MEIA
Manitoba Environmental Industries Association

Manitoba New Home Construction Waste Diversion Study - Phase 2 Operational Pilot

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STRATEGYMAKERS CONSULTING

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Disclaimer

The contents of this report are for information purposes only and should not be interpreted by readers as legal, professional or commercial advice.

[1] Green Manitoba has since been dissolved. Project now falls under direction of Manitoba Sustainable Development - Sustainable and Green Initiatives Branch.

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Summary & Key Findings – Phase 2 Operational Pilot Study

Manitoba Environmental Industries Association (MEIA) engaged StrategyMakers Consulting Inc. to complete an analysis and operational pilot study towards assisting Manitoba home builders to increase diversion of construction waste from landfill. The project, which is funded by Manitoba Sustainable Development and has received the support of the Manitoba Home Builders Association (MHBA), was completed in two phases:

- Phase 1 – Baseline analysis and pre-feasibility study (Fall 2016 to Fall 2017)
- Phase 2 – Operational pilot study (Fall 2017 to Fall 2018)

This report contains findings from **Phase 2 – Operational Pilot Study** which involved the collection, sorting and delivery of waste and recyclable/divertible materials from four new residential homes constructed in southwest Winnipeg between October 2017 and May 2018. The operational pilot was fully completed in July 2018.

**This study focuses on waste generated during the construction of new residential homes - a distinct subcategory of Construction, Renovation and Demolition (CRD) waste. Findings and results from this study are NOT transferrable to discussions regarding Renovation or Demolition activities, nor should they be considered transferable to waste from the non-residential construction sector.*

Summary of Key Findings

Building on the Phase 1 findings, completion of the Phase 2 Operational Pilot Study yields six important final conclusions to the study, including:

1. **Approximately 2.0 kilograms of waste was generated per square foot of new home built.** Since most new homes built in Manitoba are constructed using a standardized wood-frame construction method, this data point can be used to calculate estimates of total waste expected from the construction of new homes. For example, it is reasonable to estimate that the total amount of waste generated from new home construction across Manitoba in 2018 was approximately 28,029 metric tonnes.
   Section 2 contains detailed findings from Phase 2 regarding new home construction waste generation and composition.

2. The results of the Phase 2 operational pilot demonstrate that, with due care and attention to the collection, separation and delivery of the various materials discarded at building sites, there is a significant potential for increasing diversion of new home construction waste in Winnipeg at this point in time. Of the 16,238 total kilograms collected from the four sites, only 3,455 kilograms (21%) was delivered and disposed to landfill as commercial mixed waste. The other 12,783 kilograms (79%) of discarded material collected from the four building sites was recycled, diverted or kept as reusable salvaged building materials.
   Section 3 contains the results of waste diversion efforts undertaken in Phase 2 and outlines potential waste diversion opportunities for new home construction waste.

3. Diverting new home construction could also yield substantial cost savings through avoided waste disposal tipping fees. Altogether, the savings from avoided disposal fees through diverting a large portion of the waste generated from the four sites included in Phase 2 totaled nearly $991 (an average of $248 per home). Extrapolating these results to the total number of housing starts in Winnipeg yields an estimated total potential savings from avoided waste disposal cost of over $1.3 million in 2018.
   Section 4 outlines costs and revenues incurred in Phase 2 operational pilot and discusses potential savings from diverting new home construction waste in Manitoba.

4. Based on current market conditions and availability and accessibility of recycling and diversion opportunities, five materials may offer the best opportunity for diversion of new home construction waste in and around Winnipeg, including:
   - ✓ Unpainted, untreated and uncontaminated Wood (Lumber, OSB and Plywood)
   - ✓ Asphalt shingles
   - ✓ Metals (ferrous, aluminum and copper)
   - ✓ Corrugated cardboard and boxboard
   - ? Drywall (gypsum board) – opportunities do exist for diverting drywall at this time but further research and consultation will be required to determine a sustainable long term solution.

   Areas of the province outside of the Winnipeg region may not have access to same diversion opportunities for these five materials and therefore will require further study.
   Section 5 contains a more in depth explanation of why these five categories of material offer the best opportunity for diversion efforts for the sector.

5. Diverting and properly disposing hazardous liquid waste and containers generated during the construction of new homes is possible at this time, and recommended. However, the financial costs and regulatory/liability issues that arise when this category of waste material is separated from mixed waste sent to landfill may be prohibitive. Further analysis of options and issues for diverting this category of waste is necessary.
   Details and further discussion on findings related to hazardous liquid waste and containers can be found in various sections throughout the report, with final conclusion detailed in Section 5.

6. The Phase 2 operational study reinforced that while there are a number of specific economic and logistical barriers limiting the diversion of waste from new home construction, there are also a number of opportunities and potential economic and environmental benefits. The methodology employed in the Phase 2 pilot does not offer a model for efficient collection, handling and processing of new home construction waste materials but the overall results and findings do highlight the opportunity for innovative players to develop efficient and effective new home construction waste collection, processing and diversion services in order to capture a portion of the dollars currently spent on waste disposal tipping fees.

   Completion of the Phase 2 operational pilot brings this study to a close. Additional research and consultation is recommended, including:
   - Conducting a larger scale pilot study to evaluate opportunities for efficiently collection and handling divertible wastes and the feasibility of establishing a centralized sorting and processing operation for new home construction waste diversion.
   - Repeating similar operational pilot studies in regions outside of Winnipeg (ex. Brandon, Winkler/Morden, Steinbach, The Pas).
   - Investigating policies and supports/incentives to drive investment in new home construction waste diversion, including a review of approaches used in other jurisdictions.
   - Initiating dialogue between home building industry, government and Certainteed (St. Gobain) to explore opportunities for partnering on a pilot study to evaluate the feasibility of developing a post-construction drywall recycling operation in Winnipeg.

   Section 5 contains a more in depth discussion of conclusions and recommendations.

Section 1 - Introduction

Background and Objectives

According to Province of Manitoba estimates, Construction, Renovation and Demolition (CR&D) waste represents approximately 20-30% of the total waste generated annually in Manitoba, making it the second largest component of the province's overall waste stream.[2]

Not surprisingly given the significant volume this category of waste contributes to Manitoba's waste disposal grounds, provincial policy makers and waste management planners have identified the diversion of CR&D waste as both an opportunity and a priority for action.

The Province of Manitoba is seeking to work with industry to implement best management practices and expand recycling of CR&D materials into value added products to increase economic benefits and avoid landfill-related costs. In October 2016, Manitoba's Minister of Sustainable Development announced funding for the Manitoba Environmental Industries Association (MEIA) to commission a comprehensive two-phase study towards assisting Manitoba's ***new*** home builders to increase the diversion of ***construction*** waste away from landfill and instead towards more environmentally sustainable uses.

Manitoba Environmental Industries Association (MEIA) engaged StrategyMakers Consulting Inc. to complete an analysis and operational pilot study towards assisting Manitoba home builders to increase diversion of construction waste from landfill. The project, which has received the support of the Manitoba Home Builders Association (MHBA), was completed in two phases:

- Phase 1 – Baseline analysis and pre-feasibility study (Fall 2016 to Fall 2017)
- Phase 2 – Operational pilot study (Fall 2017 to Fall 2018)

**This study focuses on waste generated during the construction of new residential homes - a distinct subcategory of Construction, Renovation and Demolition (CRD) waste. Findings and results from this study are NOT transferrable to discussions regarding Renovation or Demolition activities. Nor can they be considered transferable to waste from the Non-residential construction sector.*

[2] Source: Manitoba Conservation and Water Stewardship, Recycling and Waste Reduction: A Discussion Paper (2014), p. 12. https://www.gov.mb.ca/conservation/envprograms/recycling/pdf/mb_recycling_strategy_2014.pdf

Recap of Main Findings Phase 1

A separate report containing Phase 1 findings was submitted to MEIA in November 2017. Interested readers are referred to the report, titled Manitoba New Home Construction Waste Diversion Study – Phase 1 (November 30, 2017), for full details and findings from Phase 1. The following is a recap of the major findings in that report and provides important context for understanding the Phase 2 operational pilot study methodology and results.

- The vast majority of new homes in Manitoba are built using wood frame construction techniques that involve a well-developed, highly standardized process. It is reasonable to expect that findings from this study can be extrapolated to homes built across Manitoba using similar wood frame construction technique.

- Three basic macroeconomic factors drive the overall volume and composition of waste generated through the construction of new residential homes in Manitoba. These are:
  - Total number of housing starts - more homes being built equals more waste generated
  - Size of homes built – the larger the home, the more waste generated
  - The degree of standardization/variation in the design of homes being built – deviations from standard dimensions and variation in the design elements of homes being built contributes to the volume and composition of waste generated.

- Phase 1 of this study yielded three important findings regarding the composition and characteristics of new home construction waste:
  - 13 distinct categories of waste material were found through the full range of construction activities observed at Phase 1 sites.
  - The composition of waste generated through each identified stages of home construction varies significantly.
  - Various forms of illegally dumped waste were found on sites throughout the observation period. Although this broad category of waste contributes to the volume and weight of waste requiring collection and disposal, it is NOT generated through the construction of new homes.

- Current waste collection, hauling and disposal practices in the sector remain largely focused on traditional approaches to waste disposal. There has been limited success, but growing interest, in recycling and diversion activities.

- Waste disposal fees ("landfill tipping fees") are a significant component of the cost of managing waste from home construction sites. Landfill tipping fees for mixed commercial waste in and around Winnipeg have grown considerably over the past decade and the trend is expected to continue. This significant and growing expense is particularly relevant to the objectives of this study as it represents a cost that can be directly avoided through recycling and diversion of home construction waste.

- There appears to be reasonably strong support from groups directly and indirectly involved in Manitoba's home construction sector to increase recycling and diversion of waste. However, a number of barriers and challenges remain:
  - Materials in the waste stream will need to be properly separated and delivered in a manner acceptable to recycled material brokers and end users.
  - The time, effort and cost of sorting and delivering recyclable and divertible materials to different end points does not yield sufficient benefit to waste haulers to justify changing their current approach.
  - Crews and trades workers at home building sites, also indicate a number of barriers and challenges including a lack of on-site recycling options, time constraints, and lack of incentives to participate (or worse, contractual arrangements that incent waste generation over conservation of materials.)
  - There is no service provider in the marketplace currently offering a comprehensive recycling/diversion solution that competes against the current practice of collecting and disposing mixed waste when measured against key performance requirements of cost, on-site spatial limitations and accessibility requirements, and service responsiveness/timeliness.

Phase 2 Objectives

Phase 2 of this broader project was designed to build on the Phase 1 findings. Specifically, the objectives of Phase 2 were to:

- work with the Manitoba Home Builders Association (MHBA) to determine and coordinate the logistics involved in reusing/recycling the different construction materials;
- determine the amount of waste being generated and the amount being diverted, by construction material type;
- quantify potential costs and savings associated with current waste management processes and diversion of construction waste (e.g., trucking, bins, tipping fees); and,

- identify the overall opportunities for increasing diversion and barriers hindering diversion.

Methodology - Phase 2

The primary objective for Phase 2 was *to work with the Manitoba Home Builders Association (MHBA) to determine and coordinate the logistics involved in reusing/recycling the different construction material.*

The methodology for Phase 2 of the study was developed in consultation with MEIA representatives and through discussions with participating home builders and members of MHBA's Workplace Safety and Health Committee.

A total of 4 homes were chosen as suitable sites for the Phase 2 operational pilot. Three of the homes were provided by Hilton homes and the 4th was provided by Qualico Homes. The four homes were chosen based on their proximity to one another, accessibility to the temporary staging area provided, and with the understanding that their anticipated production schedule would fit within the Phase 2 study timelines.

Profile of Sites Used in Phase 2 Operational Pilot (Addresses kept confidential)

Site Number	Neighborhood	Builder	Size of Home (Square Feet)	Completion Date
1	Prairie Pointe	Hilton	1871	March 2018
2	Prairie Pointe	Qualico	2142	May 2018
3	Prairie Pointe	Hilton	1742	May 2018
4	South Pointe	Hilton	2342	May 2018

StrategyMakers provided waste hauling services throughout the full period of construction for each of the 4 homes selected. StrategyMakers worked with each participating builder's site supervisors to ensure that waste hauling service met standards equivalent to current level of

service provided by their normal contractor (i.e. timely pickup, collection/hauling through full period of building, minimal disruption to building site operations, etc.)

Providing direct collection/hauling services during this study was deemed necessary to ensure the proper weighing, tracking and documenting of waste collected, diverted and disposed.

StrategyMakers retained full responsibility for ensuring that all necessary safety protocols were followed and that appropriate risk and liability protection was secured for its worker on site (ex. Workers Compensation Board coverage).

Consistent with current industry practices, initial framing waste was allowed to be piled on the ground at the site. Once the framing stage was completed, temporary, wood "bins" were constructed at each site. The wood bins were made from Oriented Strand Board walls and 2by4 lumber support pieces, (salvaged from the framing waste wherever possible). The bins measured 4' high and 8' x 8' square.

Framing waste piled on ground

Wood bin constructed on site

StrategyMakers monitored all 4 sites each week and conducted the physical collection of waste materials from each site as necessary. Collected material was photographed, weighed, sorted, documented, and ultimately delivered to a variety of locations.

All material was loaded and sorted manually. A small 6' x 10' utility trailer with custom-built sidewalls was used for the collection and delivery of all loads. **This method is NOT recommended as an efficient and viable option for collecting and delivering waste or recyclables from new home construction. It was simply the most flexible and cost-effective option <u>for the purposes of Phase 2 of the study</u>** which required manually-intensive sorting, weighing and tracking of materials.

Utility trailer used for collection and delivery of waste from Phase 2 sites

The exact process for sorting, weighing and loading waste varied depending on the contents of the waste pile and/or bin at the time of pick-up. Each load was evaluated in real time to determine the most effective way to ensure accurate weighing of each category of waste while also allowing some degree of efficiency in loading and delivering materials (i.e. carrying full loads and avoiding double-handling wherever possible).

Some manual sorting was done right at the site for all loads. In situations where there was sufficient volume of one category of waste, the materials were separated and delivered directly to end disposal or diversion site. For example, lumber and clean wood that met specifications for acceptance at FinMac lumber was often picked out of piles and bins, loaded right onto the trailer, taken through the City of Winnipeg Brady Road weigh scale, and then delivered directly to FinMac lumber.

Many recyclable/divertible materials such as corrugated cardboard, metals, asphalt shingles, some plastics and other categories were generated in small volumes throughout the building stage. These materials were taken to a temporary sorting/staging area provided by Ladco Company Ltd. in one of their fenced compounds in South Pointe. StrategyMakers used this area throughout the pilot as a temporary holding place for materials that could be held until sufficient volume was collected to allow more efficient delivery. Every effort was made to ensure the sorting/staging area remained clean and orderly throughout the length of the project.

Sign and fencing around staging area

Staging area

Significant care was taken to ensure accurate weighing of all loads and wastes generated from each of the 4 homes included in this study. All loads and materials were initially weighed at the City of Winnipeg Brady Road commercial waste site scale. Recyclable materials such as corrugated cardboard, ferrous metal, copper were also weighed upon delivery to processors/brokers, providing a second degree of certainty to the accuracy of data. A small, commercial grade handheld scale was also used for weighing certain materials separately (ex. beverage containers found in construction waste bins).

Photographs were taken of each home as it was built and relevant observations were noted (see Appendix 5). Trades workers encountered on site were occasionally interviewed informally to gain an understanding of relevant information regarding their process, materials and practices/behaviours.

Applicable safety protocols were strictly adhered to during site visits. Our purpose and intentions were communicated clearly to work crews encountered on site and interviewees were advised that their participation was strictly confidential and entirely voluntary.

Provincial regulations and required procedures for collecting and handling hazardous waste materials were also followed where applicable. Strategy Makers registered for a Hazardous Waste Generator Registration Number (MBG14323) and contracted a licensed hazardous waste collector/processor (Miller Environmental) to properly dispose of all hazardous wastes collected during the Phase 2 pilot. See Appendix 4 for images of hazardous waste documentation.

Construction on the last of the four homes was completed in late May 2018. Removal and clean-up of materials held at the staging area and final deliveries of waste and recyclable materials was completed by July 2018.

A note about handling of drywall (gypsum board) waste in Phase 2

The handling of drywall (gypsum board) waste presented a further degree of complexity and steps were required.

As outlined in the Phase 1 report, new home drywall installers are often required under their agreement with homebuilders to separate their drywall scraps/waste and make their own arrangements for collection and disposal. This meant that special arrangements had to be made with drywall installers and their hired waste haulers for the handling of drywall waste in Phase 2 to ensure that accurate and complete data could be gathered.

StrategyMakers was able to intercept and handle drywall waste from three of the four homes. The fourth was missed due to miscommunication with the contracted hauler. There was also a challenge with weigh scale availability on one of the three loads collected and delivered by StrategyMakers. In the end, drywall from only 2 of the 4 homes was weighed directly by StrategyMakers.

To overcome this deficiency and ensure that reasonably accurate and comparable data on drywall (gypsum board) waste was gathered, StrategyMakers worked with a local drywall installer who voluntarily provided additional data on drywall waste from similar homes under construction to augment the data we were able to collect through our own collection/weighing efforts. (See discussion on Drywall in Section 3 and data in Appendix 2 for further details.)

Section 2 – *Generation* of New Home Construction Waste in Manitoba

The detailed tracking and measuring of waste generated through the construction of new residential homes is not a regulatory requirement in Manitoba, nor is it a common practice among Manitoba's homebuilders, waste haulers or waste disposal ground (landfill) operators. As a result, there is very little data available on the quantity and composition of waste generated in Manitoba during the construction of new residential homes.

One of the principle objectives of the Manitoba New Home Waste Construction Study is to gather accurate data to develop a baseline estimate of the amount of waste generated during the construction of new residential homes built in Manitoba through standardized wood-frame construction techniques.

> ***Reminder to Readers:*** *The data and calculations in this section cannot be used to estimate waste from Residential Renovation and Demolition activities, residential homes built through alternative, non-wood frame home building techniques or to any non-Residential Construction, Renovation and Demolition activities.*

Findings – Waste Generated at Phase 2 Sites

In Phase 1 it was reported that the total weight of waste collected from the sites under observation ranged from 4,430 to 8,120 kilograms. It was noted that these preliminary numbers were provided voluntarily by one waste hauler and it was not possible to control for external factors and inaccuracies inherent to the hauler's waste collection/disposal practices which may have skewed results, including:

- could not test for leakages between building sites (construction crews often place waste in the most convenient receptacle, even if the receptacle is on an adjacent site.)
- could not adjust for illegally dumped waste (various non-construction site wastes were observed in the bins in Phase 1 including heavy items such as car tires and parts, used mattresses, large furniture, large cabinetry, etc.)
- could not adjust for mud, concrete and other especially heavy materials improperly loaded into hauler's waste bins by construction crews (a relatively small, but heavy amount of mud and broken concrete were observed at various times in the Phase 1 bins.)

In Phase 2 StrategyMakers provided waste hauling services throughout the full period of construction for each of the 4 homes selected. This allowed for accurate weighing, tracking and documenting of all waste collected, diverted and disposed. It also allowed for separation of any particularly heavy, non-home construction waste (illegally dumped heavy/bulky items, large/heavy chunks of mud that got attached to waste during rainy periods) and removal of waste that was clearly identifiable as generated from an adjacent site. For example, roofing shingles were found in one bin that were clearly identifiable as belonging to the adjacent site due to color difference and also because the shingles had already been installed on the home months earlier.

Table 2.1 below shows the data for the 4 homes in the Phase 2 pilot. The amount of waste generated from the sites ranged from 3,440 to 4,825 Kilograms per site. The weighted average for the 4 homes is 4,059 Kilograms per home and the median is 3,986 Kilograms per home.

The amount of waste generated per square foot of home built also ranged considerably from site to site, from a low of 1.74 kilograms per square foot at Site 4 to a high of 2.25 kilograms per square foot at site 2. The weighted average for the data set was **2.01 kilograms per square foot** and the median was 2.03 kilograms per square foot.

Table 2.1 – Weight of Waste Generated in Phase 2 Sites

Site	Size of Home Built (Square Feet)	Total Waste Generated (Kilograms)	Waste Generated Per Square Foot Built (Kgs/Sq.Ft.)
Site 1	1871	3440	1.84
Site 2	2142	4825	2.25
Site 3	1742	3886	2.23
Site 4	2342	4087	1.74
TOTALS	**8097**	**16238**	**2.01**
Range Minimum	*1742*	*3440*	*1.74*
Range Maximum	*2342*	*4825*	*2.25*
Overall Average	*2024*	*4059*	*2.01*
Median	*2007*	*3986*	*2.03*

Baseline Estimate of the Quantity of Waste Generated through New Residential Home Construction in Manitoba (Update to Preliminary Estimates Reported in Phase 1)

The *weighted average kilograms of waste generated per square foot of home constructed* is an especially useful metric for planning waste diversion policies and activities for this sector. This metric provides a common factor that can be extrapolated to any size of home being built through the standardized wood-frame construction technique. It also provides a common standard that will be useful for benchmarking against findings in other jurisdictions, calculating overall waste generation and trends for the province and individual communities, and calculating recycling/diversion rates and similar performance measures.

Table 2.2 is an updated version of Table 4 from the Phase 1 report with the resulting calculation from Phase 2 data added[3]. Although Phase 2 represents a limited data set, it is reasonable to conclude that **2.0 kilograms of waste will be generated per square foot of new home constructed in Manitoba through standardized wood-frame construction techniques**.

The results of the Phase 2 pilot closely match the USEPA estimate, which was calculated based on a robust assessment of waste audits conducted on a total of 95 residential homes constructed in various jurisdictions across the United States.

Reminder to Readers: *The data and calculations in this section cannot be used to estimate waste from Residential Renovation and Demolition activities, residential homes built through alternative, non-wood frame home building techniques or to any non-Residential Construction, Renovation and Demolition activities.*

[3] Comparative data for this table was sourced from Kelleher, Perry and Robin, the Province of Manitoba's general estimate CRD waste, Statistics Canada data and results from a USEPA study. A detailed explanation of the calculations employed can be found in Appendix 2 of the Phase 1 report.

Table 2.2 – Updated from Phase 1 - Estimate of average kilograms of waste generated per square foot of new home constructed in Manitoba

	Kelleher, Perry, Robins	Province of Manitoba (20%)	Province of Manitoba (30%)	USEPA	Phase 1 Study Homes	**Phase 2 Study Homes**
Average Kilograms of Waste Generated Per Square Foot of New Home Constructed in Manitoba	0.64	1.68	2.53	1.99	3.05	2.0

Projected Total Amount of Waste Generated Through New Home Construction in Winnipeg, and Manitoba, Based on Housing Starts Data

Applying the estimated average of 2.0 kilograms of waste generated per square foot of new home constructed in Manitoba through standardized wood-frame construction techniques to housing starts data and current estimates on the average size of new home constructed may provide a reasonably accurate baseline estimate of the total waste generated through new home construction in Winnipeg and across the province.

Table 2.3 shows the estimated total amount of waste generated through new home construction in Manitoba over the past five years based on housing starts data and an average new home size of 1900 Square Feet.[4]

As expected, the estimated amount of waste generated moves in line with the total number of homes being built in a given year. Housing starts across Manitoba over the past 5 years were lowest in 2016 and it is expected that the amount of waste generated through new home construction would also have been lowest for the period at approximately 20,208 metric tonnes. Housing starts peaked in 2017 and total waste generated would have also peaked for the period at 28,504 metric tonnes.

[4] Reported by The Canadian Home Builders Association in http://news.nationalpost.com/news/canada/the-incredible-shrinking-home-why-canadas-houses-are-getting-smaller. (Manitoba Home Builders Association confirmed Manitoba's data is similar to national average).

Table 2.3 – Estimated Total Waste Generated Through New Home Construction: Manitoba (2013 to 2018)

	Manitoba Housing starts, by year (Excludes Apartment Building starts)				
	Actual 2014	**Actual 2015**	**Actual 2016**	**Actual 2017**	**Actual 2018**
Housing Starts Manitoba[1, 2] **Excludes Apartment building starts*	6,220	5,501	5,318	7501	7376
Multiply by Average size of home built	*1,900*	*1,900*	*1,900*	*1900*	*1900*
Equals Estimated Total Square Feet of home built in Manitoba each year	11,818,000	10,451,900	10,104,200	14,251,900	14,014,400
Multiply by Average Kgs of Waste Generated Per Square Foot	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
Equals Total Kilograms of Waste Generated in MB each year	23,636,000	20,903,800	20,208,400	28,503,800	28,028,800
Divide by 1000, equals **Total Tonnes of Waste Generated through new home construction in MB Each Year**	**23,636**	**20,904**	**20,208**	**28,504**	**28,029**

[1] Manitoba data from 2012-2018 sourced from: Statistics Canada. Table 34-10-0135-01 Canada Mortgage and Housing Corporation, housing starts, under construction and completions, all areas, quarterly (filters applied to segregate for Manitoba and exclude apartment building starts)

[2] Manitoba projections for 2017 and 2018 sourced from: Canada Mortgage and Housing Corporation, HOUSING MARKET OUTLOOK-Prairie Region Highlights, Fourth Quarter 2016. Link: https://www.cmhc-schl.gc.ca/odpub/esub/65438/65438_2016_B02.pdf?fr=1490823601829

Table 2.4 shows the estimated total amount of waste generated through new home construction in the City of Winnipeg over the same period and using the same calculations.

Inside Winnipeg, housing starts were also lowest in 2016 and the estimated amount of waste generated through new home construction in the city would also been lowest for the period at approximately 15,405 metric tonnes. Housing starts peaked in 2017 and total waste generated would have also peaked for the period at 21,360 metric tonnes.

Table 2.4 – Estimated Total Waste Generated Through New Home Construction: Winnipeg (2013 to 2018)

	Actual 2014	Actual 2015	Actual 2016	Actual 2017	Actual 2018
Housing Starts Winnipeg[3] *Excludes Apartment building starts	4,248	4400	4054	5621	5384
Multiply by Average size of home built	*1,900*	*1,900*	*1,900*	*1900*	*1900*
Equals Estimated Total Square Feet of home built in Manitoba each year	8,071,200	8,360,000	7,702,600	10,679,900	10,229,600
Multiply by Average Kgs of Waste Generated Per Square Foot	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
Equals Total Kilograms of Waste Generated in MB each year	16,142,400	16,720,000	15,405,200	21,359,800	20,459,200
Divide by 1000, equals **Total Tonnes of Waste Generated through new home construction in MB Each Year**	**16,142**	**16,720**	**15,405**	**21,360**	**20,459**

[3] Winnipeg data from 2012-2018 sourced from: Canada Mortgage and Housing Corporation, HOUSING NOW TABLES - Winnipeg CMA, February 2017. Link: https://www.cmhc-schl.gc.ca/odpub/esub/64191/64191_2017_M02.pdf?fr=1490824447636

Similar analysis can be done on any community within the province for which housing start data is available. This means any community or homebuilder in Manitoba can use the above methodology to calculate a reasonably accurate estimate of how much waste can be expected from new residential housing developments (excluding apartment buildings).

*In situations where more robust risk and sensitivity analysis is merited, it is possible and recommended, to run additional scenarios repeating the above calculations using the the Minimum (1.74 Kgs/sq.ft.) and Maximum (2.25 Kgs/sq.ft.) ranges observed in the Phase 2 data set (see Table 2.1).

Results - Waste Generation By-Material (Composition of New Home Construction Waste Stream)

Phase 2 was also designed to allow gathering accurate data on the composition of the new home construction waste stream. Table 2.5 shows a breakdown of the waste generated at the sites included in Phase 2.

Table 2.5 Breakdown of Waste Generated/Collected from Phase 2 Sites

Material	Total Weight Collected	Percentage of Total
Unpainted, Untreated and Uncontaminated Wood (lumber, OSB, plywood)	6,140	37.8%
Ferrous Metals	365	2.2%
Aluminum	65	0.4%
Copper	10	0.1%
Cardboard & Boxboard	661	4.1%
Hazardous Liquids & Containers	157	1.0%
PET & HDPE plastic food and beverage containers	6	0.0%
Asphalt Shingles	881	5.4%
Drywall (Gypsum board)	4,384	27.0%
Discarded building materials suitable for Re-use or Re-purposing (not including salvaged wood)[1]	115	0.7%
Residual Waste[2]	3,455	21.3%
Total	**16,238**	**100.0%**

[1] Discarded building materials found in the waste stream included the following items: wood and laminate flooring pieces suitable for re-use/repurposing, cabinet doors in usable condition, baseboard scraps in usable lengths and condition, inadvertently or incorrectly discarded door hardware, electrical/lighting supplies

[2] Residual waste includes all other materials and items that do not fit into any of the above major categories (ex. engineered wood products, fibreglass insulation, single and mixed resin plastics other than PET and HDPE food and beverage containers, etc.)

Approximately 6,140 kilograms of **Unpainted, Untreated and Uncontaminated Wood** (lumber, Oriented Strand Board, plywood) was collected, representing nearly 38% of the total weight collected in Phase 2.

Drywall was the second largest component of the waste stream, contributing approximately 4,384 kilograms or 27% of the total weight collected in Phase 2.

Although not a major contributor by volume, **Asphalt roofing shingles** are heavy and contributed approximately 881 kilograms, roughly 5% of the total weight collected.

Cardboard and Boxboard contributed 661 kilograms, approximately 4% of the total weight collected. This material takes up significant volume in waste bins and collection vehicles.

Overall, **Metals** contributed 435 kilograms, approximately 3% of the total weight. Ferrous was the most prevalent metal (365 Kgs or 2%). Aluminum scraps, which have significant salvage value, are usually recycled directly by of the installers or removed out from waste bins by scavengers. As a result, Phase 2 only showed 65 Kgs (~0.4%) of aluminum in the waste. Copper is even more valuable and therefore only a negligible amount was found (10 Kgs or 0.06%).

Approximately 157 Kgs of **Hazardous Liquid waste in containers** were found in the waste stream, just under 1% of the total waste. While negligible by both weight and observed volume, this category of waste is significant in its potential environmental impact and cost of disposal (discussed in Section 5).

A small amount (115 kilograms or 0.7%) of material in the waste stream was **Discarded building materials (not including salvaged lumber, OSB and plywood)** that were deemed to be reusable or possibly could be re-purposed in smaller building or craft projects, including the following items: wood and laminate flooring pieces suitable for re-use/repurposing, cabinet doors in usable condition, baseboard scraps in usable lengths and condition, inadvertently or incorrectly discarded door hardware, electrical/lighting supplies.

Residual Waste including all other materials and items that do not fit into any of the above major categories (ex. engineered wood products, fibreglass insulation, single and mixed resin plastics other than PET and HDPE food and beverage containers, etc.) totaled 3,455 kilograms (21% of total weight collected). These materials could not be reused, recycled, diverted or kept for repurposing and therefore were **disposed to landfill**.

A Note about Illegally Dumped Material in Phase 2

In Phase 1 of the study, a significant amount of illegally dumped, non-construction material was observed in or around the waste bins at new home construction sites. It was noted at the time that these non-construction waste materials contribute a significant amount of volume and weight (and handling and disposal cost) to the new home construction waste stream.

Large cabinet on framing waste at Phase 1 site

Old mattresses inside dumpster at Phase 1 site

Surprisingly, in Phase 2, there was very little of this illegally dumped, non-construction waste found in the bins or on the four sites. Examining the reasons behind this result is beyond the scope of this study but it may be in some part due to the following factors:

- The temporary wood bins used in Phase 2 were smaller and had lower walls than the large roll-off dumpsters haulers were using at some of the Phase 1 sites. This meant that very large bulky items (mattresses, car tires, old cabinets) would have been more visible in the Phase 2 bins, perhaps discouraging illegal dumping of bulky materials.
- Residents, and workers, near home construction sites may also observe that the large roll-off dumpster bins are serviced by automated collection trucks and therefore perceive that the materials they dump in the dumpster adds minimal burden and cost to the waste collector/hauler. In contrast, servicing the temporary wood bins used in Phase 2 sites may be viewed as requiring more manual effort and it may be possible that some individuals may be more able to self-justify illegal dumping where they perceive they are causing minimal burden.
- Three of the four sites chosen for Phase 2 happened to be on a street where adjacent homes were being constructed at roughly the same time. Many of the Phase 1 sites were situated next to homes that were already occupied. It was clear during Phase 1 observations that neighbors often dumped their bulky waste into the construction bins next door.

Section 3 – Results: *Diversion* of New Home Construction Waste

Another important objective of the Phase 2 operational pilot study was to determine the amount of new home construction waste that could potentially be diverted from disposal in Winnipeg at this point in time through reuse, recycling, recovery and other environmentally preferred alternatives. The waste diversion results of the Phase 2 operational pilot are presented below.

Results – Overall Diversion of New Home Construction Waste

Overall, the results of the Phase 2 operational pilot demonstrate that, with due care and attention to the collection, separation and delivery of the various materials discarded at building sites, there is a significant potential for increasing diversion of new home construction waste in Winnipeg at this point in time.

> ***A note about the "due care and attention" to waste diversion efforts in Phase 2:***
> *The high diversion rate achieved during this operational pilot study is partially reflective of the extreme diligence applied in sorting waste materials to meet the specific objectives of the project. For example, even the smallest pieces of divertible lumber scraps were separated out and delivered to biomass energy market. Such an extreme level of sorting may not be scalable to new home construction waste diversion efforts involving higher volumes, at least in the near term where it is anticipated that sorting equipment and technology may be limited.*

Table 3.1 provides a summary of the results of the Phase 2 pilot. Of the 16,238 total kilograms collected from the four sites, only 3,455 kilograms (21%) was delivered and disposed to landfill as commercial mixed waste. The other 12,783 kilograms (79%) of discarded material collected from the four building sites was recycled, diverted or kept as reusable salvaged building materials. Diversion as a percentage of waste collected was fairly consistent across the four sites, ranging from 76% at site number four to 83% at site number 1.

Table 3.1 – Phase 2 Results: Overall Diversion of New Home Construction Waste

Site #	Square Footage of Home	Total Weight Collected (Kgs)	Waste Disposed Directly to Landfill (Kgs)	Material Recycled, Diverted and Salvaged (Kgs)	Percent Diverted by Site
1	1871	3,440	570	2,870	83%
2	2142	4,825	900	3,925	81%
3	1742	3,886	890	2,996	77%
4	2342	4,087	980	3,107	76%
Adjustment - Final Cleanup of Sorting/Staging Area	n/a	-	115	(115.0)	
Total	**8,097**	**16,238**	**3,455**	**12,783**	
Overall Percentage			**21%**	**79%**	

Phase 2 Sorting for Material Diversion (9 Groupings)

Site observations and interviews conducted in Phase 1 of the Manitoba New Home Construction Waste Diversion Study showed that there are 12 major categories of waste material generated during the construction of new homes built using the standardized wood-frame construction method[5]. It was also determined in Phase 1 that feasible reuse, recycling and diversion opportunities *in Manitoba at the time* generally only existed for some materials contained in the 12 major categories.

Phase 2 focused primarily on those construction materials for which reuse, recycling and diversion opportunities exist. Specifically, the components of the 12 major categories were collected from building sites and sorted into the following 9 groupings based on known reuse, recycling and diversion opportunities in the Winnipeg area during the study period.

[5] Table 5, Report to MEIA: Manitoba New Home Construction Waste Diversion Study – Phase 1, page 33.

Grouping 1 – Wood suitable for energy recovery (Group1a) or salvage/reuse (Group 1b)

- Clean (unpainted, untreated, uncontaminated) dimensional lumber scraps
- Oriented Strand Board (OSB) and untreated plywood
- Wood pallets, crates and strips used for shipping supplies to site

Grouping 2 – Metals accepted for recycling

- Ferrous metals, including: Steel strapping, Steel wire mesh scraps, Rigid metal ducting pieces and scraps, Metal packaging, Nails, screws and metal hardware fasteners of varying types and sizes
- Non-Ferrous metals (Aluminum fascia, soffits, eaves and scrap drop ceiling Ts; Copper electrical wire scraps)

Grouping 3 – Paper materials accepted for recycling

- Corrugated cardboard (OCC) boxes, lining and packaging in various sizes and shapes
- Boxboard and other paper packaging including carpet rolls and packaging for fixtures and supplies

Grouping 4 - Fibreglass/Asphalt Roofing Shingles to be processed for use in new asphalt

- Fibreglass/asphalt roofing shingles scraps, cutoffs, and often remaining full sheets from open packages– roofing shingles placed on new homes now contain a fibreglass layer.

Grouping 5 - Hazardous Liquid Wastes & Containers to be sent to hazardous waste management facilities for proper disposal

- Containers/products including: Expandable foam insulation canisters, Caulking and sealant tubes, Empty containers of plumbing adhesives, 5 gallon, HDPE #2 plastic paint pails, Flooring adhesives

Grouping 6 – Drywall (that was 100% free of nails, paints or other contaminants) that could be recycled or used as an additive to composting operations.

- Drywall (aka gypsum board) scraps in various lengths, widths, angles and damaged full sheets

Grouping 7 – Plastics that are currently accepted by recycling processors

- PET beverage containers and HDPE packaging

Grouping 8 – Select building materials that could be salvaged, reused or re-purposed (not including salvaged lumber, OSB and plywood which is reported separately as Group 1b)

- Building materials suitable for reuse in building and/or craft projects, including: baseboards/trim in good condition and sizes suitable for use; flooring pieces usable for re-purposing in craft projects; discarded items in usable condition (ex. extra door hardware, a few cabinet doors)

Grouping 9 – All remaining materials (anything found in the bins that could not be reused, recycled or diverted at the time of the operational pilot)[6]

- Engineered Wood Products (EWP) scraps and damaged pieces including: Pressure Treated Lumber and plywood, Particle Board, Medium Density Fibreboard (MDF), Engineered wood and wood/composite flooring
- Plastics used in construction including: Flexible High Density Polyethylene (HDPE) drainage pipe scraps, Rigid polyethylene (PE) pipe gas and vent pipe scraps, Rigid ABS (Acrylonitrile-Butadiene-Styrene) plumbing pipe scraps, PEX (Cross-linked polyethylene) water supply lines scraps, Polystyrene foam blocks and packaging, Sheathing from electrical conduit wire scraps, Plastic film, Polyvinyl chloride (PVC) siding scraps and damaged pieces, Polyvinyl chloride (PVC) flooring scraps, Mixed plastic foam flooring/carpet underlayment scraps
- Non-recyclable papers- Paperboard construction tubing, waxed paper, contaminated paper
- Carpeting - Carpet scraps, cut-offs and odd-shaped pieces (often bagged in garbage bags)
- Fibreglass insulation - Fibreglass batte insulation scraps, Flexible fibreglass insulated ducting
- High-density polyethylene fiber "house wrap" scraps, ends of rolls, and damaged pieces
- Fiberglass/Mineral/Fiber acoustical ceiling tiles unusable ends/angles
- Cement-based materials, stone/masonry and ceramics scraps
- This grouping also included any non-construction, illegally dumped waste found in the bins

[6] Further analysis of individual subcategories within Group 9 may become more important in future studies but they were not weighed and tracked separately in this operational pilot study.

Waste Diversion Results for Each of the Nine Material Groupings

Table 3.2 below shows the site specific, and overall waste diversion results for each of the nine groupings.

Table 3.2 Diversion by Site and by Material Grouping

Waste Material Grouping	Site 1	Site 2	Site 3	Site 4	Adjustments Cleanup of Staging Area	Total Weight By Grouping (Kgs)	% of Total
Group 1a - Wood delivered for use in biomass energy recovery systems	556	1,445	930	886	120	**3,937**	**24.2%**
Group 1b - Wood (lumber, OSB and plywood) kept for salvage	786	681	350	672	(286)	**2,203**	**13.6%**
Group 2a - Metals: Ferrous	80	103	69	113		**365**	**2.2%**
Group 2b - Metals: Aluminum	6	3	11	45		**65**	**0.4%**
Group 2c - Metals: Copper	1	2	1	1	5	**10**	**0.1%**
Group 3 - Paper (Cardboard, Boxboard)	245	184	133	99		**661**	**4.1%**
Group 4 - Roofing Shingles	110	220	272	279		**881**	**5.4%**
Group 5 - Hazardous liquid waste in containers	30	54	33	40		**157**	**1.0%**
Group 6 - Drywall (aka Gypsum board)	1,029	1,205	1,190	960		**4,384**	**27.0%**
Group 7 - PET and HDPE Plastic Packaging	27	30	7	11	(68.5)	**6**	**0.0%**
Group 8 - Salvaged Building Materials					115	**115**	**0.7%**
Group 9 - Waste disposed directly to landfill	570	900	890	980	115	**3,455**	**21.3%**
Total Weight Collected (Kgs)	**3,440**	**4,825**	**3,886**	**4,087**	-	**16,238**	**100.0%**

Approximately 3,937 kilograms of unpainted, untreated and uncontaminated wood (Group 1a) representing 24% of the total weight of material collected in Phase 2 was diverted to be used as a biomass fuel source in small scale energy recovery facilities in and near Winnipeg.

An additional 2,203 kilograms of wood, including dimensional lumber, Oriented Strand Board and plywood pieces were deemed to be salvageable and kept for use in smaller building and craft projects (Group 1b).

Overall, approximately 435 kgs of metals (Group 2) representing 3% of the total weight of materials collected in Phase 2 were delivered to scrap metal brokers for recycling into new metal products. Most of the metal recycled was ferrous (365 Kgs or 2%). Aluminum scraps, which have significant salvage value, are usually recycled directly by of the installers or removed out waste bins by scavengers. As a result, only 65 Kgs (0.4% of total) of aluminum was collected and recycled. Copper is even more valuable and therefore only a negligible amount was found (10 Kgs or 0.06% of total)

Approximately 661 kilograms of Cardboard and Boxboard (Group 3) was collected and delivered to a local paper recycling processor representing approximately 4% of the total weight of material collected.

Over 881 kilograms of Asphalt roofing shingles (Group 4) were collected and diverted for processing into new asphalt, representing over 5% of the total weight of material collected.

Approximately 157 Kgs of Hazardous Liquid waste in containers (Group 5) were found in the waste stream, representing just under 1% of the total waste collected. These materials were diverted to a proper hazardous waste management facility.

Over 27% of the material collected in Phase 2, was drywall or gypsum board (Group 6). Approximately 4,384 kilograms of drywall was collected and delivered to commercial composting operations in Winnipeg and Winkler, Manitoba.

All mixed and single resin plastics were initially collected and stored at the staging area. In the end, recycling opportunities were found only for PET and HDPE plastics totaling 6 kilograms (Group 7). The remaining plastics had to be sent for disposal and are included in the Group 9 weight.

Approximately 115 kilograms (0.7% of total material collected), was select pieces of good quality leftover wood flooring and a small number of other items (door hardware, cabinet

doors) that were deemed salvageable and potentially reused or re-purposed in craft projects (Group 8).[7]

And finally, a total of 3,455 kilograms of material (approximately 21% of the total collected) could not be reused, recycled, diverted or kept for repurposing and therefore was disposed to landfill (Group 9).

Group 1a – Wood suitable for energy recovery

This group was comprised of the following materials:

- Clean dimensional lumber (unpainted, untreated, uncontaminated), including dimensional lumber scraps, cut-offs and damaged pieces in various lengths
- Oriented Strand Board (OSB) and untreated plywood
- Wood pallets, crates and strips used for shipping supplies to site

The majority of clean dimensional lumber and OSB is generated during the framing stage of construction, although some small amounts are also generated through the entire construction cycle. Wood pallets, shipping crates and wood strips can be found in the waste stream throughout the building cycle.

The total weight of wood found to be suitable for energy recovery was 3937 kilograms, representing approximately 24% of the total waste collected from the four sites.

[7] Reusable building materials (Group 8) were initially collected and weighed together with salvageable wood, and later separated and weighed during the final cleanup of the staging area. Therefore, site-specific weights are not available for Group 8 materials.

The 3937 kilograms of clean lumber, OSB and pallets/crates was all delivered to Perimeter Lumber, (the processing division of Finmac Lumber Limited), located just south of Winnipeg in La Salle Manitoba at Highway #330.

Finmac currently accepts delivery of unpainted and untreated lumber, OSB and pallets/crates at no charge from pre-approved suppliers. The company monitors deliveries to ensure delivered wood meets strict quality standards. Wood accepted at the site is shredded for various uses including use on-site in special furnace/burners that help heat and dry new lumber and wood products as part of Finmac's wood processing operation, and; sale to outside buyers who use the wood as biomass energy in furnaces/burners.

Group 2a, b, c – Metals to be recycled

This group was comprised of the following:

- Ferrous metals, including: Steel strapping, Steel wire mesh scraps, Rigid metal ducting pieces and scraps, Metal spools (packaging for bulk electrical conduit wire), Nails, screws and metal hardware fasteners of varying types and sizes

- Non-Ferrous metals (Aluminum fascia, soffits, eaves and drop ceiling cross member scraps; Copper electrical wire scraps)

Sporadic amounts of ferrous metals (Group 2a) are generated through the entire construction cycle. Steel strapping is found during the framing stage. Metal ducting scraps are generated during the installation of heating and ventilation pipes. Discarded metal spools used in the sale of bulk electrical conduit wire are found during the rough-in electrical stage. Damaged and mishandled nails, screws and assorted fasteners are found in very small amounts throughout the build. One large tank of compressed air was also found in a waste bin at one of the four homes. Metal wire mesh scraps are generated when the exterior of the home is wrapped in preparation for installation of stucco.

The total weight of ferrous metals collected at the four sites was 365 kilograms, representing approximately 2.2% of the total waste collected.

Aluminum scraps (Group 2b) are generated mainly during the installation of fascia, soffits and eaves. Much of the aluminum is recycled directly by the installers because of its relatively high scrap value. Some installers don't bother recycling their aluminum and simply dispose of the scraps in the waste bin.

The total weight of aluminum collected at the four sites was 65 kilograms, representing approximately 0.4% of the total waste collected. It should be noted that this does not necessarily represent the total amount of aluminum waste generated. Aluminum is often removed from waste bins by individuals who monitor construction sites specifically for valuable metals.

Only a minute amount of copper waste (Group 2c) is found in new home construction waste bins, most of it in contained in electrical wire scraps generated during the rough-in electrical stage of building.

The total amount of copper collected at the four sites was 10 kilograms, representing approximately 0.06% of the total waste collected. It should be noted that this does not represent the total amount generated. Most, if not all, electricians recycle their own copper wire scraps because of the high value of copper. Any visible and significant amount of copper wire that does make its way into the bin is very quickly snapped up by individuals monitoring construction bins for valuable material. The copper we observed on site was typically very short lengths of electrical wire that were either missed or deemed insignificant and not worth gathering.

All of the metals (ferrous, aluminum and copper) collected during the operational pilot were delivered to Urbanmine Inc. located at 72 Rothwell Road in Winnipeg.

Urbanmine Inc. is one of Winnipeg's many scrap metal brokers. The company accepts all shapes and sizes of steel, copper, brass, aluminum, stainless steel, high-temperature alloy or lead and other metals. All material is weighed on entry and prices paid for materials vary according to market conditions.

Group 3 – Paper materials to be recycled

This group was comprised of the following materials:

- Corrugated cardboard (OCC) boxes, lining and packaging in various sizes and shapes
- Boxboard and other paper packaging including carpet rolls and packaging for fixtures and supplies

Corrugated cardboard (OCC) and boxboard (OBB) is generated through the entire construction cycle, but especially in the later stages of building.

The total weight of corrugated cardboard and boxboard collected was 661 kilograms, representing approximately 4.1% of the total waste collected from the four sites.

In addition to being a significant contributor to the total weight of material collected, corrugated cardboard and boxboard is a major contributor to the overall volume of waste collected. Cardboard boxes ranging in size from very small to very large (big enough to encase furnaces and hot water tanks) are typically discarded into, or near bins, uncollapsed. These uncollapsed boxes fill waste bins and collection vehicles faster than necessary. A significant amount of time and effort was expended in cutting, collapsing and condensing corrugated cardboard boxes and large boxboard rolls to maximize space in the trailer during collection and delivery.

The 661.2 kilograms of cardboard, boxboard and a minute amount of other printed paper was all delivered to Cascades Recovery at 100 Omands Creek in Winnipeg. Cascades Recovery works with their parent company to recycle these fibres into a variety of new paper products.

Group 4 - Fibreglass/Asphalt Roofing Shingles

This group was comprised of the following materials:

- Fibreglass/asphalt roofing shingles scraps, cut-offs, and damaged or leftover full sheets

Waste fibreglass/asphalt roofing shingles are generated during a specific stage of construction. Once the walls and roof of the home is fully sheathed in OSB and/or plywood, specialty roofing crews install the shingles all within a very short period.

The total weight of fibreglass/asphalt roofing shingles waste collected was 881 kilograms, representing approximately 5.4% of the total waste collected from the four sites.

All 881 kilograms of fibreglass/asphalt shingles was delivered to Penner Waste Winnipeg division, located just west of the Winnipeg perimeter at 14 Wanda Way.

Penner Waste currently accepts delivery of waste fibreglass/asphalt shingles at variable fees depending on the cleanliness of the load. Loads contaminated with garbage or plastic film are charged extra fees. Nails in the shingles are acceptable. The Waste shingles accepted at the site are ground up with specialized equipment and resold for various uses including:

- Added into asphalt in private projects as a replacement for virgin oil.
- Used by municipalities for dust suppression on gravel roads and parking lots.
- Turned into bicycle paths and walkways at campgrounds.
- Used for creating driveways, walking paths, etc.

Group 5 - Hazardous Liquid Wastes & Containers

This group was comprised of containers and products similar to what may be found in the household hazardous waste (HHW) stream, including mostly:

- Expandable foam insulation canisters
- Caulking and sealant tubes
- Empty containers of plumbing adhesives
- 5 gallon, HDPE #2 plastic paint pails
- Flooring adhesives

Hazardous liquid wastes and containers are generated during in small amounts through the entire construction cycle.

The total weight of hazardous liquid wastes & containers collected was 157 kilograms, representing approximately 1% of the total waste collected from the four sites.

Paint containers and containers that are eligible under the for free drop-off at household hazardous waste depots under the rules of the Manitoba Household Hazardous Waste Stewardship Program were delivered directly to the Miller Environmental site at 1803 Hekla and the City of Winnipeg Brady Road 4Rs site.

The remaining hazardous liquid wastes & containers collected are not eligible for free drop-off because they were generated at commercial sites. This material was stored at the staging area until all construction was completed at all four sites. Miller Environmental was contracted to pick up the materials from the staging area.[8]

Miller Environmental disposes of hazardous waste and containers at their treatment and processing facility in St. Jean Baptiste, Manitoba.

Group 6 – Drywall (Gypsumboard)

This group was comprised exclusively of drywall (gypsum board) scraps in various lengths, widths, angles. Except for the odd exception, unlike drywall waste from renovation and demolition projects, drywall waste generated during the construction of new homes does not contain screws, nails, paint or other contaminants.

In all of the sites included in both Phase 1 and Phase 2 of this study, it was found that drywall waste is typically kept separate from all the other waste generated on new home construction sites. Drywall installers are responsible for hauling and disposing their own drywall waste from

[8] Provincial regulations and required procedures for collecting and handling hazardous waste materials were also followed where applicable. Strategy Makers registered for a Hazardous Waste Generator Registration Number (MBG14323). See Appendix 4 for registration forms and documentation.

each home they are contracted to service and drywall crews are told not to put drywall scraps in the bin provided by the homebuilder. Some installers use their own crews to collect drywall waste from each home. Others subcontract their own waste hauler to provide the service. Home builders and drywall installers consulted during Phase 1 and 2 confirm that this is standard practice, at least in Winnipeg.

As a result of this practice, drywall waste from new home construction is especially uniform in composition and generally free of nails, screws, paint or any other contaminants. This makes drywall waste from new home construction very different from drywall waste from renovation or demolition projects.

Drywall waste is generated during two very specific stages of construction. The majority of this waste is generated after the rough in electrical, plumbing and all heating ducts are installed. At this time the interior walls are covered with drywall. Full sheets are preferred by installers wherever possible to minimize seams and need for the more tedious and time-consuming tasks of taping, puttying and sanding to create the smooth finished walls.

Additional drywall waste is also generated in homes where finished basements are part of the building specifications. Installation of drywall in the basement level of new homes is completed as a separate activity later in the building cycle.

As noted in the Methodology section of this report, the handling of drywall (gypsum board) waste presented additional complexity. StrategyMakers was able to intercept and handle drywall waste from three of the four homes. There was also a challenge with weigh scale availability on one of the three loads collected and delivered by StrategyMakers. In the end, drywall from only 2 of the 4 homes was actually weighed by StrategyMakers.

To overcome this deficiency and ensure that reasonably accurate and comparable data on drywall (gypsum board) waste was gathered, StrategyMakers worked with a local drywall installer who voluntarily provided additional data on drywall waste from similar homes under construction to augment the data we were able to collect through our own collection/weighing efforts.

Using the data and calculations shown in Appendix 2, it is estimated that the total weight of drywall collected from the four sites was 4384 kilograms, representing approximately 27% of the total waste collected from the four sites.

The collected drywall was delivered to two locations:

- 2 loads were delivered to Samborski Environmental Ltd in LaSalle, Manitoba
- 2 loads were taken to Penner Waste composting facility in Winkler, Manitoba

Both of these recipients purport to use the drywall as an additive to their composting operation.[9]

[9] Samborski Environmental's composting operation in LaSalle has since been closed down.

Discussions with Local Drywall (Gypsum board) Manufacturer

Winnipeg is home to a drywall (gypsum board) manufacturing facility owned and operated by CertainTeed (the North American subsidiary of Paris-based St. Gobain (www.saint-gobain-northamerica.com/business/brands/certainteed).

An attempt was made to arrange for a test load of drywall scraps from one of the Phase 2 sites to the facility to determine if the material was suitable as feedstock for recycling into new drywall (gypsum board).

It was determined that the Winnipeg facility was not yet able to receive post-construction waste. However, the company did agree to have a representative conduct a brief visual inspection to determine if the drywall waste collected from the Phase 2 sites appeared to meet the same quality standards the company and its processing partners are currently achieving in drywall (gypsum board) recycling facilities in British Columbia.

On February 8, 2018, a load of drywall waste collected from Site 3 was taken to CertainTeed's plant in St. James Winnipeg for a brief visual inspection by the Regional Manufacturing Manager of Western Canada.

After reiterating that the facility does not have capacity to recycle post-construction drywall waste at this time, and that stringent testing and quality control certification would be required before any recycling of drywall was even attempted, we were advised that the condition of the load of drywall collected from Site 3 did appear on preliminary inspection to be similar to the material that is accepted for recycling in the British Columbia process.

The reason new home construction drywall waste is potentially acceptable as feedstock for recycling into new drywall is that, unlike drywall waste from renovation and demolition activities, the drywall waste collected from new home construction in Winnipeg is:

- generally clean and free of paint, glue, residues, mold or other contaminants
- generally contains no nails, screws or other fasteners
- currently collected separately from other construction waste and is largely kept dry and free of snow, mud and other site-based contamination

CertainTeed (St. Gobain) does not have any near term plans to establish post-construction drywall (gypsum board) recycling initiatives in Winnipeg but they did express an interest in continuing dialogue with the home construction sector on longer-term possibilities.

After the visual inspection, the load of drywall waste from Site 3 was delivered to Penner Waste's composting operation in Winkler, Manitoba.

Group 7 – Plastics that were being accepted by recycling processors

Unfortunately, most single and mixed resin plastics used in the construction of new homes was not being accepted by local processors/brokers of recycled plastics at the time of the study. As a result, most plastics were sent to landfill (see Group 9).

Group 7 was comprised only of the following plastic products:

- PET beverage containers (from worker lunches)
- HDPE food and product packaging (mainly from worker lunches but also a small amount of household waste plastic illegally disposed in the construction site bins)

Only a very small amount of PET and HDPE plastic containers was collected. The total weight was just over 6 kilograms, representing approximately 0.04% of the total waste collected from the four sites. The picture at right shows a large portion of the PET and HDPE containers collected, fitting inside one medium sized waste receptacle.

The PET beverage containers and HDPE containers were delivered to the appropriate recycling receptacle at the Brady Road 4Rs Site.

Group 1b and Group 8 – Wood and other building materials that could be salvaged, reused or re-purposed

Consistent with the underlying objectives of this study and the 4Rs hierarchy for waste diversion (Reduce, Reuse, Recycle, Recover), some of the materials collected from waste bins and framing waste piles at the four sites were set aside to be salvaged and reused or re-purposed as building materials for smaller projects.

The vast majority of material salvaged from the waste stream (2,203 kilograms) was wood in the form of dimensional lumber pieces ranging in lengths from 2 feet to 7 feet and Oriented Strand Board sections in various sizes less than full sheets (Group 1b).

A small amount (115 kilograms) of other salvaged materials (Group 8) included:

- cut offs from baseboards and trim
- scraps and leftover pieces from installed wood and composite flooring
- a few kitchen/bath cabinet doors that were discarded (some still in the original box)

The purpose of salvaging all of these materials was simply to determine if any of the collected pieces could be reused and re-purposed in other applications.

The salvaged materials were moved to the author's personal workshop. A significant portion of the material has already been used as inputs to small building projects (photos below).

Table saw/work bench from salvaged wood

Outdoor work bench with storage

Washer/Dryer pedestal made from salvaged lumber, OSB, baseboards, and laminate flooring scraps

The remaining pieces are being held for similar projects to be completed in spring/summer (outdoor storage cabinets, craft outdoor furniture).

There may be some unusable lumber and OSB scraps leftover. These will be collected and delivered to Finmac lumber similar to Group 1 materials. Some of the salvaged materials (ex. cabinet doors) have been stored in dry location over the winter and will be re-inspected and potentially donated to Habitat Re-Store in Winnipeg.

The work done as part of the Phase 2 operational pilot will not inform the economic feasibility of salvaging large volumes of building materials from the new home construction waste stream for re-use or re-purposing, nor will it inform the most effective and efficient approach for salvaging materials. However, it does demonstrate that, with some effort and creativity, a significant portion of the building materials (especially wood) found in the new home construction waste stream may be suitable for reuse and/or re-purposing into smaller building and craft projects.

Group 9 – All remaining materials – anything that could not be reused, recycled or diverted at the time of the operational pilot

Any material that could not be reused, recycled or diverted at the time of the Phase 2 operational pilot, was included in this group, including:

- Engineered Wood Products (EWP) scraps and damaged pieces in various lengths, widths, angles, including: Pressure Treated Lumber and plywood, Particle Board, Medium Density Fibreboard (MDF), Engineered wood and wood/composite flooring
- All Single and Mixed Resin Plastics used in construction including: Flexible High Density Polyethylene (HDPE) plastic drainage pipe scraps, Rigid polyethylene plastic pipe gas and vent pipe scraps, Rigid ABS (Acrylonitrile-Butadiene-Styrene) plastic plumbing pipe scraps, damaged pieces and connectors, PEX (Cross-linked polyethylene) plastic water supply lines scraps, Polystyrene – including: Large polystyrene foam blocks, Polystyrene foam packaging and liner, Plastic sheathing of electrical conduit wire scraps (*copper wire removed), Plastic film - packaging for various building materials (various colors), Polyvinyl chloride (PVC) siding scraps and damaged pieces, Polyvinyl chloride (PVC) flooring scraps in various widths, lengths, angles, colors and patterns, Polyethylene, polypropylene or mixed plastic foam flooring and carpet underlayment scraps
- Non-recyclable paper materials - Paperboard construction tubing used when pouring footings (typically contain cement/concrete residue), Kraft paper bags – packaging for stucco sand, contaminated paper (ex. cardboard with paint residue)
- Carpeting - Carpet scraps, cut-offs and odd-shaped pieces (often bagged in garbage bags)
- Fibreglass insulation - Fibreglass batte insulation scraps (typically bagged in its original film packaging); Flexible fibreglass insulated ducting
- High-density polyethylene fiber “house wrap” scraps, ends of rolls, and damaged pieces
- Fiberglass/Mineral/Fiber acoustical ceiling tiles unusable ends/angles
- Cement-based materials, stone/masonry and ceramics including: Natural and manufactured stone veneer scraps; Ceramic tiles; Cement board siding scraps and damaged pieces

Detailed analysis of the individual subcategories within Group 9 may become more important in future research but it was not deemed necessary for the purposes this study. Subsequently the various subcategories in Group 9 were not weighed and tracked separately. Instead, they were all collected and weighed together then disposed directly to the Brady Road Landfill.

The total weight of waste disposed to landfill was 3,455 kilograms, representing approximately 21% of the total amount of material collected from the four sites.

All 3,455 kilograms of waste was disposed as mixed commercial waste at the City of Winnipeg Brady Road landfill.

It should be noted that recycling opportunities for some of the materials in this group may exist in other jurisdictions (ex. fibreglass batte insulation is being recycled in Alberta) and/or at different points in time (ex. some of the resins of plastic used in construction materials have been accepted for recycling in the past and may be accepted again in the future). However, there were no known diversion opportunities available within the Winnipeg area at the time of the pilot.

Section 4 – Costs and *Potential* Savings from Diverting New Home Construction Waste in Manitoba

The methodology, manpower and equipment used in Phase 2 was chosen primarily to meet the objective of gathering accurate and valuable waste diversion data to assist policy makers and home building sector participants to pursue practical measures for diverting new home construction waste.

As a result, there are important considerations that need to be taken into account when analyzing the potential costs and savings information reported in this section. Specifically:

- Phase 2 was a micro pilot study involving only four homes, two participating home builders, and one individual acting as the waste hauler for the four sites. This represents only a small fraction of the homes built across the province and does not in any way capture the wide variation in contractual arrangements made between homebuilders, waste haulers and other relevant parties (landfill operators, recyclers, etc.).
- The methodology used by StrategyMakers for collecting, sorting and disposing/delivering the waste was developed specifically for the purpose and objectives of this study. It does NOT reflect standard practices used by waste haulers currently servicing the new home building sector. It is also NOT reflective of an efficient collection, sorting, hauling system for new home construction waste diversion.
- Once a suitable end market was found for each grouping, no further attempt was made to negotiate better revenues or tipping fee terms. Storage space limitations, time constraints and loading and handling logistics outweighed the pursuit of optimum pricing. This means higher revenues and/or more favourable tipping arrangements may be possible.
- Revenues received from the sale of recyclable materials (metals, cardboard/boxboard), and tipping fees paid for diverting certain materials (clean wood, asphalt shingles, drywall) also reflect market conditions at the time of delivery. Revenues and tipping fees fluctuate according to market conditions and the quantity and quality of the materials delivered. For example, the market value for corrugated cardboard was at low levels during the pilot study but does increase substantially during periods of high demand.

Despite the above limitations, meaningful information was gathered on the cost and potential savings of diverting new home construction waste in Manitoba. Table 4.1 provides a summary of the costs and revenues incurred during the study and offers insight into the potential avoided waste disposal costs and revenues that may be realized from diverting new home

construction waste from landfill. The data shown in the summary table is further explained in the sections that follow.

Table 4.1 Summary of Costs & Revenues - Phase 2 Operational Pilot

Total tipping fee that would have been payable had we delivered all 16,238 Kgs of waste collected from the 4 sites to City of Winnipeg Brady Road landfill ($78/tonne)		*$1,266.54*	(A)
Tipping fee paid on the 3,455 Kgs of waste delivered to Brady Road landfill ($78/tonne)	$266.76		
Tipping fee paid for disposal of 881 kgs of Asphalt Shingles at Penner Waste Winnipeg site (~$44/tonne)	$38.73		
Tipping Fee paid for disposal of 4,384 kgs of Drywall at Penner Waste (Winkler) and Samborski (LaSalle) (charged $20 to $30 per full load)	$110.00		
Total Actual Tipping Fees Paid		$415.49	(B)
Landfill tipping fees Avoided		$851.05	(A)-(B) = (C)
Revenue Received: Ferrous Metals	$71.10		
Revenue Received: Aluminum	$23.00		
Revenue Received: Copper	$39.05		
Imputed Revenue at Current Value: Cardboard	$6.60		
Total Revenue Received		$139.75	(D)
Overall Savings Potential (<u>Before accounting for hazardous waste removal</u>)		**$990.80**	(C) + (D)

Savings from Avoided Landfill Tipping Fees

A total of 16,238 kilograms (16.24 tonnes) of waste was collected from the four sites included in Phase 2. The City of Winnipeg currently charges a tipping fee of $78/tonne for disposing mixed commercial waste at the Brady Road landfill. This means that <u>*it would have*</u> cost approximately $1267 if all of the waste collected from the four sites was simply delivered to the landfill and disposed as mixed commercial waste.

After sorting and diverting over 79% of the waste collected, only 3,455 kilograms (~3.46 tonnes) of waste was in fact delivered and disposed to landfill, incurring actual waste disposal tipping fees totaling $266.76.[10] Additional tipping fees of $38.73 were incurred for diverting asphalt shingles (approximately $44 per tonne delivered to Penner Waste). Additional tipping fees of $110 were also incurred for diverting drywall waste to Penner Waste and Samborski (price ranged from $20-$30 per load delivered, not by weight). Therefore, $415.49 was paid in total tipping fees during Phase 2, a savings of just over $851.

Revenues from the Sale of Recyclable Materials

Metals delivered to urbanmines Inc. generated a small but meaningful amount of revenue. The 365 kilograms of ferrous metals recycled yielded $71.10 in revenue (an average of approximately $0.195 per kilogram). The 65 kilograms of aluminum recycled yielded $23.00 in revenue (an average of approximately $0.357 per kilogram). The 10 kilograms of copper recycled yielded a total of $39.05 in revenue (an average of $3.91 per kilogram).

To minimize administrative burden related to the small amount of Corrugated Cardboard and Boxboard generated during the Phase 2 micro pilot, it was determined that there would be no actual revenue exchanged for this grouping. Nevertheless the imputed market value of Corrugated Cardboard and Boxboard delivered to Cascades Recovery Inc. at the time of the study was quoted at approximately $10/tonne, resulting in an imputed contribution to revenue of approximately $6.60 from the sale of recycled Cardboad and Boxboard. It should also be noted that the value of Corrugated Cardboard is currently at a historical low and can fluctuate considerably over time. At peak demand, collection and recycling of this material category may generate considerable revenue for recycling programs.

Overall, the total revenue received from the sale of scrap metals and the imputed revenue receivable from sale of Cardboard and Boxboard equals $139.75.

[10] It should also be noted that actual tipping fees paid for disposal at Brady Road were higher than necessary because we often delivered very small loads of waste and were charged a flat minimum fee regardless of the weight (the minimum fee increased from $15 to $20 per load midway through the study period). Had we delivered larger loads less frequently, or been charged actual weight of these small loads, the total actual tipping fees paid throughout Phase 2 would have been modestly lower.

Potential Savings from Avoided Waste Disposal – (Before Accounting for Hazardous Waste Removal)

Taking into account the $851 savings from avoided tipping fees, and an added revenue gain of $139.75, the potential savings from avoided waste disposal costs for the four sites included in Phase 2 totaled nearly $991 (an average of $248 per home).

Hazardous Waste Removal – A Significant Cost for the Phase 2 Operational Pilot

One of the unanticipated findings of the Phase 2 operational pilot was the significantly high cost incurred for the removal of materials that fall within the category of hazardous liquid waste & containers, including:

- Expandable foam insulation canisters
- Caulking and sealant tubes
- Empty containers of plumbing adhesives
- 5 gallon, HDPE #2 plastic paint pails
- Flooring adhesives

Under current waste hauling practices in the sector, the above hazardous liquid wastes & containers collected from home building sites are not separated for management as hazardous waste. Instead they are collected mixed with other waste and ultimately disposed directly to landfill as commercial waste loads. This means waste haulers are currently paying $78/tonne in Winnipeg to dispose of these materials.

Through the Phase 2 pilot, a total of approximately 157 kilograms of this material was collected from the four sites, (approximately 1% of the total waste collected). Paint containers and containers that are eligible under the for free drop-off at household hazardous waste depots under the rules of the Manitoba Household Hazardous Waste Stewardship Program were delivered at no cost directly to the Miller Environmental site at 1803 Hekla and the City of Winnipeg Brady Road 4Rs site. The remaining hazardous liquid wastes & containers collected are not eligible for free drop-off because they were generated at commercial sites. This material was stored at the staging area until all construction was completed at all four sites.

Following regulatory requirements, StrategyMakers Consulting applied for a Hazardous Waste Generator Registration Number and registered for a one time pickup from the staging area. Miller Environmental was then contracted to pick up the materials from the staging area for delivery to their processing and treatment facility in St. Jean Baptiste, Manitoba. The total cost incurred for the removal of the 157 kilograms of hazardous liquid wastes & containers was $966.53.

The high cost of properly separating and disposing of hazardous and liquid wastes materially reduced the overall financial savings achieved through the Phase 2 pilot. Further research will be needed to determine opportunities for more efficiently managing hazardous liquid wastes and containers from new home construction.

Extrapolating Results - An Illustration of Potential Waste *Disposal* Savings to Winnipeg's Home Building Sector

Setting aside for a moment the high cost of properly managing hazardous liquid waste & containers (Grouping 5), it appears that diverting non-hazardous waste to avoid tipping fees and generate revenue from sale of recyclables could yield significant savings that could be used to offset additional costs that will likely be incurred for collecting, handling, storing and delivering the various groupings of materials to appropriate recycling/diversion facilities.

As an illustration, Table 4.2 shows an estimated potential savings available for all homes built in the City of Winnipeg over the past five years, calculated by extrapolating the average savings of $248 per home to the total number of homes built in Winnipeg.

	2014	2015	2016	2017	2018
Housing Starts Winnipeg	4,248	4400	4054	5621	5384
Projected Total Potential Savings Based on Phase 2 Results	*$1,053,504*	*$1,091,200*	*$1,005,392*	*$1,394,008*	*$1,335,232*

The table shows that projected total potential savings based on Phase 2 results could be in excess of $1.3M per year for the sector as a whole. (Tipping fees and availability of

recycling/diversion opportunities outside of Winnipeg vary widely by community and region, therefore the potential savings calculated in Phase 2 only apply to Winnipeg).

The results and extrapolations indicate that there could be significant potential costs savings from diverting new home construction waste to avoid landfill tipping fees and/or receive revenue from sale of recyclables.

Factoring in Collection, Sorting and Processing Costs

The methodology used by StrategyMakers for collecting, sorting and delivering the waste from the 4 sites was developed specifically for the purpose and objectives of this study. It does NOT reflect standard practices used by all waste haulers currently servicing the new home building sector, nor is it reflective of an efficient collection, sorting, hauling system for diverting waste from new home construction sites.

As result, determining the full costs of collecting, sorting and processing waste from new home construction for waste diversion will require further study. However, a number of important observations can be made at this time, including:

- Implementing recycling and diversion activities will not change the total weight and volume of waste material to be collected from new home construction waste sites. Regardless of how many bins are put on site, how many different collection vehicles are used to service those bins, how frequently the bins are serviced, or where the material is delivered to, the overall amount of material to be moved will still be approximately 2.01 kilograms per square foot of house built.

- The Phase 2 operational pilot demonstrates that adding more bins and requiring on-site sorting of waste is not essential in order to achieve high levels of recycling and diversion. Decisions on the number and size of bins needed for servicing a site are currently made between haulers and homebuilders based on site requirements (available space, placement requirements), bin inventories, collection equipment used, and factors related to anticipated frequency of pick-ups (volume of waste expected, distance between site and waste disposal grounds, etc.). Implementing recycling and diversion activities will add another level of complexity to decisions regarding bin placement and servicing it is not

necessary, nor will it be practical, to stipulate a one-size-fits-all approach for all homebuilding sites.

- Sorting and separating of wastes into the various categories (groups) based on end market specifications will be essential and this is where the bulk of added collection and handling costs should be expected. Manual sorting and separating of waste on-site is possible but NOT recommended. Providing marked bins and requiring crews to source separate their waste into the marked bins may be possible in some building sites (and is already being done in some larger commercial construction projects in Winnipeg). Another option will be to establish centralized sorting/processing facilities.

Aside from determining the most efficient method, a more fundamental question to be asked is if the potential savings from avoided waste disposal fees is sufficient to offset the additional effort and cost of separating, handling, and delivering the various groupings of materials to appropriate recycling/diversion facilities.

Past and current waste hauling practices in the sector suggest that the potential savings have not yet been perceived to be sufficient to drive extensive change. However, as discussed in Phase 1 report there is evidence of growing effort to divert waste to avoid or reduce landfill tipping fees in Winnipeg.

Considering the average potential savings from avoided waste disposal is in the range of $248 per home (over $1.3M in total potential annual savings across Winnipeg's home building sector), and that waste disposal costs and tipping fees are trending higher, it appears there is plenty of opportunity for innovative players to develop efficient and effective new home construction waste collection, processing and diversion services in order to capture a portion of the dollars currently spent on waste disposal tipping fees.

Section 5 – Phase 2 Conclusions & Recommendations

Working closely with participating homebuilders, and in consultation with members of Manitoba Home Builders Association's Workplace Safety and Health Committee, the Phase 2 pilot involved collecting all waste generated from 4 new home construction sites in Winnipeg. The collected waste was sorted, weighed, documented and then either delivered to local recycling/diversion end markets or sent to landfill if no recycling/diversion options were found.

Completion of the operational pilot study build on the findings from Phase 1 and yields six important final conclusions, including:

1. Based on the total weight of waste collected from the 4 sites in Phase 2 (16,238 tonnes) and the combined total square footage of the 4 homes (8097 sq. ft.), **approximately 2.0 kilograms of waste was generated per square foot of new home built.** Since most new homes built in Manitoba are constructed using a fairly standardized, wood frame construction method, this data point can be used to calculate reasonably accurate estimates of total waste expected from the construction of new homes.
    - Multiplying this factor by the number of housing starts and the average size of home built in the province, it is estimated that the total amount of waste generated from new home construction across Manitoba in 2018 was approximately 28,029 metric tonnes (approximately 20,459 metric tonnes was generated in Winnipeg).

2. Overall, the results of the Phase 2 operational pilot demonstrate that, with due care and attention to the collection, separation and delivery of the various materials discarded at building sites, there is a significant potential for increasing diversion of new home construction waste in the Winnipeg region at this point in time. Of the 16,238 total kilograms collected from the four sites, only 3,455 kilograms (21%) was delivered and disposed to landfill as commercial mixed waste. The other 12,898 kilograms (79%) of discarded material collected from the four building sites was recycled, diverted or kept as reusable salvaged building materials.

3. Diverting new home construction could also yield substantial cost savings in the form of avoided waste disposal tipping fees. If all 16,238 kilograms of waste collected from the 4 sites would have been taken to the City of Winnipeg Brady Road Landfill, we would have paid approximately $1267 in tipping fees. By diverting 79% of the waste collected to accessible recycling, energy recovery and other reuse opportunities, only $415 was paid in

landfill tipping fees. In addition, some of the recycled materials carry a positive market value and generated an additional $139.75 in revenue. Altogether, the potential financial benefit of diverting a large portion of the waste generated from the four sites included in Phase 2 totaled nearly $991 (an average of $248 per home). Extrapolating these results to the total number of housing starts in Winnipeg yields an estimated total potential savings from avoided waste disposal cost of over $1.3 million in 2018.

4. Based on current market conditions and availability and accessibility of recycling and diversion opportunities, five materials may offer the best opportunity for diversion of new home construction waste in and around Winnipeg. (Areas of the province outside of the Winnipeg region may not have access to same opportunities and therefore will require further study.)

Material	**Why pursuing opportunities for diverting this material should be a priority**
Unpainted, untreated and uncontaminated Wood (Lumber, OSB and Plywood)	✓largest component of new home construction waste stream, therefore highest potential savings through avoided landfill tipping fees ✓relatively easy to separate from other new home construction waste ✓local end markets exist and demand for biomass fuel appears to be robust and possibly growing as alternative energy demand grows ✓significant portion may also be suitable for salvage and reuse
Asphalt shingles	✓heavy weight therefore high potential for cost savings from avoided landfill tipping fees ✓easily identifiable waste generated at very specific point in construction process therefore relatively easy to separate ✓local end markets exist and demand appears to be steady ✓value of Recycled Asphalt Shingles is not sufficient to cover cost of processing but allows end markets to accept shingles at significantly reduced tipping fees compared to current landfill tipping fees.
Metals (ferrous, aluminum and copper)	✓while not a large component, some metal is still found in new home construction waste bins ✓Metals are worth recycling due to potential savings from landfill tipping fees plus the revenue from sale to scrap metal buyers. ✓Aluminum and copper are especially valuable and concentrated efforts to collect these materials can help offset overall cost of sorting and separating new home construction waste. ✓Once recycling/diversion initiatives are started, “pickers” and scavengers should be discouraged to ensure that materials with high value are captured to help offset overall costs.
Corrugated	✓While not a big contributor by weight, cardboard and boxboard take

cardboard and boxboard	up a great deal of volume in new home construction waste bins ✓ Cardboard and boxboard are both readily recyclable in Winnipeg and may yield significant revenue when recycled fibre markets are at periods of high demand and prices for recycled cardboard and boxboard are high ? Cardboard and boxboard found in new home construction waste is bulky and collecting, separating and handling this material efficiently will likely require dedicated effort, and/or additional equipment.
Drywall (gypsum board)	✓ Drywall is heavy weight and therefore could yield significant cost savings from avoided landfill tipping fees. ✓ In many cases, drywall waste is already being collected and handled separately from other new home construction waste. ✓ Unlike drywall waste from renovation and demolition projects, drywall waste from new home construction is also NOT contaminated with any paint, residues, nails or screws. ? At this time one local market exists for diverting clean drywall waste in the Winnipeg (and Winkler) area. The company (Penner Waste) indicates that are able to accept more clean drywall but they will not have the capacity to handle all of the drywall waste that is generated from new home construction in the city. Additional research and development of end uses for drywall waste will need to be undertaken.

5. The logistics and economics of handling and properly disposing hazardous liquid waste and containers found in the new home construction waste stream requires further investigation. Currently, waste haulers do not separate out this category of waste and therefore hazardous liquid waste are disposed along with non-hazardous materials as mixed commercial waste. By separating these materials out for environmentally responsible diversion to a hazardous waste management processing facility, the Phase 2 pilot study collector assumed the liability, and significant cost, of contracting the services of a properly licensed service provided. If the pricing incurred during the Phase 2 pilot is indicative of the current market conditions for hazardous waste management, there is a strong disincentive in place and it is highly unlikely waste haulers will make any attempt to change their current practices.

6. The Phase 2 operational study reinforced that while there are a number of specific economic and logistical barriers limiting the diversion of waste from new home construction, there are also a number of opportunities and potential economic and

environmental benefits. The methodology employed in the Phase 2 pilot does not offer a model for efficient collection, handling and processing of new home construction waste materials but the overall results and findings do highlight the opportunity for innovative players to develop efficient and effective new home construction waste collection, processing and diversion services in order to capture a portion of the dollars currently spent on waste disposal tipping fees.

Suggested Further Research & Recommendations for Further Consultation

This report marks the completion of the two phases of the New Home Construction Waste Diversion Study. While ambitious and comprehensive in scope, the study did have some limitations and therefore further research and consultation is merited, including:

1. Designing and implementing a larger scale pilot study to evaluate opportunities for efficiently collection and handling divertible wastes and especially the feasibility of establishing a centralized sorting and processing operation for new home construction waste diversion. Phase 2 methodology was designed specifically to meet the objectives of this initial study and did not allow for proper assessment of collection and processing efficiencies.

2. Using the Phase 2 pilot study methodology, repeating similar operational pilot studies in regions outside of Winnipeg (ex. Brandon, Winkler/Morden, Steinbach, The Pas). Employing consistent methodology in various regions of the province will strengthen reliability of the data and also allow for deeper understanding of regional differences.

3. Investigating policies and supports/incentives to drive investment in new home construction waste diversion, including a review of approaches used in other jurisdictions (ex. Alberta, BC, Nova Scotia).

4. Conducting further research and market development studies to increase waste diversion options for drywall waste. It is especially recommended that MHBA, and provincial government, initiate further discussions with Certainteed (St. Gobain) to explore opportunities for establishing a formal pilot study to evaluate the feasibility of developing a post-construction drywall recycling operation in Winnipeg.

----- END OF PHASE 2 REPORT -----

Appendix 1 – Waste Generation, Collection & Disposal/Diversion Data By Site

Date	Net weight	Final Residual Waste Disposed to Landfill	Wood waste delivered directly to FinMac	Weighed Metal - Ferrous	Weighed Aluminum	Weighed copper	Weighed Cardboard and Boxboard	Weighed Hazardous Waste in Containers	Weighed Plastic	Weighed Shingles	Weighed Drywall	Material kept for salvage/reuse	Total tipping fee paid at landfill or diversion yard
28-Sep-17	529.7	0	220	0	0	0	0	0	0	0	0	309.7	$ -
29-Sep-17	485.7	30	210	8.5	0	0	7	7	0.5	0	0	222.7	$ 15.00
17-Oct-17	110	0	0	0	0	0	0	0	0	110	0	0	$ -
27-Oct-17	35.7	0	0	11.5	0	0.25	2.45	1.5	6.4	0	0	13.6	$ -
27-Nov-17	60	0	0	11.8	3.5	0	15.7	0.5	5.4	0	0	23.1	$ -
11-Dec-17	1029.05	0	0	0	0	0	0	0	0	0	1029.05	0	$ 20.00
20-Jan-18	370	230	105.9	8	0	0	23.8	0	2.3	0	0	0	$ 16.56
9-Feb-18	194	90	0	32.3	0	0	43	0	0	0	0	28.7	$ 15.00
10-Mar-18	180	50	0	6	0	0	0	0	0	0	0	124	$ 20.00
10-Mar-18	98	0	0	0	0	0	98	0	0	0	0	0	$ -
15-Mar-18	348	170	20	2	2	1	55	21	12.5	0	0	64.5	$ 20.00
Subtotals - Site 1	**3,440.2**	**570.0**	**555.9**	**80.1**	**5.5**	**1.3**	**245.0**	**30.0**	**27.1**	**110.0**	**1,029.1**	**786.3**	**$ 106.56**

Date	Net weight	Final Residual Waste Disposed to Landfill	Wood waste delivered directly to FinMac	Weighed Metal - Ferrous	Weighed Aluminum	Weighed copper	Weighed Cardboard and Boxboard	Weighed Hazardous Waste in Containers	Weighed Plastic	Weighed Shingles	Weighed Drywall	Material kept for salvage/reuse	Total tipping fee paid at landfill or diversion yard
30-Nov-17	540	0	540	0	0	0	0	0	0	0	0	0	$ -
1-Dec-17	270	0	270	0	0	0	0	0	0	0	0	0	$ -
1-Dec-17	560	0	0	25	0.5	0	6.5	6.3	0.9	0	0	520.8	$ -
31-Jan-18	110	110	0	0	0	0	0	0	0	0	0	0	$ 15.00
10-Feb-18	20	20	0	0	0	0	0	0	0	0	0	0	$ 15.00
10-Feb-18	1145	0	0	0	0	0	0	0	0	0	1145	0	$ 30.00
27-Feb-18	530	190	0	58.6	1.9	0	0	0	0	219.5	60	0	$ 15.00
27-Feb-18	350	0	295.1	0	0	0	27.5	9.4	18	0	0	0	$ -
16-Apr-18	330	160	170	0	0	0	0	0	0	0	0	0	$ 20.00
16-Apr-18	210	70	0	0	0	0	70	32.8	0	0	0	37.2	$ 20.00
26-May-18	320	320	0	0	0	0	0	0	0	0	0	0	$ 24.96
26-May-18	270	30	0	19.4	0.5	1.5	80	5	11	0	0	122.6	$ 20.00
26-May-18	170	0	170	0	0	0	0	0	0	0	0	0	$ -
Subtotals - Site 2	**4,825.1**	**900.0**	**1,445.1**	**103.0**	**2.9**	**1.5**	**184.0**	**53.5**	**29.9**	**219.5**	**1,205.1**	**680.6**	**$ 159.96**

Date	Net weight	Final Residual Waste Disposed to Landfill	Wood waste delivered directly to FinMac	Weighed Metal - Ferrous	Weighed Aluminum	Weighed copper	Weighed Cardboard and Boxboard	Weighed Hazardous Waste in Containers	Weighed Plastic	Weighed Shingles	Weighed Drywall	Material kept for salvage/reuse	Total tipping fee paid at landfill or diversion yard
21-Dec-17	540	0	540	0	0	0	0	0	0	0	0	0	$ -
21-Dec-17	154.5	0	0	13.2	0	0	8.4	3.9	0	0	0	129	$ -
19-Jan-18	290	0	0	17.8	0	0	0	0	0	272.2	0	0	$ -
26-Feb-18	181.5	100	0	0	10.1	0	32.7	0	1	0	0	37.7	$ 15.00
28-Feb-18	1190	0	0	0	0	0	0	0	0	0	1190	0	$ 30.00
5-Apr-18	330	290	0	0	0	0	40	0	0	0	0	0	$ 22.62
5-Apr-18	290	0	160	23.5	0	0	0	22.8	0	0	0	83.7	$ -
27-Apr-18	100	50	0	0	0	0	0	0	0	0	0	50	$ 20.00
24-May-18	360	360	0	0	0	0	0	0	0	0	0	0	$ 28.08
24-May-18	320	90	230	0	0	0	0	0	0	0	0	0	$ 20.00
24-May-18	130	0	0	14	1	1.2	51.9	6.6	5.5	0	0	50	$ -
Subtotals - Site 3	**3,886.0**	**890.0**	**930.0**	**68.5**	**11.1**	**1.2**	**133.0**	**33.3**	**6.5**	**272.2**	**1,190.0**	**350.2**	**$ 135.70**

Date	Net weight	Final Residual Waste Disposed to Landfill	Wood waste delivered directly to FinMac	Weighed Metal - Ferrous	Weighed Aluminum	Weighed copper	Weighed Cardboard and Boxboard	Weighed Hazardous Waste in Containers	Weighed Plastic	Weighed Shingles	Weighed Drywall	Material kept for salvage/reuse	Total tipping fee paid at landfill or diversion yard
27-Nov-17	436	0	436	0	0	0	0	0	0	0	0	0	$ -
28-Nov-17	546	0	0	17.4	0	0	0	5.3	0	0	0	523.3	$ -
28-Dec-17	470	290	0	0	0	0	0	0	0	180	0	0	$ 20.88
28-Dec-17	330	0	240	17.2	0	0	26.7	0	6.8	0	0	39.3	$ -
19-Jan-18	960	0	0	0	0	0	0	0	0	0	960	0	$ 20.00
19-Jan-18	44.5	0	0	0	44.5	0	0	0	0	0	0	0	$ -
9-Feb-18	240	130	0	10.2	0.25	0	18.3	0	0	0	0	81.25	$ 15.00
23-Mar-18	270	270	0	0	0	0	0	0	0	0	0	0	$ 21.06
23-Mar-18	480	150	110	58.1	0	0	0	34.8	0	99.3	0	27.8	$ 20.00
6-Apr-18	150	120	0	0	0	0	30	0	0	0	0	0	$ 20.00
23-May-18	160	20	100	10	0.25	1	24.25	0	4.5	0	0	0	$ 20.00
Subtotals - Site 4	**4,086.5**	**980.0**	**886.0**	**112.9**	**45.0**	**1.0**	**99.3**	**40.1**	**11.3**	**279.3**	**960.0**	**671.7**	**$ 136.94**

Adjustments – Cleanup of storage/staging area not shown (see 3.2 in report for details)

Date	Net weight	Final Residual Waste Disposed to Landfill	Wood waste delivered directly to FinMac	Weighed Metal - Ferrous	Weighed Aluminum	Weighed copper	Weighed Cardboard and Boxboard	Weighed Hazardous Waste in Containers	Weighed Plastic	Weighed Shingles	Weighed Drywall	Material kept for salvage/reuse	Total tipping fee paid at landfill or diversion yard
OVERALL TOTALS	**16,237.8**	**3,454.5**	**3,937.0**	**364.5**	**64.5**	**10.0**	**661.2**	**156.9**	**6.3**	**881.0**	**4,384.2**	**2,317.8**	**$ 559.16**

Appendix 2 – Additional Drywall Data & Calculations

Using supplemental data on drywall waste collected from six homes voluntarily provided by Gypsum Drywall Interiors (GDI) Limited, and the actual weight of drywall waste from 2 of the 4 homes in the Phase 2 pilot, it is estimated that the average weight of drywall waste generated per square foot of home built equals approximately 0.54 kilograms/sq.ft.

Source Data Identifier[1]	Square Footage	Kgs of Drywall Waste Collected[2]
Supplemental Data - ID#30	2041	2010
Supplemental Data - ID#39	1443	
Supplemental Data - ID#72	1558	1910
Supplemental Data - ID#58	2142	
Supplemental Data - ID#185	1847	2010
Supplemental Data - ID#24	1838	
Actual Weight of Drywall from Site 3	1742	1190
Actual Weight of Drywall from Site 4	2342	960
Total for Sample	**14953**	**8080**
Average Kgs of Drywall Waste per Sq. Ft. of Home Built		**0.55**

[1] The term "Supplemental Data ID#" simply refers to the six homes for which data was supplied (i.e. street names have been removed for confidentiality.)

[2] The waste hauler that serviced the Supplemental Data homes combined waste from 2 homes in each load. The total weight for the combined load is shown.

This number was then used to estimate the weight of drywall waste generated from Site 1 and Site 2 where weighing of drywall waste was missed due the factors noted on page 14. (There was also a small amount of drywall waste found in Site 2 bins later in the construction process resulting in a final number for drywall waste for that particular home that is slightly higher than 0.55Kgs x 2142 square feet.)

Appendix 3 – Examples of Weigh Scale Tickets and Receipts

*The following are examples of scale tickets and receipts. All original scale tickets and receipts gathered through Phase 2 will be kept on file by StrategyMakers for a period of 3 years and will be made available for inspection upon reasonable request.

Load 7-02-09

1120 Waverley Street
LANDFILL ADMINISTRATIVE SITE
WINNIPEG, MB R3T 0P4
Phone: (204) 986-5563

Weighed: MB
Deposit: MB
BILL TO: 0
CASH CUSTOMER

Vehicle ID:
Reference: HDV595

DATE IN: 09-02-2018 TIME IN: 16:18:36
DATE OUT: 09-02-2018 TIME OUT: 16:41:40

INBOUND TICKET Number: 06-01968751

SCALE 1 GROSS WT.	3050 KG
SCALE 2 TARE WT.	2960 KG
NET WEIGHT	90 KG

Qty	Description	Amount
0.09	COMMERC & INDUSTRIAL	15.00

TICKET AMOUNT:	15.00
AMT. TENDERED:	15.00
CHANGE AMOUNT:	0.00
CARD/AUTH VISA	15.00

X_____

RATES INCLUDE ALL APPLICABLE FEES

Example of Scale ticket showing 90Kgs of waste disposed as Mixed Commercial Waste.

43-1A

1120 [illegible] Street
LANDFILL ADMINISTRATIVE SITE
WINNIPEG, MB R3T 0P4
Phone: (204) 986-5563

Weighed: AG
BILL TO: 0
CASH CUSTOMER

Vehicle ID:
Reference:

DATE IN: 01-12-2017 TIME IN: 10:3[illegible]
DATE OUT: 01-12-2017 TIME OUT: 10:3[illegible]

INBOUND TICKET Number: 06-0195315[illegible]

SCALE 1 GROSS WT	3360 KG
STORED TARE WT	0 KG
NET WEIGHT	3360 KG

Qty	Description	Amount
3.36	WEIGHT ONLY TICKET	0.00

TICKET AMOUNT: 0.00

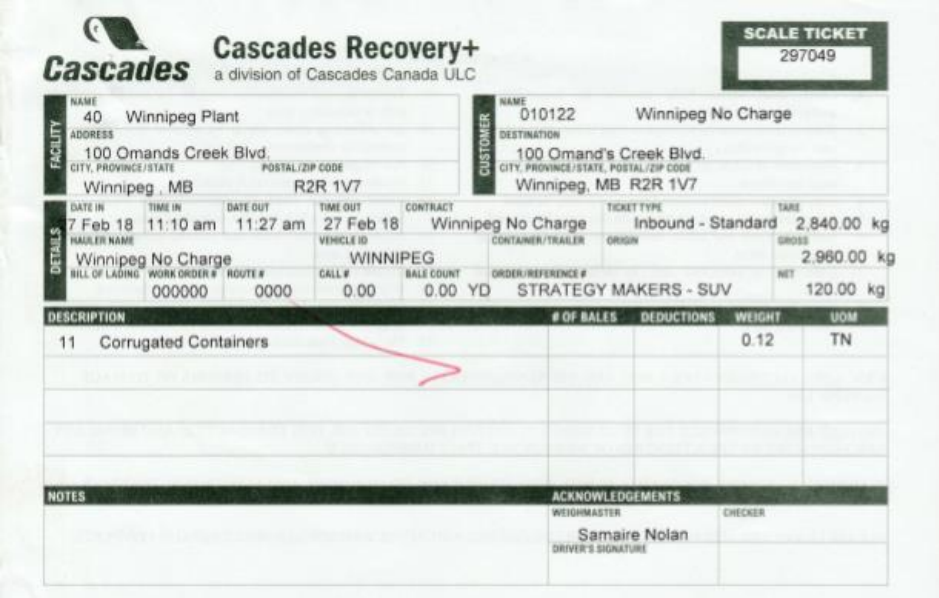
Load 43-12-1A

X_____

3360 kg Full
-2820 kg Empty
540 kg Wood to Finmac

RATES INCLUDE ALL APPLICABLE FEES

Example of scale ticket showing full trailer loaded prior to delivery of clean wood to Finmac Lumber. (Delivered wood = gross weight minus 2820kgs empty truck/trailer= 540Kgs)



Cascades

Cascades Recovery+
a division of Cascades Canada ULC

SCALE TICKET 297049

FACILITY
NAME: 40 Winnipeg Plant
ADDRESS: 100 Omands Creek Blvd.
CITY, PROVINCE/STATE: Winnipeg , MB
POSTAL/ZIP CODE: R2R 1V7

CUSTOMER
NAME: 010122 Winnipeg No Charge
DESTINATION: 100 Omand's Creek Blvd.
CITY, PROVINCE/STATE, POSTAL/ZIP CODE: Winnipeg, MB R2R 1V7

DETAILS

DATE IN	TIME IN	DATE OUT	TIME OUT	CONTRACT	TICKET TYPE	TARE
7 Feb 18	11:10 am	11:27 am	27 Feb 18	Winnipeg No Charge	Inbound - Standard	2,840.00 kg

HAULER NAME	VEHICLE ID	CONTAINER/TRAILER	ORIGIN	GROSS
Winnipeg No Charge	WINNIPEG			2,960.00 kg

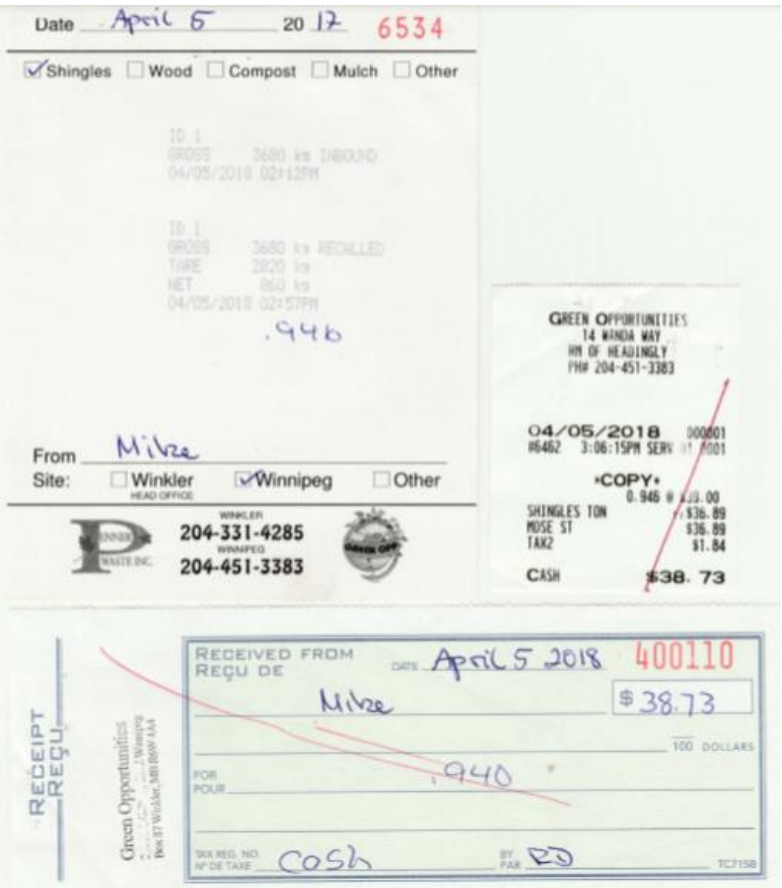
BILL OF LADING	WORK ORDER #	ROUTE #	CALL #	BALE COUNT	ORDER/REFERENCE #	NET
	000000	0000	0.00	0.00 YD	STRATEGY MAKERS - SUV	120.00 kg

DESCRIPTION	# OF BALES	DEDUCTIONS	WEIGHT	UOM
11 Corrugated Containers			0.12	TN

NOTES

ACKNOWLEDGEMENTS
WEIGHMASTER: Samaire Nolan
CHECKER:
DRIVER'S SIGNATURE:

Example showing corrugated cardboard delivered to Cascades Recovery.



Date April 5 2017 6534

☑ Shingles ☐ Wood ☐ Compost ☐ Mulch ☐ Other

.946

From Mike

Site: ☐ Winkler (HEAD OFFICE) ☑ Winnipeg ☐ Other

WINKLER 204-331-4285
WINNIPEG 204-451-3383

GREEN OPPORTUNITIES
14 WANDA WAY
RM OF HEADINGLY
PH# 204-451-3383

04/05/2018 000001
#6462 3:06:15PM SERV 0001

•COPY•

0.946 @ 40.00
SHINGLES TON $36.89
MOSE ST $36.89
TAX2 $1.84
CASH $38.73

RECEIPT / REÇU

RECEIVED FROM / REÇU DE Mike
DATE April 5 2018 400110
$ 38.73
100 DOLLARS
FOR / POUR .940
'SKK REG. NO. / N° DE TAXE Cash
BY / PAR RD
TC715B

Green Opportunities

Example showing roof shingles delivered to Green Opportunities (a division of Penner Waste)

PAYMENT RECEIPT

Urbanmine
72 Rothwell Road
Winnipeg, MB R3P 2H7
(204) 774-0192

urbanmine
Metal Recycling Redefined

Receipt:74627
Customer:10841

Date:3/29/2018
Time:4:05:03 PM

Ticket:86691
Operator:Shelly D

Weigh In:3/29/2018 3:49:40 PM
Weigh Out:3/29/2018 4:04:49 PM

Commodity	Gross	Tare	Net	Price	TOTAL $
Steel	6,640	6,580	60	240.0000/NT	7.20

Ticket Total: 7.20

No. of Tickets:1
Payment Method:EZCash

Total Paid: $7.20

I certify that I am the owner of the materials described on this ticket

Example showing ferrous metal delivered to urbanmine inc.

PAYMENT RECEIPT

Urbanmine
72 Rothwell Road
Winnipeg, MB R3P 2H7
(204) 774-0192

urbanmine
Metal Recycling Redefined

Receipt:82159
Customer:10841

Date:6/13/2018
Time:2:12:07 PM

Ticket:96528
Operator:Sabrina F

Weigh In:6/13/2018 2:10:19 PM
Weigh Out:6/13/2018 2:10:28 PM

Commodity	Gross	Tare	Net	Price	TOTAL $
Aluminum	274	228	46	0.5000/LB	23.00

Ticket Total: 23.00

No. of Tickets:1
Payment Method:EZCash

Total Paid: $23.00

I certify that I am the owner of the materials described on this ticket

Example showing aluminum delivered to urbanmine inc.


Samborski
Environmental Ltd.
Jan 19/10
Strategy Makers Consulting
1 load Drywall Recycle 19 05
Paid
GST 95
TOTAL 20 00
65076
INVOICE

Receipts from load of drywall (gypsum board) delivered to Samborksi

Appendix 4 – Hazardous Waste Documents

Manitoba

Sustainable Development
Environmental Stewardship
Environmental Approvals

Hazardous Waste Program

1007 Century St
Winnipeg MB, R3H 0W4

Acknowledgement of Receipt for
Hazardous Waste Registration Form

This document will acknowledge receipt of the hazardous waste registration form submitted to Manitoba Sustainable Development by the following waste consignor (generator):

Company:	StrategyMakers Consulting
Attention:	Mike Fernandes Principal
Mailing Address:	PO BOX 21094 RPO Charlswood Winnipeg MB R3R 3E0
Date Received:	June 25, 2018
New / Supplement / Update:	New
Generation Site:	90 Shahi St Winnipeg MB

The Hazardous Waste Generator Registration Number (Provincial ID No.) assigned to the above noted generation site is as follows:

MBG14323

In accordance with Manitoba Regulation 195/2015 (*Hazardous Waste Regulation*) pursuant to The Dangerous Goods Handling and Transportation Act, Manitoba Sustainable Development must be notified in writing, to the above address, when there are any changes or additions to the information recorded on your registration form.

This document and the attached copy of the registration form should be retained in your files and provided to an inspector on request.

Date: June 29, 2018

Raj Rathamano
Environment Officer
Phone: (204)945-7086
Fax: (204) 948-2338

RR/cb-f
Enclosure

HAZARDOUS WASTE REGISTRATION FORM

Hazardous Waste Regulation M.R. 195/2015

Please read the "Guide to completing the hazardous waste registration form" before completing this form

Manitoba Sustainable Development

Check all that apply: ■ New Company ☐ Name Change ☐ Moved ☐ Additional Site ☐ Update

Section 1 Generator Identification

Generator: StrategyMakers Consulting - New Home Construction Waste Diversion Study (Legal Name of the Company) Corp. File # if app.: 6278605

Mailing Address: PO Box 21094 RPO Charleswood City: Winnipeg Prov.: MB Postal Code: R3R0L2

Operation Name: StrategyMakers Consulting Physical Site Location: Point West Way 90 Shabist (Street name & number or Legal description)

Operation Mailing Address: PO Bo 21094 RPO Charleswood City: Winnipeg Prov.: MB Postal Code: R3R0

Section 2 Waste Description (if more than 4 types of waste, please attach an additional sheet)

	Physical State (S or L)	TDG Shipping Name or Type of Hazardous Waste (from Schedules A or B or C)	UN Number or Provincial Waste Code (from Schedules A or B or C)	TDG Class (if applicable)	Packing Group (if applicable)	Provincial Waste Class Code (from "Key to Waste Codes")	Quantity generated per month (L or Kg)	Frequency of generation Code (C, B, R or O)	Treatment or Disposal Code (D, R or X)
a)	L	Waste Adhesives	UN1133	3	II	232I	50 L	O	X
b)	L	Waste Paint	UN1263	3	II	145I	50 L	O	X
c)	S	Waste Aerosols	UN1950 B	2.1	N/A	331I	50 kg	O	X
d)									

Section 3 Waste Management Information

General business type: Research Study - New Home Construction Waste Diversion Study
(E.g. Automotive repair, electroplating, printing, etc.)

Source of hazardous waste: Research Study - 4 test homes in Winnipeg
(Source or type of process generating waste)

Hazardous waste carrier(s) used: Miller Environmental

Hazardous waste receiver(s) used: Miller Environmental

Section 4 Certification

I certify that the information provided on this form is correct and complete.

Signature of Contact Person with the Operation: _____ Date (dd/mm/yy): 24 / 06 / 18

Print Name of Contact Person: Mike Fernandes Position/Title: Principal

Telephone : 204-223-4460 Fax : n/a Email : mikefernandes@strategymakers.ca

MBG 14323 OPR:072670 Business Code _____ For Departmental use only : Form checked by _____ Region Winnipeg Form processed by _____

Personal information is collected under the authority of *the Dangerous Goods Handling and Transportation Act, Hazardous Waste Regulation* M. R. 195/2015, and will be used to issue the Hazardous Waste Registration Number (Provincial ID number) and for administration and enforcement purposes. It is protected by the privacy provisions of *The Freedom of Information and Protection of Privacy Act*. If you have any questions, contact the Access & Privacy Co-ordinator, Box 85, 200, Saulteaux Crescent, Winnipeg MB R3J 3W3; 1 (204) 945-4170.

Revised Sept. 2006, Dec. 2012 & May 2016

Movement Document Attachment Sheet

Consignor Name: StrategyMakers
Consignor Address: 96 Shadi

SO # 57464
Tech:

UN No.	Shipping Name	Class Sub/ Class	PG	Quantity Shipped	Units L/KG	Pack. No.	Profile #	Manifest #	ERG#	Type	Size
1133	Adhesives	3	II	400	L	2	37078	J631843-5	A		205L
1950	Aerosols	2.1	6G	100	KG	1	37071		C		205L
1263	Paint	3	II	205	L	1	37074		A		205L
1993	Flammable Liquid, n.o.s. (Xylene)	3	II	2	L	1	37073		A		20L

24 HOUR NUMBER 204-957-6327

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, are properly classified and packaged, have dangerous goods safety marks properly affixed or displayed on them, and are in all respects in proper condition for transport according to the Transportation of Dangerous Goods Regulations

Consignor (Print Name): Mike Fernandes

Date: 19 July 18

B – Lalpacks & Gaylords—Equivalency Certificate # SU11161 (Item 4)
B – Tubekids—Equivalency Certificate # SU 7135 (Rem. III)

C – Aerosols—Equivalency Certificate # SU11160 (Item 2)
D – Batteries on Pallets—Equivalency Certificate #SU10981 (Rem. 3)

Appendix 5 – Photo Log and Site Visit Notes