Report

Analysis of Mixed Waste Processing (MWP)

Newport Resource Recovery Facility

Project I.D.: 14R002

Prepared For Ramsey/Washington Counties Resource Recovery Project

September 2014

RAMSEY/WASHINGTON COUNTY
RESOURCE RECOVERY PROJECT
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75 YEARS

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September 15, 2014

Zack Hansen and Judy Hunter
Ramsey/Washington Counties Resource Recovery Project Joint Staff Committee
2785 White Bear Avenue, Suite 350
Maplewood, MN 55109

Dear Zack and Judy:

RE: Analysis of Mixed Waste Processing (MWP) at the Newport Resource Recovery Facility

This letter transmits the Final Report documenting the Analysis of Mixed Waste Processing at the Newport Facility. Analysis included placement of equipment to fit at the Newport Facility, estimated cost of site construction and equipment, material recovery projections, and potential revenue from marketable materials. The data and information in the report will be useful for the current planning process addressing State goals for recycling and organics recovery.

We look forward to working with you and your team in this planning process.

Sincerely,

Foth Infrastructure & Environment, LLC

Warren Shuros
Client Director

Nathan Klett
Project Environmental Engineer

cc: Kate Bartlett, Ramsey County

Analysis of Mixed Waste Processing (MWP)

Distribution

No. of Copies	Sent To
	Zack Hansen Ramsey/Washington Counties Resource Recovery Project Joint Staff Committee
	Judy Hunter Ramsey/Washington Counties Resource Recovery Project Joint Staff Committee
	Kate Bartlett Ramsey County

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Executive Summary

An analysis was performed to determine if a Mixed Waste Processing (MWP) system designed to manage the 405,000 tons of available mixed MSW could be co-located with the current Refuse Derived Fuel (RDF) system at the Newport Facility. The objective of this analysis is to determine how installation of an MWP system can help achieve the specific recycling and organics recovery goals.

This analysis included:

- Determining the materials targeted for recovery
- Determining the required MWP equipment size
- Selection of two MWP options
- Analysis of possible lay-outs for MWP
- Estimating costs associated with MWP
- Estimating material recovery
- Estimating potential revenue

The *Waste Composition Study* dated August 2014 by Foth was used as the basis for conceptual design of a MWP system. Results from the conceptual design process indicated two preferred options for MWP; targeting organics and commercial corrugated cardboard (cardboard) or targeting both organics/cardboard and recyclable containers. Based on equipment sizing information provided by equipment vendors a flexible lay-out for each option is presented using much of the existing infrastructure.

The waste composition percent, projected tons of targeted material received at the Newport Facility, estimated percent recovery with MWP and the estimated tons of material recovered used in this analysis are presented in Table ES-1.

The estimated percent recovery for PET and HDPE are considered conservative estimates considering the equipment vendors have indicated 85% recovery as part of a performance guarantee. The recovery rate for cardboard was not provided by the equipment vendor and will only be targeted in the pre-sort station, thus a 50% recovery rate is assumed. The recovery estimates for ferrous and non-ferrous are considered appropriate given the available data for recovery at the current Newport Facility. The lower percent recovery estimated for organics is considered appropriate since there is very little data available for comparable systems (accepting commercial and residential MSW and targeting organics for AD) and considering the East Metro region's well established source separation recycling programs.

Table ES-1
Estimated Percent Recovery with MWP and the Estimated Tons of Material Recovered

Material	Waste Composition (%)	Total Tons of Material in Waste Stream Based on Composition Study [1]	Estimated Percent Recovery (%)	Estimated Tons Recovered
PET	1.1%	3,740	75%	2,805
HDPE	0.6%	2,040	75%	1,530
Cardboard/Boxboard	6.4%	11,970[2]	50%	5,985
Ferrous (tin/steel containers)	2.4%	8,160	90%	7,345
Non-ferrous	0.8%	2,720	85%	2,310
Organics (food and yard waste)	25%	85,000	50%[3]	42,500

1. Assumes 340,000 tons of MSW will be processed with two MWP lines at the Newport Facility annually
2. Assumes 55% of the 340,000 tons processed is commercial waste
3. Assumes 50% of the targeted organic material is separated from the 2 inch minus disc screen and will pass over the 1 inch minus disc screen for recovery as organic material

A summary of the costs, potential revenue and percent recovery increase associated with installation of MWP targeting organics and targeting organics and containers is presented in Table ES-2.

Table ES-2
Summary of the Costs, Potential Revenue and Percent Recovery

Potential MWP Systems	Site Related Costs	Equipment Costs	Total Estimated Costs	O&M Costs[1]	Potential Revenue	% Increase in Recovery[2]
Targeting Organics	$4,500,000 - $5,300,000	$8,250,000 - $8,750,000	$12,750,000 - $14,050,000	$5,238,900 - $6,088,900	$620,000	4.6%
Targeting Organics and Containers	$5,900,000 - $7,000,000	$11,950,000 - $12,750,000	$17,850,000 - $19,750,000	$6,461,650 - $7,311,650	$4,650,000	5.9%

1. Includes costs associated with organics transportation and disposal
2. Percent increase in recovery is calculated using 921,500 tons/year of mixed MSW managed by the Counties

A MWP system targeting organics is estimated to increase the recovery rate by 4.6% and provides some revenue from ferrous and cardboard recovery using the drum magnet and manual pre-sorting, respectively. The MWP system targeting organics and containers results in a potential increase in the recovery rate of 5.9% and also provides a potential revenue source for offsetting a portion of the associated operation and maintenance costs.

The increase in recovery rates from installation of an MWP system cannot be simply added to the estimated recovery rate presented in the *Estimated Calculations of Additional SSR/SSO Tons* memorandum dated September 2014, because implementation of SSO/SSR affects the waste composition that would be available for processing with an MWP system. Therefore, additional analysis was performed to estimate how implementation of a source separated organics/source

separated recycling (SSO/SSR) program would affect the waste composition and thus the recovery rates if an enhanced SSO/SSR program was combined with installation of an MWP system. The results of this analysis indicate a decrease in the amount of recoverable materials in the MSW processed using an MWP system. Additionally, the data results indicate a decrease in the amount of material available for targeted recovery using MWP. The recovery rate of 5.9% using only MWP (no SSO/SSR) is reduced to an estimated 2.9% when SSO/SSR and MWP are combined. However, by analyzing the effect of SSO/SSR on the waste composition and determining the potentially available material remaining in the MSW for recovery using MWP, an additive recovery rate can be calculated. The result is a cumulative recovery rate of 14.1% from SSO/SSR (11.2%) and MWP (2.9%).

When added to the current recycling rate (53%), this cumulative recovery rate, at 67.1%, is still significantly less than the Minnesota Legislature's Goal of 75%.

1 Purpose

Further analysis of the potential for mixed waste processing (MWP) at the current Newport Resource Recovery Facility was requested by the Ramsey/Washington Counties Resource Recovery Project Board (Project Board). The purpose of this report is to present information related to combining an MWP system with the current Refuse-Derived Fuel (RDF) processing system at the Newport Facility. This report details the methodology used for evaluating MWP at the Newport Facility, the options for an MWP system at the Facility, the estimated material recovery projections, and the estimated capital and O&M costs for implementing the two preferred MWP system options.

In order to meet state requirements, the Counties have specific recycling and organics recovery goals. One of the intended outcomes of this analysis is to determine how implementation of an MWP system at the Newport Facility would help to achieve the state goals.

Before a conceptual design for an MWP system can be developed, a general understanding of the waste composition is necessary, in order to determine what materials the MWP system should be targeting for recovery. As a part of the overall project for the Project Board, a waste composition study was conducted at the Newport Facility from Monday, June 23 through Monday, June 30, 2014.

2 Support Data

Specific procedures and results for the waste composition study are presented in the *Waste Composition Study* dated August 2014 by Foth. Generally, the study concluded that 25% of the material being delivered to the Newport Facility was categorized as either food or yard waste. These findings provided the necessary information to initiate discussions with various MWP equipment vendors such as Bulk Handling Systems (BHS) for conceptual design of an MWP system targeting the organic fraction (food and yard waste) of the waste stream being delivered to the Newport Facility.

Staff from Foth and BHS conducted a site visit to the Newport Facility to discuss options for locating the MWP equipment as well as the best option for integrating an MWP system with the existing RDF system. Staff from RRT provided input on the benefits and drawbacks of several of the equipment locations suggested. In addition to the site visit to the Newport Facility, Foth and BHS conducted several meetings and telephone discussions to determine the critical aspects of an MWP system relative to meeting the recycling goals.

The outcome from additional site visits to the Newport Facility and follow up meetings, combined with further review of the waste composition data, estimated recovery rates and current market prices for recyclable materials resulted in two preferred options for MWP at the Newport Facility.

One option involves specifically targeting the food and yard waste fraction of the incoming material. The other option includes food and yard waste recovery as well as recovery of marketable containers (PET, HDPE, ferrous, and non-ferrous). Both options include the ability to recover cardboard to increase the overall county recovery rate.

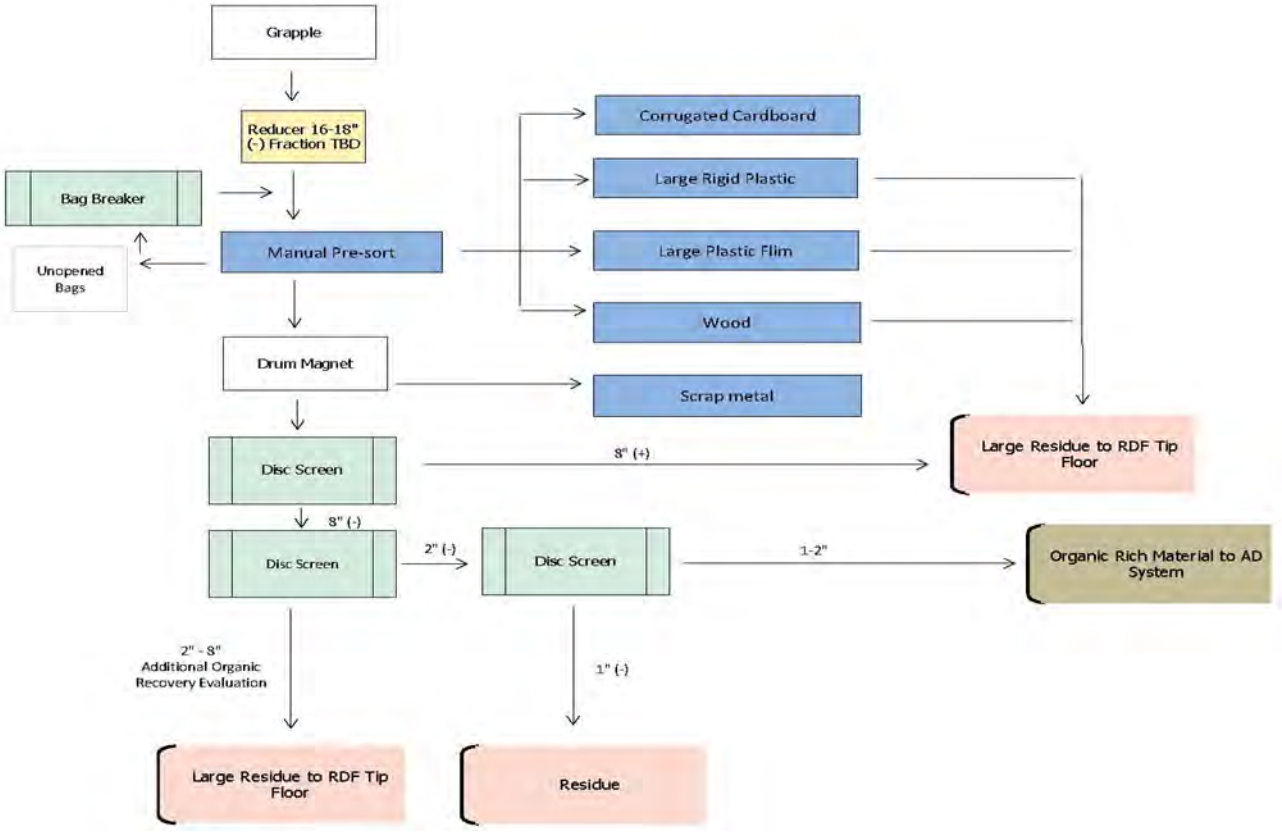
Both options involve some form of initial ferrous recovery to improve system efficiency and recovery rates. Neither option specifically targets recycling of most other paper categories as these are assumed to be recovered as RDF and are a minor fraction based on the data from the waste composition study. In addition, recovery of other paper from mixed MSW results in a low quality product due to contamination from other wastes (e.g. glass and food wastes).

2.1 MWP – Targeting Organics

The process flow for the MWP recovery system targeting organics is shown in Figure 2-1. Material will be delivered to the existing tipping floor and will be manually sorted using a loader and grapple prior to loading the waste onto an in-feed conveyor to remove obvious non-recoverable materials (as is currently performed at the Newport Facility).

This manual sorting is intended to remove items such as mattresses, LP tanks, large concrete pieces, etc., that may be too bulky to process or may damage equipment.

Figure 2-1
Process Flow Diagram for MWP System Targeting Organics



Material loaded onto the in-feed conveyor will be conveyed upward to a reducer to open bags and provide a consistent burden (thickness) of material across the conveyor. The material is then conveyed to a manual pre-sort station in order to remove large rigid plastic, large film plastic and wood as well as recover corrugated cardboard. Un-opened bags are also removed at the manual

pre-sort station and sent to a bag breaker to liberate the contents such as food wastes. The material then re-enters the manual pre-sort station to allow for sorting.

Once material passes the pre-sort station it is conveyed to a drum magnet for the initial ferrous removal stage. The material then enters a disc screen for size separation at an 8 inch fraction. Material greater than 8 inches in size is returned to the tipping floor for processing into RDF. Material less than 8 inches in size is conveyed to a second disc screen for additional size separation to a 2 inch fraction.

Material greater than 2 inches is returned to the tipping floor for processing into RDF. The material 2 inches and smaller is sent through an additional disc screen. This final disc screen is intended to separate the fine material (less than 1 inch) from the organic rich material (between 1 and 2 inches). The fine material is sent back to the tipping floor and the organic material is intended to be further processed in an anaerobic digestion (AD) system.

The layout of this system assumes that most organic material is between 1 and 2 inches. If larger organic material is present in recoverable quantities, a different configuration of disc screen sizes could be implemented to recover additional material. However, experience with targeting the organic fraction from MSW for delivery to an AD facility was not identified in preliminary discussions. The material intended for processing at an AD facility may require additional "clean-up" depending on the intended end use for the anaerobically digested material after leaving the AD facility. This approach will need additional, closer analysis to move forward.

2.2 MWP – Organics and Containers

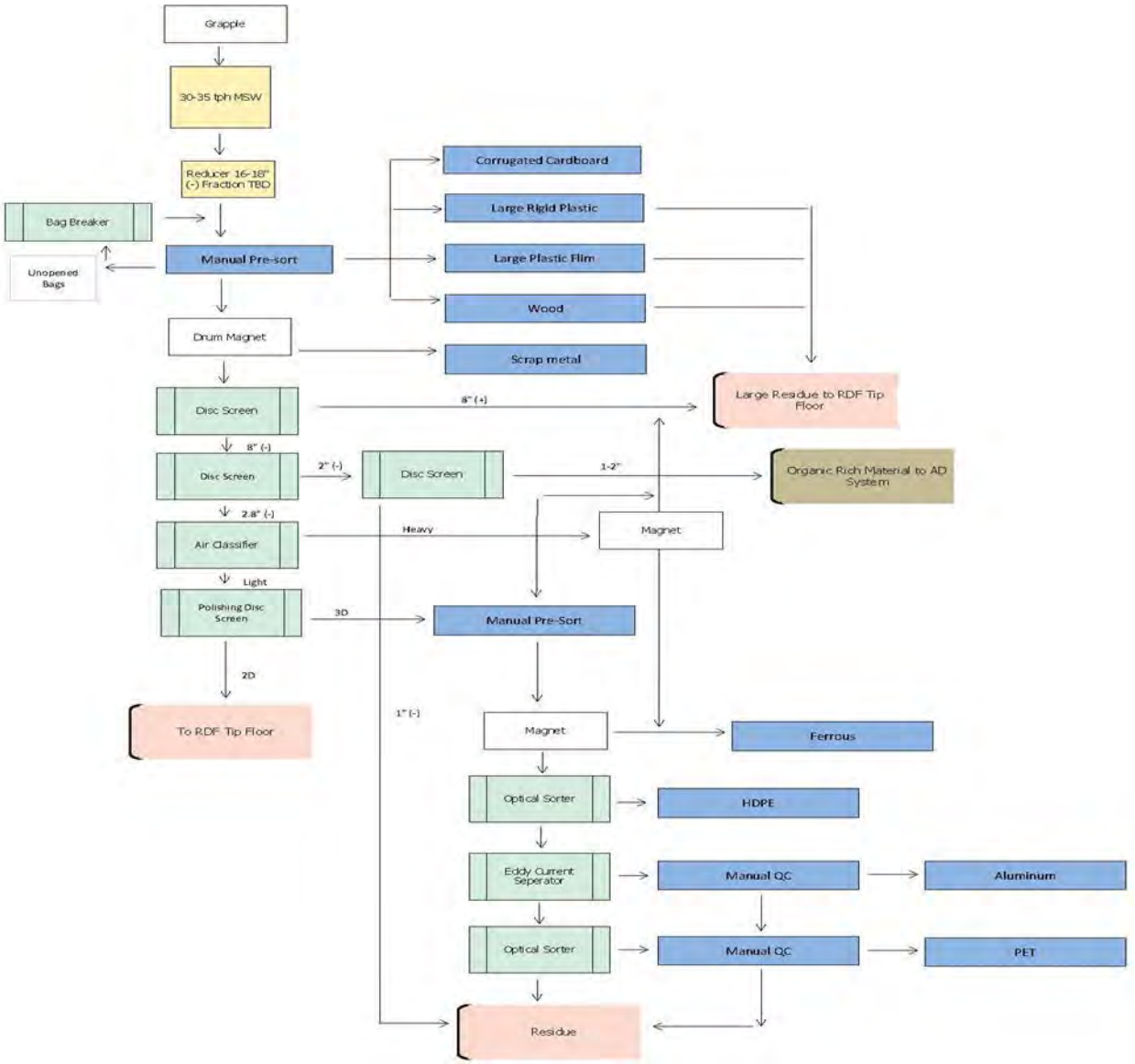
The process flow for the MWP recovery system targeting both organics and containers is shown in Figure 2-2.

The initial steps of an MWP system targeting organics and containers are the same as described for the MWP system targeting organics (i.e. tipping floor grapple to in-feed and incline conveyor to reducer to manual pre-sort with bag breaker when necessary to drum magnet to 8 inch disc screen to 2 inch disc screen).

The main function of the second disc screen is to remove the fine material (less than 2 inches in size). The fine material is conveyed to a third disc screen for size separation to one inch as is conducted in the organic targeted scenario. Material between 2 and 8 inches in size from the second disc screen is conveyed to an air classifier for density separation.

The heavy material is conveyed to a cross-belt magnet where additional ferrous is removed and the remaining nonferrous heavy material is conveyed back to the tip floor for RDF processing. The light material is conveyed to a polishing screen to separate the 2 and 3 dimensional materials.

Figure 2-2
Process Flow Diagram for MWP System
Targeting Organics and Containers



The 2 dimensional materials are conveyed back to the tipping floor for RDF processing. The 3 dimensional materials are conveyed to a manual pre-sort station for removal of items that reduce the efficiency or effectiveness of the remaining processes. Once the 3 dimensional light materials pass the manual pre-sort station they are also conveyed past a cross-belt magnet for additional ferrous removal (as was performed with the heavy materials).

The 3 dimensional light materials continue on to an optical sorter. The first optical sorter is designed to recover HDPE plastic from the material stream. Material is then conveyed to an eddy current separator for non-ferrous recovery and finally through a second optical sorter for recovery of PET plastic. Material remaining in the waste stream is considered residue and is

conveyed to the tipping floor for processing through the RDF system. The residue from MWP would be sent back to the RDF processing line in order to maximize recovery rates.

2.3 MWP Sizing Requirements

A single MWP line is designed to operate at 30-35 tons per hour (TPH). If the MWP equipment operates generally following the current schedule at the Newport Facility (18 hours/day 4 days/week, 10 hours/day 2 days/week, and 8 hours/day the remaining day/week for a total time of operation of 4,836 hours/year, which includes 1 hour/day for start-up/shut-down operations where processing does not occur), a single line can process approximately 145,000 to 170,000 tons/year or 290,000 to 340,000 tons/year with 2 MWP lines. This does not provide capacity to process the entire available waste stream (405,000 tons/year). However, a third line did not receive further consideration since it would far exceed the necessary capacity (435,000 to 510,000 tons/year with three MWP lines) and adequate space may not be available at the Facility to construct a third line. Excess material could be by-passed directly to the RDF lines or operating hours could be adjusted to accommodate 405,000 tons/year using 2 MWP lines.

2.4 Design Details for MWP Targeting Organics

If the MWP system focuses on organics recovery (no container recovery) the system would include 2 lines with one line integrated along the south east side of the current tipping floor and a second line located partially to the north of and extending into the north east corner of the existing tipping floor. Each processing line requires a space approximately 50’ by 200’. Figure 2-3 shows the existing site with the space required for each processing line overlaid in red in the proposed locations.

This configuration provides the flexibility to process the residential deliveries on one line and the commercial deliveries on the second line. This scenario also allows for targeting of different or additional materials such as adding a storage bunker to the commercial line to target cardboard which was prevalent in commercial waste from the waste composition study data results.

The south MWP line would be positioned so the in-feed conveyor starts at the far southeast corner of the existing tipping floor and material would be processed through the system towards the current RDF in-feed area. As large rigid and film plastics and wood are removed, these materials would be returned to the tipping floor to be processed into RDF. Two openings would need to be constructed in the east wall of the tipping floor area to allow for loading of the scrap metal and organics. The 2-8 inch material coming off the end of the processing line would be conveyed to the RDF in-feed. It is anticipated that no additional processing of material would be necessary prior to entering the RDF line.

The north MWP line would require significantly more site work to install. The “citizen drop” area (shown to the north of the current tipping floor) would be removed and the area would require excavation to allow for expansion of the tipping floor. The expanded tipping floor would extend north to the area described as the Easement Agreement Area approximately 125 feet and would match the width of the existing tipping floor (160 feet) in the east west direction for an expansion area of approximately 20,000 square feet as shown in Figure 2-3. In addition to the tipping floor expansion, the bulky waste shredder would require relocation to install the second MWP line along the east tipping floor wall. The bulky waste shredder could be relocated to the

central portion of the west tipping floor wall as shown on Figure 2-3. Concrete push walls would be constructed around all equipment to maintain tipping floor efficiency.

Figure 2-3
Potential Layout for Organics Targeted MWP
and Tipping Floor Expansion

The second (north) MWP line would be positioned with the in-feed conveyor in the northeast corner of the expanded tipping floor and material would be processed through the system towards the current RDF in-feed area. Similar to the south MWP line, large rigid and film plastics and wood would be returned to the tipping floor to be processed into RDF. An additional storage bunker would be located at the north line at the manual pre-sort area to allow for recovery of cardboard from the commercial waste stream and would include a baler to bale recovered cardboard. This would assist in increasing the overall recycling rate. Two openings would be constructed in the east wall of the tipping floor area as a part of the expansion to allow for loading of the scrap metal and organics. The 2-8 inch material coming off the end of the processing line would be conveyed to the RDF in-feed. It is anticipated that no additional processing of material would be necessary prior to entering the RDF line.

3 Construction Cost Estimate

The estimated cost for an MWP system targeting organics includes the site and building related costs as well as the cost for purchasing and installing the MWP equipment. The site work generally includes:

- Removal of existing “citizen drop” area
- Removal of the north tipping floor wall

- Excavation and grading
- Foundation excavation
- Concrete push wall installation
- Metal building installation
- Equipment related foundation installation
- Utilities installation necessary for MWP equipment
- Relocation of the Bulky Waste Shredder

Using 2014 dollars, the site related costs described above are estimated (based on contractor bid results for similar building/renovation projects recently awarded) to be approximately $4.5 to $5.3 million.

Not included in the current cost estimate are the costs associated with renovation of the trash load out (TLO) area. Staff from RRT recently indicated that the TLO area is in need of major repairs and a potential alternative to repairing the existing equipment is to relocate the entire TLO area. Renovation or relocation of the TLO area is not included as a part of this report considering a decision relative to the TLO area will likely be made in the near future and may affect future design considerations.

The estimated cost for the MWP equipment includes 2 – 35 ton per hour (TPH) processing lines from the grapple and in-feed conveyor to the 2 inch disc screen (including the 1 inch disc screen). Also included in the equipment cost estimate is a single additional loader for the tipping floor so there is a loader at each MWP line and one at the RDF in-feed area. Using 2014 dollars, the estimated equipment cost, including installation, is approximately $8.25 to $8.75 million, based on communication with MWP and heavy equipment vendors.

4 Operation and Maintenance Cost Estimate

The operation and maintenance cost associated with the MWP system targeting organics includes 5 sorters at each of the manual pre-sort stations (one station per line), one supervisor, and an additional maintenance staff member. Also, an additional loader operator would be required to bring waste to the in-feed of the MWP lines. Additional grapple operators are not anticipated considering these positions are already covered by the existing RDF process operation and waste processed through the MWP line is not anticipated to need additional sorting prior to entering the RDF lines. Based on the operating schedule previously discussed, it is anticipated that 10 (5 at each sorting line) sorters, one supervisor, and an additional maintenance staff member will be at the Facility during the hours of operation necessary to process the incoming material. Additional helpers, mechanic staff and an electrician will be necessary during the “clean-up” or non-operational hours, which are estimated to be 8 hours/day 7 days/week.

Labor rates for the positions are estimated based on discussions with RRT staff using the current labor rate categories. Labor rates are assumed to be at the low end of the current labor rates since there is not currently a “sorter” labor category at the facility (assumed to be comparable to the “helper” category). An average labor rate of $25/hour (including benefits) for sorters is used in this analysis. The labor rate for maintenance staff, electricians, and mechanics is estimated to be $40/hour. An additional 18% is added to each labor rate to account for vacation, sick leave and holiday pay when overtime pay may be required (1.5 to 2 times the typical hourly rate).

4.1 Operational Hours

10 sorters/shift x 1 shifts/day x 10 hours/shift x 6 days/week x $29.50/hour	=	$17,700
10 sorters/shift x 1 shift/day x 8 hours/shift x 5 days/week x $29.50/hour	=	$11,800
$/week	=	$29,500
$/year	=	$1,534,000

1 maintenance/shift x 1 shift/day x 10 hours/shift x 6 days/week x $47.20/hour	=	$2,832
1 maintenance/shift x 1 shift/day x 8 hours/shift x 5 days/week x $47.20/hour	=	$1,888
$/week	=	$4,720
$/year	=	$245,440

1 operator/shift x 1 shift/day x 10 hours/shift x 6 days/week x $41.30/hour	=	$2,478
1 operator/shift x 1 shift/day x 8 hours/shift x 5 days/week x $41.30/hour	=	$1,652
$/week	=	$4,130
$/year	=	$214,760

It is anticipated that 1 supervisor would be at the facility during operation to oversee the MWP system. An hourly rate of $53.10 for supervisors is used for this analysis.

1 supervisor/shift x 1 shifts/day x 10 hours/shift x 6 days/week x $53.10/hour	=	$3,186
1 supervisor/shift x 1 shift/day x 8 hours/shift x 5 days/week x $53.10/hour	=	$2,124
$/week	=	$5,310
$/year	=	$276,120

4.2 Non-Operational Hours

4 helpers/shift x 1 shift/day x 8 hours/shift x 7 days/week x $29.50/hour	=	$6,610
$/year	=	$343,720

1 mechanics/shift x 1 shift/day x 8 hours/shift x 7 days/week x $47.20/hour	=	$2,643
$/year	=	$137,436

1 electrician/shift x 1 shift/day x 8 hours/shift x 7 days/week x $47.20/hour	=	$2,643
$/year	=	$137,436

Based on the estimated labor rates and operating the system for an average of 10 hours/day 6 days/week and 8 hours/day 5 days/week (subtracting 1 hour/day for start-up and shutdown) for a total time of operation of 4,836 hours/year and includes the non-operational hourly labor costs, the total estimated labor cost is approximately $2,888,900.

The addition of an MWP system will increase the electrical usage at the Facility. However, the MWP system is more efficient and demands less electricity than the current equipment. Therefore the increase in electrical usage based on installation of 2 – 35 TPH organics lines is estimated to cost approximately $250,000 annually. This represents approximately a 30% increase over the electrical cost estimate for the current RDF system.

The MWP system equipment maintenance generally includes costs associated with the conveyors, reducers, and disc screens. Based on the anticipated maintenance items and communication with equipment vendors, the estimated maintenance cost for the MWP system targeting organics and cardboard is $400,000/year.

Total annual operation and maintenance cost associated with operation of an MWP system targeting organics and cardboard are estimated to be approximately $3,538,900 (not including disposal of recovered organics).

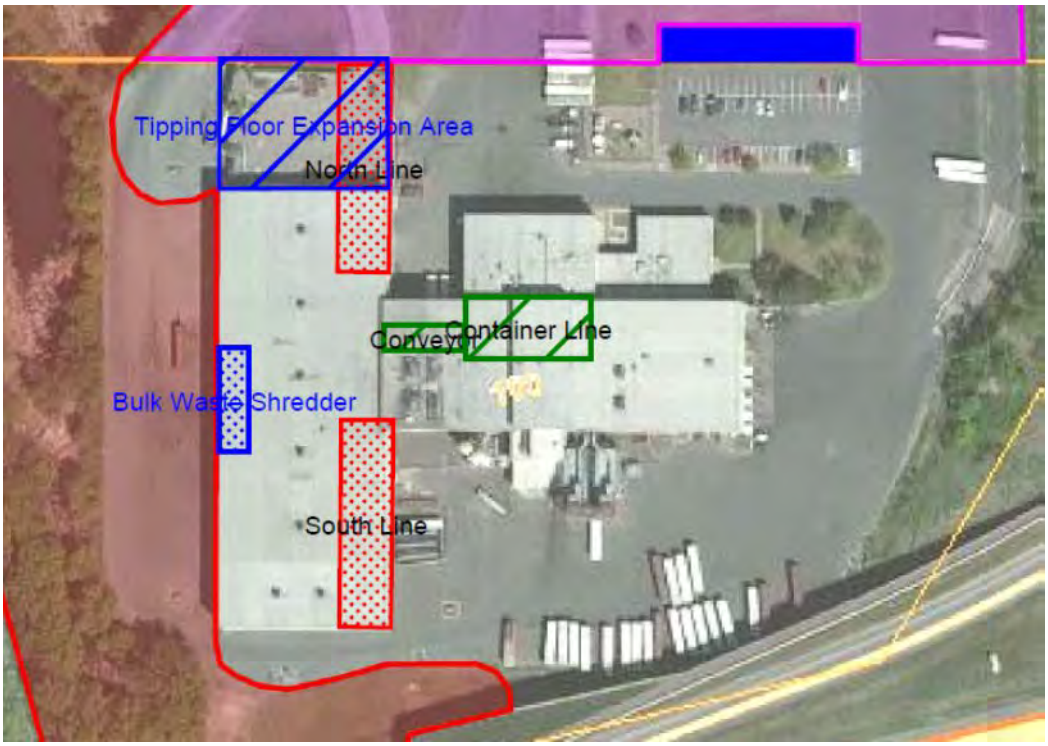
4.3 Design Details for MWP Targeting Organics and Containers

Assuming the MWP system presented in Figure 4-1 was selected to manage 340,000 tons/year it would require two lines for initial separation (up to the density separation). The two lines would converge after the density separator and a single line for containers (light 2-8 inch material) would be capable of managing ferrous, non-ferrous and marketable plastics recovery. The layout of the entire system is shown in Figure 4-1.

Each of the MWP lines described previously for targeting organics would remain in the same location, but would require the addition of a density separation unit to separate the light material from the heavy material. The heavy material would pass a cross belt magnet for additional ferrous recovery on its way back to the tipping floor for processing into RDF. Any recovered ferrous would be conveyed back and combined with the scrap metal recovered by the drum magnets.

The light material from each MWP line would be conveyed to a single elevated conveyor located between the northern most RDF line and the TLO area. This conveyor would convey material past the existing TLO area to a single polishing screen located north of the RDF lines. This area of the existing building has approximately 40’ ceilings, which would allow for an elevated container line. By elevating the container line, an area for storage of recovered material beneath each recovery component may still be available. Elevating the container line also makes it possible to “stack” the equipment (optical sorters and eddy current separator) saving floor space.

Figure 4-1
Potential Layout for an MWP System
Targeting Organic and Containers



5 Construction Cost Estimate

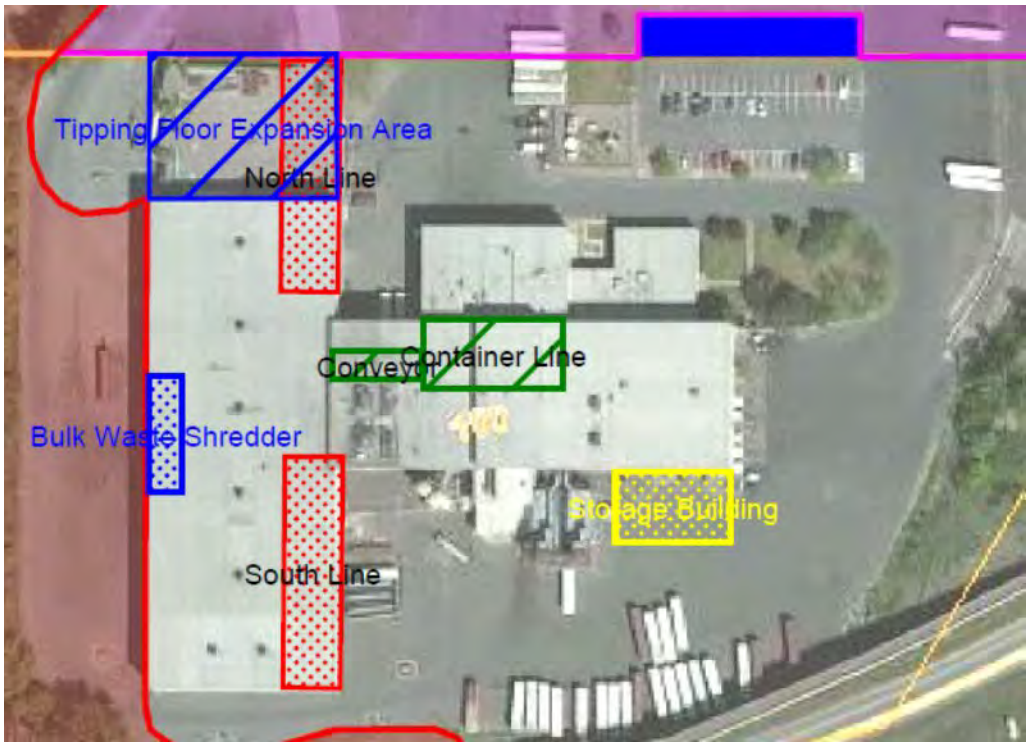
The estimated site related construction costs presented for the MWP system targeting organics would also pertain to the container line. Additionally, there would be costs associated with construction of a new building necessary to store items currently stored north of the RDF lines. This storage building could be constructed south of the RDF processing lines and east of the existing air handling units as shown on Figure 5-1.

Based on the items stored in the current building, it is estimated that the storage building will need to be approximately 6,000 square feet (60' by 100').

The additional site related construction costs for the container line include the following:

- Remove existing pavement (building footprint)
- Foundation excavation
- Concrete floor (8 inch)
- Pre-engineered metal building system
- Lighting/electrical
- Equipment related foundations
- Additional structural members for equipment

Figure 5-1
Potential Layout for the Necessary Storage Building



The estimated additional site construction cost associated with the addition of a container line is estimated to be $1.4 to $1.7 million using 2014 dollars, based on recent construction project bid results. This estimate assumes the new storage building is a "cold storage" area and would not be climate controlled. The total site related construction costs for adding two "front-end" MWP lines capable of processing 35 TPH and a single container line capable of processing the three (3) dimensional material from both lines is estimated to be $5.9 to $7 million, using 2014 dollars.

The additional container line equipment includes the addition of two density separation units (one at each "organics" line), two cross-belt magnets, additional conveyors, a single processing line capable of processing the three (3) dimensional materials separated from a 70 TPH system (material from both organics lines), and installation. The estimated additional cost for this system is $3.7 to $4 million, based on information provided by MWP system equipment vendors. The total equipment cost associated with MWP from the tipping floor through the end of the container sort line is estimated to be $11.95 to $12.75 million, using 2014 dollars.

The total cost for adding MWP equipment, including the container line as well as the site related construction is estimated to be between $17.85 and $19.75 million.

Operation and maintenance costs are associated with operating the MWP system. These costs include 14 sorters/quality control (QC) personnel at the three manual pre-sort stations (one for each organic line and one for the container line) and the QC areas shown on Figure 2-2, one supervisor, and an additional maintenance staff member. Similar to the MWP system targeting organics, an additional loader and operator would be required to bring waste to the in-feed of the MWP lines however; no additional grapple operators are anticipated to be necessary. Based on

the operating schedule previously discussed, it is anticipated that 14 sorters, one supervisor, and an additional maintenance staff member will be at the Facility during the hours of operation necessary to process the incoming material. Additionally, 6 helpers, 2 mechanics and an electrician will be necessary during the "clean-up" or non-operational hours, which are estimated to be 8 hours/day 7 days/week.

Labor rates for the positions are estimated as discussed previously for the MWP system targeting organics.

5.1 Operational Hours

14 sorters/shift x 1 shifts/day x 10 hours/shift x 6 days/week x $29.50/hour	=	$24,780
14 sorters/shift x 1 shift/day x 8 hours/shift x 5 days/week x $29.50/hour	=	$16,520
$/week	=	$41,300
$/year	=	$2,147,600
1 maintenance/shift x 1 shifts/day x 10 hours/shift x 6 days/week x $47.20/hour	=	$2,832
1 maintenance/shift x 1 shift/day x 8 hours/shift x 5 days/week x $47.20/hour	=	$1,888
$/week	=	$4,720
$/year	=	$245,440
1 operator/shift x 1 shift/day x 10 hours/shift x 6 days/week x $41.30/hour	=	$2,478
1 operator/shift x 1 shift/day x 8 hours/shift x 5 days/week x $41.30/hour	=	$1,652
$/week	=	$4,130
$/year	=	$214,760

It is anticipated that 1 supervisor would be at the facility during operation to oversee the MWP system. An hourly rate of $53.10 for supervisors is used for this analysis.

1 supervisor/shift x 1 shifts/day x 10 hours/shift x 6 days/week x $53.10/hour	=	$3,186
1 supervisor/shift x 1 shift/day x 8 hours/shift x 5 days/week x $53.10/hour	=	$2,124
$/week	=	$5,310
$/year	=	$276,120

5.2 Non-Operational Hours

6 helpers/shift x 1 shift/day x 8 hours/shift x 7 days/week x $29.50/hour	=	$9,912
$/year	=	$515,424
2 mechanics/shift x 1 shift/day x 8 hours/shift x 7 days/week x $47.20/hour	=	$5,286
$/year	=	$274,872
1 electrician/shift x 1 shift/day x 8 hours/shift x 7 days/week x $47.20/hour	=	$2,643
$/year	=	$137,436

Based on the estimated rates and operating the system for an average of 10 hours/day 6 days/week and 8 hours/day 5 days/week (subtracting 1 hour/day for start-up and shutdown) for a total time of operation of 4,836 hours/year and including the non-operational hourly labor costs,

the total estimated labor cost is approximately $3,811,650. The addition of the container line portion of the MWP system will also increase the electrical usage at the Facility. The increase in electrical usage based on installation of a 70 TPH container line is estimated to cost approximately $125,000 annually. This is in addition to the estimated $250,000 annual cost associated with the organics lines for a total cost of $375,000 annually for electrical usage to operate the entire system. This represents approximately a 50% increase over the electrical cost estimate for the current RDF system.

The container line equipment maintenance generally includes costs associated with the conveyors, air classifiers, optical and eddy current separators and the polishing screen. Based on the anticipated maintenance items and communication with equipment vendors the estimated maintenance cost for the container line is $175,000/year and is in addition to the estimated $400,000/year for the organics line. Therefore, the total equipment maintenance cost for the MWP system targeting organics and containers is estimated to be $575,000/year.

Total annual operation and maintenance cost associated with operation of an MWP system targeting organics and containers are estimated to be approximately $4,761,650 (not including disposal of organics).

6 Recovery Estimates

In order to estimate the recovery rate of the MWP system the following assumptions will be used:

- Annual MSW delivered to the Newport Facility = 405,000 tons
- Annual MSW assumed to be processed by the MWP lines = 340,000 tons
- Targeted organics (food waste and yard waste) from the Waste Composition Study = 25%
- Targeted cardboard/boxboard in commercial wastes (55% of total) from the Waste Composition Study = 6.4%
- Targeted PET from the Waste Composition Study = 1.1%
- Targeted HDPE from the Waste Composition Study = 0.6%
- Targeted Ferrous from the Waste Composition Study = 2.4%
- Targeted Non-ferrous from the Waste Composition Study = 0.8%
- Estimated recovery percentages provided by equipment vendor

The estimated recovery percentages for PET, HDPE, cardboard, ferrous and nonferrous are generally well documented and are typically included as a performance requirement in contract documents prior to installation of an MWP system. However, providing an accurate estimate of the percent recovery for organics for use in an AD system is difficult since there is very little data available for comparable systems (accepting commercial and residential MSW and targeting

organics for AD), especially with the East Metro region's well established source separation recycling programs.

A similar system was recently constructed in Montgomery, Alabama with preliminary data just beginning to become available. This system has an organics component (2 inch minus disc screen) which is used to separate materials for composting (an AD facility is planned for the near future).

Organics intended to be anaerobically digested may require additional "clean up" which would reduce the overall recovery rate. There is additional uncertainty in using the estimated organic recovery percentages since the incoming waste composition in Montgomery is likely quite different to the material received at the Newport Facility and may affect the recovery rates.

Table 6-1 lists the recovery percentages provided as a performance guarantee in the contract documents for the Montgomery MWP system. Also shown are the conservative recovery percentages that will be used to determine the estimated tons of recovered material at the Newport Facility.

Table 6-1
Vendor Provided Recovery Protection and Percent Recovery Used for Estimating Potential Tons Recovered at Newport

Material	Montgomery % Recovery	Conservative % Recovery
PET	85%	75%
HDPE	85%	75%
Cardboard/Boxboard	NP[1]	50%
Ferrous (Tin/Steel containers)	90%	90%
Non-ferrous (Aluminum)	90%	85%
Organics	Insufficient Data	50%[2]

[1] NP = Not provided by the equipment vendor for the Montgomery system

[2] Assumes 50% of the targeted organic material is separated from the 2 inch minus disc screen and will pass over the 1 inch minus disc screen and be recovered as organic material.

A 10% reduction is applied to the recovery numbers guaranteed at the Montgomery Facility to adjust for potential variability in waste composition estimate for PET and HDPE recovery. Based on the current amount of recovered ferrous at the Newport Facility and the fact that additional magnets would be incorporated into an MWP system, no reduction is applied to the ferrous recovery rate. A 5% reduction is applied to the non-ferrous recovery number guaranteed at the Montgomery Facility to adjust for potential variability in waste composition.

Additional information pertaining to organic recovery will need to be further evaluated as data become available. An understanding of the end use market for materials from the AD facility will also need to be evaluated to determine what fraction of inorganic contaminants is allowable at the AD facility.

Table 6-2 summarizes the estimated recovered tons by material type using the previously presented MWP system for organics and containers as well as the average actual percent recovered for ferrous and non-ferrous at the Newport Facility.

Table 6-2
Estimated Tons Recovered with MWP System at the Newport Facility

Material	Waste Composition (%)	Total Tons of Material in Waste Stream Based on Composition Study [1]	Estimated Percent Recovery (%)	Estimated Tons Recovered	Average Actual Percent Recovered From Waste Received at the Newport Facility (%)	Tons Recovered at the Newport Facility Based on Average Actual Percent Recovered
PET	1.1%	3,740	75%	2,805	NR	NR
HDPE	0.6%	2,040	75%	1,530	NR	NR
Cardboard/Boxboard	6.4%	11,970[2]	50%	5,985	NR	NR
Ferrous (tin/steel containers)	2.4%	8,160	90%	7,345	2.8%	11,200
Non-ferrous	0.8%	2,720	85%	2,310	0.2%	800
Organics (food and yard waste)	25%	85,000	50%[3]	42,500	NR	NR
Totals	**NA**	**114,130**	**NA**	**62,475**	**NA**	**NA**

[1] Assumes 340,000 tons of MSW will be processed with two MWP lines at the Newport Facility annually

[2] Assumes 55% of the 340,000 tons processed is commercial waste

[3] Assumes 50% of the targeted organic material is separated from the 2 inch minus disc screen and will pass over the 1 inch minus disc screen for recovery as organic material

NR = Not Recovered as separately a marketable material

Over 405,000 tons of waste were delivered to the Newport Facility during 2013

Currently PET, HDPE, cardboard, and organics are not recovered at the Newport Facility as separately marketed materials so no comparison is made between the current system and the potential MWP system. Ferrous and non-ferrous are currently recovered at the Newport Facility, however, the actual tons of these materials delivered to the Newport Facility are not specifically known so the current percent recovery for these materials cannot be calculated or directly compared with the estimated percent recovery for the MWP system.

The 2.8% actual average ferrous recovered (amount of material reported as "sold" in the Newport Facility Annual Report) was determined using data from the past 16 years. The 2.4% ferrous fraction of the delivered waste resulting from the waste composition study was based on a waste sorting event that took place Monday, June 23 through Monday June 30, 2014. The waste composition study included "Steel Cans" and "Other Scrap Metal" as individual categories with 90% confidence intervals of +/- 0.1% and 1.0%, respectively. For this analysis these categories were combined as simply ferrous with a 90% confidence interval of +/- 1.0%. Therefore, the average actual ferrous recovered (2.8%) is within the confidence interval determined from the data collected during the waste composition study.

The waste composition study results indicate that the waste is composed of 0.8% non-ferrous with a 90% confidence interval of +/- 0.2% as compared to the average actual percent recovered of 0.2%. This may suggest that the current system for non-ferrous recovery may be over burdened with other material thus reducing the recovery rate. Additionally, scrap aluminum that is not used for beverage containers may not be recovered with existing equipment, but could be counted in the Waste Composition Study. This difference may also indicate that the data point from the waste composition study is over-estimating the annual amount of non-ferrous available for recovery.

With a high percentage of organics in the waste stream (from the waste composition data) and an assumed recovery rate of 50%, the tons of organic material recovered is estimated to be 10.5% of the incoming waste (an additional total recovery of 4.6% towards the Counties' goals based on 921,500 tons/year of total solid waste managed). The remaining recovered materials include the PET, HDPE, ferrous and non-ferrous, of which ferrous and non-ferrous are already included in the Counties overall annual recycling percent total. To calculate the increased recycling rate associated with the addition of a MWP system, the following assumptions are used:

- All recovered PET included toward recycling goal
- All recovered HDPE included towards recycling goal
- All recovered cardboard included towards recycling goal
- No ferrous included towards recycling goal
- Increase in non-ferrous (2,310-800 = 1,510 tons) included towards recycling goal

Using these assumptions, the non-organic recovered materials represent approximately 2.9 % of the incoming material at the Newport Facility and 1.3% of total recovery. The estimated total additional tons recovered (all material types) is 54,330 tons or approximately 13.4% of the 405,000 tons available in the waste stream to be received at the Newport Facility or 5.9% of total recovery (based on the Counties managing 921,500 tons/year of mixed MSW).

The PET, HDPE, cardboard, ferrous and non-ferrous are marketable products that are considered a potential revenue source. The market for these materials is dependent on the quality (cleanliness) and is subject to fluctuations. Recyclables recovered through MWP are typically lower quality than those recovered through source separated recycling. A thirty percent (30%) discount from the market price was assumed. Table 6-3 presents the estimated revenue from the sale of these marketable materials.

Table 6-3
Estimated Potential Revenue from Materials Recovered Using an MWP System

Material	Current Market Rate/Ton[1]	Assumed Market Price/Ton[2]	Estimated Annual Revenue
PET	$355	$250	$701,250
HDPE	$560	$390	$596,700
Cardboard	$70	$49	$293,265
Ferrous (Tin/Steel containers)	$115	$80	$514,150
Non-ferrous (Aluminum)	$1570	$1,100	$2,541,000
		Estimated Total Annual Revenue	$4,646,365

[1] Current market prices from RecyclingMarkets.net accessed on August 25, 2014.
[2] The assumed market price is approximately 70% of the current market price to be conservative given market variability.

The estimated revenue associated with the marketable materials recovered using an MWP system is estimated to be approximately $4.65 million annually. This is considered a conservative estimate based on data from the waste composition study, reduced recovery rates, and reduced market value for marketable materials.

There are also costs associated with the recovered organics from the MWP system. Currently there is no established market for the organic material recovered from the MWP system. However, there is an AD facility in the early stages of development in the vicinity of the existing Newport Facility. For preliminary budgetary economics, a range in cost for organics management is estimated to be between $40 and $60/ton.

Given the estimated volume of material and cost per ton, the estimated annual cost is approximately $1,700,000 to $2,550,000 for disposal of the organic fraction recovered with the MWP system. The cost for disposal of the organic fraction will depend on the cleanliness of the organic and the contract price negotiated with the AD facility for management of the organic material. Preliminary discussions with the AD facility staff indicate that similar AD facilities accept organics for between $20 and $75/ton depending on quality.

7 Summary Table – Implementation of MWP Only

Table 7-1 provides a summary of the capital costs, O&M costs, revenues, and percentages of increase in recovery.

Table 7-1
Summary of Costs Associated with MWP, Potential Revenue, and Percent Increase in Recovery Goals

Potential MWP Systems	Site Capital Costs	Equipment Capital Costs	Total Estimated Capital Costs	Annual O&M Costs[1]	Potential Annual Revenue	% Increase in Recovery[2]
Targeting Organics	$4,500,000 - $5,300,000	$8,250,000 - $8,750,000	$12,750,000 - $14,050,000	$5,238,900 - $6,088,900	$619,665	4.6%
Targeting Organics and Containers	$5,900,000 - $7,000,000	$11,950,000 - $12,750,000	$17,850,000 - $19,750,000	$6,461,650 - $7,311,650	$4,646,365	5.9%

[1] Includes costs associated with organics transportation and disposal

[2] Percent increase in recovery is calculated using 921,500 tons/year of mixed MSW managed by the Counties

The addition of an MWP system targeting organics potentially results in a 4.6% increase towards the 75% goal. This system provides potential revenue for the Counties from recovery of some (approximately 50%) ferrous material and cardboard. By including the container line as a part of the MWP system, there is an increase in the percent recovery (5.9%) as well as potential for the system to provide additional revenue. The potential revenue from the MWP system that includes a container line will help to offset some of the associated operation and maintenance costs, but is not projected to pay for all operation and maintenance associated with MWP.

Assuming the capital costs are amortized at 4% over 20 years, the annual costs range from approximately $938,000 to $1,453,000.

Additionally, as a part of the overall diversion goals (75%), the Project Board is also examining recovery of source separated organics/source separated recycling (SSO/SSR). Information specific to SSO/SSR is presented in the *Estimated Calculations of Additional SSR/SSO Tons* memorandum dated September 2014 by Foth. The following section provides the results and discussion of implementing enhanced SSO/SSR combined with an MWP system.

8 Combining SSO/SSR with MWP

If enhanced SSO/SSR was implemented, the amount of material within the waste stream "available" for processing with an MWP system targeting organics and containers would be reduced. In other words, the increased recovery rate through implementation of enhanced SSO/SSR and the increased recovery rate through installation of an MWP system are not directly additive because enhanced SSO/SSR implementation reduces the volume of "available" tons in the waste stream for MWP system capture. This section presents the estimated material recovery projections for HDPE, PET, cardboard, organics, ferrous and non-ferrous if the Counties implemented enhanced SSO/SSR and combined implementation with installation of an MWP system targeting organics and containers at the Newport Facility.

Data from the *Estimated Calculations of Additional SSR/SSO Tons* memorandum dated September 2014 indicate the estimated amount of each recyclable material targeted using MWP remaining in the MSW after implementation of enhanced SSO/SSR are generally as follows:

- HDPE = 1,400 tons
- PET = 2,600 tons
- Cardboard = 4,240 tons (commercial waste only)
- Ferrous = 5,900 tons
- Non-ferrous = 1,450 tons
- Organics (food and yard waste) = 52,300 tons
- Total tons = 80,940

The estimated tons of material that remain in the waste stream after implementation of SSO/SSR are used in conjunction with the estimated recovery rates using a MWP system as presented in Table 6-1.

Not all of the 405,000 tons/year assumed to be delivered to the Newport Facility if SSO/SSR was implemented will be processed with two - 35 ton per hour (TPH) MWP lines. The MWP system is estimated to be capable of processing 340,000 tons/year, so the amount of potentially recoverable material is adjusted based on the MWP systems estimated through-put of 340,000 tons of MSW/year. Therefore, 84% (340,000/405,000 = 0.84 or 84%) of the 405,000 tons/year of MSW is assumed to be processed and an assumed 84% of the recoverable material remaining in the MSW after SSO/SSR implementation is available for recovery with an MWP system.

In addition to adjusting the tons of recoverable material in the MSW that will enter the MWP system, a 10% reduction in the estimated recovery rate of the system for PET and HDPE is applied to account for assumed difficulty in recovery with reduced PET and HDPE material volume. This efficiency reduction is shown and used in the calculations in Table 8-1.

Table 8-1
Estimated Tons Recovered with Installation of an MWP System at the Newport Facility after Implementation of Enhanced SSO/SSR

Material	Tons of Material in MSW for Recovery (after implementation of SSO/SSR)[1]	Total Tons of Material Projected to be Processed using MSW[2]	Estimated Percent Recovery using MWP equipment (%)	Estimated Tons Recovered using SSO/SSR and MWP	Approximate Increase in Percent Recovery Toward County Goal Based on 921,500 tons
PET	2,600	2,190	65%	1,425	0.2%
HDPE	1,400	1,175	65%	765	0.1%
Cardboard/Boxboard	4,240[3]	3,560	50%	1,780	0.2%
Ferrous (tin/steel containers)	5,900	4,950	90%	4,455	0.5%[4]
Non-ferrous	1,450	1,220	85%	1,035	0.1%[4]
Organics (food and yard waste)	52,300	43,930	50%	21,965	2.4%
TOTAL	**80,940**	**75,660**	**NA**	**31,425**	**2.9%**

[1] Based on results from the SSO/SSR memo

[2] Assumes 340,000 tons of MSW will be processed using an MWP system (85% of available)

[3] Assumes only the commercial fraction of the cardboard will be targeted using an MWP system

[4] Ferrous and non-ferrous are not included in the increased percent recovery because the materials are already being recovered at a similar rate at the Newport Facility

As is expected, implementation of SSO/SSR decreases the amount of material in the MSW available for recovery through MWP as compared to a MWP system alone. By far, recovery of organic material using a MWP system has the most significant impact on the overall recovery at 2.4%. Table 8-2 presents the estimated increase in percent recovery thorough implementation of enhanced SSO/SSR alone, the increase percent recovery with enhanced SSO/SSR and installation of an MWP system and the total additive increase in percent recovery towards the County goal.

Table 8-2
Estimated Increase in Percent Recovery with SSO/SSR Only, MWP after SSO and SSR and the Additive Increase in Recovery Rate with SSO/SSR and MWP Combined

Material	Approximate Increase in Percent Recovery Toward County Goal using SSO/SSR	Approximate Increase in Percent Recovery Toward County Goal Using MWP After SSO/SSR	Approximate Increase in Total Percent Recovery Toward County Goal Based on 921,500 tons
PET	0.2%	0.2%	0.4%
HDPE	0.1%	0.1%	0.2%
Cardboard/Boxboard	0.7%	0.2%	0.9%
Ferrous (tin/steel containers)	0.5%	0.5%[1]	0.5%
Non-ferrous	0.1%	0.1%[1]	0.1%
Organics (food and yard waste)	5.0%	2.4%	7.4%
Materials Recovered Through SSO/SSR Implementation only	4.6%	NA	4.6%
TOTAL	**11.2%**	**2.9%[1]**	**14.1%**

[1] Ferrous and non-ferrous are not included in the increased percent recovery because the materials are already being recovered at a similar rate at the Newport Facility.

The estimated increase in recovery rate with implementation of enhanced SSO/SSR only and installation of a MWP system only are 11.2% and 5.9%, respectively. These estimated recovery rates are not directly additive. Results presented in Table 8-2 indicate that processing MSW after implementation of enhanced SSO/SSR decreases the amount of recyclable material available for recovery using a MWP system by approximately 3.0% (from 5.9% to 2.9%). However, results from combining implementation of enhanced SSO/SSR with installation of an MWP system indicate that an additional 2.9% recovery is achievable. This is in addition to the estimated 11.2% recovery with implementation of SSO/SSR alone. Therefore, if both SSO/SSR and MWP were implemented, the estimated additional material recovery rate is estimated to be 14.1%. When added to the current recycling rate (53%), this cumulative recovery rate, at 67.1%, is still significantly less than the Minnesota Legislature's Goal of 75%.

9 Next Steps

In order to obtain more definitive recovery rate information through the use of a MWP system, staff from RRT indicated a willingness to send 3 semi-truck loads of mixed MSW entering the Newport Facility to the Montgomery MWP system. This would provide more definitive recovery rates using County specific waste with a MWP system that is very similar to the design presented in this report. Another next step, that may help to determine organics disposal cost and

organic use in an AD facility, is to obtain a sample of the 2 inch minus “organics” from the Montgomery facility. This material would be provided to potential AD vendors (currently SaniGreen has indicated interest) to determine how the material would react to the vendor specific technology and would assist in determining a more definitive cost estimates.

Both of these next steps will require additional communication with RRT, AD vendors, and staff from the Montgomery facility.