	174	100%



6. Did you receive information on what can be recycled under single stream recycling?

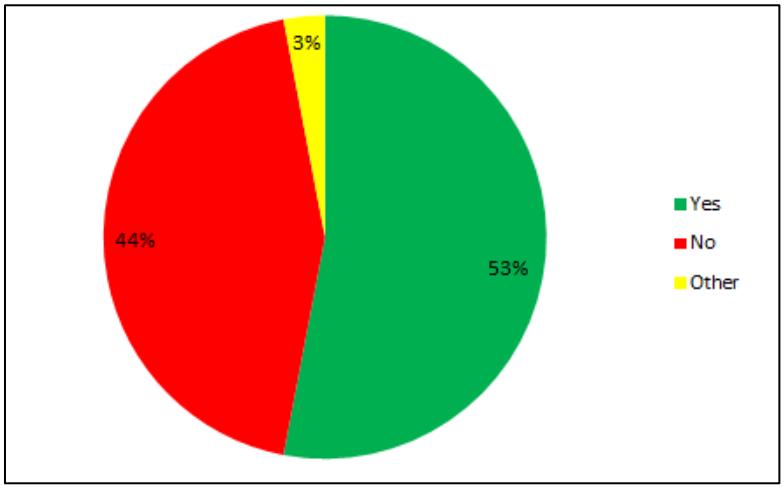
#	Answer	Response	%
1	Yes	62	36%
2	No	89	51%
3	I don't know what single stream recycling is	23	13%
	Total	174	100%



7. Are you aware that there is information sheets posted around campus detailing what can or cannot be recycled?

#	Answer	Response	%
1	Yes	92	53%
2	No	76	44%
3	Other	5	3%
	Total	173	100%

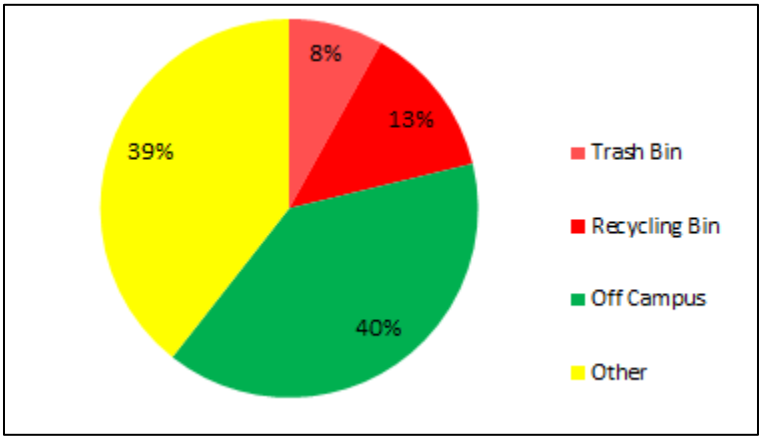
Comments can be found in the full version



8. Where do you dispose of your unnecessary electronics? (Electronics refer to items such as light bulbs, phones, batteries, computer parts, etc.)

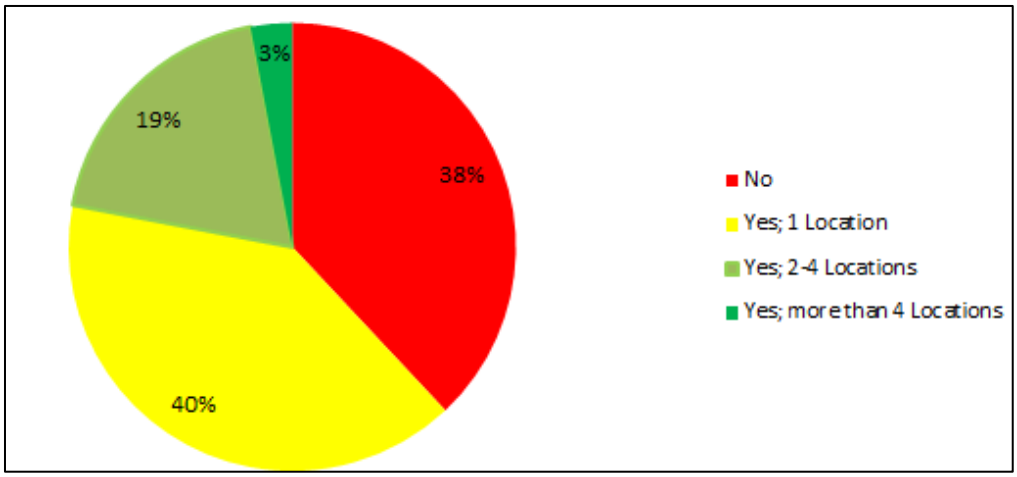
#	Answer	Response	%
1	Trash Bin	14	8%
2	Recycling Bin	23	13%
3	Off Campus	68	39%
4	Other	68	39%
	Total	173	100%

Comments can be found in the full version



9. Do you know where there are electronics and battery disposal bins on campus?

#	Answer	Response	%
1	No	65	38%
2	Yes; 1 Location	70	40%
3	Yes; 2-4 Locations	33	19%
4	Yes; more than 4 Locations	5	3%
	Total	173	100%



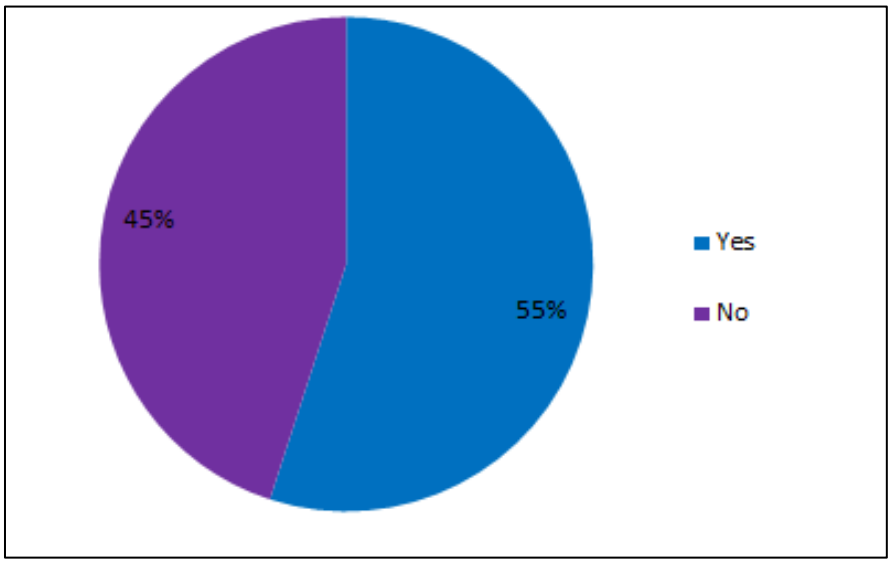
10. You answered that you knew where there are electronic/battery disposals on campus. In which locations?

Full comments list in the full version

A Selection of Responses:
Salisbury Labs 2nd floor
stockroom - Goddard Hall, Campus Center
Residential Services in East Hall and Help Desk in Library
In the print center area of the Gordon Library
In Fuller Labs. Unaware I could recycle electronics as well as batteries. Can I recycle electronics from my home in those bins?
Department break rooms
Project Center, 2nd Floor
I have seen one in Gateway
Residential Services, Founders Laundry Room
Student Activities Suite Campus Center
AK202 (ECE Department Office). Battery recycling bin.
Math Dept. Office
Kaven Hall has 1 bin
Washburn Labs, loading dock of Kaven Hall, Higgins Laboratories, AK

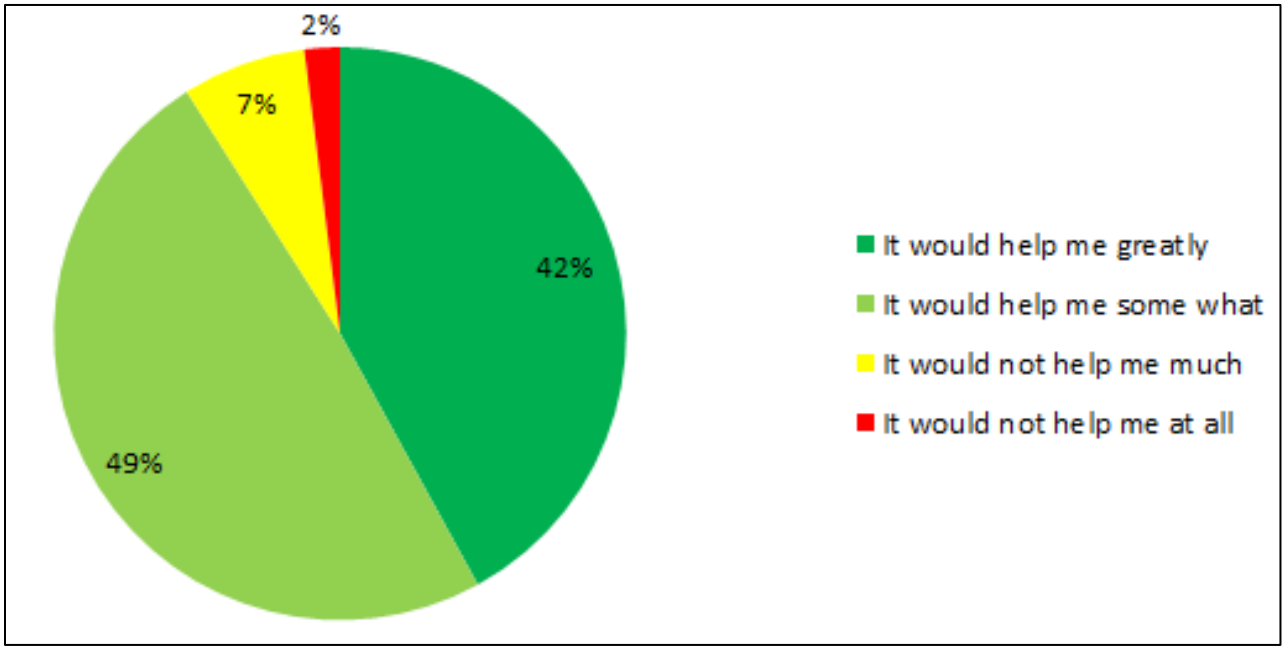
11. Do you think having an app that would allow you to search what items are recyclable would be helpful?

#	Answer	Response	%
1	Yes	94	55%
2	No	78	45%
	Total	172	100%



12. Custodians at WPI took a similar survey. One of the comments recorded on several surveys was improving the posters describing what can and cannot be recycled by adding more detail. Do you think this would make it easier for you to sort waste at WPI?

#	Answer	Response	%
1	It would help me greatly	72	42%
2	It would help me some what	85	49%
3	It would not help me much	12	7%
4	It would not help me at all	3	2%
	Total	172	100%



13. (Do you have any comments/recommendations regarding waste sorting/management on campus? (Ex: Food, Recyclables, Electronics, etc...)
Full comments list available in the full version.

Comments:
Make bins available. Recently the can and bottle one disappeared from my work area.
Instructions on trash bin are favorable
Need better site information...next to the bins.
Having a less exhaustive list or words printed directly on the recycle bins would help. right now bins say "paper" but then the sign says a whole list of things. much simpler if a bin says "paper, cans, bottles" or "paper, metal, plastic" or whatever, along with 1 rule of thumb about what NOT to put in. keep it simple
Some of the electronic recycling bins have disappeared so I can no longer find/use them.
Having the same types of recycling bins in all areas of campus would make things simpler
And also not just post the information, but email it to all campus members
Appreciate the annual? free recycling days sponsored by, I think, Facilities
Large posters with instructions -- along with the PROPER RECYCLING BINS - would encourage more recycling. Sometimes people just don't know what to do, so recyclable items end up in the trash. Thank you for the initiative to improve recycling!
I am not sure how food is recycled but assume it goes off to farms? Probably clearer information on the recycle bins themselves would be helpful
There are many green bins, but frequently it's unclear what goes in that bin. Also, recycling differs between WPI, home, and other locations, which adds additional confusion.
I would like to know that all efforts are made, on a continual basis, to include as much material as possible in the recycling and that the signage/app is kept up-to-date.
have more frequent electronics drives where we can bring in recyclables from home
I recycle more at home because I can easily clean food containers. I can do that as easily at work, so I throw out the containers instead of recycling them.
"Recycling is like rearranging deck chairs on the Titanic."
People have to know more about which plastics are recyclable and that products cannot have food waste on them. Some of the most committed recyclers are doing more harm than good and would want to know this.
Better labels on the recycle bins themselves might also help.
Perhaps adhering a label that lists acceptable recyclables on all recycle bins would be helpful. Someone in my office had no idea that WPI went to single stream recycling.
I've mentioned before to have larger cardboard recycling bins outside of mail services for high volume package times to help keep the area organized instead of full of opened boxes
One person takes ownership of it
We need a central location (campus center?) to recycle used printer cartridges
Perhaps all faculty, staff and students when they enter WPI should have a session explaining how they can recycle and what can be recycled. If they start their career at WPI having this information, then they are more likely to get into good habits from the beginning.

Appendix G

Associate Director of Buildings and Events: Terrence (Terry) Pellerin
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 03/19/15 @ 1:00 p.m.

Q: What kind of duties do you perform on a day to day basis?
A: Terry oversees the cleaning being done on campus in the athletic buildings, residential halls, and academic halls. He also oversees the proper recycling of furniture. Lastly, he also is responsible for set-ups of events.

Q: What is your role in ensuring sustainability on campus?
A: Terry was approached in the early 1990s by an MQP group. The MQP aimed at implementing recycling on campus after performing a 6-month waste audit and discovering that our campus had the potential to recycle a decent amount of its waste. After the students graduated, Facilities took over the project. Terry restructured his cleaning crew and found that he could take two of his custodians that weren't as necessary in one area on campus and use their manpower instead to collect recycling on campus. In its early stages, the recyclables collected was mainly paper. Terry contacted Waste Management and they agreed to provide bins to separate their recyclables from their waste. They also set up a recycling compactor on campus to be able to toss our recyclables. Not long after this implementation of recycling on our campus, state regulations began to arise making it mandatory for institutions to have a recycling program.

Q: We were told that the company Waste Management collects our recycling. Does it also haul our waste (do you know if they bring it to the same location as the recycling plant)?
A: Waste management is now responsible for hauling both our waste and recyclables. Waste Management hauls recyclables to their sorting center and hauls our trash to their energy producing plant. WPI is also a member of the IRN (Institution Recycling Network). Through this program, institutions pay to be a member and the company hauls miscellaneous reusable materials such as electronics and furniture. It is composed of approximately 100 schools. This IRN program, unlike many similar programs, pledges to dismantle and keep electronic waste in the United States. Terry is aware of programs that claim to remove electronic waste for free but they send the accumulated e-waste to other countries and as a result, pose as a major health issue to their citizens. This program also removes WPI's old furniture and donates it to areas of need. For example, in 2005, WPI did some remodeling and removed some of its older furniture. When hurricane Katrina happened, the IRN took our furniture and donated it to the hurricane's victims.

Q: Can you give us a brief walk through about the path of recycling from when the custodian removes it to when Waste Management retrieves it?

A: WPI has recycling bins in pretty much all academic and residential buildings. Green bags for recycle bins are provided to custodians for the ease of recognition. Large recycling bins with wheels are wheeled out to the front of each building when they are full and picked up by the recycling crew for proper disposal. There are two recycling compactors on campus. Our main compactor is the one located near Kaven Hall and we have a back-up compactor behind the library that is used only if our primary one is full. All of our recycling now goes into one compactor. Prior to August of 2014, one compactor was used for paper and the other was used for cardboard. Finally, Waste Management comes by and hauls our recyclables away. Any Casella waste containers are usually just from contractors working on campus and they bring their own disposal systems.

Q: Why single stream? What is your opinion about single stream recycling?

A: WPI converted to single stream because there was supposed to be a 20% increase in recycling participation, however it was nowhere near this result. It would not be a problem to return to recycling sorting where paper is separated from cans and bottles as well as cardboard. He believes that the main issue with single stream is educating students on the proper disposal. He also believes that with the Director of Sustainability to be hired, it would be hard for him/her to focus on both the teaching and operations aspect to sustainability. Overall, single stream was a big disappointment but it may have the potential to grow.

Q: Who is involved in training full time and temporary custodians? What topics are discussed?

A: Terry is primarily in charge of training for custodians. There are also various types training that take place throughout the year that discuss various topics. Currently, there is no sort of training that discusses single stream or recycling in general. Therefore it would be possible to implement a program that our IQP can come up with.

Q: Is there a separate training for those responsible for e-waste disposal or do all custodians undergo training? Who goes around collecting the battery containers? How often is this done?

A: There are two categories of miscellaneous waste: E-waste and universal waste. Universal waste consists of items such as light bulbs. Dave Messier is responsible for managing the universal waste. Custodians bring him the waste, but only he is trained on how to dispose of it. Custodians are supposed to bring their universal waste to the back of Daniels Hall. The company which collects the universal waste only arrives to haul it when they are called in. Most main offices in all buildings have battery disposal containers. There are approximately 35 battery disposal containers around campus.

Q: If we were to propose an open top trash bin, would that be possible to implement? What are your concerns?
A: Mainly there are fire code issues about having open trash bins. However, having Slim Jim styled trash bins instead of the current old bins are a possibility.

Q: If we wanted to add a compost bin to the campus center dining area and the goats head would we be able to implement it? Who would be responsible for implementing this?
A: Yes, having a separate trash bin that is clearly labeled for food waste would be possible to implement. Facilities would just have to place another bin there and then work on making sure the trash is removed constantly and disposed of properly.

Facilities Systems Manager and member of the WPI Sustainability Task Force: Elizabeth Tomaszewski
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 03/20/15 @ 2:00 p.m.

Q: **We understand your role is the Facilities Systems Manager and Interim Director of Sustainability, what does this entail?**
A: Liz told us that she is actually the former sustainability coordinator and currently the interim coordinator and Facilities Systems Manager. Her tasks differ based on the time of year. For example, during December-March, a lot of her time is spent dealing with surveys sent to the school for information collection regarding matters involving her position such as gathering information for STARS and Princeton Review. She is also the advisor of the Student Green Team. ~70% her time during the academic school year is sustainability related. She was the main writer of the 2013-2014 Sustainability Report and it was published online. She also accepted an eco-award in Boston because of the Electronic Vehicle refueling stations on campus.

Q: What goals have you made and how can our IQP group help you reach your goals on the topic of waste management?
A: While the campus has converted to single stream recycling, we need to find the most effective way of communicating information. We can also work with the Student Green Team, as their goals are similar to ours, in waste minimization.
In addition, the cost and benefits of waste removal should be analyzed. We should analyze the amount of time to empty waste bins by custodians. This would provide information on how practical a solution would be.

Q: Do you know why our campus decided to convert to single stream recycling? Any issues that have been brought to your attention?
A: It was to make it more compatible with the students at this school, by simplifying the system. A big problem that she noticed with the implementation was the lack of communication to the students. This was supposed to be the job of the Director of Sustainability, but she left before anything significant was accomplished. Liz also believes that a challenge in making the single stream implementation a success was the need of a motivation for students to change their behavior.

Q: In relation to the topic of single stream, but also as its own issue, what are the issues with food waste?
A: In the current system the food waste in residential dorms is only able to go into the trash bins. She also stated that during the waste audit, a lot of recyclables from food packaging were grossly contaminated. However, short of discontinuing plastic food container use, this could continue to be an issue. They are usually unable to be cleaned to the required degree, realistically.

Q: The Massachusetts Commercial Food Waste Ban states that institutions that produce over 1 ton of food per week are required to divert it from landfills. Can you tell us exactly what that means?
A: It means that the ton of food, plus excess over that amount must be diverted. All of it.

Q: Can you tell us about the food waste disposal partnerships that WPI has? Pig farmer? Is the Heifer International Farm close enough to use or maybe Jordan Farm?
A: There are two pig farmers, with one of them acting more as a backup. Approximately 550 pounds of food is collected per day. If other sources of food waste become present, and there is a need for additional means of removal, Heifer's farm is close enough to be able to collect food waste.

Jordan Farm is nearby and were originally trying to make a partnership with WPI to utilize an anaerobic digester. However, alone we did not produce enough waste to make this cost effective. If all of the members of the Worcester Consortium banded together to utilize this, it likely could have been done. However, WPI decided to make the partnership with local pig farmers instead.

Q: What are your thoughts on collecting the food waste in the Campus Center Food Court? Would using one or more receptacles labelled for food waste work?
A: Liz thought that it was a great idea and could be very effective, but likely could not be set up as a permanent structure, such as in Morgan Commons (Pulse on Dining Marketplace).

Q: What do you know about Eco-reps? Who are they?
A: Liz originally created the ECO reps, oversaw them, and would like to see them revived. For the first two years, the program did not accomplish anything significant. Then the school brought in Greener You, which greatly improved the effectiveness of the program. The ECO reps have not always been continuously active, because of the schedules of their supervisors. Therefore this task fell to the Director of Sustainability,

Q: What are the best improvements that you could think of to make to the campus? Number/type of bins? What have other colleges done?
A: Liz is not sure about the effectiveness of increasing the number of waste receptacles. She thinks that the better focus is on positioning and location of bins on campus. One specific place is the paved walkway between Morgan Hall, the Recreational Center, and the football field.
One change made by Worcester State was to place all waste bins outside of classrooms. Initial a lot of trash/waste was left in the classrooms. However eventually this mostly stopped and recycling rates increased. A similar idea towards an improvement at WPI might need to initially cost more money, to improve and save in the future. A spend money to make money logic.
By standardizing labeling of waste bins in a uniform way, meanings of each bin will be clearer. For example, using identical Slim Jims for trash. Additionally the out-of-date posters should be removed to further improve this.

An improvement to the overall campus would be to stop wasting money with overall waste. Examples are: electrical/light, water, in addition to solid waste (trash, recyclable, electronics). This money could go into other things, such as financial aid.

The optimal improvement that Liz could think of was having a campus that produces no trash. This can be done through recycling and composting amongst other methods

Q: What are your thoughts on Terracycling?
A: A student on the green team tried to organize this effort. However, it was not implemented because it was likely not going to be sustainable. This was probably due to a lack of interest.

Q: Are there plans to hire a new Director of Sustainability for the upcoming school year?
A: The school/taskforce is waiting to start hiring process until the new Provost takes over. Assuming there is full support by the Provost, hopefully a new Director will be hired in the summer.

Q: What are your thoughts on us coming up with complete plan that we can hand to the new Director of Sustainability?
A: Liz thought that us doing the groundwork would allow the new Director to "turn the key." We would give the new director all of the tools they need, and all we would require of them is to actually implement. This would make the solution implement faster, as the new Director will not have to spend too much time finding out these facts themselves.

Q: If you had an unlimited budget and resources, what would you do?
A: These are the main items that Liz would want to cover:

1. Make Recycling more convenient
2. Make trash and recycling locations well known to people on campus
3. Have the extra waste receptacles used during events be of a better quality
4. Put water bottle filling station everywhere on campus including outside especially since they are designed to not freeze in cold temperatures.

President of Green Team/ Student Sustainability Coordinator: Mary Prescott
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 03/23/15 @ 2:00 p.m.

Q: What is your role on the WPI campus?
A: Mary Prescott was interim Vice President of the Green Team last year but currently is President and serves as a member of the Sustainability Task force here on campus.

Q: What has your organization already done on campus?
A: Mary has had small events providing ways for students to make a difference in the world in a small way. She gave us a couple of examples of events that their club has done throughout the year. Some of these events include the Lighting fair, Waste audit, LED giveaways, and many more.

Q: What plans does the Green Team have for making our campus more sustainable?
A: Mary explained how they took initiative to get a campus bin count. However, due to the loss of the Director of Sustainability, these ideas were put to a halt. She did mention how the green team would help us implement better posters if we can come up with visual type posters with less of a list of items since they want to do that too. A QR code would also be implemented into the poster so it allows students to see a webpage that says what can and can't be recycled. Another plan that she wants to someday implement is putting recycling bins in the bathrooms to see if students will recycle their things when entering or exiting the area. She says she will wait for our project to give her recommendations and that she will help us implement different things. The Sustainability task force is always looking for ways to make WPI more sustainable and our IQP is also part of that initiative according to her.

Q: Would a campus-wide email at the beginning of the year explaining recycling on campus be possible/ useful?
A: A campus-wide email was indeed possible; however, this was never sent out. Mary said she does not recall getting an email at the beginning of the year on single stream recycling.

Q: We received the waste audit results from last year. Who can we talk about to get permission in using these results in our report?
A: Mary mentioned Liz down in the facilities department and how we can ask her for the permission to use the data from the Waste Audit that takes place every year.

Q: What is your opinion on single-stream recycling? What do you believe contributed to the low turnouts of recycling potential during the audits?
A: Mary said when it comes to cardboard she thought more bins would be helpful with the process since students get lots of packages. She also said she had mixed feelings about the old method of recycling that included separation when compared to the new single stream method.

She gave an example of how in the campus center students who drank Dunkin Donuts drinks knew the cup was recyclable, but would not take the time to empty out and rinse the cups hence making single stream inefficient due to the contamination on paper and cardboard from the fluids and ice within the drinks that students would then go and recycle. Mary thinks that single stream would only work if you have a sink near the trash bin so apartments or residence halls like faraday would be able to do single stream. Mary also mentioned that she thinks what contributed to the low turnouts had to do with the fact that the sustainability page has not been updated for up to 2 years. She also mentioned that the director not being there to aid on motivation and education to students of the new single stream implementation caused students to get confused on the proper way of dumping their trash so they built bad habits. Third she mentioned how the waste audit results are not easily accessible unless you are specifically looking for sustainability. She agreed that a better communication should be put in place between the students and Sustainability efforts at WPI.

Q: Would talking about single stream recycling during new student orientation be possible to do yearly?

A: Mary liked that we had the idea of having a guest speaker or TED talk on recycling during new student orientation and the proper way that single stream recycling should be done here on campus in accordance to our trash hauler "Waste Management". We also talked about trying to get a waste management representative to talk and answer questions students might have on gray area topics such as pizza boxes or dirty peanut butter jars. She seemed excited about the idea especially because electronics would also be addressed. She also told us about how the green team would try and have a pre RecycleMania event in the very beginning of the academic year when students are more likely to do what they are told. Students would build good habits and hopefully the other class years that come in the following year will start to catch on and do the same.

Q: Does the Faculty Green Team still exist? Was it reformed to the Sustainability Task Force?

A: Faculty Green team is basically the Sustainability task force according to Mary. She told us about her boss Eric Keys and how he is a sustainability coordinator at WPI. She mentioned how he is the person who would help bring Eco-reps back if they were to revive the Eco-reps.

Complex Coordinator: Ashley Merchant
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 03/23/15 @ 4:00 p.m.

Q: Can you tell us a little more about your role here on campus?
A: Ashley is a complex coordinator for Stoddard, Institute, Peripheral properties, Ellsworth and Fuller Apartments. She is also involved in RA interactions and maintaining the areas she is responsible for. Lastly, she and Amy Beth conduct bi weekly walkthroughs on alternating weeks with a Facilities supervisor.

Q: Is it feasible for someone to take a peek inside the trash to make sure recyclables are not inside the trash bin and vice versa during the walkthroughs and address it with an RA who can then address it with their residents?
A: Currently, they just look for maintenance issues, conditions of rooms, and to make sure work orders have been done. Adding a recycling peek would be difficult due to timing simply because walkthroughs don't begin until approximately 8:30 am and by then most custodians may have already emptied the bins. She told us, however, that she does sometimes address blatant miss-sorting herself. She also said that because the waste audit information is not readily available unless someone goes out of their way to look for it, she does not know how successful each building is in terms of recycling.

Q: How does recycling differ from dorm to dorm?
A: In East and Faraday dorms, there are trash rooms located on each hallway in which students can dump their small waste and recycle bins into larger bins to be removed daily by a custodian. Freshman and Founders hall have receptacles in each of their hallways. Ellsworth and Fuller Apartments have to take their trash and recyclables to the area located next to Daniels Hall where the trash compactor is. The peripheral properties have multiple trash bins around their houses and a custodian comes by daily to remove any trash and recyclables.

Q: What types of programs are done every year for residents? Do any of them include a tutorial on proper waste disposal? Are these mandatory?
A: RA programs vary from year to year. Sometimes there are programs that are specific to certain areas. RAs have the option to do recycling/sustainability programs such as making plastic ware into a fish bowl. However, as of now, a recycling program is not mandatory. She believes that training RAs to be well informed is just a small fraction of the problem; the problem is campus-wide. For example, waste and trash bins are not universal. She believes that by having clear indicators of recycle bins and trash bins would be extremely helpful. Indicators such as a color specific to only recycle bins or a clear symbol depicting recycling at WPI would help familiarize students with recycling. One example of this is that, in Worcester, trash is always placed in yellow bags which are clearly recognizable simply by observation. Another way to possibly help students who are confused about what can be recycled is better recycling posters

with pictures. She believes that long lists of items will repel a student from recycling because they will not take the time to read the list. Lastly, she also believes that students need to receive more education and communication on recycling on campus.

Q: What issues are you aware of on campus regarding recycling?
A: She believes there is an issue in Fuller and Ellsworth Apartments in regards to the accessibility to the trash disposal units. She believes that students feel like they will get into trouble for leaving the trash outside of the trash compactor where it can potentially be blown by the wind and make a mess all over. She thinks that the idea of having a small trash and recycling center in the Fuller/ Ellsworth "Quad" area on the concrete would be a good idea.

Another aspect to recycling that could use some improvement is the electronics waste subject. The proper disposal of e-waste is not widely known about on campus. Ashley told us that a student once came up to her to ask what to do with a broken lamp and she had to use her best judgment about its proper disposal. She also mentioned that there has been a large battery sitting on top of the Residential Services battery disposal bin since she was hired in 2013 and no one has been by to pick it up. She does not know who to call or tell to dispose of the battery; there is no information on the bin.

Q: What is your opinion on single stream recycling?
A: She believes that single stream was initiated in order to be more accommodating with WPI students' busy schedules. She thinks that the message of a recycling method that is easy to do got lost and instead made students think they can be indolent and just throw out recyclables in the trash bin without checking. She also believes that each trash and recycle bin should have a sign directly on it as opposed to above it on a wall somewhere in case bins are removed from their original locations.

Q: Would RAs be able to incorporate shutting off the lights in common rooms and bathrooms into their nightly rounds? What about peeking into recycle bins to make sure residents are not tossing contaminates into the recycle bins and recyclables into the trash?
A: Ashley believes it is definitely possible to have RAs shut off lights at the end of their rounds as a temporary fix. Another possible temporary fix is to have stickers around the light switches that say to turn off the lights after exiting the area. Having sensors installed in bathrooms and common rooms is a better long term solution. She also told us that in Stoddard B, there are already rooms where sensors control the shut off of lights in vacant rooms. Stoddard A and C will soon incorporate this as they undergo remodeling. She did provide us with a disclaimer. She said that students have to feel as though their input is being heard. She believes Facilities have to be able to respond to comments provided on nightly rounds by the RAs otherwise they will not bother to respond honestly.

Another issue we discussed during this interview is the belief students have that since they are paying very high tuition bills, they should squeeze every cent of it out of WPI by leaving the lights on and turning the heat on high. She believes the best way to combat this is to teach

students where their tuition goes and to understand their consumption and how inflation impacts our tuition bills. One way to do this is to show students in each building how much they are spending in electricity and water. Another possibility is to discuss about what their consumption would mean to third world countries. Lastly, Ashley recommended talking with Mike Hamilton to incorporate recycling into his social media campaign. She told us that he is very good at looking at the psychology behind social media behaviors and the use of hashtags to reach out to social media users.

Co-Chairperson of the Sustainability Task Force and Professor of Electrical & Computer Engineering at WPI: Professor John Orr
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 03/24/15 @ 11:00 a.m.

Q: We understand that your role is the Chairman of the Sustainability board. What are the tasks involved in this role?
A: Professor Orr is the Co-Chairman, along with Jeff Solomon for the Sustainability Task force. They both work with the help of the task force try to promote sustainability. They do this in a variety of ways such as but not limited to IQPs, courses, research.

Q: What are your thoughts on the issues with single stream recycling?
A: A lot of the issues are fixable. A small amount of room for error should be expected, but nowhere near what is being shown currently. He believes that single stream is a good idea. The biggest issue that needs to change is people's behavior.

Q: How do you believe we can proceed in improving the issues on campus?
A: Professor Orr believes we need to simplify, promote uniformity… Basically, we need a plan.

IQP groups (like us) investigating the causes behind sustainability failures, is very helpful because we can devote a great deal of time towards it. In addition, we bring the perspective of students to the problems. ECO Reps would be people to use for shutting off unneeded lights. In addition, people can bring questions to them regarding sustainability questions.

By possibly having the green team do more frequent waste audits, we could get more knowledge on the data (change in results based on season). Also more posters around campus could help. All of this requires volunteers to make them happen.

We need to show that at WPI we are serious about recycling and sustainability in general

Q: What will be looked for looked at when hiring the new Director of Sustainability
A: What will be looked for in the hiring of the new Director of Sustainability, is somebody that can deal with both the operational side and academic side. As there is a new Provost taking office this summer, the task force is waiting until then. This is to insure that the new Director is a good fit. As stated before the Director of Sustainability deals with two sides of the issues on campus and reports to both the Chief Financial Officer (operational side) and the Provost (academic side).

Q: It has come to our attention as students that the sustainability report and waste audit results are not reaching students unless they go out and search for it. Is there any way to email it out every year so students get exposed to this important information?
A: There are issues with sending mass email to the students at WPI because of regulation by the Student Government Association (SGA). Increasing the availability and visibility (getting people to notice it) of the Sustainability Report could be significantly helpful. The biggest issue for this is "getting to the top" of the whole "mess" of social media for online awareness. Professor Orr believes that it is because of this that it is harder to get information out there, despite technology allowing people to be in contact with one another in most situations. It covers up important information.

Q: Do you know when the WPI campus started providing separate disposal for electronic waste?
A: For the specific date ask Liz when we started using it, could be at least 10 years. The loading dock at the back of Fuller Labs is a disposal area for electronic waste. However, it is not widely known because WPI does not want it to get unprofessional looking as a dumping ground.

Q: Is there any way to implement a faculty recycling training for former and new incoming faculty every year?
A: Professor Orr thinks that this is a good idea. However, it is easier said than done because too many things are discussed in such a short time in new faculty training. They should be able to at least give out website(s) name(s)/links. Then information could be obtained afterwards. Send an email with the link and more information could also be useful.

Q: What are your thoughts regarding other sustainability programs, such as composting and TerraCycling?
A: Professor Orr believes that composting and using compostable dining materials can be helpful, but is probably secondary issue currently. Professor Orr has limited knowledge of TerraCycling.

Director of Dining Services: Joseph Kraskouskas
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 03/25/15 @ 3:30 p.m.

Q: We understand that your roles with Chartwells are the Dining Services Manager and Marketing Manager. How do you work to promote sustainability on campus on a weekly basis through these roles?

A: Project clean plate was a program that was initially started at WPI. The goal was to establish a baseline change in students' behavior. The idea was to get rid of the "eyes are bigger than stomach" mentality by introducing smaller plates. They also eliminated trays from their dining halls in order to make it difficult to carry more than one plate at a time. This way, only a small amount of food was possible to carry in the initial filling. This resulted in a 20-40% reduction in food waste produced. There are other programs Chartwells does to promote sustainability such as the Annual Be A Star program and the Fryer Waste Oil recycling.

Q: We researched some of the sustainability programs Chartwells take part in. There was a mention of waste reduction through a Trim Trax campaign. Can you elaborate on what this program does beyond eliminating food waste?

A: The idea behind Trim Trax was to make less kitchen waste. An example was given by a carrot cutting analogy. Cutting a quarter inch thick vs half inch extra off the stem of a carrot to be thrown out does not seem like a big difference. However, each bit of the waste goes into a clear bucket for the pig farmer. The bucket is transparent to show that although small amounts of food waste doesn't seem to make a difference but combined, this food waste add up significantly.

Q: Roughly, how much food waste is generated in each dining facility? Is it a relatively small amount, medium amount, or large amount?

A: The Campus Center and Goats Head dining facilities are newer and generate significantly less food waste. Most of their waste is just kitchen waste usually less than 50 lb. No running total is kept at this time. The amount of food waste the campus center generates can vary based on catering events. Usually the Goats Head Restaurant generates the least amount of food waste. Very recently, Dunkin Donuts began giving uneaten donuts to the pig farmer in order to divert this food from landfills.

Q: We learned from Liz Tomaszewski that Chartwells must follow a Massachusetts Commercial Food Waste Disposal Ban. We researched the ban but only found information on what types of facilities the ban applied to. It never stated whether institutions that produce a ton or more per week had to divert all of it or just whatever amount is over the one ton allotment. Does Chartwells divert all their food waste or just what puts it above the one ton limit?

A: Chartwells has been diverting their food waste for about 10 years which is years before the Massachusetts food waste mandate went into effect. They divert all of their food waste not just what is over the one ton allotment.

Q: It is our understanding that a pig farmer hauls away Chartwells' food waste. How often does he come to pick up food waste? Does he haul food waste from every dining hall or just Morgan Commons?

A: The pig farmer comes 2 to 3 times a week to pick up food waste. There is no charge; it is simply a mutually beneficial exchange. The approximate values of food waste per day are 400 lbs. a day in Morgan Commons, 50 lbs. in the Campus Center, and less than 50 lbs. in the Goats Head Restaurant. There is an opportunity to have counters made with the same set-up as the POD (napkins in one bin and food waste in the other) in the Campus Center. This is pending as they await approval by WPI for funding to make this happen.

Q: If facilities added a separate bin near the trash bins only for food in each of the other two dining facilities, do you believe this would help to divert more food waste?

A: He does believe that having a separate bin will help. From day to day, the amount wouldn't be much, but any food we can divert would be beneficial especially for the pig farmer.

Q: Are there plans to use compostable silverware in the near future?

A: Catering uses Greenware which are compostable silverware. A negative by product is that hot foods partially disintegrate this compostable silverware but there is still the possibility to use compostable silverware for takeout.

Waste Management: John Henry, Michelle Lee, and Ed Conley
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 04/02/15 @ 10:00 a.m.

Q: Do you recommend resorting back to source separated recycling or do you recommend instead trying to address the students, faculty, and staff about making sure containers are cleaned for single stream recycling? If we were to convert back to the old method, would our waste still be sorted through the single stream recycling sorting line?
A: Both single stream and source separated recycling are a problem to the machines. They don't believe that the type of recycling is the problem but rather the lacks of information students receive on proper disposal methods to avoid contamination.

Q: Do you have a website/app/QR code that people can use to determine the correct bin for their waste?
A: There was initial development on an app several years ago by a student group. In the end, the app was not implemented because the regulations on recycling changes frequently and it would be too costly to keep the app updated. This is why they instead prefer to use the posters for information.

Q: Which of these items can be recycled? (Styrofoam, yogurt cups, pizza boxes)
A: Styrofoam can be recycled just not at that Waste Management facility because it's very light. They would have to wait a long time for the weight of the Styrofoam to finally become profitable for them to ship. While the typical commodities load is 20 tons per truckload, the mass of the Styrofoam per truckload is ~1 ton. Thus, they personally do not recycle Styrofoam. Yogurt cups are recyclable if the number on the bottom of the plastic cup is 1 or 2 as well as not intensely contaminated by food waste. Pizza boxes are also accepted as long as there are no scrap pieces of food in the box nor lots of oil stains. Pizza boxes with just a little grease are ok.

Q: How has WM's other institutional clients approached the transition from one method to another?
A: Most of their clients have an easy time switching to single stream recycling. It is not uncommon for the recycling rate of the client to double or even triple. The rates falling at WPI was a big surprise to them when we mentioned it.

Q: Is there any way we could get updated posters with images on them either a copy or just emailed?
A: Yes this can be done free of charge. Following this meeting, our IQP group will put WPI Facilities in contact with Waste Management's Total Recycle Program. Michelle Lee promised to provide additional educational materials which we felt would help to motivate students, faculty, and staff to recycle. She also would like to work with the green team to suggest programs and conduct waste audits.

Q: Is food contamination more common now that single stream is encouraged?
A: To their knowledge there have always been issues with food contamination at their plant, regardless of the sorting method. This is because some people, not only do not recycle, but they use recycling bins as trash bins. Therefore paper contamination can occur either way. Also, when wet materials such as wet paper (either from the rain or from contamination) get loaded onto their sorting line, it must be removed to avoid ruining the machines. Additionally, since Waste Management sends some of their bales of recyclables overseas, they must follow shipping regulations which include food restrictions. Therefore, they can't have food accidentally slip by into the recyclables sent overseas. Lastly, when items such as water bottles still have liquids in them, they are accidentally sorted with heavy materials such as glass rather than with light materials such as plastic. This is a problem because when the plastic with liquid finds its way into the glass section, it must be removed manually by workers and disposed of.

Another issue not related to food contamination is the issue of bagged items. Items that are bagged are difficult to rip open in the assembly line and are essentially considered trash if they are unable to open it easily. They strongly encouraged informing custodians to leave recyclables bags untied to increase their efficiency.

Q: Would you be willing to send a guest speaker to New Student Orientation to explain why we should be recycling and do a brief explanation on what we should and shouldn't be recycling in accordance to Waste Management recycling?
A: Waste Management is more than happy to come and be a guest speaker for New Student Orientation as well as for faculty.

Appendix H

Associate Director of Buildings and Events: Terrence (Terry) Pellerin
Participants: Stacey Chaves & Eduardo Sandoval
Date: 04/13/15 @ 11:00 a.m.

Q: From our surveys we found that some faculty members have witnessed their custodian combining the trash and recycling every day. Additional faculty have been told by custodians to just combine waste and recycling as it goes to the same place. One custodian commented that there should be a consequence for the custodians found doing this. We too believe there should be a consequence for doing this. Is this possible? What possible consequences can they face?
A: It would be possible for custodians to face consequences for combining trash and recyclables as long as a building and custodian can be identified. After that, the supervisors would intervene and even Terry himself if need be.

Q: Building off the previous question, it is possible that some of the actions taken by custodians are due to a lack of knowledge about recycling. We believe this can be solved by having the custodians take a training session explaining the benefits of recycling and the harms of not doing so. If we were to provide a list of topics to include in such a training program, can this be done yearly?
A: Definitely! If our team is able to put together a training program for the custodians, Terry would incorporate it into his yearly trainings. He believes a PowerPoint presentation that explains the correct methods of recycling and why it is important that custodians recycle properly. He also recommended that our group hold the first round of trainings in order for the supervisors and himself to learn what topics we would like to include in the yearly trainings.

Q: A suggestion that has come to our attention from both surveys and interviews is the importance of uniformity. We plan on proposing buying uniform bins such as the Slim Jims. In addition, we want to enforce that all of the bags used by custodians for recycling bins be green. Our team will provide a number of Slim Jims needed, to be ordered when the budget is issued. This way the new set-up can occur as soon as possible.
A: Terry said that although we have some Slim Jims in stock, it would be nice to know how many bins he needs to order when he receives his fiscal year budget in July. We told Terry that through our campus tours we have been inventorying each type of waste and recycle bin and documenting its location. That way we can simply provide a number of bins needed, a specific location where a bin is needed, and what type of bin is needed. Additionally, we will provide a number of locations that need an updated recycling poster and where these locations are in each building.

Q: While it is important to show uniformity to the single stream system, some areas may benefit from an additional cardboard container. By placing a cardboard container in places like the mail room it can reduce clutter in an area. Additionally as cardboard items tend to be bulkier, it is not efficient to have a single stream bin filled by three or four cardboard items. In the survey that went out to staff, faculty, and students, we received a comment about having at least one additional cardboard bin near the mailroom. Is this possible?

A: Terry believes that having an additional cardboard bin near the mailroom would take up too much room in such a small space. He mentioned too that in the past, cardboard was only collected 5 days a week and, to meet the increasing demand to remove the accumulating cardboard boxes, is now removed 7 days a week.

Q: It has been brought to our attention from our touring of the campus that there is not always a one-to-one trash and recycling bin set-up. With the diagrams that we are compiling, would this be an easy fix?

A: Given the location of where these bins are needed, this would definitely be an easy fix.

Q: Another finding of our data collection is that there are some exterior areas, such as behind the Recreational Center, where there are no recycling bins. This leads to recyclables ending up in the trash bin. Could more exterior recycle bins be added here?

A: Terry informed us that he has been trying to eliminate exterior waste bins. His belief is that by eliminating waste bins outdoors, people would be more likely to hold onto their trash and throw it out elsewhere. Therefore, it would be pointless to add exterior recycle bins if the facilities department plans on removing exterior bins.

Q: As a result of our surveys and campus tours, we have determined that informational posters are very helpful in the proper sorting of waste. This is an example of a poster (Reprinted as Figure H-1) that we believe would make sorting out different types of waste easier. It has fewer words and is more to the point about what can and cannot go into each bin through the usage of pictures. Does WPI print these posters? Do we get them from Waste Management?

Figure H-1: Updated poster provided by Waste Management. It is more appealing to the eye because there are no longer lists of what can and can't be placed in the recycle bin; All acceptable materials are summarized by pictures.

A: Terry believes that these posters are definitely better than current ones. However, Waste Management should be contacted about printing posters and how much it would cost.

Q: We believe that placing the posters on each bin in addition to or instead of above the cans would be helpful. Would this be possible?

A: Yes. Especially since this would be consistent all around campus rather than just on some wall.

Q: You stated in a previous interview that the loading dock behind Fuller Labs is the disposal area for electronics. However, this is downplayed so it does not become a dumping ground. Would it better if there was a number for students, faculty, and staff to call if they have large electronics to be dumped there that way the custodians can be more organized about it?

A: The reason that the loading dock area is not advertised for e-waste dumping is because there is a cost associated with disposing of e-waste and universal waste. He faces the dilemma of deciding whether recycling e-waste is the moral obligation of the university or the community. He would prefer if instead, free e-waste drives were advertised and alternative drop-off locations. Additionally, advertising our school's yearly e-waste drive would an excellent solution.

Q: Can there be more frequent electronic drives?

A: There could but he would prefer if there weren't. This is because an e-waste drive costs anywhere from $2-3,000. He did suggest, however, that the e-waste drive take place closer to the end of the year so that it coincides with move-out days.

Q: We would like to put another trash bin in the Campus Center just for food waste and labeled as so? Is this possible? Do you have a spare bin we can use next week to place in the Campus Center?

A: Chartwells would be the ones financially responsible for buying an additional bin for food waste disposal.

Complex Coordinator: Ashley Merchant
Participants: Stacey Chaves and Eduardo Sandoval
Date: 04/16/15 @ 11:00 a.m.

Q: We discussed in a previous interview the possibility of incorporating a short single stream recycling training program for RA's during their RA training. Waste Management has agreed to speak at New Student Orientation so freshmen will be introduced to this knowledge in A term. By making RA's have a mandatory single stream recycling program for their students at the beginning of A term would allow for upperclassmen to get educated on the subject. For freshmen, it may be nice to have a mandatory program in the second half of the year as a refresher. Whom can we talk to for implementation?
A: According to Ashley, residential services are re-structuring their residential advisor programs. For this reason, she doesn't believe they would be able to incorporate any training nor mandatory programs.

Q: We will be pushing forward for e-waste bins to have contact information on them for emptying. We will make a list of every location of these boxes and document it for the person picking it up to know exactly where it is located when it's called in.
A: She was happy to hear of this potential implementation.

Q: Do you know anything about the status of the recycling center/programming area outside Ellsworth apartments?
A: She had not heard anyone mention this recycling center/programming area.

Q: We also plan to put posters on recycling bins instead of on walls
A: She agrees that this is a better alternative than to try and determine a location for posters on walls.

Q: For next year, will it still be possible to have RA's shut off lights while on rounds and if people are in common rooms to remind them to shut off lights when they leave? Also we plan to have stickers put on the light switches. Who can we talk to about permission to do this?
A: Amy Beth would probably have to give the permission to do this.

Facilities Systems Manager and member of the WPI Sustainability Task Force: Elizabeth Tomaszewski

Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff

Date: 04/16/15 @ 1:00 p.m.

Q: A suggestion that has come to our attention from both surveys and interviews is the importance of uniformity. We plan on proposing buying uniform bins such as the Slim Jims. In addition, we want to enforce that all of the bags used by custodians for recycling bins be green. Our team will provide a number of Slim Jims needed, to be ordered when the budget is issued. This way the new set-up can occur as soon as possible.

A: Liz Tomaszewski believes that updating all waste bins to Slim Jim bins are a good idea. However, she would find larger Slim Jim containers, if they are available, so they could hold more waste. She also thinks green bags are helpful for identifying whether disposed waste in bags are recyclable or trash.

Q: It has been brought to our attention from our touring of the campus that there is not always a one-to-one trash to recycling bin set-up. With the lists that we are compiling, would this be an easy fix?

A: Liz agrees that the waste disposal should be 1 to 1. She likes from our campus tours, we will provide a final count of the number of new waste bins that the school needs to order. Additionally, we have the locations detailed by words and pictures of where to place the new bins which she finds extremely useful.

Q: From our follow up interview with Terry, he mentioned that he doesn't want to advertise the Fuller Labs loading dock as an electronic waste disposal area. Can we provide information about other options for the students, faculty, and staff to dispose of their waste?

A: The city of Worcester has an electronic waste drive, which they perform annually, around the time that WPI has their own electronic waste drive. Information on this yearly drive can be posted on the sustainability website.

Q: We are doing a custodial training program to teach custodians about proper waste sorting with single stream and e-waste. This will be continued in future trainings by Terry Pellerin and the custodial supervisors.

A: Liz thinks having a PowerPoint that can be updated and used yearly is a great idea.

Q: From our interview with Waste Management Company, we found that they perform free programs such as waste audits for their clients. They want to work alongside the green team as well to educate the community. For the waste audits, would you like them done at the same time as your waste audit or later in the year to measure progress (this of course is for you and the green team to work out with Waste Management).

A: Liz was happy to hear about these free programs Waste Management has to offer. She also believes that having an additional waste audit at the end of the year to measure progress is a great idea.

Q: We have obtained a poster from Waste Management that has less words and more pictures. Could these be ordered for the upcoming year?
A: Liz would prefer that we attempt to get the posters for free from Waste Management first. If this is not possible, she can try to push printing new posters through in the Facilities budget.

Q: We will be proposing placing the recycling informational posters on recycling bins rather than on walls. Who would be in charge of placing these posters on the bin if they arrive after we complete the project?
A: Liz needs Terry's permission to place the posters on bins but we have her approval.

Q: Who can send an informational email about single stream recycling and the locations of electronic disposal boxes at the beginning of the year?
A: Eventually the duty of sending informational emails will fall to the role of Director of Sustainability. However, currently the duty would fall on Liz or Terry.

Q: If we tell you things we found work on other campus' sustainability web pages, can you or whoever is in charge of the webpage update it to reflect these additions?
A: Currently, Liz is in charge of the website. However, this role will also eventually be the responsibility of the Director of Sustainability.

Q: Provided this is ok with Residential Services, is it possible for the green team to go around residence halls and put "please shut off light when leaving" stickers on the light switches?
A: Liz thinks that the funding for this program would probably go through the Facilities Department, so she could try to push it through for the budget.

Q: Waste Management considers all tied bags trash. Therefore, we will require that the custodian responsible for recycling rip an opening in the bags of recyclables right before they are tossed into the compactor.
A: Liz was shocked to hear about this and she is grateful for our idea to have a custodian slice open each recycling bag before throwing them into the compactor.

Q: We noticed that there are changes to the waste bin set-up in some locations on campus. These bins now reflect single stream which is great news. Do you know who is changing bins around campus?
A: Liz has no idea who has been changing the bins.

President of Green Team/ Student Coordinator: Mary Prescott
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 04/16/15 @ 4:00 p.m.

Q: From our interview with Waste Management Company, we found that they perform free programs such as waste audits for their clients. They want to work alongside the green team as well to educate the community. For the waste audits, would you like them done at the same time as your waste audit or later in the year to measure progress (this of course is for you to work out with Waste Management). Also, whose contact would you like us to provide to Waste Management?
A: She was happy to hear about the free programs and agrees with Elizabeth Tomaszewski about having an additional waste audit at the end of the year to measure progress. Additionally, we can give the Waste Management contact to either Mary or Liz.

Q: We have obtained a poster from Waste Management that has less words and more pictures. We know you were working on making a poster. Are you interested in this one?
A: Mary thinks that either Waste Management's poster or hers is fine as long as the poster is informative.

Q: We will be proposing placing the recycling informational posters on recycling bins rather than on walls. Who would be in charge of placing these posters on the bin if they arrive after we complete the project?
A: A few years back the green team did something similar so the green team could be the ones actually to place the posters on the bins.

Q: Who can send an informational email about single stream recycling and the locations of electronic disposal boxes at the beginning of the year?
A: Mary thinks that Liz is the best person to send the email, as her name is probably the most well-known on campus from her role with the facilities department and the Sustainability Task Force. Mary does not know if the locations of all of the electronic waste boxes are still available on the sustainability website. If not, the Green Team can find and record the electronic waste box locations.

Q: If we tell you things we found work on other campus' sustainability web pages, can you or whoever is in charge of the webpage update it to reflect these additions?
A: Mary said that she would make sure the Sustainability webpage was updated.

Q: Is it possible for the green team to go around residence halls and put "please shut off light when leaving" stickers on the light switches?
A: Yes it is possible. Mary does not know if the facilities department or some other department would pay for this.

Q: Our team has been diligently working on inventorying all waste bins on campus and their locations. We will be giving this list to facilities so they can order additional Slim Jims for next year when they get this budget in July. This document additionally provides pictures which show what the current waste bin set-up is and also helps identify locations.

A: The Green Team is conducting their own campus tours of WPI marking down the locations of the types of waste bins on floor plans. This would complement the descriptions of each location and final count of new bins needed that our IQP group has assembled to give the facilities department.

Associate Director of Operations: Amy Beth Laythe
Participants: Stacey Chaves, Eduardo Sandoval, Brian Sokoloff
Date: 04/17/15 @ 3:00 p.m.

Q: We plan on recommending incorporating a short single stream recycling training program for RA's during their RA training. We also believe having a mandatory sustainability program by the RA's will help to spread the knowledge about proper waste sorting. Whom can we talk to for implementation?
A: According to Amy Beth, spreading such information is not the responsibility of the residential advisors. She instead would rather try and resurrect the eco-rep program WPI had a few years back.

Q: We will be pushing forward for e-waste bins to have contact information on them for emptying. We will make a list of every location of these boxes and document it for the person picking it up to know exactly where it is located when it's called in.
A: She was also happy to hear of this potential implementation.

Q: Do you know anything about the status of the recycling center/programming area outside Ellsworth apartments?
A: She informed us that this idea never even entered the planning stage. It was more of a wishful thinking and she never plans to have residential services create such an area.

Q: We also plan to put posters on recycling bins instead of on walls
A: She fully supports this idea as opposed to having residential advisors spread the knowledge.

Q: For next year, will it still be possible to have RA's shut off lights while on rounds and if people are in common rooms to remind them to shut off lights when they leave? Also we plan to have stickers put on the light switches. Who can we talk to about permission to do this?
A: Amy Beth did not like this idea as she believes it would be pointless if a resident uses the bathroom after the RA has already walked through and shut the lights.

Director of Dining Services: Joseph Kraskouskas
Participants: Stacey Chaves, Eduardo Sandoval, and Brian Sokoloff
Date: 04/22/15 @ 3:00 p.m.

Q: We think that cafeterias should use compostable material. In a previous interview, you mentioned that Chartwells attempted to us compostable materials, however they began to dissolve when introduced to hot temperatures. We plan to recommend that in the future Chartwells attempt to incorporate more compostable materials as new technologies become available.
A: The company that makes the dispenser that we have right now does not produce compostable materials at this time. Similarly, Joseph has not found a company that produces good quality compostable utensils but has agreed to be on the lookout.

Q: You mentioned in a previous interview that there were plans to build a food and trash separate disposal station in the Campus Center, similar to Morgan Commons. Could you give us a status update on this?
A: Joseph will likely find out about the budget approval on the food and trash disposal station in May because it will likely be a decision involving the input of the board of trustees.

Q: We want to propose that Chartwells provide one bin which would be labeled for food waste only. That way, additional food is diverted from landfills. This could be a test round where a bin could be temporary or permanent based on whether the disposal station is approved or not and whether or not there is even any food diverted in a given day. This test round would also prevent spending thousands of dollars for a food waste disposal station if not a lot of food is diverted in a given day.
A: Joseph agreed that placing the food waste bin for short term trial would be useful. By doing so, Chartwells could get a rough idea of the impact a food and trash separation station would bring. Then they could see if the impact is worth spending the money on building the station. However, Joseph warned that because the test set-up would be short term, it may not be an accurate representation. Joseph also had concerns with the aesthetics of placing bins around the food areas in both the short-term and long-term.

Q: Do the Goat's head staff have a bin to toss any food waste left by students?
A: Joseph will follow up with us, as he has a meeting today with the Goat's Head personnel. An update will follow.

UPDATE: 04/29/15
The Goat's Head does not have a food waste bin for consumers or bus boys to use for disposal of food waste. However, now they will be implementing a bin for the bus boys to dispose the food waste, and this bin will be given to the pig farmer as well.

Appendix I


Recycling at WPI
Custodial Training Program
1
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What Will Be Covered
Proper Procedures
Consequences
Importance of Recycling
MEMO
2
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What is the Proper Bin Setup?

3

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What is the Proper Disposal Method?

- Posters should be posted above all recycling bins

4

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What is the Proper Disposal Method?






5

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Your Role Matters!

6

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Why should you care about Recycling?

GLASS PACKAGING IS
100%
RECYCLABLE
ENDLESSLY, WITH NO LOSS TO PURITY

Did you Know?

Recycling **one** aluminum can saves enough energy to run a TV for 3 hours

Or a 100 watt bulb for almost an entire day

Please Recycle!

Did you Know?

One ton of recycled paper can save:

- 17 trees
- 380 gallons of oil
- three cubic yards of landfill space
- 4,000 kilowatts of energy
- 7,000 gallons of water!

Please Recycle Here

7

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Consequences

8

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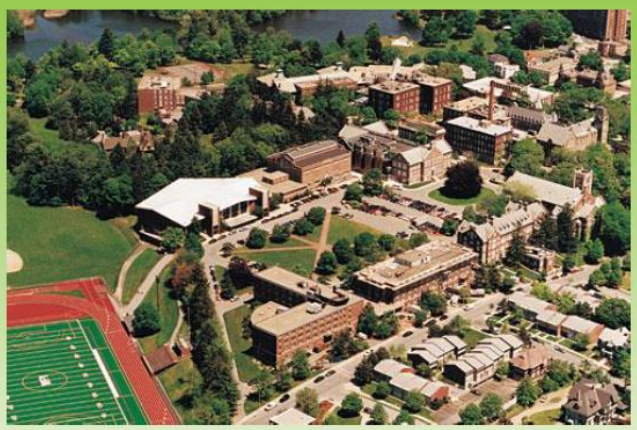

Thank You

9

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Appendix J

See the attached Appendix J Excel File. This includes the buildings inventoried, where in each building bins are located, the number and types of each bin, and any additional comments we had about each set-up.