Digging Deep Through School Trash

A waste composition analysis of trash, recycling and organic material discarded at public schools in Minnesota

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Executive summary

How much waste is generated by Minnesota schools? How much of a typical school's waste could be recycled? These questions are easy to ask, but harder to answer.

This report details findings from a comprehensive school waste sort and composition study conducted in 2010 to provide answers to those questions. The Minnesota Pollution Control Agency (MPCA), in partnership with Hennepin County and the City of Minneapolis, evaluated the waste generated at six schools over a two-day period in April 2010. The subject schools included two elementary, two middle, and two high schools and included both urban and suburban schools. All six schools had ongoing recycling and organics composting programs. This study differed from many others in that it was designed to evaluate all of the material schools discard, including the materials collected as trash, as recycling, and as organics. It did not include any waste collected or managed at the schools as construction and demolition, medical or hazardous wastes.

Understanding the total generation and composition of school waste can help in identifying targets for reducing waste and designing and evaluating recycling and organics programs. The findings of this study should help municipal solid waste professionals, school operations and facilities managers, or any member of a school community to better understand the most accessible and significant opportunities for improving the waste-management practices of the schools with which they work.

Methodology

All the waste from the schools' trash, organics recycling, and recycling streams was collected for two days and identified by school, the waste stream, and the day it was generated. Collected waste was then sorted into 19 material categories. This allowed analysis of total generation and composition, as well as contamination of recycling and organics recycling, and capture rates for all of the schools.

Key results

- Over seventy-eight percent (78%) of school waste materials could be diverted from the trash to organics composting and container and paper recycling collection programs.
- Fifty percent (50%) of school waste could be managed via organics composting programs that accept food waste, liquids and nonrecyclable paper.

- The most prominent single material generated by schools was food waste, which was 23.9% of the total waste generated.
- True garbage, at 15.04%, was the second most prominent single material in the waste.
- Recyclable paper — materials from the three categories of "cardboard", "white office paper" and "mixed paper" — accounted for 23.51% of the total waste materials generated by schools.
- Nonrecyclable paper was also a particularly prominent material, at nearly 11%. Nonrecyclable paper includes items such as paper towels, napkins and paper plates, which are accepted in the subject schools' organics composting programs.
- Twenty-eight percent (28%) of school waste, by weight, could be diverted into the recycling stream.
- The subject schools had an average waste generation of .52 lb per capita per day.
- By extrapolation, this means an estimated 483,520 lb of waste are generated per day at Minnesota K-12 public schools.
- The six schools collectively had a 41.15% overall recycling rate.
- They are capturing 65.65% of the recyclables they generate and capturing 27.27% of the compostables they generate. If 100% of the recyclables and compostables were captured the recycling and composting rate could rise to over 78%.
- The percentage of individual recyclable materials generated at schools that are collected (captured) for recycling varies. For example, 33.22% of all the plastic bottles, 56.97% of mixed paper, and 95.36% of cardboard are captured for recycling.
- The percentage of compostable materials captured by the organics composting programs was 27.77%.
- A total of 62.9% of what is currently thrown away in the trash is compostable or recyclable. Compostable materials are 47.38% of what is thrown away in the trash, and recyclable materials make up 15.5% of the trash.

Conclusions

Substantial components of the waste stream in Minnesota schools could be reduced, recycled or composted. There is great opportunity to expand and improve school recycling and composting programs. In addition, this study points to opportunities to reduce overall waste generation by adopting additional waste prevention strategies and implementing expanded use of reusable items. Although schools are not, per capita, the largest waste generators in the state, their waste impact is significant because of the sheer number of schools, students and staff. Making the effort to act on the potential for improved waste management at our schools will return dividends in schools' budgets and in conserved natural resources.

Introduction

How much waste is generated by Minnesota schools? How much of a typical school's waste could be recycled? These questions are easy to ask, but harder to answer.

This report details findings from a comprehensive school waste composition study conducted in 2010 to provide answers to those questions. The Minnesota Pollution Control Agency (MPCA), in partnership with Hennepin County and the City of Minneapolis, evaluated the waste generated at six schools over a two-day period in April 2010.

This school waste composition analysis differs from others in that it was designed to evaluate all of the material schools discard, including trash, recycling and organics. Other studies encountered by staff involved in this project focused on evaluating what was thrown away in the trash. While that approach provides useful information that can help improve recycling and/or organics programs, it also leaves many questions unanswered. By evaluating all of the waste streams from schools, this report is designed to answer a number of questions, such as:

- How much total waste is generated by schools?
- How much of the material generated at a typical school could be recycled?
- What percentage of the recyclable material available is being captured by the existing recycling program?
- How much of the material generated at a typical school could be composted or processed through a food-to-animals program?
- What percentage of the organic material is being captured by the existing composting programs?
- How much of the material placed in recycling and organics bins is contamination? What types of materials are prominent contaminants?
- What materials are present in the overall waste stream generated by schools? How prominent are those materials?

Understanding the total generation and composition of school waste can help in identifying targets for reducing waste and designing and evaluating recycling and organics programs. The findings of this study should help municipal solid waste professionals, school operations and facilities managers, or any member of a school community to better understand the most accessible and significant opportunities for improving the waste management practices of the schools with which they work.

Study methodology

Study purpose and participating schools

The study's methodology was developed to:

a. collect, sort and record the types and weights of all the trash, recycling and organic materials generated by the schools in a two-day period;

b. separate out and weigh 19 material categories of recyclables, organics, and trash generated; and

c. record how much of each of those material categories was found in the schools' source-separated recycling, organics and trash streams.

The study was designed to yield a complete picture of the six subject schools' total daily generation from the two study days, Monday and Tuesday, April 26 and 27. The sorting of the waste took place on April 28 and 29. The sample protocol, material sorting categories, and field methodology are discussed below.

This study evaluated waste from six public schools in the Twin Cities metropolitan area: two elementary schools, two middle schools, and two high schools. Three of the schools (one at each grade level) are in the City of Minneapolis and three are located in suburbs of Minneapolis. All six schools have active organics recycling programs. In addition, they are all in compliance with Minnesota's Public Entities Recycling Statute §115A.151 which requires at least 3 materials be collected for recycling. The schools were selected in part because staff at each school agreed to participate and because they represented a mix of urban and suburban schools, a mix of socioeconomic levels, and had typical characteristics in terms of school size, facilities, and waste generation.

The six schools that participated in the study were:

- Burroughs Elementary School, Minneapolis
- Clear Springs Elementary School, Minnetonka
- Northeast Middle School, Minneapolis
- Hopkins West Junior High School, Hopkins
- Minnetonka High School, Minnetonka
- Washburn High School, Minneapolis

The six subject schools, all located in Hennepin County, Minnesota, included both urban and suburban schools, larger and smaller student enrollments, and a wide range of percentages of students eligible for free lunch (from 5% to 80%). The six subject schools comprised a small sample of all Minnesota public schools, of which there were 2,006 as of July 1, 2009 (Minnesota Department of Education, **http://education.state.mn.us/mdeprod/groups/InformationTech/documents/Report/015666.pdf**, accessed 6/9/10). The study was not stratified to proportionately reflect the total number of elementary, middle and high schools in Minnesota, or to reflect the number of students in each tier statewide. Weighted averages, based on the proportion of staff and students at each grade level statewide, were used during data analysis to account for the lack of stratification of the sample of schools. Further explanation of this issue and weighted averages is found in Appendix G.

Schools pride themselves on what makes them unique. Even in waste generation, the data show some striking differences. To better understand these differences, each school's waste generation and management operations were detailed. Key differences are noted in the Study Results section when they are theorized to explain differences in data. The complete school profiles and each school's individual results are detailed in Appendix A.

While schools are all unique, it is also true that what is in school waste is fairly consistent from school to school, especially within the same school grade tier. For that reason, the MPCA believes the waste generated by schools in this study may be representative of all waste generated at urban and suburban public schools in Minnesota.

Rural public schools operate under the same rules of operation as the urban and suburban schools in this study, and are held to the same standards. Private, parochial and charter schools, however, may operate significantly differently from typical public schools. For this reason, this study's findings are posited to be reflective of all regular public schools — including rural ones — but not of all private, parochial, or charter schools or alternative or vocational public schools.

No rural public schools or private, parochial or charter schools were included in the study. Any extension of this study's findings to these types of schools is left to the reader, who may choose to compare a school of interest to the profiles of the subject schools (see the school profiles in Appendix A).

Waste sampling determination

The goal when determining a waste study sampling protocol is to ensure that the waste that is sorted is representative of the larger population from which it is drawn. Sometimes the design is to take a few small samples from many schools. In this study, however, the approach was to analyze all the waste from a few schools. This is called a "census" approach. As with the population census, the goal is to count everything, not just a sample.

Both approaches are valid ways to reduce the variability, and, thus, potential sampling error, of the waste sample. In this case, because of the smaller number of subject schools, the study required that all waste be sorted. It was important in this study to ensure that all trash, recycling and organics from the two study days was carefully collected and sorted. Had a selection of waste samples been taken from the six schools, the error or variation would have been unacceptably high.

Material sorting categories

This study was concerned only with the materials that were routinely discarded as municipal solid waste (the regular trash) or collected for recycling or organics recycling. Other regulated waste streams, such as hazardous, medical, or construction and demolition waste, which are handled as separate streams, were not collected or counted. If any of these wastes were found in the regular trash, recycling or organics, they were noted and counted.

This study divided the collected materials into 19 categories. These categories were selected to reflect both the schools' current waste management systems (organics recycling and standard paper and container recycling) and to gather information that could be useful in discussions of future reduction or diversion programs (e.g., determining the value of switching from disposable trays to reusable ones, or separating white office paper from mixed paper for recycling).

There was no separation of aluminum from ferrous cans, or polyethylene terephthalate (PET) from high-density polyethylene (HDPE) plastics. In addition, there was no separate category for scrap metal (sorters reported finding only one or two small scrap metal items, school locks). The categories used in this study are listed below, along with examples of products in each category.

1. Nonrecyclable paper
   - Paper cups & plates
   - Paper napkins
   - Tissues & paper towels
   - Pizza boxes
   - Paper boats (e.g., French fry containers)
   - Wax-covered cardboard
2. Milk cartons
   (Note: Aseptic containers, such as juice boxes, were treated as true garbage.)
3. Compostable trays
4. Styrofoam trays
5. Food waste
6. Liquid
7. Recyclable Paper - OCC (old corrugated containers)
   - Uncoated corrugated shipping & storage boxes
8. Recyclable Paper - White office paper
   - White & pastel copy paper
   - Post-it notes™
9. Recyclable paper - Mixed paper
   - Magazines, books & newspapers
   - Construction paper
   - Mail
   - Manila envelopes & folders
   - Shredded paper
   - Paper ream wrappers
   - Paperboard/boxboard
     - Cereal boxes
     - Paper towel & toilet paper rolls
10. #1 & #2 plastic bottles with necks
11. Metal cans
12. Glass bottles
13. Reusables - still in good, usable condition
    - 3-ring binders, paper clips
    - Folders
    - Clothing
    - Tyvek™ envelopes
14. Plastics #1 - #6 (NOT #1 & #2 bottles with necks)

15 Plastic film

- Plastic grocery & produce bags
- Plastic zipper type bags
- Plastic frozen food bags
- Plastic stretch/shrink wrap, including that from paper products.

16 True garbage

- Sporks
- Packets
  - Packets of disposable silverware
  - Ketchup packets
- Straws
- Unlabeled plastics or #7 plastics
- Chip bags, candy/granola bar wrappers (foil/plastic)
- Other Styrofoam (bowls, clamshells – not trays)
- Nonrecyclable plastic film (including heavily food tainted)
- #1 -# 6 plastics of mixed components or product tainted (e.g., glue bottles, glue sticks)
- Juice boxes

17 C&D (construction & demolition debris)

- Concrete, wood, glass and metals
- Salvaged building components

18 HW (hazardous waste)

- Paint/thinners
- Glue
- Cleaning supplies (bleach, ammonia)
- Fluorescent lamps

19 E-waste (Electronic waste)

- Electronic appliances (e.g., TVs, VCRs, computers)
- Small electronics
- Electronic components

Materials that fit into the last three categories (C&D, HW and E-waste) are not supposed to be disposed of in trash, recycling or organics containers. Only materials that ended up in trash, recycling or compost containers were sorted. Thus, materials from those categories that were previously separated out for proper recycling were not included in this analysis. For example, expired fluorescent lamps set aside for recycling through a lamp recycler were not measured.

Field methodology

The key for this study was that, at the start of the sorting, all waste could be identified by the school it came from, the day it was generated, and the stream it was in (recycling, organics, or trash).

The following collection and sorting protocol was used in this study:

- Before the start of the study, researchers met with the head engineer at each school to explain details of the collection method and determine how many 96-gallon carts or large-capacity roll-off dumpsters would be needed to collect the waste at that school.
- Researchers provided self-adhesive labels to the school engineers to affix to each bag of waste generated during the study. Each label had the name of the school, the day of waste generation, and the stream (either "recycling," "organics" or "trash").
- Researchers provided labels that the school engineers taped to each 96-gallon cart or roll-off dumpster which also clearly indicated the school, the day, and the waste stream. Containers were delivered to the school. In cases where dock space was limited, enough carts were delivered to hold all the waste generated just through Monday night. Early Tuesday these were picked up and replaced with fresh carts to collect Tuesday's generated waste.
- The study protocol included collecting and labeling the waste generated on the weekend, but only so that it could be kept separate from the intended study waste from Monday and Tuesday. (Weekend waste was discarded/recycled and was not sorted, though it was weighed).
- The researchers met with custodial staff the day before the study started and each day that waste was collected for analysis. Site visits were done to ensure the methodology was implemented according to plan and to assist school staff with any issues or questions that came up.
- Three sorting stations (tables and sorting bins) were set up in the designated sorting area at the Hennepin County-owned and -operated Brooklyn Park Transfer Station and Household Hazardous Waste drop-off center.
- Tare weights of the bins used to capture sorted waste were written on the sides of the bins.
- All study containers were delivered to (but not dumped at) the designated sorting area at the Brooklyn Park Transfer Station and Household Hazardous Waste drop-off center.
- Each sorting table had a team of three to six sorters, one of whom was the table captain who made sorting categorization decisions.
- Designated runners delivered labeled carts and bags to the sorting stations and each sorting team then sorted one or two bags at a time, picking through the samples and sorting them into the various categories. Most of the materials went into labeled, blue recycling bins. Large quantities of old corrugated cardboard (OCC) went into wheeled carts. Liquid from beverage containers was emptied into 5-gallon pails and poured down the sanitary sewer after it was weighed.
- When any sorting bins were full or when all the waste from one of the waste streams of a school had been sorted, the bins were weighed. Both gross and tare weight were entered into an Excel data spreadsheet under the appropriate school, day and waste stream. The spreadsheet was programmed to calculate the net weight of the waste in each bin.

- Once the individual materials had been weighed, they were taken to designated areas for appropriate management. Areas were designated for corrugated cardboard, mixed paper, cans, plastic bottles, glass bottles (brown, green or clear), organics (including milk cartons) and trash.
- Unrecyclable batteries, consumer electronics, hazardous waste and other problem materials were set aside, inspected by Hennepin County staff, and managed appropriately.

The sorting was done by knowledgeable and experienced solid waste professionals and some volunteers. Solid waste staff from Hennepin County, the Minnesota Pollution Control Agency, and the City of Minneapolis worked side-by-side with volunteers throughout the sorting process. Solid waste professionals from these organizations were stationed at each sorting station to help maintain quality control, and to provide assistance to volunteers as needed.

The sorting area was clean and well organized. There was almost no opportunity for confusion of the waste streams during sorting. Even when a sorting table captain forgot what school or waste stream they were sorting before the materials were weighed and data entered, this could be ascertained by looking at the labels on the bag of waste or the label on the cart.

In total, 7,546 lb. of materials were collected, and 6,012 lb. of materials were sorted. The 1,534 lb. of unsorted waste was not sorted because of time considerations. However, because of the labeling sytem, the material not sorted was identifiable by stream and school. It was primarily trash from Minnetonka High School from one day. For data analysis, researchers were able to allocate the unsorted waste to proper categories based on the composition of the waste from that school for the other day.

Limitations of methodology

Though the overall sampling and sorting methodology used in this study provides detailed data, and the composition averages have a 90% confidence interval, some factors inherent in the methodology may have placed limitations on the data obtained. These factors include:

- The sampling and sorting events were two days in duration. This provides a snapshot of the waste generation and recycling efforts for the schools. While the days were chosen to represent days within a full five-day week of school and without any holidays within a week before or after, it is still just a snapshot and represents only about 1% of the annual picture.
- Only the materials set out for the study were collected. In two incidents, materials were inadvertently not collected for the study. Minnetonka High School placed a small portion of its cardboard in its regular cardboard container instead of in the study roll-off. No adjustment was made to the data to account for this material. At Northeast Middle School, no carts with Tuesday's recycling were delivered to the sorting site. It isn't clear what happened to those materials. Because the researchers had five months of weights of Northeast's weekly recycling, they were able to ascertain that the Monday recycling was very typical, and made an assumption that Tuesday's recycling materials would be about the same as Monday's weight.
- Some bags of materials collected in the schools were likely mislabeled by the engineers or custodians. For example, a bag of used paper towels was labeled as "recycling". However, custodians had on-site visits the day before the study started and on each day of the study collection, and were generally

enthusiastic and cooperative, so we believe that these errors were substantially minimized. On-site observation of the bags also confirmed that these errors were not common.

- Two segments of the waste collected as part of the study were not sorted. Materials generated over the weekend were intentionally not sorted. Weekend materials were labeled and collected, so that the weekend waste could be kept separate from the waste generated on the two weekdays which the study was most concerned with. In addition, there were fractions of the waste (primarily the trash stream) from both of the participating high schools that did not get sorted because of lack of time. Counting both the weekend and the other unsorted waste, approximately 20% of the waste generated was not sorted. The weekday material that was not sorted was distributed proportionally to the appropriate category based on the data derived from the more than 6,000 pounds (lb) of sorted waste. The labeling system used allowed sorters to identify each bag of waste by material stream (trash, recycling or organics), date generated and school of origin.
- The materials collected from schools were specific to public schools and may vary somewhat from private, parochial, charter or vocational schools' wastes.
- Inconsistency of understanding of which materials belonged in which categories may have had an impact on the data. Even with on-site training, monitoring and providing guidance to sorters, complete sorting accuracy is more a goal than a fact. The main example of this was food-covered plastics. For a while on the first sorting day, one sorting table put them in the trash, thinking that they weren't clean enough to be considered potentially recyclable, while the others put them with the #1-#6 plastics.

With that said, it is believed that the data obtained from this study are valid and accurate to the degree that is needed for understanding school waste generation and composition. These data should be helpful for targeting educational reduction campaigns toward certain high-volume one-use materials or targeting recycling or organics campaigns toward capturing specific materials in the trash stream.

Study results

Composition

Table 1 and Figure 1 both reflect the composition of waste by weight at the participating elementary, middle and high schools and an overall average for all grade levels combined. The most prominent single material in the waste stream at schools was food waste, which was 23.90% of the waste generated. True garbage was the second most prominent single category represented; but it accounted for only 15.04% of overall waste. Recyclable paper — which includes materials sorted into three categories) cardboard, white office paper and mixed paper) represented 23.51% of the generated waste. (Details of the types of items included in each category are outlined on page 10 of this report.)

The three recyclable paper categories were tracked separately to help schools and solid waste professionals evaluate whether it makes sense to collect them for recycling comingled or separated. Each situation is unique, but the price a recycler can receive for clean white office paper typically exceeds the price received for mixed paper. This may or may not come into play for individual schools or districts as they negotiate contracts for recycling services. While revenue shares for recyclables are not currently common, recycling service providers are offering revenue shares more often than in the past. Schools must take into account a variety of factors in evaluating which recycling program makes the most sense for them. The convenience of comingling or sorting recyclables, space considerations, and the cost and availability of services are also very important considerations. Additional information about the value of white office paper and mixed paper is included in Appendix E.

Nonrecyclable paper was also a particularly prominent material. Nonrecyclable paper includes items such as paper towels, napkins and paper plates. Nonrecyclable paper is often acceptable in commercial organics programs but not in food-to-animals programs. Its prominence is particularly significant as more and more schools evaluate the benefits of implementing food-to-animals programs or organics composting programs.

Note that in Table 1, and elsewhere in the report, that where aggregated data and results are presented, the averages are weighted averages. The researchers opted to use weighted averages to account for differences in waste generation in the individual schools within grade tiers, and to make sure the information is presented in a way that takes into account the proportion of the statewide student and staff populations in each of the three tiers - elementary, middle and high schools. A more thorough description of how the weighted averages were calculated is included in Appendix G. Results reported for individual schools is raw, unweighted data and details of each school's composition can be found in Appendix A.

The aggregated data represented in the "All Schools" column takes into account that in the whole of Minnesota public schools it is estimated that 41% of students and staff are found in elementary schools, 22.5% are found in middle schools and 36.5% are in high schools. This adjusts for the mix of schools chosen for this project, which did not have the same proportional breakdown.

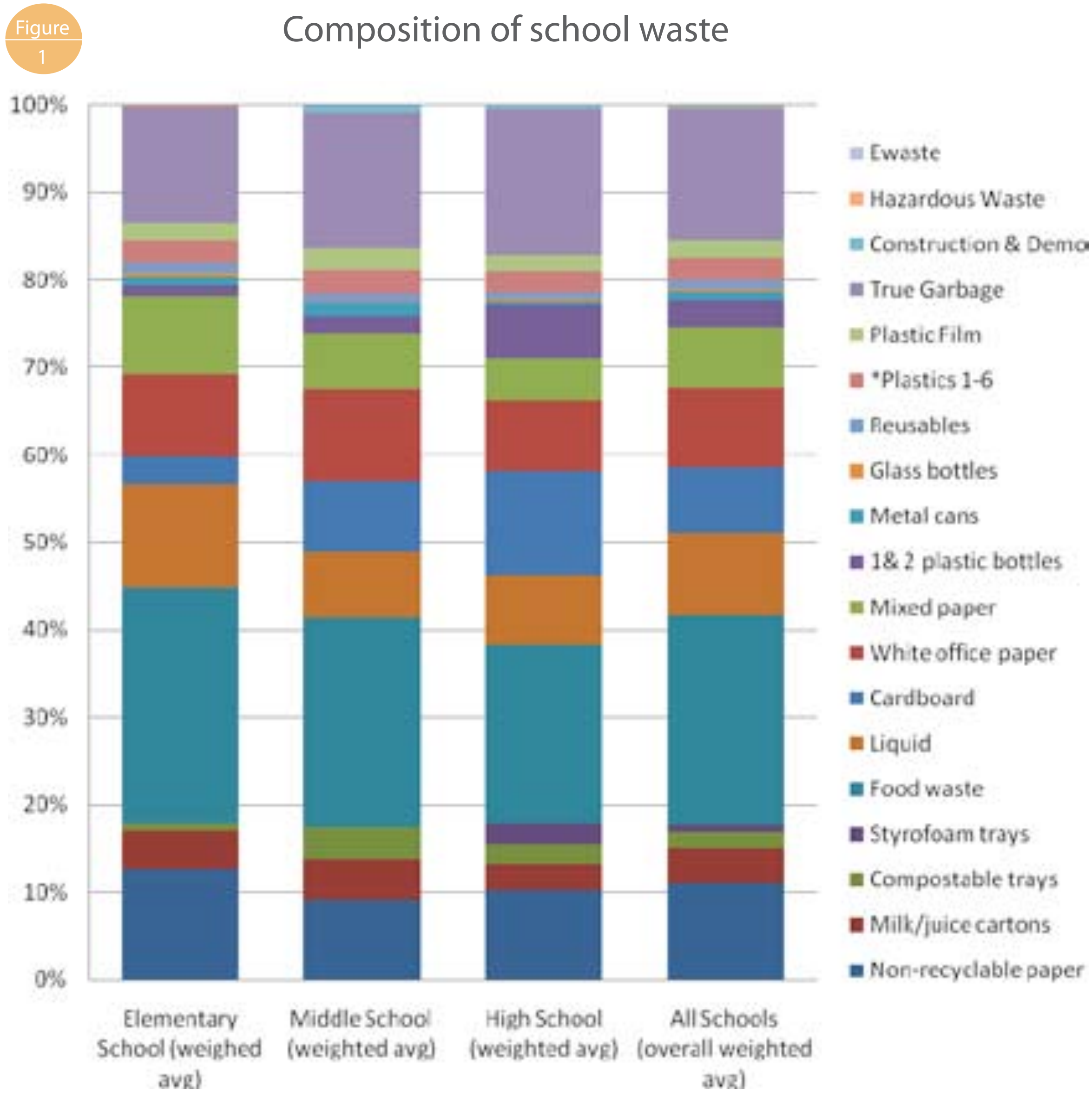
Table 1

Composition of school waste

Material	Elementary school weighted average	Middle school weighted average	High school weighted average	All schools overall weighted average
Nonrecyclable paper	12.67%	9.13%	10.2%	10.99%
Milk cartons	4.40%	4.63%	3.0%	3.94%
Compostable trays	0.77%	3.65%	2.3%	1.97%
Styrofoam trays	0.03%	0.00%	2.4%	0.87%
Food waste	26.99%	23.97%	20.4%	23.90%
Liquid	11.79%	7.58%	8.0%	9.47%
Cardboard	3.16%	8.11%	11.9%	7.48%
White office paper	9.39%	10.51%	7.9%	9.11%
Mixed paper	9.02%	6.32%	4.9%	6.92%
1 & 2 plastic bottles	1.18%	1.94%	5.9%	3.09%
Metal cans	0.94%	1.46%	0.6%	0.93%
Glass bottles	0.49%	0.17%	0.2%	0.33%
Reusables	1.14%	0.97%	0.6%	0.92%
Plastics 1-6 *	2.62%	2.77%	2.5%	2.60%
Plastic film	1.85%	2.47%	1.9%	1.99%
True garbage	13.32%	15.51%	16.7%	15.04%
Construction & demo	0.00%	0.70%	0.2%	0.24%
Hazardous waste (HW)	0.24%	0.05%	0.1%	0.13%
E-waste	0.01%	0.06%	0.2%	0.08%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

* *Plastics 1-6; NOT 1 & 2 bottles with necks*

Figure 1



Minnesota has an established hierarchy for managing waste in the most environmentally preferable way possible (Figure 2). Whenever possible the top priority is preventing the creation of the waste in the first place through reduction or reuse. Recycling is the next most preferred option. Those priorities are followed within the hierarchy by recovering food waste, which can be done through reuse (e.g., food shelves); through a food-to-animals program; or by composting. All of these options are preferred to disposal. Because diverting food waste from disposal is preferred, many schools, including the six participating in this study, have begun to collect and process their organic waste separately. The data from this study suggest that schools that operate food-to-animals programs could divert almost 33% of their waste (combined food waste and liquid) via such a program. Composting programs typically can handle nonrecyclable paper, compostable trays and milk cartons in addition to food waste and liquids. This study shows that all of these materials together account for just over 50% of the waste generated by schools. Additional information about food-to-animals and composting programs is included in Appendix C.

Figure 2

Minnesota's waste management hierarchy

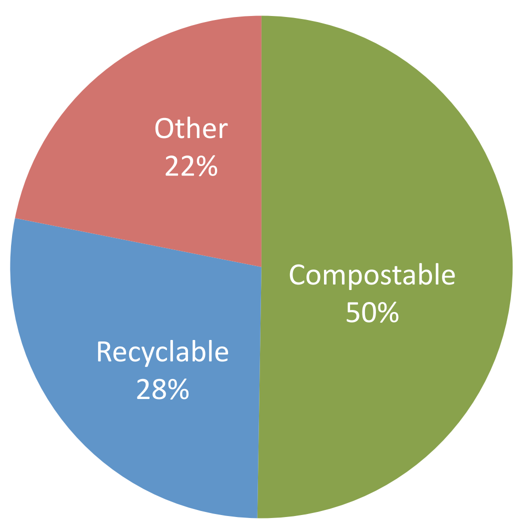
Recyclable and compostable components of school waste

This sort examined all discarded waste including material that was separated for recycling and composting. Many other studies have examined trash to determine how many recyclables (or organics) were not captured by existing programs. However, since a primary goal of this study was to evaluate how much of the total material discarded could be recycled or composted, all three material streams were collected and sorted.

Figure 3 below depicts data from all grade levels and details which components of the waste stream are recyclable, which are compostable, and which components are neither recyclable nor compostable via traditional recycling programs. The data suggest that an optimally performing school could conceivably recycle or compost in excess of 78% of the material it discards.

Figure 3

Recyclable and compostable components of school waste



The materials considered recyclable for this evaluation included only materials that are commonly collected throughout the state by recycling haulers. These include:

- Cardboard
- White Office Paper
- Mixed Paper
- #1 & #2 Plastic Bottles
- Metal Cans
- Glass Bottles

Materials included in the 'compostable' category on Figure 3 include:

- Nonrecyclable Paper
- Milk Cartons
- Compostable Trays
- Food Waste
- Liquid

Schools with food-to-animals programs for organics recycling would be able to divert food waste and liquid, which would account for approximately 33% of the waste stream, instead of the 50% that is potentially compostable.

Milk cartons are a unique material. Some recycling programs have begun collecting and recycling milk cartons and there is reason to hope this practice will become more common. In areas where recycling is not yet an option, composting offers an excellent alternative for milk cartons. As the waste hierarchy indicates, if a material can be recycled or composted, recycling is considered the environmentally preferable choice.

The liquid component of the waste stream is useful in both composting and food-to-animals operations although individual schools may opt to sewer this material to ease cleanup for custodial staff. The six schools that participated in this study all instruct students to empty their partially full beverages before placing the containers into a recycling or composting bin. The captured liquid is then poured down the drain and thus does not end up mixed with solid waste. In comparison, many schools with food-to-animals programs instruct students to pour liquids in with food waste. Liquid is typically heavy, so it's important to consider which process is used when interpreting data and when comparing this study to other analyses of waste. Additional information about liquids is included in Appendix D.

Materials included in the Other category on Figure 3 include:

- Styrofoam Trays
- Reusables
- Plastics #1-#6 (not including plastic bottles)
- Plastic Film
- True Garbage

- Construction and Demolition Waste
- Hazardous Waste
- E-waste

Many of the materials included in the Other category could and/or should not be considered trash. For example, plastic film is quickly becoming a commonly recycled material and there is reason to hope opportunities to recycle it will expand in the coming years. Though less so, the same is true of other types of plastics — defined as Plastics #1 - #6. While most plastic recycling programs only collect plastic bottles, markets for these other plastics are far more prominent than they were only two or three years ago. Hazardous waste and e-waste (electronic items) also should not, and legally cannot, be disposed of as regular trash. Guidelines describing recycling options differ locally for these materials. County solid waste staff can inform schools how to properly handle these types of materials.

Styrofoam trays typically cannot be recycled but alternatives are widely available. Only two of the six participating schools used Styrofoam trays. Three schools used compostable trays and one used the most environmentally preferred option: reusable trays.

This category was deliberately called "Other" instead of "Trash" because, ultimately, only the segment defined as "true garbage" should be managed as garbage. Even within the true garbage category there are a number of viable strategies a school could pursue to reduce or eliminate materials from this category.

Waste Generation at Schools

In addition to gathering data on what materials are prominent in the waste generated at schools, this study also provides insight regarding how much waste is generated at schools. The quantity of waste generated by a school is an important metric for evaluating the school's environmental impact. Quite simply when less waste is generated more resources are conserved. The waste hierarchy prioritizes reduction and reuse because these strategies offer superior environmental benefits to all other waste management methods – including recycling.

How much waste does my school generate? How can my school get that data?

The Minneapolis Public Schools district has access to extensive data about the trash, recycling and organics generated at its schools because it implemented a resource management contract with its waste hauler. Resource management programs are based on the concept that waste hauling contracts can be improved to meet environmental and economic goals. Resource management contracts can include any provisions that the customer and waste hauler agree to. Some common elements included in resource management contracts are improved data gathering and reporting on wastes generated, more expansive and involved education provided by waste haulers, provisions for periodic right-sizing of containers and sometimes revenue shares for recyclables. Learn more about how resource management could help your school and view template resource management contracts at **www.pca.state.mn.us/resourcemanagement**.

Table 2 outlines how much waste was generated at each school over the two days of the waste sort. The waste generated includes all trash, recyclables and compostables that were discarded in all three materials streams. Student and staff populations are also listed to demonstrate how much waste was generated on a per capita basis by all regular daily users of the building. Minneapolis Public Schools has arranged with its hauler to have trash, recycling and organics weights reported for all district schools on a monthly basis. For comparison, five months of those data were used to calculate per capita waste generation over a longer time period. The numbers from the current study are very close to the numbers collected by the hauler over five months. This suggests that data from this 2-day study are reliable.

Table 2

Waste generated at study schools

School	Number of students (April)	Number of staff* (April)	Total population	Waste generated (lb)**	Daily per capita waste (lb) study***	Daily per capita waste (lb) (hauler)****
Burroughs (elementary)	762.0	54.4	816.4	574.20	0.35	0.30
Clear Springs (elementary)	584.0	97.0	681.0	845.46	0.62	Not Available
Northeast (middle)	519.0	73.3	592.3	739.73	0.62	0.65
Hopkins West Junior (middle)	856.0	85.0	941.0	864.00	0.46	Not Available
Washburn (high)	818.0	107.1	925.1	1255.62	0.68	0.66
Minnetonka (high)	2,775.0	308.0	3,083.0	3267.30	0.53	Not Available

* *Full-time Equivalent staff – includes teachers, administrators and non-licensed staff.*

** *Total waste generated over two days*

*** *Calculated based on waste generated over the two study days*

**** *Data provided by Minneapolis Public Schools from the hauler's reports for five months of waste generation (November 2009 - March 2010).*

Table 3 reflects how much waste is generated daily at all the public schools in Minnesota, assuming they generate waste at the same rate as the schools that participated in this study.

Table 3

Daily waste generated by minnesota schools

	Per capita/day (lb)	MN population of school tier*	Waste generated statewide per school day (lb)
Elementary (K-5)	0.47	413,401	195,969
Middle (6-8)	0.52	206,001	107,732
High (9-12)	0.56	309,711	174,746
Total	0.52	929,113	483,520

* *Statewide student and staff population data source: Minnesota Department of Education*

Recommendations for reducing waste

While recycling and composting efforts often receive the most attention, efforts designed to reduce the amount of waste generated have the greatest potential to reduce costs and benefit the environment. When an item that would otherwise be discarded as trash, recycling or organics recycling is “reduced” that means it is never used in the first place, and waste is prevented. Thus, there’s no need to obtain raw materials for its manufacture, or to use energy to manufacture, transport or dispose of it. It is because waste prevention avoids this consumption of resources that it is the top priority in the waste hierarchy.

Many schools have implemented policies and programs designed to reduce waste. Some simple strategies that can accomplish this goal include implementing paper reduction programs, expanding the use of reusable items, extending the life of items, and eliminating the use of products with short life-spans. The composition data from this study suggest a number of materials could be targeted for reduction.

For instance, the Prairie Creek Community School in the Northfield School District is an environmental magnet school that has taken great strides to reduce their waste. With an active parent organization, the school uses reusable trays, plates, bowls, and flatware. The students who bring their lunches from home are asked to take the uneaten portion of their lunch home with them. This accomplishes two goals it reduces the school’s waste, and also gives feedback to the parents about what their children are eating or not eating.

More information about waste reduction strategies is detailed below.

a. Paper reduction

Paper materials (cardboard, office paper and mixed paper) accounted for 23.48% of the school waste. Office paper in particular can be easily reduced. Simple strategies, such as duplex printing, reducing the size of margins, and reusing paper with printing on only one side can significantly reduce paper use and waste generation. Reducing paper waste is advantageous from both an environmental and economic standpoint because it can reduce both disposal and procurement costs. Guidelines, strategies and resources for reducing paper use at schools can be found on **www.reduce.org**.

Junk mail is another source of paper waste that is a good target for reduction – many schools receive excessive quantities of catalogs and unwanted solicitations which create paper waste. Mixed paper, which includes junk mail, accounted for nearly 7% of the waste generated at schools participating in this study. Asking mailers to have staff names removed from mailing lists or to mail fewer copies to a school can be an effective way to reduce waste. Schools can also contact distributors of other common items, such as extra copies of phone directories, if they are not wanted. A small, up-front effort can reduce schools’ waste generation and also save staff and janitorial time in sorting and handling unwanted paper.

b. Reuse - trays, utensils and food

Promoting and implementing reuse is an excellent way to reduce waste.

Disposable trays in the cafeteria can be a meaningful target for reduction. Reusable trays, dishes and utensils can be washed and used repeatedly. Any school evaluating the materials used in its cafeteria must consider procurement and disposal costs for disposable items. Comparing those costs to a one-time procurement cost, and staffing and washing costs can be challenging, but it is certainly a worthwhile exercise from an environmental standpoint. One of the schools that participated in this study uses reusable trays, and many other schools across the state have found it practical to use reusable utensils and trays. While waste from compostable and Styrofoam trays was tracked in separate categories for this study, disposable utensils were tracked within the true garbage category. A number of other potentially reusable containers also contributed to the true garbage category.

Food waste can be reduced through reuse. To accomplish this, a number of Minnesota schools have set up tables where students can place uneaten and unwanted wrapped items (such as granola bars and chips) or unopened milk cartons. These items are then available for other students who want them.

Food reuse tables, and most composting or food-to-animals programs, tend to work best when cafeterias have an orderly and systematic recycling, composting and disposal process. In most situations, the best way to accomplish this is to have students pass through a line adjacent to recycling, compost and trash containers which can be paired with a food reuse table. Having a person designated to monitor this process can also help keep things orderly and ensure that materials are disposed of properly. The role of monitor can be filled by a teacher, student or parent volunteer and indications are that students quickly learn how to use the system, making the monitoring process relatively simple.

There are many factors that contribute to the generation of food waste at schools. Policies that define quantities and types of food which much be served to students impact waste generation. Students who are served food that they do not eat generate more waste. Another contributing factor to food waste generation may be the amount of time students have to eat – less time to eat may contribute to less food being consumed and more food being wasted.

c. Bulk purchasing and distribution

Additional waste prevention is possible through a strategy that has been common in cafeterias for many years: providing products in bulk. Container and packaging waste accounts for 30.8% of all municipal solid waste and is one of the more substantial sources of waste (EPA, 2008). Distributing items without packaging is a viable option for a wide variety of food items. It is particularly effective at reducing waste when paired with the use of reusable containers and/or utensils. In a cafeteria, bulk distribution of condiments, chips, salads and even beverages may be feasible. Other sources of unnecessary packaging, such as the film packaging surrounding packets of disposable utensils, napkins and straws, can be eliminated through bulk distribution.

Capture rates

A capture rate indicates the extent that a recycling program is capturing a recyclable material. If a school has a capture rate of 90% for office paper, then nine out of 10 pounds of the office paper generated at that school is being recovered for recycling.

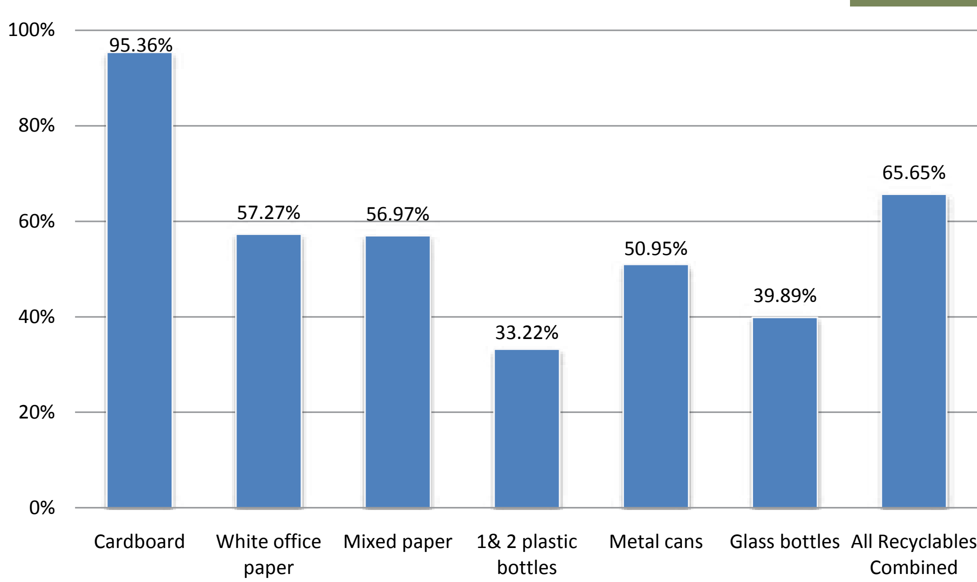
The graph in Figure 4 depicts the combined capture rate for recyclable material at the six schools that participated in the study. Capture rates for the individual schools have also been calculated and are included in each school's profile in Appendix A.

This capture rate analysis shows there is significant opportunity to capture more materials for recycling. While the capture rate for cardboard is strong, over 40% of the other types of recyclable paper are still not being recycled. Capture rates for beverage containers, such as plastic bottles and aluminum cans, are even lower — more beverage containers are thrown away than are recycled. However, since school capture rates have not been previously evaluated, these numbers simply represent a starting point. Nevertheless, the current capture rates demonstrate that it's feasible to recycle substantially more than programs are currently recycling. Capture rates for each of the six schools that participated in the study are detailed in Appendix A of this report.

The graph in Figure 5 depicts the capture rates for

Figure 4

Capture rates for recyclables



Capture rates vs. Recycling rates

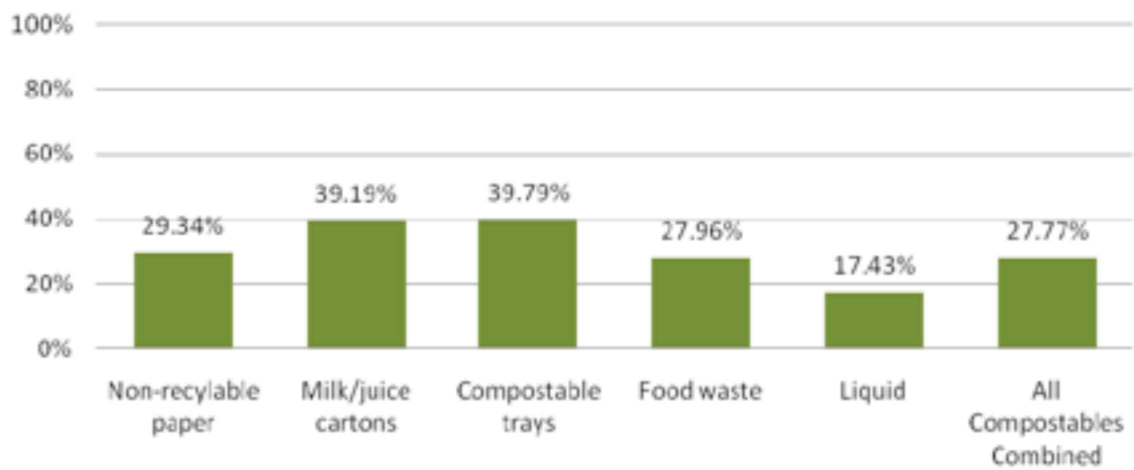
A recycling rate indicates the percentage of a school's waste that has been placed in recycling containers. For example, if a school were to generate 100 lb. of waste, 50 lb. of which is placed in recycling containers, it would have a 50% recycling rate. A capture rate defines how much of a recyclable material is captured by a recycling program. For example, if a school generates 100 lb. of cardboard and recycles 90 lb., the capture rate for cardboard is 90%.

compostable materials at the six schools that participated in the study. Capture rates for the individual schools have also been calculated and are included in each school's profile in Appendix A.

The capture rates for compostable material show even more opportunity for increased recovery of

Figure 5

Capture rates for compostables



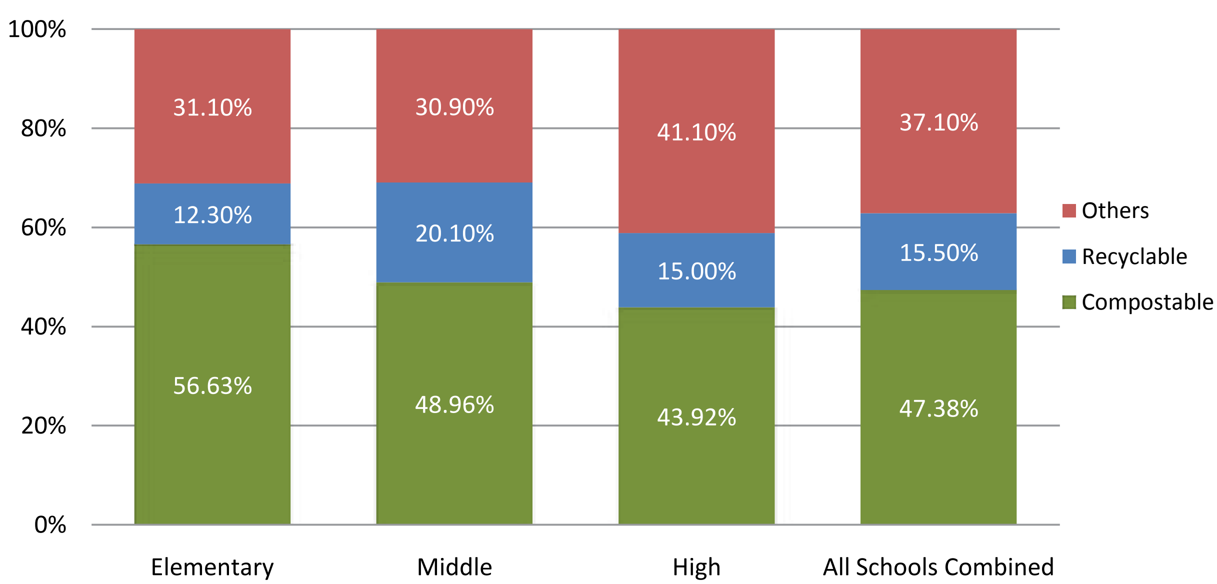
compostables than the capture rates for recyclables. In all the categories of compostable materials, at least 60% of the material is not being captured. The capture rates demonstrate that, in the sample schools, all of which have organics programs in place, there is a significant opportunity to increase composting.

In addition, Figure 6 shows that the material currently discarded (thrown away in garbage containers) is largely comprised of recyclable and compostable material that could be captured for recycling or composting.

For all schools combined the graph shows that 15.5% of the trash could be recycled and 47.4% could be

Figure 6

Recyclable and compostable materials in trash



composted. Thus, 63% of what is now disposed of could be handled in a more environmentally friendly manner. Furthermore, since recyclables and compostable are not subject to the Solid Waste Management Tax, the data suggest that there is potential for schools to save money through significant improvement of recycling and composting programs. Additional information detailing cost considerations for schools related to recycling and composting programs is addressed in Appendix F.

Current recycling and composting rates

A recycling rate indicates the percentage of a school's total waste that is being recovered for recycling. A composting rate indicates how much of a school's total waste is being recovered for composting. Solid waste professionals often refer to either or both of these as "diversion." The amount of material diverted from the trash stream is known as the diversion rate.

As noted above in the capture rate analysis, there is opportunity to greatly improve current recycling and organics diversion rates. Ideally, a school would work towards maximizing capture rates and also preventing or reducing waste generation. This is particularly true if a school can reduce waste that cannot otherwise be recycled or composted. In some cases a school may target recyclable materials (such as paper or single use plastic water bottles) for reduction. If successful, these efforts might actually reduce a school's recycling rate even as they reduce the overall waste generation because there is simply less material in the stream to recycle. Still, reduction is always preferable even to recycling, which is why a recycling rate should only be one metric in evaluating the environmental impact of a school's waste management efforts.

Table 4 shows an example of how effective reduction programs could lead to a decrease in the recycling rate. In this example, the school successfully reduced paper generation by 10% and this resulted in a reduction of its recycling rate.

This serves to demonstrate that a school's recycling rate is only one metric by which to evaluate its waste-related environmental impact. Currently most schools do not receive reports from their trash and recycling service providers detailing this information. Those that are receiving data typically have a provision written into their contracts with their trash and recycling hauler.

Table 4

Potential impact of waste prevention to recycling rate

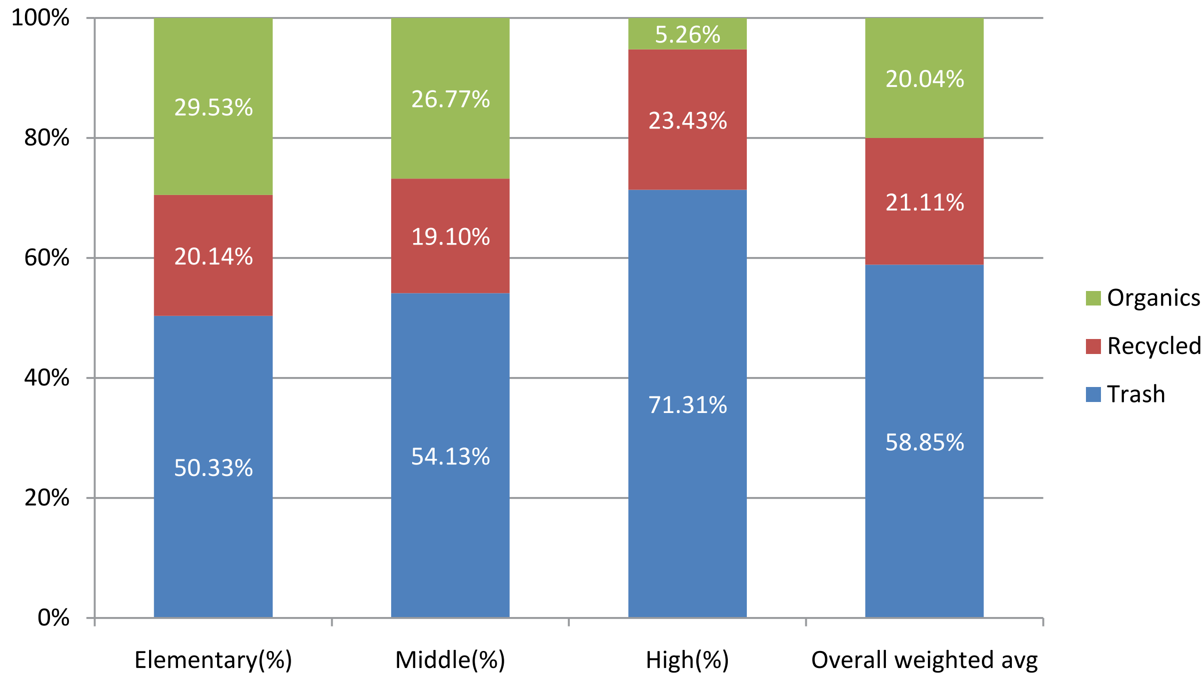
	Imaginary school before paper reduction program	Imaginary school after implementing paper reduction program*
Overall daily waste	1,000 lb	976.5 lb
Daily recyclable paper waste generated	235 lb	211.5 lb*
Daily other recyclables generated	44 lb	44 lb
Recycling rate	27.90%	26.20%

** Reflects 10% reduction in paper generated.*

The graph in Figure 7 depicts the current recycling and composting rates over the two-day sort period at the schools that participated in the study. The data represented below show the percentage of all generated materials actually being collected in the recycling and organics bins. The material available for capture is noted in the section titled Capture rates (page 24).

Figure 7

Recycling and composting rates by school tier



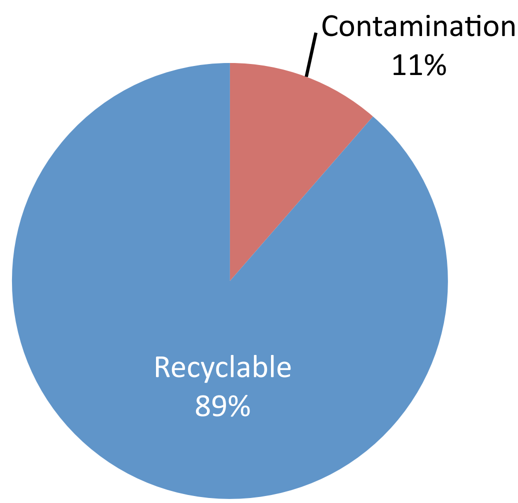
The data suggest that organics programs have been less successful at high schools than at middle and elementary schools. There are a number of possible explanations for this. Many of the elementary and middle schools have systems in place where teachers, students or volunteers monitor the recycling and composting bins during breakfast and lunch. These monitors are less common in high schools and their role in getting students acclimated to concepts like composting is very important. High schools also frequently allow students to leave school grounds and eat lunch elsewhere. Since most high schools offer composting only in the cafeteria, substantial portions of the compostable waste are not generated near collection containers. Furthermore, students who are high school age may be less inclined to accept advice from adults on how important it is to participate in composting or recycling programs.

Contamination in recycling and composting streams

With any recycling or composting program, there is occasional contamination. This means the wrong items end up in the bins designated for recycling or composting. Figure 8 depicts the amount of contamination that was in the combined total recycling stream for all six schools. Each school's contamination was also evaluated and is presented in Appendix A of this report.

Figure 8

Contamination in recycling (all schools)



The most prominent contaminant found in the recycling stream was liquid which accounted for 47% of the total contamination. While it is preferable to empty beverage containers before recycling, it is not easy to regulate. Some schools have been successful in devising strategies to make it easier for students to empty partially full containers prior to recycling. This can be advantageous for custodial staff since it lessens the weight of the containers they must move.

The second most prominent contaminant found in the recycling stream was nonrecyclable paper, which accounted for 17% of the contamination. There is often confusion about which types of paper are recyclable and which are not. Items like paper towels, napkins and paper plates are not accepted in paper recycling programs. However, most compost programs can handle those materials. Office paper, school paper, mail, magazines, catalogs and newspaper all can be recycled in virtually any paper recycling program. Recycling contamination rates from individual schools ranged from 0% to 18%.

Figure 9 depicts the amount of contamination that was found in the recycling for each grade tier. It's important to note that the contamination rate only indicates how much nonrecyclable material was placed in recycling containers. The capture rate (see page 24) denotes how much of the available recyclable material is recovered by the recycling program. It may be the case that a school has very little contamination in part because very few items are put in the recycling bins.

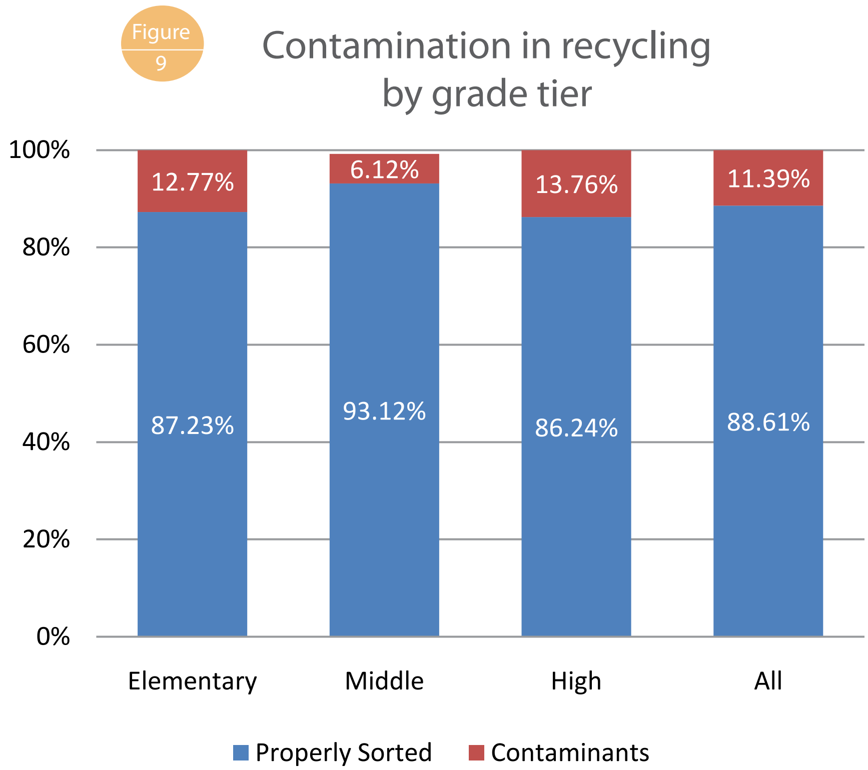
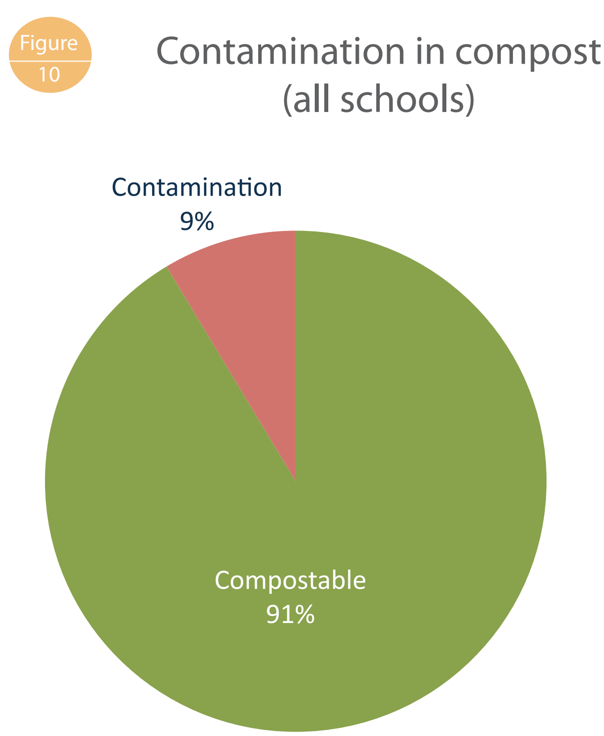


Figure 10 depicts how much contamination was in the combined total composting stream for all six schools. Again, each school's contamination was also evaluated and is presented in Appendix A of this report.



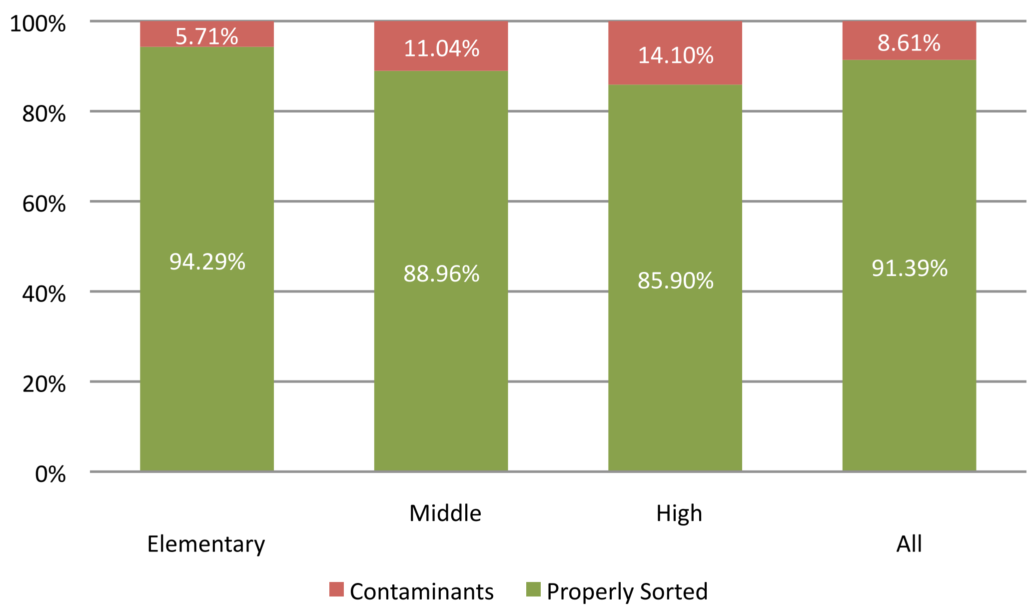
There was relatively little contamination in compost bins. True garbage accounted for 55% of the contamination within the compost stream. True garbage included items such as condiment packets, straws, Styrofoam clamshells and snack bar wrappers. Compost contamination rates from individual schools ranged from 2% to 23%.

Recyclable paper was also considered a contaminant for the analysis depicted in the graph above. While recyclable paper can be composted, recycling the paper is a better environmental management method. Seventeen percent of the contamination in the composting stream was made up of recyclable paper.

Figure 11 depicts how much contamination was found in the compost for each grade tier. It's important to note that the contamination rate only indicates how much non-compostable material was placed in composting containers. The capture rate (see page 24) denotes how much of the available compostable material is recovered by the composting program.

Figure 11

Contamination in compost by grade tier



Conclusions

Substantial components of the waste stream in Minnesota schools could be reduced, recycled or composted. There is great opportunity to expand and improve school recycling and composting programs. While existing programs have already begun to capture over 40% of the waste stream through recycling and composting, 78% of school's waste could be diverted to these recycling and composting programs. Recyclables account for approximately 28% of all that is discarded. An even larger portion — 50% of the waste generated at schools — is compostable.

The most prominent materials in Minnesota schools' waste are food waste and recyclable paper (cardboard, office paper and mixed paper). True garbage (material that cannot be readily recycled or composted) is only 15% of what schools are throwing away. Just by fully capturing for recycling traditional recyclables (paper, metal cans, plastic bottles and glass bottles) and compostables schools could divert 78% of what they generate. As recycling markets expand and collection infrastructure is developed, materials like plastic film and other types of plastic containers have the potential to push diversion rates higher.

There are many opportunities for reducing the overall quantity of waste generated which has the potential to save schools money in addition to reducing their environmental impact.

Though schools are not, per capita, the largest waste generators in the state, their waste impact is significant because of the sheer number of schools, students and staff. Furthermore, the way waste is handled at schools sends an important message to all the students who will form habits there and carry them into Minnesota's future. Making the effort to act on the potential for improved waste management at our schools will return dividends in schools' saved dollars and in conserved natural resources.

Appendix A – school profiles

Burroughs Elementary – Minneapolis Public Schools

This appendix provides profiles of each school so educators can compare and contrast their own schools to those that participated in this study. These schools were selected in part because they have many characteristics common at schools across the state. However, the study authors recognize each school is unique and have chosen to present this information so readers can form their own conclusions about what strategies will work best and which opportunities should be prioritized when exploring changes to waste management practices.

All schools that participated in the study are public schools and have ongoing recycling and organics composting programs. Because this study analyzed the entire waste stream, even schools without organics composting programs should find the data from the sample schools relevant because they highlight what percentage of total waste generated is comprised of organic material.

Grades K-5

Number of staff *(Full time equivalent)*: 54.4

Number of students: 762

Students served breakfast daily (estimated):. 130

Students served school lunch daily (estimated):.. . 240 (31%)

Percentage of free or reduced lunch: 20%

Food preparation: . .. . Off site

Cafeteria trays/utensils: . .. . Compostable trays, disposable utensils

Recycling program: . .. . Single stream

Burroughs was the first school in the Minneapolis Public Schools to pilot organics recycling before the program was officially offered across the district. The school did not have any unusual events or activities during the days the waste was generated and collected.

http://burroughs.mpls.k12.mn.us/

Table A1 – details the composition and total amount of waste generated at Burroughs Elementary School during this two-day study. During the study period, Burroughs Elementary generated .35 pounds (lb) of waste per capita per day. This was the lowest per capita generation of the six study schools.

Table A1

Burroughs elementary school waste composition

Material	2-day Total (lb)	% of Total	Trash (lb)	Trash %	Recycling (lb)	Recycling %	Organics (lb)	Organics %
Nonrecylable paper	72.20	12.6%	44.60	13.6%	11.70	8.2%	15.90	15.3%
Milk/juice cartons	21.70	3.8%	8.60	2.6%	0.50	0.3%	12.60	12.1%
Compostable trays	11.00	1.9%	1.00	0.3%	0.60	0.4%	9.40	9.0%
Styrofoam trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Food waste	124.40	21.7%	68.30	20.9%	0.30	0.2%	55.80	53.6%
Liquid	23.40	4.1%	20.80	6.4%	0.00	0.0%	2.60	2.5%
OCC	18.80	3.3%	0.60	0.2%	18.20	12.7%	0.00	0.0%
White office paper	87.70	15.3%	19.00	5.8%	68.70	48.0%	0.00	0.0%
Mixed paper	62.40	10.9%	21.40	6.5%	36.00	25.2%	5.00	4.8%
#1 & 2 plastic bottles	3.20	0.6%	2.40	0.7%	0.80	0.6%	0.00	0.0%
Metal cans	1.30	0.2%	0.80	0.2%	0.50	0.3%	0.00	0.0%
Glass bottles	3.90	0.7%	2.10	0.6%	1.80	1.3%	0.00	0.0%
Reusables	12.10	2.1%	10.60	3.2%	1.50	1.0%	0.00	0.0%
Plastics #1-6	21.10	3.7%	20.50	6.3%	0.60	0.4%	0.00	0.0%
Plastic film	12.10	2.1%	10.60	3.2%	0.90	0.6%	0.60	0.6%
True garbage	95.40	16.6%	93.70	28.7%	1.00	0.7%	0.70	0.7%
C&D	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
HW	3.40	0.6%	1.80	0.6%	0.00	0.0%	1.60	1.5%
E-waste	0.10	0.0%	0.10	0.0%	0.00	0.0%	0.00	0.0%
Total	**574.20**	**100.0%**	**326.90**	**100.0%**	**143.10**	**100.0%**	**104.20**	**100.0%**

Figure A1 – depicts the recycling and composting rate for Burroughs Elementary at the time of the waste sort in April 2010. This means that of all the waste generated, 25% was in the recycling stream and 18% was in the organics composting stream.

Figure A2 – depicts the capture rates for recyclable material at Burroughs Elementary. The capture rate is the amount of all available recyclable material that is captured by the recycling program.

Figure A3 – depicts the capture rates for compostable materials at Burroughs Elementary.

Figure A1

Burroughs Elementary School recycling and composting rates

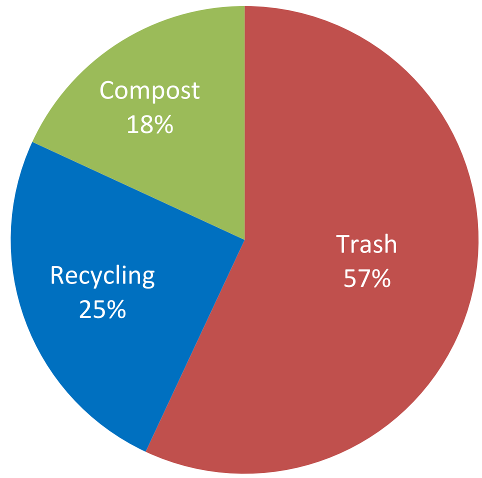


Figure A2

Burroughs Elementary School capture rates for recyclables

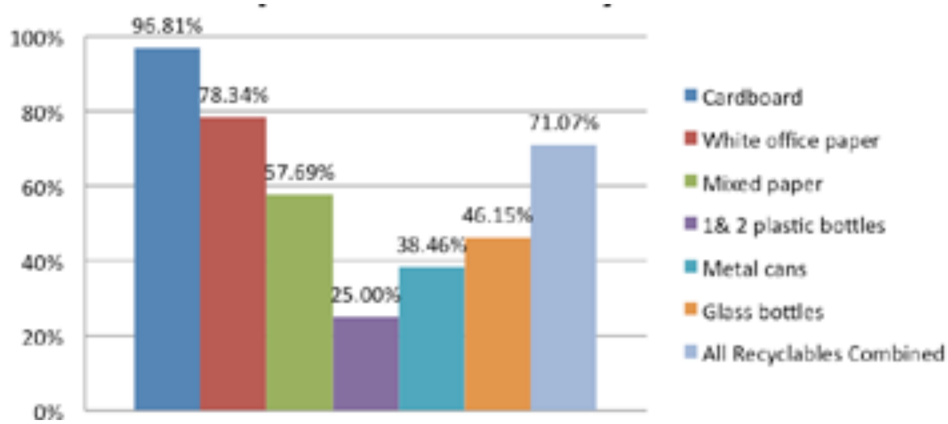


Figure A3

Burroughs Elementary School capture rates for compostables

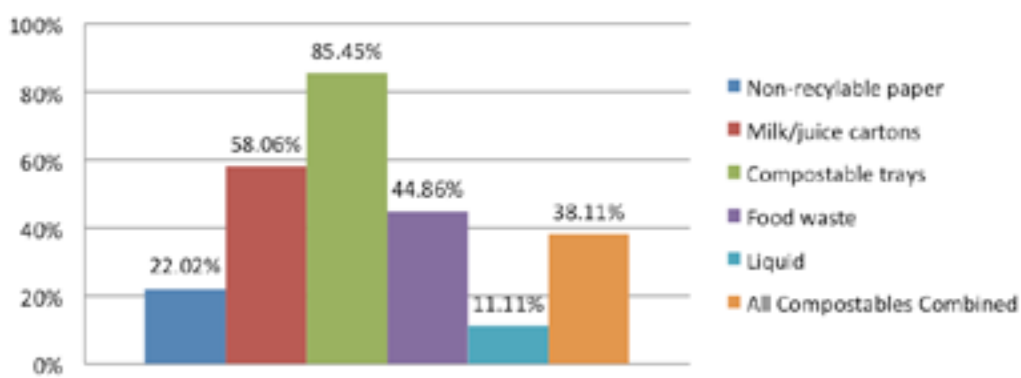


Figure A4 Burroughs Elementary School recycling contamination

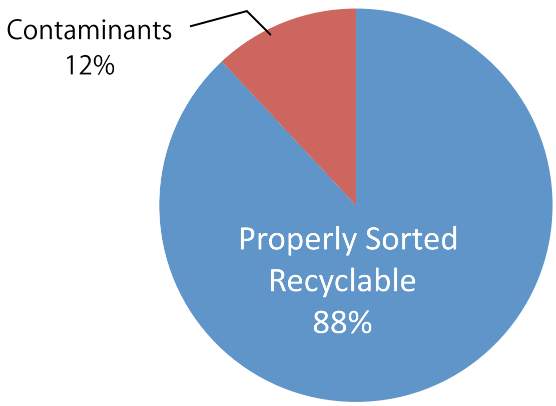


Figure A5 Burroughs Elementary School compost contamination

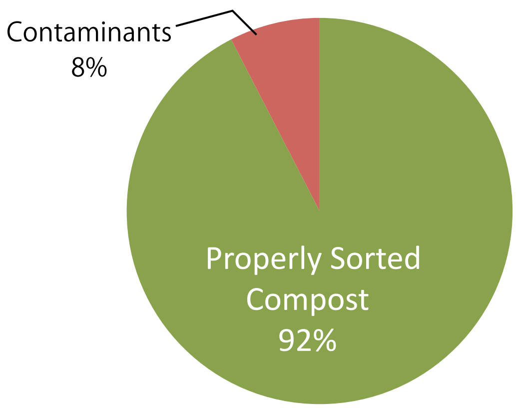


Figure A4 – shows how much contamination (materials not accepted in the recycling program) was found in the recycling at Burroughs Elementary. At Burroughs, the most prominent contaminant, by weight, found in the recycling was nonrecyclable paper, which accounted for 68% of the contamination. Nonrecyclable paper, which includes items like paper towels, napkins and paper plates, should be composted (where available) or disposed (where composting is unavailable). Nonrecyclable paper cannot be recycled.

Figure A5 – depicts how much noncompostable material was found in the composting containers. Mixed paper accounted for 63.29% of the contamination found in the compost. While mixed paper can be composted, to capture it for its highest and best use, environmental experts recommend recycling it.

Clear Springs Elementary School –
Minnetonka School District

Grades: K-5

Number of staff *(Full time equivalent)*: 97

Number of students: 584

Students served breakfast daily (estimated): 40

Students served school lunch daily (estimated): . . . 450 (75%)

Percentage of free or reduced lunch: 5%

Food preparation: . . . . On site

Cafeteria trays/utensils: . . . . Reusable trays

Recycling program: . . . . Dual stream

Clear Springs has a well-established organics collection program. The school did not have any unusual events or activities during the days the waste was generated.

www.minnetonka.k12.mn.us/Schools/ClearSprings

Table A2

Clear springs elementary school waste composition

Material	2-day Total (lb)	% of Total Sorted	Trash (lb)	Trash %	Recycling (lb)	Recycling %	Organics (lb)	Organics %
Nonrecyclable paper	107.60	12.7%	46.90	12.1%	10.40	7.3%	50.30	16.0%
Milk/juice cartons	40.80	4.8%	11.30	2.9%	0.00	0.0%	29.50	9.4%
Compostable trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Styrofoam trays	0.42	0.0%	0.42	0.1%	0.00	0.0%	0.00	0.0%
Food waste	258.80	30.6%	94.50	24.4%	0.30	0.2%	164.00	52.1%
Liquid	144.00	17.0%	79.60	20.5%	5.30	3.7%	59.10	18.8%
OCC	26.10	3.1%	2.00	0.5%	24.10	16.9%	0.00	0.0%
White office paper	45.60	5.4%	8.50	2.2%	37.10	26.0%	0.00	0.0%
Mixed paper	65.63	7.8%	20.93	5.4%	44.70	31.3%	0.00	0.0%
#1 & 2 plastic bottles	13.50	1.6%	8.70	2.2%	3.80	2.7%	1.00	0.3%
Metal cans	11.99	1.4%	1.29	0.3%	10.70	7.5%	0.00	0.0%
Glass bottles	3.00	0.4%	0.0%	3.00	2.1%	0.00	0.0%	0.0%
Reusables	4.10	0.5%	4.10	1.1%	0.00	0.0%	0.00	0.0%
Plastics #1-6	16.10	1.9%	14.00	3.6%	0.20	0.1%	1.90	0.6%
Plastic film	14.10	1.7%	10.90	2.8%	1.70	1.2%	1.50	0.5%
True garbage	93.72	11.1%	84.50	21.8%	1.50	1.1%	7.72	2.5%
C&D	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
HW	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
E-waste	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Total	845.46	100.0%	387.64	100.0%	142.80	100.0%	315.02	100.0%

Figure A6 – depicts the recycling and composting rate for Clear Springs Elementary at the time of the waste sort in April 2010.

Figure A7 – depicts the capture rates for recyclable material at Clear Springs Elementary. The capture rate is the amount of all available recyclable material that is captured by the recycling program.

Figure A8 – depicts the capture rates for compostable materials at Clear Springs Elementary.

Figure A6

Clear Springs Elementary School recycling and composting rate

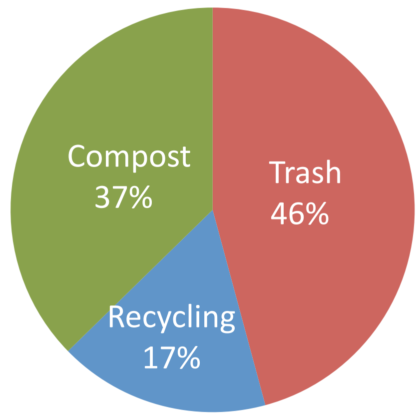


Figure A7

Clear Springs Elementary School capture rates for recyclables

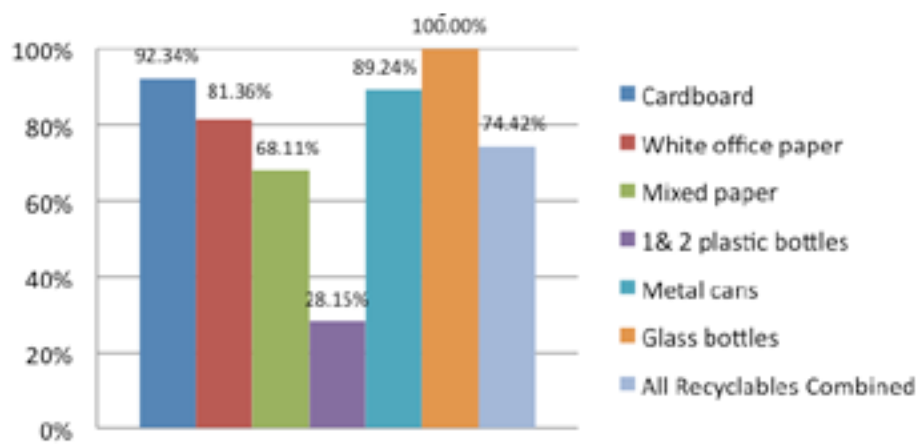


Figure A8

Clear Springs Elementary School capture rates for compostables

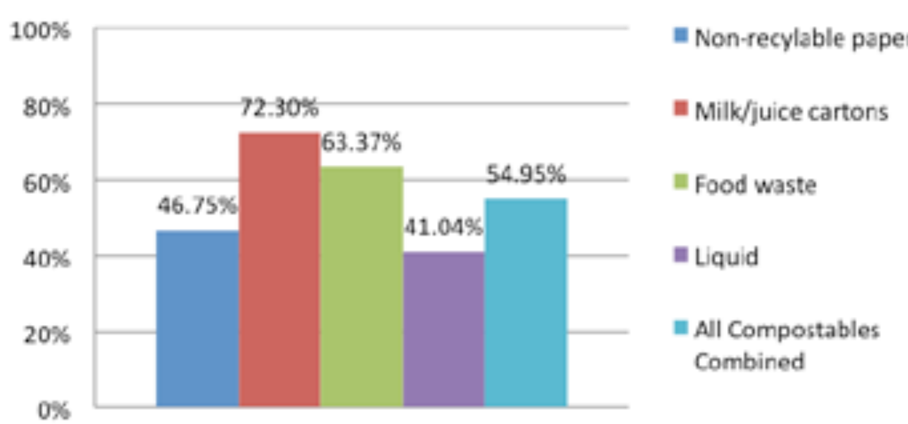


Figure A9

Clear Springs Elementary School recycling contamination

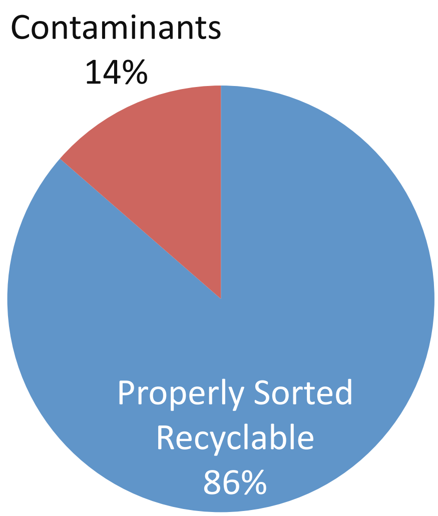


Figure A10

Clear Springs Elementary School compost contamination

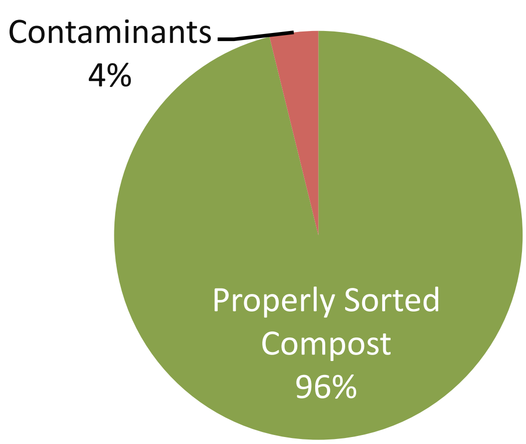


Figure A9 – depicts the amount of nonrecyclable material that was found in the recycling at Clear Springs Elementary. Over half, 53%, of the contamination was nonrecyclable paper which could be put in the school's organics collection; paper towels, napkins and paper plates are generally not accepted in paper recycling programs and should be composted (or disposed of if composting is unavailable).

Figure A10 – shows that there was only 4% contamination (noncompostable material) found in the composting containers at Clear Springs. Though very well sorted, some true garbage still ended up in the compost stream, which lowers the quality of compost. True garbage was the major contaminant; it constituted over half of the 4%. Other contaminants were plastic film and plastics #1-#6.

Northeast Middle School –
Minneapolis Public Schools

Grades: 6-8

Number of staff *(Full time equivalent)*: 73.3

Number of students: 519

Students served breakfast daily (estimated): 40

Students served school lunch daily (estimated): . 450 (75%)

Percentage of free or reduced lunch: 80%

Food preparation: . . . . Off site

Cafeteria trays/utensils: . . . . Compostable trays

Recycling program: . . . . Single stream

Though organics recycling was newly adopted in fall of 2009, Northeast has worked diligently to raise awareness and participation in both the organics and recycling programs. During the study period, the school hosted its normal afterschool activities. In addition, a large cooking event likely contributed additional food wrapping to the waste stream.

http://northeast.mpls.k12.mn.us/

Table A3 – reflects the composition of waste at Northeast during the waste sort.

Table A3

Northeast Middle School waste composition

Material	2-day Total (lb)	% of Total Sorted	Trash (lb)	Trash %	Recycling (lb)	Recycling %	Organics (lb)	Organics %
Nonrecyclable paper	54.30	7.3%	40.70	7.9%	0.00	0.0%	13.60	8.5%
Milk/juice cartons	31.60	4.3%	13.90	2.7%	0.00	0.0%	17.70	11.1%
Compostable trays	58.60	7.9%	19.20	3.7%	0.00	0.0%	39.40	24.7%
Styrofoam trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Food waste	149.70	20.2%	98.50	19.2%	0.00	0.0%	51.20	32.2%
Liquid	36.60	4.9%	31.00	6.0%	0.00	0.0%	5.60	3.5%
OCC	57.50	7.8%	2.30	0.4%	55.20	81.1%	0.00	0.0%
White office paper	88.14	11.9%	71.50	14.0%	10.44	15.3%	6.20	3.9%
Mixed paper	42.80	5.8%	40.70	7.9%	1.40	2.1%	0.70	0.4%
#1 & 2 plastic bottles	3.85	0.5%	3.80	0.7%	0.00	0.0%	0.05	0.0%
Metal cans	3.60	0.5%	2.60	0.5%	0.80	1.2%	0.20	0.1%
Glass bottles	1.20	0.2%	0.70	0.1%	0.00	0.0%	0.50	0.3%
Reusables	11.50	1.6%	11.50	2.2%	0.00	0.0%	0.00	0.0%
Plastics #1-6	28.84	3.9%	25.70	5.0%	0.00	0.0%	3.14	2.0%
Plastic film	1.96	0.3%	1.80	0.4%	0.00	0.0%	0.16	0.1%
True garbage	168.60	22.8%	147.60	28.8%	0.20	0.3%	20.80	13.1%
C&D	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
HW	0.60	0.1%	0.60	0.1%	0.00	0.0%	0.00	0.0%
E-waste	0.34	0.0%	0.34	0.1%	0.00	0.0%	0.00	0.0%
Total	739.73	100.0%	512.44	100.0%	68.04	100.0%	159.25	100.0%

Figure A11 – depicts the recycling and composting rate for Northeast Middle at the time of the waste sort in April 2010.

Figure A12 – depicts the capture rates for recyclable material at Northeast Middle. The capture rate is the amount of all available recyclable material that is captured by the recycling program. When looking at capture rates, it is also good to look back at the composition of waste to get an idea of how much material was available. The low capture rates for mixed paper and white office paper, which were about 6% and 12% of all waste, respectively, suggest that efforts to improve recycling might focus on these materials. On the other hand, the 0% capture rates for plastic and glass bottles may be less urgent than it seems when one considers that they are only .5% and .2% of the waste stream. There are simply very few bottles to capture.

Figure A13 - depicts the capture rates for compostable materials at Northeast Middle School.

Figure A11

Northeast Middle School recycling and composting rates

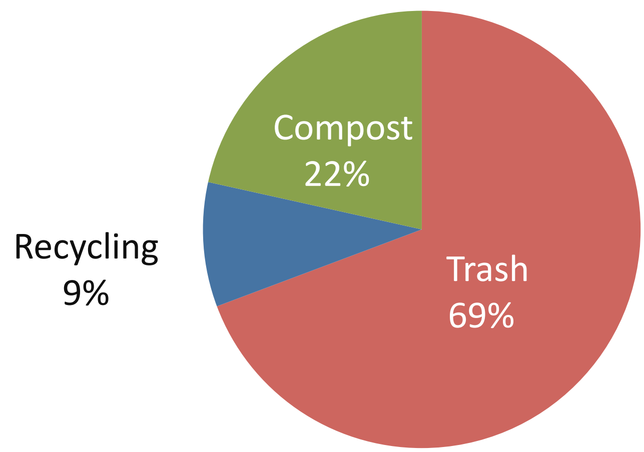


Figure A12

Northeast Middle School capture rates for recyclables

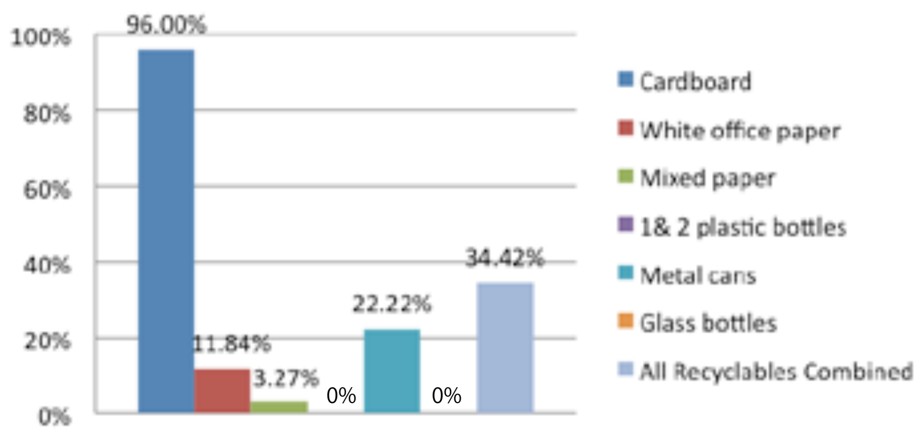


Figure A13

Northeast Middle School capture rates for compostables

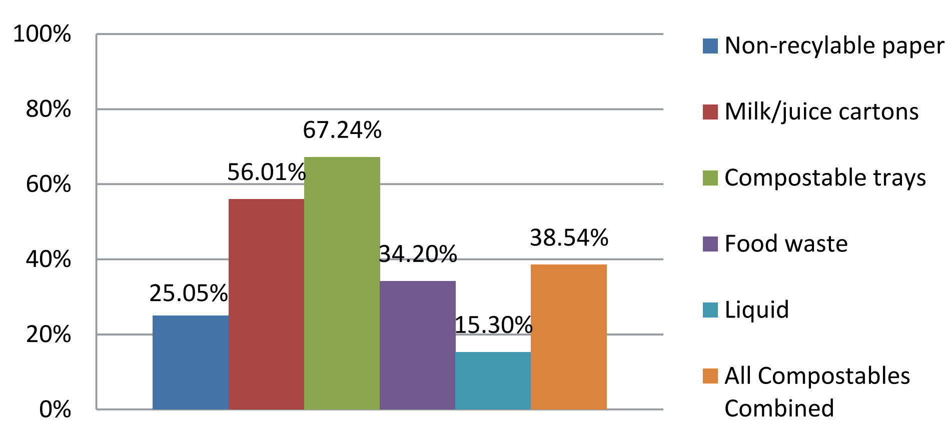


Figure A14

Northeast Middle School recycling contamination

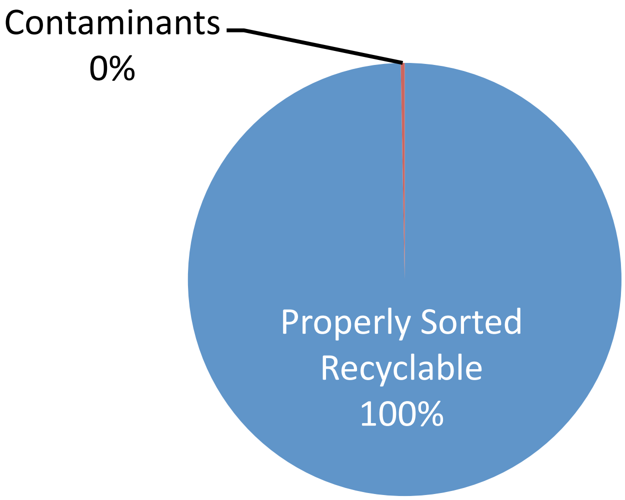


Figure A15

Northeast Middle School compost contamination

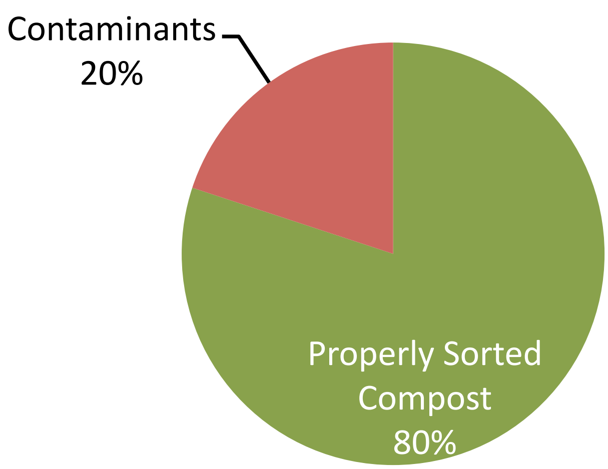


Figure A14 - depicts the amount of nonrecyclable material that was found in the recycling at Northeast. Nearly all the material that was diverted for recycling by students and staff of Northeast was indeed recyclable! Only trace amounts of contaminant were discovered.

Figure A15 - depicts how much noncompostable material was found in the composting containers. Despite providing a nearly pure recycling stream, 20% of waste diverted towards composting consisted of contamination, mostly garbage.

Hopkins West Junior High School –
City of Minnetonka, Hopkins School District

Grades: 7-9

Number of staff *(Full time equivalent)*: 85

Number of students: 856

Students served breakfast daily (estimated): 50

Students served school lunch daily (estimated): . . . . Unknown

Percentage of free or reduced lunch: 18%

Food preparation: . . . . Mixed. Most off-site, some final prep on-site

Cafeteria trays/utensils: . . . . Reusable trays, plates & utensils

Recycling program: . . . . Dual stream

During the study period, some waste from the athletic fields generated on nonstudy days may have been added to the study waste.

www.hopkins.k12.mn.us/schools/hopkins-west-junior-high

Table A4

Hopkins West Junior High School waste composition

Material	2-day Total (lb)	% of Total Sorted	Trash (lb)	Trash %	Recycling (lb)	Recycling %	Organics (lb)	Organics %
Nonrecylable paper	92.10	10.7%	60.90	17.1%	1.50	0.6%	29.70	11.0%
Milk/juice cartons	42.60	4.9%	6.00	1.7%	0.20	0.1%	36.40	13.5%
Compostable trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Styrofoam trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Food waste	234.70	27.2%	61.10	17.2%	0.00	0.0%	173.60	64.3%
Liquid	85.00	9.8%	39.40	11.1%	21.00	8.8%	24.60	9.1%
OCC	72.50	8.4%	4.40	1.2%	68.10	28.6%	0.00	0.0%
White office paper	80.40	9.3%	11.00	3.1%	69.40	29.1%	0.00	0.0%
Mixed paper	58.60	6.8%	14.80	4.2%	42.60	17.9%	1.20	0.4%
#1 & 2 plastic bottles	27.30	3.2%	14.80	4.2%	12.30	5.2%	0.20	0.1%
Metal cans	19.80	2.3%	6.00	1.7%	13.80	5.8%	0.00	0.0%
Glass bottles	1.50	0.2%	1.50	0.4%	0.00	0.0%	0.00	0.0%
Reusables	4.00	0.5%	3.40	1.0%	0.30	0.1%	0.30	0.1%
Plastics #1-6	15.60	1.8%	14.30	4.0%	0.40	0.2%	0.90	0.3%
Plastic film	37.60	4.4%	30.30	8.5%	6.90	2.9%	0.40	0.1%
True garbage	80.20	9.3%	75.60	21.3%	1.80	0.8%	2.80	1.0%
C&D	11.30	1.3%	11.30	3.2%	0.00	0.0%	0.00	0.0%
HW	0.20	0.0%	0.20	0.1%	0.00	0.0%	0.00	0.0%
E-waste	0.60	0.1%	0.60	0.2%	0.00	0.0%	0.00	0.0%
Total	864.00	100.0%	355.60	100.0%	238.30	100.0%	270.10	100.0%

Figure A16

Hopkins West Junior High School recycling and composting rates

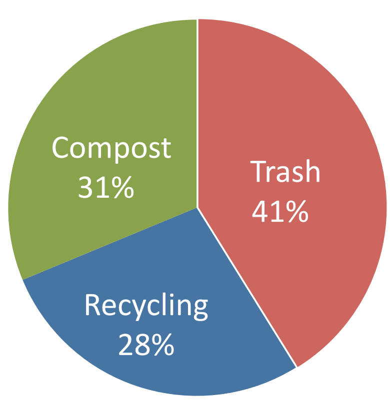


Figure A16 - depicts the recycling and composting rate for Hopkins West Junior at the time of the waste sort in April 2010.

Figure A17 - This graph below depicts the capture rates for recyclable material at Hopkins West Junior High. The capture rate is the amount of all available recyclable material that is captured by the recycling program. The 0% capture rate for glass bottles is not as alarming as it may seem – they make up only .2% of the waste stream, only 1.5 lb over the two days. It is good that other more prevalent materials are being captured at higher rates.

Figure A18 - depicts the capture rates for compostable materials at Hopkins West Junior.

Figure A19 - depicts how much nonrecyclable material was found in the recycling at Hopkins West Junior. 65% of contamination was liquid waste. The next most abundant contaminant was plastic film.

Figure A17

Hopkins West Junior High School capture rates for recyclables

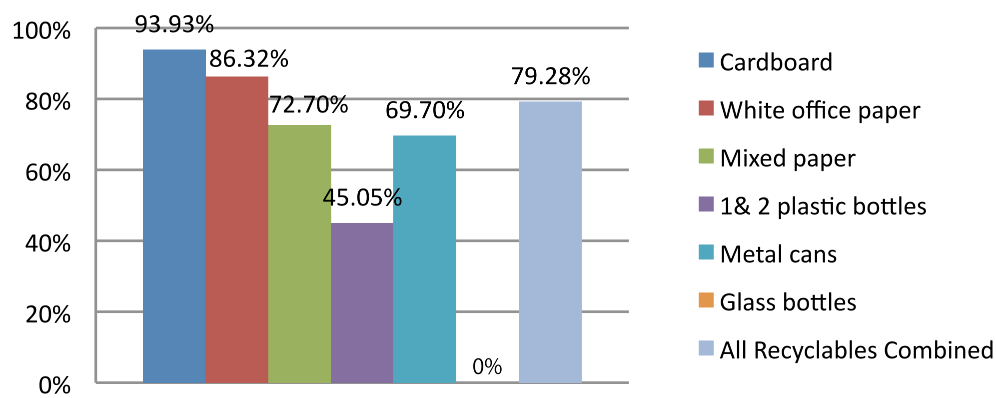


Figure A18

Hopkins West Junior High School capture rates for compostables

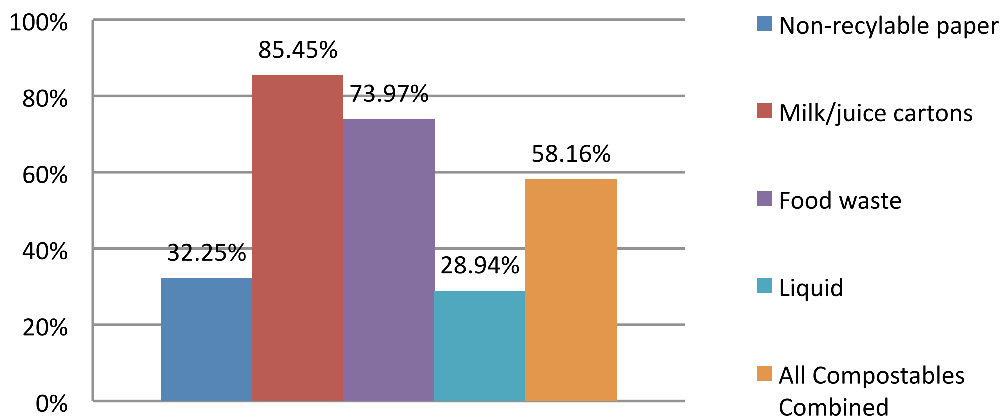


Figure A19

Hopkins West Junior High School recycling contamination

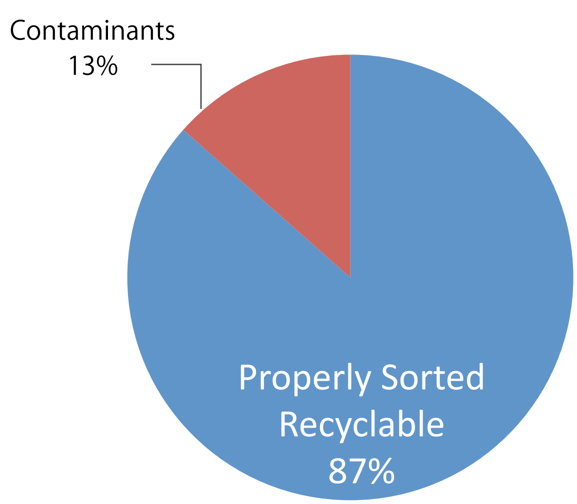


Figure A20

Hopkins West Junior High compost contamination

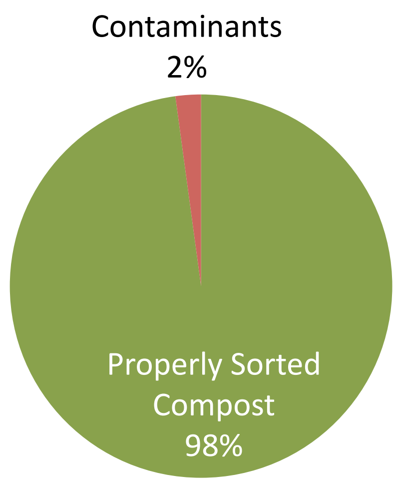


Figure A20 - depicts how much noncompostable material was found in the composting containers. Only a minute fraction of Hopkins West Junior High's organics loads were contaminated, mostly with true garbage.

Minnetonka High School –
Minnetonka School District

Grades: **9-12**

Number of staff *(Full time equivalent)*: 308

Number of students: 2,775

Students served breakfast daily (estimated): 300

Students served school lunch daily (estimated): Unknown

Percentage of free or reduced lunch: 7%

Food preparation: On site

Cafeteria trays/utensils: On-site; Cafeteria trays/utensils: Styrofoam trays

Recycling program: Dual stream

This is the only high school in the Minnetonka School District. The district has a long-running organics recycling program. There was a theatre performance during the study period which may or may not have increased waste generation.

www.minnetonka.k12.mn.us/Schools/MinnetonkaHighSchool

Table A5 - The table below reflects the composition of waste in each waste stream at Minnetonka during the study.

Table A5

Minnetonka High School waste composition

Material	2-day Total (lb)	% of Total Sorted	Trash (lb)	Trash %	Recycling (lb)	Recycling %	Organics (lb)	Organics %
Nonrecyclable paper	325.37	10.0%	222.17	9.6%	6.30	0.7%	96.90	91.9%
Milk/juice cartons	76.09	2.3%	76.07	3.3%	0.00	0.0%	0.02	0.0%
Compostable trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Styrofoam trays	106.61	3.3%	106.61	4.6%	0.00	0.0%	0.00	0.0%
Food waste	695.54	21.3%	691.74	30.0%	3.04	0.4%	0.76	0.7%
Liquid	252.82	7.7%	190.52	8.3%	59.60	6.9%	2.70	2.6%
OCC	439.06	13.4%	17.78	0.8%	421.28	49.1%	0.00	0.0%
White office paper	261.80	8.0%	106.68	4.6%	155.00	18.1%	0.12	0.1%
Mixed paper	160.80	4.9%	56.40	2.4%	103.54	12.1%	0.86	0.8%
#1 & 2 plastic bottles	234.27	7.2%	146.84	6.4%	86.20	10.0%	1.23	1.2%
Metal cans	18.95	0.6%	13.19	0.6%	5.70	0.7%	0.06	0.1%
Glass bottles	8.41	0.3%	5.41	0.2%	3.00	0.3%	0.00	0.0%
Reusables	15.10	0.5%	14.88	0.6%	0.22	0.0%	0.00	0.0%
Plastics #1-6	74.59	2.3%	72.34	3.1%	2.05	0.2%	0.20	0.2%
Plastic film	37.10	1.1%	36.62	1.6%	0.44	0.1%	0.04	0.0%
True garbage	544.18	16.7%	529.64	23.0%	11.94	1.4%	2.60	2.5%
C&D	10.55	0.3%	10.55	0.5%	0.00	0.0%	0.00	0.0%
HW	2.68	0.1%	2.68	0.1%	0.00	0.0%	0.00	0.0%
E-waste	3.38	0.1%	3.38	0.1%	0.00	0.0%	0.00	0.0%
Total	3,267.30	100.0%	2,303.50	100.0%	858.31	100.0%	105.49	100.0%

Figure A21- depicts the recycling and composting rate for Minnetonka High School at the time of the waste sort in April 2010.

Figure A22 - depicts the capture rates for recyclable material at Minnetonka High School. The capture rate is the amount of all available recyclable material that is captured by the recycling program.

Figure A23 - depicts the capture rates for compostable materials at Minnetonka High School. The capture rates show that there are big opportunities to capture more materials, especially food waste, of which only 1% is currently captured.

Figure A21

Minnetonka High School recycling and composting rates

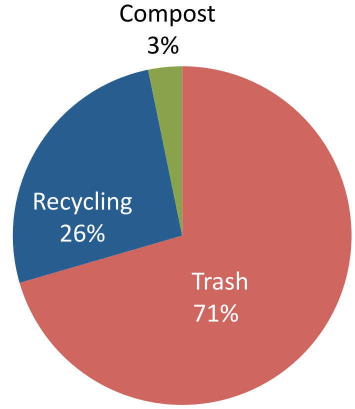


Figure A22

Minnetonka High School capture rates for recyclables

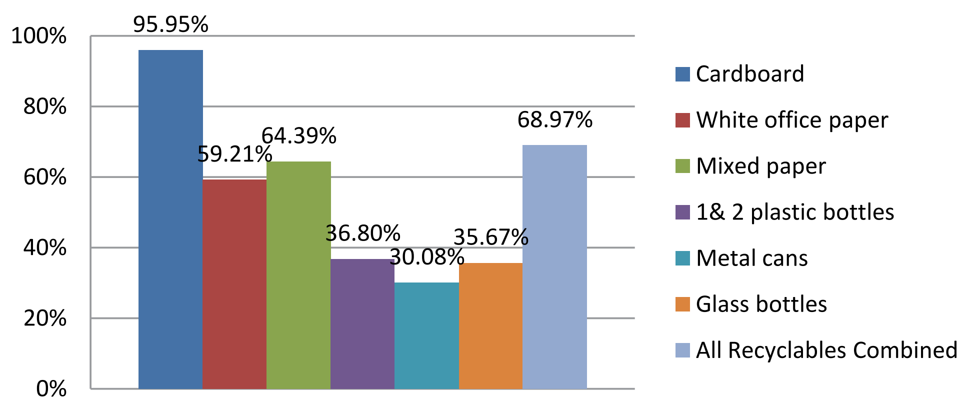


Figure A23

Minnetonka High School capture rates for compostables

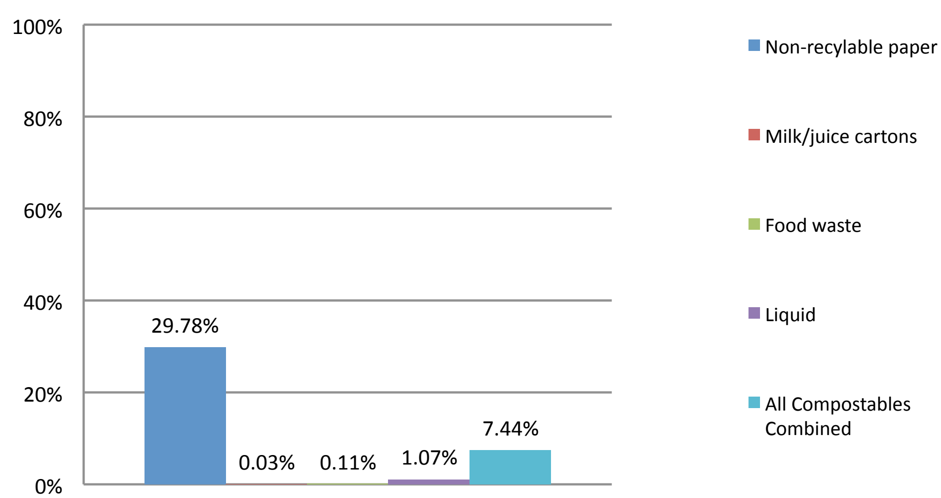


Figure A24

Minnetonka High School recycling contamination

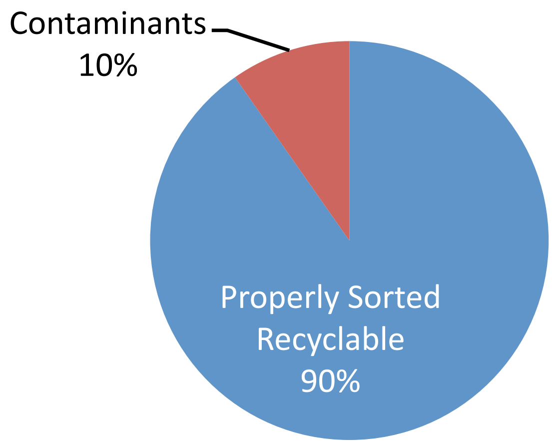


Figure A25

Minnetonka High School compost contamination

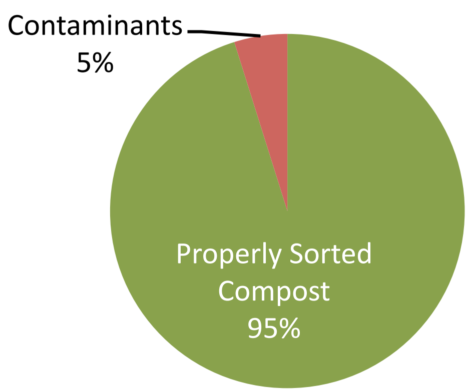


Figure A24 - depicts how much nonrecyclable material was found in the recycling at Minnetonka. 71% of contamination was made up of liquid waste.

Figure A25 - shows that only 5% of the materials in the composting containers was non-compostable material. True garbage was the primary contaminant, followed by #1 and #2 plastic bottles.

Minneapolis Public Schools –
Washburn High School

Grades: **9-12**

Number of staff *(Full time equivalent)*: 107.1

Number of students: 818

Students served breakfast daily (estimated): 350

Students served school lunch daily (estimated): . . . 520

Percentage of free or reduced lunch: 60%

Food preparation: . . . . Off site

Cafeteria trays/utensils: . . . . Compostable trays

Recycling program: . . . . Single stream

Washburn High School of Minneapolis Public Schools has only recently incorporated organics recycling into its waste management methods. After-school community education classes are routine at Washburn, and waste generated during the Monday and Tuesday classes were included in the study data.

Washburn High School http://washburn.mpls.k12.mn.us/

Table A6

Washburn High School waste composition

Table A6 - reflects the composition of waste at Washburn during the waste sort.

Material	2-day Total (lb)	% of Total Sorted	Trash (lb)	Trash %	Recycling (lb)	Recycling %	Organics (lb)	Organics %
Nonrecyclable paper	138.14	11.0%	110.44	12.0%	2.40	1.2%	25.30	19.1%
Milk/juice cartons	59.28	4.7%	46.28	5.0%	2.60	1.3%	10.40	7.9%
Compostable trays	102.29	8.1%	78.09	8.5%	4.60	2.3%	19.60	14.8%
Styrofoam trays	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
Food waste	226.89	18.1%	188.49	20.4%	11.30	5.6%	27.10	20.5%
Liquid	109.93	8.8%	88.33	9.6%	2.60	1.3%	19.00	14.4%
OCC	100.45	8.0%	5.55	0.6%	94.40	46.9%	0.50	0.4%
White office paper	96.93	7.7%	59.13	6.4%	37.70	18.7%	0.10	0.1%
Mixed paper	62.38	5.0%	32.18	3.5%	29.60	14.7%	0.60	0.5%
1 & 2 plastic bottles	34.82	2.8%	31.32	3.4%	2.20	1.1%	1.30	1.0%
Metal cans	8.35	0.7%	7.25	0.8%	1.10	0.5%	0.00	0.0%
Glass bottles	2.80	0.2%	2.30	0.2%	0.50	0.2%	0.00	0.0%
Reusables	14.09	1.1%	13.09	1.4%	1.00	0.5%	0.00	0.0%
Plastics #1-6	37.79	3.0%	31.59	3.4%	2.40	1.2%	3.80	2.9%
Plastic film	46.76	3.7%	35.36	3.8%	3.30	1.6%	8.10	6.1%
True Garbage	209.60	16.7%	187.50	20.3%	5.60	2.8%	16.50	12.5%
C&D	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
HW	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
E-waste	5.12	0.4%	5.12	0.6%	0.00	0.0%	0.00	0.0%
Total	1,255.62	100.0%	922.02	100.0%	201.30	100.0%	132.30	100.0%

Figure A26 - depicts the recycling and composting rates for Washburn at the time of the waste sort in April 2010.

Figure A27 – depicts the capture rates for recyclable material at Washburn. The capture rate is the amount of all available recyclable material that is captured by the recycling program.

Figure A28 – depicts the capture rates for compostable materials at Washburn.

Figure A26

Washburn High School recycling and composting rates

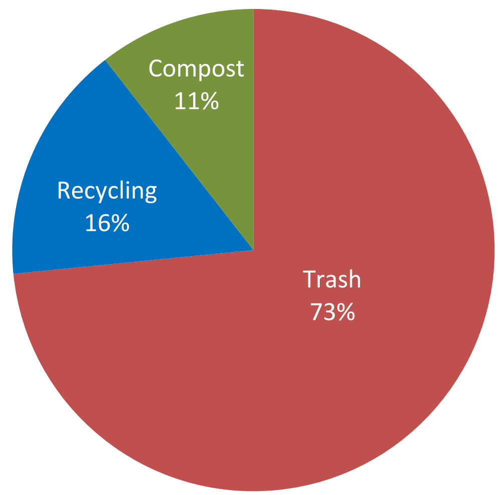


Figure A27

Washburn High School capture rates for recyclables

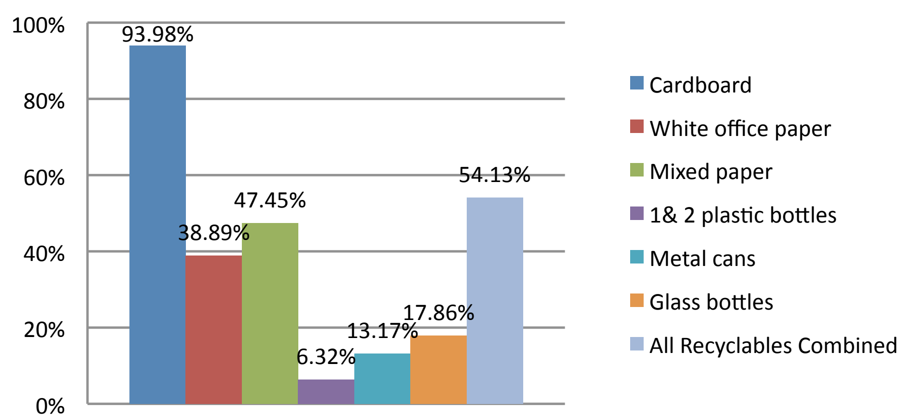


Figure A28

Washburn High School capture rates for compostables

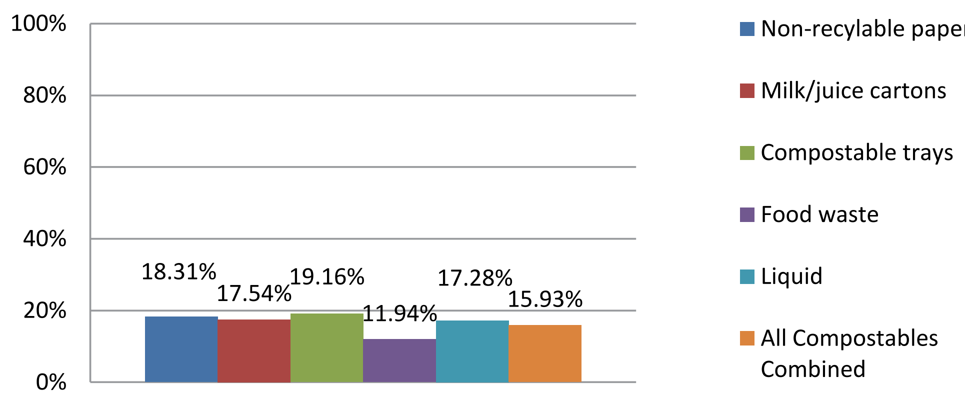


Figure A29

Washburn High School recycling contamination

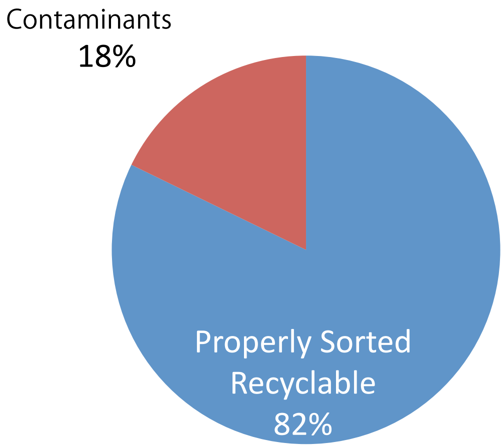


Figure A30

Washburn High compost contamination

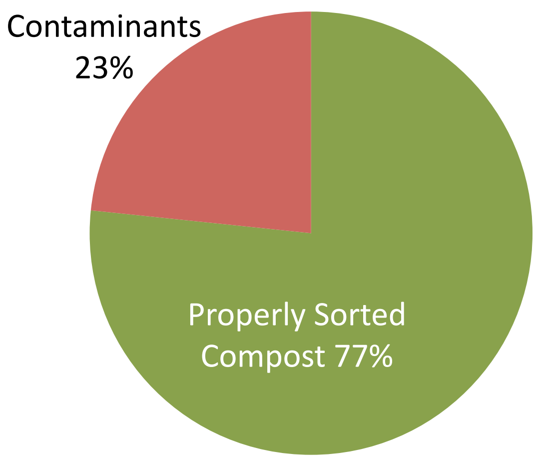


Figure A29 – depicts how much nonrecyclable material was found in the recycling at Washburn. Organic waste made up 58% of the contamination found in the recyclables.

Figure A30 – depicts how much noncompostable material was found in the composting containers. Nearly a quarter of waste collected for composting was contaminants -- mostly true garbage and plastics.

Appendix B –
urban and suburban school data and results

Initially the vision for this project was to sort waste from schools from all over Minnesota. For a variety of reasons that approach was not feasible. Instead, the project planning team opted to focus on schools within Hennepin County, which is Minnesota's most populous county and includes urban and suburban areas. The schools selected all had characteristics that were common at schools elsewhere in the state. This approach was intended to make the results relevant for public schools throughout the state. While every school is unique, many of the challenges and opportunities schools have related to waste prevention and recycling are similar at schools everywhere.

Table B1

Composition of school waste: by location

Material	Urban weighted average	Suburban weighted average	Overall weighted average
Nonrecyclable paper	10.3%	10.6%	10.99%
Milk/juice cartons	4.4%	3.2%	3.94%
Compostable trays	6.7%	0.0%	1.97%
Styrofoam trays	0.0%	2.2%	0.87%
Food waste	19.5%	23.9%	23.90%
Liquid	6.6%	9.7%	9.47%
Cardboard	6.9%	10.8%	7.48%
White office paper	10.6%	7.8%	9.11%
Mixed paper	6.5%	5.7%	6.92%
#1 & 2 plastic bottles	1.6%	5.5%	3.09%
Metal cans	0.5%	1.0%	0.93%
Glass bottles	0.3%	0.3%	0.33%
Reusables	1.5%	0.5%	0.92%
Plastics #1-6	3.4%	2.1%	2.60%
Plastic film	2.4%	1.8%	1.99%
True garbage	18.4%	14.4%	15.04%
C&D	0.0%	0.4%	0.24%
HW	0.2%	0.1%	0.13%
E-waste	0.2%	0.1%	0.08%
Total	100.0%	100.0%	100.0%

Three urban schools and three suburban schools participated in the study. One elementary, one middle and one high school were urban, all located within the City of Minneapolis. One elementary, one middle and one high school were suburban and located west of Minneapolis.

The study results show some differences between urban and suburban schools. Table B1 details the waste composition from urban and suburban schools.

Figure B1

Waste composition of urban and suburban schools

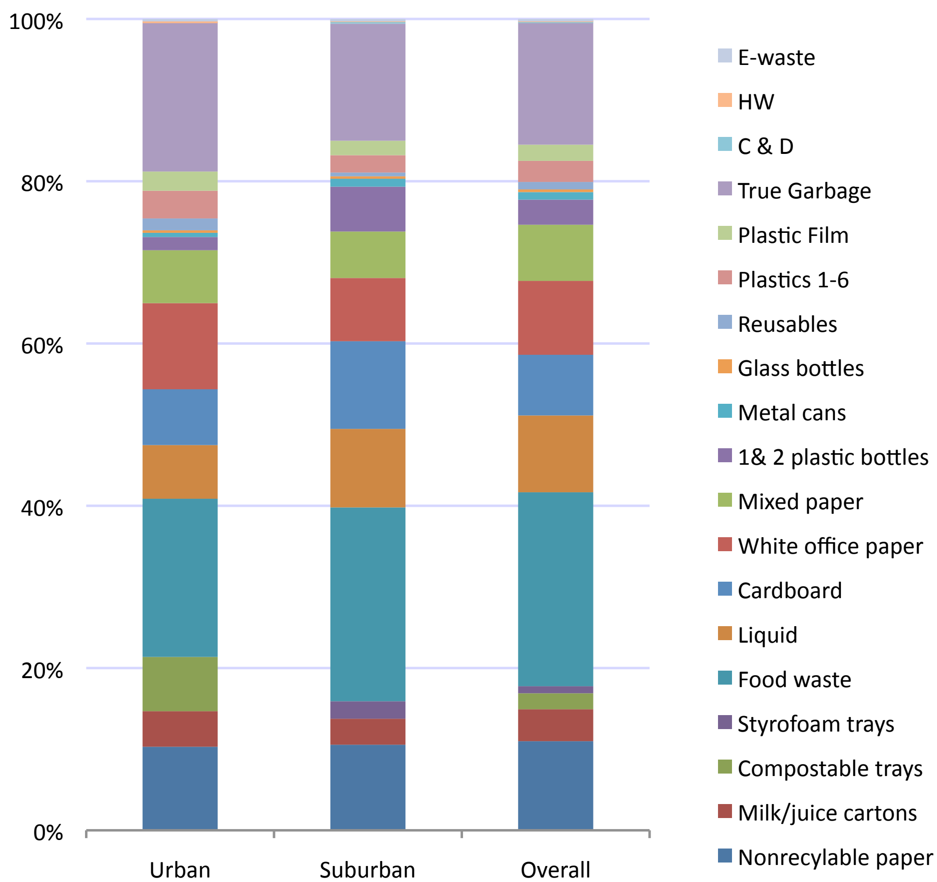


Figure B1 – compares the combined waste composition at the three urban schools that participated in the study to the three suburban schools.

A number of the differences in composition can be attributed to procedures in place at the participating schools and may, in fact, have little to do with the location of the schools. All three urban schools use compostable trays in their cafeterias, two of the three suburban schools use Styrofoam trays and one suburban school uses reusable trays. As a result, the waste associated with compostable or Styrofoam trays is one of the more noteworthy differences between urban and suburban schools. Other types of plastic packaging, defined as Plastics #1-6, were also more prominent at urban schools than at suburban schools. The participating urban schools used more packaging of this type in their food service operations.

These differences demonstrate that decisions made related to food service substantially impact the waste generated at a school. The reusable tray and dishware option generates no waste, which contributed to tray waste being less prominent at suburban schools. The compostable option accounted for a larger segment of the waste at schools using them, but also represents the best currently available single-use option with an alternative to true disposal. Because the Styrofoam trays cannot be recycled or composted, they must be disposed. It's also worth noting that these results are calculated in terms of weight, and while that is one way of measuring solid waste data, volume is also an important consideration. Trash and recycling haulers empty containers (and charge for service) when the containers are full, not when they are heavy. This is important to note because voluminous products like Styrofoam can fill a dumpster faster despite their light weight. This report includes further discussion of this issue in Appendix D – Volume, Weight and Cafeteria Trays.

There were also some differences in the recycling and composting recovery rates at the urban and suburban schools that participated in the study.

Figure B2

Recycling and composting rates by school location

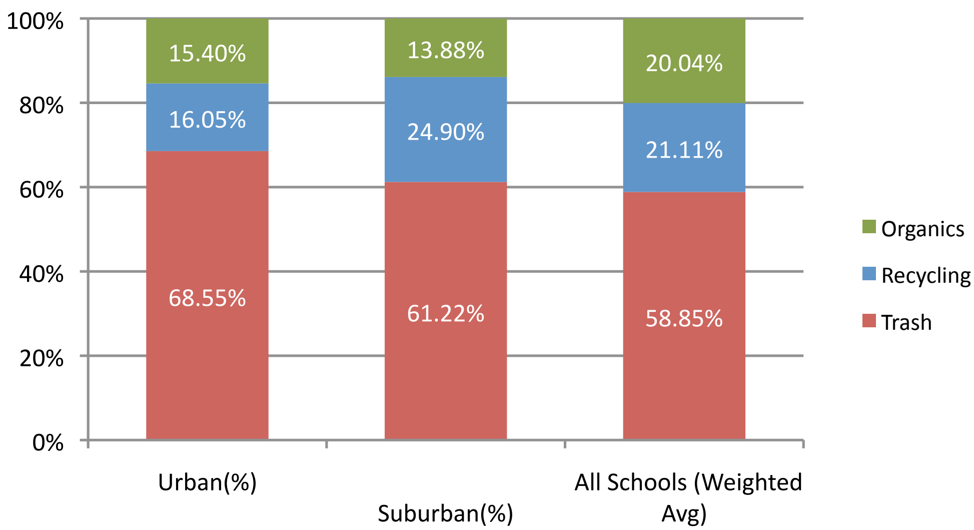


Figure B3

Recyclable and compostable materials in the trash by school location

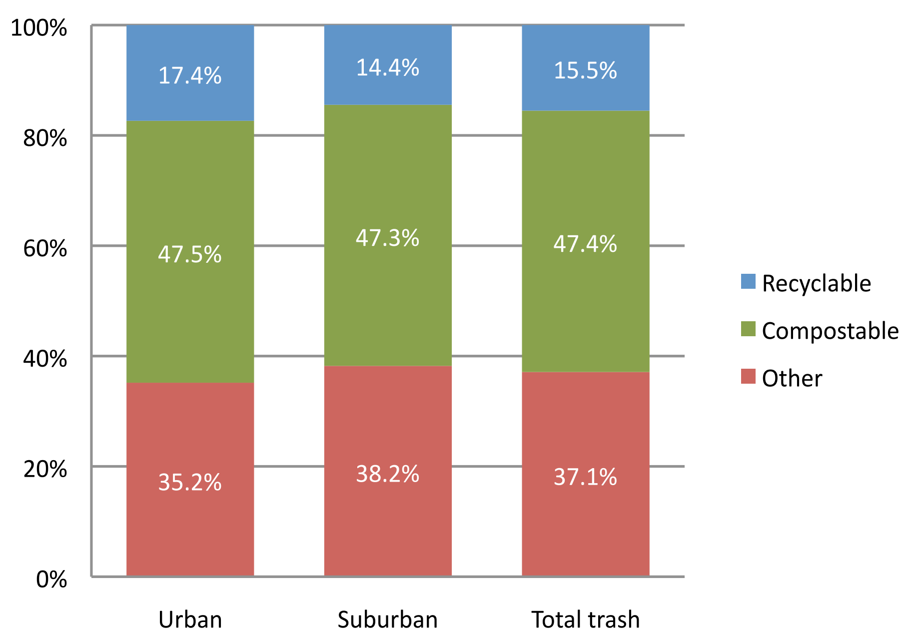


Figure B2 – depicts recovery rates in these two categories of schools.

Figure B3 – Urban and suburban schools have substantial opportunity to increase recovery of recyclable and compostable materials. Figure B3 depicts how much of the material currently disposed of as trash could be either recycled or composted at each category of school. Recyclables included in this analysis were calculated based only upon materials that are commonly accepted throughout the state by recycling collectors. Items that could be recycled less easily, such as plastic film, are not included.

If the six schools that participated in this study recovered all of their traditional recyclables and compostables, they would be able to divert 62.9% of what is currently being thrown away. Even more of that material could be diverted if a school were to implement recycling for less commonly recycled items.

Appendix C –
Considerations and data: food-to-animals and composting

Diversion options

Solid waste professionals and environmental experts utilize the waste management hierarchy to prioritize the most environmentally preferably way of dealing with waste (Figure C1). The hierarchy ranks reduction and reuse above all else, with recycling being the next most preferred option. Donating unused, edible food for human consumption is usually considered reuse and is universally accepted as a best practice for that material. Handling food waste via a food-to animals program requires some processing but is also often considered a form of reuse. Composting is also included in the hierarchy as a method for handling food waste that is preferable to disposal. Composting is unique in that it is typically able to also manage nonrecyclable paper. Solid waste professionals often use the term ‘organics recycling’ to describe composting and/or food-to-animals programs. Any waste that is comprised of plant or animal based material is considered organic. Regardless of which option is chosen, schools that manage organic waste separately are engaged in an environmentally preferred practice.

Figure C1 **Minnesota’s waste management hierarchy**

All of the options for diverting organic waste from disposal are preferable to disposal. The two options most commonly available to schools are recovering food waste and liquids to feed animals, and recovering food waste, liquids and nonrecyclable paper for composting. There are even a few schools in Minnesota (e.g., Stowe Elementary near Duluth and the Fond du Lac Reservation school) that manage a portion of their food waste through vermicomposting (composting with worms) programs on their grounds. While useful and effective, the vermicomposting option will not be addressed in depth here.

As with any waste recovery effort, waste generators' choice of recovery program is dependent in part on local availability and the willingness of local haulers to transport the material to those facilities. Facilities and farmers equipped to handle organic material are not currently available in all parts of the state, and in many cases a school interested in diverting its organic material must decide between food-to-animals and composting based on local access. Schools are encouraged to contact their county solid waste staff to evaluate which options are available locally and whether there is a potential to partner with a local farmer or unit of government to develop a recovery option.

Food-to-animals programs and composting programs may differ in the types of materials that are accepted for each process. Food-to-animals programs are equipped to take food waste and liquids, but often exclude meat. Food to animals programs must carefully screen for any contaminants since inappropriate items could be harmful to animals if ingested.

Commercial composting programs typically handle a wider variety of materials, such as food waste, nonrecyclable paper and other types of compostable packaging. There are occasional exceptions to this; for example, Western Lake Superior Sanitary District's compost facility, which serves the greater Duluth area, accepts only food waste because of specific considerations at the compost site. Commercial compost facilities are generally less sensitive to incidental contamination and, because they can handle a wider variety of materials, they may be a more attractive diversion option.

Diversion potential

Food waste was the most prominent material found in this study, accounting for 23.9% of the waste generated at schools.

Food and liquid waste can be managed through either a food-to-animals program or an organics composting program.

Figure C2 – depicts how much material can be diverted if a school were to capture all recyclable materials and all materials suitable for a food-to-animals program – up to 61% of the total waste generated.

Figure C3 – Typical compost programs can handle food waste, liquids, and food-soiled and nonrecyclable paper (which includes paper products, such as paper napkins and towels, paper plates and cups), milk cartons and compostable trays. Figure C3 depicts the amount of material that can be recovered if a school were to recover all recyclables and all materials suitable for a typical composting program – up to 78% of the waste generated.

Figure C2

Potential recovery through combined recycling and food-to-animal program

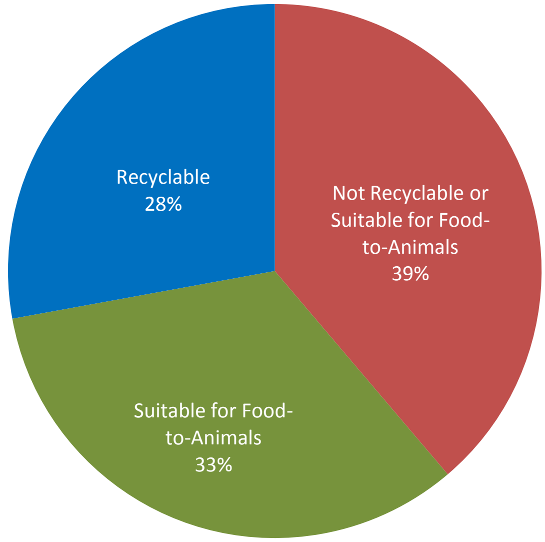
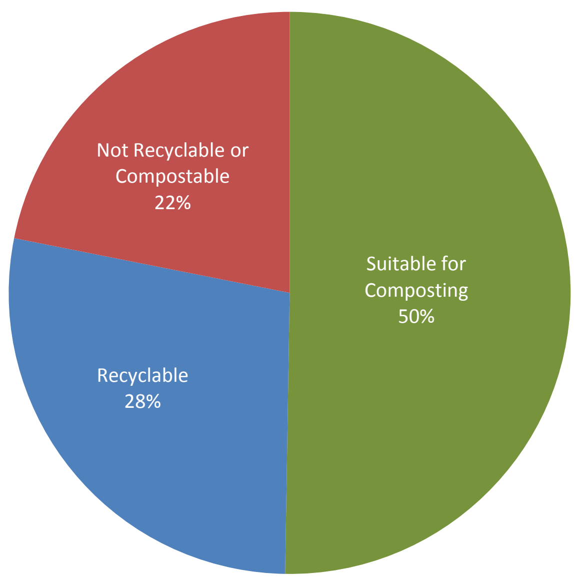


Figure C3

Potential recovery through combined recycling and composting program



In conclusion, there are pros and cons to both food-to-animal and organics composting programs. Schools with access to both types of programs should have a clear vision for their program and a good understanding of the waste they generate to help them decide which program is appropriate. Either type of program can effectively divert substantial portions of school waste, and both are better than sending the material to a landfill or incinerator.

Appendix D –
Considerations related to volume and weight

To determine the composition of waste at schools, researchers in this study sorted over 6,000 lb of waste that was generated over a two-day period at six schools. The garbage, recycling and compostables that were collected for the study were transported to the sorting area in 50 carts (96-gallon capacity), three 20-cubic-yard roll-off containers, and one 30-cubic-yard roll-off container. During the sorting, waste was poured onto a table, segregated into the material categories, and then weighed. While weight is one useful metric for evaluating and tracking waste, the volume of waste is also an important consideration.

Trash haulers design collection schedules to empty trash and recycling containers when they are full. Schools, or any other waste generators, are typically charged based on the frequency of collection and size of the container. Of these two factors, frequency of collection (how often a truck and driver stop at a given location to pick up material) accounts for the larger portion of what a customer is charged. Schools with smaller dumpsters and less frequent collection pay less than schools with larger containers and more frequent collection. With rare exception, pick-up charges do not vary based on the weight of material collected – quite simply a full dumpster must be emptied regardless of how heavy or light it is. Therefore, it is in a school's interest to reduce not only the weight of material collected but also the volume.

Examining the weight of a material can also lead to some misleading conclusions if volume is not also considered. For example, two prominent waste categories in this analysis were liquid and Styrofoam trays. In the combined results, liquid accounts for 9.47% of a school's waste and Styrofoam accounts for 0.87%. In reality, Styrofoam trays take up substantially more space in a trash container and as a result their use has more impact on trash and recycling costs.

As noted above, liquid waste accounted for 9.47% of the waste generated by the schools participating in this study. All of these schools have programs in place designed to capture liquid waste for sewer drains in an effort to minimize the liquid component of the trash. These six schools all have composting programs which can accommodate liquid waste. However, these composting programs are easier for the custodial staff to

Figure D1 – With loosely packed cafeteria trays, the capacity of a 96-gallon cart was 114 trays, or 4.4 lb of waste.

manage when most of the liquid has been separated out. With food-to-animals programs, the liquid is in many ways beneficial because it supports the cooking process that is used to turn the food waste into animal feed. Had this study included schools with food-to-animals programs or schools that did not separate out liquid waste, it's likely that liquid waste would have accounted for a larger portion of the waste stream by weight. In comparing this analysis to others, the difference in how liquids are managed is an important consideration, particularly since liquid is a heavy but not particularly voluminous material.

Schools have found it advantageous to develop strategies for reducing the volume of collected waste. One school in our study that uses Styrofoam trays also uses a trash compactor to compact its waste prior to having it hauled away. While that can make economic sense for large generators of trash, it is less sensible for medium-size and small facilities. Other schools have implemented "tray stacking" practices – students stack their lunch trays prior to disposal. This strategy has been effective at substantially reducing the volume of waste, which then has allowed for less frequent trash collection and reduced costs.

To illustrate the impact of having students stack trays, the waste-sorting team examined how many Styrofoam trays would fit in a standard 96-gallon cart. When tossed loosely into the cart, 114 trays fit into it and the tray waste, despite filling the container, weighed only 4.4 lb. When stacked neatly, the 96-gallon cart held 920 trays that weighed 37.8 lb, or eight times as much. In other words, custodians will tote one cart or bag of stacked trays for every 8 carts or bags of randomly tossed trays.

Figure D1

Figure D2

Figure D2 – With neatly stacked cafeteria trays, the capacity of a 96-gallon cart was 920 trays or 37.8 lb of waste.

Appendix E –
white paper and mixed paper: value

Paper accounts for 31% of the waste (before recycling) disposed of in the United States, more than any other material. Included in the broad category of paper waste are recyclable papers, such as office paper, junk mail, cardboard, magazines and newspapers. This study found that recyclable paper (the combination of the study's categories of "Mixed paper", "White office paper" and "Old corrugated cardboard") accounted for 23.51% of the waste generated at the six participating schools. Thus, recyclable paper comprises a large portion of waste generated at schools.

Sorters were instructed to use the guidelines below in sorting recyclable paper into these three categories:

1. Cardboard *(also known as OCC, or old corrugated cardboard)*
   - Uncoated corrugated shipping and storage boxes *(i.e., no wax)*
2. White office paper
   - White and pastel copy paper
   - Post-it notes™
3. Mixed paper
   - Magazines, books and newspapers
   - Construction paper
   - Mail
   - Manila envelopes and folders
   - Shredded paper
   - Paper ream wrappers
   - Paperboard/boxboard
     - Cereal boxes
     - Paper towel and toilet paper cores

   Many recycling haulers allow schools to commingle, or mix, these types of paper together. Sorting guidelines can be different in different parts of the state – schools can contact their recycling hauler to ensure they are familiar with the guidelines for their program.

After recyclables are collected and processed recyclers sell the materials to end markets that use the material to make new products. The revenue received through the sale of those materials varies depending on the material. For example, one ton of aluminum typically fetches a much higher price than a ton of HDPE plastic. The same is true with paper – white office paper is more valuable than mixed paper. When office paper is mixed with other types of recyclable paper (listed above), it becomes classified by recyclers as mixed paper. Paper is sold to end markets in bales, which are large bricks of paper compressed for shipping. The composition of the bale needs to be all white office paper for it to be sold as such.

Market prices vary over time and from region to region. Like any other commodity, supply and demand determine at what price each material can be sold. Table E1 below reflects reported prices in the Midwest for June of 2010.

Table E1

Recycling market prices for paper

Material	price per ton*
Cardboard	$105-$115
White office paper	$275-$285
Mixed paper	$65-$75

*Source: official board markets, vol. 86, No. 24, June, 2010

It's important to note that end markets pay these prices to recyclers for bales of material. For recyclers to be in a position to sell the material at these prices, they must first collect and process the material. Typically the revenue from the material does not exceed the costs of collection which is why recycling is not free to the consumer. However, since the alternative to recycling is disposal, which has collection costs and tipping fees at landfills or incinerators, recycling comparatively offers economic and environmental advantages.

Appendix F –
cost implications

Some schools and many cities that operate curbside recycling programs have built revenue shares into their contracts with recycling haulers. This strategy can create an economic incentive for the school to recycle more material although the revenue received is likely to be in the form of a credit that does not offset all collection and processing costs.

The primary purpose of this study was to assess waste generation and composition at schools. An extensive cost-benefit analysis was outside the scope of this project. However, as budgets tighten, schools are facing substantial pressures to minimize expenditures across all programs, including waste management. The data gathered for this study suggest that, as a group, public schools within Minnesota currently generate more than 43,000 tons of waste annually. Managing all of that waste is an expensive endeavor. This section addresses some of the complexities in waste management costs and where the levers are for schools to make the most of their waste management dollars.

It's difficult to make broad conclusions about how much schools are spending on trash and recycling services. It's also difficult to offer meaningful statewide information that accurately reflects how costs could change if a school successfully expands its recycling program or implements a composting or food-to-animals program. However, there are some considerations schools can take into account in evaluating how program changes might impact their situations.

Fees for trash, recycling and composting services vary locally and must factor in transportation costs and disposal fees, both of which can vary widely. Recycling at public schools and all public entities is required by law throughout the state. When implementing expanded programs there are often start-up costs associated with the purchase of containers and signage. In many situations, there are also some ongoing costs for items, such as compostable bags, trays and utensils, that must be considered.

Despite these challenges, there may be opportunities for cost savings for well designed and highly functioning recycling, composting and food-to-animals programs. The state and many local governments have tax structures designed to promote recycling and composting. For example, all trash within Minnesota is subject to the Solid Waste Management tax, which is assessed to trash bills but not assessed to source-separated recycling or organics. Schools are subject to the commercial rate of the State's Solid Waste Management tax, which is assessed at 17% of total trash service charges. Several counties also assess additional fees or taxes to trash that are not assessed to recycling or organics. These fees can be assessed as high as 37.5%, over and above the state tax.

Minimizing these fees by maximizing diversion of recyclables and organics can result in a reduction in trash fees if either trash volume or pick-up frequency is reduced. The reduction in solid waste taxes and fees may or may not offset the fees for having compostable materials separately collected.

Since most waste generators are billed by volume of waste (container size) and number of pick-ups of containers, a waste generator can reduce trash costs by reducing the size of container it has and/or by reducing the frequency of collection. Of these two factors, frequency of collection (how often a truck and driver stop by to pick up material) accounts for the largest portion of what a customer is charged.
There are two simple and effective strategies to reduce container size or frequency of collection. The first is to reduce overall waste generation. The second is to maximize the recovery of recyclables and compostables. In both cases, as the amount of trash is reduced, to realize any cost savings, the school needs to adjust container sizes or frequency of collection accordingly. Since schools have the potential to divert up to 78% of the waste they generate through recycling and composting, there is reason to believe these strategies have great potential to reduce costs.

Appendix G –
Weighted averages

In research such as this, where a sample is used to represent a larger population, it is ideal for the sample population to be in the same proportions as the whole population, or stratified. For example, if you want to know the likely outcome of an election, surveyors usually ask a sample of people that has the same percentages of women, men, young and old, as the whole population of likely voters. In this study, we used a sample of schools to represent the whole population of schools in Minnesota. However, our study sample did not have the same proportion of staff and students in each grade tier (elementary, middle and high school) as the whole population of Minnesota public schools.

To adjust for this, the statewide proportions were used to weight the waste composition data in this report. The weighted average was used to more accurately reflect the proportions of students and staff in elementary, middle and high schools across the state within each grade tier and at the aggregated "combined" or "all schools" level.

The variable used to weight the composition data to calculate the combined results for all schools was the estimated student and staff population at each grade tier statewide. To calculate these estimates, data from the Minnesota Department of Education (MDE) was used. The MDE data did not neatly break down into the grade tiers used in this report to define elementary, middle and high schools. For example, we defined elementary schools as schools covering kindergarten through fifth grades. While this is the most common type of elementary school, schools in the state vary as to which grades are included within each tier. Some elementary schools include K-5, K-6 or even K-8. Staff data were even more difficult to break into appropriate grade tiers. As such, we used statewide aggregate staff numbers and student populations per grade level to estimate staff populations within our defined grade tiers. The student and staff populations were then combined and used to weight the composition data to provide the cumulative number for all schools.

So, this means that since elementary schools account for 41% of the state's student and staff population, we weighted the composition data from the two elementary schools in the study so that it constitutes 41% of the "combined" or "all schools" composition. Middle and high school data were handled the same way. 22.5% of the state's population is found in middle schools and 36.5% is found in high schools.

The formula for this calculation was:

[(composition % of material X) x (elementary population %)] + [(composition % of material X) x (middle population %)] + [(composition % of material X) x (high population %)] = all schools weighted average

We also weighted the composition data within each grade tier to get grade tier averages for each material that take into account the different amounts of material generated at each school. For example, we had two elementary schools in the study. One of the elementary schools generated 845.46 lb of waste over the two days of the sort while the other generated only 574.20 lb.. To account for this, we weighted the school grade tier averages based on the amount of material generated at each school.

This has only a slight impact on the final numbers. For instance, nonrecyclable paper at elementary schools is 12.67% of the total elementary tier waste calculated as a weighted average; calculated as an arithmetic average, it would have been reported as 12.65%.

The formula for this calculation was:

[(composition % of material X at school A) x (total pounds of waste generated by school A)] + [(composition % of material X at school B) x (total pounds of waste generated by school B)]/total pounds of waste generated by both schools = weighted average per grade tier

Weighted Average Example:

A teacher is grading her students based on their performance on four exams. She decides the final exam will be worth twice as much as the three previous exams. Imagine a student received these scores on his exams: 70, 80, and 75 on the first three exams and 85 on the final exam

In this example, the student's grade would be calculated with a weighted average where the final exam score is weighted to be twice as important as the previous three exams. The calculation to determine the grade would thus be: (70 + 80 + 75 + 85+ 85) / 5 = 79

Had the teacher not weighted the final exam – and instead calculated the grade based on the average test score, or arithmetic mean –the calculation would have been: (70 + 80 + 75 + 85) / 4= 77.5