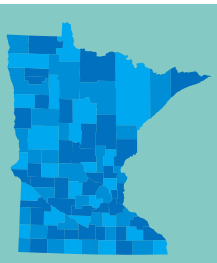
Construction and Demolition

November 2020

Construction and Demolition Materials Composition Study

MINNESOTA POLLUTION CONTROL AGENCY



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Contributors/acknowledgements

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- Olmsted County Kalmar Landfill – Rochester
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Contents

Acronyms and definitions

Acronyms

C&D: Construction and Demolition

EPA: U.S. Environmental Protection Agency

HDPE: High Density Polyethylene (commonly referred to as #2 plastics)

HVAC: Heating, Venting, and Air Conditioning

MPCA: Minnesota Pollution Control Agency

MSW: Municipal solid waste

MMSW: Mixed municipal solid waste

OCC: Old Corrugated Cardboard/Containers

QA/QC: Quality Assurance/Quality Control

R/C: Remainder and Composite

Definitions

Commercial materials: Materials generated from business, institutional, or other non-residential structure building projects

C&D materials: Materials resulting from construction, renovation, deconstruction, and/or demolition; for purposes of this report materials are limited to those defined in Appendix A

Construction materials: Materials resulting from new structure construction

Demolition materials: Materials generating from the tear-down of structures and buildings

Greater Minnesota: Region encompassing the 80 counties not included in the Metro region

Metro: Region encompassing Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties

Mixed municipal solid waste: Garbage, refuse, and other solid waste from residential, commercial, industrial, and community activities that the generator of the waste aggregates for collection; does not include auto hulks, street sweepings, ash, construction debris, mining waste, sludges, tree and agricultural wastes, tires, lead acid batteries, motor and vehicle fluids and filters, and other materials collected, processed, and disposed of as separate waste streams

Municipal Solid Waste: Combination of Mixed Municipal Solid Waste and recyclable materials, managed at solid waste land disposal facilities

Non-C&D materials: Materials resulting from activities not included in residential or commercial categories, but containing materials consistent with these sectors (pallets, rock, wood, etc.)

Processing: The treatment of waste after collection and before disposal; processing includes but is not limited to reduction, storage, separation, exchange, resource recovery, physical, chemical, or biological modification, and transfer from one waste facility to another

Recyclable materials: Materials that are separated from mixed municipal solid waste for the purpose of recycling or composting, including paper, glass, plastics, metals, automobile oil, batteries, source-separated compostable materials, and sole source food waste streams that are managed through biodegradation processes. Refuse-derived fuel or other material that is destroyed by incineration is not a recyclable material.

Renovation materials: Materials resulting from remodeling or repair jobs, including roof replacements

Residential materials: Materials generated from housing structure building projects

Solid waste land disposal facility: A facility used to dispose of solid waste in or on the land ("facility")

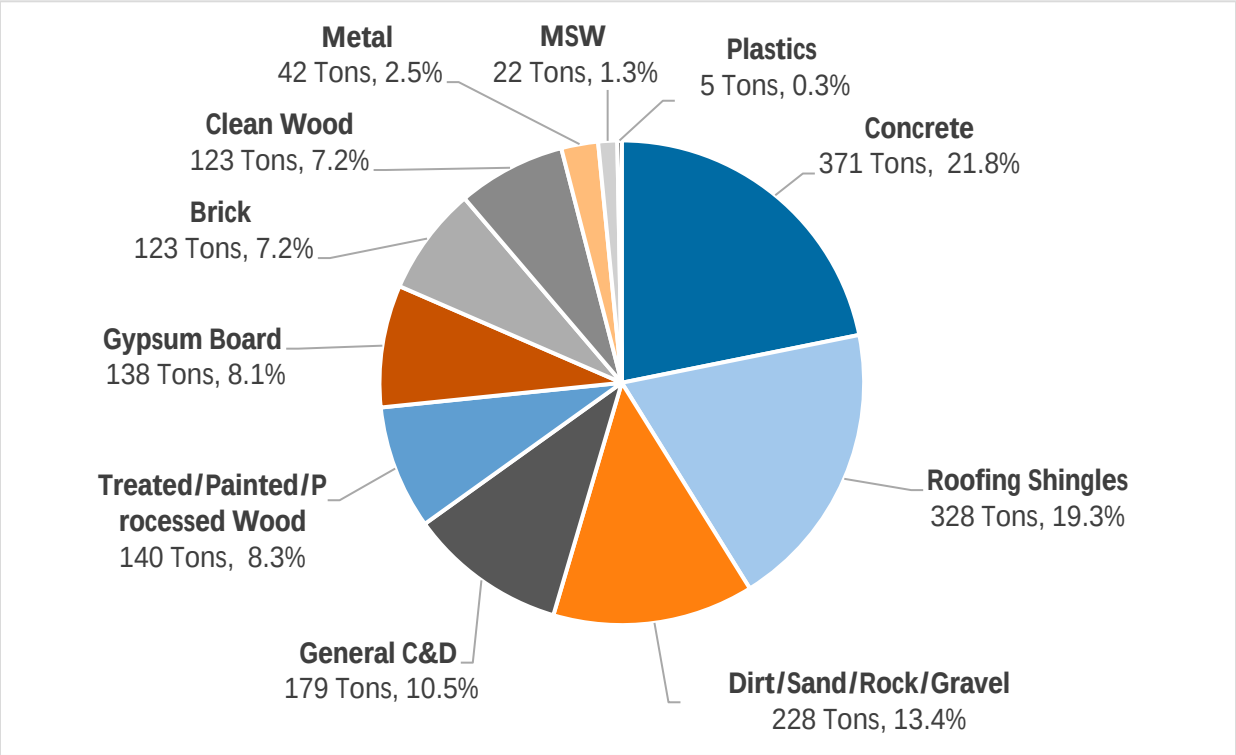
Executive summary

In an effort to identify opportunities for reducing the environmental impacts of the State of Minnesota's building sector, the Minnesota Pollution Control Agency (MPCA) conducted a study on the generation and composition of construction and demolition (C&D) materials originating in Minnesota and disposed of at permitted solid waste facilities with C&D disposal areas, typically C&D landfills. The goal of this report is to gain a stronger understanding of the material categories and prevalence of those materials within the C&D waste stream. 1

A total of 375 loads, or 1,699 tons of C&D debris were surveyed at seven facilities across the state for this report, which included both the landfill and processing areas at one facility, Dem-Con Recovery and Recycling. The three material categories that made up the largest percentage of the total waste composition are: Concrete (21.8%), Roofing Shingles (19.3%), and Dirt/Sand/Rock/Gravel (13.4%), as seen in Figure 1. Combined, these categories represent over 54% of statewide C&D waste.

The results and analysis completed in this study help the MPCA look at how different materials are being wasted, which is useful in determining how to improve building material management strategies for recycling and reuse. For instance, are there replacement materials that would have a smaller environmental footprint from a material life cycle perspective? Are there materials that would be more durable and have a longer life before disposal? What reuse and recycling markets are strong in Minnesota or surrounding states? What markets need support and expansion, and how can Minnesota diversify markets to make them more stable? Answering these questions will allow the MPCA to define program strategies and identify priorities to most effectively prevent building material waste and identify alternative management methods to keep materials in use as long as possible before disposal.

Figure 1. Aggregate statewide C&D waste composition, 2019



Introduction

Background

The state of Minnesota has over 120 facilities that accept C&D debris for disposal, including Class I, Class II, and Class III C&D landfills (as defined in the "Facility Classification" section of the 2005 Demolition Landfill Guidance Document), transfer stations, and C&D recycling facilities (MPCA, 2005). The MPCA issues solid waste permits for facilities that accept C&D debris for disposal and for each facility that monitors the surrounding groundwater, the MPCA requires an annual report be submitted describing the groundwater quality for that year. As outlined in the Groundwater Impacts of Unlined Construction and Demolition Debris Landfilling report, disposal of C&D waste in Class I unlined landfills is known to cause higher concentrations of contaminants of concern above the allowable drinking water standards as defined by the Minnesota Department of Health () (MPCA, 2019). The groundwater findings from this report led to the establishment of two stakeholder groups, advising the MPCA on statewide opportunities for improving the protection of groundwater near C&D landfills and opportunities for increasing sustainable building and material management.

The U.S. Environmental Protection Agency (EPA) estimates 569 million tons of C&D debris were generated in the United States in 2017, which is more than twice the amount of municipal solid waste (MSW) generated in the same year (EPA, 2020). In order to determine the amount of C&D debris generated in Minnesota, the MPCA used annual reports from permitted solid waste facilities which includes the types and amounts of waste managed. While the MPCA additionally collects detailed MSW generation data from counties, the same level of granularity isn't required for C&D data. Furthermore, while the state of Minnesota's efforts to reduce MSW generation and recycle more residential waste have grown, the same prioritization hasn't historically been given to the reuse and recycling of C&D materials. The MPCA estimates that about 20% of C&D material is currently recycled, despite many constituents in the C&D waste stream having more potential for reuse and recycling. At this point, the MPCA has limited formal data on C&D material handled outside the solid waste stream.

This study aims to fill the gaps in information for C&D material and waste management in the state of Minnesota, and help inform future decision-making processes for Minnesota's building material management system. The research included characterization studies at facilities across the state, including locations in both the Metro and Greater Minnesota regions.

Objectives

The MPCA identified the following objectives for the statewide C&D study:

- Provide data on the composition of C&D waste in Minnesota, noting any differences between Greater Minnesota and the Metro regions.
- Investigate C&D material generation and management practices based on C&D landfill reports.
- Detail seasonal differences in the composition of C&D waste.

Methodology

Demographic regions

This study was conducted to gather information on the C&D waste stream from representative sites in two regions of Minnesota:

- **Metro:** The seven-county region that covers Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties.
- **Greater Minnesota:** The remaining 80 counties outside the seven-county Metro region.

Throughout this report, results are presented separately by region and in the statewide aggregate.

C&D waste disposal

Minnesota requires solid waste management facilities to report the amount of materials handled and disposed of at the facility to the MPCA in their solid waste annual report, a requirement of Minn. R. 7035.2585. Table 1 summarizes the reported statewide quantities of C&D materials disposed in 2019 by region of origin.

Table 1. C&D waste disposed in Minnesota by region of origin

Region	Tons of C&D disposed	Percent of total C&D disposed
Greater Minnesota	499,699	32.6%
Metro	1,034,427	67.4%
Total	1,534,127	100.0%

The composition of C&D materials being disposed in Minnesota is roughly one third from Greater Minnesota and two-thirds from the Metro.

Study design – visual characterization

Host facilities and schedule

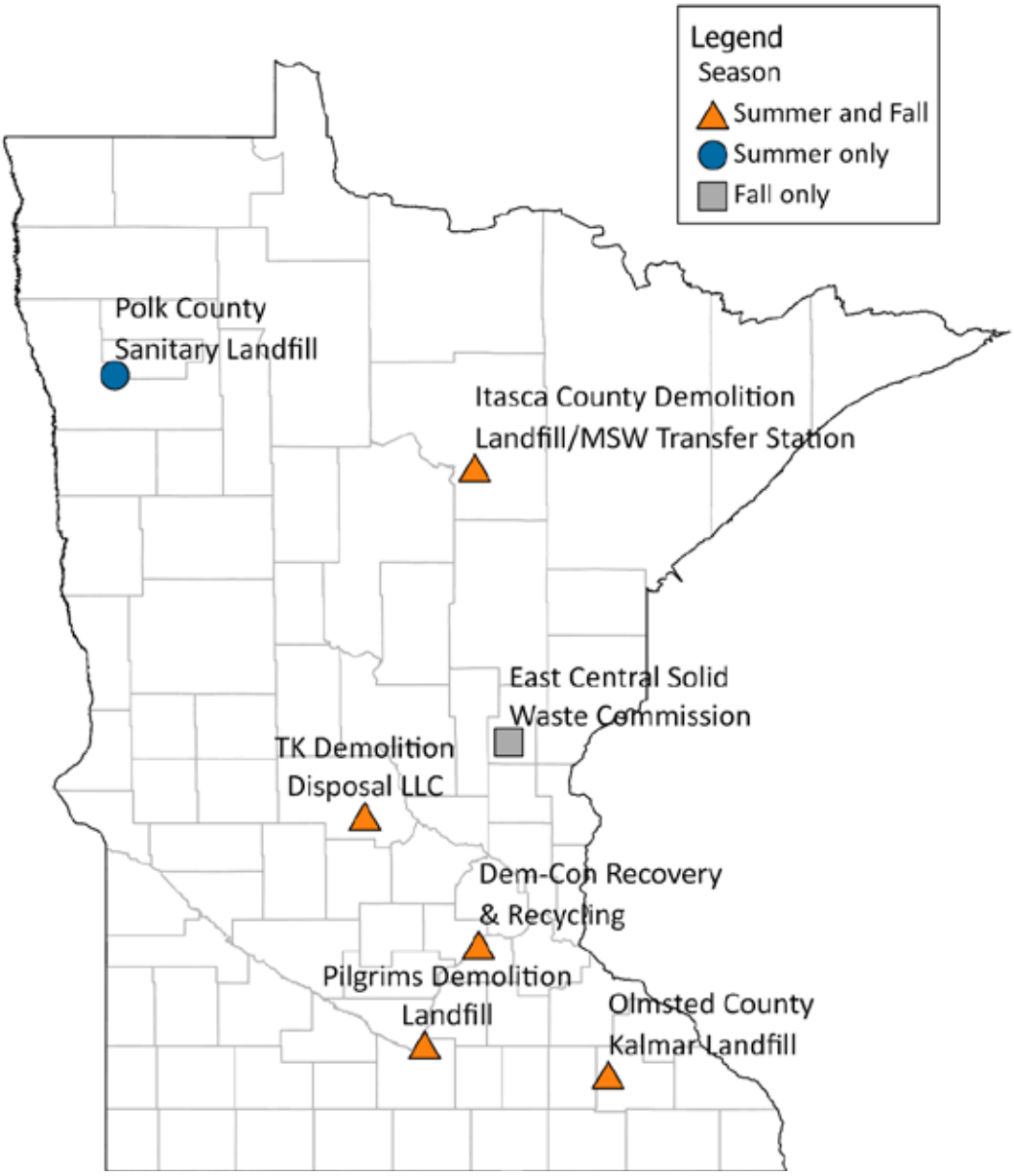
In the state of Minnesota, there are 126 permitted solid waste facilities with C&D disposal areas on-site. Nine of these facilities are located within the Metro region, with the remaining 117 in Greater Minnesota. Transfer facilities may also handle C&D materials, but aren't included in these counts. In order to be selected for visual load surveying for this C&D composition analysis, facilities needed to:

- Accept a sufficient quantity of materials to justify a full day of visual surveying.
- Have a scale available in order to weigh each load.
- Have adequate space on their tip floor and working space to safely host the project.
- Have the ability and willingness to periodically spread out a tipped load for better viewing the interior of the piles.
- Have access to scale data through on-site communications (radio, cell phone) if loads are not given a ticket as they enter.

This study also specifically focused on assessing multiple Class I landfills. These landfills are not lined and are therefore limited to only accepting C&D materials, compared to Class II and III that may also accept other wastes, as defined in 2005 Demolition Landfill Guidance document (MPCA, 2005). Prior to this composition analysis, the MPCA conducted its study on the groundwater impacts of unlined C&D

landfilling at Class I landfills as well, and therefore wanted to document the types of materials entering these facilities (MPCA, 2019). Figure 2 provides a map of the facilities that hosted the field data collection for characterizing C&D loads.

Figure 2. Map of facilities hosting field data collection by season



The visual surveying of C&D loads occurred over two seasons in 2019: Summer (June 3-7) and Fall (October 7-11). Most of the facilities were visited by a single enumerator who performed the visual surveys; however, two enumerators started each season at Dem-Con's facility to initiate data collection and calibrate their processes. The enumerators then traveled independently to the remaining facilities to complete single day collections for the remainder of the week. Table 2 provides the specific dates that field activities occurred at each facility.

It should be noted that the characterization of C&D material at Dem-Con, the only Class III landfill, included both loads destined for landfill and loads diverted to an on-site C&D processing area. The reason both disposed and processed loads were characterized is there is not extensive C&D recycling capacity elsewhere in Minnesota, and little mixed C&D is typically delivered to processing facilities.

Therefore, in most areas of the state, all of the C&D arriving at landfills would be expected to be land disposed.

Table 2. Detailed field activities by facility. Includes region the facility is located and specific dates that field activities occurred.

Demographic Region	Facility	Disposal Area Classification	Summer 2019	Fall 2019
Metro	Dem-Con Recovery & Recycling	Class I, II, III	June 3-5	Oct. 7-9
Greater MN	TK Demolition Disposal LLC (TKI)	Class I	June 5	Oct. 9
Greater MN	Olmsted County Kalmar Landfill	Class I	June 6	October 10
Greater MN	Itasca County Demolition Landfill/MSW Transfer Station	Class I	June 6	October 10
Greater MN	Pilgrim Demolition Landfill	Class I	June 7	October 11
Greater MN	Polk County Sanitary Landfill	Class I	June 7	N/A
Greater MN	East Central Solid Waste Commission (ECSWC)	Class I	N/A	October 11

During the last day of the Fall data collection, a winter storm prevented field work at the Polk County Landfill. The East Central Solid Waste Commission (ECSWC) landfill in Mora replaced the Polk County Landfill in order to prevent the loss of an additional day of data collection; however, the change of location created limitations for the comparison of results from the Summer to Fall data collection.

Not all host facilities routinely use a truck scale for C&D loads. For example, the ECSWC Landfill scale mixed municipal solid waste (MMSW) loads but not C&D loads. Additionally, several of the other facilities did not routinely scale in all C&D loads, but in order to maximize the number of loads surveyed, some composition estimates were made for loads without corresponding scale weights.

Of the 434 loads surveyed at the seven host facilities, 59 did not get scaled due to the following circumstances:

- Small hauler loads at the Itasca County facility are not scaled, and few large-volume loads of C&D come to this facility. Seven large-volume loads were scaled at the demolition disposal area and 38 small-hauler unscaled loads were visually-surveyed at the drop-off area.
- During the Summer data collection, the hauler of one of the surveyed loads at the Pilgrim Demolition Landfill left the facility without scaling out.
- During the Fall data collection, Dem-Con experienced high traffic flow. Their rate options allow customers to elect to pay a flat fee per cubic yard on certain material types, thereby bypassing the scale on exit and alleviating traffic delays. Thirteen of the 150 loads surveyed at Dem-Con in the Fall data collection were unscaled, flat fee loads.
- During the Fall data collection, one load at TKI was hauled by a private hauler who paid by volume rather than weight. All other loads were hauled by TKI trucks and drivers, and were able to scale in and provide empty tare weights for load weight calculation.
- Vehicles delivering material to the ECSWC Landfill C&D disposal area do not scale out as a matter of standard practice.

At the conclusion of the survey, the MPCA opted to exclude from the analysis the loads that did not have a corresponding scale weight because the derived weight of these composition estimates could not be calibrated against actual scale weights.

Load collection targets

The targeted number of loads to be characterized per day by each enumerator at each facility was 25 loads. However, truck traffic volumes, daily delivery patterns, inclement weather, inconsistent enumerator documentation, and seasonal/regional delivery variations prevented the achievement of this target. Table 3 details the planned load assessment according to the number of days scheduled at each facility, along with the actual loads assessed. It also shows the number of samples calibrated against actual scale weights. These 375 samples were ultimately used as the basis for the composition analysis.

Table 3. Sampling plan

Facility	Planned samples	Actual samples- Summer *June 3-7, 2019*	Actual samples- Fall *October 7–11, 2019*	Total samples	Total scaled samples
Dem-Con Recovery & Recycling	250	82	150	232	219
TK Demolition Disposal LLC	50	29	30	59	58
Olmsted County Kalmar Landfill	50	3	13	16	16
Itasca County Demolition Landfill/MSW Transfer Station	50	23	22	45	7
Pilgrim Demolition Landfill	50	29	17	46	45
Polk County Sanitary Landfill	50	30	NA	30	30
East Central Solid Waste Commission	0	NA	6	6	0
Total	**500**	**196**	**238**	**434**	**375**

Material categories

Specific material categories and subcategories used for this characterization study were approved by the MPCA. A variance between the Summer and Fall data collection included the addition of Insulation and Rubber Products for material subcategories. During the Summer data collection, it became clear these materials made up a significant portion of the loads and would benefit from their own material subcategories, as opposed to being included in remainder and composite (R/C) and Other C&D. For the Summer dataset, Insulation and Rubber Products could not be broken out of the R/C and Other C&D subcategory and were estimated as 0% when calculating the confidence intervals. Detailed definitions for the characterization categories are included in Appendix A.

Sample selection and collection process

When possible, MSW Consultants relied on random selection of inbound loads of C&D debris for the visual characterization. MSW Consultants deployed one or two experienced professional staff

(depending on the facility and day) to coordinate with scale house staff, facility supervisors, tip area spotters, and inbound drivers to select loads for surveying. The system varied by facility, as proximity to the scale, varying traffic flows, and facility operations were taken into consideration. Equipment operators provided assistance in spreading the loads as requested so the interior of the loads could be observed when they weren't fully visible while offloading. On most occasions the driver of the targeted vehicle was instructed to spread the load out during the tipping process and staff could observe as it unloaded.

MSW Consultants believes the selection of loads was entirely random, although at some facilities where truck traffic was light, every load was characterized. At other facilities with heavier inbound traffic, surveying progressed at a steady pace throughout the day with the next available delivery being selected after each preceding load was characterized.

Generator sectors and types

As drivers neared the tip area, they were interviewed about their load. First, a brief explanation was provided to each driver regarding the purpose of the study. If the load contained C&D waste, they were asked if it originated from a residential or commercial job site. Drivers also indicated whether their loads were coming from construction, renovation, demolition, or a combination of these categories. While the scope of this study included materials from road and bridge construction and demolition projects, during the data collection there weren't loads from these projects observed.

Visual characterization

Visual surveying of a load of C&D waste involves recording the truck and load dimensions, followed by the observation of the major material components in the tipped load. The basic steps to visual surveying include:

1. Measuring and recording the type of vehicle, dimensions or capacity (ex. 30-yard roll-off) of the incoming load prior to tipping, and, if possible, estimating the percent fullness of the vehicle.
2. Observing the load tipping. With a larger load, one deemed too large to tip in a single pile and assess all materials, the vehicle driver spreads out the load as it tips. When feasible, the enumerator stands at a safe distance to the side and rear of the offloading vehicle to observe the offloading, noting items falling within the load that may be covered. Load operators spread out materials that aren't visible on occasion. These activities assist the visual assessment by making it easier to discern dense materials such as block, brick, and dirt that tend to sink to the bottom of the pile.
3. Marking the major material categories during a first pass around the tipped load, while estimating the percentage of the load made up of these major materials by volume.
4. Noting the subcategories contained in each major material category during a second pass around the tipped load, while estimating the percentage of the major material category made up of the material subcategories by volume. For example, subcategories of Clean Wood include Untreated Dimensional Lumber, Untreated Engineered Wood, and Wood Pallets/Crates/Spools.
5. Confirming the estimated percentages of all categories and subcategories add up to 100%, and confirming the estimated yardage of material categories is realistic, given the overall load or container dimensions and volume.
6. Entering percentages into MSW Consultants' proprietary tablet-based application to apply material density values to the volume estimates in order to get a real-time conversion from volume to weight-based composition. The total estimated weight based on the visual composition is then

compared to the scaled weight of the load. If the estimated weight is not within a 10% margin of error of the actual scale weight, the application prompts the enumerators to reassess their evaluation.

At every permitted solid waste facility with a C&D disposal area that scaled C&D loads, MSW Consultants obtained actual weights of surveyed loads so visual estimates were compared to and adjusted, if needed, to accurately reflect the load weight. For the previously described unscaled loads, the visual estimate was not calibrated against a known load weight. Because of this, the unscaled loads were removed from the study calculations.

MSW Consultants compiled material densities from various published sources and has also modified certain material densities based on their body of related project work. A table of the baseline density factors embossed in the application can be found in Appendix B.

The application allows the enumerator to adjust density factors depending on the observed compactness or saturation of each individual constituent. For example, overlapping dimensional lumber that contains noticeable airspace may have the density factor adjusted down. Stacked, flattened cardboard boxes or plywood sheets with no noticeable airspace may have the density adjusted up. Although this feature exists, enumerators are not typically adjusting the density factors on a regular basis as other aspects of the volumetric estimate would also need adjusting.

Data management and quality control

To ensure data accuracy and integrity, the study adhered to the following quality assurance and quality control (QA/QC) procedures:

- Assigning a unique combination sample number, identifying the facility of origin, and noting the date and time of each sample prior to recording the material category and subcategory composition for each sample.
- Designing the data entry databases to create a standard for vehicle types, types of materials, recording of weight, etc. to prevent out-of-range values from being recorded.

At the conclusion of the Summer and Fall field data collections, the composition data entered into the database was analyzed to determine the estimated weight in pounds and estimated mean percent associated with each material in the loads. The mean composition, as well as a confidence interval, was calculated at a 90% level of confidence.

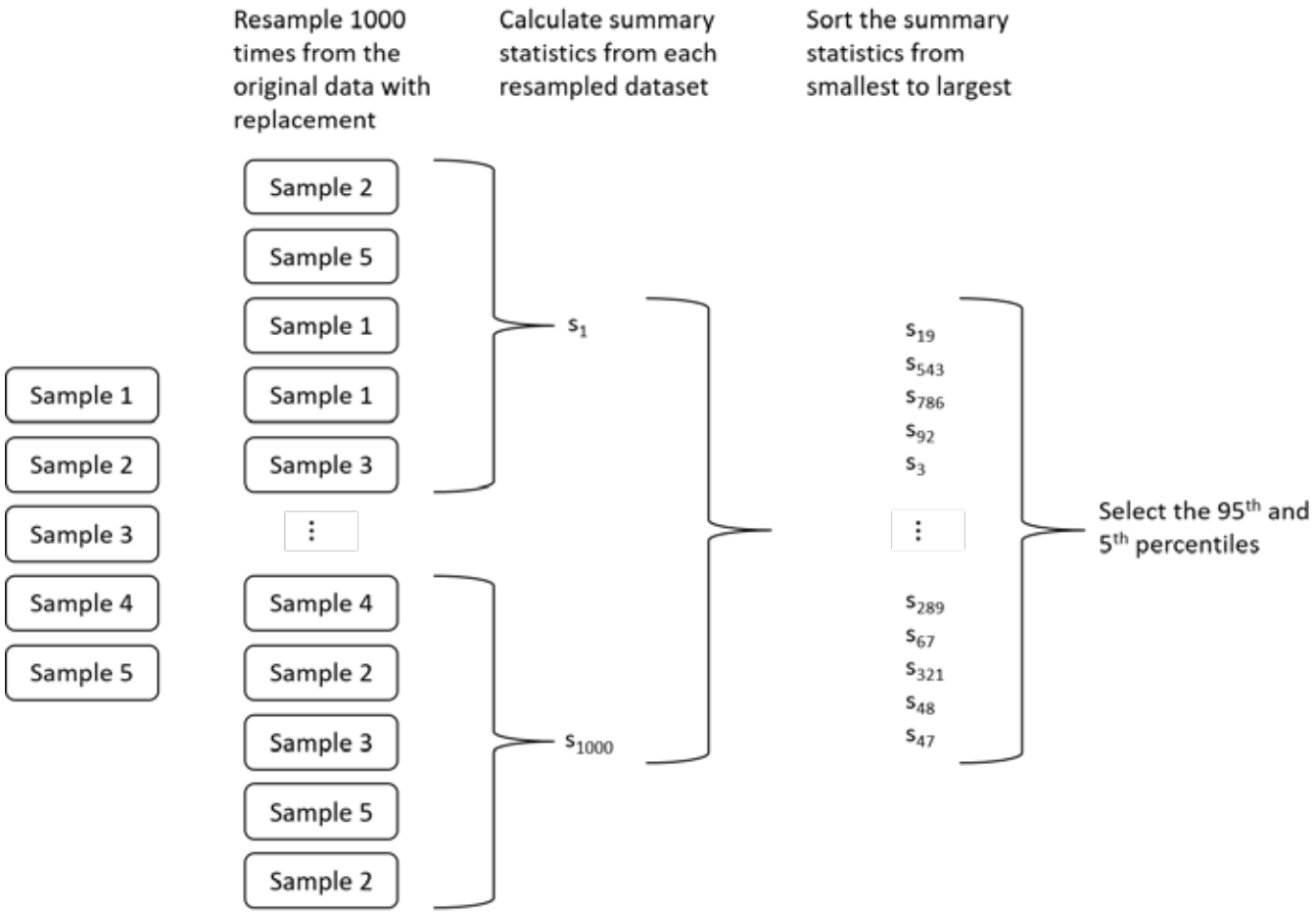
The steps for visual volumetric survey data analysis include:

1. Converting the volumetric estimates of each surveyed load to weight-based estimates, using density factors. MSW Consultants accumulated the density factors from industry resources and supplemented them with real-world densities obtained in other material characterization studies.
2. Determining the sample mean composition for each material category once visual sample data is converted to estimate weights, by (i) summing the weight of each material in each surveyed load, (ii) summing the total weight of all surveyed loads, and (iii) dividing the first value by the second value to determine the percent-by-weight composition.
3. Comparing the calculated load weights (determined during the visual assessment step) against the actual reported weights as presented on the ticketing information obtained for each load.

Determination of the 90% confidence interval was achieved using bootstrapping, a statistical technique that uses resampling. Resampling is the method of drawing repeated samples from the original data samples, where all samples have equal chance of being selected and can be selected more than once. Resampling achieves an estimate of the possible range of values for the sample statistic. In this study, all

material weights and associated sample weights were resampled, expanding the original sampled data by creating 1,000 hypothetical additional sorts (assuming the original sampled data are unbiased and representative of C&D waste). Resampling with replacement in this scenario allowed the sampled composition data to be selected again each time a new hypothetical sample was selected (i.e. in dataset s_1 represented in Figure 3, Sample 1 was selected twice since after the first time it was selected, it was replaced and still available to be selected again). These additional material compositions are then sorted from smallest to largest, and the 95th and 5th percentiles are selected to create the 90% confidence interval for the estimated composition percent. Figure 3 shows how the bootstrapping process is used to create the confidence intervals, and the R code used to perform the calculations is presented in Appendix C.

Figure 3. Illustration of bootstrapping to calculate the 90% confidence interval for a specific summary statistic



Bootstrapping works well when there are a large number of samples and the samples were selected to be representative of the population at large. It has the added benefit of being a non-parametric method which means no additional assumptions (e.g. data are normally distributed) are needed to estimate the 90% confidence interval.

C&D characterization

This section provides data about the composition of the C&D waste stream received at permitted solid waste facilities with C&D disposal areas or recovery processing facilities. Detailed state-level results are shown in the following sections, and results by participating facilities that authorized their release are provided in Appendix D.

Table 4 provides a high-level summary of the loads broken down by season (Summer and Fall) and by load type. The overall amount of material originating from Construction loads stays constant between the seasons, while the percent of Demolition loads drops and Renovation increases from Summer to Fall.

Table 4. Amount of material generated by project type for each season

Load Type	Summer	Fall	Grand Total
Construction	18.8%	18.0%	18.4%
Demolition	49.7%	28.7%	39.0%
Mixed C&D	2.4%	1.7%	2.0%
Non C&D	0.0%	2.7%	1.4%
Renovation	29.2%	48.9%	39.1%

Table 5 adds an additional layer to Table 4 by including Region, comparing the amount of material by project type from season to season within Greater Minnesota as compared to the Metro region. Between both the Metro and Greater Minnesota there is an increase in the amount of material sorted that originated from Renovation loads and a decrease in Demolition. This change is more pronounced in the Metro than Greater Minnesota region, where the amount generated by Construction loads also decreases between seasons.

Table 5. Amount of material generated by project type for each season by region

Region	Load Type	Summer	Fall	Grand Total
Greater Minnesota	Construction	10.0%	8.5%	9.4%
	Demolition	62.9%	55.5%	60.0%
	Mixed C&D	4.3%	3.0%	3.8%
	Non C&D	0.0%	4.7%	1.9%
	Renovation	22.8%	28.3%	24.9%
Greater Minnesota Total		55.9%	35.0%	45.3%
Metro Area	Construction	29.9%	23.2%	25.8%
	Demolition	32.9%	14.3%	21.7%
	Mixed C&D	0.0%	1.0%	0.6%
	Non C&D	0.0%	1.6%	1.0%
	Renovation	37.3%	59.9%	50.9%
Metro Area Total		44.1%	65.0%	54.7%

Aggregate statewide results

A total of 375 loads, weighing 1,699 tons, were surveyed from across the state. Figure 4 shows the composition of the 1,699 tons of C&D scaled waste that were surveyed, broken into the eleven most prevalent material categories. The three material categories that made up the largest percentage of the total waste composition, included Concrete (21.8%), Roofing Shingles (19.3%), and Dirt/Sand/Rock/Gravel (13.4%). Combined these three categories represent over 54% of statewide C&D waste materials.

Wood accounts for 15.5%, when combining the two wood categories (Treated/Painted/Processed Wood and Clean Wood). The wood categories were tracked separately for the study because they have different end markets; however, it's interesting to note how large of a combined category wood is in the overall composition. Excluding MSW (1.3%) and General C&D (10.5%), the remaining materials categories, Gypsum Board, Brick, and Plastics, represent 18.1% of the total. Gypsum Board and Brick are the two largest categories in this subset, at approximately 8% and 7% respectively. Both of these materials have some markets for either reuse or recycling. Gypsum board is ground down and added into clay soils to increase drainage in some states, and bricks can often be reused.

Figure 4. Aggregate statewide C&D waste composition

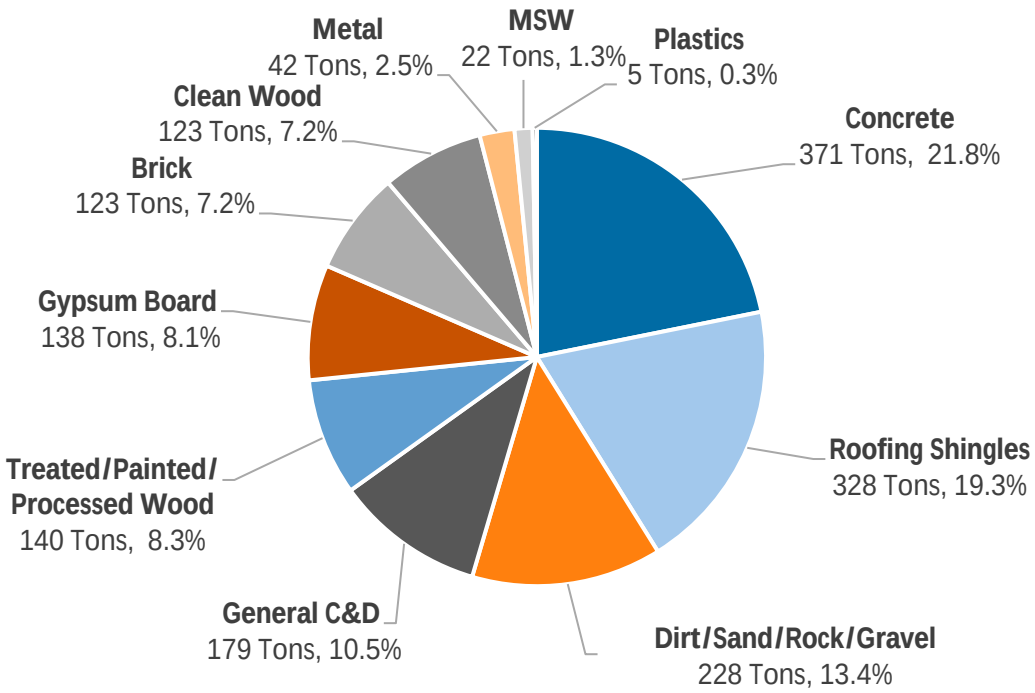


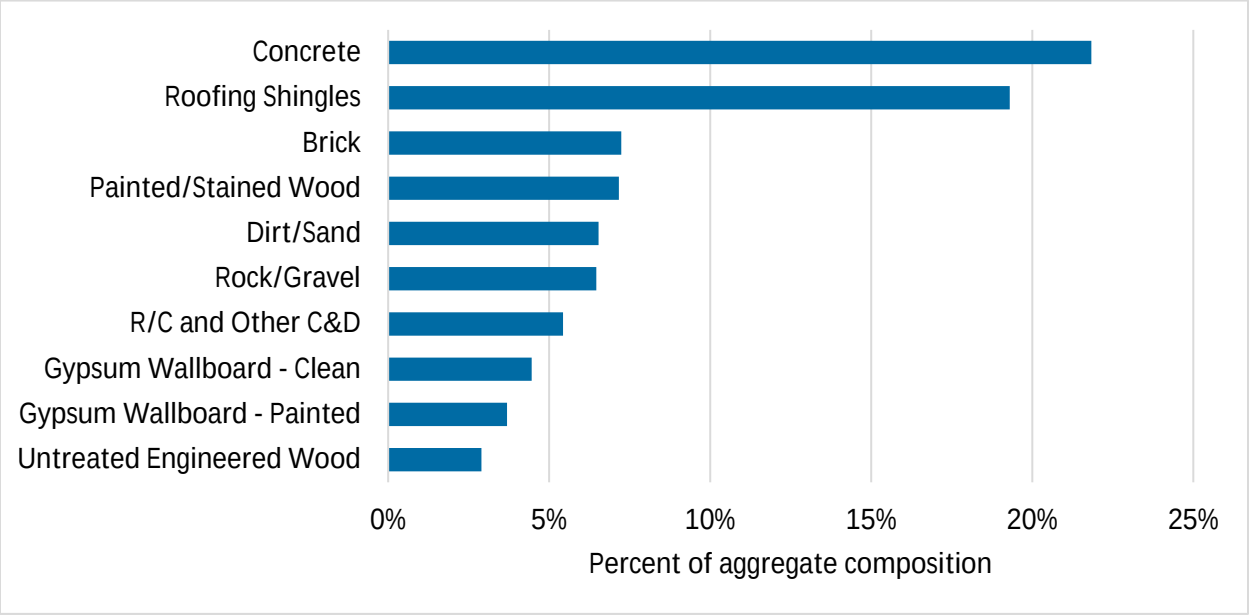
Table 6 provides a detailed statistical profile of aggregate statewide C&D waste. For each material category and subcategory, the mean percent of the statewide total and the 90% confidence bounds are shown.

Table 6. Minnesota statewide aggregate composition by weight with 90% confidence intervals

		Conf. Int. (90%)				Conf. Int. (90%)	
Material	**Mean**	**Lower**	**Upper**	**Material**	**Mean**	**Lower**	**Upper**
Concrete	**21.8%**	**18.4%**	**25.5%**	**Gypsum Board**	**8.1%**	**6.6%**	**9.8%**
				Clean	4.5%	3.3%	5.8%
Roofing Shingles	**19.3%**	**16.3%**	**22.9%**	Painted	3.7%	2.8%	4.7%
Brick	**7.2%**	**5.0%**	**9.6%**	**Clean Wood**	**7.2%**	**6.1%**	**8.5%**
				Untreated Dimen. Lumber	2.3%	1.7%	3.0%
Dirt/Sand/Rock/Gravel	**13.4%**	**10.7%**	**16.3%**	Untreated Eng. Wood	2.9%	2.3%	3.6%
Dirt/Sand	6.5%	4.9%	8.4%	Wood Pallets/ Crates/Spools	2.0%	1.6%	2.4%
Rock/Gravel	6.5%	4.3%	8.9%				
Yard Waste	0.4%	0.2%	0.8%	**Metal**	**2.5%**	**2.0%**	**3.1%**
				Appliances	0.0%	0.0%	0.0%
General C&D	**10.5%**	**8.4%**	**12.8%**	Composite Metal (wires)	0.0%	0.0%	0.0%
Acoustic Tiling	0.1%	0.1%	0.2%	Ferrous Scrap	1.4%	1.0%	2.0%
Asbestos	0.0%	0.0%	0.0%	Non-Ferrous Metal	1.0%	0.8%	1.2%
Asphalt	2.1%	0.6%	3.9%				
Carpet	0.4%	0.3%	0.6%	**MSW**	**1.3%**	**1.0%**	**1.6%**
Carpet Padding	0.1%	0.0%	0.1%	Bulky Items (inc. mattresses)	0.2%	0.1%	0.2%
Ceramics/Porcelain Fixture	1.2%	0.6%	1.8%	E-Waste	0.0%	0.0%	0.0%
Flat Glass	0.2%	0.1%	0.3%	MMSW	0.2%	0.2%	0.3%
HVAC Ducting	0.0%	0.0%	0.0%	Other Paper	0.1%	0.1%	0.2%
Insulation	0.4%	0.2%	0.7%	R/C and Other Glass	0.1%	0.0%	0.1%
Plastic Piping	0.1%	0.0%	0.1%	Tires	0.0%	0.0%	0.0%
Plastic Siding/Decking	0.2%	0.1%	0.2%	Uncoated OCC – Recyclable	0.7%	0.5%	0.9%
R/C and Other C&D	5.4%	4.3%	6.9%				
Rubber Products	0.3%	0.1%	0.5%	**Plastics**	**0.3%**	**0.2%**	**0.4%**
Tyvek Building Wrap	0.0%	0.0%	0.0%	Durable Plastic Items	0.1%	0.0%	0.1%
				Film Plastic (Comm./Indus.)	0.1%	0.1%	0.2%
Treated/Painted/ Processed Wood	**8.3%**	**7.0%**	**9.8%**	HDPE Buckets	0.0%	0.0%	0.0%
Painted/Stained Wood	7.2%	5.9%	8.5%	Plastic Furniture	0.0%	0.0%	0.0%
Treated Wood	0.6%	0.3%	0.9%	R/C and Other Plastic	0.1%	0.1%	0.2%
Wood Furniture	0.5%	0.3%	0.8%				

Figure 5 shows the top 10 most prevalent individual constituents in the aggregate C&D waste stream. Concrete and Roofing Shingles remain the most prevalent individual materials. Brick and Painted/Stained Wood are the next most prevalent, despite being less than half of the percent amount of Concrete and Roofing Shingles. Dirt/Sand and Rock/Gravel make up a large amount as individual materials, especially when considering these materials can be used on-site for fill or landscaping if uncontaminated.

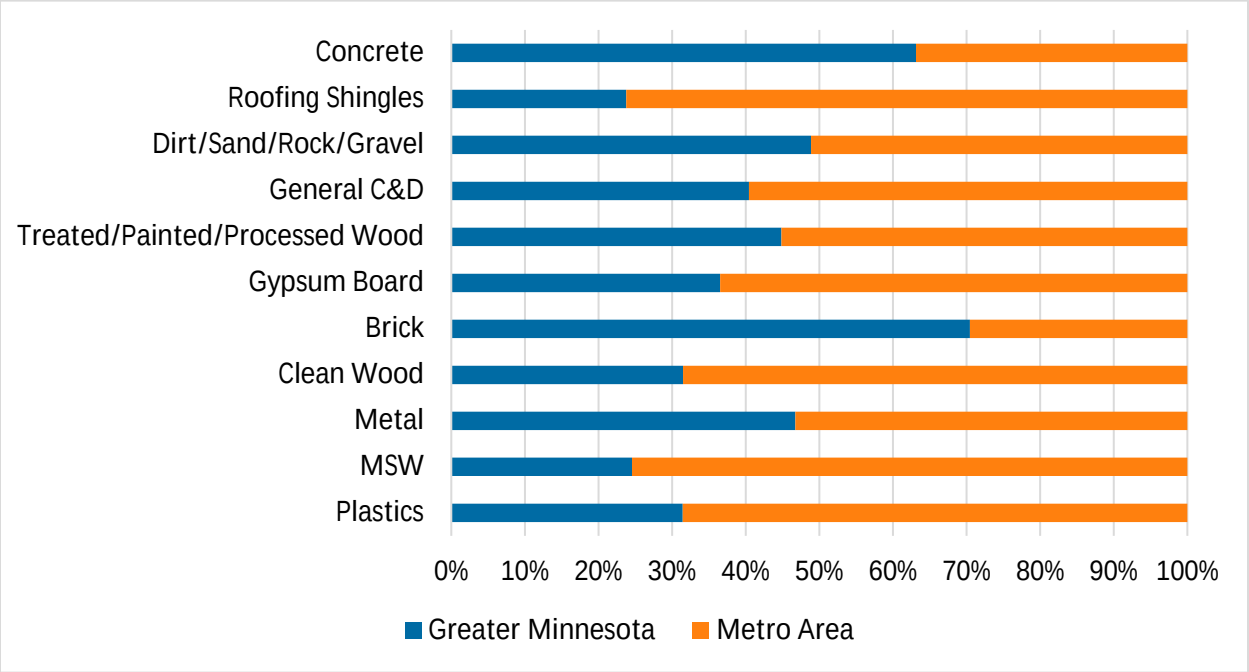
Figure 5. Top 10 most prevalent materials in aggregate surveyed C&D materials



Composition by region

Figure 6 compares the composition of C&D waste disposal by demographic region. Of the 375 load samples, 219 loads (58.4%) were completed at Metro facilities and 156 loads (41.6%) were completed at Greater Minnesota facilities.

Figure 6. Comparison of C&D composition by region



C&D loads disposed at Metro facilities contained significantly more Roofing Shingles and significantly less Concrete by weight when compared to Greater Minnesota C&D facilities. The hypothesis for this variance is that disposal tipping fees may be higher in the Metro region, along with more outlets for recycling of concrete as aggregate on project sites, instead of disposing at a facility. During the Fall data

collection, several facilities reported multiple hailstorms occurring over the summer that may have increased the rate of roofing replacement in both the Metro and Greater Minnesota regions. Weather events can have a notable impact on the composition of materials in the C&D waste stream.

Figure 7 shows the top 10 most prevalent individual materials by demographic region, further highlighting the previously noted variances.

Figure 7. Comparison of top 10 most prevalent materials by demographic region

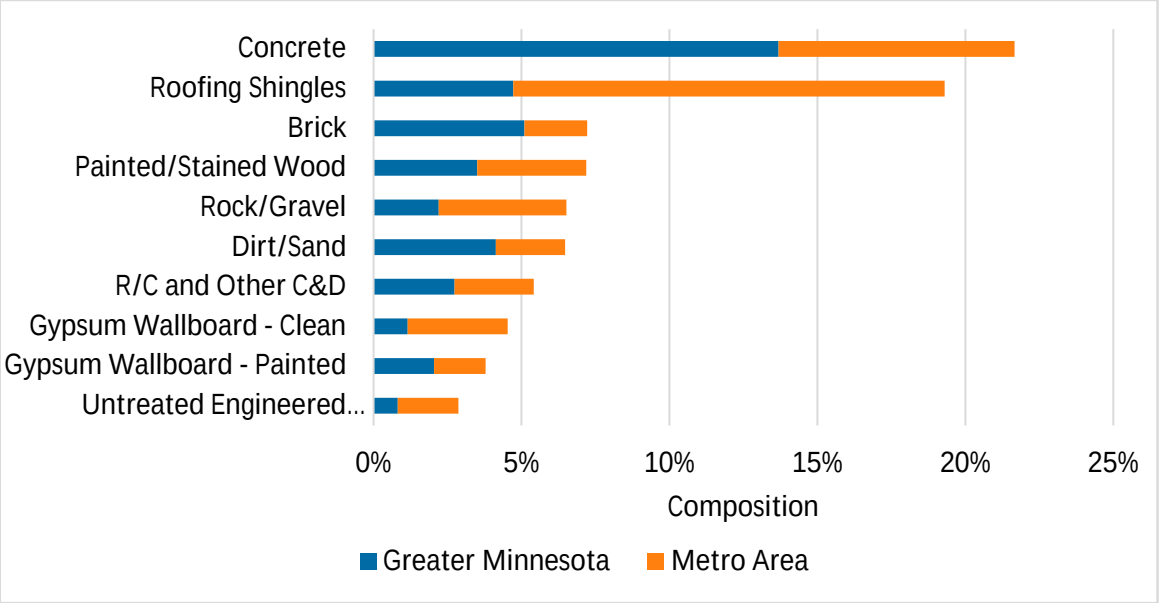


Table 7 and Table 8 provide detailed statistical profiles of C&D waste in Greater Minnesota and Metro regions, respectively.

Table 7. Greater Minnesota aggregate material composition by weight with 90% confidence intervals

		Conf. Int. (90%)				Conf. Int. (90%)	
Material	**Mean**	**Lower**	**Upper**	**Material**	**Mean**	**Lower**	**Upper**
Concrete	**30.8%**	**25.0%**	**36.0%**	**Gypsum Board**	**6.6%**	**4.9%**	**8.7%**
				Clean	2.3%	1.4%	3.4%
Roofing Shingles	**10.2%**	**7.1%**	**13.8%**	Painted	4.3%	2.8%	5.9%
Brick	**11.4%**	**7.4%**	**15.6%**	**Clean Wood**	**5.1%**	**3.8%**	**6.7%**
				Untreated Dimen. Lumber	1.6%	1.1%	2.2%
Dirt/Sand/Rock/Gravel	**14.6%**	**11.2%**	**18.3%**	Untreated Eng. Wood	1.8%	1.3%	2.6%
Dirt/Sand	9.3%	6.4%	12.3%	Wood Pallets/ Crates/Spools	1.7%	1.1%	2.3%
Rock/Gravel	4.7%	2.8%	6.9%				
Yard Waste	0.6%	0.1%	1.3%	**Metal**	**2.6%**	**2.1%**	**3.1%**
				Appliances	0.0%	0.0%	0.0%
General C&D	**9.5%**	**7.1%**	**12.0%**	Composite Metal (wires)	0.0%	0.0%	0.1%
Acoustic Tiling	0.2%	0.1%	0.3%	Ferrous Scrap	1.2%	0.9%	1.6%
Asbestos	0.0%	0.0%	0.0%	Non-Ferrous Metal	1.3%	1.0%	1.6%

		Conf. Int. (90%)				Conf. Int. (90%)	
Material	**Mean**	**Lower**	**Upper**	**Material**	**Mean**	**Lower**	**Upper**
Asphalt	1.0%	0.1%	2.2%				
Carpet	0.1%	0.1%	0.2%	**MSW**	**0.7%**	**0.4%**	**1.1%**
Carpet Padding	0.0%	0.0%	0.0%	Bulky Items (inc. mattresses)	0.1%	0.0%	0.1%
Ceramics/Porcelain Fixture	1.2%	0.4%	2.0%	E-Waste	0.0%	0.0%	0.0%
Flat Glass	0.2%	0.1%	0.3%	MMSW	0.1%	0.0%	0.1%
HVAC Ducting	0.0%	0.0%	0.0%	Other Paper	0.0%	0.0%	0.0%
Insulation	0.6%	0.2%	1.0%	R/C and Other Glass	0.1%	0.0%	0.1%
Plastic Piping	0.1%	0.0%	0.1%	Tires	0.0%	0.0%	0.0%
Plastic Siding/Decking	0.1%	0.0%	0.2%	Uncoated OCC – Recyclable	0.4%	0.2%	0.7%
R/C and Other C&D	6.1%	4.2%	8.5%				
Rubber Products	0.1%	0.0%	0.2%	**Plastics**	**0.2%**	**0.1%**	**0.3%**
Tyvek Building Wrap	0.0%	0.0%	0.0%	Durable Plastic Items	0.0%	0.0%	0.0%
				Film Plastic (Comm./Indus.)	0.1%	0.0%	0.1%
Treated/Painted/ Processed Wood	**8.3%**	**6.5%**	**10.5%**	HDPE Buckets	0.0%	0.0%	0.0%
Painted/Stained Wood	7.7%	6.0%	9.5%	Plastic Furniture	0.0%	0.0%	0.0%
Treated Wood	0.2%	0.1%	0.3%	R/C and Other Plastic	0.1%	0.0%	0.2%
Wood Furniture	0.4%	0.2%	0.6%				

Table 8. Metro aggregate material composition by weight with 90% confidence intervals

		Conf. Int. (90%)				Conf. Int. (90%)	
Material	**Mean**	**Lower**	**Upper**	**Material**	**Mean**	**Lower**	**Upper**
Concrete	**14.6%**	**10.4%**	**18.9%**	**Gypsum Board**	**9.4%**	**6.8%**	**11.9%**
				Clean	6.2%	4.1%	8.4%
Roofing Shingles	**26.7%**	**21.6%**	**31.4%**	Painted	3.2%	2.1%	4.4%
Brick	**3.9%**	**1.9%**	**6.2%**	**Clean Wood**	**9.0%**	**7.3%**	**10.9%**
				Untreated Dimen. Lumber	2.9%	2.0%	3.9%
Dirt/Sand/Rock/Gravel	**12.4%**	**8.5%**	**16.8%**	Untreated Eng. Wood	3.8%	2.9%	4.7%
Dirt/Sand	4.3%	2.7%	6.4%	Wood Pallets/ Crates/Spools	2.3%	1.7%	2.9%
Rock/Gravel	7.9%	4.0%	11.8%				
Yard Waste	0.2%	0.1%	0.4%	**Metal**	**2.4%**	**1.6%**	**3.3%**
				Appliances	0.0%	0.0%	0.0%

General C&D	**11.4%**	**8.1%**	**15.0%**	Composite Metal (wires)	0.0%	0.0%	0.0%
Acoustic Tiling	0.1%	0.0%	0.2%	Ferrous Scrap	1.6%	0.9%	2.6%
Asbestos	0.0%	0.0%	0.0%	Non-Ferrous Metal	0.8%	0.5%	1.0%
Asphalt	3.1%	0.5%	6.0%				
Carpet	0.7%	0.5%	0.9%	**MSW**	**1.7%**	**1.4%**	**2.2%**
Carpet Padding	0.1%	0.0%	0.1%	Bulky Items (inc. mattresses)	0.2%	0.1%	0.3%
Ceramics/Porcelain Fixture	1.3%	0.4%	2.3%	E-Waste	0.0%	0.0%	0.1%
Flat Glass	0.3%	0.1%	0.4%	MMSW	0.3%	0.2%	0.4%
HVAC Ducting	0.0%	0.0%	0.0%	Other Paper	0.2%	0.1%	0.3%
Insulation	0.3%	0.2%	0.4%	R/C and Other Glass	0.1%	0.0%	0.2%
Plastic Piping	0.1%	0.0%	0.1%	Tires	0.0%	0.0%	0.0%
Plastic Siding/Decking	0.2%	0.1%	0.4%	Uncoated OCC – Recyclable	0.9%	0.7%	1.2%
R/C and Other C&D	4.9%	3.4%	6.8%				
Rubber Products	0.4%	0.1%	0.8%	**Plastics**	**0.4%**	**0.3%**	**0.5%**
Tyvek Building Wrap	0.0%	0.0%	0.0%	Durable Plastic Items	0.1%	0.0%	0.1%
				Film Plastic (Comm./Indus.)	0.2%	0.1%	0.2%
Treated/Painted/ Processed Wood	**8.3%**	**6.4%**	**10.3%**	HDPE Buckets	0.0%	0.0%	0.0%
Painted/Stained Wood	6.7%	5.1%	8.5%	Plastic Furniture	0.0%	0.0%	0.0%
Treated Wood	0.9%	0.5%	1.4%	R/C and Other Plastic	0.1%	0.1%	0.2%
Wood Furniture	0.6%	0.3%	1.1%				

Table 9 shows the estimated material tonnages generated statewide and within both regions, using the generation numbers displayed in Table 1.

Table 9. Estimated weight of material (in lbs.) using C&D disposal amounts statewide and regional (Greater Minnesota and Metro)

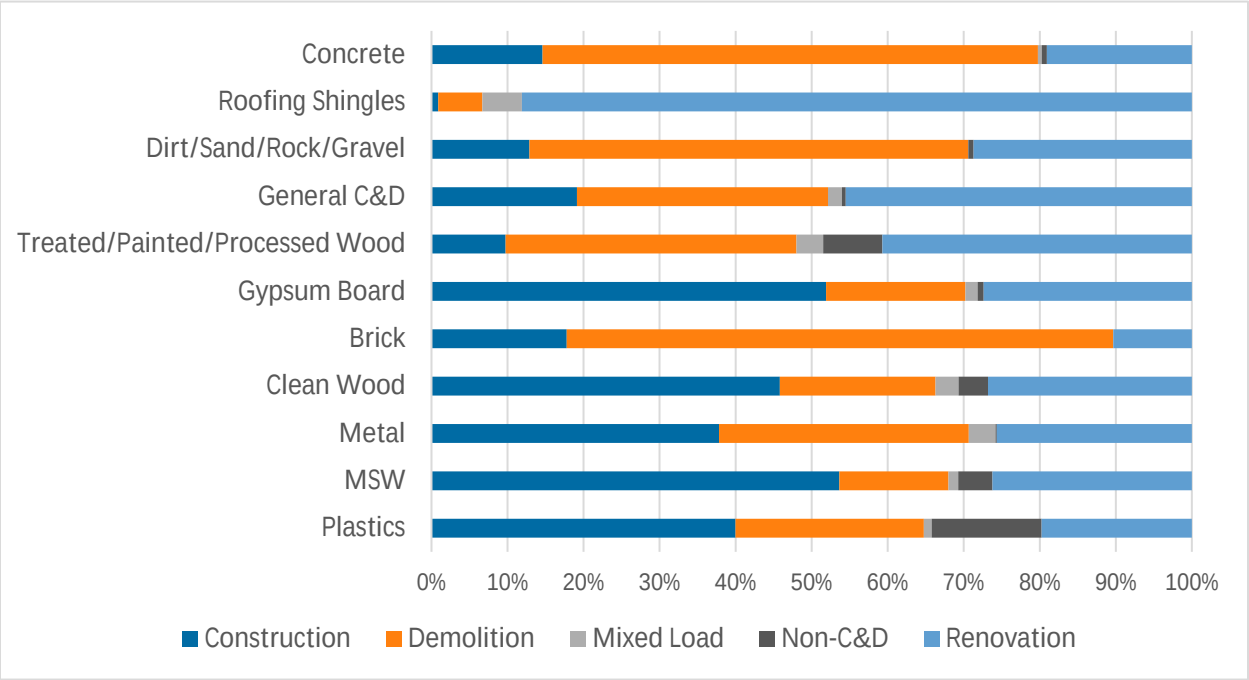
Material	All MN	Greater MN	Metro	Material	All MN	Greater MN	Metro
Concrete	334,967	153,725	150,872	**Gypsum Board**	125,026	33,203	96,942
				Clean	68,380	11,643	63,972
Roofing Shingles	296,129	51,145	275,825	Painted	56,646	21,560	32,970
Brick	111,080	56,897	40,082	**Clean Wood**	110,722	25,337	92,686
				Untreated Dimen. Lumber	35,449	7,820	30,165
Dirt/Sand/Rock/Gravel	205,903	73,153	128,608	Untreated Eng. Wood	44,433	9,193	38,835
Dirt/Sand	100,244	46,469	44,370	Wood Pallets/ Crates/Spools	30,839	8,324	23,687
Rock/Gravel	99,163	23,483	81,682				
Yard Waste	6,496	3,201	2,556	**Metal**	37,706	12,814	24,530
				Appliances	93	54	24

General C&D	161,800	47,567	117,729	Composite Metal (wires)	416	204	165
Acoustic Tiling	1,820	889	729	Ferrous Scrap	21,882	6,148	16,400
Asbestos	0	0	0	Non-Ferrous Metal	15,315	6,408	7,941
Asphalt	32,473	4,779	31,641				
Carpet	6,891	697	7,247	**MSW**	19,421	3,466	17,902
Carpet Padding	901	79	968	Bulky Items (inc. mattresses)	2,372	442	2,154
Ceramics/Porcelain Fixture	18,628	5,774	13,055	E-Waste	292	35	298
Flat Glass	3,438	833	2,801	MMSW	3,195	390	3,247
HVAC Ducting	189	49	147	Other Paper	1,847	127	2,042
Insulation	6,535	2,854	3,187	R/C and Other Glass	1,292	366	964
Plastic Piping	1,071	331	754	Tires	20	0	25
Plastic Siding/Decking	2,502	492	2,229	Uncoated OCC – Recyclable	10,404	2,106	9,172
R/C and Other C&D	83,285	30,440	50,591				
Rubber Products	4,021	329	4,360	**Plastics**	4,548	1,039	3,810
Tyvek Building Wrap	46	21	21	Durable Plastic Items	832	108	835
				Film Plastic (Comm./Indus.)	1,712	273	1,633
Treated/Painted/Processed Wood	126,825	41,353	85,442	HDPE Buckets	226	40	208
Painted/Stained Wood	109,914	38,434	69,689	Plastic Furniture	21	0	25
Treated Wood	8,985	1,000	9,296	R/C and Other Plastic	1,758	618	1,108
Wood Furniture	7,926	1,920	6,456				

Composition by generation type

Of the 375 loads documented in this study, 84 loads (22.4%) were generated from Construction projects, 94 loads (25.1%) were generated from Demolition projects, 183 loads (48.8%) were from Renovation projects, and 14 loads (3.7%) were either Mixed Loads or Non-C&D loads. Figure 8 compares the composition of surveyed C&D waste by generator type and highlights the material categories that are most prevalent for each.

Figure 8. Comparison of material composition by C&D generator type

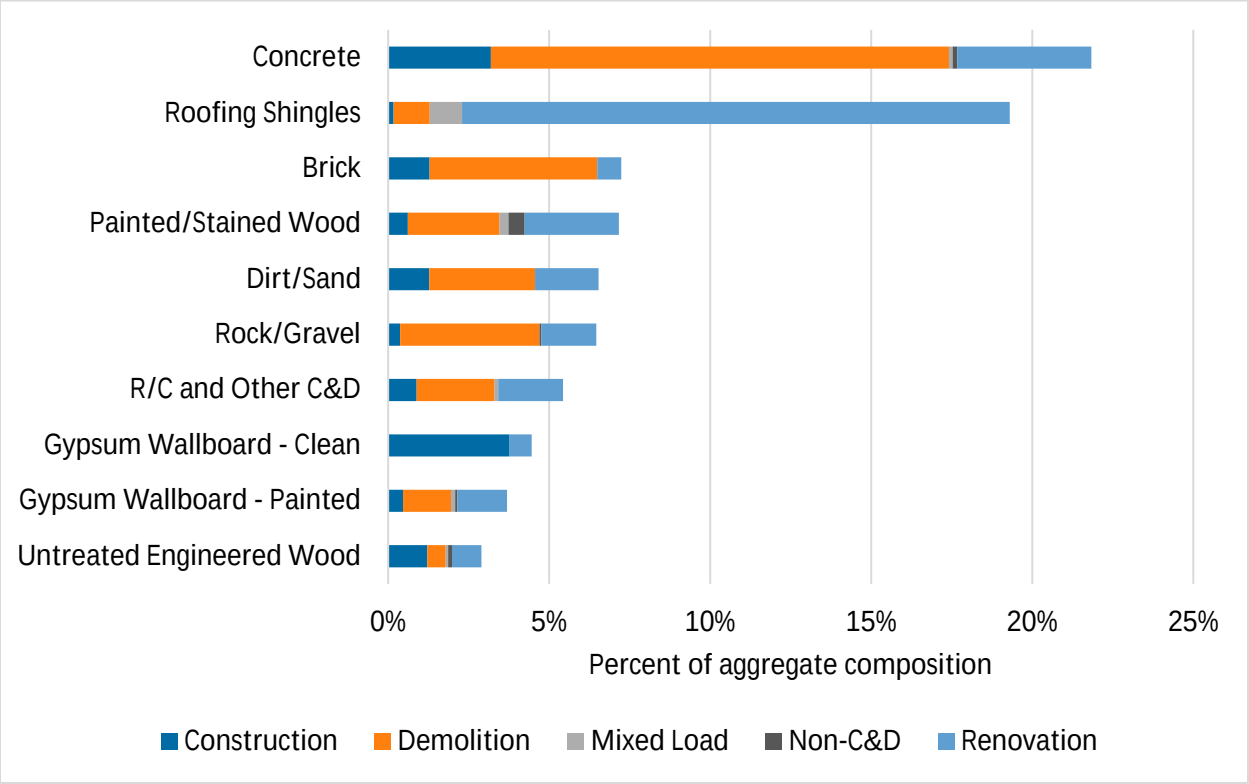


Observations include:

- Unlike Demolition and Renovation loads, Construction loads did not tend to favor any one material type, but more than 50% of Gypsum Board and MSW were sourced from Construction loads. Demolition loads contained the most Concrete, Brick, Dirt/Sand, and Rock/Gravel. This is reasonable given these materials often become mixed together with other debris during the demolition process, and therefore become more difficult to separate and divert from disposal.
- Renovation loads contained the greatest percentage of Roofing Material, and was also the most common material sorted as a part of the total material make-up for this generator type. This is expected given all re-roofing project loads were classified as Renovation during this study.
- Mixed Generator and Non-C&D loads also included a significant number of loads that contained recyclable materials (materials that have a strong market for re-manufacturing) such as Metal and Plastics and often came from transfer stations.

Figure 9 shows the top 10 most prevalent individual materials by generator type. Study findings indicate the generator type influences the prevalence of materials disposed. Initiatives to increase diversion of C&D materials from disposal through reuse and recycling should recognize these differences and develop unique programs targeted to each generator type. For instance, contractors trying to recover concrete from demolition jobs or clean gypsum from construction sites could provide a separate dumpster on-site. The closer to the source the material is separated, the higher the likelihood that material can be reused or recycled.

Figure 9. Comparison of top 10 most prevalent materials by generator type



Composition by season

Of the 375 sample loads, 196 loads (45%) were completed in the Summer data collection, and 238 loads (55%) were completed in the Fall data collection. Figure 10 compares the composition of aggregate statewide C&D composition by season. As previously noted, reported statewide hailstorms at the end of the summer may have resulted in increased loads with roof renovation materials in the Fall data collection. As Table 4 shows, the increased Renovation project loads vs Demolition project loads likely explain the difference in Concrete vs Roofing shingles from season to season.

Figure 40. Summer vs Fall material composition

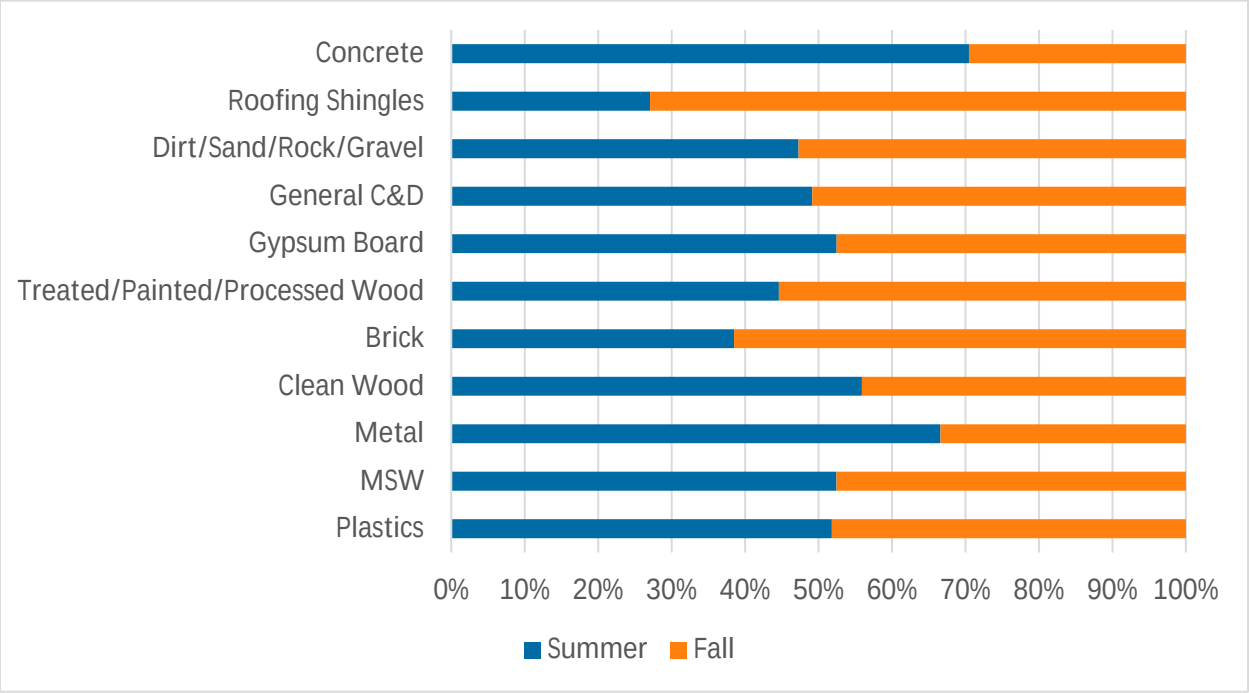
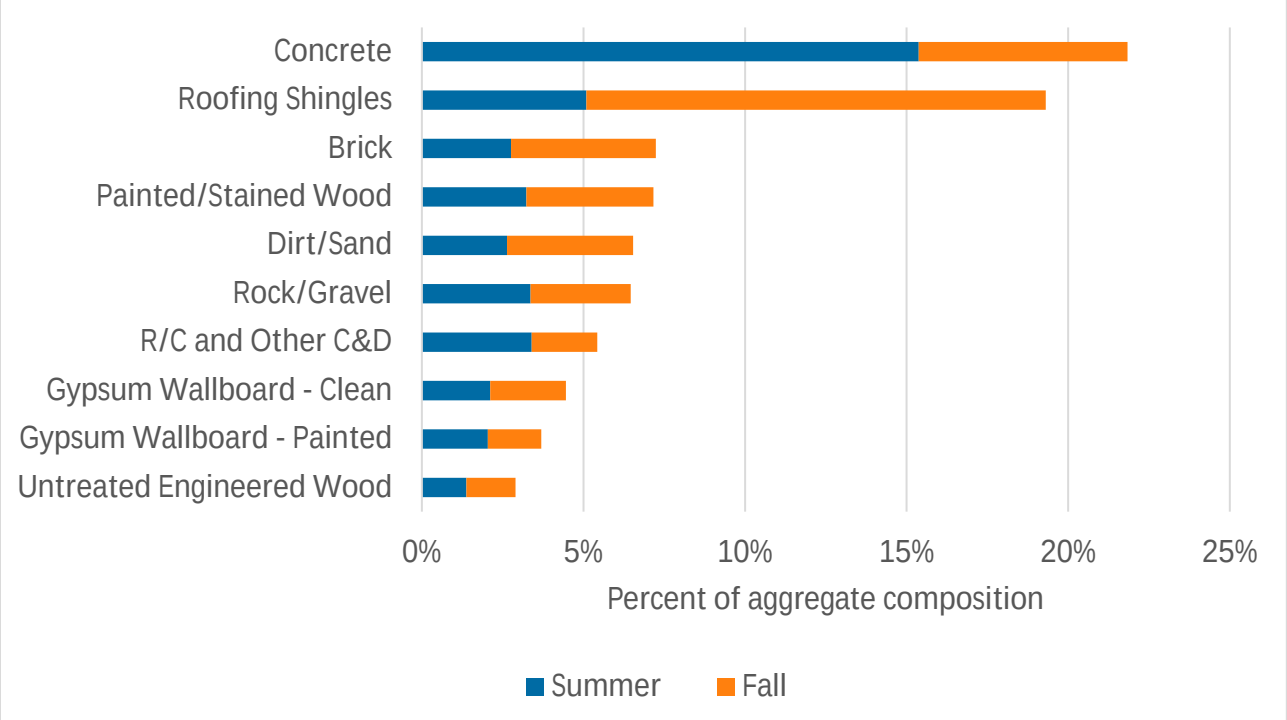


Figure 11 shows the top 10 most prevalent individual materials by season. During the Summer, loads were observed from several large demolition projects, and during the Fall, roofing loads were most prevalent.

Figure 51. Comparison of top 10 most prevalent materials by season



While most material category percentages remained consistent between the Summer and Fall collections (noted in Table 10), the incidence of Concrete and Roofing Shingles essentially reversed, likely due to the type of project activity occurring. As noted in the Methodology, Insulation and Rubber

were two material categories added for the Fall data collection that had previously been included in the R/C and Other C&D material category during the Summer data collection. There are variances in materials from season to season because of the variation of work contractors do throughout the year. One contractor indicated to MPCA staff that contractors are often booked far in advance for demolition/construction jobs, and start those earlier in the summer and work more on renovation-based projects later in the year.

Table 10. Summer vs Fall Material Composition

Material	Summer	Fall	Diff	Material	Summer	Fall	Diff
Concrete	**31.5%**	**12.6%**	**18.8%**	**Gypsum Board**	**8.5%**	**7.8%**	**0.7%**
				Clean	4.33%	4.58%	**-0.3%**
Roofing Shingles	**10.4%**	**27.8%**	**-17.4%**	Painted	4.17%	3.23%	**0.9%**
Brick	**5.6%**	**8.8%**	**-3.1%**	**Clean Wood**	**8.2%**	**6.3%**	**1.9%**
				Untreated Dimen. Lumber	3.34%	1.33%	**2.0%**
Dirt/Sand/ Rock/Gravel	**12.9%**	**14.0%**	**-1.1%**	Untreated Eng. Wood	2.82%	2.97%	**-0.2%**
Dirt/Sand	5.39%	7.63%	**-2.2%**	Wood Pallets/ Crates/Spools	2.05%	1.97%	**0.1%**
Rock/Gravel	6.88%	6.06%	**0.8%**				
Yard Waste	0.58%	0.28%	**0.3%**	**Metal**	**3.3%**	**1.7%**	**1.6%**
				Appliances	0.00%	0.01%	**0.0%**
General C&D	**10.5%**	**10.6%**	**0.0%**	Composite Metal (wires)	0.04%	0.01%	**0.0%**
Acoustic Tiling	0.22%	0.02%	**0.2%**	Ferrous Scrap	1.75%	1.12%	**0.6%**
Asbestos	0.00%	0.00%	**0.0%**	Non-Ferrous Metal	1.50%	0.52%	**1.0%**
Asphalt	1.92%	2.31%	**-0.4%**				
Carpet	0.44%	0.46%	**0.0%**	**MSW**	**1.4%**	**1.2%**	**0.2%**
Carpet Padding	0.06%	0.05%	**0.0%**	Bulky Items (inc. mattresses)	0.12%	0.19%	**-0.1%**
Ceramics/Porcelain Fixture	0.54%	1.85%	**-1.3%**	E-Waste	0.03%	0.00%	**0.0%**
Flat Glass	0.21%	0.24%	**0.0%**	MMSW	0.23%	0.19%	**0.0%**
HVAC Ducting	0.01%	0.01%	**0.0%**	Other Paper	0.19%	0.05%	**0.1%**
Insulation	0.00%	0.83%	**-0.8%**	R/C and Other Glass	0.05%	0.12%	**-0.1%**
Plastic Piping	0.09%	0.05%	**0.0%**	Tires	0.00%	0.00%	**0.0%**
Plastic Siding/Decking	0.07%	0.25%	**-0.2%**	Uncoated OCC - Recyclable	0.74%	0.62%	**0.1%**
R/C and Other C&D	6.96%	3.97%	**3.0%**				
Rubber Products	0.00%	0.51%	**-0.5%**	**Plastics**	**0.3%**	**0.3%**	**0.0%**
Tyvek Building Wrap	0.00%	0.00%	**0.0%**	Durable Plastic Items	0.05%	0.06%	**0.0%**
				Film Plastic (Comm./Indus.)	0.11%	0.12%	**0.0%**
Treated/Painted/ Processed Wood	**7.4%**	**9.1%**	**-1.6%**	HDPE Buckets	0.02%	0.01%	**0.0%**
Painted/Stained Wood	6.62%	7.68%	**-1.1%**	Plastic Furniture	0.00%	0.00%	**0.0%**
Treated Wood	0.30%	0.86%	**-0.6%**	R/C & Other Plastic	0.13%	0.10%	**0.0%**
Wood Furniture	0.51%	0.52%	**0.0%**				

Conclusions

Summary

In surveying 434 loads and completing additional analysis to confirm confidence intervals for the datasets, this report serves as a good foundation for documenting the composition of disposed C&D material originating in Minnesota. Collecting field data across the state's permitted solid waste facilities with C&D disposal areas (and one processing facility) captured representative samples from both Greater Minnesota and the Metro region. Although the study would benefit from expanding field data collection to additional disposal facilities across the state, in both metro and non-metro facility locations, there is no evidence to suggest the existing data is biased or representational of C&D waste in Minnesota. Useful comparisons were made when analyzing data between two seasons and multiple load generators (Construction, Demolition, Renovation, and Mixed/Non-C&D); however, because this study is a snapshot in time, it doesn't account for all of the complex variations with C&D generation, material reuse and recycling, and disposal across the state.

Compared to the majority of available C&D characterization studies in public literature over the past ten years, this research effort used a tablet-based application with built-in logic-checking and density conversions to enable real-time comparison of the enumerator's visual estimate with the actual scale weight of surveyed loads. The composition estimates are therefore assumed to be more consistent from load to load. Given the expense and operational impacts associated with manual sorting of C&D waste, the methodology used for this study was a successful balance of accuracy and cost-effectiveness, while minimizing the impact to host disposal facilities' operations.

Recommendations

Routinely update Minnesota statewide C&D composition research: A comprehensive analysis of Minnesota's C&D materials in the disposal stream provides insight to the overall management of materials in this sector. The MPCA has historically performed statewide MMSW characterization studies, and this study expands the dataset to include C&D materials. In order to document change over time and track progress through different initiatives, C&D composition studies should be conducted at least as frequently as MMSW characterization studies. Given the homogenous loads that can be delivered to C&D landfills, such as roll-offs of roofing shingles or concrete, it is important to do routine composition studies so these individual loads of specific materials do not skew composition results, especially when loads may be tied to either seasonally-specific construction and demolition projects with seasonally-driven material composition.

Increase facility participation in future studies: Should the MPCA conduct future waste characterization studies, it is recommended that additional C&D disposal facilities in the Metro region of the state be recruited to participate in field data collection, ensuring a more accurate representation of the statewide waste stream. This study by design focused on Class I C&D landfills. Future studies should also look at capturing waste characterization data from additional Class II and Class III C&D sites, as well as processing areas.

Conduct statewide C&D facility "at the gate" surveys: While Minnesota Rules require facilities to report C&D material quantities, a gap exists with providing more granular details on the generation of C&D materials, as indicated by some loads containing wastes not classified as C&D waste. Future studies would benefit from "at the gate" surveys at a large subset of the state's C&D disposal facilities to document the breakdown of Construction, Demolition, Renovation, and Mixed/Non-C&D loads. Gate

surveys are conducted by identifying all vehicles entering a facility throughout the day, noting the type of materials, the weight or volume, and the originating generator class. This information captures all load types (C&D, MMSW, special waste, etc.) and gives perspective on the overall statewide waste stream.

Create a robust and thorough contractor, hauler, and retailer survey: Based on current practices, it appears there are notable reuse and recycling efforts already occurring in Minnesota. Surveying is needed to verify this assumption further, and strengthen the statewide data quantifying the amount of materials being reused and recycled, identifying which markets are the strongest and weakest, and confirming what support is needed to scale these efforts.

Implement statewide reuse or recycling requirements: Recognition is growing across the United States about the environmental benefits of deconstructing buildings instead of demolishing them in order to extend the usable life of existing materials. Implementing statewide reuse and recycling requirements and/or deconstruction ordinances at a local level can help create consistency and establish necessary support systems for this transition. Requirements could reduce the barriers that currently make it difficult to deconstruct or separate materials for recycling at the site. As part of an ordinance, a contractor would have to allow for extra time to deconstruct and capture materials, leveling the playing field for this more sustainable practice. Examples of other factors needed to shift building and material management practices include, but aren't limited to, creating deconstruction and demolition certifications, providing incentives for material reuse and recycling, and securing adequate material sorting and storage spaces on job sites.

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Appendix A: Material categories

Brick: Includes all types of fire-clay brick and cinder blocks (concrete/ash cinder building block).

Concrete: Includes concrete with or without rebar attached. Examples include building foundations, concrete paving, and poured concrete structures.

Clean Wood:

- **Untreated Dimensional Lumber**: Includes non-treated processed wood for building, manufacturing, landscaping, and packaging. Examples include dimensional lumber, lumber cutoffs, wood scraps, and wood siding. May contain nails or other trace contaminants.
- **Untreated Eng. Wood**: Includes plywood (layers of wood glued together), oriented strandboard (OSB) (a layered, mat-formed panel product made of strands, flakes, or wafers sliced from small diameter, round wood logs, and bonded under heat and pressure), and medium density fiber (MDF) and particle board (manufactured lumber sheeting made of glued wood fibers or particles).
- **Wood Pallets/Crates/Spools**: Includes wood pallets, crates and spools used for shipping or storage of goods, whether painted, unpainted, or made of engineered lumber.

Dirt/Sand/Rock/Gravel:

- **Dirt/Sand**: Includes materials made of dirt or sand. This category is often left over from land clearing activities.
- **Rock/Gravel**: Includes pathway gravel and other natural or mechanically crushed aggregate materials.
- **Yard Waste**: Includes plant material from any public or private landscapes. Examples include leaves, grass clippings, sea weed, plants, prunings, shrubs, limbs, logs, and stumps generated by removing vegetation from public or private land by mechanical or manual means.

General C&D:

- **Acoustic Tiling**: Includes synthetic or natural fiber tiles and panels used for finishing ceilings, restricting air, and/or improving aesthetics and sound control.
- **Asbestos**: Includes building materials containing asbestos fibrous content, a hazardous heat-resistant material. Asbestos was used in insulation, piping, wallboard, and other structural components until the 1970s.
- **Asphalt**: Includes asphalt paving materials, set or unset.
- **Carpet**: Includes flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material.
- **Carpet Padding**: Includes plastic, foam, felt, or other material used under carpet to provide insulation and padding.
- **Ceramics/Porcelain Fixture**: Includes fixtures such as toilets, sinks, and bathtubs made of ceramic material.
- **Flat Glass**: Includes flat pieces of glass, such as windows.
- **HVAC Ducting**: Includes conduits or passages to deliver and remove air, made from a variety of materials such as galvanized steel, aluminum, plastic, or fiberglass.
- **Insulation**: Includes materials used for weather or sound barrier, typically fiberglass or cellulose materials in various forms such as long strips/bats, wallboards, expanded foam, and small blown-in particles.

- **Plastic Piping**: Includes piping used for utilities or other heavy-duty applications made of plastic materials.
- **Plastic Siding/Decking**: Includes plastic materials used for siding on buildings or building decks.
- **R/C and Other C&D**: Includes C&D debris that is difficult to identify and separate into categories. Also includes composite fixtures/countertops, various wall and flooring materials with backings, and miscellaneous C&D materials.
- **Rubber Products**: Includes finished products and scrap materials made of natural and synthetic rubber, such as matting/tarps, inner tubes (not tires), rubber hoses, foam rubber, granules or powder. Includes rubber gloves and footwear (if predominately rubber).
- **Tyvek Building Wrap**: Includes specialized Tyvek wrap used to protect buildings from wind or moisture intrusion.

Gypsum Board:

- **Clean**: Includes clean (i.e. unpainted) interior wall covering made of a sheet of gypsum sandwiched between paper layers. Clean boards can be used or unused, broken or whole sheets, drywall, plasterboard, Gyproc, and wallboard.
- **Painted**: Includes interior wall covering made of a sheet of gypsum sandwiched between paper layers which has been painted, wallpapered, or otherwise altered from the clean product. Painted boards can be used or unused, broken or whole sheets, drywall, plasterboard, Gyproc, and wallboard.

Metal:

- **Appliances**: Includes household machines that use electricity and, in some cases, Freon. Examples include refrigerators, stoves, washers, dryers, freezers, and dishwashers.
- **Composite Metal (wires)**: Includes wiring that may or may not be encased in other materials, used for various applications (electrical, telecommunications, etc.).
- **Ferrous Scrap**: Includes ferrous and alloyed ferrous scrap materials originating from residential, commercial, or institutional sources that are attracted to a magnet. Includes rebar, empty paint cans, and HVAC ducting (galvanized and ungalvanized).
- **Non-Ferrous Metal**: Includes non-magnetic metals such as aluminum, brass, bronze, silver, lead copper, zinc, and stainless steel.

Municipal solid waste:

- **Bulky Items (inc. mattresses)**: Includes large, hard-to-handle items that are not defined separately. Examples include composite furniture, mattresses, box springs, and base components.
- **E-Waste**: Includes computers, monitors, printers, televisions, stereos, VCRs, DVD players, etc.
- **MMSW**: Includes household and job site waste that is bagged or loose, and consists primarily of municipal solid waste. Examples include beverage containers, food wastes, and other refuse generated on construction sites by Non-C&D activities or deposited by third parties in collection containers.
- **Other Paper**: Includes multi-page bound paper items (glued or stapled), made of glossy coated paper. This paper is usually slick, smooth to the touch, and reflects light. Examples include glossy magazines, catalogs, brochures, and pamphlets. Does not include newspaper inserts.
- **R/C and Other Glass**: Includes materials made of glass that are not flat, and may be combined with other materials, such as metal or wood. Examples include bottles, decorative glass building blocks, ceramics, mirrors, etc.

- **Tires**: Includes all synthetic, natural rubber, pneumatic, or solid core tires.
- **Uncoated OCC - Recyclable**: Includes corrugated boxes or paper bags made from Kraft paper with a wavy center layer sandwiched between two outer layers without wax coating on the inside or outside. Examples of corrugated boxes include cardboard shipping containers and moving boxes, computer packaging cartons, and sheets/pieces of boxes and cartons. Does not include chipboard. Examples of Kraft paper include paper grocery bags, un-soiled fast food bags, department store bags, and heavyweight sheets of packing paper.

Plastics:

- **Durable Plastic Items**: Includes items made of sturdy plastic materials.
- **Film Plastic (Comm./Indus.)**: Includes any recyclable polyethylene (high density, low density, linear low density) film plastic, including sheet plastic, shrink wrap, and some tarps.
- **HDPE Buckets**: Includes high density polyethylene buckets.
- **Plastic Furniture**: Includes furniture made of plastic materials.
- **R/C and Other Plastic**: Includes all other plastic materials such as plastic bottles, jars and containers, rigid plastic components, expanded foam plastics, and non-recyclable film plastics.

Roofing Shingles:

- Includes asphalt shingles and tar roofing paper. Does not include wood or metal roofing material.

Treated/Painted/Processed Wood:

- **Painted/Stained Wood**: Includes wood that has an external coating applied. Examples include painted or stained dimensional lumber, lumber cutoffs, wood scraps, wood shake roofing, and wood siding.
- **Treated Wood**: Includes wood that has had an external coating applied, been pressure treated, chemically treated (with copper, etc.), or treated with creosote. Examples include railroad ties, marine timbers and pilings, landscape timbers, and telephone poles.
- **Wood Furniture**: Includes household and office furniture manufactured of mostly wood. Includes chairs, tables, sofas, bookcases, cabinets, doors, desks, etc.

Appendix B: Volume-to-weight conversion factors

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
Appliances	Major Appliances							
	Dishwasher	1	Unit		125		125	1
	Clothes Dryer	1	Unit		125		125	1
	Stove	1	Unit		150		150	1
	Refrigerator	1	Unit		250		250	1
	Clothes Washer	1	Unit		150		150	1
Automotive	Lead-Acid Battery							
	Auto	1	Battery		36		36	3
	Truck	1	Battery		47		47	3
	Scrap Tire							
	Light Duty Tires (passenger, light truck)	1	Tire		22.5		22.5	5
	Commercial Tires	1	Tire		120		120	5
	Fluids							
	Used Motor Oil	1	Gallon		7.4		7.4	2
	Antifreeze	1	Gallon		8.42		8.42	2
	Other Automotive							
	Oil Filters not crushed	1	Drum		175		175	1
	Oil Filters crushed	1	Drum		700		700	1
	Oil Filters	1	Gallon		5		5	1
Carpeting	Carpeting							
	Carpet	1	Cubic Yard		147		147	6
	Carpet Padding	1	Cubic Yard		62		62	6
Commingled Recyclable Material	Containers (Plastic bottles, Aluminum cans, Steel cans, Glass bottles) and Paper							
	Commingled Recyclables	1	Cubic Yard		262		262	4
	Containers (Plastic bottles, Aluminum cans, Steel cans, Glass bottles), Corrugated Containers and Paper							
	Campus Recyclables	1	Cubic Yard		92		92	7
	Commingled Recyclables	1	Cubic Yard		111		111	4
	Containers (Plastic bottles, Aluminum cans, Steel cans, Glass bottles) - No Paper							
	Campus Recyclables	1	Cubic Yard		70		70	7
	Commingled Recyclables	1	Cubic Yard		67		67	4
	Commercial Recyclables	1	Cubic Yard		113		113	8
	Containers (Cans, Plastic) - No glass							
	Campus Recyclables	1	Cubic Yard		32		32	7
	Containers (Cans, Plastic) and Paper - No glass							

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
	Residential Recyclables	1	Cubic Yard		260		260	2
Commingled Recyclable Material	Containers (Food/beverage, Glass) Corrugated Containers and Paper							
	Commercial Recyclables	1	Cubic Yard		88		88	2
	Commercial Recyclables	1	Cubic Yard		58		58	21
	Multifamily Recyclables	1	Cubic Yard		96		96	2
	Multifamily Recyclables	1	Cubic Yard		51		51	21
	Single family Recyclables	1	Cubic Yard		126		126	2
	Containers (Food/beverage, Glass) Corrugated Containers and Paper - No glass							
	Campus Recyclables	1	Cubic Yard		139		139	2
	Commercial Recyclables	1	Cubic Yard		155		155	2
Electronics	Computer Equipment							
	Desktop	1	Unit		27		27	24
	Laptop	1	Unit		9.8		9.8	24
	Monitor							
	CRT	1	Unit		40		40	1
	15"	1	Unit		30		30	2
	17"	1	Unit		45		45	2
	21"	1	Unit		60		60	2
	Flat Panel	1	Unit		24		24	1
	Mixed Monitors	1	Unit		29.4		29.4	24
	Televisions							
	CRT <19 inch	1	Unit		41		41	1
	CRT >19 inch	1	Unit		73		73	1
	Flat Panel	1	Unit		29		29	1
	Mixed TVs	1	Unit		67.3		67.3	24
	Peripheral Devices							
	Printers	1	Unit		16.1		16.1	24
	Mice	1	Unit		0.2		0.2	9
	Keyboards	1	Unit		2.9		2.9	9
	Mobile Devices							
	Cellular Phone	1	Unit		0.22		0.22	9
	Mixed Electronics							
	Brown Goods	1	Cubic Yard		343		343	6
	Computer-related Electronics	1	Cubic Yard		354		354	6
	Other Small Consumer Electronics	1	Cubic Yard		438		438	6
Food	Food							
	Fats, Oils, Grease	1	55-Gallon		412		412	2

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
	Organics - commercial	1	Cubic Yard		135		135	21
	Source Separated Organics - commercial	1	Cubic Yard		1,000		1,000	15
Food	Food Waste - restaurants	1	Cubic Yard		396		396	21
	Food Waste	1	Cubic Yard		463		463	4
	Food Waste	1	Cubic Foot	22		45	33.5	4
	Food Waste - university	1	Gallon		3.8		3.8	22
	Food Waste	1	64-Gallon Tote		150		150	4
	Food Waste	2	Cubic Yard Full Towable		2,736		2,736	4
Glass	Glass Bottles							
	Loose	1	Cubic Yard		380		380	4
Metals	Aluminum Cans							
	Uncompacted	1	Cubic Yard		46		46	4
	Uncompacted	1	Case (=24 cans)		0.7		0.7	11
	Baled	1	Cubic Yard	250		500	375	10
	Steel Cans							
	Whole	1	Cubic Yard	50		175	112.5	10
	Baled	1	Cubic Yard	700		1,000	850	10
	Steel Cans - Institution							
	Whole	1	Can		0.09		0.09	7
	Whole	1	Cubic Yard		136		136	7
Paper	Newsprint							
	Loose	1	Cubic Yard	360		800	580	1
	Baled	1	Cubic Yard	750		1,000	875	10
	Books - paperback, loose	1	Cubic Yard		428		428	23
	Old Corrugated Containers							
	Flattened	1	Cubic Yard		106		106	4
	Baled	1	Cubic Yard	700		1,100	900	10
	Old Corrugated Containers and Chip Board							

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
	Uncompacted	1	Cubic Yard		74.54		74.54	4
	Office Paper							
	Computer Paper - Loose	1	Cubic Yard	375		465	420	1
	Computer Paper - Compacted/Baled	1	Cubic Yard	755		925	840	1
	Mixed Paper							
	Mixed Paper - Loose	1	Cubic Yard		150		150	25
	Mixed Paper - Loose	1	Cubic Yard		323		323	4
Paper	Mixed Paper - Compacted	1	Cubic Yard	610		755	682.5	1
	Mixed Paper - Shredded	1	Cubic Yard		128		128	4
	Mixed Paper - Baled	1	Cubic Yard	1,000		1,200	1,100	10
	Miscellaneous Paper - Cartons							
	Cartons (milk and juice) uncrushed	1	Cubic Yard		50		50	7
	PET							
	PET Bottles - baled	1	Bale (30" x 42" x 48")	525		630	577.5	12
	PET Thermoform - baled	1	Bale (30" x 42" x 48")	525		595	560	12
	HDPE							
	HDPE Dairy - baled	1	Bale (30" x 42" x 48")	525		700	612.5	12
Plastic	HDPE Mixed - baled	1	Bale (30" x 42" x 48")	525		700	612.5	12
	HDPE Buckets	1	Cubic Yard		35		35	28
	Mixed PET and HDPE							
	Mixed PET and HDPE - Loose	1	Cubic Yard		32		32	7
	Mixed Bottles/Containers #1-#7							
	Mixed Bottles/Containers #1-#7 - Loose	1	Cubic Yard		40.4		40.4	4
	Mixed Bottles/Containers #3-#7							
	Mixed Bottles/Containers #3-#7 - Loose	1	Cubic Yard		25.7		25.7	4
	Film							
	LDPE, loose	1	Cubic Yard		35		35	13
	LDPE, compacted	1	Cubic Yard		150		150	13

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
	LDPE, baled	1	Bale (30" x 42" x 48")		1,100		1,100	13
	Miscellaneous Plastic							
	Trash bags	1	Cubic Yard		35		35	6
	Grocery/Merchandise Bags	1	Cubic Yard		35		35	6
Plastic	Expanded Polystyrene, Packaging/Insulation	1	Cubic Yard		32		32	6
	Mixed Textiles							
Textiles	Textiles, loose	1	Cubic Yard	125		175	150	10
	Textiles, Baled	1	Cubic Yard	600		750	675	10
	Wood							
	Wood Chips, green	1	Cubic Yard		473		473	1
	Wood Chips, dry	1	Cubic Yard		243		243	1
Wood	Saw Dust, wet	1	Cubic Yard		530		530	1
	Saw Dust, dry	1	Cubic Yard		275		275	1
	Pallets	1	Pallet		25		25	1
	Pallets and Crates	1	Cubic Yard		169		169	18
	Christmas Trees, loose	1	Cubic Yard		30		30	1
	Yard Trimmings							
	Leaves	1	Cubic Yard	250		500	375	1
	Leaves (Minnesota)	1	Cubic Yard	300		383	341.5	15
Yard Trimmings	Mixed Yard Waste							
	Uncompacted	1	Cubic Yard		250		250	1
	Compacted	1	Cubic Yard		640		640	1
	Prunings & Trimmings	1	Cubic Yard		127		127	6
	Branches & Stumps	1	Cubic Yard		127		127	6
Mixed Municipal Solid Waste	MMSW - Commercial							
	Commercial - dry waste	1	Cubic Yard	56		73	64.5	16, 8
	Commercial - all waste, uncompacted	1	Cubic Yard		138		138	21
	MSW - Residential, Institutional, Commercial							
	Uncompacted	1	Cubic Yard	250		300	275	14

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
	Compacted	1	Cubic Yard	400		700	550	14
	MSW - Multifamily uncompacted	1	Cubic Yard		95		95	21
	Bulky Items (including mattresses)	1	Cubic Yard		150		150	28
	MMSW - Landfill							
Municipal Solid Waste	Compacted - MMSW Small Landfill with Best Management Practices	1	Cubic Yard	1,200		1,700	1,450	17
	Compacted - MMSW Large Landfill with Best Management Practices	1	Cubic Yard	1,700		2,000	1,850	17
	Compacted - MMSW Very Large Landfill with Best Management and Cover Practices, Combined MMSW/Industrial/and other solid waste, or/and Leachate Recirculation	1	Cubic Yard		2,000		2,000	17
C&D	Concrete							
	Large Concrete with Re-bar	1	Cubic Yard		999		999	25
	Large Concrete without Re-bar	1	Cubic Yard		999		999	25
	Small Concrete with Re-bar	1	Cubic Yard		999		999	25
	Small Concrete without Re-bar	1	Cubic Yard		999		999	25
	Asphalt Paving							
	Large Asphalt paving with Re-bar	1	Cubic Yard		773		773	19
	Large Asphalt paving without Re-bar	1	Cubic Yard		773		773	19
	Small Asphalt Paving with Re-bar	1	Cubic Yard		773		773	19
	Small Asphalt Paving without Re-bar	1	Cubic Yard		773		773	19
	Roofing							
	Composition Roofing	1	Cubic Yard		731		731	18
	Other Asphalt Roofing	1	Cubic Yard		731		731	18
	Other Aggregates	1	Cubic Yard		860		860	18
	Wood							
	Clean Dimensional Lumber	1	Cubic Yard		169		169	18
	Clean Engineered Wood	1	Cubic Yard		268		268	18

				Estimated Weight (lbs)				
Category	**Recyclable Materials**	**Volume**	**Units**	**Min.**	**Avg.**	**Max.**	**Calculated Average**	**Source**
	Other Recyclable Wood	1	Cubic Yard		169		169	18
	Painted/Stained Wood	1	Cubic Yard		169		169	18
	Treated Wood	1	Cubic Yard		169		169	18
	Gypsum Board							
	Clean Gypsum Board	1	Cubic Yard		467		467	18
	Painted/Demolition Gypsum	1	Cubic Yard		467		467	18
	Aggregate							
	Large Rock	1	Cubic Yard		2,200		2,200	25
	Small Rock/Gravel	1	Cubic Yard		2,200		2,200	25
	Dirt and Sand	1	Cubic Yard		929		929	18
	Remainder/Composite C&D	1	Cubic Yard		417		417	18
	Construction & Demolition Bulk	1	Cubic Yard		484		484	20
	Rubber Products							
	Rubber matting and tarping	1	Cubic Yard		945		945	27
C&D	Insulation							
	Insulation materials	1	Cubic Yard		75		75	28
	Porcelain/Ceramics							
	Ceramics/Porcelain Fixtures	1	Cubic Yard		860		860	26
	Metal							
	Major Appliances	1	Cubic Yard		145		145	18
	Other Ferrous	1	Cubic Yard		225		225	18
	Other Non-Ferrous	1	Cubic Yard		225		225	18
	Remainder/Composite Metal (avg. of metals, without used oil filters)	1	Cubic Yard		175		175	25
	HVAC Ducting	1	Cubic Yard		47		47	18
	Asbestos							
	Asbestos	1	Cubic Yard		800		800	26

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Appendix C: Code for calculating bootstrapped confidence intervals

```
library(tidyverse)

library(readxl)

library(janitor)

library(lubridate)

library(data.table)

#location for the output

file_loc <- "X:/EA/P2/Waste Reduction/C&D initiative/2019-2021 SBG work/C&D
waste study contract/Waste study data/Combined data/"


#Location of the season 1 raw data on your computer

#Season 1 has been updated to include Rubber Products and Insulation

#as they were not measured directly in Season 1, all entries are 0 lbs

s1_file_loc <- 'X:/EA/P2/Waste Reduction/C&D initiative/2019-2021 SBG
work/C&D waste study contract/Waste study data/Waste Comp Sort_Season 1/Raw
Data Season 1-v3.xlsx'


#Reading in the main body of the data - material by weights for

#all samples, ignoring header as that will be read separately

s1 <- read_excel(s1_file_loc,

                 sheet = 'Season 1-v2',

                 col_names = c('Group', 'Code', 'Material', 1:196),

                 range = 'A12:GQ55') %>%

  data.table()


#Turns the data from wide to long so that it can be joined easily

#to season 2

s1_melt <- melt(s1, id.vars = c('Group', 'Code', 'Material'),

       variable.name = 'Sample #', value.name = 'lbs',

       variable.factor = FALSE)


#reading in the header information which includes Location, Origin,

#Hauler Type, Load Type, Load Scale Weight, Truck Type,
```

```
#Generator Type, Enumerator
location_s1 <- read_excel(s1_file_loc,
                          sheet = 'Season 1-v2', col_names = FALSE,
                          na = c("", "N/A"),
                          range = 'C1:GQ10')

#Transposing the header information,
#first column contains the column names
location_s1_t <- data.table::transpose(location_s1, make.names = 1)

#Joining header information to the material weights
s1 <- inner_join(s1_melt, location_s1_t, by = "Sample #")
#Create season variable for later analysis
s1 <- mutate(s1, Season = 'Season 1') %>%
  select(-Code)
#Location of the season 2 raw data on your computer
s2_file_loc <- 'X:/EA/P2/Waste Reduction/C&D initiative/2019-2021 SBG
work/C&D waste study contract/Waste study data/Waste Comp Sort_Season 2/Copy
of Raw Data Season2.xlsx'

#Reading in the main body of the data - material by weights for
#all samples, ignoring header as that will be read separately
s2 <- read_excel(s2_file_loc,
                 sheet = 'Season 2',
                 col_names = c('Group', 'Code', 'Material', 1:238),
                 range = 'A12:IG55') %>%
  data.table()
#Turns the data from wide to long so that it can be joined easily
#to season 1
s2_melt <- melt(s2, id.vars = c('Group', 'Code', 'Material'),
           variable.name = 'Sample #', value.name = 'lbs')

#reading in the header information which includes Location, Origin,
#Hauler Type, Load Type, Load Scale Weight, Truck Type,
```

```
#Generator Type, Enumerator
location_s2 <- read_excel(s2_file_loc,
                          sheet = 'Season 2', col_names = FALSE,
                          na = c("", "N/A"),
                          range = 'C1:IG10')

#Transposing the header information
location_s2_t <- data.table::transpose(location_s2, make.names = 1)
#Ensuring that both season 1 and season 2 have the same variable names
names(location_s2_t) <- names(location_s1_t)

#Joining header information to the material weights
s2 <- inner_join(s2_melt, location_s2_t, by = "Sample #")
#Create season variable for later analysis
s2 <- mutate(s2, Season = 'Season 2') %>%
  select(-Code)

#Union of s1 and s2, correct Material names from Season to Season,
#create a unique sample id combining sample # and Season
combined <- bind_rows(s1,s2) %>%
  mutate(Material = ifelse(Material == "Other C&D",
                           "R/C and Other C&D",
                           Material),
         unique_id = paste(Season, `Sample #`, sep = "_"))

#Create dataset of total sample weights for each sample
sample_weights <- combined %>%
  group_by(unique_id) %>%
  summarise(sample_weights = sum(lbs))

categories <- read_csv(paste0(file_loc, "Categories_by_Material.csv"))

#Join the categories to the total dataset and
#join total sample weights for each sample
```

```
#filter out all Load Scale Weights that are not measured
total <- left_join(combined,categories, by = "Material") %>%
  left_join(sample_weights, by = "unique_id") %>%
  filter(`Load Scale Weight` > 0)

#set seed for reproducibility
set.seed(20201020)

#function for calculating the composition of material
comp <- function(data){
  sum(data$lbs)/sum(data$sample_weights)
}

#Function for creation of 90% confidence intervals
#using bootstrap methodology
bootstrap_ci <- function(data, n = 1000){
  reps <- replicate(n, data[sample(1:nrow(data), replace = TRUE),],
                    simplify = F)
  ratio <- sapply(reps, comp)
  return(tibble(mean = comp(data),
                ci_lower = quantile(ratio, 0.05),
                ci_upper = quantile(ratio, .95)))
}

statewide <- total %>%
  group_by(Category, Material) %>%
  group_modify(~bootstrap_ci(.x, n = 1000))

statewide_category <- total %>%
  filter(`Load Scale Weight` > 0) %>%
  group_by(unique_id, Category) %>%
  summarise(lbs = sum(lbs)) %>%
  left_join(sample_weights, by = 'unique_id') %>%
  group_by(Category) %>%
```

```
  group_modify(~bootstrap_ci(.x, n = 1000))

region <- total %>%
  group_by(Origin, Category, Material) %>%
  group_modify(~bootstrap_ci(.x, n = 1000))

region_category <- total %>%
  filter(`Load Scale Weight` > 0) %>%
  group_by(unique_id, Origin, Category) %>%
  summarise(lbs = sum(lbs)) %>%
  left_join(sample_weights, by = 'unique_id') %>%
  group_by(Origin, Category) %>%
  group_modify(~bootstrap_ci(.x, n = 1000))

facility <- combined %>%
  left_join(categories, by = "Material") %>%
  left_join(sample_weights, by = "unique_id") %>%
  group_by(Origin, Location, Category, Material) %>%
  summarise(lbs = sum(lbs), total = sum(sample_weights),
            composition = sum(lbs)/sum(sample_weights))
```

Appendix D: Characterization results per facility

The following tables are the detailed results for each facility which granted permission for their individual results to be published. The results include the tonnage of each material sorted at the facility and the estimated composition for the total. Non-scaled samples are also included in the estimates per facility but they are not included in the statewide or regional estimates. The raw data is available on request from the MPCA.

*Note: the Dem-Con Recovery & Recycling is split into two tables as the sort was performed at two locations at the facility, the landfill area and the material recovery facility.

Table 11. Dem-Con Landfill (Shakopee) detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**136.6**	**14.8%**	**Gypsum Board**	**72.5**	**7.9%**
			Gypsum Wallboard - Clean	**43.6**	**4.7%**
Roofing Shingles	**286.4**	**31.0%**	Gypsum Wallboard - Painted	**28.9**	**3.1%**
Brick	**37.5**	**4.1%**	**Clean Wood**	**68.1**	**7.4%**
			Untreated Dimen. Lumber	**23.1**	**2.5%**
Dirt/Sand/Rock/Gravel	**107.6**	**11.7%**	Untreated Eng. Wood	**27.2**	**2.9%**
Dirt/Sand	**35.3**	**3.8%**	Wood Pallets/Crates/Spools	**17.9**	**1.9%**
Rock/Gravel	**70.4**	**7.6%**			
Yard Waste	**1.9**	**0.2%**	**Metal**	**20.5**	**2.2%**
			Appliances	**0.0**	**0.0%**
General C&D	**106.4**	**11.5%**	Composite Metal (wires)	**0.1**	**0.0%**
Acoustic Tiling	**0.7**	**0.1%**	Ferrous Scrap	**14.0**	**1.5%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**6.4**	**0.7%**
Asphalt	**28.7**	**3.1%**			
Carpet	**5.6**	**0.6%**	**MSW**	**12.5**	**1.4%**
Carpet Padding	**0.8**	**0.1%**	Bulky Items (inc. mattresses)	**1.7**	**0.2%**
Ceramics/Porcelain Fixture	**10.7**	**1.2%**	E-Waste	**0.3**	**0.0%**
Flat Glass	**2.2**	**0.2%**	MMSW	**2.3**	**0.3%**
HVAC Ducting	**0.1**	**0.0%**	Other Paper	**1.1**	**0.1%**
Insulation	**3.0**	**0.3%**	R/C and Other Glass	**0.5**	**0.1%**
Plastic Piping	**0.6**	**0.1%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**1.7**	**0.2%**	Uncoated OCC - Recyclable	**6.6**	**0.7%**
R/C and Other C&D	**45.6**	**4.9%**			
Rubber Products	**6.7**	**0.7%**	**Plastics**	**2.9**	**0.3%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.6**	**0.1%**
			Film Plastic (Comm./Indus.)	**1.3**	**0.1%**
Treated/Painted/Processed Wood	**72.0**	**7.8%**	HDPE Buckets	**0.1**	**0.0%**
Painted/Stained Wood	**60.9**	**6.6%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**7.7**	**0.8%**	R/C and Other Plastic	**0.9**	**0.1%**
Wood Furniture**	**3.3**	**0.4%**			
Number of Scaled Loads	193		Scaled Tons Surveyed	861	
Number of Estimated Loads	13		Estimated Tons Surveyed	62	

*Pursuant to an approved Industrial Solid Waste Management Plan (ISWMP).

**This facility can accept built-in furniture, not loose furniture. This category reflects wooden building type materials attached to other materials, torn from structures, etc.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.

Table 12. Dem-Con Material Recovery Facility (Shakopee) detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**4.7**	**6.1%**	**Gypsum Board**	**15.8**	**20.6%**
			Gypsum Wallboard - Clean	**14.4**	**18.7%**
Roofing Shingles	**1.6**	**2.1%**	Gypsum Wallboard - Painted	**1.4**	**1.9%**
Brick	**1.8**	**2.3%**	**Clean Wood**	**19.0**	**24.7%**
			Untreated Dimen. Lumber	**5.4**	**7.0%**
Dirt/Sand/Rock/Gravel	**9.0**	**11.7%**	Untreated Eng. Wood	**9.9**	**12.9%**
Dirt/Sand	**4.9**	**6.4%**	Wood Pallets/Crates/Spools	**3.7**	**4.8%**
Rock/Gravel	**3.6**	**4.7%**			
Yard Waste	**0.5**	**0.6%**	**Metal**	**2.1**	**2.7%**
			Appliances	**0.0**	**0.0%**
General C&D	**10.1**	**13.2%**	Composite Metal (wires)	**0.0**	**0.1%**
Acoustic Tiling	**0.0**	**0.0%**	Ferrous Scrap	**1.1**	**1.4%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**1.0**	**1.2%**
Asphalt	**0.0**	**0.0%**			
Carpet	**1.0**	**1.3%**	**MSW**	**3.9**	**5.1%**
Carpet Padding	**0.0**	**0.1%**	Bulky Items (inc. mattresses)	**0.3**	**0.3%**
Ceramics/Porcelain Fixture	**1.2**	**1.6%**	E-Waste	**0.0**	**0.0%**
Flat Glass	**0.3**	**0.4%**	MMSW	**0.7**	**0.9%**
HVAC Ducting	**0.0**	**0.0%**	Other Paper	**0.8**	**1.0%**
Insulation	**0.1**	**0.1%**	R/C and Other Glass	**0.3**	**0.4%**
Plastic Piping	**0.1**	**0.1%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**0.4**	**0.5%**	Uncoated OCC - Recyclable	**1.8**	**2.4%**
R/C and Other C&D	**7.1**	**9.3%**			
Rubber Products	**0.0**	**0.0%**	**Plastics**	**0.6**	**0.8%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.1**	**0.2%**
			Film Plastic (Comm./Indus.)	**0.2**	**0.3%**
Treated/Painted/Processed Wood	**8.1**	**10.6%**	HDPE Buckets	**0.1**	**0.1%**
Painted/Stained Wood	**4.9**	**6.4%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**0.7**	**0.9%**	R/C and Other Plastic	**0.1**	**0.2%**
Wood Furniture**	**2.5**	**3.3%**			
Number of Scaled Loads	26		Scaled Tons Surveyed	77	
Number of Estimated Loads	0		Estimated Tons Surveyed	0	

*Pursuant to an approved ISWMP.

**This facility can accept built-in furniture, not loose furniture. This category reflects wooden building type materials attached to other materials, torn from structures, etc.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.

Table 13. East Central Solid Waste Commission detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**0.1**	**1.4%**	**Gypsum Board**	**1.2**	**13.4%**
			Gypsum Wallboard - Clean	**0.0**	**0.0%**
Roofing Shingles	**7.4**	**82.2%**	Gypsum Wallboard - Painted	**1.2**	**13.4%**
Brick	**0.0**	**0.0%**	**Clean Wood**	**0.0**	**0.3%**
			Untreated Dimen. Lumber	**0.0**	**0.2%**
Dirt/Sand/Rock/Gravel	**0.0**	**0.1%**	Untreated Eng. Wood	**0.0**	**0.1%**
Dirt/Sand	**0.0**	**0.0%**	Wood Pallets/Crates/Spools	**0.0**	**0.0%**
Rock/Gravel	**0.0**	**0.0%**			
Yard Waste	**0.0**	**0.1%**	**Metal**	**0.0**	**0.1%**
			Appliances	**0.0**	**0.0%**
General C&D	**0.2**	**2.1%**	Composite Metal (wires)	**0.0**	**0.0%**
Acoustic Tiling	**0.0**	**0.0%**	Ferrous Scrap	**0.0**	**0.0%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**0.0**	**0.1%**
Asphalt	**0.0**	**0.0%**			
Carpet	**0.0**	**0.0%**	**MSW**	**0.0**	**0.2%**
Carpet Padding	**0.0**	**0.0%**	Bulky Items (inc. mattresses)	**0.0**	**0.0%**
Ceramics/Porcelain Fixture	**0.1**	**0.7%**	E-Waste	**0.0**	**0.0%**
Flat Glass	**0.0**	**0.0%**	MMSW	**0.0**	**0.0%**
HVAC Ducting	**0.0**	**0.0%**	Other Paper	**0.0**	**0.0%**
Insulation	**0.0**	**0.0%**	R/C and Other Glass	**0.0**	**0.2%**
Plastic Piping	**0.0**	**0.0%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**0.0**	**0.0%**	Uncoated OCC - Recyclable	**0.0**	**0.0%**
R/C and Other C&D	**0.1**	**1.4%**			
Rubber Products	**0.0**	**0.0%**	**Plastics**	**0.0**	**0.0%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.0**	**0.0%**
			Film Plastic (Comm./Indus.)	**0.0**	**0.0%**
Treated/Painted/Processed Wood	**0.0**	**0.2%**	HDPE Buckets	**0.0**	**0.0%**
Painted/Stained Wood	**0.0**	**0.2%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**0.0**	**0.0%**	R/C and Other Plastic	**0.0**	**0.0%**
Wood Furniture	**0.0**	**0.0%**			
Number of Scaled Loads	0		Scaled Tons Surveyed	0	
Number of Estimated Loads	6		Estimated Tons Surveyed	9	

*Pursuant to an approved ISWMP.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.

Table 14. Itasca County Demolition Landfill/MSW Transfer Station detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**2.5**	**4.4%**	**Gypsum Board**	**5.7**	**9.9%**
			Gypsum Wallboard - Clean	**2.0**	**3.5%**
Roofing Shingles	**22.3**	**38.7%**	Gypsum Wallboard - Painted	**3.7**	**6.3%**
Brick	**2.1**	**3.7%**	**Clean Wood**	**4.3**	**7.5%**
			Untreated Dimen. Lumber	**1.6**	**2.7%**
Dirt/Sand/Rock/Gravel	**0.5**	**0.9%**	Untreated Eng. Wood	**1.6**	**2.8%**
Dirt/Sand	**0.0**	**0.1%**	Wood Pallets/Crates/Spools	**1.1**	**2.0%**
Rock/Gravel	**0.4**	**0.7%**			
Yard Waste	**0.1**	**0.2%**	**Metal**	**3.1**	**5.4%**
			Appliances	**0.0**	**0.0%**
General C&D	**6.2**	**10.8%**	Composite Metal (wires)	**0.0**	**0.0%**
Acoustic Tiling	**0.0**	**0.1%**	Ferrous Scrap	**1.4**	**2.4%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**1.7**	**3.0%**
Asphalt	**0.0**	**0.0%**			
Carpet	**0.0**	**0.0%**	**MSW**	**0.8**	**1.3%**
Carpet Padding	**0.0**	**0.0%**	Bulky Items (inc. mattresses)	**0.0**	**0.0%**
Ceramics/Porcelain Fixture	**2.1**	**3.6%**	E-Waste	**0.0**	**0.0%**
Flat Glass	**0.2**	**0.3%**	MMSW	**0.0**	**0.0%**
HVAC Ducting	**0.0**	**0.0%**	Other Paper	**0.0**	**0.0%**
Insulation	**1.5**	**2.7%**	R/C and Other Glass	**0.8**	**1.3%**
Plastic Piping	**0.0**	**0.0%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**0.1**	**0.2%**	Uncoated OCC - Recyclable	**0.0**	**0.0%**
R/C and Other C&D	**2.1**	**3.7%**			
Rubber Products	**0.1**	**0.2%**	**Plastics**	**0.2**	**0.3%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.0**	**0.0%**
			Film Plastic (Comm./Indus.)	**0.0**	**0.0%**
Treated/Painted/Processed Wood	**9.9**	**17.2%**	HDPE Buckets	**0.0**	**0.0%**
Painted/Stained Wood	**9.4**	**16.3%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**0.1**	**0.1%**	R/C and Other Plastic	**0.2**	**0.3%**
Wood Furniture	**0.4**	**0.8%**			
Number of Scaled Loads	7		Scaled Tons Surveyed	31	
Number of Estimated Loads	38		Estimated Tons Surveyed	27	

*Pursuant to an approved ISWMP.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.

Table 15. Olmsted County Kalmar Landfill detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**26.3**	**20.9%**	**Gypsum Board**	**1.8**	**1.4%**
			Gypsum Wallboard - Clean	**1.0**	**0.8%**
Roofing Shingles	**6.2**	**4.9%**	Gypsum Wallboard - Painted	**0.8**	**0.7%**
Brick	**41.3**	**32.8%**	**Clean Wood**	**0.7**	**0.6%**
			Untreated Dimen. Lumber	**0.1**	**0.1%**
Dirt/Sand/Rock/Gravel	**22.0**	**17.5%**	Untreated Eng. Wood	**0.5**	**0.4%**
Dirt/Sand	**12.0**	**9.5%**	Wood Pallets/Crates/Spools	**0.1**	**0.0%**
Rock/Gravel	**10.1**	**8.0%**			
Yard Waste	**0.0**	**0.0%**	**Metal**	**2.9**	**2.3%**
			Appliances	**0.1**	**0.1%**
General C&D	**21.1**	**16.8%**	Composite Metal (wires)	**0.0**	**0.0%**
Acoustic Tiling	**0.0**	**0.0%**	Ferrous Scrap	**1.5**	**1.2%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**1.4**	**1.1%**
Asphalt	**6.1**	**4.9%**			
Carpet	**0.0**	**0.0%**	**MSW**	**0.2**	**0.2%**
Carpet Padding	**0.0**	**0.0%**	Bulky Items (inc. mattresses)	**0.2**	**0.1%**
Ceramics/Porcelain Fixture	**4.8**	**3.8%**	E-Waste	**0.0**	**0.0%**
Flat Glass	**0.1**	**0.1%**	MMSW	**0.0**	**0.0%**
HVAC Ducting	**0.0**	**0.0%**	Other Paper	**0.0**	**0.0%**
Insulation	**0.1**	**0.1%**	R/C and Other Glass	**0.0**	**0.0%**
Plastic Piping	**0.0**	**0.0%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**0.0**	**0.0%**	Uncoated OCC - Recyclable	**0.0**	**0.0%**
R/C and Other C&D	**9.6**	**7.6%**			
Rubber Products	**0.4**	**0.3%**	**Plastics**	**0.1**	**0.1%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.0**	**0.0%**
			Film Plastic (Comm./Indus.)	**0.0**	**0.0%**
Treated/Painted/Processed Wood	**3.2**	**2.5%**	HDPE Buckets	**0.0**	**0.0%**
Painted/Stained Wood	**3.0**	**2.4%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**0.1**	**0.1%**	R/C and Other Plastic	**0.0**	**0.0%**
Wood Furniture	**0.0**	**0.0%**			
Number of Scaled Loads	16		Scaled Tons Surveyed	126	
Number of Estimated Loads	0		Estimated Tons Surveyed	0	

*Pursuant to an approved ISWMP.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.

Table 16. Polk County Sanitary Landfill detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**156.5**	**56.4%**	**Gypsum Board**	**9.7**	**3.5%**
			Gypsum Wallboard - Clean	**1.6**	**0.6%**
Roofing Shingles	**2.2**	**0.8%**	Gypsum Wallboard - Painted	**8.1**	**2.9%**
Brick	**25.5**	**9.2%**	**Clean Wood**	**3.8**	**1.4%**
			Untreated Dimen. Lumber	**2.5**	**0.9%**
Dirt/Sand/Rock/Gravel	**37.4**	**13.5%**	Untreated Eng. Wood	**0.5**	**0.2%**
Dirt/Sand	**27.7**	**10.0%**	Wood Pallets/Crates/Spools	**0.8**	**0.3%**
Rock/Gravel	**5.8**	**2.1%**			
Yard Waste	**3.9**	**1.4%**	**Metal**	**7.8**	**2.8%**
			Appliances	**0.0**	**0.0%**
General C&D	**25.0**	**9.0%**	Composite Metal (wires)	**0.2**	**0.1%**
Acoustic Tiling	**0.5**	**0.2%**	Ferrous Scrap	**1.8**	**0.6%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**5.8**	**2.1%**
Asphalt	**0.2**	**0.1%**			
Carpet	**0.1**	**0.0%**	**MSW**	**0.1**	**0.0%**
Carpet Padding	**0.0**	**0.0%**	Bulky Items (inc. mattresses)	**0.0**	**0.0%**
Ceramics/Porcelain Fixture	**0.2**	**0.1%**	E-Waste	**0.0**	**0.0%**
Flat Glass	**0.2**	**0.1%**	MMSW	**0.0**	**0.0%**
HVAC Ducting	**0.0**	**0.0%**	Other Paper	**0.0**	**0.0%**
Insulation	**0.0**	**0.0%**	R/C and Other Glass	**0.1**	**0.0%**
Plastic Piping	**0.0**	**0.0%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**0.1**	**0.1%**	Uncoated OCC - Recyclable	**0.0**	**0.0%**
R/C and Other C&D	**23.6**	**8.5%**			
Rubber Products	**0.0**	**0.0%**	**Plastics**	**0.5**	**0.2%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.0**	**0.0%**
			Film Plastic (Comm./Indus.)	**0.0**	**0.0%**
Treated/Painted/Processed Wood	**9.0**	**3.3%**	HDPE Buckets	**0.0**	**0.0%**
Painted/Stained Wood	**8.7**	**3.1%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**0.0**	**0.0%**	R/C and Other Plastic	**0.5**	**0.2%**
Wood Furniture	**0.3**	**0.1%**			
Number of Scaled Loads	30		Scaled Tons Surveyed	277	
Number of Estimated Loads	0		Estimated Tons Surveyed	0	

*Pursuant to an approved ISWMP.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.

Table 17. TK Demolition Disposal LLC detailed facility results by Material

Material	Tons	Percent	Material	Tons	Percent
Concrete	**28.4**	**13.2%**	**Gypsum Board**	**34.4**	**15.9%**
			Gypsum Wallboard - Clean	**12.6**	**5.9%**
Roofing Shingles	**23.3**	**10.8%**	Gypsum Wallboard - Painted	**21.8**	**10.1%**
Brick	**15.6**	**7.2%**	**Clean Wood**	**27.4**	**12.7%**
			Untreated Dimen. Lumber	**7.7**	**3.5%**
Dirt/Sand/Rock/Gravel	**21.9**	**10.2%**	Untreated Eng. Wood	**10.1**	**4.7%**
Dirt/Sand	**3.8**	**1.8%**	Wood Pallets/Crates/Spools	**9.6**	**4.5%**
Rock/Gravel	**17.4**	**8.1%**			
Yard Waste	**0.8**	**0.3%**	**Metal**	**5.6**	**2.6%**
			Appliances	**0.0**	**0.0%**
General C&D	**15.6**	**7.2%**	Composite Metal (wires)	**0.1**	**0.1%**
Acoustic Tiling	**0.8**	**0.4%**	Ferrous Scrap	**3.7**	**1.7%**
Asbestos*	**0.0**	**0.0%**	Non-Ferrous Metal	**1.8**	**0.8%**
Asphalt	**0.9**	**0.4%**			
Carpet	**0.9**	**0.4%**	**MSW**	**4.3**	**2.0%**
Carpet Padding	**0.1**	**0.1%**	Bulky Items (inc. mattresses)	**0.5**	**0.2%**
Ceramics/Porcelain Fixture	**2.2**	**1.0%**	E-Waste	**0.0**	**0.0%**
Flat Glass	**0.6**	**0.3%**	MMSW	**0.6**	**0.3%**
HVAC Ducting	**0.0**	**0.0%**	Other Paper	**0.1**	**0.1%**
Insulation	**1.6**	**0.8%**	R/C and Other Glass	**0.1**	**0.1%**
Plastic Piping	**0.2**	**0.1%**	Tires	**0.0**	**0.0%**
Plastic Siding/Decking	**0.4**	**0.2%**	Uncoated OCC - Recyclable	**3.0**	**1.4%**
R/C and Other C&D	**7.8**	**3.6%**			
Rubber Products	**0.0**	**0.0%**	**Plastics**	**0.8**	**0.4%**
Tyvek Building Wrap	**0.0**	**0.0%**	Durable Plastic Items	**0.1**	**0.0%**
			Film Plastic (Comm./Indus.)	**0.3**	**0.2%**
Treated/Painted/Processed Wood	**38.5**	**17.8%**	HDPE Buckets	**0.0**	**0.0%**
Painted/Stained Wood	**35.2**	**16.3%**	Plastic Furniture	**0.0**	**0.0%**
Treated Wood	**1.6**	**0.8%**	R/C and Other Plastic	**0.4**	**0.2%**
Wood Furniture	**1.7**	**0.8%**			
Number of Scaled Loads	58		Scaled Tons Surveyed	211	
Number of Estimated Loads	1		Estimated Tons Surveyed	5	

*Pursuant to an approved ISWMP.

Visual characterization was conducted on tipped loads. Following classification, facility staff removed anything within the load that was unacceptable to be disposed there.