



PLASTIC FILM RECOVERY

Executive summary

This project developed and implemented a pilot plastic film recycling model for a shopping center in Chapel Hill, North Carolina. Working with representatives of the Orange County (North Carolina) Solid Waste Management Department, Harris Teeter grocery chain, and the American Chemistry Council, this team took inspiration from the trash vs. treasure notion that one person's (or organization's) waste is another's resource. Plastic film serves as raw material for the composite lumber industry, among other other applications. As a large supermarket company with multiple locations that handle vast quantities of plastic film, Harris Teeter is able to collect, bale, and sell their waste plastic film for reuse by composite lumber manufacturers. This project sought to enlist other stores in a shopping center anchored by a Harris Teeter store, in a model of cooperative plastic film recovery and diversion from the waste stream.

The team surveyed small-store owners before and after the pilot, audited the waste at the shopping center, estimated the volume by category, collected and logged plastic film for delivery to the grocery anchor, and provided recommendations for future activities. As spin-off benefits, they identified the need for other recycling services, which were put in place and reduced other waste during the course of the project.

Lessons Learned

- Identify and enlist key partners: local government, property manager, major retail outlet, sources of funding
- Identify potential participants: retail, universities, industry, other producers of plastic film
- Create a schedule and determine major project goals (allowing enough time for the unpredicted and for follow-up)
- Determine which method of communication is most efficient for various businesses: in person, phone, or email
- Create an educational campaign and distribute general information to targeted businesses
- Try to find potential economic and/or environmental incentives to encourage participation
- Get personal! Find managers, employees, owners, etc., who will be supportive and assist them in any way possible

Plastic Film Recycling Initiative

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Introduction

At UNC-Chapel Hill, all students majoring in Environmental Science or Studies, or minoring in Sustainability, participate in a capstone project. The projects involve partnering with institutions or organizations from the outside community to achieve real-world environmental goals and give students experience in the environmental field before graduation.

Background/Purpose

The purpose of this project is to develop and implement an autonomously operating plastic film recycling model for a shopping center in Chapel Hill, North Carolina. Interest in this project arose from concerns of the Orange County Solid Waste Management Department about the volume of reclaimable plastic film being disposed of in the county's landfill. Plastic film makes up an estimated 6% of the waste stream entering the Orange County landfill; with the landfill expected to fill by 2011, reducing the volume of incoming plastic film through increased recycling offers a potentially valuable route for preserving scarce landfill space.¹ Plastic film waste, which can be recycled, includes clean and dry plastic film labeled #2 and #4 (high-density polyethylene and low-density polyethylene film).

This project takes inspiration from the trash vs. treasure notion that one person's (or organization's) waste is another's resource. Plastic film serves as raw material for the composite lumber industry, as well as having other applications. As a large company with multiple locations that handle vast quantities of plastic film, Harris Teeter finds it commercially viable to

¹ Orange County Waste Characterization Study. Rep. no. 3-9. Apr. 2005. Orange County Department of Solid Waste. 5 May 2009 <<http://www.co.orange.nc.us/recycling/docs/WasteSort2005/Summary2005.pdf>>.

collect, bale, and sell their waste plastic film for reuse by composite lumber manufacturers. In cooperation with Harris Teeter and Orange County Solid Waste Management, the UNC Institute for the Environment Capstone program began working with the other stores in the shopping center surrounding Harris Teeter to engage them in Harris Teeter's existing plastic film recycling scheme.

Materials and Methods

The project began with meetings of the six-member student project team with Blair Pollock (Solid Waste Planner with Orange County Solid Waste Management), Dawn Reeves (Manager of Environmental Sustainability for Harris Teeter), and Nina Bellucci Butler (Moore Recycling Associates and American Chemistry Council). The interested parties mapped out a semester-long initiative to examine the potential reduction of plastic waste volume through the development of a collection system that diverts the plastic film from the waste stream and into Harris Teeter's bale stock.

Following the initial meetings, the student team toured the landfill for a first-hand view of the county's waste collection system, and went behind the scenes to look at Harris Teeter's existing plastic film recycling practices at the back of the store. The landlord provided an initial list of shopping center tenants and contact information.

Before making direct contact with the individual shopping center tenants, the capstone team drafted an introductory letter to be sent out by the landlord of the shopping center, describing the project and professing institutional support. The next step was preparing and distributing an initial survey to gather information on the tenants' current waste disposal practices. Part of the survey requested permission from the tenants to place plastic film recycling bins in the front and/or back of the store. Other questions focused on the amount of plastic film produced by each business, the volume and shared usage of shopping center dumpsters, and the current costs to individual stores of regular trash collection. A cover letter attached to the surveys introduced the project team and outlined the tentative plan. An informational memo was included as well, to illustrate the types and acceptable conditions of recyclable plastic film. To collect the survey

data, team members contacted tenants and conducted follow-up interviews by phone or in person. In general, store managers were more receptive to in-person contact.

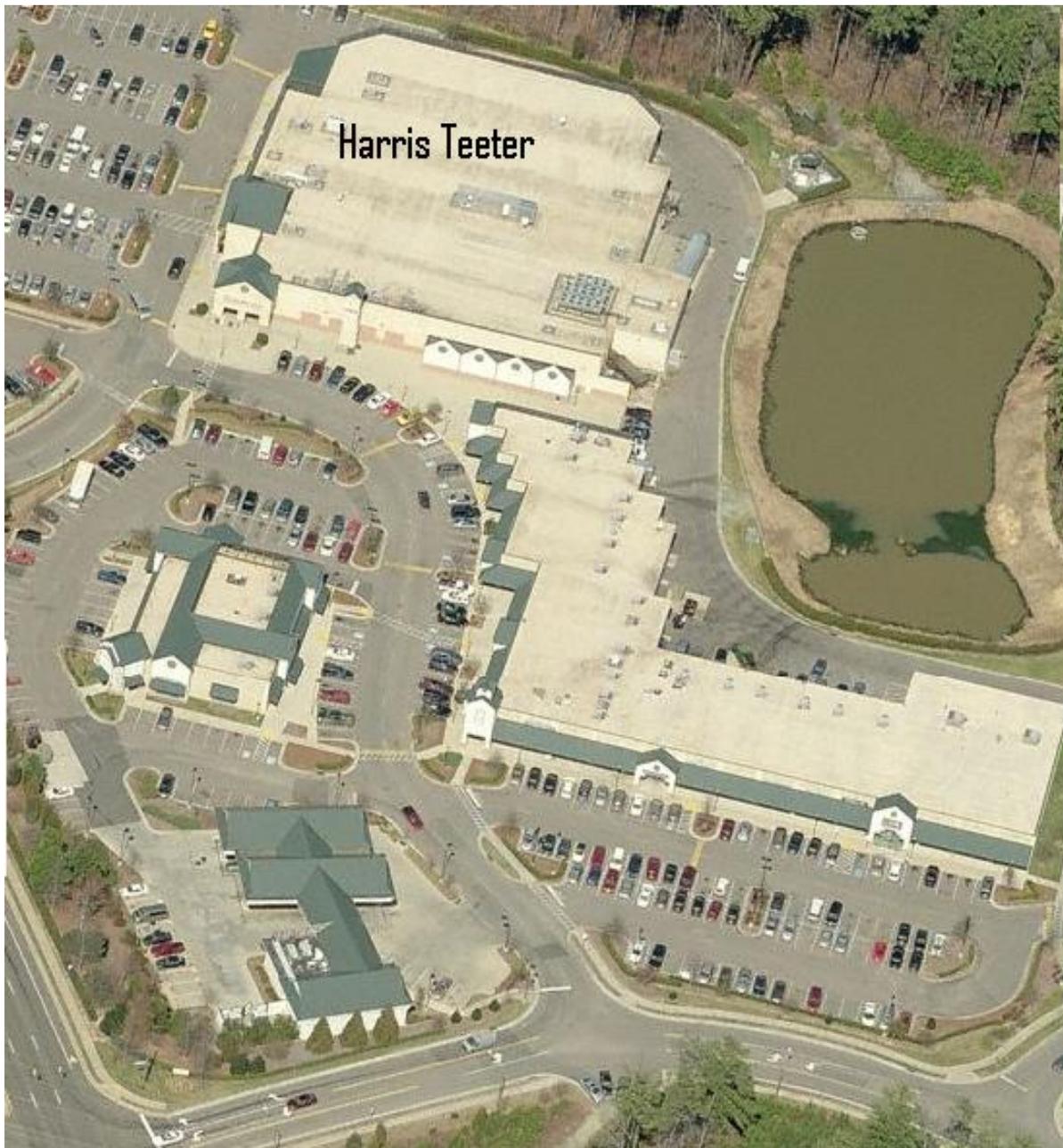


Figure 1. Aerial view of shopping center—site of the project

After training from Mr. Pollock, the team conducted an initial waste audit in order to establish a baseline level of plastic film in the shopping center’s waste stream. The audit consisted of

collecting the trash from two dumpsters in the shopping center, categorizing the types of material within the trash, and recording the estimated volume for each type of waste. The team initially attempted a waste audit on a Wednesday because of county trash pick-up scheduled for Mondays, Tuesdays, and Thursdays. Unfortunately, the Wednesday attempts yielded little garbage. Therefore, the initial and final waste audits were conducted on Friday, March 20th and Friday, May 1st.

Once survey data collection was complete, the team launched the film collection program in partnership with those businesses willing to place a film recycling bin in the front or back of their store. The bins, provided by the American Chemistry Council, consisted of a metal frame, plastic top attachable with bungee cords, and signs and decals (Figure 2). The bins came with several 40-gallon bags, which fit neatly over the metal frame and allowed customers and employees to see inside the bins, in order to discourage and reduce contamination of the film with any non-film items such as bottles, paper, food items, or other garbage.



Figure 2. Indoor bin

Each Friday for six weeks, several team members collected the film from each bin, replacing the bag with a new one and recording the volume of film collected (using five-gallon buckets to measure volume), as well as the volume and category of contaminant in each bin. In a process of informal education and peer motivation, more bins were added over the six week period as additional stores observed the activity and agreed to accept bins. The total number of collection bins increased from two bins to 10 bins over the course of the study.



Figure 3. Bin in back of shopping center

To facilitate participation, team members continued to communicate with stores after the initial survey was complete, with updates on progress of the study and participation of their neighbors. Instead of asking about space for a bin, team members showed them the bins, after which they seemed much more receptive to its size and appearance. For stores that claimed lack of space, a community bin was installed in a back hallway, which allowed three stores to use the same bin. Another store, supplied with bags, logged their own film collection each week. To make the film recycling even easier, the county provided a large and clearly labeled trash-can style recycling bin at the back of the center. This bin provided extra space for film collection, in case the small in-store bins filled up before the next collection date (Figure 3).

The team also decided to install outdoor bins to encourage the recycling of film by customers. To adapt the donated film bins for outdoor use, the team used wood recovered from the landfill to build two sturdier, more weather-proof frames, on which the same uniform bags and plastic lids could fit (Figure 4). These outdoor bins, painted and labeled with the same signs, soon claimed the highest collection rates. With permission from the landlord of the shopping center, the team placed one bin strategically on the sidewalk outside of a business that had declined to participate, but which the team suspected was a large producer of plastic film. The other outdoor bin was placed at a gas station located within the shopping center, but set apart from the rest of the stores at a distance that might dampen recycling activity.

At the end of the six-week collection period, the team sent each participating store a thank-you note from the team, with an enclosed letter from Orange County Waste Management, encouraging them to continue recycling plastic film, paper, and other recyclables after the pilot has ended. This would require them to continue to collect their own film and bring it themselves to the customer drop-off location within the front entrance of Harris Teeter. A *post hoc* survey was used to collect information on the stores' views of the convenience and importance of the project. In this survey, many of the participating stores confirmed their willingness to deliver their own film to Harris Teeter. However, Harris Teeter was unable to provide an employee to collect the film

themselves once a week, even from only the outdoor bins, though they are the beneficiaries of the collection partnership with the shopping center.



Figure 4. Outdoor weather-proof bin

Results

Initial survey

According to the initial survey results, none of the stores knew the actual size of the dumpsters, and three of the eight stores surveyed reported a “regular”-sized dumpster (Table 1). All of the stores except the pizza place reported sharing the dumpster with other shopping center tenants. All of the stores surveyed, except the “bird supply store,” reported that “the landlord” or “the shopping center” held the dumpster contract. None of the shopping center tenants knew whether the landlord would be able to modify the terms of the waste disposal contract, and none of the tenants knew the exact rate that the landlord paid for waste disposal (Table 1). It is interesting that these retail stores are unaware of the costs of waste management, indicating that waste and the costs associated with its disposal are not a financial concern for most of the stores.

Table 1. Initial survey data		
Survey Question	Wellness store	General medical practice
Size of dumpster?	Unknown	Regular
Shared dumpster?	Shared	Shared
Who holds dumpster contract?	Shopping Center	Landlord
Could the above contract be modified?	Unknown	Unknown
Cash rate,? If yes, what is the rate?	N/A	Unknown
Types of waste disposed of separately?	Cardboard	Cardboard
Is plastic film recycled?	No	No
What fraction of waste is plastic film?	Less than 5%	Very little
Amount of film customers leave store with?	Very little	None
Type (if tenant offers information)?	Plastic bags	N/A
Is there a storefront return system?	No	No
Willing to collect film in-house?	Yes	No
Willing to house a front-of-store bin for customers?	No	No
Space to collect plastic film until a weekly pick-up?	Yes. In back room.	N/A
Willing to arrange for its drop-off at Harris Teeter?	Yes	No
Survey Question	Pizza place	Cleaning service
Size of dumpster?	4 large trash cans & 1 dumpster	Regular
Shared dumpster?	Not shared	Shared
Who holds dumpster contract?	Shopping Center	Landlord controls/county collects
Could the above contract be modified?	Never discussed	Never discussed/capacity sufficient
Cash rate,? If yes, what is the rate?	Bundled pro-rate	Unknown
Types of waste disposed of separately?	None	Plastic bottles and cardboard
Is plastic film recycled?	No	Yes
What fraction of waste is plastic film?	Unknown	Unknown
Amount of film customers leave store with?	Unknown	None
Type (if tenant offers information)?	Plastic bags	N/A
Is there a storefront return system?	No	No
Willing to collect film in-house?	Yes	Yes
Willing to house a front-of-store bin for customers?	Yes	Yes / only one
Space to collect plastic film until a weekly pick-up?	Yes	Unknown
Willing to arrange for its drop-off at Harris Teeter?	Yes	Yes only w/ financial incentive
Survey Question	Video rental*	Chocolatier*
Size of dumpster?	Missing data	Missing data
Shared dumpster?	Missing data	Missing data
Who holds dumpster contract?	Missing data	Missing data
Could the above contract be modified?	Missing data	Missing data
Cash rate,? If yes, what is the rate?	Missing data	Missing data
Types of waste disposed of separately?	Missing data	Missing data
Is plastic film recycled?	No	Missing data
What fraction of waste is plastic film?	Not sure	Missing data
Amount of film customers leave store with?	Very little	Missing data
Type (if tenant offers information)?	No	Missing data
Is there a storefront return system?	Yes	Yes
Willing to collect film in-house?	No	No -- use interior hallway
Willing to house a front-of-store bin for customers?	Yes	No
Space to collect plastic film until a weekly pick-up?	Yes	Missing data
Willing to arrange for its drop-off at Harris Teeter?	Yes	Missing data
Survey Question	Packing/shipping store	Bird supply store
Size of dumpster?	Unknown	Regular
Shared dumpster?	Shared	Shared
Who holds dumpster contract?	Landlord	Not sure
Could the above contract be modified?	Unknown	Landlord decides
Cash rate,? If yes, what is the rate?	Unknown	Included in rent
Types of waste disposed of separately?	Paper, plastic bottles, bubble wrap, peanuts	Cardboard, bubble wrap, paper, paper towels, styrofoam, shrink wrap, trash
Is plastic film recycled?	No	Reuses as packaging material
What fraction of waste is plastic film?	Unknown	20-25%
Amount of film customers leave store with?	Very little	Unknown
Type (if tenant offers information)?	Missing data	Plastic bags and packaging
Is there a storefront return system?	No	No
Willing to collect film in-house?	No	Yes
Willing to house a front-of-store bin for customers?	N/A	No
Space to collect plastic film until a weekly pick-up?	N/A	No
Willing to arrange for its drop-off at Harris Teeter?	N/A	Yes

Note that surveys marked with an asterisk are incomplete. Most initial surveys were conducted over the phone, and gathering complete data depended on team member's communication skills and the amicability of the store staff. *Post hoc* surveys were completed in person.

The recycling practices of the shopping center tenants were very mixed. Four of the stores reported that they recycle cardboard. The cleaning service, in addition to recycling cardboard, also reported that they recycle plastic bottles. The packing and shipping store and the bird supply store had the most comprehensive recycling practices. According to the survey, the packing/shipping store recycles paper, plastic bottles, bubble wrap, and peanuts. The bird supply store recycles cardboard, bubble wrap, Styrofoam, paper, shrink wrap, paper towels, trash (Table 1).

Of the eight stores surveyed, only three had any idea about how much plastic film was consumed. The wellness store responded that less than 5% of their waste was plastic film; the general medical practice responded “very little.” The bird supply store, however, responded that plastic makes up about 20-25% of their waste. Only two stores reported reusing or recycling plastic film. The bird supply store used some of the plastic film to package breakable items with which customers leave the store. One employee of the cleaning service claimed to take any film generated to a friend who ships her artwork across the country; the film was used as packaging material. The wellness store, pizza place, and bird supply store offer plastic shopping bags to their customers. None of the stores surveyed reported a return system for plastic film (Table 1). These findings suggest that beyond those stores that reused plastic film innovatively, most did not realize that plastic film can be recycled. Additionally, this indicates that implementing a more comprehensive waste management program would be beneficial.

When the project was initially proposed and initial survey results were gathered, five of the eight stores agreed to participate. Later, the cleaning service lost interest and did not participate, and the packing and shipping store and chocolatier agreed later in the course of the project after an initial negative response. The optician also joined in the study but did not complete an initial survey. In summary, six of the eight stores initially surveyed followed through and participated. The cleaning service and general medical practice completed the initial survey but did not

participate. Of the six surveyed participants, only one agreed to a front-of-store bin. (The cleaning service also initially agreed to a front-of-store bin but later backed out of the pilot study.) For the remaining five participants, back-of-store bins were installed or film was taken to Harris Teeter on an as-needed basis because of limited storage space (See Table 1).

Post Hoc survey

As documented below, of the participating stores—packing/shipping store, chocolatier, wellness, bird supply, video, and optician— all completed *post-hoc* surveys. Initial survey data is available for all participants except the optician. Six of the stores depended on capstone team members to collect the plastic film and carry it to the recycling deposit in Harris Teeter at the front of the store. Only the bird supply store asked an employee to carry the plastic film to Harris Teeter and logged the volume itself instead of depending on a team member (Table 2).

Table 2. Post hoc survey results

	Packing/ shipping	Chocolatier	Wellness	Bird supply	Video rental	Optician
In store plastic film recycling bin?	Yes	Yes	Yes	No	Yes	Yes
If yes, how full was it in a typical week?	About half	Less than half	Less than half	N/A	Less than half	Full
Did you/employee take plastic film to the bins near Harris Teeter?	No	No	No	Yes	No	No
If yes, how often?	N/A	N/A	N/A	Weekly	N/A	N/A
Did you rely on capstone students to collect your plastic film recycling?	Yes	Yes	Yes	No	Yes	No
Do you plan to continue to collect plastic film?	Yes	Yes	Yes	Yes	Yes	Yes
If yes, how do you expect to recycle it?	Collect in store	Take to the collection bins	Collect in store and take to the collection bins	Take to the collection bins	Collect in store	Take to collection bins
How convenient was it to recycle plastic film?	Very convenient	Somewhat inconvenient	Very convenient	Somewhat convenient	Very convenient	Very convenient
What difficulties did you encounter in recycling plastic film?	Honestly we don't do much. No problems	Awareness of employees and deciding where to place the bin	No difficulties. I am more aware of the waste we generate	There is no place to keep bag permanently	N/A	None
Any customer feedback—positive or negative?	No	No	No	No	No	No
If yes, please describe:	N/A	N/A	N/A	N/A	N/A	N/A

All of the participants agreed to continue to collect plastic film. Four of the stores described the collection of plastic film as “very convenient.” The bird supply store called the collection process “somewhat convenient.” The chocolate shop called the collection “somewhat inconvenient.” None of the stores reported customer feedback in response to the plastic film recycling pilot (See Table 2).

Waste audit

Results from the initial and final waste audits showed that the amount of recyclable bottles and cans in the dumpsters remain approximately the same, at about 3 gallons (figure 5) and 3-4% (Figure 6). The amount of organics and paper both decreased dramatically, from 46 to 17 gallons and from 33 to 4 gallons, respectively (Figure 5). Their shares likewise dropped, from 46% to 26% for organics and 33% to 5% for paper (Figure 6). However, both garbage and plastic film increased, from 10 to 29 gallons for garbage and from 7 to 13 gallons for plastic film (Figure 5). These numbers also reflect a substantially larger share of total waste, increasing from 10% to 45% and 7% to 20% of total waste, respectively (see Figure 6). This may be due in large part to decreases in volume (and thus in share) of recyclable bottles, cans and paper during the course of the project, with both new recycling facilities and greater awareness on the part of participating stores.

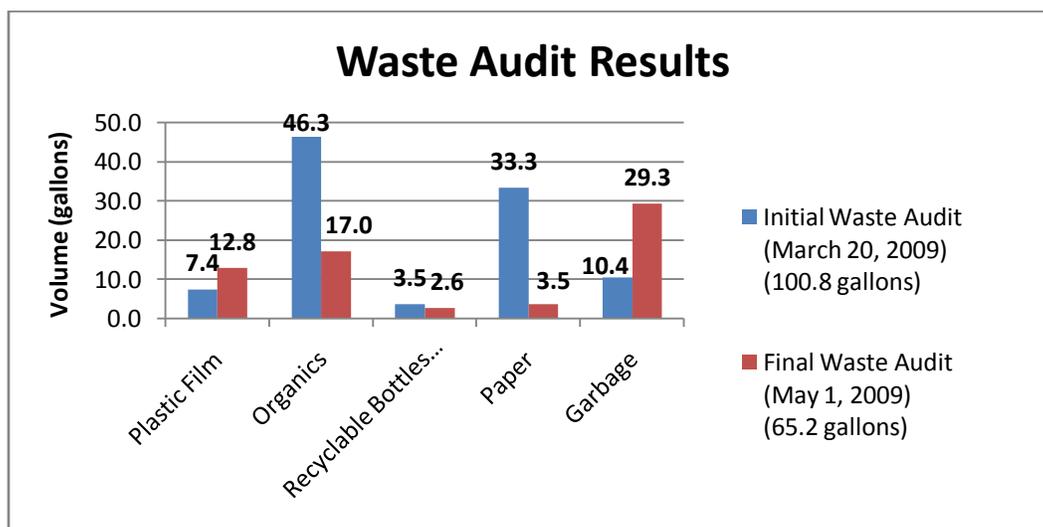


Figure 5. Initial and final waste audit results—volume by category

Finally, note that while the waste audits were completed on the same day of the week in order to account for day-to-day routines, irregular delivery schedules and uneven patterns of waste production introduce substantial uncertainty about how representative the waste audits are of aggregate waste generation in aggregate and by category— as mentioned later in Discussions and Recommendations.

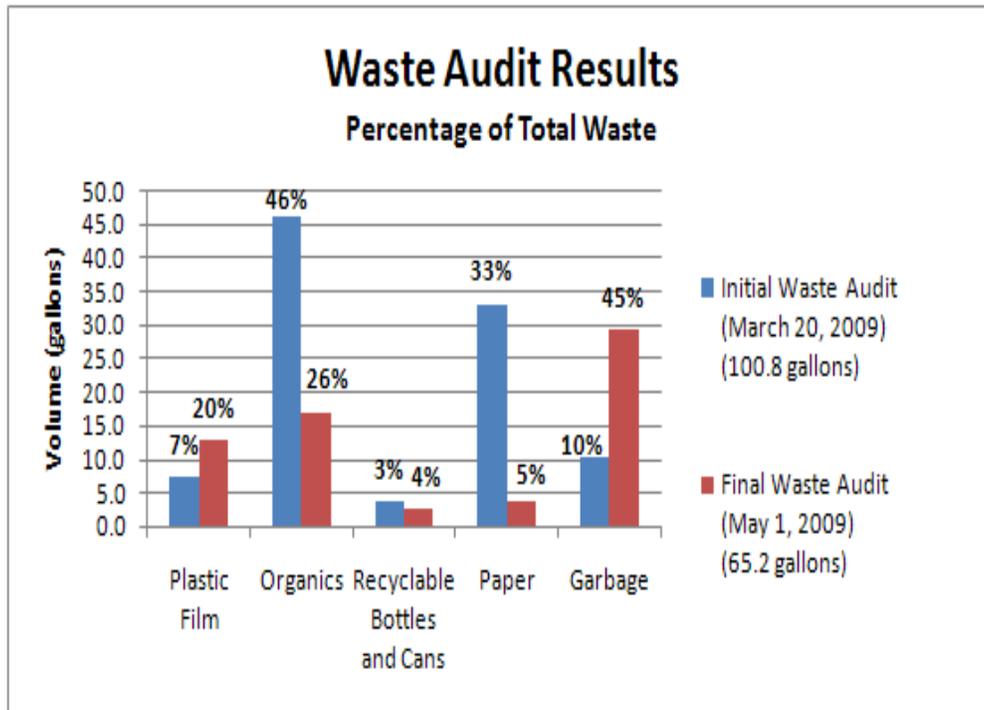


Figure 6. Initial and final waste audit results—percentage by category

Plastic film collection

Figure 7 shows simple plots of raw volumes of plastic film collected from participating stores. Note that bins were installed on different dates. Stores with no data points did not yet have bins in place. Film collection and counted in the “outdoor” bin includes some from the bird supply store. As discussed earlier, the amount of plastic collected each week may reflect delivery schedules, volume produced, and reuse of plastic.

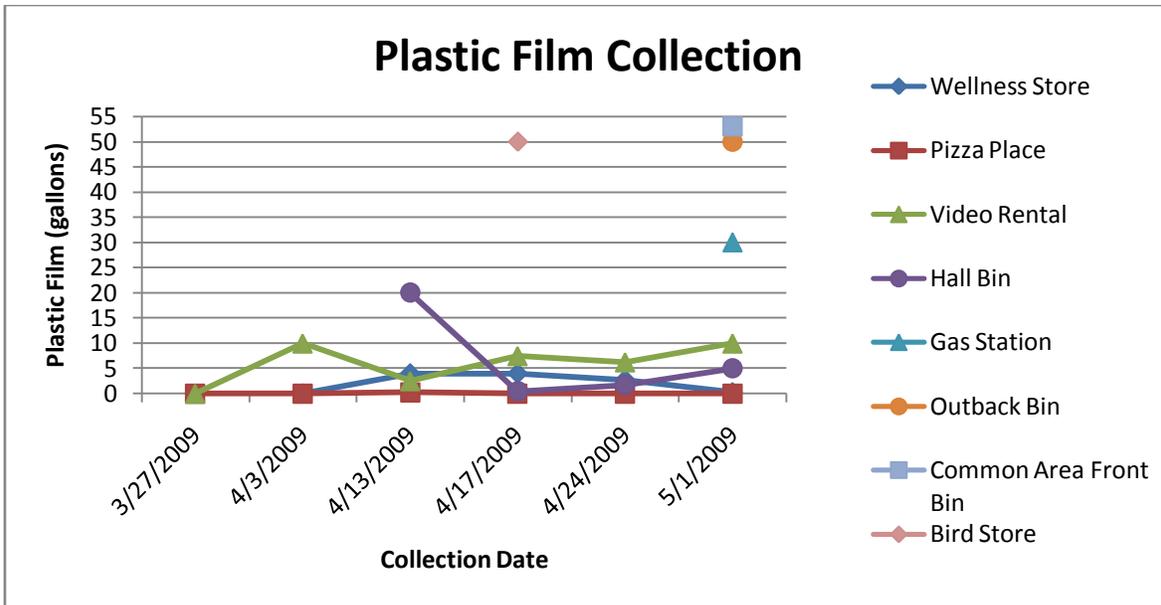


Figure 7. Plastic film collected on weekly basis

Figure 8 shows weekly averages for plastic film collected at each bin location; here too the outdoor bin includes some film originating at the bird supply store but not counted in that stores weekly average.

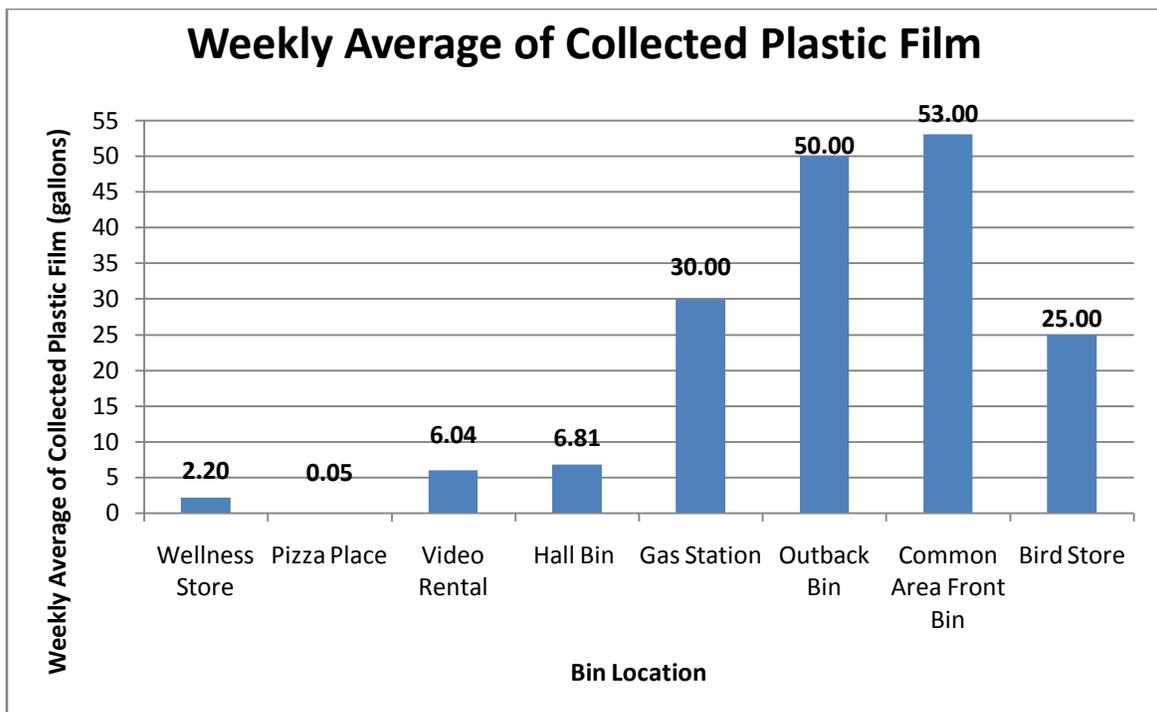


Figure 8. Weekly average of plastic film collected in each bin location

The total amount of film collected from all bins over the course of six weeks is an estimated 258 gallons. The bin locations from which we collected the most film on a weekly average are the outdoor bin in the common area of shopping center, the outdoor bin in the back of the shopping center and the gas station bin, with 53, 50 and 30 gallons, respectively. The bird supply store also collected a significant amount of plastic on a weekly average, with 25 gallons. Some of the plastic film within the outdoor bin in the back of the shopping center also can be attributed to the bird supply store. The bin location that collected the least amount of film on a weekly average is the pizzeria, with less than one-tenth of a gallon. Most weeks during film collection, the bin in the pizzeria contained only trash (see Figure 8 and appendix Table 1).

Discussion and Recommendations

From the initial survey, we found that only one of the stores, the cleaning service, recycled plastic film already. One, the bird supply store, reused plastic film in-house.

Challenges – Business Communication and Bin Locations

Some of the biggest challenges faced in the pilot project occurred in the beginning, when establishing a relationship with each business. Many of the issues centered on the store space and people-power needed to follow through with the recycling program. Although a letter from the landlord explaining our project went to each business in advance, the team discovered when introducing themselves personally that most businesses either had not read the letter or had only briefly looked at it. In addition, the methods of soliciting responses for the surveys were flawed; after the surveys were distributed along with a cover letter, none of the businesses contacted the team to complete the questionnaire. The follow-up required phone calls (sometimes multiple) to each business in order to complete the initial survey and judge whether each business was interested in participating. Some businesses expressed strong interest in participating, while others were hesitant. After several rejections, the team found that in-person interaction with the businesses proved to be more effective and gave the team a better opportunity to explain the importance of the project and the level of involvement expected from each business. Most notably, one store appeared uninterested in the project on the phone and claimed to produce no

plastic film, but after the bin was placed in the back of the store and the staff informed of its presence, the store began participating enthusiastically. Conducting the survey in person puts more pressure on the stores to participate and would have provided the group with more immediate information. The team recommend that future projects gather initial information in person.

In the beginning, four of the eight stores surveyed said that they were not willing to collect film. While the project assumed that bins would be placed inside of the stores, two of the four businesses that indicated in the initial survey a willingness to collect film declined to place a bin in their stores. The stores that rejected the bins said that they did not have space in the front of the store for such a bulky collection bin or commented that the bin would be an eye-sore. The birds supply store—an otherwise strong supporter of the project—hesitated to install a bin because of their minimal floor space and the possibility of interference with their customers. This store also features an aesthetic design that would have been disrupted by the presence of a bin. Blockbuster opted to place their bin in the back, primarily for employees. Both the bird supply store and the video rental store, which recognized their considerable consumption of plastic film, were more willing to participate because they foresaw positive results from their extra efforts. Only the pizzeria and the cleaning service responded that they were interested in hosting a bin in the front of the store, but the latter decided not to participate because the bin was too large for the low volume of plastic film they said they generated. On the other hand, once the team was able to physically show the bins to shopping center tenants, others, like the wellness store, seemed more willing to participate. Often, chain-stores were slower to agree because permission was required from a corporate superior. The team found that the more information that could be provided and physically demonstrated, e.g., bringing in a display bin and posters, the more receptive the store was to participating.

Eventually the team reached compromises with many of the stores, and as the weekly collections progressed, the stores seemed increasingly familiar with what counted as recyclable plastic film. At the suggestion of the owner of the chocolatier, a bin was placed in an interior service hallway that was shared and accessible by the packing and shipping store, the chocolate shop, and the optician. The video rental store agreed to place their bin in the restroom, used mostly by employees, although this contributed to some contamination with paper towels. The bird supply

store agreed to collect their film, log the volume of film they recycled, and bring their film to Harris Teeter as their shipments arrived, because there was no room in the store for the bin. The wellness store also kept the bin in their staff-only back room. In comparison, the bin in the pizzeria encountered problems almost immediately. One week after it was installed, an inspection revealed that the bag had been filled with food waste, paper and other non-recyclable waste, but no plastic. Over the next few weeks, the results were much the same. The experience at this business raised the idea that the pizzeria, as well as other similar eateries, could benefit from some form of commercial composting. This could lead to another project where an anchor store, like Harris Teeter, could collect plastic film as well as industrial grade compost. Additionally, overall contamination was lower in back-of-store bins. In order to avoid contamination, we recommend only back-of-store bins for restaurants; avoid front-of-store and bathroom bins unless compost and/or other types of recycling are offered.

In addition to space limitations and the waste issue at the pizzeria, we became aware that customers of non-participating businesses would benefit from a more central, outdoor location. Some fine-tuning of the bin placement could better serve businesses, as well. In the end, a rear hallway linking three businesses turned out to be a perfect candidate for a bin, and another was placed next to the garbage dumpsters and existing recycling bins. Next, we sought more public locations for several bins. Since the team had already run into problems with the utilitarian design of the bins when presenting them to businesses, we determined that some sort of enclosure would integrate the bins into the shopping center better, as well as anchor them against wind. A simple design with wood salvaged from the county landfill was devised (Figure 4). We placed two of these bins outside in the common area of the shopping center, near the non-participating drycleaner, in hopes that customers would recycle their bags there.

Paper and General Recycling

During the course of the project, many stores became interested in other materials that could be recycled and asked for help in setting up a collection plan. The Plastics capstone team noticed that there was no paper recycling bin near the dumpster and plastic/aluminum bin in the service parking lot. In the initial waste audit, 33% (by volume) of the dumpster waste generated by the shopping center (excluding Harris Teeter and the nearby gas station) consisted of paper. Even though recycling bins for plastic and glass bottles were stationed behind the shopping center near

the dumpsters, the businesses had no access to a paper recycling bin. After the team notified Orange County Solid Waste Management of the need for a paper recycling bin, the county installed a bin and the stores quickly began to recycle mixed paper. Their use of the paper bin was reflected in the final waste audit, where paper constituted only 5.4% of waste by volume. Thus, these paper recycling bins appear to be successful in diverting a significant amount of paper from this shopping center away from the county's landfill.

If this project were to be replicated, offering stores the option of in-store paper recycling bins, plastic bottle/aluminum bins, and compost bins would be more effective at both reducing waste and educating the store tenants. The participating stores seemed to learn about recycling and become interested in increasing their efforts as the project progressed. For example, the wellness store installed a make-shift paper recycling bin next to our plastic film bin, and much of what went into the pizzeria's bin was a type of recyclable but not necessarily film.

Plastic Film and the Orange County Landfill

According to Orange County Solid Waste Management, plastic film makes up an estimated 6% of waste entering the Orange County landfill. The initial waste audit found 7% of the dumpster volume to be plastic film, consistent with Orange County Solid Waste Management's estimate. The goal of this plastic film recycling film project was to reduce the percentage of plastic film in the dumpster. However, the final waste audit found that plastic film made up 20% of the garbage in the dumpster by volume. This number seems implausible, especially because the same week yielded a record amount of plastic film – more than 120 gallons. This may relate to the fact that our waste audit was a snapshot of one particular day of the week, and included plastic film from a non-participating Chinese restaurant in the shopping center. The higher percentage of plastic film in the dumpster also likely reflects the placement of a new paper recycling bin during the study and subsequent diversion of paper from the dumpsters. This surprising result also could be due to the varying shipment schedules of the participating stores. For example, the bird supply store receives shipments only every two weeks, but they produce lots of plastic film waste. It is possible that our first waste audit did not catch the bird supply store on a week their shipment had come in. Garbage is picked up three times a week, and it is possible that the initial waste audit went on a day after the plastic film waste had already been picked up. In short, the trash

composition may depend on the timing of shipments, customer flow, and seasonal retail patterns. Checking the dumpsters every day for the duration of a week at the beginning and end of the project would provide a more comprehensive waste audit, although this was not feasible for our project, given resource constraints—human and other.

The amount of plastic collected during this project, while impressive, is part of the larger story of waste management and resource use. In a sense, more plastic collected is “good,” but *only* if we assume this plastic will be produced and shipped anyway, such that the plastic recovery project has diverted the plastic away from the landfill and to some other useful purpose. Retail stores that succeed in generating less plastic film (through purchasing choices, management practices, etc.) represent an even better model of waste reduction. In the future, it would be useful to track the quantity of plastic recovered relative to plastic sent to the retail stores, to better judge the full impact of plastic film recovery and more comprehensively contribute to a resource-efficient retail landscape.

Economic considerations of garbage disposal

Apart from the opportunity to claim a greener image and practice good citizenship, this waste reduction pilot did not provide a financial incentive to participating small retail stores. An incentive of some kind might have motivated greater participation and further reduced the share of plastic film in the waste stream. The businesses at the shopping center currently use six dumpsters, which are rented through Waste Industries. Three of these dumpsters are for bagged garbage, and the other three are specifically for cardboard. The volume of each dumpster is 8 cubic yards. According to the data from the first waste audit, were the shopping center to recycle all of the paper, aluminum, plastic bottles, and plastic film entering the waste stream, it would reduce its waste by 44%, eliminating the need for at least one of three trash-only dumpsters (and eliminating/reducing the rental fee). The shopping center also could cut the fee it pays to Chapel Hill Public Works, which empties the six dumpsters on a weekly basis. The yearly fee for emptying the dumpsters is \$6,873, which is paid in quarterly installments. This works out to \$22 per week to empty each dumpster. Eliminating one dumpster could save the shopping center’s property managers more than \$1,145.5 in a year, assuming *pro rata* savings. The key is to incorporate this saving for the landlord into the tenants’ rent so that they see a financial benefit

for reducing waste. Given our findings and the amount of plastic film being diverted each week, there may be a financial incentive for businesses that choose to participate in similar projects.

Composting incentive

The addition of a composting program could cut the shopping center's waste an additional margin. The March audit showed compostables make up 46% of the total waste stream at the shopping center, with actual garbage amounting to only 10% of the waste stream. The May 1, 2009 audit showed compostables dropping to only 26%, while the amount of garbage grew in volume, and even more in share (to nearly 45%) as other categories of waste dropped off. This leads the team to believe that a comprehensive waste reduction program, including all recyclables and compostables, could lead to the elimination of at least one and perhaps two of the shopping center's trash-only dumpsters. We recommend that future projects take this comprehensive approach and require that the landlord incorporate a rent reduction for tenants participating in the full range of waste-reduction options outlined above.

Post Hoc survey responses

Post hoc surveys were given to each of the six participating businesses to determine the convenience of recycling plastic film, elicit feedback from customers, and learn whether the businesses plan to continue to recycle plastic. A majority of the businesses stated that recycling plastic film was somewhat or very convenient for them. Some of the issues stores encountered were related to the amount of plastic film they generated; e.g., there was not enough to collect on a regular basis. Employees appeared still unaware of plastic film recycling. The businesses received no customer feedback about the bins—not surprising since only one business had a bin in their store front. The remaining bins were either in the back of the store or in a back hallway serving the businesses themselves. However, since the outdoor bins located in the common area of the shopping center were full during collection, we would expect overall positive customer feedback for those bins. The participating businesses all plan to keep recycling plastic film, and will do so in a variety of ways. The businesses with bins located in their store or in a common hallway all kept their bins at the end of the project and were given extra recyclable bags for the bins. Also, all participating businesses were made aware of the outdoor bins in the common area and in the back of the shopping center along with the collection bins inside Harris Teeter.

Still, whether or not recycling will continue is difficult to determine. Several of the businesses voluntarily offered to carry over plastic film to Harris Teeter once the capstone left, saying they already shop for groceries there. The persistence of the shared hallway bin depends largely on the amount of interaction between the businesses that use it; delegating the task of emptying it was left to the individual stores. There is still uncertainty over whether or not these businesses will actually comply and bring their plastic film over to Harris Teeter.

To make sure that the plastic film gets to where it needs to go, we recommend that one employee from Harris Teeter go on a collection round of the three bins outside and the four bins inside once a week. If the last week of data collection is any example, this will be especially necessary because the quantity of plastic film generated in some weeks will be too large to put in the one collection bin inside of Harris Teeter. While the hope is that it will not significantly change the daily operations of the store, Harris Teeter needs to weigh the benefits of the increased mass of plastic film. Harris Teeter could also make this more convenient by moving two of the outdoor bins in front of their store. Additionally, in order to promote Harris Teeter's participation in such a positive endeavor and to physically demonstrate the end product, they could advertise by placing a bench made of plastic lumber near the bins in front of their store.

Other companies that recycle their plastic film (from customers, shippers, packaging, etc.) may be motivated by environmental or citizenship concerns more than by purely financial incentives. An example is Weaver Street Market in nearby Carrboro, North Carolina—the largest coop in the southeast U.S. They save the film in bags in a rear storage area and then bale the plastic film set aside for them. This bale weighs about 500 lbs. and reduces the tipping fees at the landfill accordingly. The bale is picked up by their recycling company, who then sells it for the best price on the market. While Weaver Street Market pays a small fee to have the plastic bale picked up, adding a minor additional expense for the cooperative, the revenue stream from recycling their cardboard offsets most of the costs associated with operating the current recycling stream, while doing something positive for the environment.

Finally, there may be value in looking deeper into the literature for other examples of successful models of resource recovery. The work of McKenzie-Mohr and others working in the area of community-based social marketing may shed light on behavioral changes of individuals and corporations.

Lessons learned

- (1) Identify and enlist key partners: local government, property manager, major retail outlet, sources of funding.
- (2) Identify potential participants: retail stores, universities, industry, and other large producers of plastic film.
- (3) Create a schedule and determine major project goals (allowing enough time for the unpredicted and for follow-up).
- (4) Determine which method of communication is most efficient for various businesses: in person, phone, or email.
- (5) Create an educational campaign and distribute general information of the project to targeted businesses
- (6) Try to find potential economic incentives and or environmental incentives to encourage participation.
- (7) Get personal! Find managers, employees, owners, etc, who will be supportive and assist them in any way possible!

Conclusion

Although there were delays in launching plastic collection, the project concluded successfully. The seven stores participating in the pilot diverted a substantial amount of plastic film from the county landfill, which bodes well for the success of future initiatives, based on these results.

It remains difficult to determine whether or not plastic film recycling will continue at the shopping center without the supervision of the capstone team. Several of the businesses voluntarily offered to begin dropping off plastic film at Harris Teeter, for example, when employees do their grocery shopping there.

It is our hope that the project was instrumental in sparking a significant degree of awareness of plastic film recycling, enough to ensure that businesses will continue to transport their plastic to Harris Teeter.

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Appendix

Table A1. Plastic Film Collection Log								
Bin Placement	Plastic Film Collected (gallons) & Notes							
	March 20	March 27	April 3	April 13	April 17	April 24	May 1	Plastic Film Total
Video rental	Installed bin in store back	0	10	2.5 film 0.8 paper	7.5	6.3 film 0.3 paper	10	36.3
Gas Station						Installed bin	30	30
GNC			Installed Bin	4	4	2.8	0.3	11.1
Hall bin behind chocolatier, optician and packing store			Installed Bin	20	0.5	1.8	5	27.3
Outdoor bin in back of shopping center						Installed bin	*50 (includes some birds store film)	50
Outdoor bin in common area						Installed bin	53	53
Pizzeria	Installed bin in store front	0 film (small amount alum cans, paper & trash)	Only trash	0.3 film 4 paper 1 recyclable bottles 2.5 organics	0 film 3 paper 0.25 recyclable bottles	0 film 2 paper 1 recyclable bottles	0 film 5 paper 1 garbage 0.5 recyclable bottles	0.3
Bird supply store			Given log sheet for film		Logged 50 film collected over 2 weeks		*Some film deposited in outdoor bin in back	50
Overall plastic film total								258

Log of Store Interactions

On Friday, February 6th, 2009, Team Plastics took an initial field trip to scope out Chapel Hill North. Dawn Reeves met us at the Harris Teeter located in the shopping center to show us the back of the store operations--including their composting bin—and where they stored their plastic film before loading it onto the trucks. Following this the Solid Waste Planner for Orange County took us on a tour of the Orange County landfill and recycling operations. This landfill will be full in 2011, but could provide more room if recycling, composting, and other waste reduction programs are implemented. Also on February 6th, the team composed a letter discussing the project and sent this to the property manager, Development-Management Inc. This letter was sent out by the Property Manager along with a letter of support on February 11th. After giving the stores enough time to receive and read the letter, the team went out on February 18th to hand out an initial survey (Appendix). The pizza restaurant seemed to be enthusiastic about the project and sat down with us and did the survey that day. For the rest of the surveys, the team decided to follow up with phone calls to the respective people (usually store and facilities managers), with follow-up phone calls made in the next couple of weeks (March 15-23).

“Video Rental Store:” Initial contact was made with the manager of the store on March, 23rd 2009. We used the rough survey dialogue to ask talk through the questions on the survey. The manager knew only that cardboard and trash were disposed of separately, while they did not recycle plastic film and had no idea how much they threw out. The manager said that the store did not produce much film, since customers rarely leave with any kind of bag. Nevertheless, the manager was willing to put a bin in the back of store for employees and shipments, though it did not seem to make sense to put one in the front. He also said that they would be willing to bring the film to Harris Teeter in the future. The first bins were put out on April 3rd at the back of the store. and plastics was collected on April 17. The collection bin has been stored in the bathroom—evidence of how precious space is and how much the aesthetics of the bin matters. The employee also gave the team a sample DVD case (plastic). Orange County Solid Waste Management will send off the sample to explore a recycling plan for this specific type of plastic.

“Gas Station:” After the initial survey, the employees said that we would need permission from the business owner. The team contacted the owner, which manages the gas station, to ask to place bins at the store, and received permission to do so on March 25, 2009. The owner was unsure of how much plastic film the front of the store and outside would generate, but he allowed a bin to be placed in the outdoor gas pump area. The back of the store does not produce film since food is delivered in plastic reusable crates. After going out to the gas station to deposit the bin, the store manager wanted to confirm with the owner that a bin was permitted. On April 8th, 2009, the team contacted the owner again to make sure the store manager was aware of the plan to place a bin outside, and set a weather-proof bin at that location soon after. After collecting a couple of weeks of film from the gas station, it was clear that there was too much contamination in the bin. The bin was moved on Friday, May 1st next to the other weather-proof bin outside of the cleaners in order to prevent contamination and increase the capacity near the cleaners.

“Dry Cleaners:” An employee of the cleaners stated that they were not interested in the project when approached with the initial survey. After we contacted the owner and explained the project, the cleaner still was not interested in participating. However, with permission from the property managers, we placed one of the weather-proof bins outside of the cleaners so that

costumers had access to a bin. During the final plastic estimate at the site, the team found that bin full of plastic bags--although there is no indication that the plastic is from the cleaners.

“Wellness Store:” While the store manager seemed a little unsure of our project, he always remained helpful and friendly. He seemed a little wary that the capstone team would try to do things that interfered with corporate rules, but realized after several in-person visits, that our plans were very unobtrusive. He also asserted that they produced no significant amount of plastic film, but realized through weekly collection that all of the small amounts accumulate into a measurable volume each week. Follow-up calls failed because the manager was out of town for a while during this time, and no other employees seemed to have heard of our project. An in-person visit on April 3rd, during which we simply asked the manager survey questions face-to-face and showed him the posters and bins, convinced him to participate and put one bin in the back of the store. Since it didn't interfere with in-store operations, he decided to not consult corporate on the matter. Since then, with each weekly collection, he was very enthusiastic and asked about the progress of the project. He has even set up a make-shift paper recycling bin to go alongside the plastic one in the back. He was very interested in the information about plastic bags using less energy to manufacture and transport than paper ones. He made a comment at one point, "You can put in your report that you got some meat-head to recycle!" He claims that his employees are enthusiastic as well, and that they will keep it going after we are gone.

“Hair Cutters:” The team delivered the initial survey to the hair cutters on February 18th, 2009. After calling back on March 19, 2009 to follow up with the survey, the hair cutters did not express interest in the project.

“Chinese Restaurant:” The initial survey was dropped off with a hostess who said she would pass it off to the manager. On March 16, the team made follow-up calls but was never able to reach the manager directly. The last interaction was made on March 27th, when a bin was shown to the restaurant; the hostess said that the restaurant was uninterested and would not be participating.

“Cleaning Service:” The cleaning service was interested in the project, but said that they generated very little plastic film waste. Once the owner saw the size of the bin, she said that the store didn't have room for the bin, especially when so little film was generated. The recyclables that are generated are largely plastic bottles that contain cleaning fluid. Additionally, the cleaners dispose of garbage in their customers' home bins.

“Optician:” A bin was placed in the communal hallway between the shipping company, the optician, and the chocolate shop. As of April 24th, an employee agreed to complete the survey upon a second visit, and he mentioned that he dug through the trash to pull out the plastic film that was generated by the business and place the film in the hallway bin. This film is largely paper towel roll wrappers.

“Pizzeria:” The team placed one bin in front of store by napkins, utensils, etc. and trash can. The team initially talked to the two owners of the pizzeria. They seemed very interested in helping with our project and lamented that none of their paper plates and plastic forks were recyclable. They were excited to begin the project. Nevertheless, after a bin was placed in the front of the store on April 3rd, 2009, customers began using it as a catch-all for all recyclables and very little clean film was collected. On Friday, April 24th the team attempted to do a final survey but

neither of the two managers were there and the other employees were busy with the lunch crowd. However, on Friday, May 1st, the team had a discussion with one of the employees who said she would pass on the concerns about the contamination with the managers. She also said she would talk to the managers about taking the plastic film waste over to Harris Teeter.

“Sandwich Store:” The highest person reached at the sandwich store was an assistant manager. The manager received the initial letter from the landlord and was given the initial survey. After receiving no response following the survey drop-off, several follow up calls were made during the week. With each call, the manager claimed to be too busy at the moment to answer questions, and would recommend better times, but always with the same result. Eventually, the manager apologized for not even having looked at the survey and said that no bins could be placed inside the store until permission from corporate was granted. Attempted follow-up calls were unanswered. In person visits were ineffective because store had high volume of customers during the day when the team was visiting the shopping center.

“Chocolatier:” On March 23, 2009 the team tried to contact the manager of the chocolate shop. The team reached him, but was asked to call back later because of a busy day. On March 27th, 2009 we tried to contact the manager again but the store was quite busy again. When we visited the store in person, the manager was at first hesitant about placing a plastic film bin in the interior of the store because the shop does not produce much plastic film and housing a bin would not be worth the space. Nevertheless, the manager said that there was a shared back hall between the shipping store, the optician, and the chocolate shop and that the team could place a bin there.

“Insurance Sales Office:” The interactions the team had with the insurance agency were similar to those with the Chinese restaurant. The initial survey was delivered on February 18th to a person working at the front desk. She said she would pass the survey off to the facilities manager. Two phone calls were made to the manager; neither was returned. In the last phone call that was made, the office said that they didn't produce much plastic and weren't interested in participating.

“General Medical Practice:” The facilities manager was not receptive to phone calls and never returned voicemails. However, when a team member went to the office in person for the second time, the facilities manager was in and able to speak to the team member in person. While he seemed sympathetic to the project, he was unclear about how much plastic film was generated by the facility. The manager said that he would need to check with the "medical director" about installing a bin in the office. In a follow up email on Tuesday, March 31, the manager said that after speaking to the medical director, the practice had decided not to participate in the project.

“Bird Supply Store:” The manager and the other employees of the bird supply store were very receptive to the project from the beginning. The store produces a lot of plastic film and reuses some of it by taking it to the shipping store or using it as packaging for fragile items. However, the excess film generated by reuse forced the manager to dispose of it in a dumpster. Though willing to participate in the project, they were not able to place a bin in the store for lack of space. After discussing possible solutions, at first the team suggested that the store should take the film to Harris Teeter when the shipments came and delivered a log sheet made specifically for them. However, after we placed an outdoor bin (provided to us by the Orange County Waste Management) in the service parking lot near the other recycling, the manager decided to place the plastic film in this bin and take it over to Harris Teeter only when the bins become full.