ANALYZING THE LEVELS OF COMPLIANCE TO THE KILLAM LIBRARY FOUR-BIN WASTE MANAGEMENT SYSTEM TO DETERMINE AREAS OF CONCERN FOR FUTURE MANAGEMENT

Final Report

ENVS/SUST 3502
April 13, 2011

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THE EXECUTIVE SUMMARY

The purpose of this audit was to observe and analyze the waste diversion compliance levels within the four-bin waste systems of Killam Dalhousie University. Two audits took place where waste was sorted and data was collected from the four-bin systems on each floor of the Killam. Interviews conducted with two custodial members working prior to the implementation of the four-bins systems emphasized that there had been major improvements of waste diversion since the implementation of the garbage systems.

After analyzing data from the waste audits, results indicated that there are still evident contamination levels within the four-bin systems. Major contamination items, which were found in each bin included coffee cups and cans. Liquid waste was also problematic as it contaminated many of the paper products, which then had to be thrown into the organics bin.

Recommendations and solutions to improve efficiency include designing an educational sustainability tour addressing proper waste diversion, creating a waste diversion visual link offered on Dalhousie's website, implementing a 5^{th} bin for liquid waste, and creating more informational signs highlighting different brands of where waste items should be placed.

Future research concerning the social relationship of individuals between floors with the lowest or highest compliance levels would be beneficial to this field of research in determining reasons for varying levels of contamination. Furthermore, a study regarding which types of sorting and diversion posters work the most efficiently would be beneficial to improving the compliance rates as well.

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1.0 INTRODUCTION

1.1 Background

The traditional practice of land filling waste is growing problematic. As population and consumption grow, waste production grows as well. These increasing rates of waste have required more land to be used for land filling and have led to multiple environmental implications, such as the contamination of adjacent land and contribution to global warming through its high methane emissions. Methane is a gas that has 21 times the ability to contribute to global warming (Thompson, Sawyer, Bonom, & Smith, 2007). High dollar amounts required to build and seal landfills make them even less appealing, and harder to maintain. It is estimated that to build an individual cell of a landfill, it would cost $15 million Canadian dollars, and another $6 millions to seal it, with additional maintenance costs. The negative environmental and financial implications due to land filling practices stand as strong reasons for mitigation efforts.

Diverting recyclable materials from landfill disposals can mitigate the adverse effects that are caused by land filling. Major benefits can include, but are not limited to, a significant decrease in greenhouse gases, retrieval of valuable resources, and stimulation to create a green economy and technology (Ontario Ministry of the Environment, 2010).

As substantial contributors to municipal waste, universities have made many efforts to increase waste diversion. Dalhousie University, a major contributor to the waste produced in the Halifax Regional Municipality (HRM), has the opportunity to lead the region in improved diversion rates. Effective monitoring of waste diversion can be achieved through the conduction of waste audits; which are essential in colleting baseline data, assisting future policy formation and monitoring the effectiveness of previous efforts.

Studies conducted across North America have shown that waste created on a university campus is largely divertible. In 2003, a waste audit was conducted in a dormitory, an academic building and the student union building at MIT, and found around 70% of the disposed trash was recyclable. This study also pointed out that by recycling 40% of the trash (their goal), the institution could save $100,000 a year – 10% of the total waste management budget (MITnews, 2003). On a national level, an audit performed at the University of Toronto showed that public areas, especially classrooms, tended to have more waste with a lower capture rate (University of Toronto, 2010). Reports proposed that increasing the number of recycling bins and reducing the number of individual garbage cans could help diversion rates.

Dalhousie University, as a participant in the Greening the Campus movement and as a major contributor to HRM waste (Christian, et al., 2010), is responsible for ameliorating its diversion rate. The university currently has a target rate of 75% waste diversion, increasing from a rate of 50% in 2009 (Facilities Management, 2009).

In 2006, Dalhousie conducted a study, which evaluated the efficiency of its recycling program. In order to monitor people's knowledge, attitude and recycling habits, an audit was performed throughout several buildings over all three campuses: the Life Sciences Centre, the Killam Library, the Student Union Building, the Engineering Buildings and the Dentistry Building (Brooks, et al., 2006). This specific study discovered that inefficiency of the multiunit bins was primarily due to lack of knowledge, the scarcity and lack of access to the multiunit bins, and the unclear labels on the bins (Brooks, et al., 2006). Recurring contaminants within this study were recyclables and organics. Amongst all respondents, 91% recommended placing more recycling facilities throughout the campuses (Brooks, et al., 2006)

An audit, conducted in 2008, of the contamination levels within the four-bin systems was conducted in Henry Hicks Academic Administration Building, the Sir Charles Tupper Medical Building and the Ira McNabb Building (Heathcote, et al., 2010). The findings of this project showed that coffee cups, solid napkins, facial tissues and cardboard were the most misplaced (Heathcote, et al., 2010). In 2009, an audit of the four-bin systems within the Life Science Centre was conducted, and large amounts of organics were found to contaminate the refuse bins (Heathcote, et al., 2010).

Early 2010 marked the beginning of a pilot project on the second floor of the Killam Library. The Library Green Team eliminated all the individual bins and placed four-bin systems on the floor in their place. An initial study was conducted to find that eliminating individual bins can decrease the garbage waste from 85% to 25%, and a decrease in contamination in the four-bin system (Heathcote, et al., 2010). Success of this pilot project has led the Library Green Team to further eliminate the individual refuse bins and place multiple four-bin systems in the atrium and all common areas of each floor of the library.

1.2 Objectives

Through the process of a waste audit and conduction of interviews, this research project sought to determine and observe compliance levels of the recently implemented four-bin system within the Dalhousie Killam Library. In addition to determining compliance levels, this project observed common contaminants, and compared contamination levels by floor. As there has been no previous study which discusses and compares contamination levels in four-bin system in different locations within the same building, or one which proves the long-term effectiveness of these systems, this project will provide data that is both useful and timely.

1.3 Purpose

In addition to monitoring the effectiveness of the four-bin system within the Killam Library, conclusions of this study are intended to contribute to the data and literature used on Dalhousie's campus. Results from this study may prove useful when performing audits of other buildings on campus, and provide concrete data to compare compliance levels between buildings. Information gathered from this study will support future strategising, policy making and educating staff and students about Dalhousie's undertaking to increase waste diversion to 75% on campus. Furthermore, the data from this study will prove useful for further studies not only in the Killam Library, but across Dalhousie's campus and other campuses nationwide.

The following report will describe the methods used to conduct the waste audit and custodial interviews, present the results from the methods, discuss the results and their implications and consider future actions and research that is applicable.

2.0 METHODS

2.1 Study Design

Both quantitative and qualitative research methods were used in order to obtain all the necessary data required to meet the defined research objectives. A quantitative approach was used to collect representative waste audit data from the Killam Library on Dalhousie University's Studley campus in order to assess the building's compliance levels to the newly implemented four bin waste management system. As well, qualitative interviews were conducted to gather behind-the-scenes knowledge of the success and failure of the waste systems. A proportional stratified random probabilistic sampling technique was implemented to collect quantitative data regarding the contents of each bin within the four bin waste system. This technique ensured representativeness among each strata of our population (Palys and Atchinson, Chapter 4, 2008). Also, non-probabilistic purposive techniques were practiced to gather qualitative data from the interviews. According to Palys and Atchinson, purposive sampling does not aim for representativeness; instead it intentionally seeks out individuals who have a specific reason for inclusion in the study (Palys and Atchinson, Chapter 4, 2008). Clearly, the custodial staff have unique knowledge about waste disposal on campus, which the interviews were designed to determine. An ethics proposal was needed to ensure confidentiality of each individual involved in the interview process**.**

2.2 Quantitative Sampling Procedures

Prior to the waste audit being conducted, the group coordinated with the Killam Library custodial staff to help schedule the audits. The group organized the date and time during which the audit would occur, so that the custodial staff knew not to dispose of the garbage, as well as to determine the prime time to collect the waste bins. The daytime custodial supervisor marked the

seven waste systems during her shift so that the evening staff would know which systems we were planning to audit, and would not remove them. If it were necessary to change the bag from one of the systems we were auditing, the bag would be labeled and left overnight in our sampling location for us to add to our audit in the morning. This helped us to achieve a consistent 24-hour garbage collection for our waste audits. Other than the custodial staff and the members of the Library Green Team, no other students or staff were informed of the date of the audit. Otherwise, individuals may have changed their waste behaviours and our audit results would not have been representative of normal waste practices (Solid Waste District, 2011). Furthermore, before the waste audit began, the team divided up procedural roles. It was recommended that each team member be assigned only one role in the sampling procedure. This way there was validity and reliability in the obtained results, without the possibility of error occurring when different individuals used slightly different procedures or techniques. Procedural roles included: Collection of the waste (entire group), one data recorder and photographer (Jennifer Allan), and four waste sorters and weighers (Mhari Lamarque, Huan Liu, Ashley White and Elsbeth Scotland).

Two audits were conducted, one on Tuesday, March 15th, and the second on Tuesday, March 22nd. Both mornings, the audit began at 6am by meeting with the daytime custodial supervisor outside the Killam Library, in order to be let into the library before public hours. Also, the early start enabled us to collect the waste before the morning staff came in contact with it. To determine how many four-bin waste systems we would sample, a proportional sampling approach was used. Since there were 9 bin sets on the first floor, 7 bin sets on the second floor, 4 bin sets on the third floor, and 5 bin sets on the fourth and fifth floors, we decided to sample 2, 2, 1, 1, and 1 four-bin waste system respectively from each floor per audit. Therefore, a total of 7

systems were sampled each waste audit, totaling 28 bags of waste. The entire team collected the representative waste bags from the four-bin systems on each floor and brought them to an area behind the circulation desk that we had arranged to use for the waste sorting. Bags were then arranged in order of floor for ease and convenience throughout the audit.

Firstly, the four waste sorters donned all necessary safety equipment, including Tyvek suits, safety glasses, and gloves. The data recorder/photographer did not require safety attire, as she never touched the waste. This equipment was provided by Rochelle Owen, Gary Davidson, and Michael Wilkinson who also provided the team with a sampling scale. All data collected was recorded in a data chart, an example of which can be found in Appendix A. The same Pitney Bowes scale, which incorporated a tare function, was used for both waste audits, which allowed for more representative data results. To begin, the weight of one sorting bin was recorded – this weight was needed to be subtracted from each recorded weight to obtain a weight for just the waste in the bag. The audit began with the first floor's waste and continued to the fifth floor, where each 4-bin system was sorted before moving onto the next one. A black garbage bag was used as a surface to sort the waste on, to avoid making any extra mess. The team consistently began with the paper bin from each system to avoid contaminating the contents with liquid. The contents of the bag were arranged on top of the garbage bag, and the photographer took a photo of the waste pile. This photo included a label in the bottom corner indicating the date, the target waste type, bin number, and floor of the four-bin waste system, in order for it to be clearly distinguished later for further analysis. Once the photo was approved, the waste sorters began to sort the contents into four sorting bins, one for each type of potential contaminant – garbage, recyclables, paper, and organic, according to the Dalhousie Waste Management Guide, found in Appendix B. Each sorting bin was weighed to calculate the weight of each type of waste within

the target waste. The data recorder kept track of the data collected, using one data chart for each four-bin waste system. As the waste was sorted, observations were made concerning the contents of the bags, particularly pointing out commonly misplaced items. This was also carried out later by photo examination. This same procedure continued for the other three target waste bags within the same four bin waste system, as well as for the other bags collected from each of the 5 floors. The refuse collected throughout the audit was properly sorted and disposed of following the audit. Also, any spills that occurred while sampling or waste residues that were left were cleaned up immediately following the audit.

Dalhousie's Audit Instructions were followed, although slight modifications were made to the procedure in order to obtain the objectives of the study (Dalhousie's Audit Instructions, 2011).

2.3 Qualitative Sampling Procedures

Our team interviewed two members of the Killam Library custodial staff. A member of the Library Green Team worked with the evening custodial supervisor to coordinate the interviews with the staff members. One member of our team was responsible for carrying out the interview process, and recording the responses. The questions that were asked to the custodial staff in our interview can be found in Appendix C.

2.4 Data Analysis

Once all data was collected, the levels of contamination within each target waste bin were determined. A percentage of each type of waste was calculated by dividing the weight of each type of waste found in one bag by the total weight of that bag. These calculations were used to analyze the level of compliance to the four bin waste system by comparing compliance between each target bin within the same four bin waste system, as well as to determine problem areas by

comparing levels of compliance between floors. Results were displayed using Microsoft Excel programming. Qualitative data displays, including bar graphs and pie charts, were used to express the final results. Data collected through observation during the waste audits, as well as by further analysis of our photographs, was taken into account and used in future discussion of our audit results.

The interview responses were used to help confirm our results found in the waste audits, as well as to gain further knowledge concerning the four bin waste system, which was fully implemented last year. We included the results in the final report in order to provide support for our quantitative data.

2.5 Delimitations and Limitations

Delimitations of this study included the fact that only the Killam Library was studied, hoping that sample would give us a representation of the entire campus, due to it being such a frequently visited building by most students. However, this was only an assumption. Limitations included the small time frame we had for this study. If further time were allowed, more audits would have been completed to provide stronger data results, but this was not practical for a five week study. Also, the responses given from the custodial interviews were out of our control, and their ability to provide some answers may not have been permitted.

3.0 RESULTS

Two waste audits were performed in the Killam Library to determine the compliance and contamination levels. The results varied from each audit and gave some insight into the research questions of this report. The results of the study will be given in this section.

The first waste audit took place on March 15, 2011. The preliminary findings showed, by visual estimation, that the garbage bins were the most contaminated and therefore had the lowest compliance levels. After analysis of the data was completed it became apparent that because contamination level was determined by weight, plastic actually had the highest contamination as shown in the following graph.

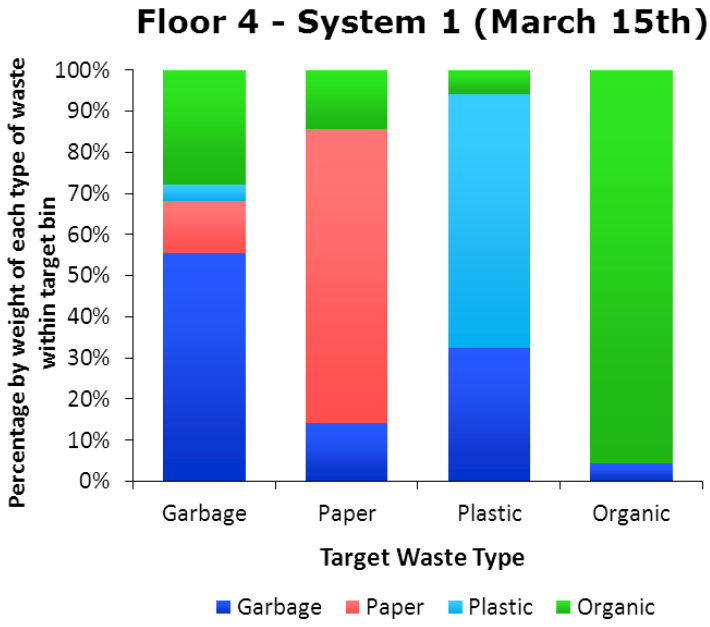

Figure 1. The contamination level of the four waste bins from the 4-bin waste system on the fourth floor collected in the firtst waste audit, on March 15, 2011.

The above graph shows that the plastic bin of the first system on the fourth floor had high levels of contamination. Garbage was the worst contaminant, found in almost every bin of every system. When garbage did appear in a bin, it was most likely found to be the heaviest (weight recorded in grams), as shown in the table below.

Floor 2 - System 1: Quiet Area		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	1550	1130	0	20	400
Paper	590	340	70	0	180
Plastic	730	220	0	460	50
Organic	1130	40	0	0	1090

Figure 2. The weight of waste collected from the Floor 2 – System 1 4-bin waste system on the March 15, 2011 waste audit.

The second waste audit took place on March 22, 2011. Again, the plastic bins were found to be the most contaminated. On every floor except the third the garbage bin was contaminated with all of the other three types of waste; paper, plastic, and organic. This is shown in the sample graph from the first system on the first floor. The high contamination levels are quite easy to point out.

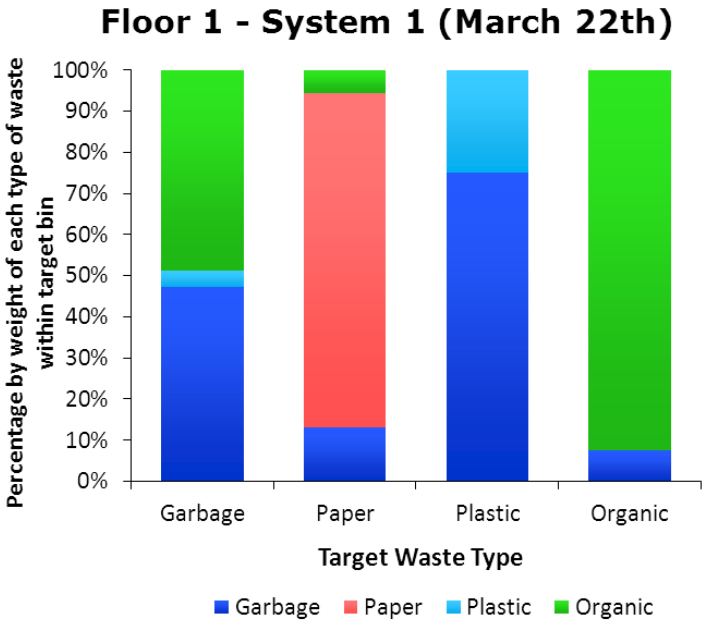

Figure 3. The contamination level of the four waste bins from the first 4-bin waste system on the first floor collected in the second waste audit, on March 22, 2011.

Overall, plastic bins had the highest contamination rate from floor 1 to floor 5, averaging 44.33%. The contamination level increased significantly on floor 5. Garbage bins had the second highest contamination rate of 42.88%. Organic bins had the lowest contamination level of 13.16%. However, on Floor 3 and Floor 5, the contamination increased significantly. Paper bins contamination level differed significantly from floor to floor, averaging 30.62%. Floor 2 and Floor were much more contaminated than the other floors.

4.0 DISCUSSION

4.1 Summary of Research Question

This study was conducted to determine the compliance level within each waste type of the four-bin disposal system on each floor of the Killam Library, to observe the commonly misplaced items, and to track the degree of success of the four-bin systems that were implemented last year. The Library Green Team hypothesized the contamination level on certain floors or areas may be higher than the rest, and specific items may be continuously displaced. In the previous study that was conducted in the Killam Library in 2010, coffee cups were found to be most commonly displaced, and a waste audit on the pilot four-bin system showed that it was possible to significantly increase the diversion rate (Heathcote, et al., 2010).

4.2 Significant Findings

Quantitative Findings

From the auditing data, both the overall weight per system and the contamination level varied by floor, which can be observed from the graph below:

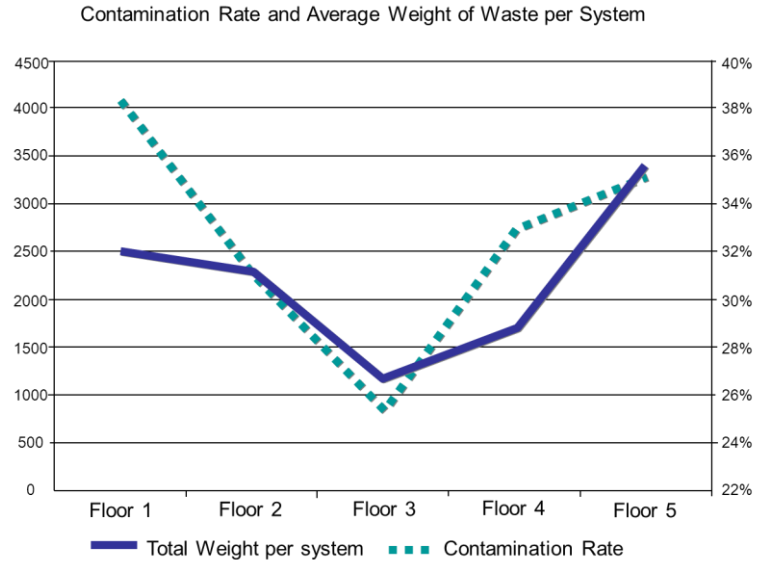

Figure 4. The contamination rate and average weight of waste per four-bin system collected from each floor of the Killam Library.

Floor one, which is the busiest area in all the five floors and where the coffee shop and food court are located, was observed to have the highest contamination level yet the amount of waste was around average.

Interestingly, on the second floor, which is almost as busy as the ground floor, had a similar amount of waste per system with floor one, but the contamination level was nearly 10% lower. What is worth noticing is that the second floor is where the previous four-bin system pilot project was conducted and where garbage cans were first completely replaced by four-bin systems. Given this, it is possible that the length of time it took to replace individual garbage cans with four-bin systems may have had an influence on people's waste diversion behavior.

The atriums from floor three to floor five are quiet study areas, and food is not allowed on the fourth floor. Among them, the 3rd floor had the lowest contamination rate as well as the least waste, and the reason remains unknown. The total weight of waste on the fourth floor was below the overall average, but the contamination rate was fairly high. The atrium on floor five, however, had a surprisingly large amount of waste, nearly 140% of the weight of waste on the first floor; meanwhile, the contamination level was the second highest of all five floors, only around 3% lower than the first floor. However, when looking into the composition of the contamination in each bin, each garbage bin was observed to be heavily contaminated by organic waste. Given that organic waste usually weighs more, the large amount of displaced organic waste may contribute to both the weight of waste, as well as the contamination level.

In general, the contamination levels were not consistent from floor to floor; neither was the overall amount of waste. The significant difference in amount of waste on different floors indicated that the frequency and usage vary in different areas in the Killam, and these may have had an impact on the waste diversion rate.

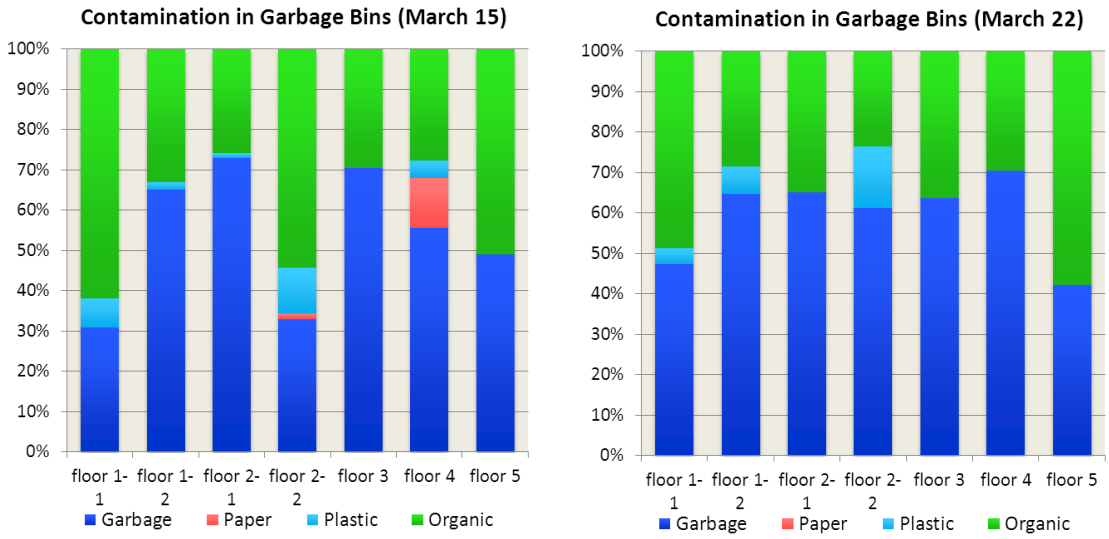

Figure 5. The contamination level calculated for each garbage bin within the 7 individual 4-bin waste systems from both waste audits.

From the waste auditing, the general garbage bins had the second highest contamination level. From the graph above, it is obvious that organic was the dominant contamination in garbage bins; meanwhile, floor one and floor five show constant and significant high contamination levels. The high contamination on floor one may have been because there was a food court near by. What is worth mentioning is that the atrium on the 4th floor is a quiet study area, and, different from the atriums on the other floors, food is prohibited. However, significantly lower amount of organic contamination was not observed on this floor in garbage bins in both of the waste audits.

The organic contamination in the garbage bins on the 5th floor was dominated by large packs of food. For instance, in the second audit, a whole box of dishes was found, contributing significantly to the contamination level.

Figure 6. A photograph taken of floor 1 – system 1 garbage bag contents on March 15th

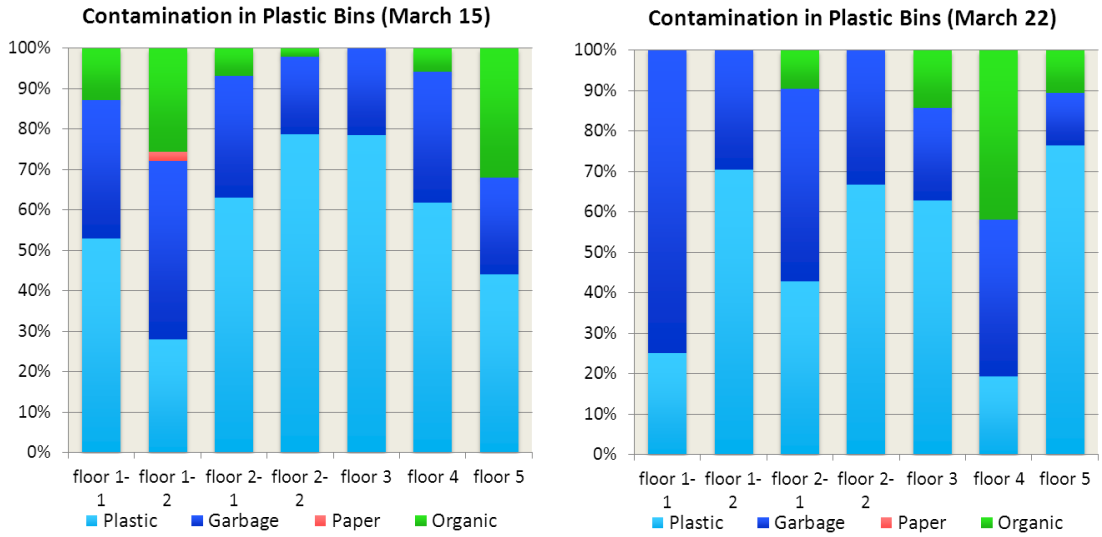

Figure 7. The contamination level calculated for each plastic/recyclable bin within the 7 individual 4-bin waste systems from both waste audits.

Surprisingly, recycling bins had the highest contamination level of all four bins. The bins on floor one were slightly more contaminated than the bins on the other floors. But, no significant and consistent contamination pattern was observed from the two waste audits.

However, the compositions of the contaminants were found to be similar. With no doubt, beverage cups were found to be the major contaminants in the recyclable bins, which included both coffee cups and juice cups; their sleeves and tissues, which were soaked by spilled liquids,

contributed to the organic contamination in these bins. Despite of these, paper (usually soaked) was occasionally found, as well as some non-recyclable plastics.

Many of the recyclable plastic bottles that were found in these bins contained liquids, and plastic caps. However, these are not supposed to be thrown into plastic bin. In this audit, all liquids were drained and they were not accounted for in the weight and total contamination level; meanwhile, given that this audit was calculated based on waste weights, the light weight of most recyclables may potentially enlarge the contaminations. All these factors may have impacted the overall results.

Figure 8. A photograph taken of floor 1 – system 1 plastic bag contents on March 15th

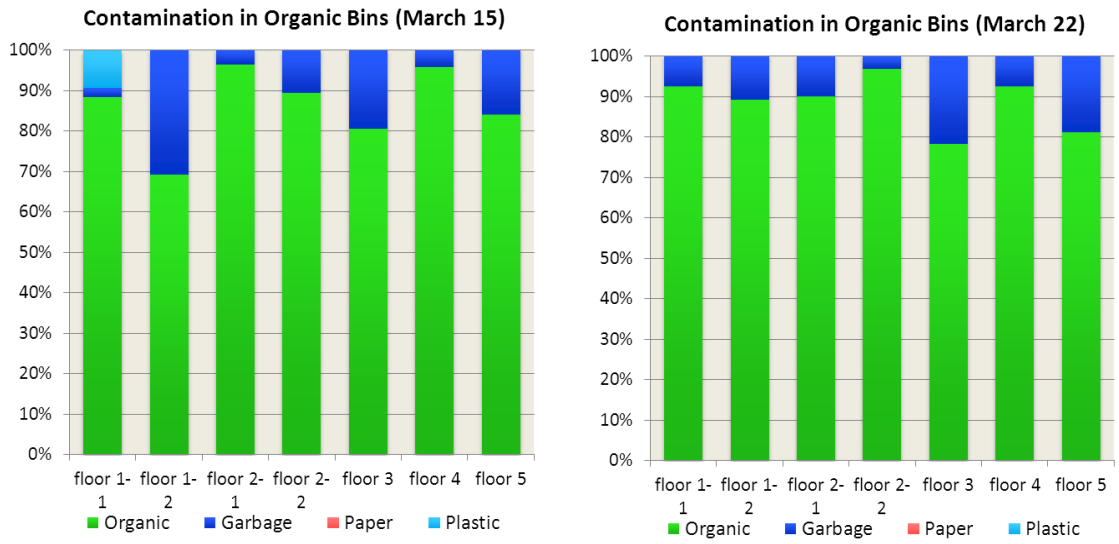

Figure 9. The contamination level calculated for each organic bin within the 7 individual 4-bin waste systems from both waste audits.

Organic bins had the lowest contamination level, and the dominant contamination was garbage, which was mostly composed of coffee cups and some food wrappers. The heavier weight of organics may have contribute to the high diversion rate given that all waste was calculated by weight in this study, and the ease of identifying organic matters may have contributed to the high diversion rate as well.

Some coffee cup sleeves were found in organic bins, which indicated that there were some individuals who have learned that these are organic. This may be the result of last year or previous efforts in informing people about waste diversion.

Figure 10. A photograph taken of floor 2 – system 2 organic bag contents on March 15th, as well as of floor 2 – system 2 paper bag contents on March 15th.

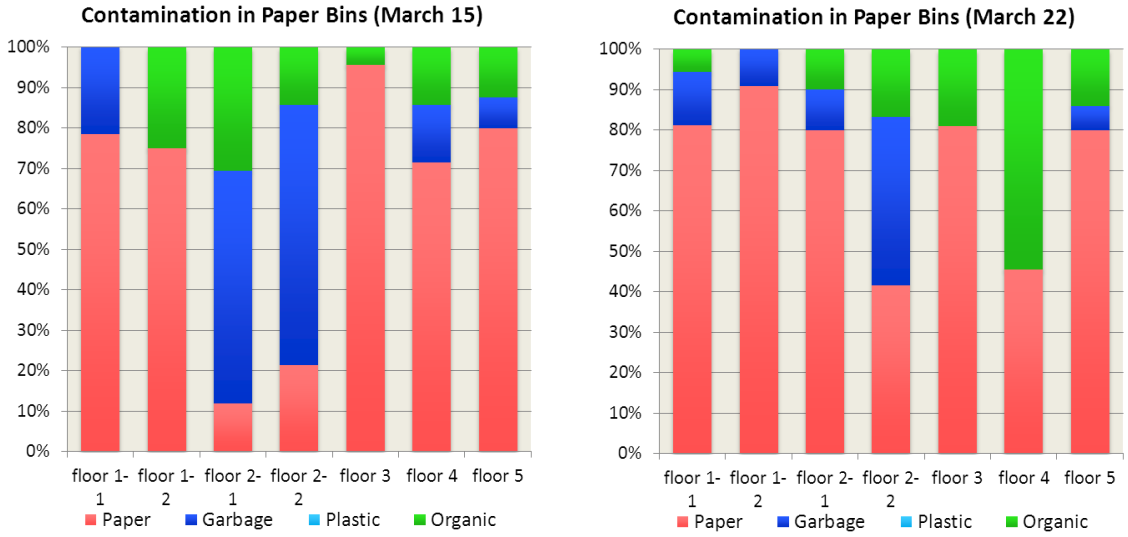

Figure 11. The contamination level calculated for each paper bin within the 7 individual 4-bin waste systems from both waste audits.

Paper bins had the second lowest overall contamination level of all four bins. In general, similar with plastic bins, no specific floor showed a significantly higher contamination level, though the bins on the second floor were slightly more contaminated.

Throughout the audit, coffee cups and food packaging were widely observed, we well, stationary products were found on the second floor in the first audit. It is not common, however, in the second audit, the leftover coffee in coffee cups soaked the paper. Therefore, the wet paper had to be counted as organic instead of diverting it to the paper bin. In addition, napkins and coffee cup sleeves were observed in paper bins.

Qualitative Finding

From the two interviews with custodial staff, an improvement of waste diversion had been noticed since the implementation of the four-bin system. However, staff commented that the four bins are always contaminated and no particular system has been observed to be significantly more contaminated than the others. In addition, they mentioned that coffee cups and cans are the major contaminants while the messy liquids are a problem as well.

The observations by the custodial staff that diversion rate has increased since last year, the dominant contribution of coffee cups in the contamination rate, as well as the problem of liquids, were consistent with the results of the waste audits. However, during the auditing, cans were not observed to be major contaminates from both the audit data and photos. The reason may be that the cans are very light thus can be less reflected in a weight-based waste audit. In addition, the garbage bags for all the bins except garbage bins are transparent. These two factors together with the comparatively large volume of cans may make these contaminations more noticeable. Only two waste audits were conducted for this study, and it may have been an anomaly that these two days had less can contaminations.

4.3 Other Key Findings

Coffee cups were still the dominant contaminant in all four bins in the Killam; however, beside the diversion of coffee cups themselves, there were several other significant factors that contributed to the contamination.

In garbage bins, organic was the major type of contamination, and vice versa. However, the organic bins were much less contaminated than garbage bins. From what was observed in the audits, the organic contamination in garbage bins (e.g. rice, pizza) were all packed in packages like plastic and paper boxes, and plastic coated paper. One reason may be that it is much easier to throw away food with its package rather than throwing food into organic bins separately. Also, sanitary concerns of individuals, for example, spilling food outside the bin or having it stick on to the cover of the bins, may have discouraged people from diverting their waste. Education or improvement on this specific issue may help to decrease this contamination, and improve diversion. Further research on the behaviours and reasons why people do not separate their food may be useful.

The plastic coated paper wrappers were commonly displaced as well. These bags should be thrown in the garbage bins, however many of them were observed in paper and organic bins. These individuals must have had good intentions to try to recycle these products, although they were not sure which bin was appropriate.

Other than the lack of diversion of coffee cups and their sleeves, tea bags and liquid inside the coffee cups were also a problem. Tea bags were unusually diverted into organic bins, and the unfinished liquids commonly contaminated the paper if they were displaced into paper bins. During the collection of garbage bags during the auditing, several bags were found to be leaking, creating a serious inconvenience to custodial staff. To avoid this problem, staff often

double bagged these bins to prevent leaking, which would double the consumption of plastic garbage bags.

Furthermore, when comparing the waste amount and contamination levels together, a positive correlation between these two factors can be observed. Given this, a high amount of waste may indicate a low diversion rate; however, to draw this conclusion, future studies are required.

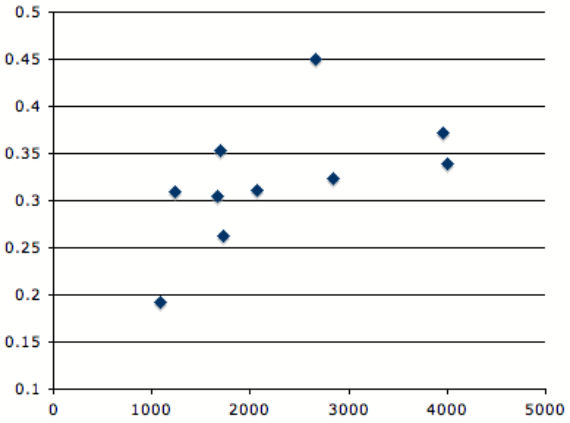

Figure 12. The positive correlation between the total waste weight collected and the overall contaminated level of the 4-bin waste systems.

4.4 Comparison with Existing Research Studies

Several key findings of this study were consistent with the findings from previous studies; however, contamination composition changes were observed.

1) Positive correlation between total amount of waste and contamination level

In Georgetown University's study in 2009, a negative correlation between total amount of waste and diversion rate was observed (Georgetown University, 2009), and this correlation was observed in the two waste audits as well. In the two waste audits, a positive-correlation between the amount of waste and contamination level can be found. However, the reason for this correlation still remains unknown, and further studies may be required to establish this correlation.

2) Most commonly displaced Item: coffee cups

Coffee cups remained the number one displaced item, which was consistent with the observation from the waste audit in the Killam in 2010 (Heathcote, et al., 2010), and it was commonly found in all the rest of the three bins. However, it is worth noticing is that some of cold drink cups are plastic #1 and can be recycled but were found to be displaced in garbage bins. With the warming weather, it is reasonable to estimate that more cold drink cup waste will be created and its contribution to contamination level will increase.

3) Four-bin System can Increase Diversion Rate & Alter Contamination Composition

When comparing the contamination rate in the garbage bins from this years audit with the auditing data in the Killam last year, significant decreases in contamination levels were observed, which indicated a higher diversion rate. Given that replacing individual garbage bins by four-bin systems was implemented after the waste audit in the Killam in 2010, a conclusion can be drawn that removal of individual bins and the use of four-bin systems can increase diversion rates, which is consistent with the findings in the waste audits in the University of Toronto as well (Heathcote, et al., 2010; University of Toronto, 2010).

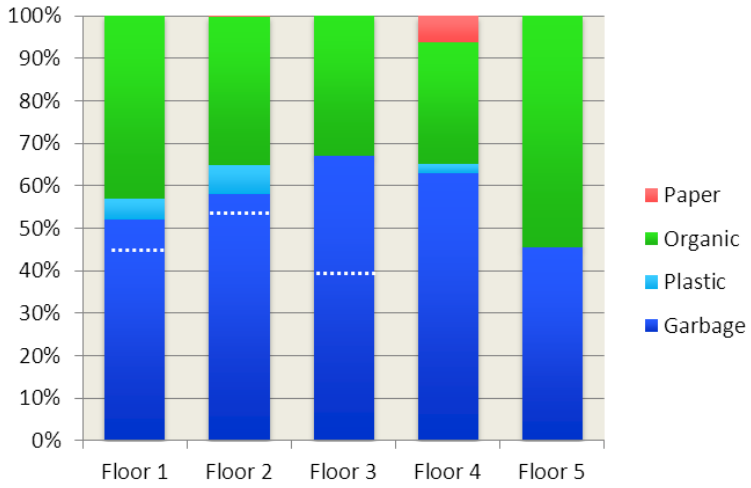

Figure 13. The contamination rate of the garbage bins within the 4-bin systems on each floor of the Killam Library, compared to the rate calculated in last years study (illustrated by the white dashed markings).

The composition of contamination in garbage bins has become less diverse since last year: the contaminations of displaced paper waste and recyclable waste have decreased tremendously, and displaced organic became the dominant contamination. These changes were not observed from previous studies (Heathercote, et al., 2010). This may be because the implementation of four-bin systems has raised people's awareness of waste diversion.

4.5 Implications for theory

Given the information and discussion above, one theory may be carefully drawn that the implementation of four-bin systems can increase diversion rates, and the composition of contamination will change; the contamination level, as well as the total amount of waste, varies in different locations. A positive-correlation between overall amount of waste and contamination rate is observed, however, the causation still remains unknown, and further research is needed to draw a conclusion about this relationship.

4.6 Findings which supported and failed to support the hypothesis

The findings from the two audits were consistent with the Library Green Team's hypothesis that contamination level would vary in different locations. Generally, the contamination level on floor one was the highest, and it was found lowest on floor three. However, no particular pattern was observed. Also plastic/recycling and paper bins were particularly highly contaminated, which failed to support the hypothesis.

The hypothesis that there would be commonly displaced contaminants was supported by the observations. The commonly displaced items were found to be coffee cups, plastic coated paper bags and wrappers, packed food, and liquids. Even though some unexpected and uncommon items like stationary dominated the contamination in one specific bin in one audit,

most displaced items were the commonly displaced ones. There was no significant finding that failed to support this hypothesis.

5.0 CONCLUSION

Conduction of this waste audit research study has brought forth several dominant problems within the waste diversion four-bin systems, and the compliance levels within the Dalhousie Killam Library. Interviews with the custodial staff working prior to the implementation of the four-bin systems and collected data indicated that there have been major improvements in the compliance levels of waste diversion after implementation. Although there have been improvements, each bin remained contaminated on a daily basis with common items such as coffee cups and cans.

5.1 Recommendations for Actions

After collecting and analyzing the data, it was evident to see where the problem areas were situated within the four-bins waste diversion systems. The following is a list of solutions developed in hopes of improving and increase the compliance levels within these four-bins systems.

Proposed Solutions:

1. Designing a tour that will educate students about sustainability on Dalhousie's campus. One of the stops will educate students on the importance of the four-bin systems, and teach them how to properly use them.
2. Liquid was a major contaminant within many of the bins, primarily from unfinished beverages. Implementation of a liquid waste bucket as a fifth bin would help to decrease the problem as liquid as a major contaminant, and would also protect other items from becoming contaminated, such as paper towel.
3. Designing an online educational waste diversion visual link, which would be available on the Library Green Teams Homepage.

4. Implementation of more informative diversion sings, which would be permanently posted above the four-bin systems. Photos of recognizable brands may also help students and faculty know where to dispose of their waste, Tim Horton's coffee cups, Second Cup bags and coffee cups, etc.

5.2 Recommendations for Future Research

This study strived to address which bins had the highest levels of contamination and why, however, there are many other studies that could be conducted pertaining to the compliance levels of the four-bin systems in the Killam. Recommendations for future research could include the social relationship of individuals between floors with the lowest or highest compliance levels. As well as a study regarding which sort of sorting and diversion posters work the most efficiently would be beneficial to improving the compliance rates.

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7.0 ACKNOWLEDGEMENTS

Our team would like to thank the following people for their assistance on our project. It would not have been possible or have gone as smoothly without them. Thank you to our instructors, Tarah Wright and Rochelle Owen for their helpful mentoring, The Library Green Team, Michelle Poan, Jan Pelley, Janice Slauenwhite, Sandra Dwyer, and Leigh Smith for their continual support and assistance throughout our project, the daytime custodial supervisor, Carla Hill, for helping with the organization, labeling and collection of the waste during our audits, the evening custodial supervisor, Juanita Haas, for her help in arranging the interviews, Nancy Melvin, for arranging the location of our waste auditing, Gary Davidson, for the helpful training session on the proper ways to conduct a waste audit he provided, Michael Wilkinson, of Facilities Management, for providing the necessary bins, gloves and scale required to conduct the audit, and to The Company House for hosting the Pecha Kucha night. Thank you!

8.0 APPENDIXES

8.1 Appendix A - Data Results

Waste Audit Data Results

Table 1. Raw data collected on March 15, 2011 from the two 4-bin waste systems on the first floor, Floor 1 – System 1, and Floor 1 – System 2.

Floor 1 - System 1: Learning Commons Writing Centre		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	1260	390	0	90	780
Paper	280	60	220	0	0
Plastic	700	240	0	370	90
Organic	430	10	0	40	380
Floor 1 - System 2: Learning Commons Help Desk		**Weight of each type of waste within target bin (grams)**			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	2000	1300	0	40	660
Paper	40	0	30	0	10
Plastic	430	190	10	120	110
Organic	130	40	0	0	90

Table 2. Raw data collected on March 22, 2011 from the two 4-bin waste systems on the first floor, Floor 1 – System 1, and Floor 1 – System 2.

Floor 1 - System 1: Learning Commons Writing Centre		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	760	360	0	30	370
Paper	530	70	430	0	30
Plastic	120	90	0	30	0
Organic	660	50	0	0	610
Floor 1 - System 2: Learning Commons Help Desk		**Weight of each type of waste within target bin (grams)**			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	2040	1320	0	140	580
Paper	110	10	100	0	0
Plastic	270	80	0	190	0
Organic	280	30	0	0	250

Table 3. Raw data collected on March 15, 2011 from the two 4-bin waste systems on the second floor, Floor 2 – System 1, and Floor 2 – System 2.

Floor 2 - System 1: Quiet Area		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	1550	1130	0	20	400
Paper	590	340	70	0	180
Plastic	730	220	0	460	50
Organic	1130	40	0	0	1090
Floor 2 - System 2: Atrium		**Weight of each type of waste within target bin (grams)**			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	700	230	10	80	380
Paper	140	90	30	0	20
Plastic	470	90	0	370	10
Organic	570	60	0	0	510

Table 4. Raw data collected on March 22, 2011 from the two 4-bin waste systems on the second floor, Floor 2 – System 1, and Floor 2 – System 2.

Floor 2 - System 1: Quiet Area		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	200	130	0	0	70
Paper	400	40	320	0	40
Plastic	420	200	0	180	40
Organic	710	70	0	0	640
Floor 2 - System 2: Atrium		**Weight of each type of waste within target bin (grams)**			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	720	440	0	110	170
Paper	120	50	50	0	20
Plastic	120	40	0	80	0
Organic	620	20	0	0	600

Table 5. Raw data collected on March 15, 2011 from the one 4-bin waste system on the third floor, Floor 3 – System 1.

Floor 3 - System 1: Atrium		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	270	190	0	0	80
Paper	230	0	220	0	10
Plastic	280	60	0	220	0
Organic	310	60	0	0	250

Table 6. Raw data collected on March 22, 2011 from the one 4-bin waste system on the third floor, Floor 3 – System 1.

Floor 3 - System 1: Atrium		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	440	280	0	0	160
Paper	210	0	170	0	40
Plastic	350	80	0	220	50
Organic	230	50	0	0	180

Table 7. Raw data collected on March 15, 2011 from the one 4-bin waste system on the fourth floor, Floor 4 – System 1.

Floor 4 - System 1: Atrium		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	720	400	90	30	200
Paper	140	20	100	0	20
Plastic	340	110	0	210	20
Organic	470	20	0	0	450

Table 8. Raw data collected on March 22, 2011 from the one 4-bin waste system on the fourth floor, Floor 4 – System 1.

Floor 4 - System 1: Atrium		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	880	620	0	0	260
Paper	110	0	50	0	60
Plastic	310	120	0	60	130
Organic	400	30	0	0	370

Table 9. Raw data collected on March 15, 2011 from the one 4-bin waste system on the fifth floor, Floor 5 – System 1.

Floor 5 - System 1: Atrium		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	1000	490	0	0	510
Paper	400	30	320	0	50
Plastic	250	60	0	110	80
Organic	1190	190	0	0	1000

Table 10. Raw data collected on March 22, 2011 from the one 4-bin waste system on the fifth floor, Floor 5 – System 1.

Floor 5 - System 1: Atrium		Weight of each type of waste within target bin (grams)			
Target Waste Type	**Total Weight (g)**	Garbage	Paper	Plastic	Organic
Garbage	1730	730	0	0	1000
Paper	850	50	680	0	120
Plastic	850	110	0	650	90
Organic	530	100	0	0	430

Contamination Level Data Results

Table 11. The contamination level in each bin of the waste collected from all seven 4-bin waste systems from March 15, 2011, the orange cell indicating the percentage of waste diverted to the correct bin.

Floor 1 - 1	Garbage	Paper	Plastic	Organic
Garbage	30.95%	0.00%	7.14%	61.90%
Paper	21.43%	78.57%	0.00%	0.00%
Plastic	34.29%	0.00%	52.86%	12.86%
Organic	2.33%	0.00%	9.30%	88.37%

Floor 1 - 2	Garbage	Paper	Plastic	Organic
Garbage	65.00%	0.00%	2.00%	33.00%
Paper	0.00%	75.00%	0.00%	25.00%
Plastic	44.19%	2.33%	27.91%	25.58%
Organic	30.77%	0.00%	0.00%	69.23%

Floor 2 - 1	Garbage	Paper	Plastic	Organic
Garbage	72.90%	0.00%	1.29%	25.81%
Paper	57.63%	11.86%	0.00%	30.51%
Plastic	30.14%	0.00%	63.01%	6.85%
Organic	3.54%	0.00%	0.00%	96.46%

Floor 2 - 2	Garbage	Paper	Plastic	Organic
Garbage	32.86%	1.43%	11.43%	54.29%
Paper	64.29%	21.43%	0.00%	14.29%
Plastic	19.15%	0.00%	78.72%	2.13%
Organic	10.53%	0.00%	0.00%	89.47%

Floor 3	Garbage	Paper	Plastic	Organic
Garbage	70.37%	0.00%	0.00%	29.63%
Paper	0.00%	95.65%	0.00%	4.35%
Plastic	21.43%	0.00%	78.57%	0.00%
Organic	19.35%	0.00%	0.00%	80.65%

Floor 4	Garbage	Paper	Plastic	Organic
Garbage	55.56%	12.50%	4.17%	27.78%
Paper	14.29%	71.43%	0.00%	14.29%
Plastic	32.35%	0.00%	61.76%	5.88%
Organic	4.26%	0.00%	0.00%	95.74%

Floor 5	Garbage	Paper	Plastic	Organic
Garbage	49.00%	0.00%	0.00%	51.00%
Paper	7.50%	80.00%	0.00%	12.50%
Plastic	24.00%	0.00%	44.00%	32.00%
Organic	15.97%	0.00%	0.00%	84.03%

Table 12. The total contamination level of all seven bins collected on March 15, 2011.

	Floor 1-1	Floor 1-2	Floor 2-1	Floor 2-2	Floor 3	Floor 4	Floor 5
Garbage	69.05%	35.00%	27.10%	67.14%	29.63%	44.44%	51.00%
Paper	21.43%	25.00%	88.14%	78.57%	4.35%	28.57%	20.00%
Plastic	47.14%	72.09%	36.99%	21.28%	21.43%	38.24%	56.00%
Organic	11.63%	30.77%	3.54%	10.53%	19.35%	4.26%	15.97%

Table 13. The contamination level in each bin of the waste collected from all seven 4-bin waste systems from March 22, 2011, the orange cell indicating the percentage of waste diverted to the correct bin.

Floor 1 - 1	Garbage	Paper	Plastic	Organic
Garbage	47.37%	0.00%	3.95%	48.68%
Paper	13.21%	81.13%	0.00%	5.66%
Plastic	75.00%	0.00%	25.00%	0.00%
Organic	7.58%	0.00%	0.00%	92.42%

Floor 1 - 2	Garbage	Paper	Plastic	Organic
Garbage	64.71%	0.00%	6.86%	28.43%
Paper	9.09%	90.91%	0.00%	0.00%
Plastic	29.63%	0.00%	70.37%	0.00%
Organic	10.71%	0.00%	0.00%	89.29%

Floor 2 - 1	Garbage	Paper	Plastic	Organic
Garbage	65.00%	0.00%	0.00%	35.00%
Paper	10.00%	80.00%	0.00%	10.00%
Plastic	47.62%	0.00%	42.86%	9.52%
Organic	9.86%	0.00%	0.00%	90.14%

Floor 2 - 2	Garbage	Paper	Plastic	Organic
Garbage	61.11%	0.00%	15.28%	23.61%
Paper	41.67%	41.67%	0.00%	16.67%
Plastic	33.33%	0.00%	66.67%	0.00%
Organic	3.23%	0.00%	0.00%	96.77%

Floor 3	Garbage	Paper	Plastic	Organic
Garbage	63.64%	0.00%	0.00%	36.36%
Paper	0.00%	80.95%	0.00%	19.05%
Plastic	22.86%	0.00%	62.86%	14.29%
Organic	21.74%	0.00%	0.00%	78.26%

Floor 4	Garbage	Paper	Plastic	Organic
Garbage	70.45%	0.00%	0.00%	29.55%
Paper	0.00%	45.45%	0.00%	54.55%
Plastic	38.71%	0.00%	19.35%	41.94%
Organic	7.50%	0.00%	0.00%	92.50%

Floor 5	Garbage	Paper	Plastic	Organic
Garbage	42.20%	0.00%	0.00%	57.80%
Paper	5.88%	80.00%	0.00%	14.12%
Plastic	12.94%	0.00%	76.47%	10.59%
Organic	18.87%	0.00%	0.00%	81.13%

Table 14. The total contamination level of all seven bins collected on March 22, 2011.

	Floor 1-1	Floor 1-2	Floor 2-1	Floor 2-2	Floor 3	Floor 4	Floor 5
Garbage	52.63%	35.29%	35.00%	38.89%	36.36%	29.55%	57.80%
Paper	18.87%	9.09%	20.00%	58.33%	19.05%	54.55%	20.00%
Plastic	75.00%	29.63%	57.14%	33.33%	37.14%	80.65%	23.53%
Organic	7.58%	10.71%	9.86%	3.23%	21.74%	7.50%	18.87%

Table 15. The average contamination level by floor of each of the four target waste bins, as well as the overall average contamination level of the garbage, paper, plastic, and organic bin, calculated from data collected during both audits.

	Floor 1	Floor 2	Floor 3	Floor 4	Floor 5	Average
Garbage	47.99%	42.03%	33.00%	36.99%	54.40%	42.88%
Paper	18.60%	61.26%	11.70%	41.56%	20.00%	30.62%
Plastic	55.97%	37.18%	29.29%	59.44%	39.76%	44.33%
Organic	15.17%	6.79%	20.55%	5.88%	17.42%	13.16%

8.2 Appendix B – Dalhousie Waste Management Guide

DALHOUSIE UNIVERSITY *Inspiring Minds*

The Dalhousie Guide to Waste Management on Campus

We're at 50% refuse diversion to recycling; our goal is to reach 75%!!!

RECYCLABLES

Rinse containers before recycling. Remove caps, straws and other waste.

All deposit bearing containers
Plastic bottles & containers (ONLY #1 PETE and #2 HDPE)
Plastic bags & shrink wrap (ONLY #4 LDPE)

Glass bottles & jars
Aluminum & steel cans
Tetra juice packs & mini sips (no straws)
Milk cartons
Aluminum foil & plates

Not Acceptable (Refuse):
Plastic/metal caps
Straws
Metal/plastic utensils
Plastic containers: #3, #5,# 6, #7

ORGANIC WASTE

No liquids.
If necessary, use a sheet of paper or some boxboard to wrap food waste.

Food Waste:
Coffee grounds & filters
Tea leaves & bags
Fruit & vegetable peelings
Table scraps
Meat, chicken & fish
Shellfish (including shells)
Dairy products
Bread, rice & pasta
Bones
Egg shells

Other solid food waste:
Paper towels & napkins
Paper bags
Boxboard (e.g. cereal boxes)
Paper plates & cold paper beverage cups

Not Acceptable in Organic Waste (Recycling or Refuse):
Waxed/filmed packaging
Frozen food containers
Corrugated cardboard (accepted under paper stream)
Styrofoam drinking cups
Coffee cups (due to plastic lining)
Newspapers & magazines

HAZARDOUS MATERIALS

For more information please visit: http://www.dal.ca/ehs/

(Hazardous: Materials or combination of materials that may cause harm to health and the environment. Includes materials that are: corrosive, ignitable, radioactive, reactive, toxic, and/or infectious.)

Batteries:
Spent 1.5 V alkaline batteries (AA, AAA, C, D, etc.)
Spent lithium batteries (does not include lithium ion batteries - see below). Pack separately with terminals taped or individually placed in clear re-sealable bags
For more information and disposal instructions, contact the Office of Environmental Health and Safety at 494-2495.
For rechargeable batteries, please visit: www.call2recycle.org to register for a free disposal program
For mercury containing lamps & lights, contact Environmental Services at 494-8396.

Surplus Research Chemicals and Hazardous Materials.
For information on the chemical exchange program (ChemEx) and the disposal of hazardous materials (biological, radioactive, chemical), please contact the Office of Environmental Health and Safety for at 494-2495.

E-WASTE

For more information please visit: http://fm.dal.ca/waste.htm

•Desktop computers
• Computer periphery (e.g. mice & keyboards)
•Computer components (e.g. circuit boards, hard drives, CPUs)
•Laptop computers
•Monitors
•Desktop printers
•Televisions
•Computer scanners
•Audio & video playback and recording systems
•Telephones and fax machines
•Vehicle audio & video systems
•Home Theatre in a Box (HTB) systems
• Toner Cartridges (see reverse)
• To have your e-waste picked up fill out the Electronics Recycling Form at: http://erecycling.dal.ca/
• For cell phone recycling please visit www.recyclemycell.ca or place in drop off bins at SUB, Rowe, Killiam and PCPC.
See reverse side for information on toner cartridges.

PAPER/ CARDBOARD

Flatten cardboard boxes. Remove paper clips and place beside paper bin.

Dry & clean paper (white or coloured)
Newspapers
Envelopes
Flyers
Glossy magazines
Journals / catalogues
Telephone books
NCR paper (No Carbon Required)
Cardboard, place beside paper bin

Not Acceptable (Refuse of Organic):
Carbon paper
Soiled paper
Boxboard
Paper towels/facial tissues

C&D Recycling

Materials such as wood, asphalt shingles, metal, and insulation are diverted to local Construction & Demolition sites. Call Environmental Services at 494-8396.
See reverse side for information on furniture.

REFUSE

Aerosol cans- empty non-hazardous
Floor sweepings
Broken glass (boxed & taped)
Disposable gloves (i.e. latex, vinyl, etc.)
Ceramics
Packaging (non-recyclable)
Potato chip bags
Disposable coffee cups
Styrofoam
Incandescent light bulbs
Cloth items (not able to be donated)

Reconsider all waste for potential reuse by yourself and others before discarding!

8.3 Appendix C – Interview Questions for Killam Custodial Staff

1. How long have you worked as a member of the Killam Library custodial staff?
2. Have you worked here since the four-bin waste system had been implemented?
3. Yes? Have you noticed any improvements in waste diversion after full implementation of the four-bin waste management system?
4. Do you notice one common mistake that is made within the bins?
5. Is one bin more commonly contaminated than others?
6. Is there a commonly misplaced item?

8.4 Appendix D – Ethics Proposal

Revised October 2010

ENVIRONMENTAL SCIENCE PROGRAM
FACULTY OF SCIENCE
DALHOUSIE UNIVERSITY

APPLICATION FOR ETHICS REVIEW OF RESEARCH INVOLVING HUMAN PARTICIPANTS
UNDERGRADUATE THESES AND IN NON-THESIS COURSE PROJECTS

GENERAL INFORMATION

1. **Title of Project:** Library Green Team

2.

Faculty Supervisor(s)	**Department**	**Ext:**	**e-mail:**
Tarah Wright	Environmental Science		tarah.wright@dal.ca

3.

Student Investigator(s)	**Department**	**e-mail:**	**Local Telephone Number:**
Ashley White	Envs	as758260@dal.ca	
Elsbeth Scotland	Sust	el929842@dal.ca	
Huan Liu	Envs	hn667135@dal.ca	
Brooke Allan	Envs	jn799298@dal.ca	
Mhari Lamarque	Sust	mh777692@dal.ca	

4. **Level of Project:**
Non-thesis Course Project [-]
Undergraduate [ ]
Graduate [ ]

Specify course and number: ENVS 3502

5. a. **Indicate the anticipated commencement date for this project:** Monday, February 28, 2011

b. **Indicate the anticipated completion date for this project:** Tuesday, April 5, 2011

SUMMARY OF PROPOSED RESEARCH

1. Purpose and Rationale for Proposed Research

Briefly describe the purpose (objectives) and rationale of the proposed project and include any hypothesis(es)/research questions to be investigated.

The purpose of this study is to determine the effectiveness of the four bin garbage system in the Killam Library. We are also looking to come up with solutions to the misuse of the system. We will perform a waste audit in the most populated areas of the library and use the information collected from that help us come up with a solution. The custodial staff will be questioned as to their thoughts about the effectiveness of the system.

2. Methodology/Procedures

a. ***Which of the following procedures will be used? Provide a copy of all materials to be used in this study.***

[ ] Survey(s) or questionnaire(s) (mail-back)
[ ] Survey(s) or questionnaire(s) (in person)
[ ] Computer-administered task(s) or survey(s)]
[-] Interview(s) (in person)
[ ] Interview(s) (by telephone)
[ ] Focus group(s)
[ ] Audio taping
[ ] Videotaping
[ ] Analysis of secondary data (no involvement with human participants)
[-] Unobtrusive observations
[ ] Other, specify _____

b. ***Provide a brief, sequential description of the procedures to be used in this study. For studies involving multiple procedures or sessions, the use of a flow chart is recommended.***

The main procedure in this project will be the waste audit. This will entail the collection of full garbage bags from the bins at predetermined times (we will be discussing the best times to collect bags with the custodial staff). The garbage bags will then be emptied and separated according to Dalhousie waste audit procedures, after which each bin will be weighed. The weight will correlate to the amount of contamination we encounter during the audit.

3. Participants Involved in the Study

a. ***Indicate who will be recruited as potential participants in this study.***

Dalhousie Participants:
[ ] Undergraduate students
[ ] Graduate students
[-] Faculty and/or staff

Non-Dal Participants:
[ ] Adolescents
[ ] Adults
[ ] Seniors
[ ] Vulnerable population* (e.g. Nursing Homes, Correctional Facilities)

** Applicant will be required to submit ethics application to appropriate Dalhousie Research Ethics Board*

b. ***Describe the potential participants in this study including group affiliation, gender, age range and any other special characteristics. If only one gender is to be recruited, provide a justification for this.***

We will be questioning some of the custodial staff at the Killam Library about their thoughts on the success of the four bin system since its implementation a little over a year ago. We will be questioning only the custodians that have been at the library since before the implementation of the four bin system so that they have the former system to compare to.

c. ***How many participants are expected to be involved in this study?*** Unknown

4. Recruitment Process and Study Location

a. ***From what source(s) will the potential participants be recruited?***

[ ] Dalhousie University undergraduate and/or graduate classes
[-] Other Dalhousie sources (specify) We will be inquiring about a list of staff that fit the criteria for our interview
[ ] Local School Boards*
[ ] Halifax Community
[ ] Agencies
[ ] Businesses, Industries, Professions
[ ] Health care settings*
[ ] Other, specify (e.g. mailing lists) _____

** Applicant may also require ethics approval from relevant authority, e.g. school board, hospital administration, etc.*

b. ***Identify who will recruit potential participants and describe the recruitment process.***
Provide a copy of any materials to be used for recruitment (e.g. posters(s), flyers, advertisement(s), letter(s), telephone and other verbal scripts).

Our contact with the Library will be arranging meetings with the custodial staff for us. If not, then we will approach the staff in the library and conduct our interview that way.

5. Compensation of Participants

Will participants receive compensation (financial or otherwise) for participation? Yes [ ] No [-]
If **Yes**, provide details:

6. Feedback to Participants

Briefly describe the plans for provision of feedback and attach a copy of the feedback letter to be used.
Wherever possible, written feedback should be provided to study participants including a statement of appreciation, details about the purpose and predictions of the study, contact information for the researchers, and the ethics review and clearance statement.

Note: When available, a copy of an executive summary of the study outcomes also should be provided to participants.

There will be no feedback letters sent to the participants of our interview. They will, however have acces to our final report if they wish to review it.

POTENTIAL BENEFITS FROM THE STUDY

1. **Identify and describe any known or anticipated direct benefits to the participants from their involvement in the project.**

   Indirectly, our project could make the custodial staff's job much easier. Contamination of the bins is a fairly large problem right now. If our study comes to some conclusions on how to cut back on contamination rates then the job of sorting the different garbage will be easier.

2. **Identify and describe any known or anticipated benefits to society from this study.**

   Broadly, if our garbage is taken care of correctly, we can hope that this will reflect on our environment. On a smaller scale, this study could benefit Dalhousie students, faculty and staff. Dalhousie pays a large amount of money to have their garbage removed, and a great deal more in fines when there is contamination. If the contamination was stopped, the money usually reserved for the fines could be used for something else that could benefits the Dalhousie students, faculty and staff.

POTENTIAL RISKS TO PARTICIPANTS FROM THE STUDY

1. **For each procedure used in this study, provide a description of any known or anticipated risks/stressors to the participants. Consider physiological, psychological, emotional, social, economic, legal, etc. risks/stressors and burdens**

   [-] No known or anticipated risks
   Explain why no risks are anticipated:
   Our only participants will be the custodial staff. We are only asking them their views on the contamination rates of the garbage. We do not anticipate that their answers will in anyway jeopardize their job security.

   [ ] Minimal risk *
   Description of risks:

   [ ] Greater than minimal risk**
   Description of risks:

* *This is the level of risk associated with everyday life*
** *This level of risk will require ethics review by appropriate Dalhousie Research Ethics Board*

2. **Describe the procedures or safeguards in place to protect the physical and psychological health of the participants in light of the risks/stresses identified in Question 1.**

   The custodians will be given complete anonymity in the final report. Only their answers will be recorded, not who gave the answer. Their answers will be used to help us better understand the four bin system, but they will not be used against them in any way.

INFORMED CONSENT PROCESS

Refer to: http://pre.ethics.gc.ca/english/policystatement/section2.cfm

1. **What process will be used to inform the potential participants about the study details and to obtain their consent for participation?**

   [ ] Information letter with written consent form; provide a copy
   [ ] Information letter with verbal consent; provide a copy
   [ ] Information/cover letter; provide a copy
   [-] Other (specify) information delivered verbally, verbal consent

2. **If written consent cannot be obtained from the potential participants, provide a justification.**

ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF DATA

1. **Explain the procedures to be used to ensure anonymity of participants and confidentiality of data both during the research and in the release of the findings.**

   The custodial staff's names will not be recorded in the final report. Their answers will be used in the final report to back up our findings, but the answers will not be used to pit two people against each other.

2. **Describe the procedures for securing written records, questionnaires, video/audio tapes and electronic data, etc.**

   Written records will be kept together with other research material with one of the group members. Material will be kept until the final report is finished at which point it will be disposed of accordingly.

3. **Indicate how long the data will be securely stored as well as the storage location over the duration of the study. Also indicate the method to be used for final disposition of the data.**

   [-] Paper Records
   [ ] Confidential shredding after _____
   [-] Data will be retained until completion of specific course.

   [ ] Audio/Video Recordings
   [ ] Erasing of audio/video tapes after _____
   [ ] Data will be retained until completion of specific course.

   [ ] Electronic Data
   [ ] Erasing of electronic data after _____
   [ ] Data will be retained until completion of specific course.

   [ ] Other _____
   (Provide details on type, retention period and final disposition, if applicable)

   Specify storage location: _____

ATTACHMENTS

Please **check** below all appendices that are attached as part of your application package:

[ ] **Recruitment Materials**: A copy of any poster(s), flyer(s), advertisement(s), letter(s), telephone or other verbal script(s) used to recruit/gain access to participants.
[ ] **Information Letter and Consent Form(s)**. Used in studies involving interaction with participants (e.g. interviews, testing, etc.)
[ ] **Information/Cover Letter(s)**. Used in studies involving surveys or questionnaires.
[ ] **Materials**: A copy of all survey(s), questionnaire(s), interview themes/sample questions for open-ended interviews, focus group questions, or any standardized tests used to collect data.

SIGNATURES OF RESEARCHERS

_____ Signature of Student Investigator(s)	_____ Date
_____ Signature of Student Investigator(s)	_____ Date
_____ Signature of Student Investigator(s)	_____ Date
_____ Signature of Student Investigator(s)	_____ Date
_____ Signature of Student Investigator(s)	_____ Date
_____ Signature of Student Investigator(s)	_____ Date
_____ Signature of Student Investigator(s)	_____ Date

FOR ENVIRONMENTAL SCIENCE PROGRAM USE ONLY:

Ethics proposal been checked for eligibility according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans

_____

Signature Date

_____

Signature Date