UNC INSTITUTE FOR THE ENVIRONMENT

ENST 698—Environmental Capstone
[Fall 2010]

Campus Waste Stream Assessment:
OWRR Strategic Improvement Plan

{Final Report}

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EXECUTIVE SUMMARY

The Campus Waste Stream Assessment is an analysis of data collected from interviews and waste audits on the campus of the University of North Carolina at Chapel Hill. The goal of this assessment is to make recommendations to the University's Office of Waste Reduction and Recycling based on the data collected throughout a semester. The recommendations focus on methods to reduce the overall volume of the campus waste stream by reducing the number of recyclables that end up in the trash. Comparison findings from a previous UNC waste stream assessment performed in 1995 were also consulted to understand what improvements have been successful in the last decade.

Interviews were conducted at three different locations on campus—Student Union, Business School, and UNC School of Law, in order to understand the social attitude towards recycling programs on campus. Interviews were performed on three major groups at each location: students, staff, and housekeeping. In general, results of the interviews suggest that people would recycle more if there were increased convenience for recycling, more information on certain recycling programs, and more recycling bin locations on campus.

Waste audits were carried out at the same locations as the interviews. By collaborating with facility managers and housekeeping at each location, the team obtained samples of a day's worth of trash from different areas throughout buildings including: lounges, classrooms, offices, conference areas, and dining areas. Trash was sorted and weighed according to predetermined waste categories. The waste audit data provide concrete information on the contents of the current waste stream. In comparison to the 1995 waste assessment, there is an increase in the amount of organics and plastics, and a decrease in office fiber, mixed paper, glass, and metal.

Based on the findings of this assessment the following recommendations have been made: (1) Increase campus recycling to 55%; (2) Further pursue organics capturing; (3) Increase recycling of office paper, plastic bottles, and cardboard; (4) Increase overall indoor recycling; (5) Increase overall outdoor recycling; (6) Partner with other departments to recycle niche products.

I. INTRODUCTION

Background:

Currently UNC-Chapel Hill has a comprehensive recycling program headed by the Office of Waste Reduction and Recycling (OWRR). The OWRR works to ~~"p~~promote comprehensive waste reduction practices and provide effective solid waste services including recycling, composting and trash disposal" within the UNC community (UNC Facilities Services Recycling website). It has been in action since 1989, and has been implementing programs and producing UNC waste stream reports for the last decade.

The last and only comprehensive waste assessment at Carolina was conducted in 1995. The campus has not collected comprehensive data on the quantity of waste produced since this time. The 1995 survey was collected over a whole year by the OWRR. Recycling has greatly increased since the time of this assessment and many new recycling programs and incentives have been added as UNC has grown. This made it necessary now, in 2010, to review the University's recycling program. This was done by taking a look at buildings to see where the previous recycling program was effective in three carefully selected campus buildings over the course of one semester. In the fall of 2010 an Environmental Capstone team, composed of six undergraduates and one graduate student, worked with Carolina's Office of Waste Reduction and Recycling to conduct waste audits, analyze building operations and behavioral data, and recommend new services and practices.

Project Overview:

The Fall 2010 Waste Audit and Strategic Waste Management Capstone Team chose three buildings in which to study recycling habits. These buildings were the Law School, the Business School, and the Student Union. These multi-use buildings were chosen as opposed to single-use buildings because a great deal of information can be obtained from one of these buildings. They each contain several different types of rooms such as classrooms, offices, conference rooms, and dining services. These are the types of buildings for which the OWRR has the least amount of data, and these buildings will be crucial in moving forward with recycling programs at Carolina. None of these buildings were studied in the 1995 waste audit, though each room-purpose can be compared to an individual building from the 1995 audit. After the team has analyzed these waste

streams, materials that may most easily and beneficially be diverted can be targeted and the University can begin discussing how to go about doing this. This will help the Office of Waste Reduction and Recycling (OWRR) plan where and how best to implement programs in the future.

Project Structure:

The Capstone team's goal was to analyze the type and amount of waste that is produced by each building, and to come up with ways to reduce the amount of recyclables that end up in the waste stream. This was accomplished by conducting waste assessments of each building for a sample of a full day's waste. Expertise and necessary equipment were provided by the OWRR and Orange County NC Solid Waste Planner Blair Pollock. The waste assessment was based on the weight of different types of materials and the overall weight of the buildings' waste sample. The 2010 report also included a behavioral component. The Capstone team conducted interviews of people in each building to assess their feelings about recycling, whether or not they recycle and if not why they do not. Using this data, improvements were proposed to the OWRR's recycling program based on behavioral themes in each building community, as well as hard data on what composes each waste stream. Categories of the waste stream that could be recycled more and those that are not being recycled at all were identified. The team then came up with methods to increase waste reduction and recycling at UNC based on the findings, the consideration of potential recyclable markets in Orange County, and successful recycling programs at other schools in the nation. Using the interview data, the team considered how best to educate members of the University with regard to waste in terms of recycling and also general volume of waste production. by The team obtained approval from the Institutional Review Board to conduct anonymous interviews; full review was not required, as these interviews posed no real threat to interviewees.

Goals:

- Describe waste assessment procedures (from building-specific to campus-wide)
- Review standard waste assessment practices, including safety standards and precautions
- Describe and review existing waste removal locations and schedules
- Contact zone managers, building facility managers to set up times to sort through the trash samples that their housekeepers set aside

- Conduct interviews to target behavioral factors in waste reduction and recycling
- Perform waste assessment: select a comprehensive trash sample collected over a day's time
- Compare findings 1995-2010
- Identify potential new and expanded programs/materials, amounts available, markets available, reasonable collection systems for recyclables
- Identify materials available for additional recycling efforts
- Make recommendations for targeting specific materials for waste reduction and increased recycling

II. INTERVIEWS

PROCEDURE

The Waste Audit Capstone Team conducted interviews of convenience samples at each of the three audit locations to compare the raw waste data with behavioral information, hoping to gain insight into what could encourage higher participation in waste reduction and recycling. The interviews also serve as an opportunity for the team to investigate trends and attitude towards recycling across various occupations, which would benefit the strategic planning process for the OWRR.

Due to a variety of factors affecting the availability of both the audit team members and interview subjects, the methods for acquiring responses varied among buildings and subject groups. The different methods will be noted in the interview findings. The team conducted a total of 46 interviews, using face-to-face and email interactions. Because of the convenience sampling, the results should be considered illustrative but not necessarily representative of each site and the community that uses it.

RESULTS

Business School

Interviews for students of the Business school were conducted in person either in Kenan-Flagler or elsewhere on campus. One faculty member was interviewed in person in the school, while the rest and the staff were contacted through email. The housekeeping staff was interviewed, during a shift break, in person and on site. The team found the following themes among the various subject groups:

Students:

Business School students expressed confusion about how and where to recycle cardboard and batteries. They said recycling needed to be more convenient for them to participate, and suggested more bins in more locations, specifically in the lower-level study rooms. These students also said that more information was needed on what can be recycled, and claimed that real convenience would include all recycling option-bins in all trash locations. Their attitudes were notably more apathetic towards recycling. Some said that if they ever recycled, it was their good deed for the day, or they did it because it was easy.

Housekeeping:

The housekeeping staff at the Business School commented that students seemed apathetic towards recycling, and thus bins should increase in number to make the process more convenient. The staff also suggested that more information be visible on the bins and around the building to make students more aware of the importance of recycling, and how to do it. The staff also noticed that people in the Business school throw away recyclable drink containers more than other recyclables.

Staff:

The staff interviewed at the Business School claimed that more recycling locations were needed in more centralized locations. They also recommended a greater visibility of bins, with all options represented at each site. The general attitude among staff members was fairly environmentally minded, but less confident about other people's recycling efforts in the building.

Faculty:

The Business School faculty members expressed confusion about which plastics can be recycled on campus. They claimed that more bin locations were needed because their students complain about having to make any effort to recycle. The faculty said that recycling was only somewhat common in their building, though their attitude toward recycling showed that it held importance, was a habit, and was important for environmental reasons.

Law School

Interviews for students of the Law School were conducted in-person in common areas by team members. Staff and faculty were approached either in person in their respective offices, or through email when more responses were needed. The housekeeping staff was approached during a shift break in the early morning. The team found the following themes among the various subject groups:

Students:

Students of the Law school had questions about whether they could, and how to, recycle batteries, electronics, and non-bottle shaped plastics. They requested more visible information about recycling in the building and on campus, and expressed a need for more centralized bins in order to make recycling more convenient for those who don't wish to go out of their way to

recycle. The general attitude towards recycling was that it is the right thing to do, and is easy enough to do when the bins are around.

Staff:

The staff of the Law school had questions about recycling cardboard, or whether it could be made more convenient as they used a high volume of cardboard. They requested more information on where to recycle various objects, especially cardboard and bottles/cans in offices. Staff members claimed that more visibility of what to recycle in both the bins and trashcans would increase people's likelihood of recycling. The common reasons for recycling were to minimize waste or guilt, and that there was an influential person in the subject's life who told them about recycling.

Faculty:

The faculty of the Law School also had questions about where to recycle boxboard boxes and batteries. Aside from this issue, this faculty seemed notably more confident about recycling in their building, and saw no major lack in the current set-up. The faculty generally professed great recycling behavior due to high levels of environmental commitment.

Housekeeping:

The Law School housekeeping staff claimed that consistency of paper recycling was lacking in the rotunda area and the kitchen. They recommended placing recycling bins next to all trash cans to increase convenience for users. This staff also pointed out that the bins in classrooms were too small for the volume of recycling compared to trash, which often led to recyclables in the trashcan..

Union

Student Union interviews were all conducted in person, on location. Team members took a couple of days to approach random students in the lounge area of the Union, and staff members on the upper floors in their offices who agreed to give 5 minutes of time. The predominantly Spanish-speaking housekeeping staff was interviewed with the partial help of Spanish-to-English interpretation by facilities managers during a break time that was approved by the team's Union staff contact. The team found the following themes among the various subject groups:

Students:

Students in the Union commented that information about recycling was lacking the visibility to promote universal participation. Many students stated that they would need some kind of incentive to increase their recycling behavior, even if the incentive is just more visibility of information and recycling bins. Suggestions included more accessible recycling bins, more bins alongside existing trashcans (or fewer trashcans and more bins), and recycling bins on the way in and out of the building. Students claimed they needed recycling to be more convenient, as most of them recycle when it is easy to do but are not passionate enough about it to make extra efforts towards recycling as much as possible. Their reasons for recycling included a sense of obligation to do so, the idea that it ~~j~~ust makes sense to recycle," and that it is often just as convenient to recycle an item as not recycling.

Housekeeping:

The housekeeping staff found that the recycling bins at Alpine Café were favored by building users over other locations. The locations of third floor recycling bins are less numerous than elsewhere in the Union, and frequency of recyclable materials in trash bins is higher in third-floor hallways than elsewhere in the Union. The staff believes that there need to be more visible signs on the bins, and around the building that explain how to, and what to, recycle, as well as to provide tangible encouragement every day for people to recycle. The general attitude of the housekeeping staff was that recycling is important in protecting the environment and keeping the building clean, and all claimed to recycle as much as possible.

Staff:

The Union staff interviewees favored hallway bins outside of offices. They used desk bins for office paper recycling only, claiming that bins for bottles and cans were lacking. The staff commented that more incentives, in the form of visibility of bins and public messages and information, were needed to increase recycling among subjects. More bins would be helpful in the hallways and offices for staff members. The staff members generally claimed to recycle, but not to the fullest potential. Their reasons for recycling were to reduce their waste, or that it made sense, or they have some influential person in their lives that convinces them of the benefit of recycling.

III. WASTE AUDIT

Method

The Fall 2010 Waste Audit and Strategic Waste Management Capstone team studied recycling habits in the UNC Law School, Business School and Student Union. The team analyzed the type and amount of waste that was produced by each building by conducting waste assessments of each building. The waste assessments were based on the weight of different types of materials and the overall weight of the buildings' waste sample. For each building, the Capstone team communicated with housekeeping staff to determine when the trash was picked up from each building in order to pick a time to conduct these waste audits. The day the audits were to be completed, the housekeeping staff left out a representative sample of bags from different areas in each of the buildings. For each building the team came up with comprehensive categories for the types of spaces. The students then had the housekeeping staff label the bags from each of these areas with different color stickers so the team could analyze what types of waste comes out of different areas of buildings.

The Union waste audit was completed on the night of October 27, 2010. The goal was to sample 30 bags, 10 from each of the three categories. The categories were Office Space, Lounge Space, and Alpine Space. The team was actually able to sample only 4 bags from the Alpine space and 10 from each of the other spaces. The waste audit was conducted in the underground trash tunnel underneath Davis Library. There were five people sorting the waste and one person recording the waste. This audit took the longest because it was the first one and took a little over two hours.

The Law School waste audit was completed on Wednesday November 3, 2010 at 8:00 A.M. The categories sampled were classrooms, offices, lounge/food/library/conferences. Eight bags were sampled from each of these areas. There were five people sorting the waste and one recorder. This audit took about an hour and a half.

The Business School waste audit was conducted the afternoon of November 3, 2010. The categories of rooms were dining, classroom, office, and lounge/library/conference. Seven bags from each location were sampled. There were three people sorting this waste, with one recorder. The process took about an hour and a half.

For each of the audits, students wore protective eyewear and puncture-proof gloves, and covered a table with tarp. The bags were opened on the table and sorted into different plastic bins depending on the category of trash. The bins were then weighed in pounds and recorded.

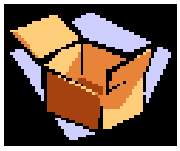
The Waste Categories

The following are the categories and subcategories that were used for each waste audit. The categories are based on those from the 1995 assessment. Amy Preble of UNC's OWRR advised the team on the elimination of a few subcategories based on what existed in the campus waste stream in 1995 and in the OWRR's observations since then. The decision was made to use the 1995 assessment as a guide for the 2010 audit because the audits will be representing the same population and general location (UNC campus).

Construction

- Carpet
- Ceiling tiles
- Other

Corrugated Cardboard



Glass

- Food and beverage bottles and jars
- Other glass (lab glass, ceramics, window glass, non-food/beverage glass)

Metals

- Aluminum cans
- Steel/tin cans

Mixed Paper

- Newspaper, magazine and catalogs,
- Boxboard (non-corrugated cardboard)

Office Fiber

- White, blend, fiber 

Organics

- Food waste
- Landscape waste
- Textiles
- Tires/rubber
- Wood 

Plastics

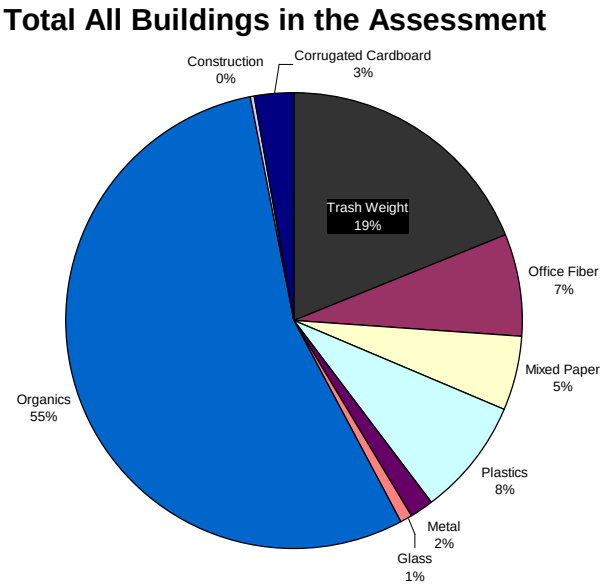
- Foam
- Other plastics (by number)
- Non-bottles shaped plastics 1-7 and bottle shaped 7's
- Packing peanuts 
- Plastic bottles #1-6 [i.e. milk jugs (HDPE) soda bottles (PET) 
- Plastic film (bags)

AUDIT DATA AND ANALYSIS

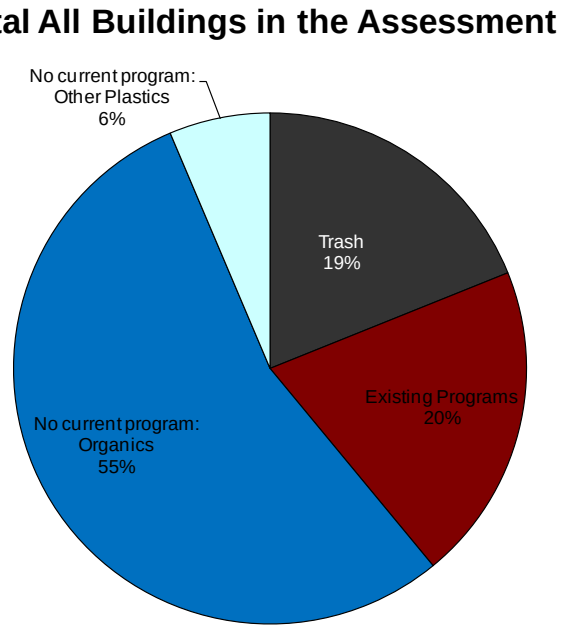
Total

In our three audits, organic materials made up the majority of the waste stream (55%). Trash was the next biggest component at 19%, followed by paper at 12%, and plastic at 8%. In the ideal, trash could be decreased to 19% of the total waste stream, with introduction of services to recycle all of the items making up the other 81% (all in potentially recoverable categories) and a 100% participation rate and full compliance with performance standards (e.g., no contamination).

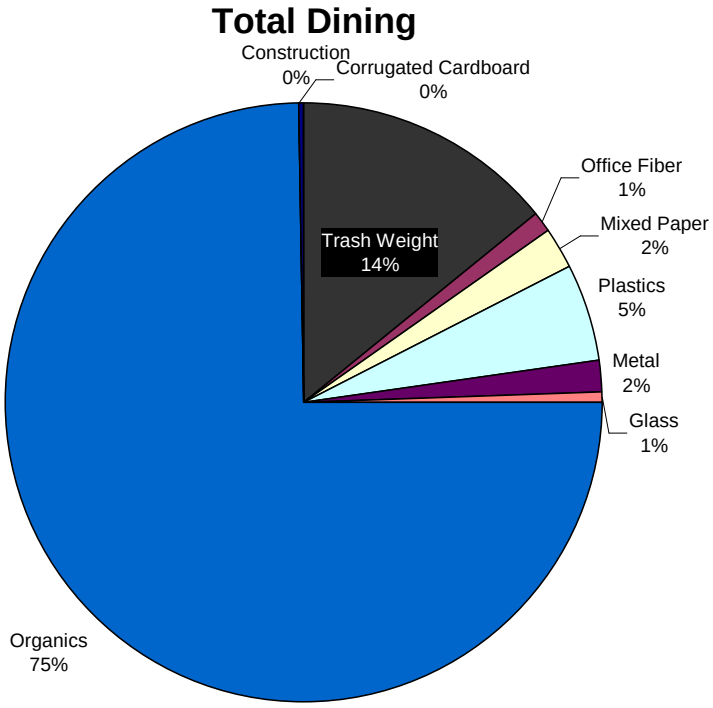
Total for all building:

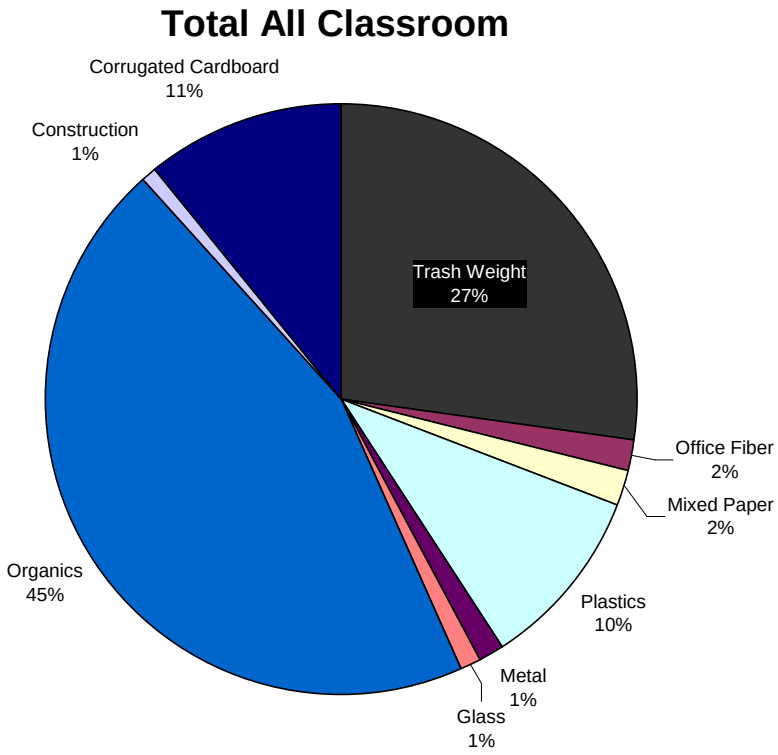


Total showing existing programs:

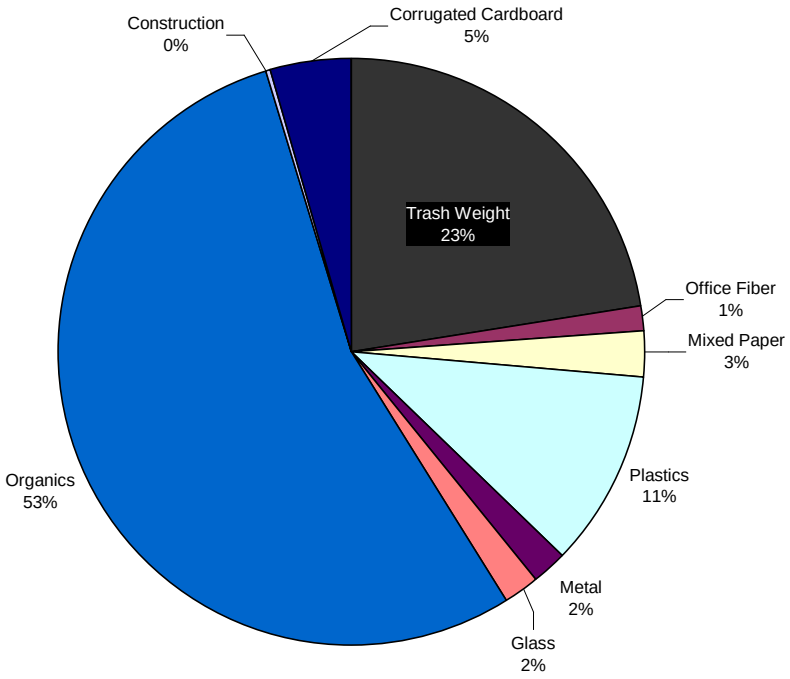


Total by area:

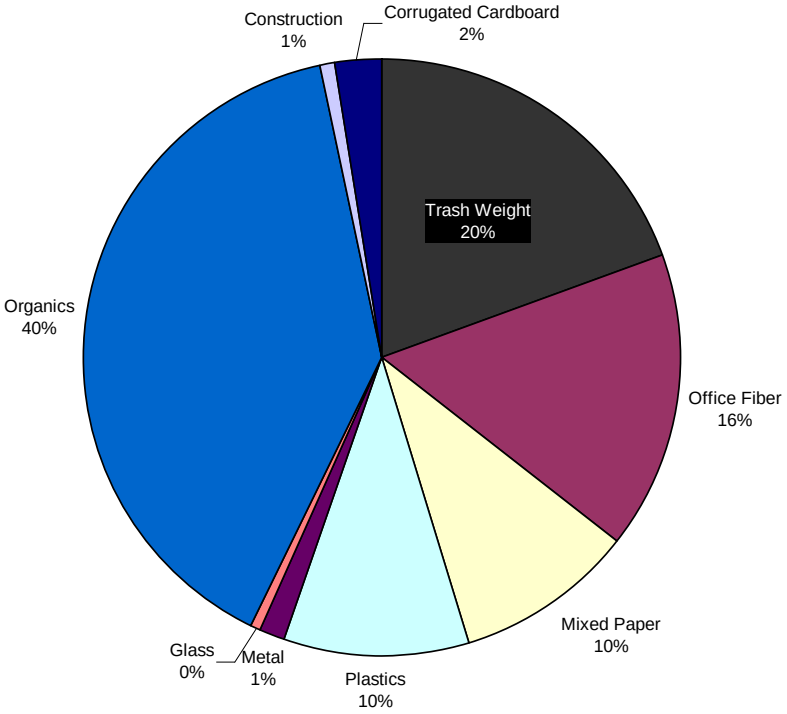




Total All Lounge/Library



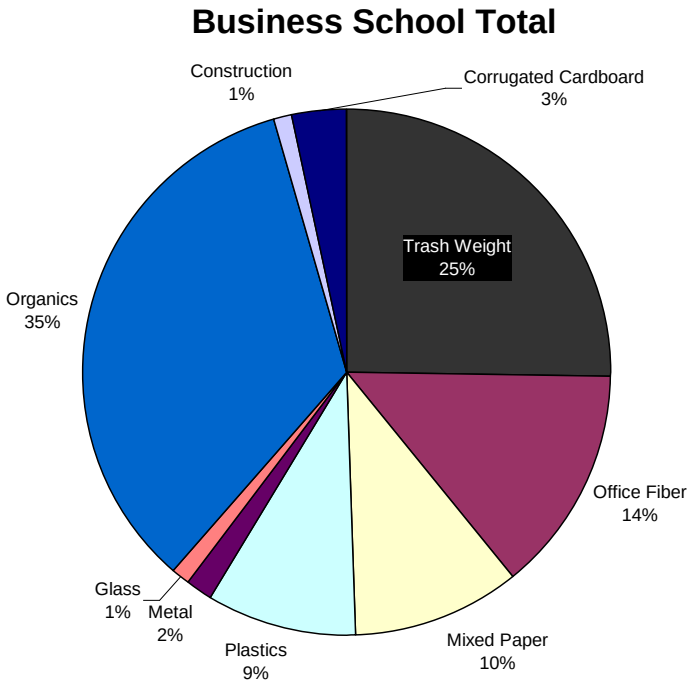
Total All Office

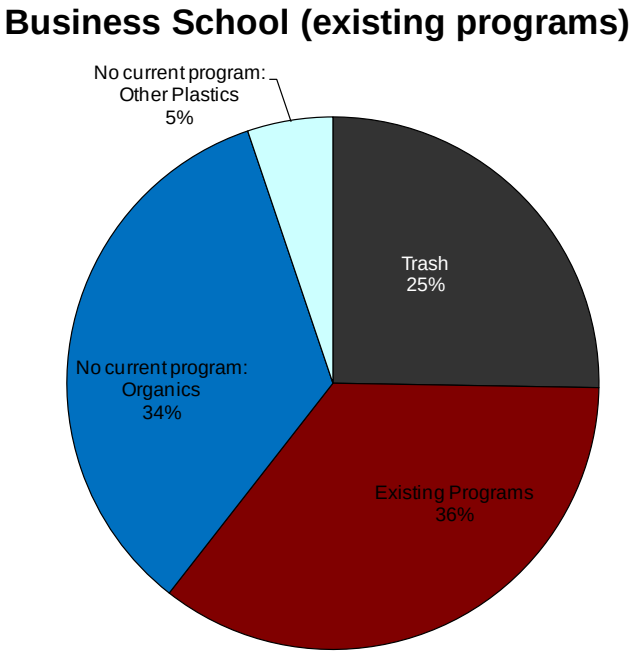


Business School

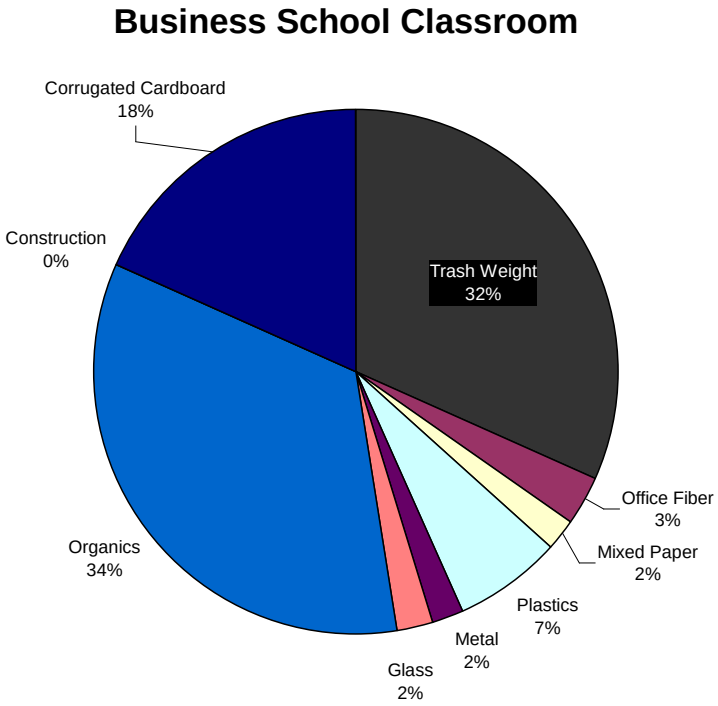
At the Business School, 28 bags weighing a total of 135.8 pounds were sampled.

The business school had the most diverse trash. Organics came in at 35% of the waste, while paper (a slightly higher ratio of office fiber to mixed paper) and trash each comprised 24%. Plastics made up 9%, with a higher percentage of that plastic being recyclable bottles than in the Union or Law School.

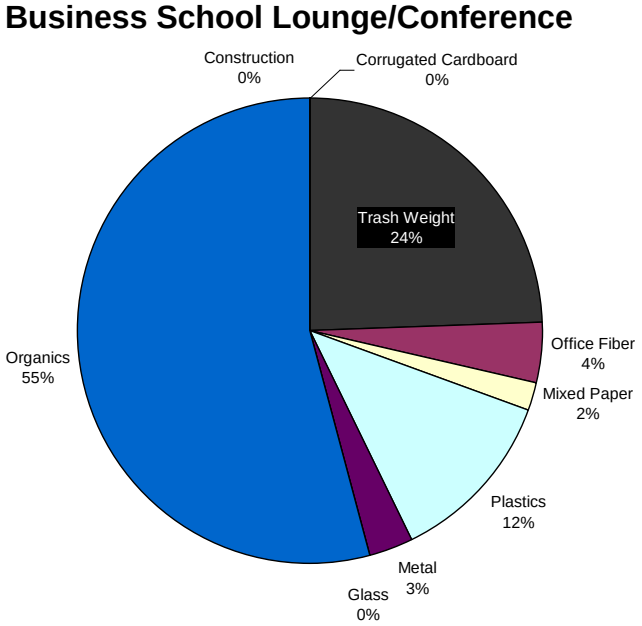




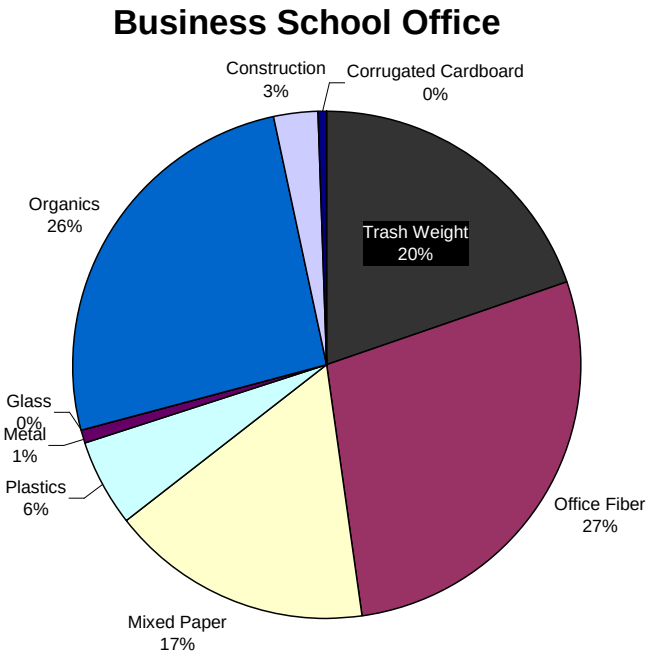
Classroom – In Business School classrooms, organics and trash made up 34% and 32% of the garbage, respectively, followed by corrugated cardboard (18%) and small amounts of paper and plastics. The high percentage of corrugated cardboard was due to an apparent pizza party.



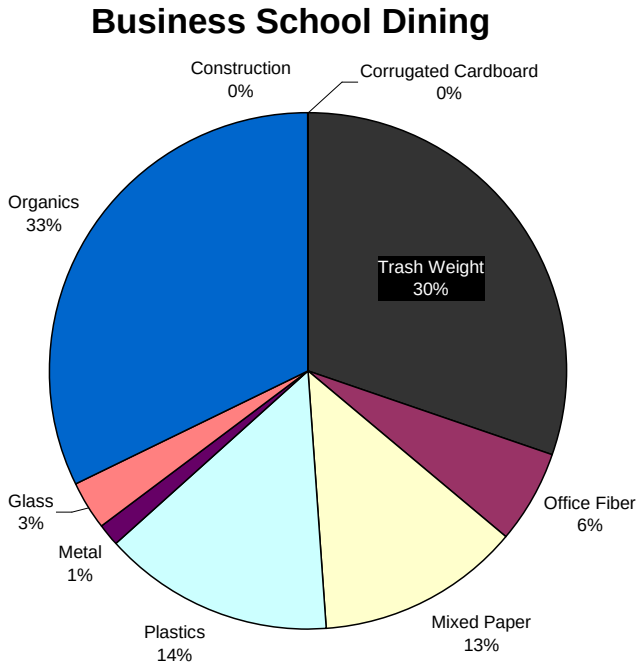
Lounge/Library/Conference – The three largest components were organics (55%), trash (24%), and plastics (12%). The team found lots of catered box lunches, including some that weren't even opened.



Office – Similar to the offices in the law school, the waste from the business school's offices was fairly diverse. Paper made up 34%, organics 26%, and trash 20%.



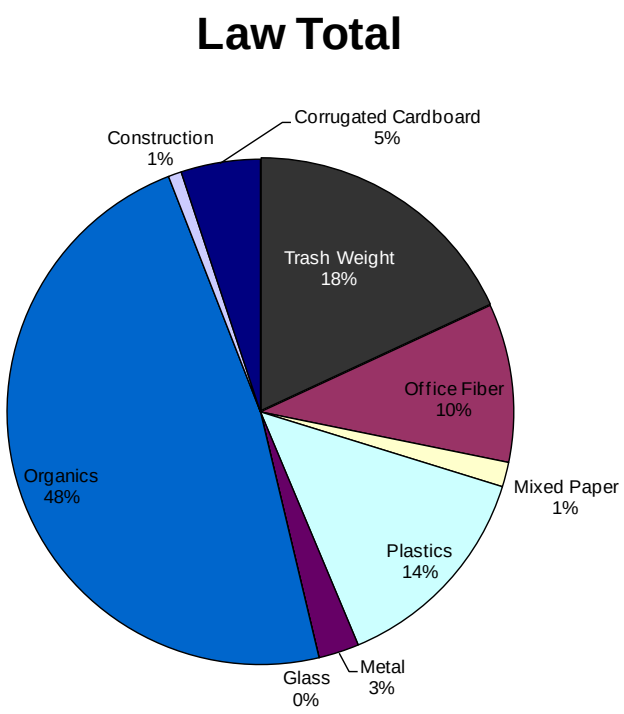
Dining – Of the three dining waste streams, the McColl Café's waste contained the lowest ratio of organics (33%). Trash made up 30%, paper 19%, and plastics 14%.

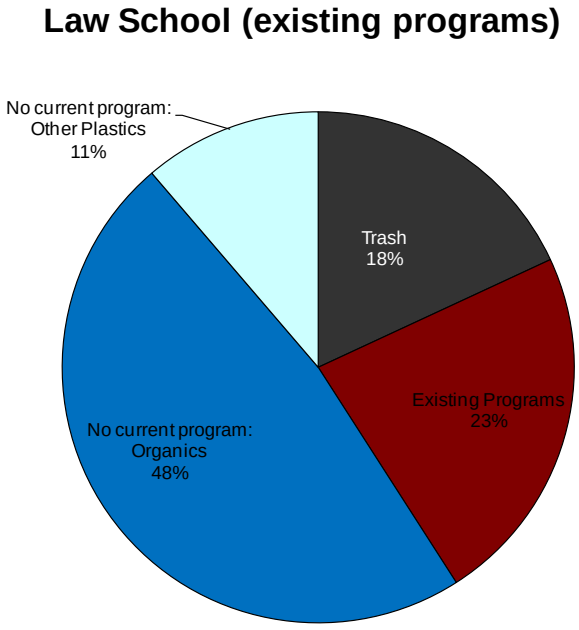


Law School

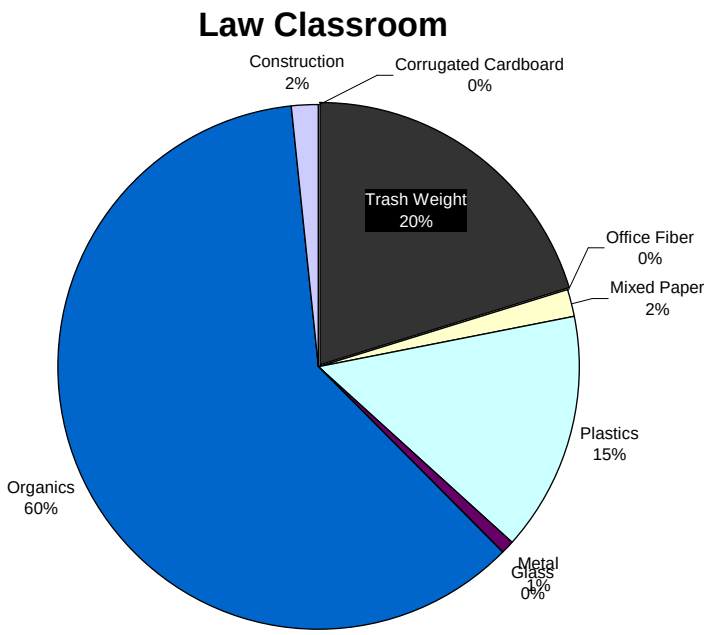
At the Law School, 24 bags weighing a total of 88.8 pounds were sampled.

Although not as much as organics (48%), there was more plastic in the law school waste than anywhere else (13%). Paper made up 12%, while trash made up 18%.

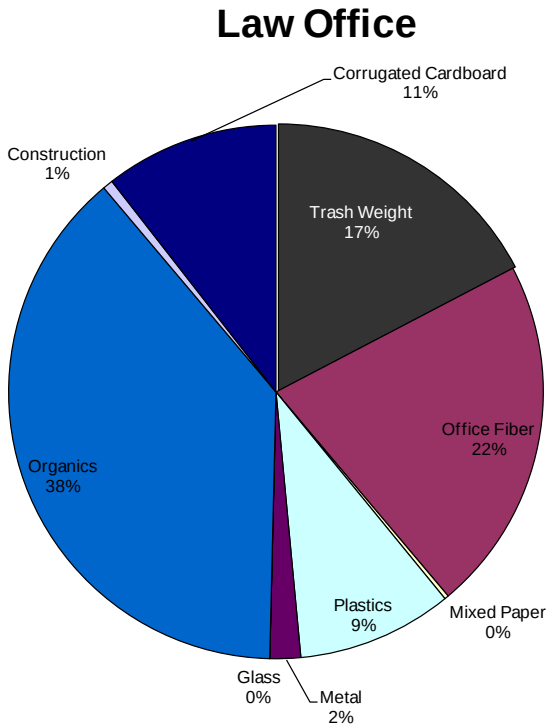




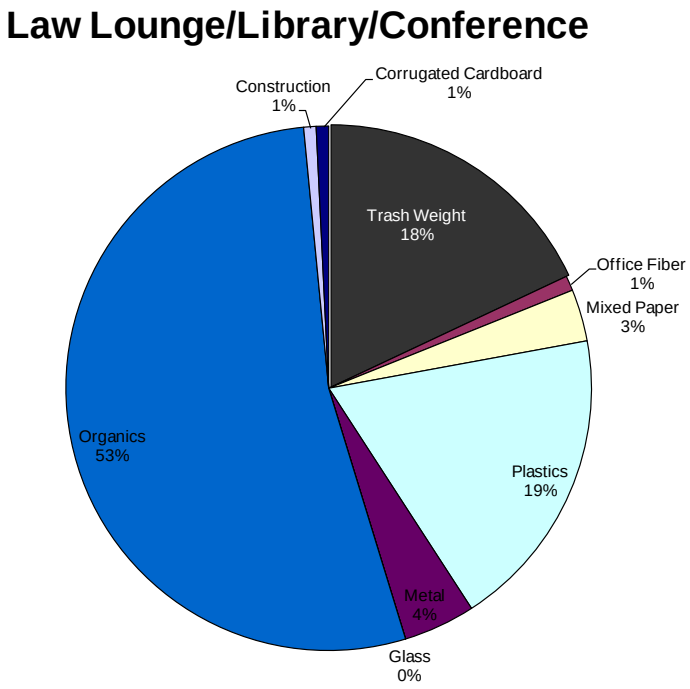
Classroom – Classroom waste in the Law School was almost all organics (60%), trash (20%), and plastics (15%).



Office – The two major materials at the Law School offices are organics and paper, which made up 38% and 22% of the waste, respectively, followed by plastics (22%) and trash (17%).



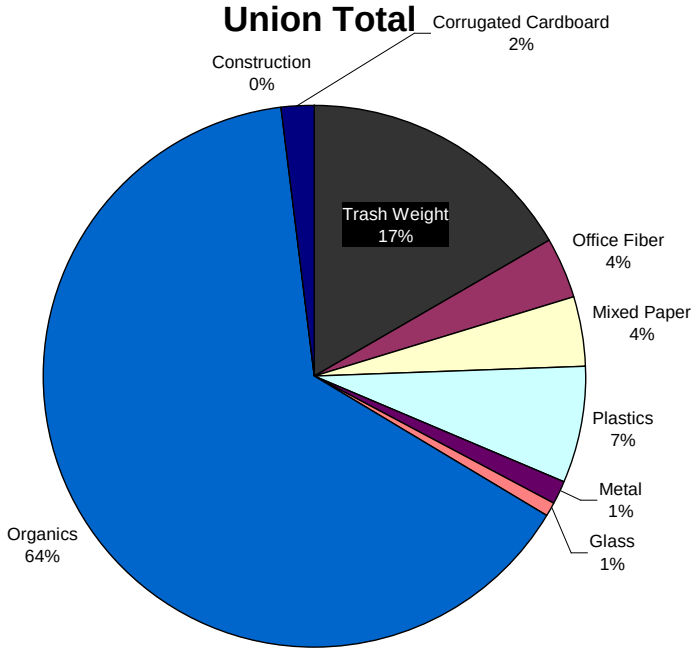
Lounge/Food/Library – 53% of this waste was organics, 19% was plastics, and 18% was trash.

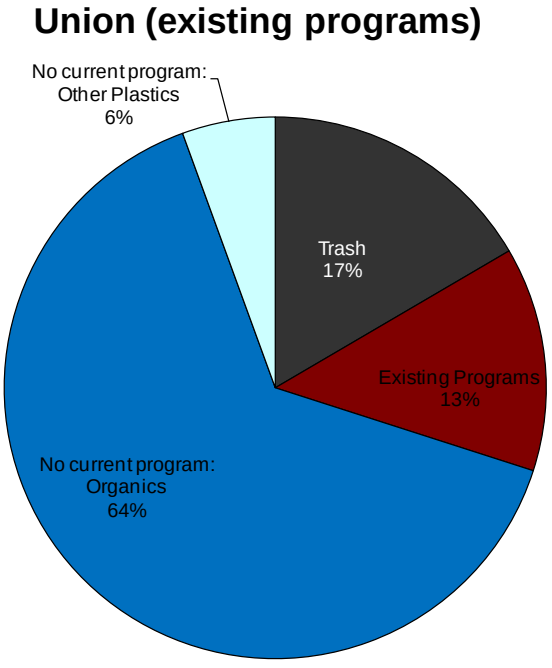


Union

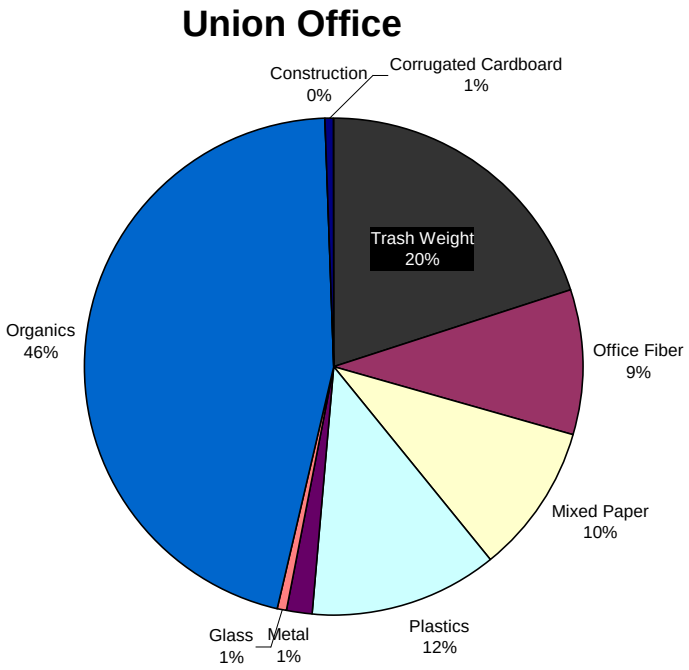
At the Union, 24 bags weighing a total of 340.2 pounds were sampled.

Organics dominated the Union's waste stream, comprising 64%. Other than trash, at 17%, the only other significant components were paper at 8% (half mixed paper, half office fiber), and plastics at 7%. Of the Union plastics, 70% was non-bottle-shaped, the highest of the three locations. Organics might be slightly inflated and paper slightly deflated because in our audit of the Union, the team categorized wet paper as organics.

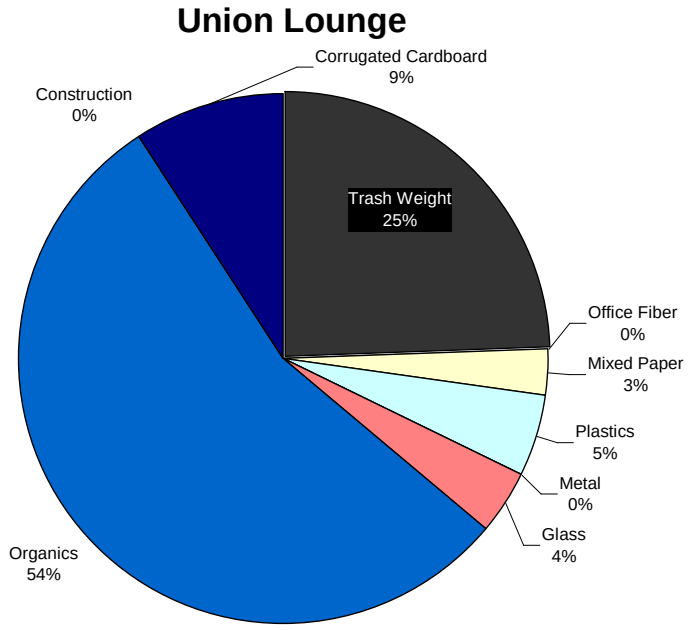




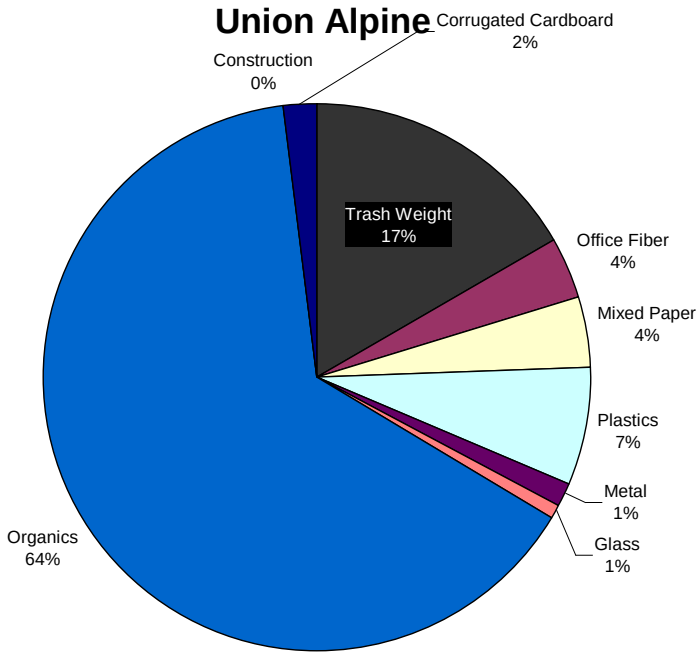
Office – What the team found the most of was organics, making up 46% of the total. Most of the Union's paper came from offices, although it still only made up 20% of office trash.



Lounge – Mostly organics (54%) and trash (25%), the lounge waste was high in corrugated cardboard (9%), and had surprisingly little paper (3%). Much of the corrugated cardboard was pizza boxes.

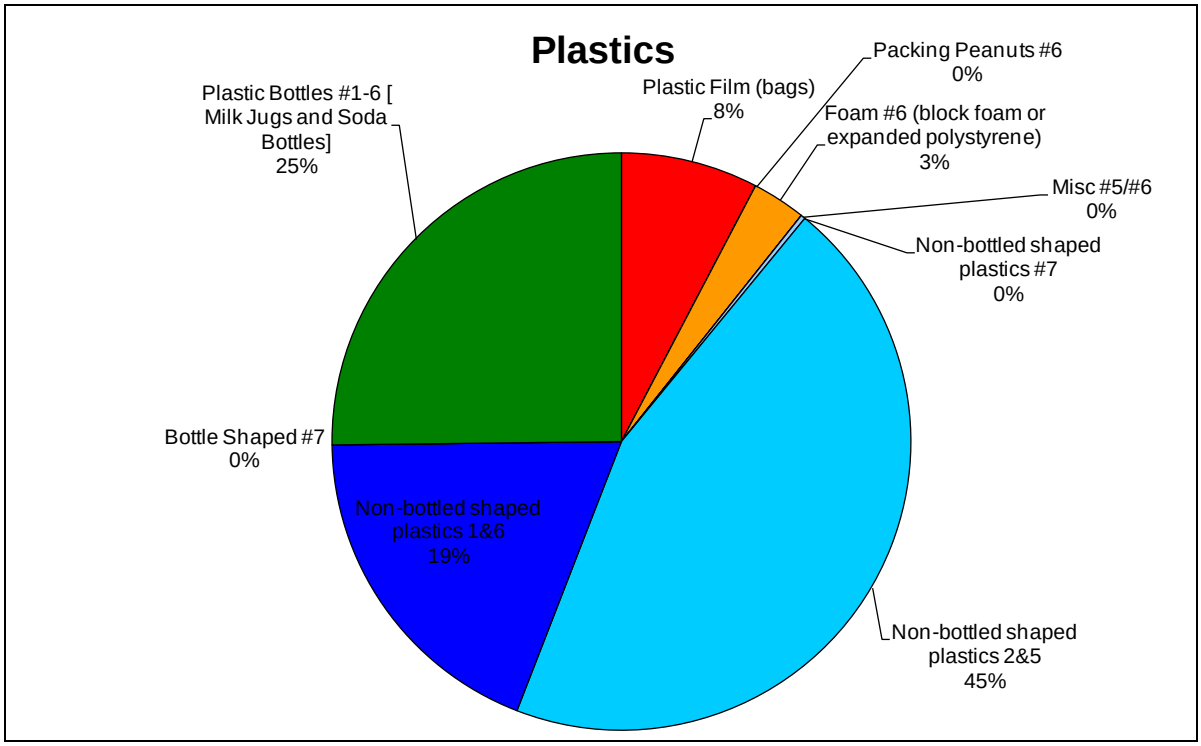


Alpine – Alpine trash was 64% organics and 17% trash. The team found lots of lettuce, deli meat, and one whole trash bag of freshly squeezed oranges. The back-of-the-house nature of this organic waste makes it a prime candidate for a composting program.

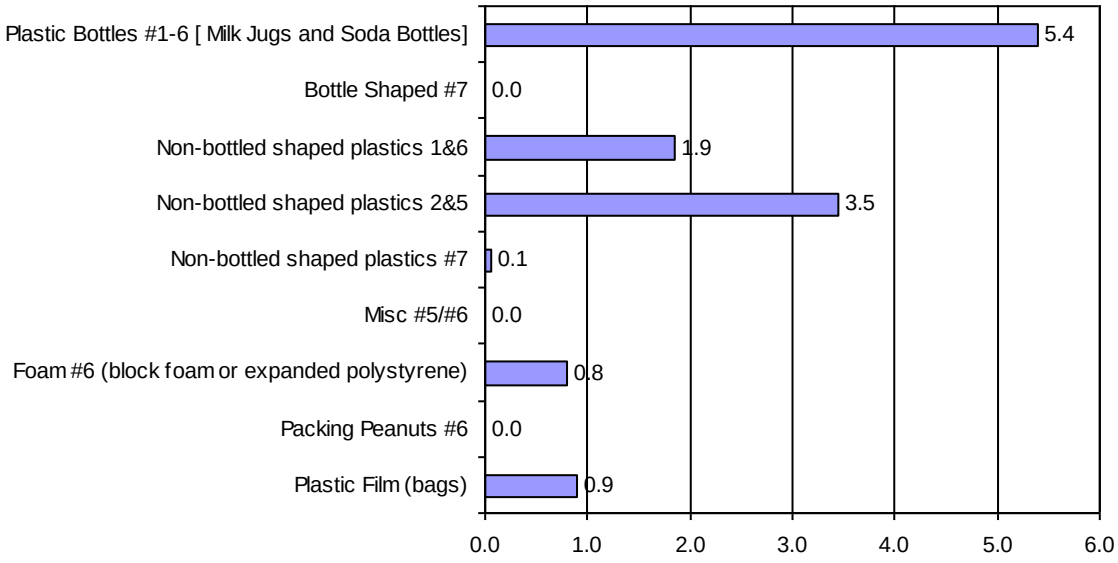


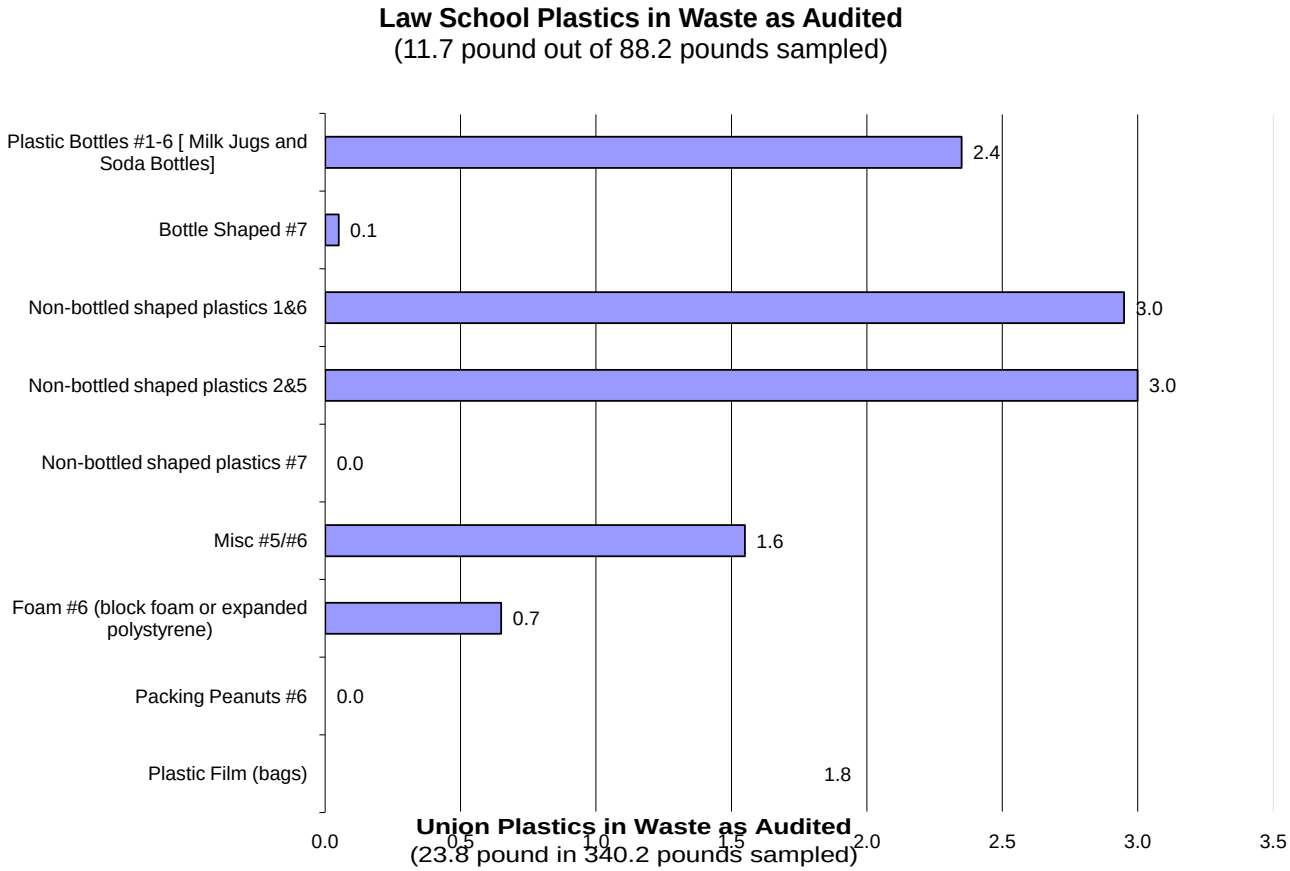
Total Plastics

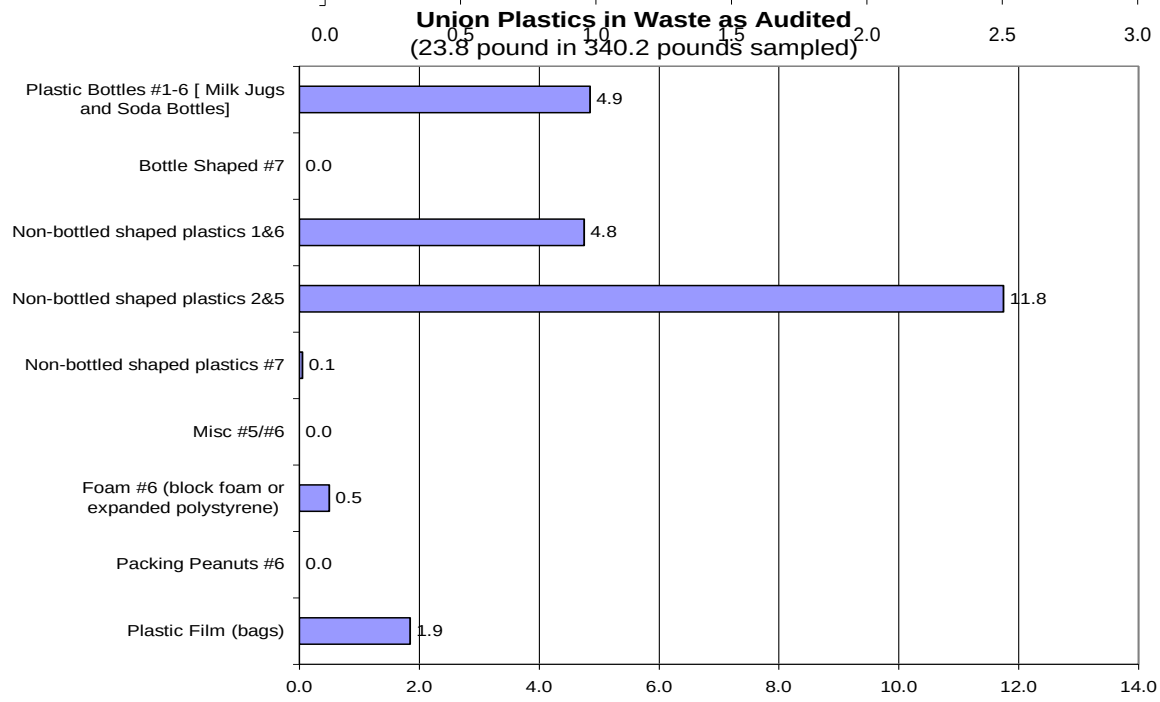
Most of the plastics the team found were non-bottle-shaped plastics (75%), which are not recyclable in most buildings on campus. (The lab program accepts some non-bottle plastics). Recyclable plastic bottles made up 25% of the plastic waste stream



Plastics in Business School Waste as Audited
(12.5 pounds out of 135.8 sampled)




Law School Plastics in Waste as Audited
(11.7 pound out of 88.2 pounds sampled)
Plastic Bottles #1-6 [Milk Jugs and Soda Bottles]
2.4
Bottle Shaped #7
0.1
Non-bottled shaped plastics 1&6
3.0
Non-bottled shaped plastics 2&5
3.0
Non-bottled shaped plastics #7
0.0
Misc #5/#6
1.6
Foam #6 (block foam or expanded polystyrene)
0.7
Packing Peanuts #6
0.0
Plastic Film (bags)
1.8
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5


Union Plastics in Waste as Audited
(23.8 pound in 340.2 pounds sampled)
Plastic Bottles #1-6 [Milk Jugs and Soda Bottles]
4.9
Bottle Shaped #7
0.0
Non-bottled shaped plastics 1&6
4.8
Non-bottled shaped plastics 2&5
11.8
Non-bottled shaped plastics #7
0.1
Misc #5/#6
0.0
Foam #6 (block foam or expanded polystyrene)
0.5
Packing Peanuts #6
0.0
Plastic Film (bags)
1.9
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

IV. Results and Comparison Assessment

The following is an overview of the percent change for office, dining and classroom spaces from 1995 Campus Waste Stream Assessment. These buildings were Bolin Creek Office Center, Lenoir Dining Hall, and Peabody Hall, respectively. For this waste assessment only the stream coming directly from the dumpsters was audited; in other words, this comparison does not include calculations made using weights from materials that had already been recycled.

Averaged Office Percent Change from 1995 Assessment of Bolin Creek Office Center:

For all of the office spaces combined, there was a 35% decrease in office fiber, 28% decrease in mixed paper, 83% increase in plastics, 55% decrease in metal, 100% decrease in glass, 210% increase in organics, and 2% increase in construction materials.

Averaged Dining Percent Change from 1995 Assessment of Lenoir Dining Hall:

For the combined dining areas, there was a 7% increase in office fiber, 44% decrease in mixed paper, 47% decrease in plastics, 77% decrease in metal, 54% decrease in glass, 29% decrease in organics, and a 7% increase in construction materials.

Average Classroom Percent Change from 1995 Assessment of Peabody Hall.

For the combined classroom areas, there was a 98% decrease in office fiber, 97% decrease in mixed paper, 45% increase in plastics, 70% decrease in metals, 85% decrease in glass, 300% increase in organics, and a 100% decrease in construction.

Percent Change from 1995 Combined Buildings to 2010 Combined Buildings:

From 1995 to 2010 for all three buildings and building types combined, there was a 42% decrease in office fiber, 56% decrease in mixed paper, 27% increase in combined plastics, 67% decrease in metals, 80% decrease in glass, 160% increase in organics, 30% decrease in construction material.

For these calculations, there are some discrepancies that may skew the results. In the 2010 audit, organics may be artificially high because wet paper was lumped in for the Union. It is also worth taking into account changes in demographics and recyclable material between 1995 and 2010. In 1995, UNC had approximately 19,000 students with about 8,000 living on campus. Today, there

are about 29,000 students attending UNC Chapel Hill. In 1995, about 6,828 tons of solid waste was land-filled and 1850 tons were recycled.

The following chart describes changes from the 1995 assessment to the current assessment for some of the most notable recyclable materials.

	(in tons)	
	FY 94-95	FY 09-10
aluminum cans	37	(see bottles/cans)
cardboard	177	827
glass bottles	192	(see bottles/cans)
plastic bottles	10	(see bottles/cans)
bottles/cans combined		222
computer paper	20	(see office paper)
white office paper	385	(see office paper)
office paper (white and colored paper)	128	479
mixed paper (boxboard, magazines, newspa	16	237
newspapers	309	(see mixed paper)
magazines	116	(see mixed paper)
food waste		469
(does not include everything recycled during the year)	1390	2234

Today aluminum cans, glass bottles and plastic bottles are mingled, and plastic bottles tend to make up a large majority compared to 1995, when the majority of items were aluminum cans and glass bottles. Mixed paper did not seem to be a strong point in the 1995 recycling program, while white office paper was the most significant paper recycling target. Today newspapers, magazines, and low-grade paper are combined, as are computer paper, colored paper, and white office paper. Between the assessments paper recycling has increased, with a decrease in the amount of newspaper recycled. This is most likely due to the increased popularity of online papers. Out of the 1995 organics, animal bedding, food waste, sawdust and landscaping waste had markets for recycling, including pig feed and compost (Coalition, 1995). One very obvious change between the two assessments is the dramatic jump in the amount of cardboard recycled. This could be because in 1995 cardboard and trash dumpsters were not paired together, or it may be that the campus is receiving more incoming cardboard now than in 1995. Changes in markets for recyclable materials between 1995 and 2010 probably influence the percent change in recyclables between the two

audits. It is important to note that there may be some inflated decreases in recyclable materials in the trash because of this.

Lounge Areas

As has been stated, this audit was not designed to replicate the 1995 Waste Stream Assessment. As such, the lounge areas and total building percentages found in this audit cannot be compared to the 1995 assessment, because the 1995 study did not include lounges as a type of room use.

However, the findings from the current audit are worth reporting as a new starting point. For lounge spaces, the average shares of the major categories in the current waste stream include 2% office fiber, 2% mixed paper, 14% plastics, 0.7% glass, 2% metal, 44% organics, and 2% construction material.

Average Building Weights:

The averaged building waste weights by percent are as follows: Office fiber was 8% of the total waste stream, mixed paper was 7%, plastics were 12%, metals were 1.5% glass was 2%, organics were 38%, and construction materials made up 2%. Trash made up approximately 30% of the total waste stream. Overall, this assessment shows that there was a campus-wide decrease in office fiber, decrease in mixed paper, and an increase in plastics, decrease in metal, decrease in glass, increase in organics, and a decrease in construction material from the total waste stream audited in 1995. Percent changes for each of these categories vary depending on space use type and may be influenced by differences in demographics and recycling behavior between the two time periods.

Plastic Breakdown:

The reported plastics in the total building statistics may be a misleading representation of recycling behavior on campus since this is a compilation of plastics rather than a breakdown into recyclable and non-recyclable subcategories. The following is a breakdown of percent change of plastic bottles in the current waste stream compared to plastic bottles found in the 1995 waste stream for each building space type.

From Bolin Creek office center's report of 13.23% in 1995, the Business School's office plastic bottles have decreased by 90% and those of the Law School have decreased by 91%.

From Lenoir's report of 9.46% from 1995, the business school's dining plastic bottles have decreased by 1% and Alpine Bagel in the student Union has shown a decrease of 100% with no plastic bottles found in their waste stream.

From Peabody's report of 5.92% in 1995, the business school's classroom plastic bottles have increased by 153% and the law school's classroom plastic bottles have decreased by 17%.

In sum, the average bottled plastics for all buildings were 2.5% of the total waste stream by weight. There was a significant decrease for office spaces averaging at 91%, a 51% decrease in bottled plastics in the audited dining areas, and a 67% increase in classroom spaces.

The findings from this comparison are overall pleasing but in some cases surprising. The large decreases in plastic bottles for office spaces and dining areas is encouraging, but further investigation into the increase of plastic bottles in classroom spaces might lead to better recycling management. For the total building assessment, which may be the most indicative of campus wide behaviors, it is satisfying to note that all recyclables have decreased, leaving an inflated percentage of organics as the largest component of the waste audit.

V. RECOMMENDATIONS

GOAL: Increase campus recycling

In the 1990s, the N.C. General Assembly set a goal for the State of North Carolina to reduce the municipal solid waste stream 40 % by 2001 –primarily through source reduction, reuse, recycling and composting."

OWRR and the UNC met this goal, but since 2001, the state has not updated the recommendation or set a new goal.

For the 2009-2010 school year, UNC had a 45% recycling level, with 55% of waste sent to a landfill.

The team recommends the Office sets a new goal to recycle 55%. In our assessments at the Student Union, the Business School and the Law School, 20% of items in the trash could be recycled under current OWRR recycling programs. Those items were office fiber, mixed paper, plastic bottles, metal, glass and corrugated cardboard. If all of those items were instead recycled in 2009-2010, that would have reduced the overall trash sent to the landfill by 1029 tons and increased the recycling level to 55%. While recycling is reliant on positive behavior from individuals, OWRR's policy decisions can facilitate better recycling on campus.

GOAL: Increase recycling of organics

Organics was the largest single percentage of types of waste found in the trash, and, in some buildings, represents a missed opportunity to reduce waste by diverting organics to compost.

The team recommends that organics from small and medium-sized dining facilities and coffee shops on campus should be collected and recycled. The team commends the organic recycling programs at Rams Head and Lenoir Dining Halls, but found many organics are still being trashed in other campus buildings.

There are three major ways to capture organic recycling on campus: —back of the house," with bins in kitchens and food preparation areas, post-consumer, with bins for customers to use in public areas like lounges, and temporary bins for special events.

In the short term, the team believes organic recycling efforts should focus on the –back of the house," as it would be simpler to train small numbers of staff and guarantee compliance.

The team supports OWRR's current program of offering to staff a compost bin at major events, and would encourage OWRR to greater publicize the program. In the long term, organics recycling and compost on the UNC campus requires further study.

The team recommends OWRR initiate further review of options and the feasibility of placing organic and compost bins in dining areas for post-consumer content and for use in special events. This review could be conducted by a future environmental capstone group.

A major concern is that unstaffed bins could become tainted by other items, such as trash or recyclables, because no one would staff the bins and explain what is compostable. In the future, it is possible that an education campaign, signs and proper placement of bins could produce usable compost from post-consumer materials.

If the individual dining locations do not produce enough waste for the organics contractor to visit the site for a pick up, the team does not believe this should be a barrier that stops organics collection from those areas.

The team recommends OWRR study the costs of two options and select the most cost-effective between using its own staff to collect the bins of organics and centralize them in one location, or pay the contractor extra to pick up from multiple sites.

GOAL: Increase recycling of office paper, plastic bottles and cardboard

The team recommends greater education of the importance of recycling to influence people's behavior.

To meet a new goal, such as increasing the recycling level to 55%, will require an aggressive commitment to education of faculty, staff, students and visitors to our University. Successful education, communication and marketing efforts can successfully change behavior, and will be necessary to increase the rate of recycling of office paper, plastic bottles [banned in landfills by N.C. statute] and cardboard [banned in landfills by Orange County ordinance]. The team supports OWRR's existing education efforts and partnerships with student groups; however, educational efforts could be enhanced by hiring additional staff, either permanent or temporary student interns, who work in educating the campus.

GOAL: Make recycling as convenient and accessible as trash disposal

The team recommends a goal of placing a recycling bin next to every trash bin, both indoors and outdoors.

For indoor locations, the team discussed two feasible options. The first would be to place small recycling bins next to each office, lounge or classroom trashcan. This option is complicated, as recycling staff may not have access to empty the bins during the day if the rooms were in use. The second option would be to pull small trash cans and have centralized waste stations in hallways and other areas, using larger trashcans and recycling bins.

In our interviews, there was a recurrent theme that people recycle when it is convenient. Most people are not going to carry a plastic bottle across campus until they see a recycling bin; they will drop it into the nearest bin they see.

The team recommends a goal of placing a recycling bin next to every trash bin outside so people walking on campus always have a chance to recycle.

If the Office could not budget purchasing additional Victor-Stanley trashcans, some Victor-Stanley trashcans could be removed and converted to recycling bins.

To cut costs in this area, the team identified a possible partnership between Grounds Services and OWRR. Grounds Services currently empties trash and OWRR empties recycling. If every station had both recycling and trash, the offices could alternate pickup or place one office in charge of all pickup.

GOAL: Partner with other departments to recycle niche products

In our interviews, people mentioned a concern for recycling or safely disposing of batteries, compact fluorescent light bulbs and print or toner ink cartridges. Currently, there is no clear, coherent campus-wide system for recycling these products.

The Department of Environment, Health and Safety coordinates efforts to recycle batteries, which contain acid, and compact fluorescent light bulbs, which contain mercury. The purchasing office accepts large toner cartridges from office printers and copiers, but smaller ink cartridges are collected separately.

The team recommends creating one central program for these products so people essentially have a one-stop way to recycle and safely dispose of potentially hazardous niche products. Such a program could incorporate a highly visible, permanent recycling center in the heart of campus, such as a clearly marked bin station in the Student Union. The photo below shows how Appalachian State University organized indoor bins for recycling CDs, batteries, cell phones, cell phone chargers, ink cartridges, plastic bags and compact fluorescent light bulbs. The team

believes a central bin station would be valuable in increasing recycling and could be set up in cooperation with Executive Branch of UNC's Student Government.

Appalachian State University Student Union Recycling Station

VI. APPENDIX

Obstacles:

The first challenge the team came upon with this project involved scheduling. As with any group collaboration effort, there were times when scheduling conflicts arose and only a few team members could participate in interviews, or several could not make it to an audit. Though this did not hinder the final product, more compatible schedules may have allowed for more efficient and plentiful data collection. It was also a challenge to get in touch with professors for interviews, more so than for any other profession or purpose.

During the audits themselves, the team found difficulty in sorting: There were many recyclables that were just too soiled to be counted as anything but trash; this also made it difficult to get a fully accurate reading on the proportion of true organics. Because the group had usually 5-7 members at audits, it lacked the manpower to spend time gathering a relatively large data sample at each audit location, or do audit enough buildings to get an assuredly accurate sample. If there were more time, more open schedules, and more members it would be possible to get a much more representative sample for the UNC community.

The team found it difficult to analyze the true percentage of materials that are not recycled at UNC because it did not weigh the recycled materials. This information would provide a lot of additional support for recycling program improvements.

The final obstacle with the project was interviewing the housekeeping staff, which posed a minor language barrier between the Spanish-speaking staff and the predominately non-Spanish-proficient capstone team. It was also difficult to coordinate interview times with the housekeeping staff, whose shifts mostly began around midnight or 4am. While this did not prevent us from acquiring the interviews, it was a challenge.

Interview Questions

For Students:

1) Do you recycle?
2) Where do you recycle? (desk side bins, centralized hallway locations, outdoor sites, other/ please specify)
3) What materials do you recycle?
4) Do you know what materials can be recycled in the bins in this building?
5) What materials would you like to recycle but can't currently?
6) What would make you want to recycle more? (location, incentives, materials, other/ please specify)
7) Is recycling convenient in this building?
8) What could make recycling more convenient in this building?
9) Do you know that there is a landfill ban on plastic bottles, aluminum cans and corrugated cardboard?
10) Does this information provide an incentive for you to recycle more?
11) Why do you recycle?
12) How do you get information about campus recycling?
13) I s there anything else you would like us to know about your recycling experience on campus?
14) If you do not recycle, what would encourage you to do so?

Interview Questions

For Staff:

1) Do you recycle?
2) Where do you recycle? (desk bins, centralized hallway locations, outdoor sites, other/please specify)
3) What materials do you recycle?
4) Do you know what materials can be recycled in the bins in this building?
5) What materials would you like to recycle but can't currently?
6) What would make you want to recycle more? (location, incentives, materials, other/ please specify)
7) Is recycling convenient in this building?
8) What could make recycling more convenient in this building?
9) Do you see users of this building actively recycling and/or reducing their waste output?
10) Are there any sections of this building that are lacking in recycling bins? For what materials?
11) What do you believe could be done to increase recycling in this building?
12) Why do you recycle?
13) I s there anything else you would like us to know about your recycling experience on campus?
14) If you do not recycle, what would encourage you to do so?

Interview Questions

For Faculty:

1) Do you recycle?
2) Where do you recycle? (desk bins, centralized hallway locations, outdoor sites, other/please specify)
3) What materials do you recycle?
4) Do you know what materials can be recycled in the bins in this building?
5) What materials would you like to recycle but can't currently?
6) What would make you want to recycle more? (location, incentives, materials, other/ please specify)
7) Is recycling convenient in this building?
8) What could make recycling more convenient in this building?
9) How much emphasis to you place on recycling in your work environment and classrooms? Is it a priority in your work space?
10) Do you ever mention recycling to your students? (ie- do you ask them to recycle old papers, lab materials, etc?)
11) Do you see users of this building actively recycling and/or reducing their waste output?
12) Are there any sections of this building that are lacking in recycling bins? For what materials?
13) What do you believe could be done to increase recycling in this building?
14) Why do you recycle?
15) I s there anything else you would like us to know about your recycling experience on campus?
16) If you do not recycle, what would encourage you to do so?

Interview Questions

For Housekeeping Staff:

1) Do you recycle?
2) What materials would you like to see recycled but are not currently?
3) Is recycling convenient for the users of this building?
4) What could make recycling more convenient in this building?
5) Do you see users of this building actively recycling and/or reducing their waste output?
6) Do users of this building favor some recycling sites over others?
7) Are there any sections of this building that are lacking in recycling bins? For what materials?
8) What do you believe could be done to increase recycling in this building?
9) Why do you recycle?
10) I s there anything else you would like us to know about your recycling experience on campus?
11) If you do not recycle, what would encourage you to do so?

Audit Images

Union Audit
Photo by Amy Preble

Union Audit
Photo by Amy Preble

Law School Audit
Photo by Cori Fowler

Law School Audit
Photo by Cori Fowler

ADDITIONAL DATA TABLES

Business School (Weight in pounds)

Waste Category--Business School	Dining	Classroom	Office	L/L/CS	Total	% Dining	% classroc	% Office	% L/L/CS	Total
Trash Weight	10.0	7.4	10.6	6.4	34.3	7.3%	5.5%	7.8%	4.7%	25.3%
Office Fiber	2.0	0.7	15.0	1.1	18.8	1.5%	0.5%	11.0%	0.8%	13.8%
White	1.7	0.4	10.4	1.1	13.5	1.3%	0.3%	7.7%	0.8%	9.9%
Fiber	0.3	0.4	4.6		5.3	0.2%	0.3%	3.4%	0.0%	3.9%
Mixed Paper	4.2	0.5	8.9	0.6	14.1	3.1%	0.3%	6.6%	0.4%	10.4%
Newspaper	1.2	0.4	2.9	0.1	4.5	0.8%	0.3%	2.1%	0.0%	3.3%
Magazines and Catalogs			3.1		3.1	0.0%	0.0%	2.3%	0.0%	2.3%
Boxboard (non-corrugated cardboard)	3.1	0.1	2.9	0.5	6.6	2.2%	0.1%	2.1%	0.4%	4.8%
Plastics	4.8	1.6	3.0	3.2	12.5	3.5%	1.1%	2.2%	2.4%	9.2%
Plastic Film (bags)	0.3	0.2	0.2	0.2	0.9	0.2%	0.1%	0.1%	0.1%	0.7%
Packing Peanuts #6	0.0	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%
Foam #6 (block foam or expanded polystyrene)	0.2	0.1	0.5	0.1	0.8	0.1%	0.1%	0.3%	0.1%	0.6%
Misc #5/#6	0.0	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%
Non-bottled shaped plastics #7	0.0	0.1	0.0	0.0	0.1	0.0%	0.0%	0.0%	0.0%	0.0%
Non-bottled shaped plastics 2&5	1.0	0.4	1.2	1.0	3.5	0.7%	0.3%	0.9%	0.7%	2.5%
Non-bottled shaped plastics 1&6	0.3	0.5	0.4	0.7	1.9	0.2%	0.4%	0.3%	0.5%	1.4%
Bottle Shaped #7	0.0	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%
Plastic Bottles #1-6 [Milk Jugs and Soda Bottles]	3.1	0.4	0.7	1.3	5.4	2.3%	0.3%	0.5%	0.9%	4.0%
Metal	0.5	0.5	0.5	0.8	2.1	0.3%	0.3%	0.3%	0.6%	1.5%
Aluminum Cans	0.5	0.5	0.3	0.8	2.0	0.3%	0.3%	0.2%	0.6%	1.5%
Steel/Tin Cans			0.1		0.1	0.0%	0.0%	0.0%	0.0%	0.0%
Glass	1.0	0.5	0.0	0.0	1.5	0.7%	0.4%	0.0%	0.0%	1.1%
Food and Beverage bottles and Jars	1.0	0.5			1.5	0.7%	0.4%	0.0%	0.0%	1.1%
Other glass (lab glass, ceramics, window glass, non-food/beverage glass)						0.0%	0.0%	0.0%	0.0%	0.0%
Organics	10.7	8.0	13.7	14.2	46.5	7.8%	5.9%	10.1%	10.4%	34.3%
Landscape waste						0.0%	0.0%	0.0%	0.0%	0.0%
Food waste (food/food wrapping, soiled paper recyclables, soiled newspapers, soiled boxboard, soiled fiber paper)	10.7	8.0	13.7	14.2	46.5	7.8%	5.9%	10.1%	10.4%	34.3%
Textiles						0.0%	0.0%	0.0%	0.0%	0.0%
Tires/Rubber						0.0%	0.0%	0.0%	0.0%	0.0%
Wood						0.0%	0.0%	0.0%	0.0%	0.0%
Construction	0.0	0.0	1.6	0.0	1.6	0.0%	0.0%	1.2%	0.0%	1.2%
Ceiling Tiles						0.0%	0.0%	0.0%	0.0%	0.0%
Carpet						0.0%	0.0%	0.0%	0.0%	0.0%
Toner Cartridge			1.6		1.6	0.0%	0.0%	1.2%	0.0%	1.2%
Corrugated Cardboard		4.3	0.3	0.0	4.5	0.0%	3.1%	0.2%	0.0%	3.3%
Total Weight	33.0	23.3	53.4	26.2	135.8	24.3%	17.2%	39.3%	19.3%	100.0%
Total Bags	7.0	7.0	7.0	7.0	28.0					

Law School (Weight in Pounds)

Waste Category--Law School	Classroom	Office	L/L/F	Total	% classroom	% office	% L/L/F	% Total
Trash Weight	3.2	7.0	5.9	16.1	3.5%	7.9%	6.6%	18.1%
Office Fiber	0.0	8.7	0.3	9.0	0.0%	9.8%	0.3%	10.1%
White		8.7	0.3	9.0	0.0%	9.8%	0.3%	10.1%
Fiber				0.0	0.0%	0.0%	0.0%	0.0%
Mixed Paper	0.3	0.1	1.1	1.4	0.3%	0.1%	1.2%	1.6%
Newspaper	0.3		0.3	0.6	0.3%	0.0%	0.3%	0.6%
Magazines and Catalogs				0.0	0.0%	0.0%	0.0%	0.0%
Boxboard (non-corrugated cardboard)		0.1	0.8	0.9	0.0%	0.1%	0.8%	1.0%
Plastics	2.4	3.8	6.2	12.4	2.7%	4.3%	6.9%	13.9%
Plastic Film (bags)	0.4	0.9	0.6	1.8	0.4%	1.0%	0.6%	2.0%
Packing Peanuts #6				0.0	0.0%	0.0%	0.0%	0.0%
Foam #6 (block foam or expanded polystyrene)	0.1	0.4	0.2	0.7	0.1%	0.5%	0.2%	0.7%
Misc #5/#6			1.6	1.6	0.0%	0.0%	1.7%	1.7%
Non-bottled shaped plastics #7				0.0	0.0%	0.0%	0.0%	0.0%
Non-bottled shaped plastics 2&5	0.5	1.2	1.3	3.0	0.6%	1.4%	1.5%	3.4%
Non-bottled shaped plastics 1&6	0.7	0.7	1.6	3.0	0.8%	0.8%	1.7%	3.3%
Bottle Shaped #7			0.1	0.1	0.0%	0.0%	0.1%	0.1%
Plastic Bottles #1-6 [Milk Jugs and Soda Bottles]	0.8	0.6	1.0	2.4	0.8%	0.7%	1.1%	2.6%
Metal	0.1	0.8	1.5	2.3	0.1%	0.8%	1.6%	2.6%
Aluminum Cans	0.1	0.8	1.4	2.3	0.1%	0.8%	1.6%	2.5%
Steel/Tin Cans			0.1	0.1	0.0%	0.0%	0.1%	0.1%
Glass	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%
Food and Beverage bottles and Jars				0.0	0.0%	0.0%	0.0%	0.0%
Other glass (lab glass, ceramics, window glass, non-food/beverage glass)				0.0	0.0%	0.0%	0.0%	0.0%
Organics	9.5	15.6	17.5	42.5	10.6%	17.5%	19.7%	47.8%
Landscape waste				0.0	0.0%	0.0%	0.0%	0.0%
Food waste (food/food wrapping, soiled paper recyclables, soiled newspapers, soiled boxboard, soiled fiber paper)	9.5	15.6	17.5	42.5	10.6%	17.5%	19.7%	47.8%
Textiles				0.0	0.0%	0.0%	0.0%	0.0%
Tires/Rubber	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%
Wood				0.0	0.0%	0.0%	0.0%	0.0%
Construction	0.3	0.3	0.3	0.8	0.3%	0.3%	0.3%	0.8%
Ceiling Tiles				0.0	0.0%	0.0%	0.0%	0.0%
Carpet	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%
Toner Cartridge				0.0	0.0%	0.0%	0.0%	0.0%
Corrugated Cardboard	0.0	4.3	0.3	4.5	0.0%	4.8%	0.3%	5.1%
Total Weight	15.6	40.4	32.8	88.8	17.6%	45.5%	36.9%	100.0%
Total Number of Bags Sampled	8.0	8.0	8.0	24.0				

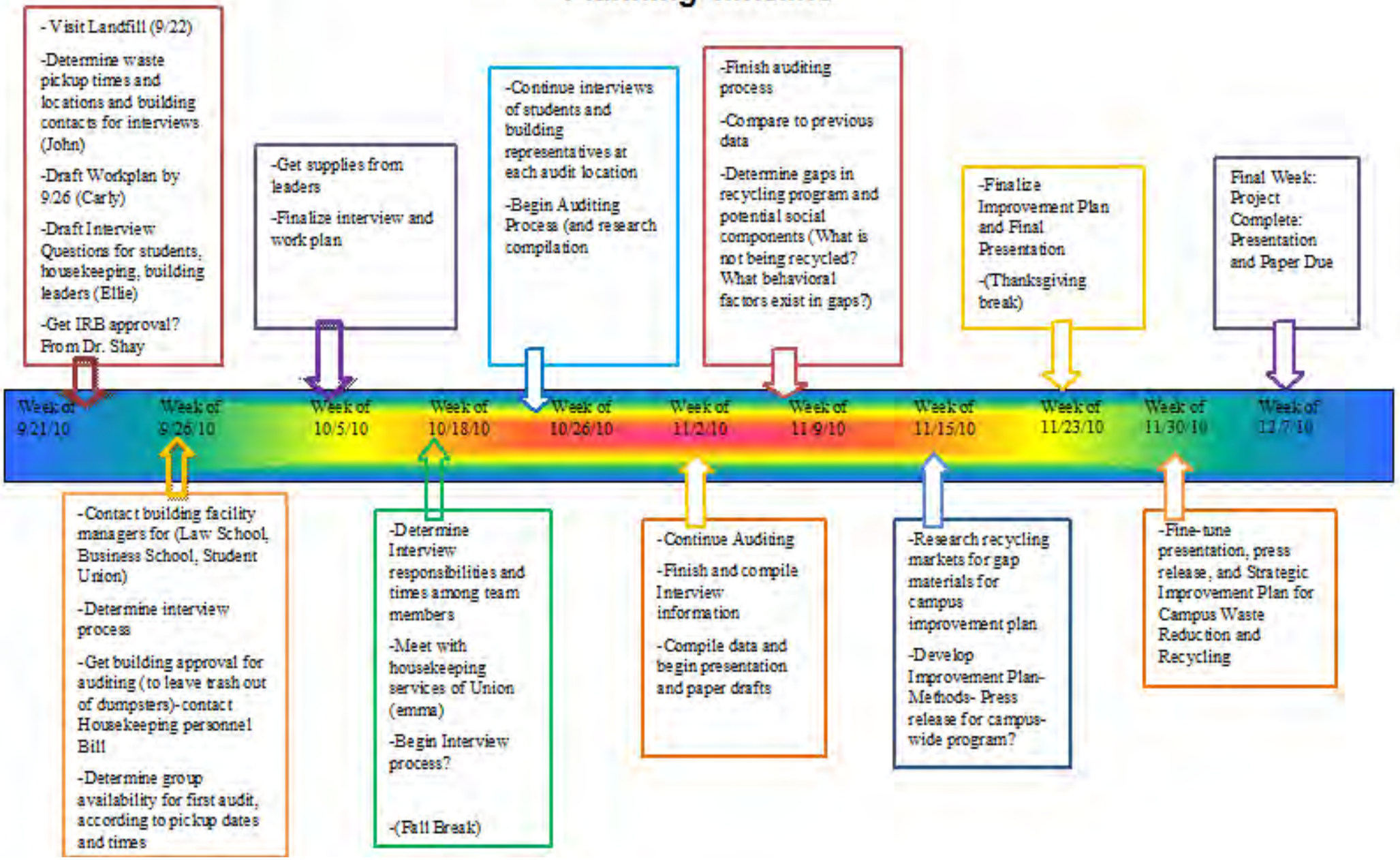
Union (Weight in Pounds)

Waste Category--Union	Office	Lounge	Alpine	Total	% Office	% Lounge	% Alpine	% Total
Trash Weight	26.5	12.9	17.0	56.4	7.8%	3.8%	5.0%	16.6%
Office Fiber	12.4	0.0	0.0	12.4	3.6%	0.0%	0.0%	3.6%
White	9.3			9.3	2.7%	0.0%	0.0%	2.7%
Fiber	3.2			3.2	0.9%	0.0%	0.0%	0.9%
Mixed Paper	12.8	1.4	0.1	14.3	3.8%	0.4%	0.0%	4.2%
Newspaper	6.6	0.5	0.1	7.2	1.9%	0.1%	0.0%	2.1%
Magazines and Catalogs	3.6	0.8		4.4	1.1%	0.2%	0.0%	1.3%
Boxboard (non-corrugated cardboard)	2.6	0.1		2.7	0.8%	0.0%	0.0%	0.8%
Plastics	16.2	2.8	4.9	23.8	4.7%	0.8%	1.4%	7.0%
Plastic Film (bags)	0.7	0.3	1.0	1.9	0.2%	0.1%	0.3%	0.5%
Packing Peanuts #6				0.0	0.0%	0.0%	0.0%	0.0%
Foam #6 (block foam or expanded polystyrene)	0.4	0.1		0.5	0.1%	0.0%	0.0%	0.1%
Misc #5/#6				0.0	0.0%	0.0%	0.0%	0.0%
Non-bottled shaped plastics #7	0.1			0.1	0.0%	0.0%	0.0%	0.0%
Non-bottled shaped plastics 2&5	8.0	0.2	3.6	11.8	2.2%	0.0%	1.0%	3.2%
Non-bottled shaped plastics 1&6	3.1	1.4	0.3	4.8	0.9%	0.4%	0.1%	1.3%
Bottle Shaped #7				0.0	0.0%	0.0%	0.0%	0.0%
Plastic Bottles #1-6 [Milk Jugs and Soda Bottles]	4.0	0.9		4.9	1.1%	0.2%	0.0%	1.3%
Metal	2.0	0.0	2.9	4.9	0.6%	0.0%	0.9%	1.4%
Aluminum Cans	2.0			2.0	0.6%	0.0%	0.0%	0.6%
Steel/Tin Cans			2.9	2.9	0.0%	0.0%	0.9%	0.9%
Glass	0.9	2.0	0.0	2.9	0.3%	0.6%	0.0%	0.9%
Food and Beverage bottles and Jars	0.9	2.0		2.9	0.3%	0.6%	0.0%	0.9%
Other glass (lab glass, ceramics, window glass, non-food/beverage glass)				0.0	0.0%	0.0%	0.0%	0.0%
Organics	60.1	28.7	130.7	219.4	17.7%	8.4%	38.4%	64.5%
Landscape waste				0.0	0.0%	0.0%	0.0%	0.0%
Food waste (food/food wrapping, soiled paper recyclables, soiled newspapers, soiled boxboard, soiled fiber paper)	60.1	28.7	130.7	219.4	17.7%	8.4%	38.4%	64.5%
Textiles				0.0	0.0%	0.0%	0.0%	0.0%
Tires/Rubber				0.0	0.0%	0.0%	0.0%	0.0%
Wood				0.0	0.0%	0.0%	0.0%	0.0%
Construction	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%
Ceiling Tiles				0.0	0.0%	0.0%	0.0%	0.0%
Carpet				0.0	0.0%	0.0%	0.0%	0.0%
Toner Cartridge				0.0	0.0%	0.0%	0.0%	0.0%
Corrugated Cardboard	0.9	4.9	0.5	6.3	0.3%	1.4%	0.1%	1.8%
Total Weight	131.6	52.6	156.0	340.2	38.7%	15.4%	45.9%	100.0%
Total Number of Bags Sampled	10.0	10.0	4.0	24.0				
1) Totals for the original table were incorrect and off by almost 300 tons. The whole column was summed vs. the subtotals.								

Team Members: John Allen, Emma Anderson, Carly Buch, Cori Fowler, Ellie Kuhn, Julian March

Updated: October 7, 2010

OWRR Waste Audit and Strategic Planning Timeline



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