Metro Waste Authority
We Know Where It Should Go

Materials Recovery Facility (MRF) Feasibility Study

June 2018

HDR
hdrinc.com
(402) 399-1000
8404 Indian Hills Drive
Omaha, NE 68114

Metro Waste Authority

We Know Where It Should Go

Contents

Tables

Figures

List of Acronyms and Abbreviations

2-D	two-dimensional
3-D	three-dimensional
C&D	construction and demolition
ECS	eddy current separator
FTE	full-time employee
FY	fiscal year
HDPE	high-density polyethylene
HDR	HDR, Inc.
HHW	household hazardous waste
ISRI	Institute of Scrap Recycling Industries
LDPE	low-density polyethylene
MAR	Mid America Recycling
MP	mixed paper
MPDR	Midwest Product Destruction and Recycling Services
MRF	materials recovery facility
MWA	Metro Waste Authority
O&M	operation and maintenance
OCC	old corrugated containers
ONP	old newspaper
PE	polyethylene
PET	polyethylene terephthalate
PETE	Same as PET
PP	polypropylene
QC	quality control
RFP	request for proposal
SRPN	sorted residential paper and news
tpd	tons per day
tph	tons per hour
tpy	tons per year
U.S.	United States of America
UBC	used beverage containers
WM	Waste Management

Executive Summary

Metro Waste Authority's (MWA) Curb It! program is the most comprehensive curbside recycling program in Iowa. This program provides curbside recycling services to almost 93,000 households within MWA's member communities. Currently, MWA delivers the recyclables to a materials recovery facility (MRF) owned by Mid America Recycling (MAR) for processing and marketing. Due to some concerns about the future of the MAR contract, MWA has decided to evaluate the possibility of developing its own MRF.

Four potential MRF operating scenarios were evaluated:

1. Existing Curb It! program — 20,000 tons per year
2. Curb It! program, small businesses, and City of Des Moines — 30,000 tons per year
3. Curb It! program, City of Des Moines, small businesses, other communities — 45,000 tons per year
4. Curb It! program, City of Des Moines, small businesses, other communities — 60,000 tons per year

Several companies currently supplying equipment to separate and process commingled recyclables were consulted regarding the type and size of equipment that would be necessary to process the single-sort commingled recyclables. Typical equipment needed to process recyclables includes conveyors, screens, air classifications systems, eddy current separators, magnets, optical sorters, manual sorters, and balers. Based on the annual volumes of materials needed, it is expected that a processing system capable of handling 25 to 35 tons per hour would be needed.

The proposed MRF would be built on the existing Grimes facility site and the Gabus Family Trust expansion property. The MRF would use some of the existing infrastructure at the transfer station, such as scales and roads, to reduce costs and minimize development impact. In addition to the MRF, it is anticipated that the site will also include a household hazardous waste management facility and Administration and Visitor/Education Building.

Recycling commodity markets were evaluated as part of the feasibility study. In general, recycling commodity markets have had significant challenges in the past few years due to low oil prices, high contamination rates, and reduced export market options. Recycling in the United States has historically relied heavily on China as an export market. Earlier in 2018, China enacted exceptionally strict quality requirements under its National Sword Policy. As a result, markets for mixed paper, plastics, and metals have been greatly affected. The result has been falling market prices for plastics and fibers. Figure ES-1 below shows the decline in mixed paper value in the Pacific Northwest. Nevertheless, many recycling commodities have value, and the current market prices were reviewed in the study.

Capital and operating costs were evaluated. Table ES-1 through Table ES-3 show the expected capital costs and operating costs of a MRF. Sensitivity analyses were performed on the operating costs due to increased recycling revenues and multiple operating shifts, the results of which are presented in Table ES-4 and Table ES-5.

Figure ES-1. Mixed Paper Market in the Pacific Northwest (2016–2018)

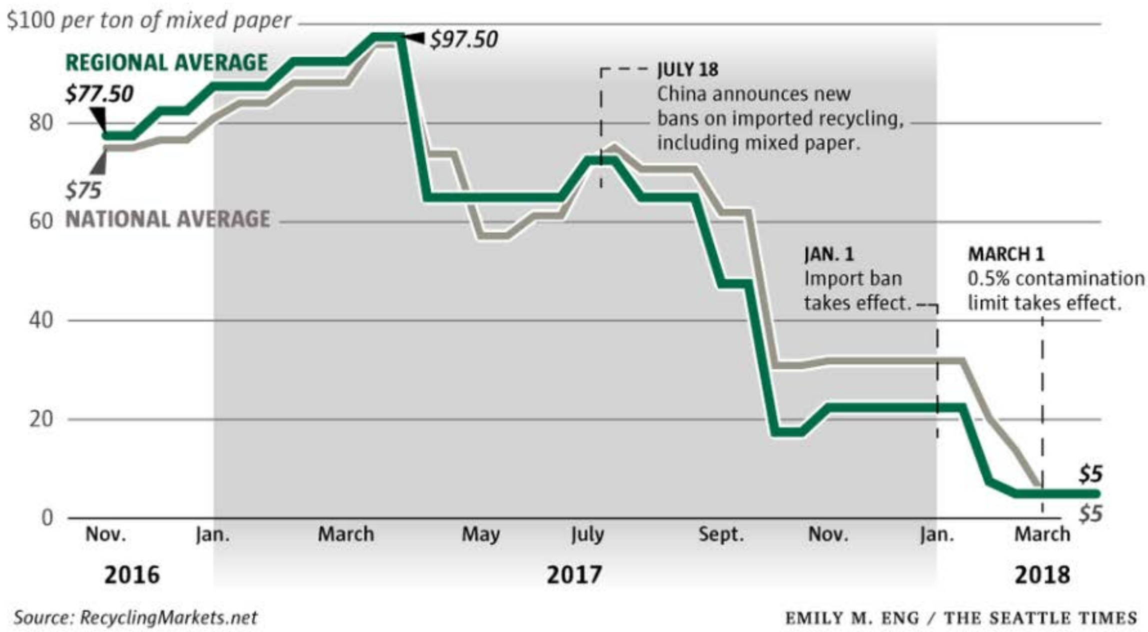


Table ES-1. Material Recovery Facility Capital Cost Summary (2018$)

Component	Size	Cost Estimate (2018$)	Cost Estimate (2022$)
Site acquisition	8.1 acres	$0	$0
Development costs		$2,215,000	$2,493,000
Direct construction costs	54,000 square feet	$11,075,000	$12,465,000
Other structures	1 scale	$125,000	$141,000
Total capital construction		**$13,415,000**	**$15,099,000**

Table ES-2. Processing and Mobile Equipment Cost Summary (2018$)

Component	Baseline	Scenario 1	Scenario 2	Scenario 3
Process system	$6,000,000	$6,000,000	$6,000,000	$12,000,000
Equipment installation, start-up, & contingency (30%)	$1,800,000	$1,800,000	$1,800,000	$3,600,000
Mobile equipment	$502,000	$502,000	$552,000	$672,000
Mobile equipment contingency (10%)	$50,000	$50,000	$55,000	$67,000
Total equipment (2018$)	**$8,352,000**	**$8,352,000**	**$8,407,000**	**$16,339,000**
Total equipment (2022$)	**$9,400,000**	**$9,400,000**	**$9,462,000**	**$18,390,000**

Table ES-3. Potential O&M Cost Opinion Summary (2018$)

Component	Baseline	Scenario 1	Scenario 2	Scenario 3
Annual debt service (20 years) – MRF	$987,000	$987,000	$987,000	$987,000
Annual debt service (10 years) – Equipment	$1,030,000	$1,030,000	$1,037,000	$2,055,000
Labor	$1,049,000	$1,217,300	$1,628,600	$1,809,700
Insurance	$131,000	$131,000	$131,000	$191,000
Facility maintenance & utilities	$574,000	$585,300	$726,900	$854,500
Equipment O&M	$276,000	$355,300	$473,000	$710,100
Residuals haul & disposal	$111,000	$165,900	$249,100	$331,500
Contingency (10%)	$214,000	$245,500	$320,920	$389,700
Annual total O&M cost opinion with debt service	**$4,372,000**	**$4,717,300**	**$5,553,800**	**$7,328,500**
Potential net revenue	$836,000	$1,254,000	$1,884,000	$2,506,000
Net O&M cost	**$3,536,000**	**$3,463,300**	**$3,669,800**	**$4,822,500**

Table ES-3 Recycling Revenue Sensitivity on Net Costs (2018$)

Component	Baseline	Scenario 1	Scenario 2	Scenario 3
Annual debt service (20 years) – MRF	$987,000	$987,000	$987,000	$987,000
Annual debt service (10 years) – Equipment	$1,030,000	$1,030,000	$1,037,000	$2,055,000
Labor	$1,049,000	$1,217,300	$1,629,600	$1,809,700
Insurance	$131,000	$131,000	$131,000	$191,000
Facility maintenance & utilities	$574,000	$585,300	$726,900	$854,500
Equipment O&M	$276,000	$355,300	$473,000	$710,100
Residuals haul & disposal	$111,000	$165,900	$249,100	$331,500
Contingency (10%)	$214,000	$245,500	$320,900	$389,700
Annual total O&M cost opinion with debt service	**$4,372,000**	**$4,717,300**	**$5,553,800**	**$7,328,500**
Potential net revenue (no increase in recyclables value)	$836,000	$1,254,000	$1,884,000	$2,506,000
Net O&M cost	**$3,536,000**	**$3,463,300**	**$3,669,800**	**$4,882,500**
Net cost per ton	**$171**	**$112**	**$79**	**$78**
Potential net revenue (20% increase in recyclables value)	$1,003,200	$1,504,800	$2,260,800	$3,007,200
Net O&M cost	**$3,368,800**	**$3,212,500**	**$3,293,000**	**$4,321,300**
Net cost per ton	**$163**	**$103**	**$71**	**$70**

Table ES-4. Potential Cost Impact from Multiple Shifts

Component	Scenario 3, One Shift	Scenario 3, Two Shifts
Annual total O&M cost opinion with debt service	$7,245,900	$6,388,100
Potential net revenue	$2,506,000	$2,506,000
Net O&M cost	**$4,739,900**	**$3,882,100**
Net cost per ton	**$76**	**$63**

The development of an MRF is expected to take approximately 36 to 48 months to complete. The steps involved in the MRF development include:

- Feasibility study 3 months
- Design and permitting 12 months
- Construction bidding and equipment procurement 6 months
- Construction 18 months
- Commissioning and start-up 3 months

Developing a MRF will involve some risk for MWA. There will be financial risks associated with the development and operation of the MRF. There will be risks associated with material quantities and quality coming to the facility. There will be risks associated with the performance of the MRF. And there will be risks associated with the marketability of the materials from the MRF.

Likewise, there are risks to MWA associated with the existing MAR contract. The number of times MAR has come to MWA for revisions to the contract has been concerning to MWA. There are risks associated with the potential future contract terms between MWA and MAR. There is a risk that MAR might not invest in the facility and eventually not be able to process commingled recyclables due to the tightening market standards. And there are therefore financial risks to MWA due to the uncertain future of the MAR contract, operations and facility.

Provided in Table ES-6 is a matrix of the risks associated with the current MAR contract and a new MWA MRF.

Table ES-5. Comparison of Future Risks

Risk Key

High Risk	
Medium Risk	
Low Risk	

Risk	Staying with MAR Contract	Developing a MWA MRF
Contract		
Volatility of Business Conditions		
Administrative Time and Involvement		
Business Relationships		
Operational		
Ability to Meet Future Market Conditions		
Potential Service Interruptions		
Quality of Materials from Customers		
Quality of recyclables		
Financial		
Capital Costs		
Operating Costs		
Rate Payer Impacts		

Some key considerations in the development of a MRF include:

- **Defined project champion** - MWA will need to identify a project champion.
- **Suitable site** - the MWA's site in Grimes appears to be suitable for a MRF.
- **Reliable supply of recyclables** - MWA will need to reach out to potential customers to ensure that enough recyclables are secured to keep operating costs reasonable.
- **MRF technology** – current technology is commercially available to process commingles recyclables.

- **Markets for sorted recyclables** - challenges exist in the current markets and MWA will need to develop high quality recyclables and trustworthy relationships with potential commodity markets.
- **Economics** – close attention will need to be paid to ensure economics are favorable for a MRF, including an adequate supply of recyclables, reliable customers and partners, appropriate technology, and good relationships with end markets.
- **Risks –** there are identified risks associated with both the development of a MRF and with the existing MWA contract that will need to be evaluated and mitigated.

Introduction and Purpose

Metro Waste Authority (MWA) operates the most comprehensive curbside recycling program in Iowa—Curb It! This program provides curbside recycling services to almost 93,000 households within MWA's member communities. Currently, MWA delivers the recyclables to a private materials recovery facility (MRF) for processing and marketing. MWA has decided to evaluate the possibility of developing its own MRF and has retained HDR, Inc. (HDR) to perform a feasibility analysis to determine whether MWA should build its own single-stream MRF and either (1) operate or contract with an operator for the MRF to recover and market recyclables or (2) to continue to contract with a privately owned MRF for these services.

In this document, HDR has evaluated current service areas (member communities) and potential service areas (other potential communities and sources of recyclables) for the MWA to understand and project potential MRF capacities. HDR has had numerous discussions with various companies offering recyclables processing technologies, spoken with some operating facility representatives, and reviewed the current recycling commodity markets (for the sale of recyclable materials). The current markets for recyclables are of concern in Iowa and across the country, in large part due to low commodity values and restrictions on recyclable exports to China (that is, China's National Sword Policy). The market conditions for recycling are therefore changing; however, the reasons why communities such as those serviced by MWA provide recycling services have not changed. This report is intended to help MWA determine the best path forward for recycling.

Metro Waste Authority's Service Area

Background

MWA is an independent government agency in the central Iowa region. MWA provides services for recycling, garbage, yard waste, and hazardous waste collection for a number of communities. MWA operates several facilities including the Metro Park East Landfill, Metro Park West Landfill, Metro Compost Center, Metro Central Transfer Station, Metro Northwest Transfer Station, Metro Hazardous Waste Drop-Off, and Metro Recycling Drop-Offs. MWA also operates several programs such as Curb It! and Compost It!, a recycling program and yard waste collection program, respectively. There are also hazardous waste drop-offs for residents and special waste disposal options for commercial and industrial businesses.

MWA currently sends its recyclables to Mid America Recycling (MAR), a private recycling company responsible for recycling 750,000 tons annually according to its website. MAR is responsible for the processing and sale of recyclables to secondary markets. MWA is not confident with its relationship with MAR or its operations and is considering the construction of an MWA-owned MRF.

Current Service Area

MWA currently comprises 23 communities in the western Iowa region, including 16 member communities, one county, and six planning members. MWA's recycling program, Curb It!, provides recycling and waste collection to all member communities, except the City of Des Moines, through a contract with Waste Management (WM). The City of Des Moines, which is serviced by Des Moines Public Works, has a separate contract with MAR to process recyclables.[1]

MWA's Curb It! program provides curbside single-stream recyclables collection service to approximately 93,000 households every 2 weeks. MWA also collects recyclables from a number of small businesses if they are along the regular collection route. Recyclables collected include paper, cardboard and boxes, contained shredded paper, food and beverage cartons, glass jars and bottles, aluminum and tin cans, plastic containers (with twist-off lids), and yogurt and margarine tubs.[2] On average, MWA collects approximately 20,000 tons of recyclables per year, and the City of Des Moines collects approximately 10,000 tons of recyclables per year.

When evaluating baseline and potential service areas, 20,000 tons per year (tpy) will be used as MWA's baseline tonnage. The combined total of 30,000 tpy for MWA's recyclables and the City of Des Moines' recyclables will be used in a sensitivity analysis in comparison to the baseline tonnage.

Potential Service Areas

MWA currently collects residential recyclables in 21 communities in the central Iowa region. However, the addition of surrounding communities (beyond current Curb It! members) would increase the amount of recyclables collected and sent to the proposed MRF, thus providing greater economies of scale and better system economics. HDR reached out to a number of potential system participants to gauge the general interest of other communities that might use the facility. Not all communities and haulers were reached, and some were non-committal. However, based on this preliminary outreach, the following communities have said that they might be willing to participate in a future MRF: Dallas County's rural section, The City of Perry, Ames, Boone County, the City of Newton, the communities of the Western Central Solid Waste Commission and the Rathbun Area Solid Waste Commission, and Iowa State University.

In addition to the outreach conducted with communities, a similar high-level outreach was conducted with key private haulers that might be willing to deliver recyclables to an MWA MRF. Haulers that have expressed interested in contracting with a future MRF are WM, which is

[1] Metro Waste Authority, "About Metro Waste Authority," accessed May 25, 2018.
[2] Metro Waste Authority, "Accepted & Not Accepted," accessed May 25, 2018.

responsible for the commercial and residential collection in Des Moines; Waste Connections of Iowa; Chitty Garbage Services; Ankeny Sanitation; Aspen Waste; Dodd's Trash Hauling and Recycling; and Al's Enterprise.

The MWA service Curb It! does not provide recycling services to apartments, or condominiums and to less than 50 small businesses. A company called RecycleMe Iowa provides recycling collection for businesses in the MWA region. RecycleMe has approximately 100 accounts and operates one truck Monday through Friday. RecycleMe currently brings all recyclables to the MAR facility and would consider delivering its collected recyclables to an MWA MRF.

Potential MRF Volumes

In order to understand the economics of existing MWA Curb It! volumes and the potential impacts of greater volumes of recyclables to the project economics, the feasibility of developing and possibly operating a new single-stream MRF has been evaluated using four different throughput scenarios. The expected participation for each scenario is shown in Table 3-1, and the anticipated annual tonnages were used in sensitivity analyses for the economic discussions in this report. The scenarios were developed using recyclable collection tonnage data for 2017.

It has been assumed that the tonnage collected by communities is essentially all residential recyclables, and the tonnage collected by private haulers is approximately 30% residential recyclables and 70% commercial recyclables. If MWA decides to proceed with development of a MRF, knowing the expected quantity of residual and commercial feedstock will be important. Residential feedstock is usually consistent within different communities in a region, provided each community targets the same components of recyclables. Commercial recyclables often will have more cardboard and fewer containers than residential recyclables; however, this will vary based on the industries served.

Table 3-1. Basis of Tonnage Estimates for Scenarios

Community/Hauler	Annual Residential Tons	Annual Commercial Tons	Total Tons from Source	Cumulative Tons
Baseline Scenario** – **20,000 tpy				
Metro Waste Authority	20,000	0	20,000	20,000
Scenario 1 – 30,000 tpy				
Baseline Scenario	20,000	0	20,000	20,000
Des Moines	10,000	0	10,000	30,000
Scenario 2 – 45,000 tpy				
Scenario 1	30,000	0	30,000	30,000
Waste Management, Des Moines metro area	2,880	6,720	9,600	39,600
Waste Connections of Iowa	750	1,750	2,500	42,100
Ankeny Commercial	0	2,600	2,600	44,700
Dallas County (rural)	259	0	259	44,959
Scenario 3 – 60,000 tpy				
Scenario 2	34,000	11,000	45,000	45,000
Perry	880	0	880	45,880
Ames	140	0	140	46,020
Iowa State University	16	36	52	46,072
Chitty Garbage Services	63	147	210	46,282
Adel (South Dallas County Landfill Agency)	285	0	285	46,567
Waukee	1,315	0	1,315	47,882
Boone County	650	0	650	48,532
Western Central Solid Waste Commission	4,800	0	4,800	53,332
Rathbun Area Solid Waste Commission	1,210	0	1,210	54,542
Dodd's Trash Hauling and Recycling	312	728	1,040	55,582

Sources: Personal communications with staff, May 8–22, 2018

The **Baseline Scenario** assumes that the new MRF would receive only the 20,000 tpy that MWA currently collects. This is illustrated in Figure 3-1 by an arrow representing the flow of material to the Metro Northwest Transfer Station, which is a potential site for an MWA MRF. In addition to the Baseline Scenario, three additional scenarios were developed for further analysis.

Scenario 1 assumes that the MRF will also receive 10,000 tpy from Des Moines, in addition to the 20,000 tpy from the Baseline Scenario, for a total of 30,000 tpy. This is illustrated in Figure 3-2, which uses arrows to represent the two material sources.

Scenario 2 assumes that, in addition to those same 30,000 tpy, another 15,000 tpy would be received from additional haulers and communities, for a total throughput of 45,000 tpy. This is illustrated in Figure 3-3, which continues to add arrows representing the additional material sources and uses various thicknesses to represent their relative quantities.

Finally, **Scenario 3** assumes that the new MRF would receive all the material in Scenario 2, plus an additional 15,000 tpy from other haulers and communities, for a total of 60,000 tpy. This is illustrated in Figure 3-4, which builds on the previous figures and shows all the potential sources of recycling material identified for this feasibility study.

Although Table 3-1, Figure 3-3, and Figure 3-4 show potential combinations of haulers and communities that could meet the approximate sizing of these scenarios, they are strictly hypothetical and are meant only to help illustrate potential economies of scale. As yet, no additional material has been committed or more importantly contracted for with MWA, and levels of interest will eventually need to be confirmed and agreements established.

Figure 3-1. Potential Sources of Recyclables, Baseline Scenario

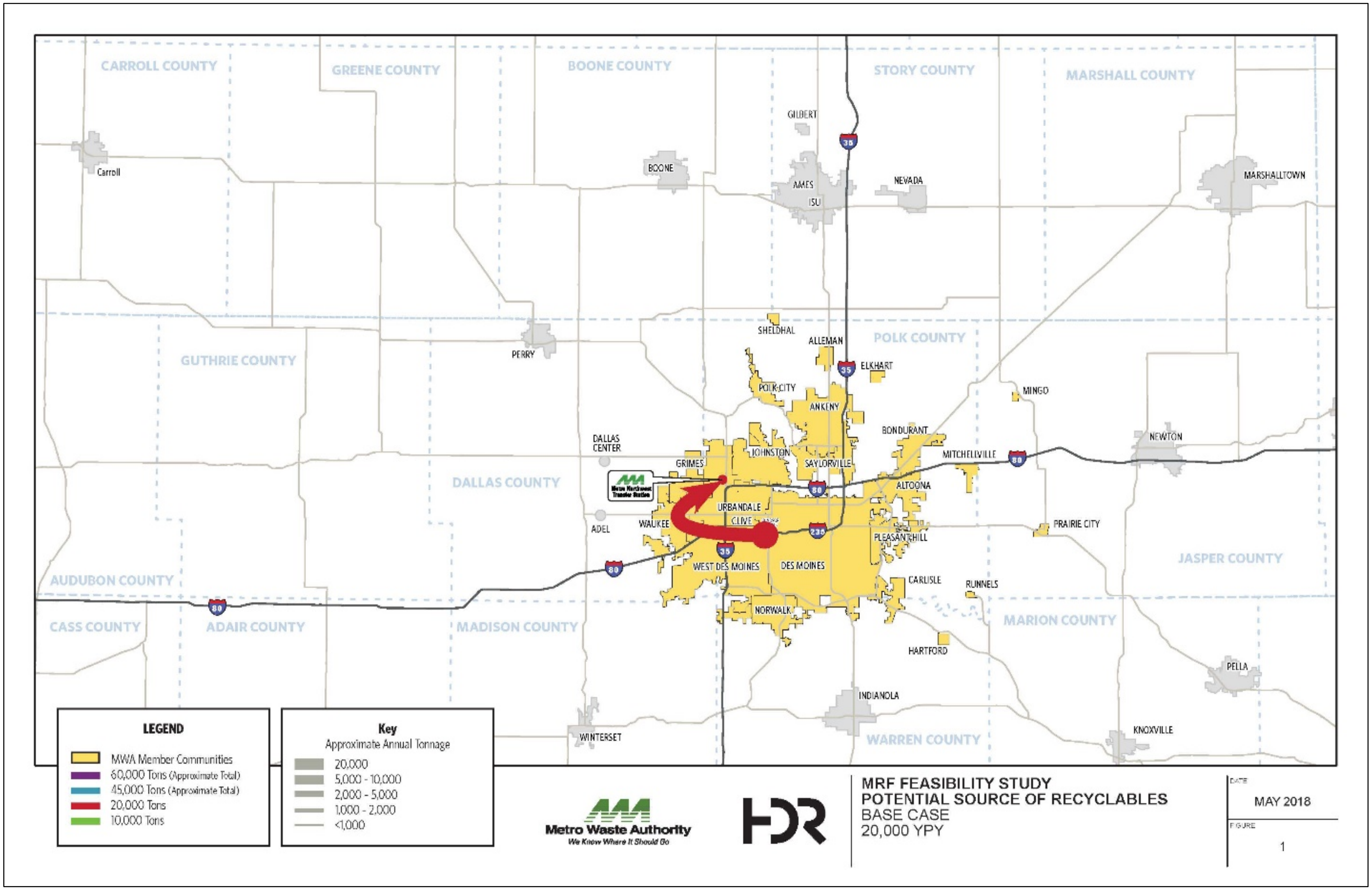


Figure 3-2. Potential Sources of Recyclables, Scenario 1

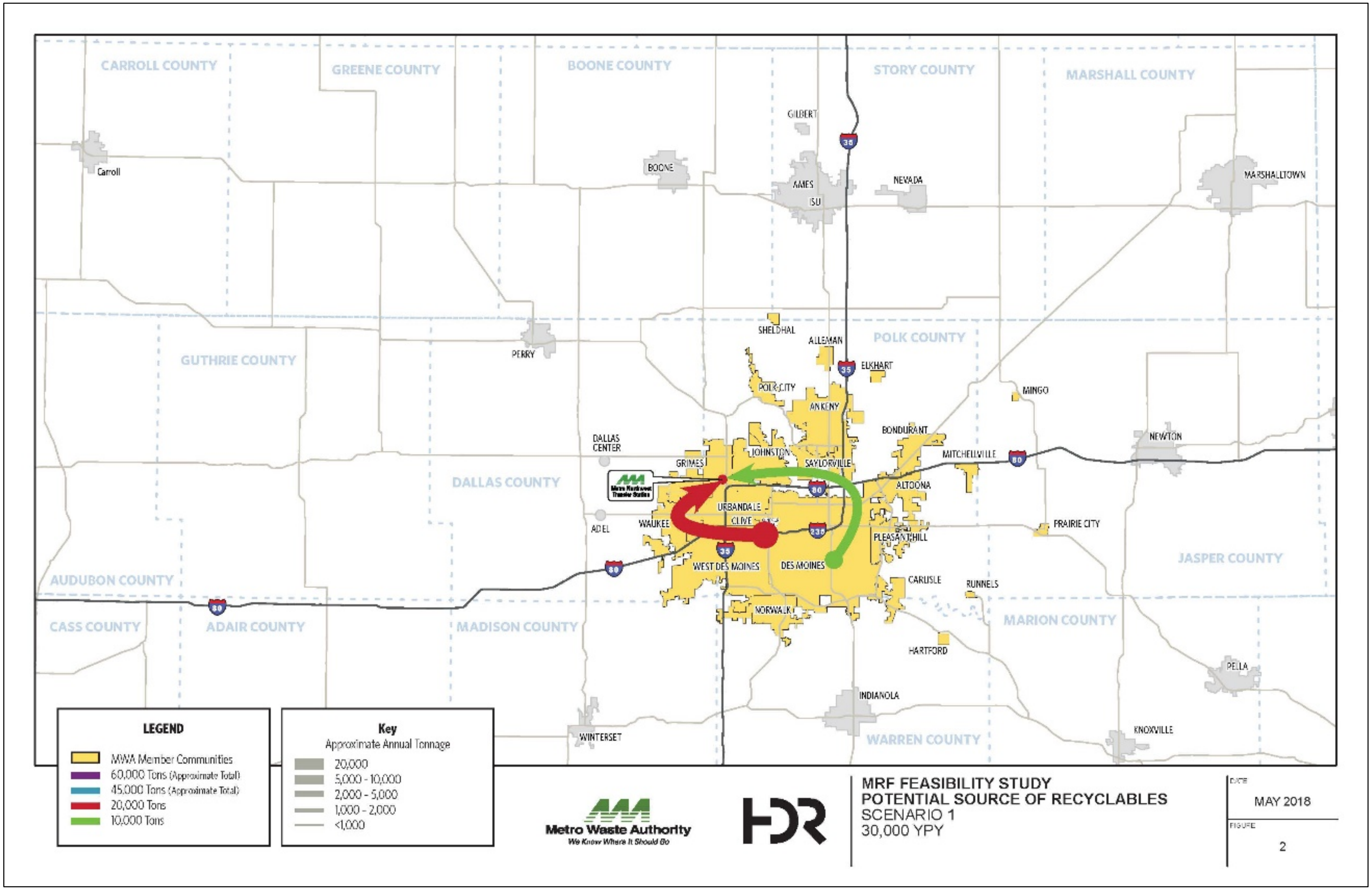


Figure 3-3. Potential Sources of Recyclables, Scenario 2

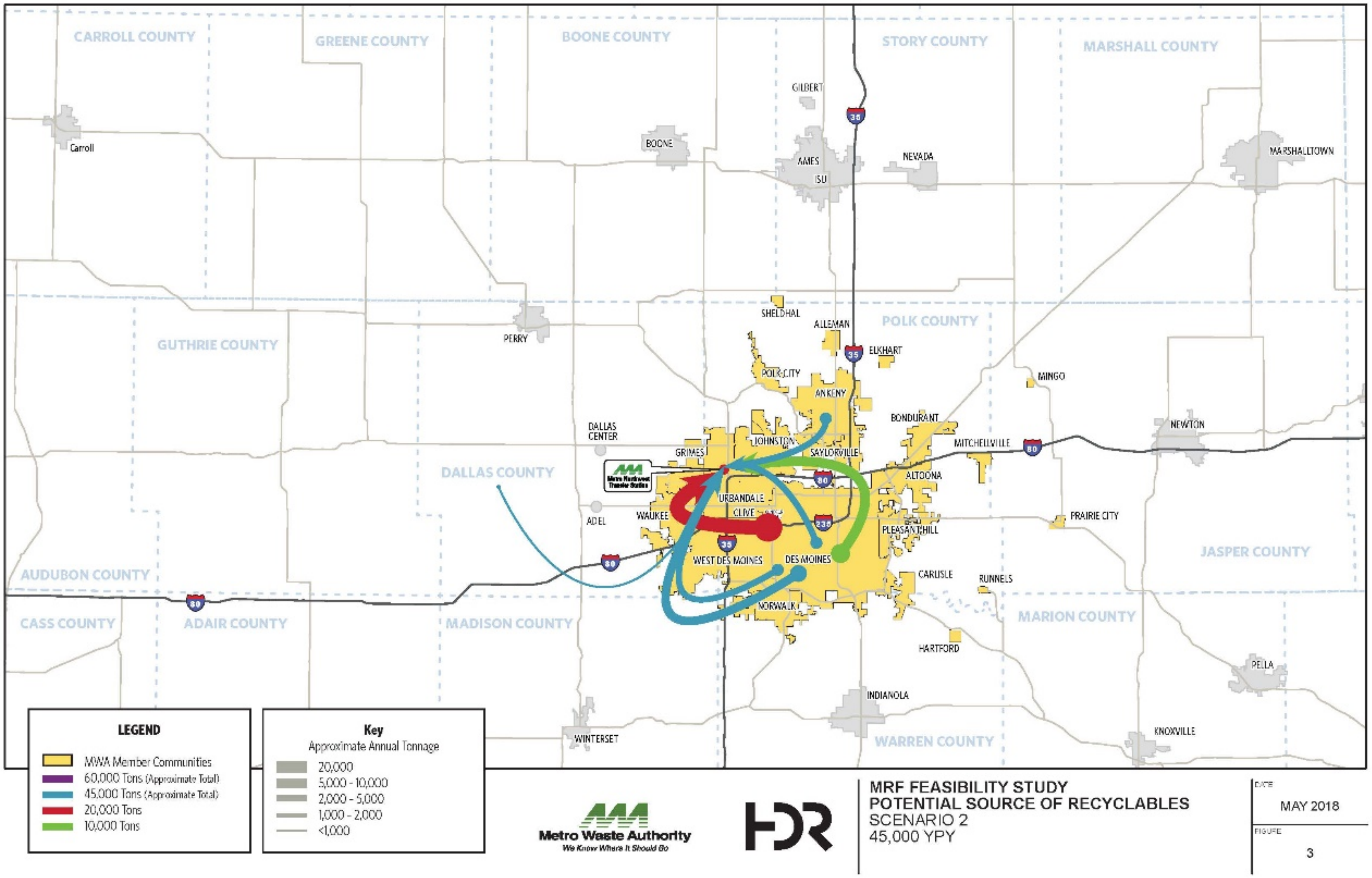
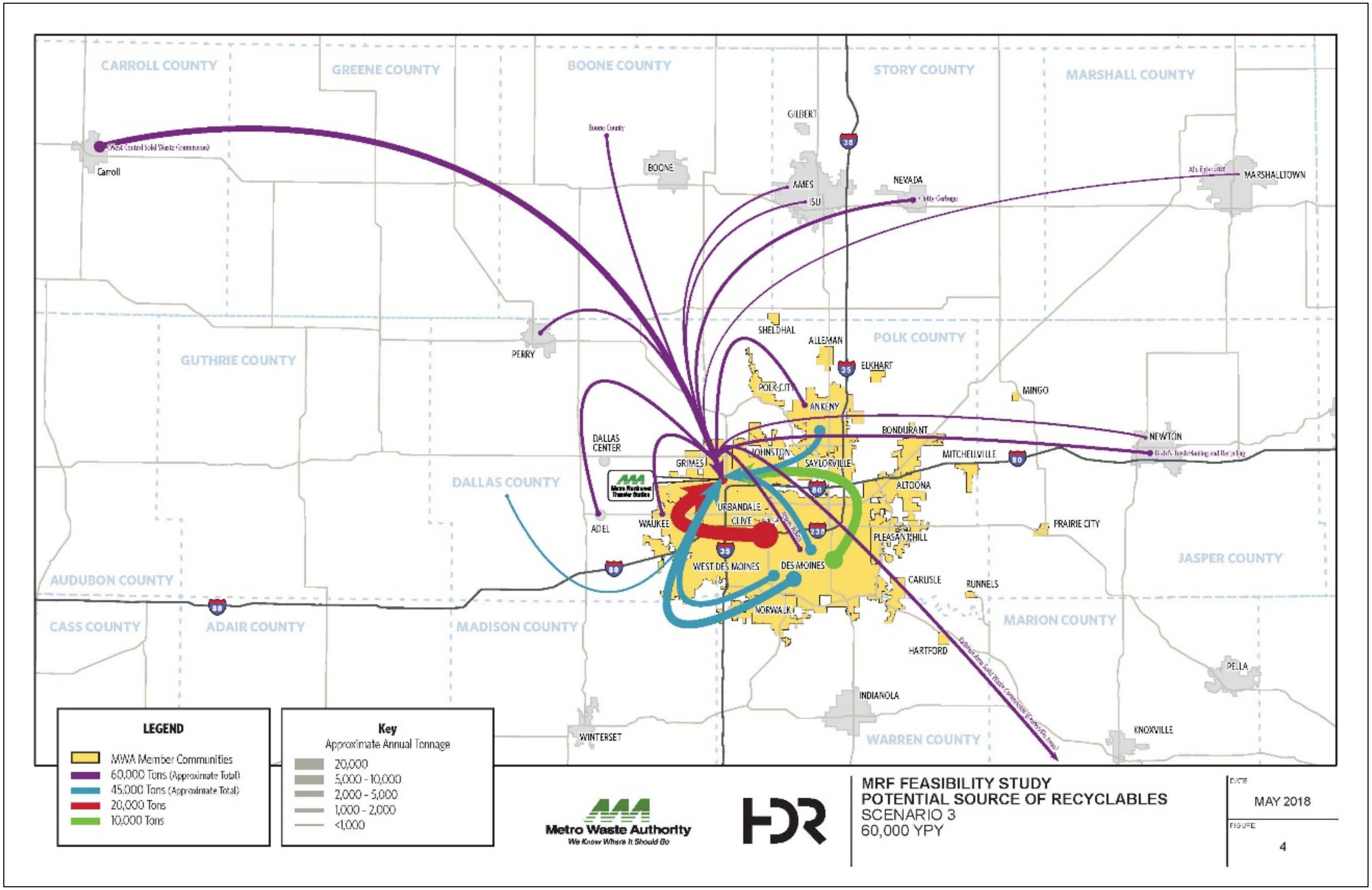


Figure 3-4. Potential Sources of Recyclables, Scenario 3



Future Tonnage Projections Methodology

Once the current (2018) annual tonnage estimates were established for each scenario, future annual tonnage quantities were estimated by correlating the recycling rate with population growth projections. It is assumed that the generation rate drivers and material mix for single-stream recyclables will remain constant for both residential and commercial collection. Therefore, residential tonnage is calculated to increase at the same rate as the population, and commercial tonnage is calculated to increase at the same rate as current jobs projections in the region.

Population projections through 2050 were obtained from the State Data Center of the State Library of Iowa. The State Data Center obtains the projections on an annual basis from Woods & Poole Economic, Inc.[3] Historical and projected populations are provided by county. For each community and hauler included in the scenarios, residential tonnage was projected to increase or decrease consistent with the population rate for the county in which the community is located. If a community or hauler spanned more than one county, the projections were weighted according to the relative population size of each county.

Employment growth for the state of Iowa is expected to be 28% from 2015 to 2045 based on Iowa Transportation Commission projections.[4] This equates to an annual growth rate of 0.93%. Commercial tonnages for all communities and haulers were projected to grow at this same rate. Table 3-2 shows the total (residential and commercial) tons projected for each scenario at key milestones. For the purpose of this feasibility study, the proposed MRF was assumed to become operational in fiscal year (FY) 2022. Since the lifespan of most equipment is expected to be approximately 10 years, equipment upgrades were included in the financial pro forma for FY2032. The MRF itself is expected to have a 20-year design life, resulting in scheduled renovations in FY2042.

Table 3-2. Annual Tonnage Projections for Each Scenario (tpy)

Scenario	2018	2022	2032	2042
Baseline	20,000	20,700	22,432	23,869
Scenario 1	30,000	31,050	33,648	35,803
Scenario 2	45,000	46,638	50,787	54,560
Scenario 3	60,000	62,059	67,276	71,985

Projections by Commodity Type

MAR performs audits of the incoming materials twice each year, in April and October. The results of the audits presented in Table 3-3 below show the proportions of commodity types and residues present in the material streams received. MWA uses these results to estimate the recyclables generated in its service area. For planning purposes, the results of the most recent

[3] Email from Gary Krob, Coordinator, State Data Center, May 16, 2018.

[4] Iowa Department of Transportation, *Iowa in Motion 2045: State Transportation Plan*. Adopted by the Iowa Transportation Commission on May 9, 2017.

audit in October 2017 were used to estimate the quantities of commodities and residue in the waste stream. The audit showed that approximately 88% of incoming materials were processed into commodities. It should be noted that the audit considered glass residue to be a commodity, although glass residue could instead be considered to be a residue if there is no market identified for it. The tonnages presented in the table are based on the commodity percentage and the annual projected tonnage for each year shown. (For more discussion regarding glass, see Section 4.4.3.)

Table 3-3. Projected Quantities by Material Type – Baseline Scenario

Material Category	Percent of Material Audited[a]	2018 Projected Tons	2022 Projected Tons	2032 Projected Tons	2042 Projected Tons
Total Commodities	***88.15%***	***17,631***	***18,093***	***18,248***	***19,775***
ONP	13.30%	2,660	2,730	2,754	2,984
MIXED	35.26%	7,053	7,238	7,300	7,911
OCC	14.92%	2,983	3,062	3,088	3,346
STEEL/TIN	2.27%	454	466	470	509
PETE	3.66%	732	752	758	821
CARTONS	0.26%	52	54	54	59
HDPE NATURAL	1.57%	314	323	325	353
HDPE COLOR	1.48%	297	305	307	333
MIX 3-7	0.23%	46	47	47	51
UBC	0.74%	148	152	154	166
3 MIX GLASS	12.32%	2,464	2,529	2,551	2,764
GLASS RESIDUE	2.13%	426	437	440	477
Total Residues	***11.85%***	***2,369***	***2,431***	***2,452***	***2,657***
Rejects & Unrecoverable Residue	10.18%	2,035	2,089	2,106	2,283
Dirt and fines	0.30%	59	61	61	67
Shrink	1.37%	275	282	284	308
Total Material	***100.00%***	***20,000***	***20,524***	***20,700***	***22,432***

[a] October 2017

Table 3-4 through Table 3-6 below show the projected quantities by material type for each scenario at each of the key milestones in the project lifetime.

Table 3-4. Projected Quantities by Material Type – Scenario 1

Material Category	Percent of Material Audited[a]	2018 Projected Tons	2022 Projected Tons	2032 Projected Tons	2042 Projected Tons
Total Commodities	***88.15%***	***26,446***	***27,372***	***29,662***	***31,562***
ONP	3,991	4,130	4,476	4,763	3,991
MIXED	10,579	10,950	11,866	12,626	10,579
OCC	4,475	4,632	5,019	5,341	4,475
STEEL/TIN	681	705	764	813	681
PETE	1,099	1,137	1,232	1,311	1,099
CARTONS	78	81	88	94	78
HDPE NATURAL	472	488	529	563	472
HDPE COLOR	445	461	499	531	445
MIX 3-7	69	71	77	82	69
UBC bin	223	230	250	266	223
3 MIX GLASS	3,696	3,826	4,146	4,411	3,696
GLASS RESIDUE	638	661	716	762	638
Total Residues	***11.85%***	***3,554***	***3,678***	***3,986***	***4,241***
Rejects & Unrecoverable Residue	10.18%	3,053	3,160	3,424	3,643
Dirt and fines	0.30%	89	92	100	106
Shrink	1.37%	412	426	462	492
Total Material	***100.00%***	***30,000***	***31,050***	***33,648***	***35,803***

[a] October 2017

Table 3-5. Projected Quantities by Material Type – Scenario 2

Material Category	Percent of Material Audited[a]	2018 Projected Tons	2022 Projected Tons	2032 Projected Tons	2042 Projected Tons
Total Commodities	***88.15%***	***39,669***	***41,113***	***44,771***	***48,097***
ONP	13.30%	5,986	6,204	6,756	7,258
MIXED	35.26%	15,869	16,446	17,910	19,240
OCC	14.92%	6,713	6,957	7,576	8,139
STEEL/TIN	2.27%	1,022	1,059	1,153	1,239
PETE	3.66%	1,648	1,708	1,860	1,998
CARTONS	0.26%	118	122	133	143
HDPE NATURAL	1.57%	707	733	798	858
HDPE COLOR	1.48%	668	692	754	810
MIX 3-7	0.23%	103	107	116	125
UBC bin	0.74%	334	346	377	405
3 MIX GLASS	12.32%	5,545	5,746	6,258	6,723
GLASS RESIDUE	2.13%	957	992	1,081	1,161
Total Residues	***11.85%***	***5,331***	***5,525***	***6,016***	***6,463***
Rejects & Unrecoverable Residue	10.18%	4,579	4,746	5,168	5,552
Dirt and fines	0.30%	134	138	151	162
Shrink	1.37%	618	640	697	749
Total Material	***100.00%***	***45,000***	***46,638***	***50,787***	***54,560***

[a] October 2017

Table 3-6. Projected Quantities by Material Type – Scenario 3

Material Category	Percent of Material Audited[a]	2018 Projected Tons	2022 Projected Tons	2032 Projected Tons	2042 Projected Tons
Total Commodities	***88.15%***	***52,892***	***54,707***	***59,307***	***63,458***
ONP	13.30%	7,981	8,255	8,949	9,576
MIXED	35.26%	21,158	21,884	23,724	25,385
OCC	14.92%	8,950	9,257	10,036	10,738
STEEL/TIN	2.27%	1,363	1,409	1,528	1,635
PETE	3.66%	2,197	2,273	2,464	2,636
CARTONS	0.26%	157	162	176	188
HDPE NATURAL	1.57%	943	976	1,058	1,132
HDPE COLOR	1.48%	890	921	998	1,068
MIX 3-7	0.23%	137	142	154	165
UBC bin	0.74%	445	460	499	534
3 MIX GLASS	12.32%	7,393	7,647	8,289	8,870
GLASS RESIDUE	2.13%	1,277	1,320	1,431	1,532
Total Residues	***11.85%***	***7,108***	***7,352***	***7,970***	***8,527***
Rejects & Unrecoverable Residue	10.18%	6,106	6,315	6,846	7,325
Dirt and fines	0.30%	178	184	200	214
Shrink	1.37%	824	852	924	989
Total Material	***100.00%***	***60,000***	***62,059***	***67,276***	***71,985***

[a] October 2017

Processing Capacity and Technology

Processing Capacity

Various approaches could be taken for sizing a MRF. HDR has developed a conceptual site plan for the proposed MRF using the existing Grimes facility site as shown in Figure 4-1. The proposed site is located on the Gabus Family Trust expansion property.

Traffic routing for the MRF is proposed to circulate around the transfer station site to reduce traffic conflicts with the transfer station traffic and partially separate commercial and public vehicles. The existing inbound truck scales could be used; however, the layout includes the addition of a separate scale and scale house to minimize queue and congestion as well as the previously mentioned commercial and public interaction.

Recycling collection trucks will weigh inbound and head directly to the MRF tipping floor. Transfer trailers, household hazardous waste (HHW) vehicles, delivery trucks, visitors, and staff will all travel around the proposed MRF to their respective destinations. Access to the Administration and Education Building is provided with a dedicated traffic lane to help keep visitors and non-professional vehicles separated for improved safety. A standalone building is provided for the Administration and Education Building, which could be reconsidered, as desired, if this project moves to further levels of development. The site allows for combining this building with the MRF if desired. A separate HHW receiving building is also shown.

For the purposes of this study, all commodities are anticipated to be shipped by truck. It is noted that rail transport may be an option and would be used if determined to be economically advantageous and technically feasible. Truck shipping costs are therefore considered to be the conservative assumption for the study.

Truck and trailer storage can be located on site. Tractor trailers are expected to exit the loading dock area and merge with the collection vehicles and other vehicles. Visitors and collection vehicles will travel around the transfer station to the facility exit. Tractor trailers will pass over the facility's outbound scale to be weighed before heading to their respective market. An enlarged site plan for just the MRF is provided in Figure 4-2.

The building footprint used to develop the MRF layout drawings is based on a 30–35 tons-per-hour (tph) MRF arrangement that uses more-advanced equipment and relies less on manual sorting of the feedstock. This equipment assumption was used because it provides a conservative arrangement for the proposed facility. The available site area also allows for some revision of the building dimensions. We consulted with four of the major MRF equipment vendors active in the US including Bulk Handling Systems, CP Manufacturing, Machinex, and Van Dyk Recycling Solutions to review space requirements and confirm technology concepts and approaches particularly as they relate to recent developments in the recycling industry.

As shown in Figure 4-2, there is internal truck maneuvering on the tipping floor with trucks entering from the west side and leaving on the east side. Alternatively, exterior maneuvering could be provided with trucks backing into the tipping floor. Up to 3 days' capacity is provided for feedstock and bale storage, and some additional tipping floor and bale storage could be provided if desired. The layout includes some additional overflow space which could be used for receiving dedicated loads of cardboard or other materials. The proposed layout shown accommodates two balers. The proposed building clear height for the project is approximately 35 feet.

The proposed facility is conceptually designed for a single shift of operation with 8 hours of runtime 5 days per week, 50 weeks per year. For the Baseline Scenario, this results in a processing rate of 10 tph or 20,000 tpy (10 tph × 8 hours/day × 5 days/week × 50 weeks/year). For each of the three scenarios, the respective sizes are:

- 30,000 tpy = 15 tph
- 45,000 tpy = 22.5 tph
- 60,000 tpy = 30 tph

A single-stream system can process between 25 and 35 tph depending on the equipment design and material mix. For the process line, infeed and baler-feed conveyors are assumed to be 60 inches wide to accommodate the largest anticipated items. After the old corrugated containers (OCC) screen, conveyors might be narrower per the vendor’s design. Fiber-sort conveyors used for optical sorting might be wider to allow for proper display of the fiber and other materials on the conveyor.

If a second shift were employed, a 15-tph processing system in theory could process 60,000 tpy of material or more. Some MRFs operate multiple shifts, shutting down briefly for periodic maintenance, repairs, and cleaning. Discussions with the MRF vendors indicated that this practice can be done successfully; however, HDR recommends that MWA carefully consider the initial proposed MRF operating plan. It is often much more difficult to get labor for a second shift, and the facility might quickly fall behind in its processing if there is a delivery issue or an equipment breakdown. On the positive side, if the initial capacity for the proposed facility is only 15 or 20 tph, providing a processing line sized for that capacity has a lower cost.

If additional tonnage is later secured, extra processing hours could be used to stretch capacity until the time were right to add a second processing line. This approach would require a building arranged to allow a second processing line or possibly the addition of more equipment within the existing processing line thus increasing the processing line capacity for the expansion. If a second processing line were added, the cost for that line would be higher, but it would allow incorporation of the latest technology. If the additional tons acquired were more heavily commercial tons, a line dedicated primarily for residential feedstock and a line dedicated primarily for commercial feedstock could be considered.

It is typically difficult to expand a facility unless the expansion is planned for and funded from the start. Our recommendation is to invest in building the largest footprint that may potentially be required initially because an MRF can never have too much tipping floor area or storage space. This provides versatility and flexibility to adapt for future conditions and changes in recycling. MRF technology continues to advance rapidly, so it is worthwhile to consider minimizing the initial investment in equipment by basing the system’s operating capacity on current processing requirements, and provided that the oversized building envelope is sized for the expanded capacity and the addition of a second processing line and storage.

The equipment assumed in this feasibility study is sized based on the target components in the feedstock and the projected maximum volumes processed for the line. This results in less change in equipment size for a 10- or 15-tph system compared to a 30-tph system than what might be expected. The difference for the smaller systems will be that the volume of feedstock does not support the use of optical sorters for some materials. The number of bottles picked on a 10- or 15-tph line might have an optical sorter for PET (polyethylene terephthalate) but not for HDPE (high-density polyethylene). Reaching the material quality necessary for fiber material could mean that optical sorting is required, but the unit might not be as wide as for a larger facility. A 30-tph system might have more than one stage of optical sorting for fiber cleanup. The equipment selection and arrangement will be determined by the equipment vendor to fit the building and to meet the required performance.

Several example figures are provided in this feasibility study based on design throughput; however, all are incorporated into the same building footprint to show the relative difference between equipment layouts. All of the example figures provided by vendors have been reversed to show a similar layout, with the tipping floor to the north and bale storage to the south.

Figure 4-3 has a conceptual arrangement for a 30-tph sorting line. It has an OCC screen and includes glass removal, fiber screens to separate containers and fiber types, optical sorters for fiber and plastic container types, as well as a magnet and eddy current separators (ECS). Quality control (QC) stations are arranged for either manual or robotic cleanup (robotic QC is not included in the capital estimate).

Figure 4-4 provides another conceptual arrangement for a 30–35 tph. Note that this arrangement is for a shorter but wider building. The arrangement requires additional tipping floor space than what is shown on the equipment arrangement. This arrangement from this vendor includes a ballistic separator and more manual fiber sorting than some other arrangements but still has optical sorting for containers and some optical sorting for fiber.

Figure 4-5 is for a 20–25 tph conceptual sort line. The processing line concept shown includes a lot of advanced-technology equipment including ballistic separation and optical sorters for both fiber and containers. Because this concept needs certain minimum conveyor and equipment widths to handle the largest anticipated feedstock, the floor space requirements are not proportionately smaller.

Figure 4-6 is for a slightly smaller conceptual system sized for about 15–20 tph. Note that this arrangement has only one baler shown and a provision for a second one. There is also more reliance on manual sorting. It also has only one optical sorter, and all containers are typically sorted manually.

Figure 4-7 is for the smallest conceptual system and is sized for up to 15 tph. It also is arranged for one baler and would need to be modified for a second baler. The line has a fiber optical sorter and a PET optical sorter but otherwise relies on manual sorting. Note that it could be housed in a substantially smaller building; however, it is still advised to provide plenty of tipping floor and bale storage, which provides increased operational flexibility, changes to equipment in the future, and safer operation.

Figure 4-1. Grimes Site Layout

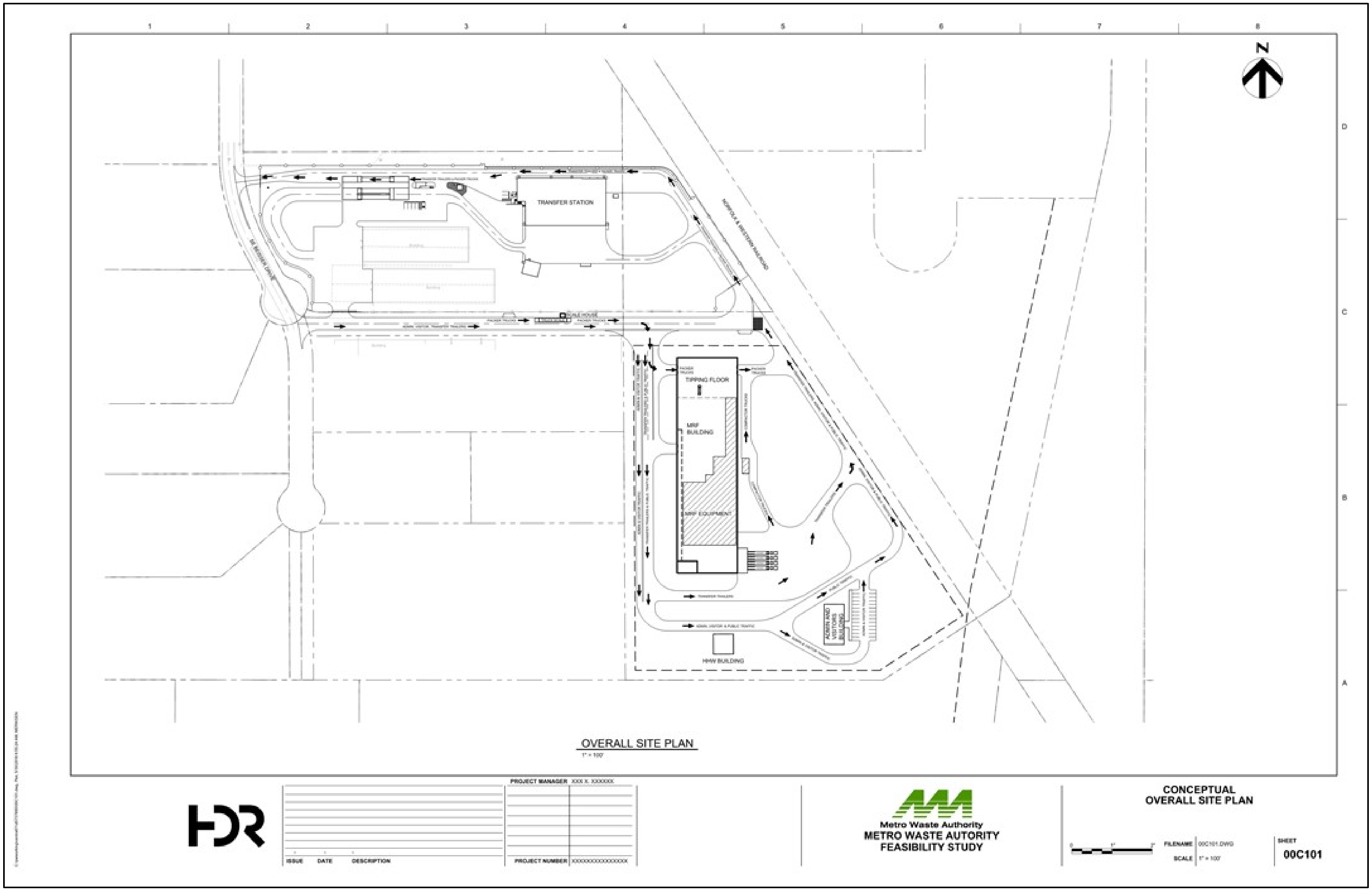


Figure 4-2. Grimes Site Layout (Enlarged)

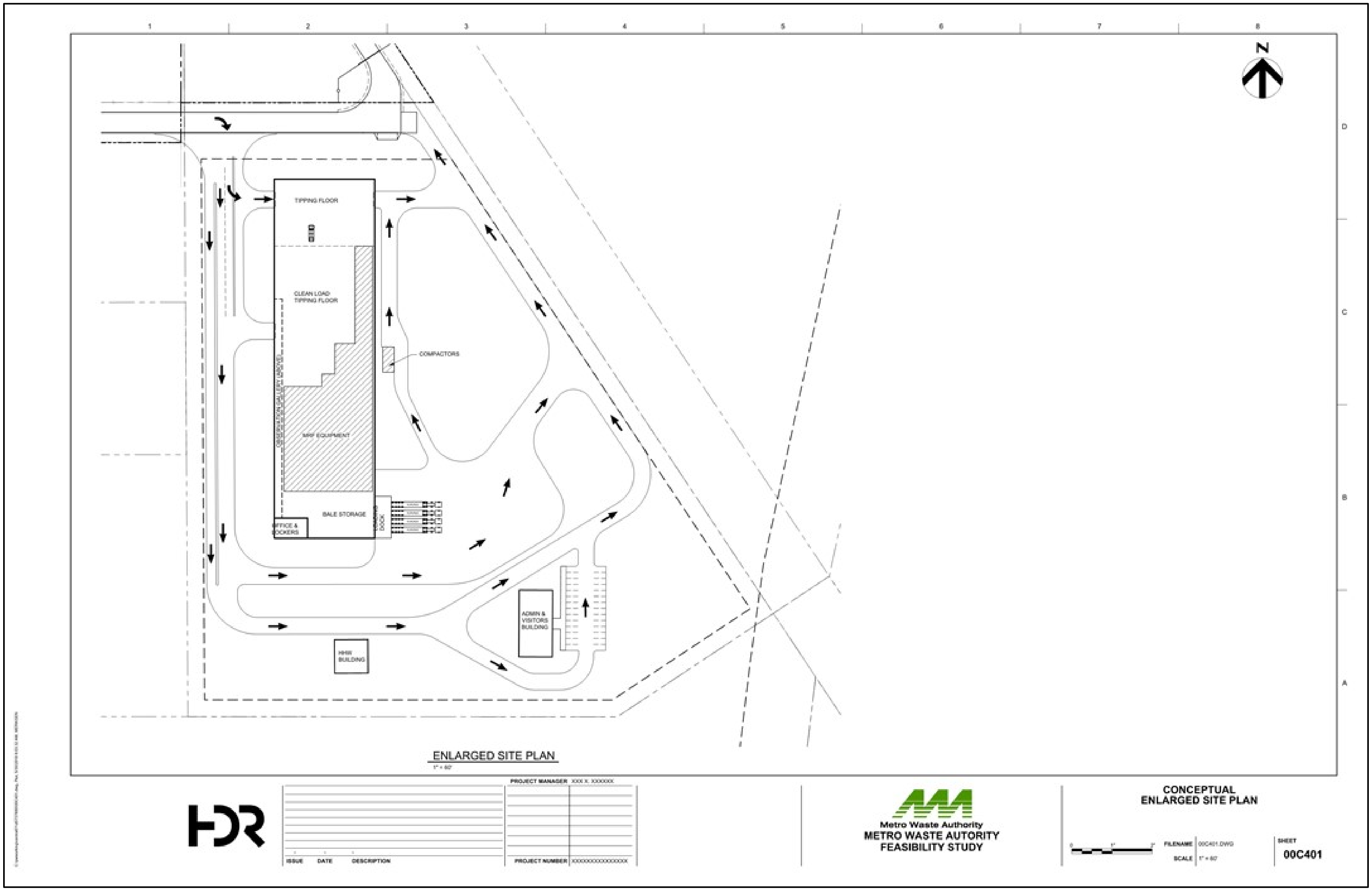


Figure 4-3. Grimes Conceptual Layout (30 tph)

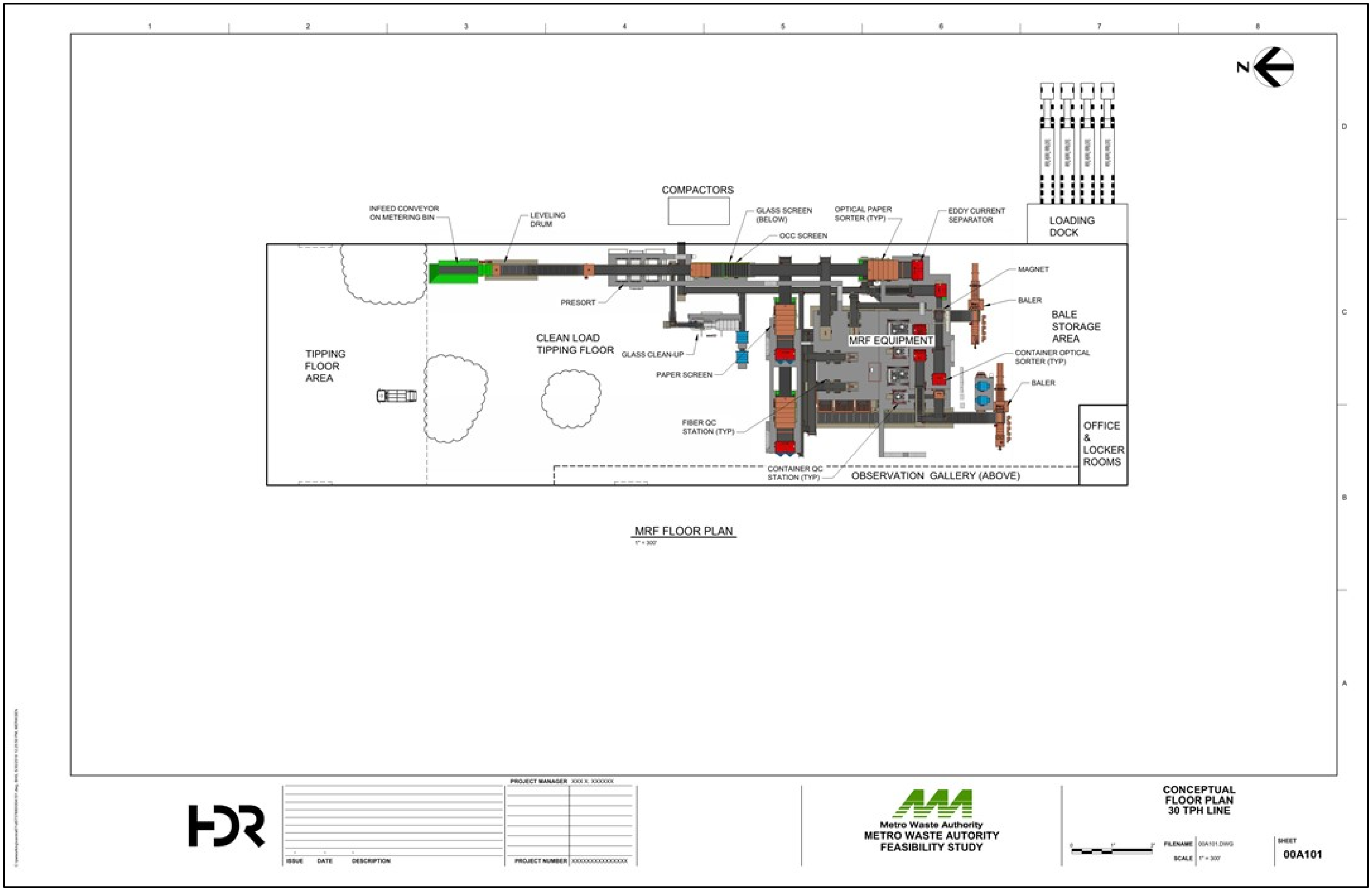


Figure 4-4. Grimes Conceptual Layout (30–35 tph)

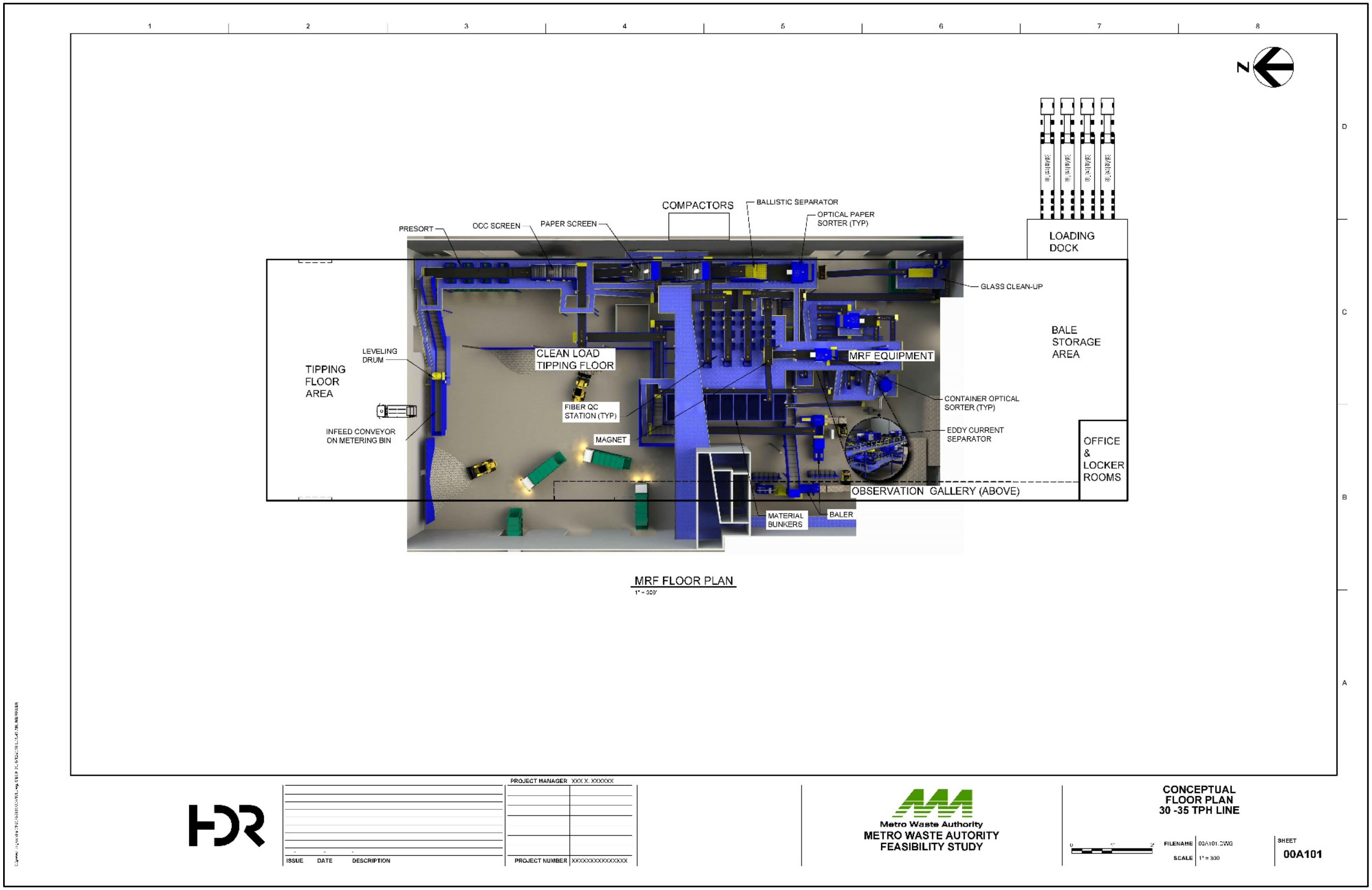


Figure 4-5. Grimes Conceptual Layout (20–25 tph)

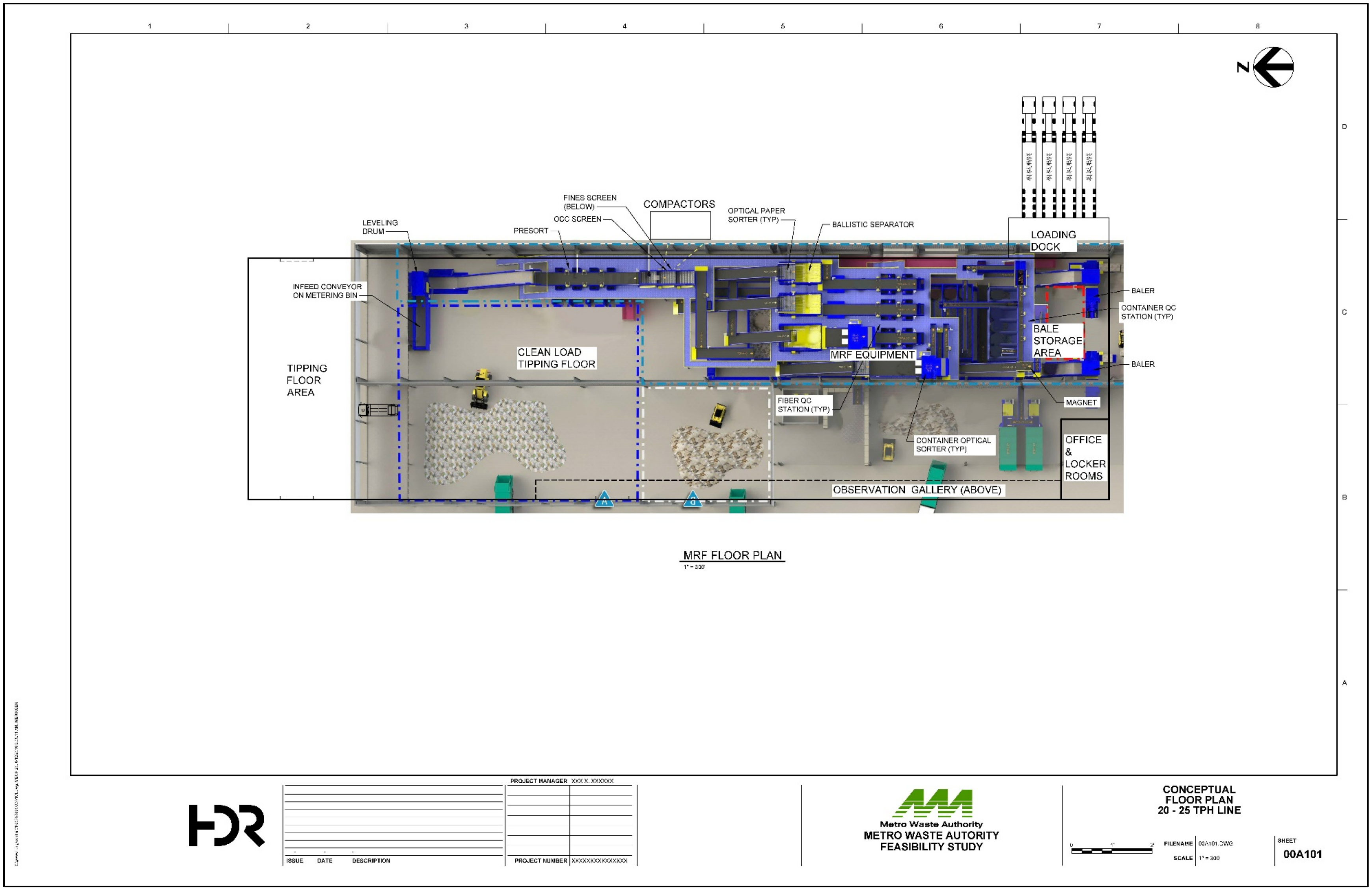


Figure 4-6. Grimes Conceptual Layout (15–20 tph)

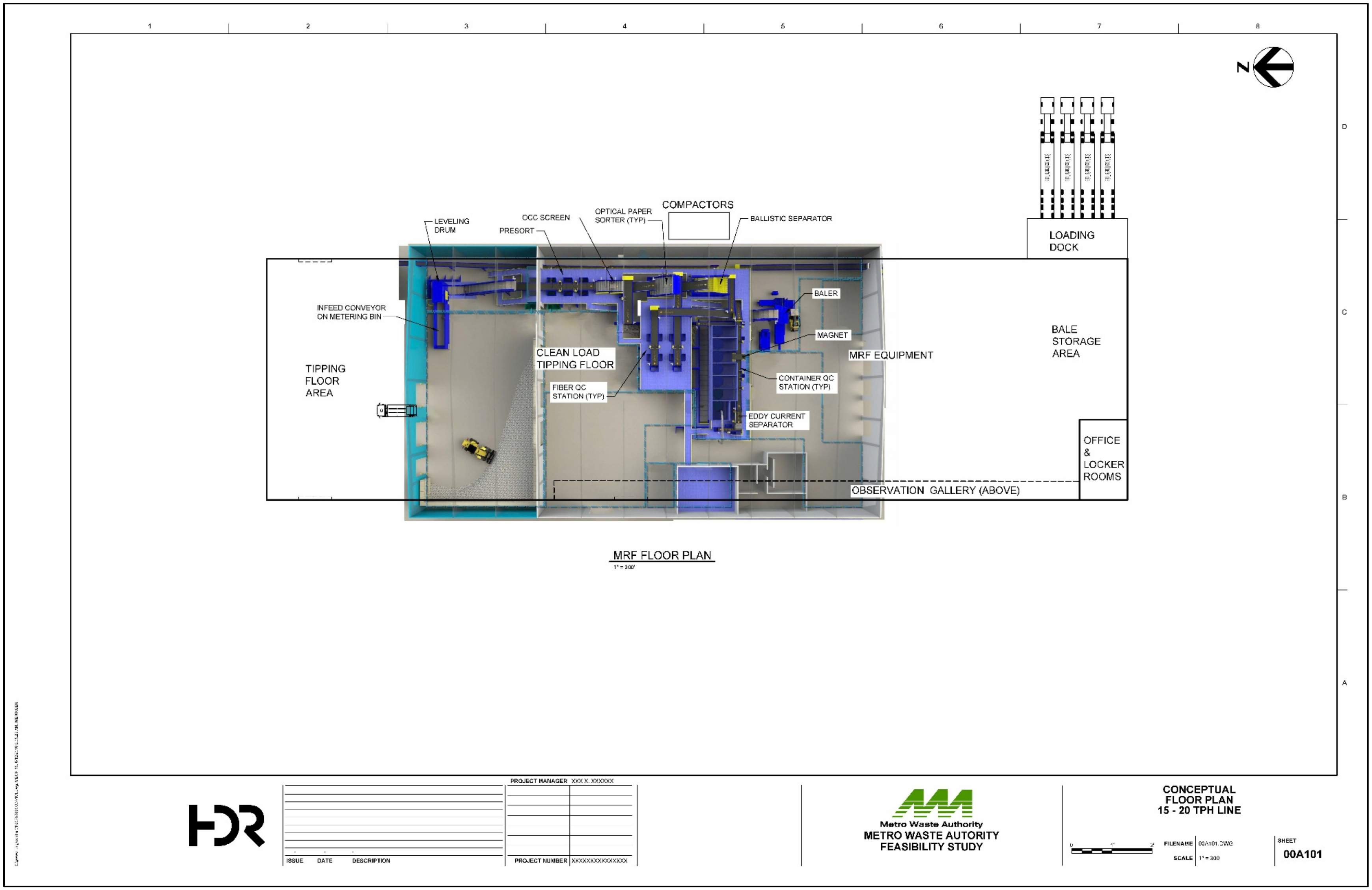
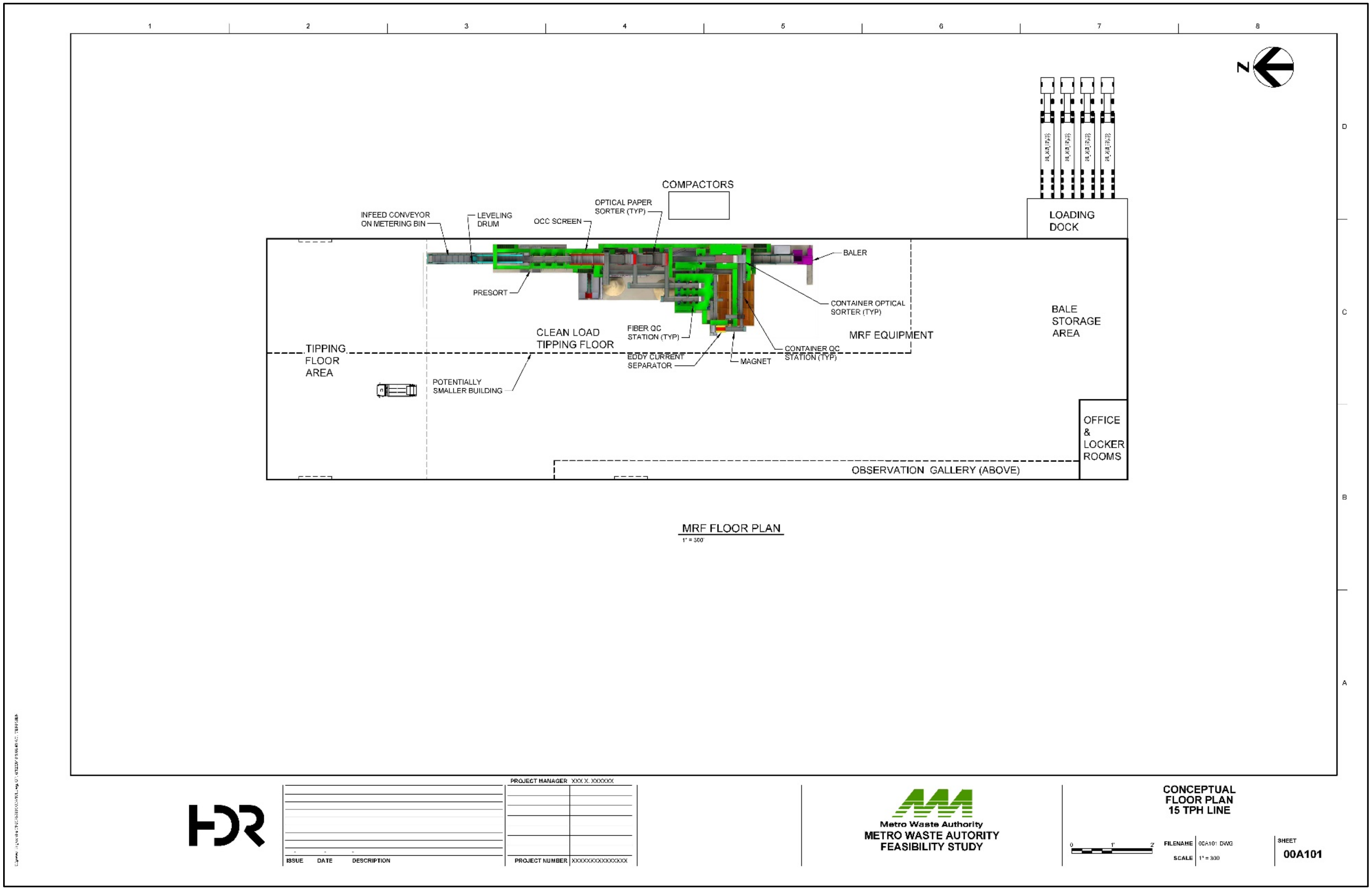


Figure 4-7. Grimes Conceptual Layout (15 tph)



Operational Approaches

MRFs come in all shapes and sizes. A key objective of the facility is to achieve the required product quality. A current industry trend is considering the type of recyclable collection program and looking at a dual-stream system versus a single-stream system to increase the quality of recovered material to meet the market demands for these material streams. Section 4.2 addresses some of the considerations required to assist in making this type of decision.

Single- versus Dual-Stream Considerations

The historical trend in MRF design has moved toward single stream processing. Early MRFs were often dual-stream systems in which the collection and processing of containers were separated from the collection and processing of fiber materials. Containers would often be processed on one line, while fibers were sorted on a separate line. In some areas this is still the practice; however, to make recycling easier for residents and thus increase participation, single-stream systems were developed. While single-stream collection costs are substantially less than the cost for dual-stream collection, the processing equipment costs for the MRF are higher because additional equipment is needed to separate the single-stream feedstock.

Most new systems being installed are single-stream systems. The processing equipment is designed to separate the containers from the fibers, and then each can be further divided. However, in some situations, an unintended consequence of single-stream systems has been the loss of product purity and quality. Because of this issue and the current state of recycling, some facility operators, owners and others in the industry calling for the reconsideration of dual-stream systems.

HDR contacted several MRF operators and discussed some of their operating issues. One operator in particular identified automated collection of feedstock as an issue for his MRF. The standard carts with their lids kept the recyclables dry, but the automated collection no longer afforded the driver a good look at what was buried in the cart. Not being able to easily identify who might not understand what should be placed in the recycling cart makes educating the right individuals much more difficult. This operator also said that, if they had the ability to do it all over again, they would not have switched from a dual-stream system to a single-stream system. They strongly recommended that MWA consider the advantages of a dual-stream system.

MWA might see improved product quality if a MRF were built for dual-stream feedstock. However, this would require more work from the residences and businesses served and thus would likely decrease participation and recycling collection rates. Dual-stream collection also has a higher cost because it requires either partitioned trucks or two trucks on routes and more stops. In addition, any other community or hauler wanting to use the facility would need to provide dual-stream feedstock, and many would likely decline to take on the added cost of dual-stream collection.

Glass in particular is problematic for single-stream systems, as further discussed below in Section 4.4.3. Keeping as much glass out of the single stream mix as possible would be beneficial for glass marketability, reduced MRF system maintenance costs, and product quality.

Facility Maintenance

Facility maintenance and upkeep are critical for maintaining equipment performance and product quality. In the past, screens would quickly become plugged with film plastic and other streamers, thereby reducing the ability of the processing line to adequately separate containers from fiber and residue from products. Every staff break was typically used to clean the screens. Because of this frequent need, the screens were sometimes cleaned unsafely. Optical sorter design used to have performance issues due to dirt and liquids blinding the optics and plugging nozzles. Conveyor or equipment downtime means extended operating hours lost revenue and increased expenses.

Newer facility designs have focused on these historical maintenance headaches, and improvement has been achieved. Newer screens not only sort materials better but are less likely to plug and lose efficiency across a shift. Newer optical sorters have relocated critical components to make them less vulnerable to damage and blinding. However, belts still rip, equipment still needs to be cleaned and greased, and components still need to be replaced.

Today’s MRF requires more programing, more electrical and instrumentation work, and less mechanical work than in the past. While the tasks often are less physically demanding, more training might be needed, so maintenance labor rates are on the rise. The number of maintenance staff might decrease for larger facilities, but the highly skilled instrumentation and control labor means that the cost will not change much, if at all. Refer to Section 6.1 for some rules of thumb for operating and maintenance costs offered by various vendors.

MRF Equipment Technologies

MRFs are designed to process heterogeneous materials and produce end products that are clean and marketable with little contamination. Maximizing efficiency while being cost-effective is a key component to successful MRF operations. This means maximizing throughput and material recovery while minimizing the amount of contaminants captured with each commodity. Designing, constructing, and equipping a new MRF involves automated machines as well as manual labor. There are several different types of MRF configurations which vary on how waste is received. They include source-separated, single-stream, dual-stream, and mixed waste. For this feasibility study, MWA requested information about a single-stream MRF. *Single-stream* means that fiber and commingled containers are combined when entering the MRF.

For MRF design, there have been two general approaches to facility design in the past: (1) a less-sophisticated (lower-) technology, higher-labor design and (2) a higher-technology and lower-labor design. The lower-technology approach has been used in many plants around the country. Often it has been applied in a manner such that more equipment is added as the MRF “grows.” Some systems have started with floor sorting at transfer stations where high-value, easy-to-sort materials such as cardboard might be pulled out or rich loads diverted to an area where this could occur. This type of operation is similar to what MWA has been doing at the Grimes facility site. Such approaches typically have grown into a conveyor sort line, and then magnets, screens, ECSs, and even optical sorters or other devices are eventually added. This approach has been taken because it is difficult to justify the cost of the significantly more expensive, higher-technology equipment.

In addition, many municipalities have also tended to install lower-technology systems to recover a specific material stream with higher value and reasonable ease of recovery. These systems have the advantage of a lower capital cost, less skilled maintenance, and increased local employment. These goals often line up well for a municipality that has only one MRF and thus is not able to spread certain costs over several facilities or nationwide. However, these systems often have lower throughput or lower production quality when processing an equivalent amount of feedstock.

Higher-technology systems have become the norm for modern MRFs, although the level and types of technology adoption varies. Optical sorters have become the standard for PET container sorting in most plants. Many plants have incorporated optical sorters for other plastic containers but have applied them in varying ways. While optical sorters could replace an ECS or magnet, generally this has not occurred because these technologies provide good service for a lower cost. Optical sorters have been used in many plants for fiber sorting. Optical sorters can sort many times the rate of a manual sorter when the material is properly displayed. Optical sorters are combining technologies and adding new ones so that the sorter not only knows the difference between paper and non-paper, it can tell the difference between types of paper, whether the paper might be soiled or waxed, what color it is, or whether it is too wet to be acceptable.

Higher-technology facilities typically result in higher capital cost, but this cost might be offset by lower labor and operating costs. These facilities generally can achieve better product purity at equivalent or higher operating rates. Although the technology continues to advance, the systems might or might not be capable of achieving the requirements established by China. This is discussed further in Section 5.3.

Standard Equipment

A MRF building is divided into a receiving area called a *tipping floor*, a processing area, and a commodity storage and loadout area. Standard equipment at an MRF includes a conveying system generally with a presort area, disc screens and other types of sorters, a sorting line to separate fibers (paper products) and containers which include various combinations of magnet separation for ferrous cans and magnetic ferrous, and ECS for aluminum cans and other non-ferrous metal. Screens are often used to separate large cardboard and other materials from smaller materials and two-dimensional (2-D) fibers (such as cardboard) from three-dimensional (3-D) materials (such as bottles and cans).

Air separation devices are used by some vendors for separating lighter (or less dense) materials from heavy (or denser) materials. Ballistic separators might be used to separate various types of 3-D materials from those that are small and those that are flat. Optical sorters are used to separate types of plastic containers, fiber products, and other materials based on the material’s chemical properties, physical properties, color, and other factors. The separated recyclables are then sent to storage and are separately baled or loaded out.

Recyclables that are sent to an MRF enter the tipping floor, where they are dumped and stored until a viable amount of recyclables is ready to be sent into the system. Tipping floors generally allow for 2 or more days of storage of incoming material. If possible, 3 days of storage increases facility operating flexibility, allowing for a short outage if necessary for equipment repairs, special events such as testing, or surges in material delivery. “Floor sorting” might be done to remove any large materials and contaminants such as garden hoses, extension cords, and microwaves that might jam or damage the sorting line. Floor sorting is usually very limited when there is also a good education program informing the facility customers regarding what materials can be received.

A bucket loader is usually used to push the recyclables onto an infeed conveyor to transport them to the presort area. Some equipment providers prefer a feeding box consisting of a large bin with a live bottom floor that can be filled with feedstock and automatically metered onto the infeed conveyor. In this manner, the operator of the front-end loader can fill the box and not be concerned about keeping the infeed conveyor uniformly filled as frequently. He or she is then freed up for short periods to manage the feed material on the tipping floor.

The presort area is meant to remove large and bulky recyclables as well as residue materials that could jam or damage the sorting equipment. The presort process is normally a manual operation. Items removed from the process in the presort area include materials such as scrap metal, bulky plastic containers and objects, clothing, film plastic, bags of shredded paper, garden hoses, or other residue. For some systems, corrugated cardboard might be recovered in presorting, or this material might be removed by downstream screens. Often, unopened plastic bags potentially containing recyclables are opened at this point as time allows. For MRFs that use a bag breaker, recyclables placed in plastic bags might also be pulled off this line and sent through a bag breaker with the bag contents sent back into the process. Bags known to contain shredded paper might also be removed for special handling to avoid the mess resulting from confetti floating around the equipment.

The next sorting processes generally use various types of disc screens to separate glass and fines (if glass is part of the commodity mix), types of fiber products, and containers. These screens are moving beds that allow smaller and/or 3-D materials to fall through or down the screen while carrying the larger 2-D materials up and over the screens.

Screens might be designed to crush glass and remove fines, separate containers from fiber products, or separate larger and more rigid fiber materials such as cardboard from smaller and more flexible office and newspaper.

The first screen often removes the larger cardboard (OCC) and containers not removed at the presort station. It is advisable to have a QC sorter check the OCC. The sorter would remove non-OCC materials such as Styrofoam or other contents from boxes, smaller containers and non-brown fiber that might “surf” over with the OCC, plastic containers, and waxed, wet, or food-contaminated OCC (pizza boxes and similar materials) undesired by the mill. Usually chipboard (such as cereal, soda, and beer boxes) is kept with the cardboard as a combined OCC product.

If glass is processed with the single-stream material, often glass and fines are removed early in the processing steps. See Section 4.4.3 for further discussion regarding glass. For many processing lines, one or more additional screening steps are used to separate the containers from the fiber. Screens, air separation, or ballistic separators in various combinations are seen as very effective for this general step.

The separated materials then move on separate conveyors where they are further divided. A series of disc screens can be used to separate different grades of paper.

A primary disc screen can remove a majority of containers, a secondary inclined disc screen can concentrate higher-quality paper such as old newspaper (ONP), and a polishing screen can remove mixed paper and residual materials. Other vendors might use air-separation devices to separate the materials, while others might use ballistic separators. The goal of all the systems is to get the highest possible separation rate of containers and residue from the fiber and, conversely, of fiber and residue from the containers. The fiber and containers can then each be separately further subdivided and cleaned.

More-modern, higher-technology fiber sorting is often done with optical sorters. Optical sorters can sort the fiber material by type of fiber to separate the “browns” (cardboard and chipboard) from the “whites” (office and newspaper). Film plastic is a frequent contaminant in fiber lines, and optical sorters do an excellent job of removing this residue. Optical sorters can reject flattened plastic or metal containers that managed to pass over the disc screens, as well as wood, glass, or other materials. Some vendors’ technology can even recognize and separate paper that is too wet or contaminated with food and other residue, or recognize and separate paper by color or other properties.

Sorting can be completed by positive or negative means. *Positive sorting* means that the desired product is pulled from the other commodities and residue passing on the conveyor. *Negative sorting* means that the desired product remains on the conveyor while all other materials are removed. Often, when there is less residue or other non-desired commodity material, the system is designed for negative sorting since this requires fewer “shoots” or picks from the material. The risk is that everything remaining on the conveyor is considered product. If some residue or other material is hidden from the optical sorter (under or inside a piece of paper or in some cases attached), or if there is a misfire, or the material is too heavy to be removed, the residue might remain with the desired commodity.

In some cases, it is better to positively sort so that the desired material is positively removed from the remaining material. However, contamination can also occur in this arrangement if a contaminant is attached to a desired commodity and is carried over with the desired commodity, or if a misfire occurs. Some product loss can occur if the sorter does not see or fire on the desired object to recover. Each application requires careful consideration for the desired outcome. If the desire is to obtain the absolutely purest product, usually a positive sort is the better approach. More than one optical sorter can be used in series to increase concentration and clean up the desired material.

Generally, optical sorters are more effective than manual sorters. Optical sorters can detect and fire on thousands more items than manual sorters can. In either case, the material on the conveyor must be properly displayed, or it cannot be properly separated. While a manual sorter can move some material out of the way, it is critical for optical sorters to be able to see each particle separately, and the particles must be stationary to the belt. For better purity, a QC sorter is generally located downstream of an optical sorter to clean up the few misfire items.

Containers today are often sorted by machine. Initial sorting can be completed with screens or by air classifiers. Manual sorting might also be used, particularly for certain commodities and smaller throughputs. Steel cans are sorted using a magnetic separator, and aluminum cans are sorted using an ECS. Plastic containers today are often separated by optical sorters or a combination of optical sorters, magnetic-based sorters, and manual sorting. The number of PET bottles can mean that one optical sorter might reduce the number of PET manual sorters from two to six down to one QC sorter. HDPE containers might be sorted by first capturing all the HDPE (colored and natural) and then either manually separating the natural from the colored HDPE or sending the HDPE past the same optical sorter or a second machine. Sometimes a combination of two or more types of commodities are pulled from the other materials and are then further separated. An example would be separating HDPE with 3-D fiber materials during a first step, then separating the HDPE by type from the 3-D material.

Commodity Storage and Densification

All commodities are stored in bunkers and are stockpiled or containerized until enough material is collected to prepare for shipment. For smaller, lower-cost facilities, the bunkers might be push-through type where the commodity falls to the floor between two push walls that are far enough apart for a loader to travel through. One end of the push walls is at the baler infeed conveyor. After enough material has accumulated in the alley, a front-end loader is used to push the material onto the baler infeed conveyor for baling. More-automated systems use a live-bottom bunker to manage the captured commodities. The bunker still has the walls on each side, but the bottom is either a walking floor or a reversible conveyor. After the bunker is full, a door on the end can be opened and the material advanced onto the baler infeed conveyor.

During operation, the conveyor or walking floor can be moved in reverse and moved forward to increase the capacity of the bunker. Expanded metal or wire bins are sometimes used for storing containers. These bins can be pneumatically filled and thus can be located away from the sorting location, offering more layout alternatives than bunker storage which generally is located directly under the sorting platform. Usually the bins are located at a point where a hatch can be opened on the bottom, allowing the contents to fall onto the baler infeed conveyor. The capacity is typically adequate for 1 or 2 bales.

The last step at an MRF is consolidating and densifying the commodities. Densification is necessary to achieve legal load limits and avoid underweight shipping charges. For most products, a large two-ram or single-ram baler is used for compaction. Paper balers can chop and fluff certain grades of paper before it is baled, and plastic balers can perforate, rip, and/or flatten certain types of plastic containers to ensure that they stay consolidated in the bales. Aluminum and steel cans are generally crushed and baled. It is very important to separate all non–used beverage can (non-UBC) materials from the UBC product to avoid discounts. Scrap metal is usually shipped loose to a local scrap yard for further processing.

Special Considerations for Glass

Glass bottles, if accepted as part of the single-stream mix, are normally crushed with a glass-breaker screen and removed from the sort line as early in the process as possible, usually just after the presort. Special glass-breaking or -crushing screens are used to break the glass into pieces. The crushed glass is collected with corks, bottle caps, rocks, shredded paper, food waste, yard clippings, ceramics, and other less-than-2-inch fines. Glass cleanup systems can be used to remove lighter fines, ferrous metal, and sometimes other components, but the glass product is usually a dirty mix of all colors of glass. The product has a very low value as a commodity, if any. The largest and possibly the only market in the Des Moines area is Ripple Glass in Kansas City. Ripple does not accept MRF glass (glass recovered from the MRF process line) because the material requires too much work on their part to clean it for their fiberglass production process. The crushed glass product can be color-sorted with optical sorters, but this is rarely done due to the high cost of the sorters and the low value of the sorted glass.

Glass can also be collected via a drop-box system. Drop boxes are located at areas where citizens can drop containers into a bin separate from other materials. In this manner, the glass is intended to be handled separately from the other recyclables. This keeps the glass clean and suitable for Ripple’s process. The drop boxes would be emptied periodically and the material consolidated and hauled to market.

Glass is an important commodity to recover for several reasons. Glass is heavy and thus increases diversion rates significantly. It often makes up about 10% to 15% of the total tonnage for a facility. Container glass is usually a commodity that local residents want to recycle. Not accepting glass might decrease interest in the recycling program.

An MRF system is designed to attempt to recover the bottles whole only for those locations where whole glass containers must be recovered for a high redemption value. Today’s glass bottles are usually so lightweight that very few bottles will survive intact beyond the presort area. The broken bottles then could be prohibitive materials in the other commodities. For nearly all other commodities, when glass is found in the bales, a discount might be applied to the shipment, thereby lowering the value of the commodities.

Having dedicated collection locations designed only for glass containers often is a better approach to glass recycling. The glass sometimes has a low value when collected in this manner. It might need to be sorted only for errantly placed fiber and container materials.

There are advantages and disadvantages for both collection approaches. It should be noted that in most cases, the glass recovered is only container glass from beverage containers and jars. Other types of glass have different properties that usually make the plate glass, cathode ray tube (CRT) glass, or other types of glass unacceptable for most glass market processes.

If glass is kept with the single-stream mix, glass is highly abrasive to the MRF equipment, significantly increasing wear and tear for sort lines where it is processed. All of the MRF equipment vendors said that it is best to keep the glass out of the MRF processing line. The maintenance cost increases significantly if the system handles glass. A glass cleanup system is required to remove the light fines, ferrous metal, and smaller material. The cleanup systems for MRF glass can vary in cost due to the levels of sophistication. The cleanup systems can vary in price and capability costing more than $150,000 but can cost as much as $500,000 for basic removal of lights, fines, some organics, and ferrous metal. Color sorting of glass is an additional investment.

The desired glass product is usually between about 3/8 inch and 1¼ inch for small glass and 1¼ inch and 2⅜ inch for larger glass. About 30% of the MRF glass product will be glass that is too small to sell. MRF glass quality is not high at about 95% clean by weight (including the ceramics and stones with the glass). The remaining 5% of the MRF glass will be bottle caps, bones, corks, heavy wet paper, etc. Fiberglass production requires a feedstock that has 0.2% or less contamination, which is why Ripple Glass does not use standard MRF glass. Cleaning up MRF glass for fiberglass production requires dryers, optical sorters, and other equipment. Only very large MRFs might consider more processing steps. A few MRFs have optical sorters that can sort glass by color and remove nearly all contaminants, but these glass sorting systems cost millions of dollars and are prohibitively expensive.

One vendor said that, as for all products but particularly for glass, one needs to know what the target market will accept. Where there are markets, most buyers are looking for ¾-inch to 2-inch pieces of mixed broken glass containers. Removing the crushed glass from the other commodities is also critical. Glass is always a prohibitive material, and significant discounts might be imposed by buyers if glass is routinely found in the other commodities.

Since glass is very dense and heavy, removing a small amount of glass goes a long way when trying to avoid exceeding a 0.5% residue content. Glass-recovery screens are usually set up in decks. A two- or three-deck system might be necessary to achieve 90% to 95% recovery (the first deck captures about 80% to 85% of the glass, and the combined removal of two decks is about 90% to 95% removal) and removal of the glass from the process line. A reasonable assumption is that about 50% of the uncaptured glass will end up in the residue line, but, with about 12% to 15% glass in the single-stream mix, this could mean that the residual glass alone could exceed a total residue limit of 0.5%.

At MAR, glass containers received in the single stream material is separated as MRF glass and is not clean enough for Ripple Glass' needs. In the single stream mix the glass bottles tend to be at the bottom of the material passing by the sorters on the conveyor, might be partially broken, and therefore are easily missed. In this case, it is much more difficult to remove the pieces, and this results in a safety concern. In addition, if the sorters focus on recovering glass, they might not have the time to capture other materials that should be removed during the presort. If glass is handled separately, drop-box collection results in a much cleaner product. However, some QC likely will be required to remove other materials improperly captured with the glass. Drop boxes require residents to handle glass separately and to make a dedicated effort to bring the glass to the drop box instead of just to the curb. Therefore, participation will drop off significantly. In addition, some residents will continue to place glass with their other recyclable, and thus not all glass can be eliminated from the MRF sort line. Continued education could help reduce the problem but is not likely to eliminate it.

Given the significant potential downside to other commodities and the loss in the minimal value of the MRF glass in the Des Moines area, HDR recommends that MWA seriously consider managing glass separately from the other single-stream materials. If this is not possible, a very stringent glass capture requirement should be imposed to protect the value of the other commodities.

Industry Standards

Materials coming out of an MRF must adhere to specifications to ensure that contamination is at a minimum. Contamination rates are important to the quality of the end products. The Institute of Scrap Recycling Industries (ISRI) grades are used by many brokers and end users for compliance. The tables below show ISRI grades for commodities produced from single-stream MRFs. Table 4-1 shows the primary types of paper or fiber commodities and the basic purity requirements which ISRI has established.

Table 4-1. ISRI Paper Grades

	ISRI Paper Grades			
Grade Number	**11**	**54**	**56**	**58**
Name	Old corrugated containers	Mixed paper	Sorted residential papers and news	Sorted clean news
Abbreviation	OCC	MP	SRPN	SCN
Prohibitive materials	<1%	<2%	<2%	<1/2%
Outthrows	<5%*	<3%	<3%	<1%
Other papers	—	—	—	10%

* For these grades, the outthrows include the sum of outthrows plus prohibitive materials.

Note that the ISRI standards have certain purity requirements. Outthrows are all papers that are so manufactured or treated or are in such a form as to be unsuitable for consumption as the grade specified. Examples might include “browns” (cardboard and chipboard) mixed in any of the “white” paper grades, or wet or soiled paper.

Prohibitive materials (prohibitives) are:

- Any materials which by their presence in a packing of paper stock will make the pack unusable as the grade specified.
- Any materials that may be damaging to equipment.
- Food debris, medical or hazardous wastes, and poisonous or other harmful substances or liquids.
- Wax or wax coating is generally a prohibitive.

Examples of prohibitives would include any plastic or aluminum containers, glass, food, etc. Other papers are defined as other grades of papers not specifically included in the desired grade.

Table 4-2 and Table 4-3 below show the plastic grades from the ISRI standards that are generally produced by MRFs.

Table 4-2. ISRI Plastic Grades

	ISRI Plastic Grades			
Name	#1–7 Bottles and Small Rigid Plastic	#3–7 Bottles and Small Rigid Plastic	MRF Film	Mixed Bulky Rigid #2 & #5
Percent in bales	65% bottles	-	-	-
Outthrows	2% paper/cardboard 1% metals, plastics, residue	2% metal/paper/ cardboard 1% liquid or residue	10% loose paper, plastics, non-ethylene film	4% other plastics 2% metal 2% liquids 2% wood 2% paper/cardboard 2% film 2% glass
Total contamination limit	5%	5%	10%	15%

Table 4-3. ISRI Plastic Bale Grades

	ISRI Plastic Bale Grades				
Name	Bale Grade	A	B	C	F
#1 PET	Total PET fraction	>94%	93–83%	82–73%	<72%
	Contamination limit	6%	7–11%	18–27%	>28%
#2 HDPE	Total HDPE fraction	>95%	94–85%	84–80%	<79%
	Contamination limit	5%	6–15%	16–20%	21%
PE and LDPE film	Total PE fraction		80% clear, up to 20% color	50% clear and 50% color	

HDPE = high-density polyethylene; LDPE = low-density polyethylene; PE = Polyethylene; PET = polyethylene terephthalate

Note that requirements imposed by the purchaser (mill or broker) can vary substantially from the ISRI standards. Prior to the recent action by China under its National Sword Policy (discussed more fully in Section 5.3), mills and brokers often allowed substantially higher prohibits and outthrows than the ISRI standards required. Most MRF processing facilities were designed to these looser requirements, generally being tested to achieve “mill standards” or whatever the market would bear at the time. This practice greatly increased production and significantly relaxed the performance requirements for MRFs.

Existing Comparable MRFs

Modern MRFs have been around since the 1970s, and by 2009 578 MRFs were operating in the United States.[5] In 2016, 65% of MRFs were single stream, which had increased dramatically from 2006 when only 27% of operating MRFs were single stream. As MRFs became single stream, their average throughput also increased, which negatively affected residue rates. To better understand and detail how current MRF operators manage their facility, HDR reached out to a few MRF operators and paired that with our overall industry understanding to identify key challenges they endure and general operating procedures. These MRFs are Eureka Recycling in Minneapolis, Minnesota; Monterey Regional Waste Management District in Monterey County, California; Fremont Recycling in Fremont, California; and Scott County MRF in Scott County, Iowa.

Eureka Recycling. Eureka Recycling is located in Minneapolis, Minnesota, and currently processes 90,000 tpy with one single-stream line and 1.5 shifts. This MRF was retrofitted in 2013 from a dual-stream system. The products from this MRF include general single-stream commodities as well as glass. The original equipment design was provided by Machinex and includes a presort line, glass breaking, an OCC sort, screens for fibers and containers, and an ECS and optical sorter. The optical sorter captures HDPE and polypropylene (PP) together, and then hand sorting is completed. QC is also done after the optical sorter using manual labor. Eureka suggests that pulling the glass out right after presort produces quality glass; however, this glass has a negative market value.

Eureka's products are designed to meet ISRI standards for Midwest markets, and Eureka believes that additional equipment such as an additional optical sorter would help them reach China standards. Furthermore, Eureka is not sending anything to China currently and prefers using local markets.

The current contamination rate for incoming materials is 7% for residential recycling and 10% for commercial recycling. The product coming out of the system is 2% contamination for paper. They are very happy with these numbers and believe the results are due to the educational investments made in the recycling sector of their community. Although Eureka is very happy with their system, they believe that a dual-stream system would lower their contamination rates inbound and outbound. They suggest setting up supply agreements with domestic markets because that will be the biggest challenge in the current dynamics.

Monterey Regional Waste Management District. Monterey Regional Waste Management District's MRF in Monterey County, California, is still under testing and is located in a building that used to house an old construction and demolition (C&D) debris MRF. The MRF is designed to process at 30 tph for single-stream recycling and will also handle mixed waste at 40 tph. A second line will also be in place to process C&D waste at 40 tph. The current equipment is supplied by Bulk Handling Systems and will have the first Kadant PAAL Konti baler in the United States. The single-stream line will include an infeed; an incline conveyor; a 12-inch screen; an

[5] U.S. Environmental Protection Agency, *Municipal Solid Waste in the United States: 2009 Facts and Figures*, December 2010.

overs presort for positive sort; hand sorting for OCC materials, metals, and other recoverable material; and then a QC for OCC. A bag breaker will also be placed somewhere before the 12-inch screen. Items that fall through the 12-inch screen will then go through another presort; a magnet; a 2-inch screen; an overs positive sort; a 2- to 12-inch Nihot air separation; lights; a polishing screen; a fiber screen; an optical sorter to remove film, flattened containers, and other residue; and a QC to remove OCC from mixed fiber. The heavies, which are containers and residue that get separated, go through an optical sorter for HDPE, an optical sorter for #3–7 plastics, an optical sorter for PET, a QC for all plastics, an ECS, and then a final QC check. The 2-inch screen is mainly for glass. The products from this MRF include general single-stream commodities as well as glass. The combined cost for the two lines was $15 million plus $8 million for the building and site renovations. Monterey plans to use 25 sorters on the single-stream line including a forklift and front-end loader. There will be 10 sorters on the C&D line. Currently the major problems at this facility are purity and quality. They are not confident that they will be able to reach the 0.5% contamination rate enforced by China.

Fremont Recycling. The Fremont Recycling facility in Fremont, California, is currently processing 24,000 tpy on one line and suggests that they still have room for more. The MRF is about 12 years old, and there has been no changes to the original equipment. The products from this MRF include general single-stream commodities including glass. The original equipment design was provided by Hustler Equipment, and Fremont is very impressed with how it has been operating. The single-stream line includes a presort line with 8 to 10 sorters; a two-deck, 2-inch steel disk screen that acts as a glass breaker; a star screen to remove fiber; a container line that is almost completely operated by hand; a magnet for recovery of ferrous cans; an ECS; and one Enterprise baler. The system has a total of 30 sorters, which includes 6 for PET. Fremont currently sells all of their products to domestic markets. In the past, some of their commodities were sent to China; however, the brokers disappeared after the strict contamination limits were put in place. They currently cannot meet China’s standards and have thought about adding optical sorters; however, they are very expensive and would not guarantee that the contamination rate will ever meet China’s limit.

Scott County MRF. The Scott County MRF in Scott County, Iowa, processed 25,000 tons last year and is expected to process 31,000 tons this year. The MRF opened in 2016 and was retrofitted to a 10-tph, single-stream MRF from a dual-stream MRF that was built in 1995–1996. In its first year as a single-stream facility, this MRF processed 14,000 tons, and Scott County attributes their rapid growth to having newer technologies in comparison to other MRFs in the Iowa region, such as MAR and Republic. The products from this MRF include general single-stream commodities including glass. The original equipment is a CP system, and Scott County is very happy with it thus far, having minimal downtime. Scott County chose this equipment based on its material throughput and safety features that are built in to make it easier to clean the system. The single-stream system includes an infeed conveyor, a metering drum, a presort station, a cardboard separator, a glass breaker, a CP screen, a fiber sort line and container sort line, an over belt magnet, and an ECS. They also have an MRF glass cleanup system, fiber bunkers, a baler, an old cardboard baler, an aluminum silo blower, and a trash compactor. They currently operate two shifts due to the increased tonnage throughput. They are currently working with 11 sorters in the first shift. Scott County is adding an optical sorter, which costs

$1 million, which will reduce the number of sorters necessary. The trucks coming into the MRF carry about 5 to 6 tons per load. Scott County currently sells their products to domestic markets and does not believe that a single-stream MRF can reach the 0.5% contamination rate necessary for China. Glass is sold at a loss after including transportation costs. Currently Scott County reaches a 2% contamination rate and believes the rate will be slightly lower with the addition of an optical sorter.

Summary. Conversations with current MRFs that operate and will be operating at a similar processing rate as the potential MRF for this feasibility study were very insightful for understanding current challenges and realistic goals that can be met. It was clear through the conversations that China's contamination rate is very difficult if not impossible to meet with current equipment, and this situation suggests that changes might be needed to improve quality before materials enter the MRF.

Recycling Commodity Markets

Current Markets

The current recycling commodity markets have been meeting significant challenges in the past year. Recycling in the United States (U.S.) used to rely heavily on China; however, with China's new contamination limits, the United States is working to find new end markets. The financial operating performance of an MRF is dependent on commodity market prices, so HDR reached out to several brokers and end users to understand the current markets.

Plastic and paper markets are at an all-time low, and some MRFs and brokers are having a difficult time finding end users to accept any mixed paper. Midwest Product Destruction and Recycling Services (MPDR), located in Des Moines, accepts all standard MRF commodities and uses recyclingmarkets.net as an index for pricing. According to recyclingmarkets.net, mixed paper dropped from $75 per ton in 2017 to $1 per ton in 2018. MPDR is currently unable to find a buyer for mixed paper. Sorted residential paper has declined dramatically as well, averaging $87 per ton in 2016 but only $27 per ton in 2018. Similarly, OCC has declined from $180 per ton in 2017 to $87 per ton in 2018.

Quincy Recycling in Quincy, Illinois, currently receives no revenue for OCC and sometimes has to pay for its disposal. The market for mixed plastics #3–7 is currently at an average of 1–2 cents per pound and has been at this price for the past year. Several brokers, such as MPDR and QRS Recycling, confirmed this low to no value and claimed that this commodity was also very difficult to sell. The value of color HDPE has slightly dropped since April, when it reached a high of 18 cents per pound and is currently at 10 cents per pound. Plastic commodities that have increased in market price are natural HDPE, PET beverage bottles, and Grade A and C film, according to recyclingmarkets.net.

The market for glass, along with all commodities, is very dependent on its contamination rate. Glass is seen to have a significantly higher market value prior to its going through an MRF. According to recyclingmarket.net, mixed glass is sold at –$0.12 per ton. Ripple Glass is currently buying glass bottles for around $25 per ton. This glass, however, must be from a drop-off center or taken out before entering a MRF. MWA should consider keeping glass out of their single-stream recycling collection and setting up a drop-off center for glass to be collected. Glass hand-collected at the front end of the MRF is also accepted by Ripple Glass.

Table 5-1 below shows current commodity prices.

Table 5-1. Current Market Pricing (May 2018)

Commodity	Price	Market Information	Specification
Mixed paper	$1/ton	Recyclingmarkets.com	ISRI
Sorted residential paper	$6/ton	Recyclingmarkets.com	ISRI
OCC	$87/ton	Recyclingmarkets.com	ISRI
PET	$0.15/pound	Recyclingmarkets.com Mohawk Industries	ISRI
Mixed plastics (#3–7)	$0.01/pound	Recyclingmarkets.com	ISRI
HDPE natural*	$0.40/pound	KW Plastics	KW Plastics
HPDE color*	$0.16/pound	KW Plastics	KW Plastics
HDPE polypropylene*	$0.10/pound	KW Plastics	KW Plastics
HDPE rigid	$0.11/pound	Recyclingmarkets.com	ISRI
Rigid plastics #2 and #5	$0.02/pound	QRS Recycling	QRS Recycling
Grade A film	$0.12/pound	Recyclingmarkets.com	ISRI
Grade C film	$0.015/pound	Recyclingmarkets.com	ISRI
Mixed glass	–$0.12/ton	Recyclingmarkets.com	ISRI
Mixed glass (full bottles)	$5–10/ton* $25–30/ton	Ripple Glass	
Used beverage containers	$0.83/pound	American Metal Market Push Resource Recovery	American Metal Market
Horizontal ram bale (HRB) steel cans	$290/gross ton	TMS International	TMS International
Hydraulic baled tin cans	$335/gross ton	TMS International	TMS International

* Includes transportation costs

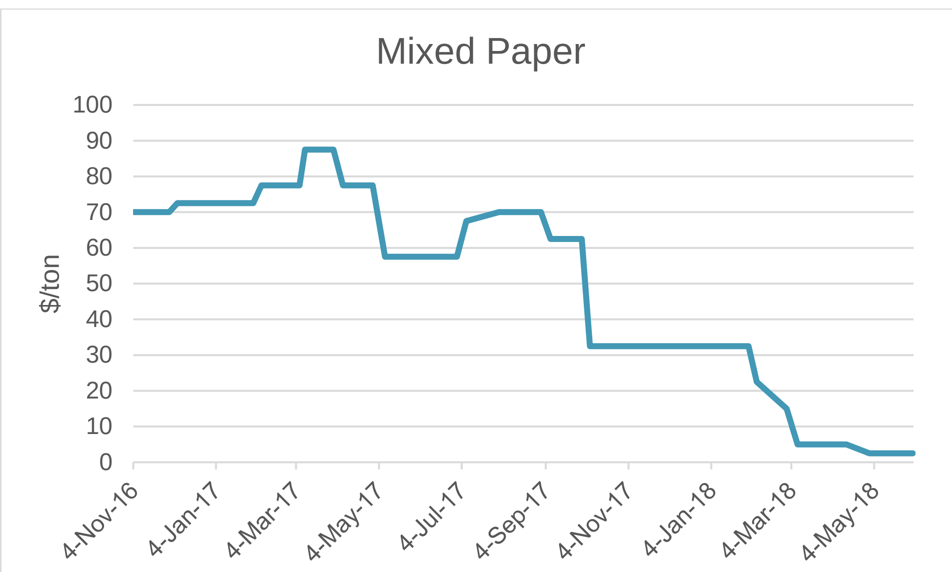
Market Stability

The future markets for recycling commodities are very important for evaluating the feasibility of an MRF. Analyzing the history of market prices will not accurately depict the future of the market. Many factors come into play when looking at market prices. The market price of a commodity is very dependent on the quality of the material; therefore, contamination rates are important drivers for high commodity prices. Research has also shown that oil prices correlate with the value of recyclables. The market for recyclables is constantly changing and for many commodities has been on a gradual decline since 2017. Below are tables showing the history of market prices which were obtained by Recyclingmarkets.net, an online pricing index.

Figure 5-1 below shows the pricing trend for mixed paper. Mixed paper consists of all types of paper but is limited in the soiled and wet paper content as well as non-fiber content materials. During the interval shown, ISRI has changed the designation of mixed paper. Today it is called a #54 mixed paper (MP) fiber product.

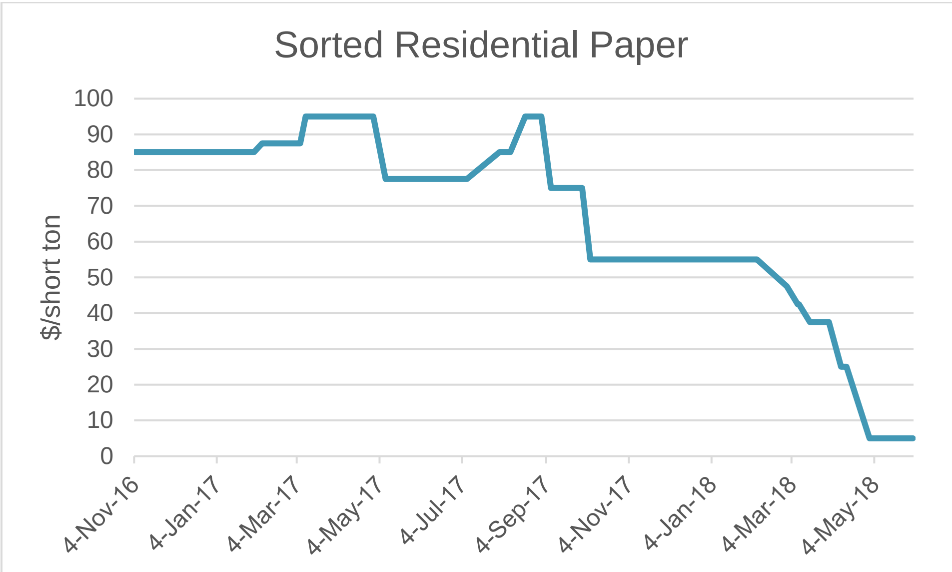
Figure 5-2 below shows the market history for sorted residential paper since late 2016. Formerly this class of fiber was either a #6 or #8 newspaper product, but these classifications have been discontinued. Sorted residential paper and news, ISRI designation #56 or SRPN, consists of paper such as newspapers, magazines, and printed paper generated in a residential household. The market for sorted residential paper has been significantly declining starting in the latter half of 2017.

Figure 5-1. Mixed Paper Regional Market Prices



Source: Recyclingmarkets.net

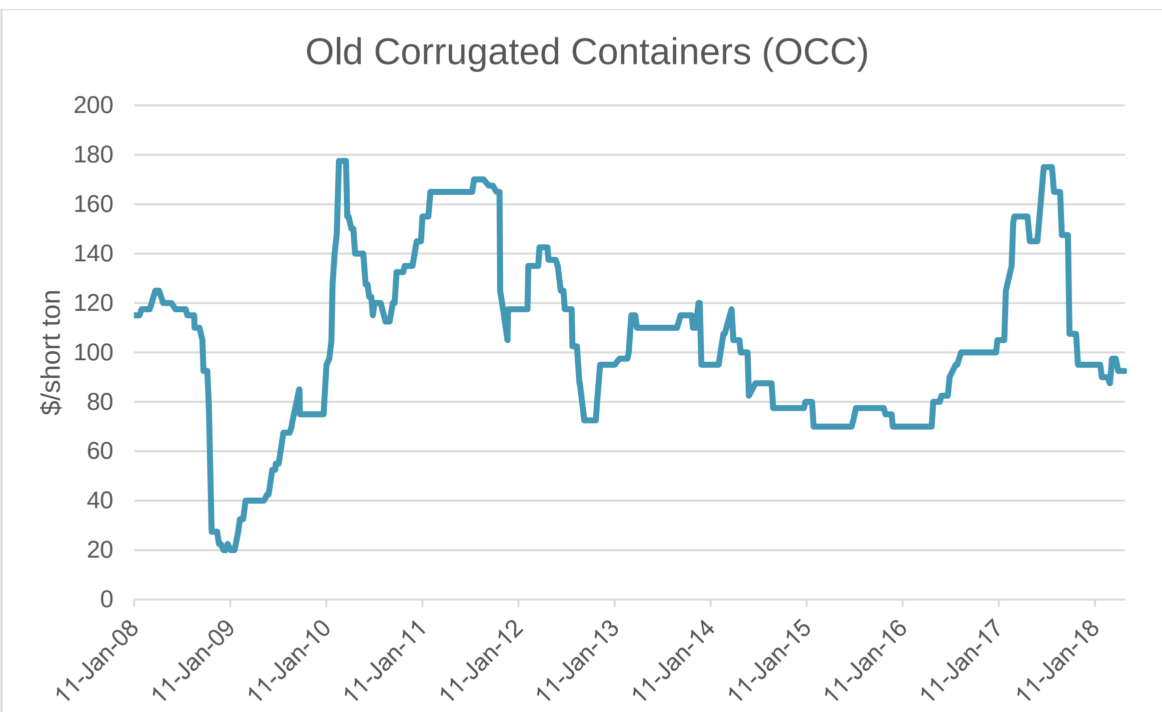
Figure 5-2. Sorted Residential Paper Regional Market Prices (2016–2018)



Source: Recyclingmarkets.net

Figure 5-3 shows the market history for OCC since 2013. OCC consists of lined corrugated containers. The market for OCC began to decline in the beginning of 2018.

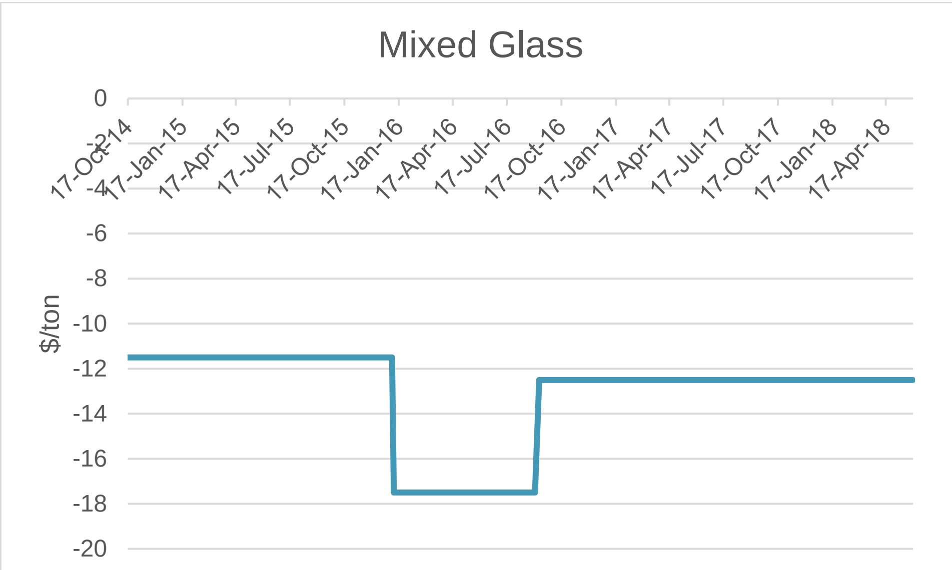
Figure 5-3. OCC Market Prices (2013–2018)



Source: Recyclingmarkets.net

Figure 5-4 shows the market for mixed glass. Mixed glass contains all colors and has been at a negative market value for several years. Conversely to this graph, brokers such as Ripple Glass are currently paying around $25 per ton for glass. The glass they accept (as stated in previous sections) must not be broken and must not go through an MRF. It is very likely that the negative market for mixed glass contains MRF glass, which is a very low quality.

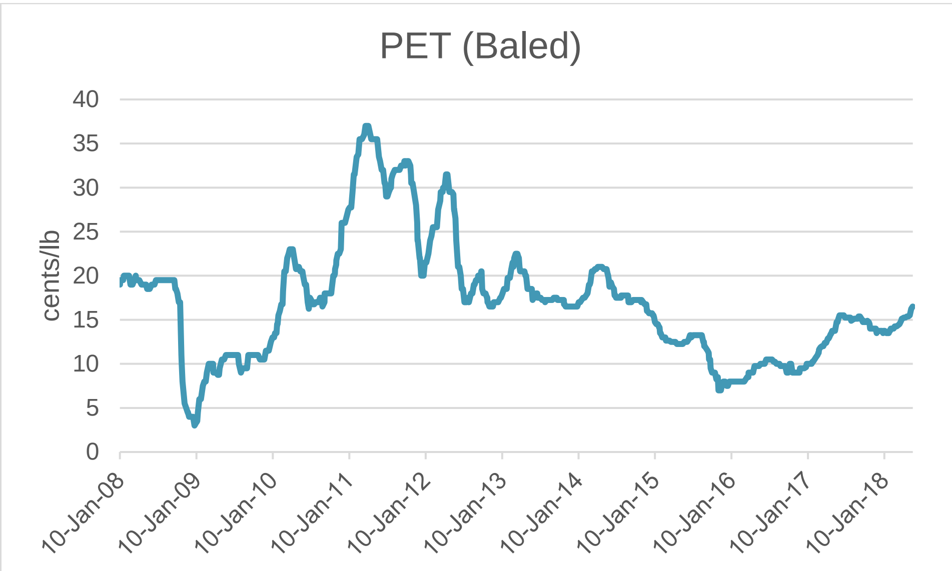
Figure 5-4. Mixed Glass Market Prices (2014–2018)



Source: Recyclingmarkets.net

Figure 5-5 shows the market for baled PET plastic and baled commingled #3–7 plastics. Both commodities have been on a steady decline since the beginning of 2017. PET mixed bottles consist of food and beverage bottles that can include up to 30% green tinted bottles. Mixed #3–7 plastics are separated from PET bottles, HDPE bottles, and mixed bulky rigid #2 and #5 bottles. Containers in this category can also include cups, trays, and tubs.

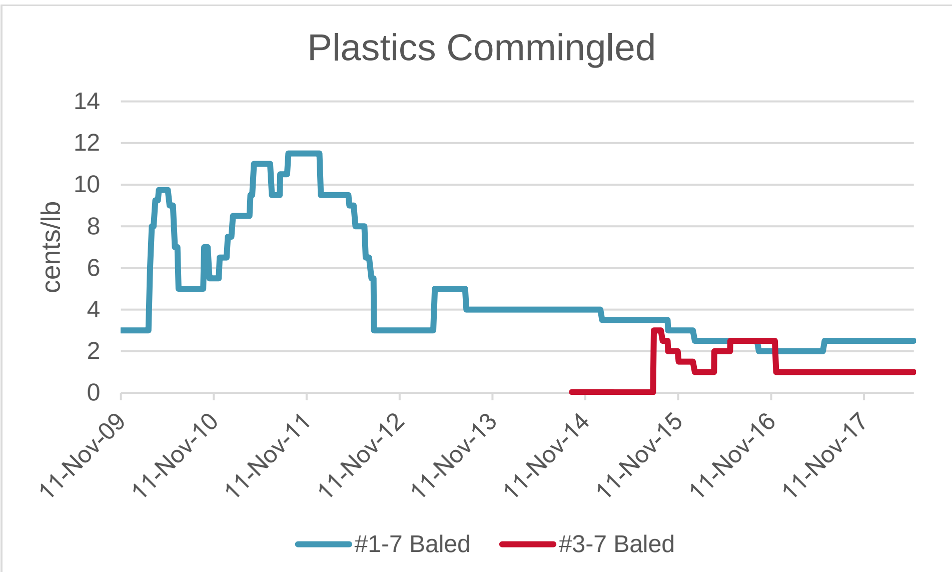
Figure 5-5: PET (Baled) Regional Market Prices (2008–2018)



Source: Recyclingmarkets.net

Figure 5-6 shows comingled mixed plastics. As shown in Figure 5-6, these designations include mixed rigid plastics including plastic bottles, thermoform packaging, cups, trays, clamshells, food tubs and pots. The #1–7 baled plastics include a mix of all containers without separating the #1, PET and #2 HDPE plastic containers. The #3–7 mixed rigid plastics have the more valuable #1 and #2 plastic containers removed, hence the price differential between the two classifications. Both of these categories do not include film plastic. These commodities limit the amount of fiber, metal, film plastic, glass, liquids, and other contaminants that are contained in the bales.

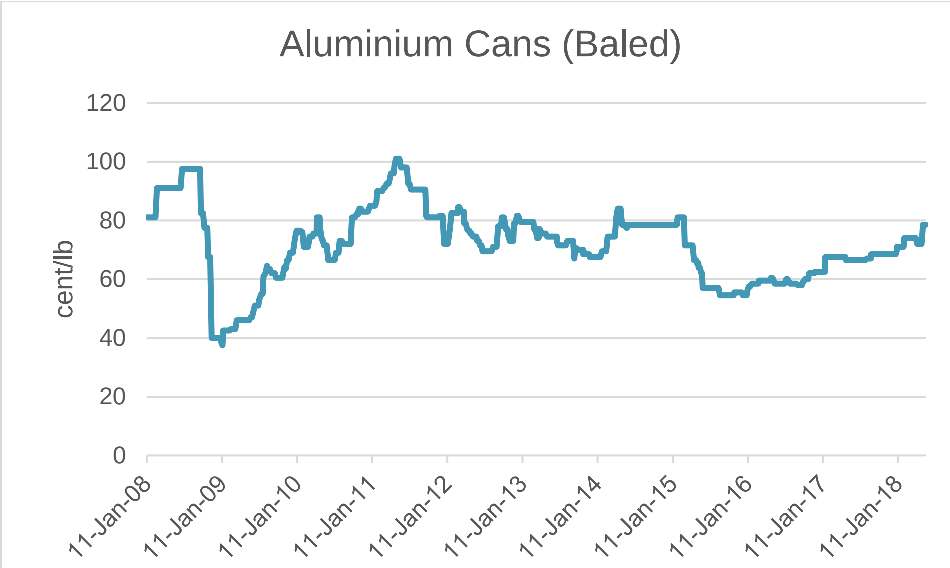
Figure 5-6. Plastic Regional Market Prices (2017–2018)



Source: Recyclingmarkets.net

Figure 5-7 below shows the markets for baled aluminum cans since the beginning of 2017.

Figure 5-7. Aluminum Can Market Prices (2017–2018)



Source: Recyclingmarkets.net

China's Influence on Markets

China has placed strict contamination standards on many recyclable materials being imported into the country. As of January 1, 2018, under the National Sword Policy, China banned 24 types of scrap materials including unsorted paper and low-grade PET bottles.[6] As of March 1, 2018, the contamination standard for plastics and fibers went from 1.5% to 0.5%. Another 16 types of waste such as car scraps and scrapped ships will be banned from being imported starting December 31, 2018. Starting December 31, 2019, scraps such as stainless steel scraps will be banned from being imported.[7]

There has been a shortage or lack of inspectors authorized to inspect shipments, and reportedly inspections are much more comprehensive when they are completed. Just recently, some China inspectors from Canada have been allowed to complete pre-inspections in the United States. At least one MRF has been approved for shipping to China. When material is shipped, it is not clear whether additional inspections and potential rejection could occur in China even though the commodities are preapproved.

This rigorous standard and other reasons have resulted in falling market prices for plastics and fibers. Prior to the stricter contamination standards, MRFs would be able to push large volumes of materials through the systems. Due to the stricter contamination standards, MRFs need to

[6] Kimiko de Freytas-Tamura, "Plastics Pile Up as China Refuses to Take the West's Recycling," *The New York Times*, January 11, 2018.

[7] The People's Republic of China, Ministry of Ecology and Environment, "China Announces Import Ban on 32 Types of Solid Waste," April 19, 2018.

more efficiently sort and complete QC measures, which slow down the process line, resulting in longer operating hours.

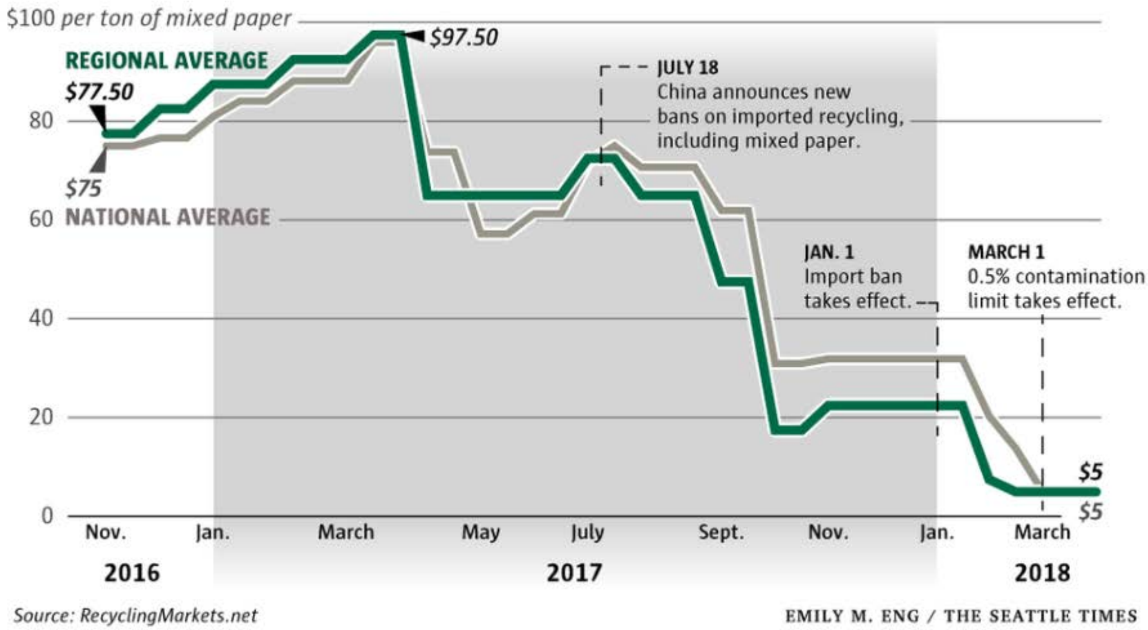
Two MRFs located in California were contacted for this feasibility study. California is known for stressing high landfill diversion. One MRF was just commissioning a new line that was designed to process single-stream material part of the time and mixed waste part of the time. The facility representative said that they were not achieving standards even close to the China requirement with single-stream material, and he expects that the fiber sorted from mixed waste will be useful only for alternative daily cover or other secondary uses. The other MRF is an older MRF. They rely heavily on manual sorting. They did not anticipate being able to achieve the China standard without very intense efforts.

QC measures are very important, and industry sources suggest QC measures need to be taken to meet the new 0.5% contamination standard, which currently cannot be reached with current systems. The addition of optical sorters, manual sorters, and updated OCC sorters that can pick up the smaller cardboard boxes that have been overflowing the OCC market (Amazon.com boxes) is necessary to consider sending commodities to China to reach the new contamination limits.

Figure 5-8 below shows the market for mixed paper in the Pacific Northwest in relation to important dates beginning with China’s policies.

Experts in the recycling industry believe that the National Sword Policy could be a phase; however, forcing facilities to push back on contamination can be positive. In addition, some recent indications appear to point to other countries tightening their requirements as well. The most current price of mixed paper (May 2018) has dropped to $1 per ton since the enforcement of the Policy.

Figure 5-8. Mixed Paper Market in the Pacific Northwest (2016–2018)



If MWA decides to build its own MRF, it might be possible to insulate itself from these concerns by carefully selecting a processing system designed to achieve the very high standards. In the past and based on current industry sources, MRFs were designed to achieve what was necessary to sell commodities. Equipment and systems were built to these lower standards and cannot achieve the performance of process lines with more-capable equipment. In addition, many systems are pushed to process at higher rates than the equipment can handle to achieve the quality standards China has enacted. Careful selection of high-performance systems with strict performance standards will mean higher capital costs but could result in a MRF that can more readily achieve the requirements.

The issue of achieving the China standard of 0.5% residue in the fiber productions was discussed with all four of the major equipment vendors. The response has been mixed regarding the ability to achieve this standard. All of them believed that they could achieve the standard in a test, but achieving the standard day in and day out with varying contamination rates, dirty screens, and material mixes was less certain. In general, all the vendors said that yield would likely go down. This makes sense since formerly unacceptable materials were being shipped, but it could also mean that more quality material is discarded. Also, in the past, the technology was not available to sort fiber products with optical sorters based on moisture, contamination, and other factors accounted for in the standards. All the vendors are relying heavily on technology—principally optical sorters as being much more effective than manual sorters or other equipment. All the vendors said that the cost of a processing line would go up by $2 million or more.

One vendor claimed that they have a better approach focused only or principally on positive sorting and never on negative sorting (pulling the desired material from the contamination), but they declined to provide layouts because they do not want to tip their hand on their approach.

They claim that their design can achieve 0.25% prohibits in tests, but they expect slightly higher value during extended operation. In principle, this approach of picking only the items you want sounds positive, but the impacts on recovery rates and missed product in residue stream could go up.

Another vendor said that they are on a fast-track learning curve and as noted above have an approach that has allowed their MRF to be approved for delivery to China. Another vendor said that, even though some MRFs have been approved for shipment, they have not been approved strictly to the 0.5% requirement and risk rejection in China. Another MRF vendor said that, while they feel they can achieve the China Policy requirements, MRFs should not be designing for that tight limit because they expect other markets will open up and limits will become more relaxed—probably much more stringent than past practice but more reasonable.

Another vendor said that they can achieve the requirement but when pressed repeatedly would only say that their top-of-the-line system was designed for 1%, not 0.5%, but should do better than 1%. Several vendors suggested that, if at all possible, an MRF should keep the glass out of the mix. Glass is very heavy, and, even with very high capture rates, a small amount of residual glass goes a long way to creating a problem.

A lot of experience will be gained in the next couple years before MWA likely will issue a request for proposal (RFP) if the decision is made to develop a MRF. The RFP process is where this issue will be resolved. The RFP must allow each vendor to propose the system they prefer. The specification for the feedstock must be realistic for contamination and mix but also must have a broad enough range that all situations will be addressed so that the facility can achieve performance when the screens are clean or dirty, at the start or end of a shift, any day of the week.

All of the vendors have their own standard list of exceptions and caveats. As noted above, one vendor does not count a piece of OCC smaller than 6 inches by 6 inches in mixed paper as residue, even though China does. They also count a PET in a fiber bale as “captured” since in fact it was captured and did not exit with the residue.

The RFP must have a strict definition of the production quality and purity requirements as well as a capture rate on the residue line for a given number of facility personnel (sorters plus other plant workers). The RFP must have a comprehensive acceptance test protocol that clearly defines how the plant will be tested—when and how many bale breaks will be completed for each commodity and residue. The RFP must also ask for all exceptions and caveats that the vendor requires for items such as feedstock variability, quality and purity definitions, sorter experience, and residue recovery. Evaluation of the proposals will be very difficult—comparing unique approaches to one another—but all must be put on a level playing field, and, where there is substantial cost difference, those impacts must be evaluated.

Education

Recovering recyclable materials is a way to create a sustainable way of living. Many Americans have adopted the practice of recycling but are unaware of the consequences contamination has on the quality of such materials and their ability to be recovered. With China's contamination rates reaching record lows, the way we recycle needs to change.

Education is a very important aspect of operating an efficient MRF. Communities and haulers need to be aware of what is recyclable and understand that contamination in the recycling bin can pose serious threats to the quality of the material recovered. Current MRFs can reach contamination rates within or close to China's new standards; however, if a community is not educated regarding what can and cannot go in the recycling bin, the low quality of their recyclables can override MRF equipment.

Facility Capital and Operational Costs

The capital and operating costs are essential to understanding the economic feasibility of adding a MRF in Grimes, Iowa. The facility is assumed to begin operations in 2022 and have a design life of 20 years. Opinions of probable cost were developed for capital and operating expenses and revenues, assuming that the facility will need to process the tonnage quantities estimated for all scenarios for the year 2042 (see Section 3.4 for more details). The Baseline Scenario and the other three scenarios vary in processing and equipment costs and labor costs.

Capital Costs

Table 6-1 below summarizes the estimated capital costs associated with constructing a clean single-stream MRF building, with enough space to accommodate processing about 72,000 tpy, or 277 tons per day (tpd). This throughput is the maximum quantity that would be expected based on Scenario 3 quantities projected to 2042. The same building cost is assumed for all scenarios. These construction costs include development and construction on 8.1 acres of land. Development costs include design and engineering, soil reports and permitting, and construction management. Construction costs include construction and general contractor fees. A planning-level contingency of 25% was included to account for unknown issues that could arise as the project evolves. The 2022 facility capital cost estimate is determined by using an annual 3% cost escalation factor.

Table 6-1. Material Recovery Facility Capital Cost Summary

Component	Size	Cost Estimate (2018$)	Cost Estimate (2022$)
Site acquisition	8.1 acres	$0	$0
Development costs		$2,215,000	$2,493,000
Direct construction costs	54,000 square feet	$11,075,000	$12,465,000
Other structures	1 scale	$125,000	$141,000
Total capital construction		**$13,415,000**	**$15,099,000**

Table 6-2 below shows the cost estimate for the processing and mobile equipment necessary to operate the MRF at different throughput levels. The Baseline Scenario, Scenario 1, and Scenario 2 each include one processing system, and Scenario 3 includes two processing systems. Some of the key features assumed for capital cost estimating purposes for each scenario include:

- Fully enclosed, pre-engineered metal building
- High strength concrete floor with wear resistant features
- Building electrical with combination of natural lighting and conventional high-intensity overhead lights
- Mechanical exhaust system
- Drive through unloading area
- High bay, column-free receiving area
- 12-foot interior concrete containment wall in receiving area
- Bale storage area
- Four loading docks
- Concrete roadways and approaches
- One inbound weigh scale on approach road
- Area for office, conference room and locker room/restroom facilities
- Elevated viewing gallery 150 feet long
- 10% general contractor fees
- 25% contingency
- 20% development costs of design/engineering, soils investigations, permitting, and construction period services

Additional assumptions reflected in the capital cost opinion for the Baseline and all Scenarios are summarized below:

- No land acquisition costs.
- No unusual site subsurface conditions that necessitate special foundations or over-excavation.
- Adequate electricity and communication services are available at the perimeter of the site.
- Water and wastewater service are of adequate size and available at the site boundary and no standpipe is required for on-site fire water.
- No special architectural treatments for the building.
- Soils for earthwork available within the price range estimated.
- No maintenance facilities, truck wash, fueling or other support facilities are included in the estimate.

Equipment installation, start-up, and contingency costs are estimated to equal approximately 30% of the process system cost. A mobile equipment contingency of 10% was included to account for unknown equipment costs that could arise. The 2022 equipment cost estimate is determined by using an annual 3% cost escalation factor.

Table 6-2. Processing and Mobile Equipment Cost Summary

Component	Baseline	Scenario 1	Scenario 2	Scenario 3
Process system	$6,000,000	$6,000,000	$6,000,000	$12,000,000
Equipment installation, start-up, & contingency (30%)	$1,800,000	$1,800,000	$1,800,000	$3,600,000
Mobile equipment	$502,000	$502,000	$552,000	$972,000
Mobile equipment contingency (10%)	$50,000	$50,000	$55,000	$97,000
Total equipment (2018$)	**$8,352,000**	**$8,352,000**	**$8,407,000**	**$16,669,000**
Total equipment (2022$)	**$9,400,000**	**$9,400,000**	**$9,462,000**	**$18,761,000**

Table 6-3 below shows the different types of equipment necessary for each scenario, which were used for determining the mobile equipment cost estimate in Table 6-2 above.

MRF processing equipment includes:

- One processing system line which is anticipated to include infeed conveyor, flow metering, presort station, cardboard screen, glass screens, fiber/container separation screen, fiber optical sorting, ferrous magnet, container optical sorting for selected commodities, ECS, QC stations, and live bottom bunker and bin storage. Scenario 3 includes two processing system lines.
- Two balers for recyclable material
- 20% for process equipment installation and start-up
- 10% contingency

Table 6-3. Mobile Equipment

Mobile Equipment	Baseline	Scenario 1	Scenario 2	Scenario 3
Front-end loader (large)	1	1	1	1
Skid loader	1	1	1	2
Forklift	1	1	2	3
Roll-off containers – 40 cubic yards	3	3	3	3
Roll-off containers (glass) – 40 cubic yards	1	1	1	1

Operational Costs

Personnel requirements were estimated for each scenario based on the expected throughput in 2022. All of the scenarios except Scenario 2 assume one 8-hour operating shift per day. The higher throughput for Scenario 2 (compared to the Baseline Scenario and Scenario 1) requires the addition of another 4 hours of operation, leading to the assumption of 1.5 shifts per day. This results in higher labor costs but keeps the additional equipment costs lower. Table 6-4 below shows the amount of personnel necessary for each scenario and for each shift, assuming 2022 tonnage rates.

Table 6-4. Personnel

		Baseline		Scenario 1		Scenario 2		Scenario 3	
Labor Category	**Labor Rates ($/hour)**	**FTE**	**Annual Cost**	**FTE**	**Annual Cost**	**FTE**	**Annual Cost**	**FTE**	**Annual Cost**
MWA facilities manager	$74	0.5	$78,000	0.5	$77,200	0.5	$77,200	0.5	$77,200
Marketing	$41	1	$84,200	1	$84,200	1	$84,200	1	$84,200
Admin/accounting	$41	0.5	$42,100	0.5	$42,100	0.5	$42,100	0.5	$42,100
Mobile equipment operators	$30	2	$123,600	2	$123,600	3	$185,300	3	$247,100
Shift foreman	$47	1	$98,300	1	$98,300	1.5	$147,400	1	$98,300
Baler/recycling equip. operators	$30	1	$61,800	1	$61,800	2	$123,600	2	$123,600
Materials sorters	$20	10	$421,200	14	$589,700	18	$758,200	22	$926,600
Maintenance/ mechanics	$34	2	$140,400	2	$140,400	3	$210,600	3	$210,600
Annual total labor cost opinion			**$1,048,800**		**$1,217,300**		**$1,628,600**		**$1,809,700**

Note: FTE = full-time employee equivalents

A potential net revenue was calculated using projected tonnages by commodity type for 2022 for each scenario, estimates of current market prices, and projected hauling costs. Hauling costs were assumed to be by truck; however rail haul may be determined to be economically beneficial and technically feasible and can be considered later. As previously discussed, market prices are continuously changing and are difficult to predict. Potential revenue should continue to be evaluated if the project is pursued. Table 6-5 below shows the assumptions made for net market revenue for each scenario.

Table 6-5. Revenue Opinion Summary (2018$)

Material	Net Market Revenue ($/Ton)*	Baseline	Scenario 1	Scenario 2	Scenario 3
ONP	($24)	($66,087)	($99,131)	($148,898)	($198,131)
Mixed paper	($29)	($211,687)	($317,531)	($476,941)	($634,643)
OCC	$57	$176,000	$264,000	$396,535	$527,651
Cartons	($38)	($2,057)	($3,085)	($4,634)	($6,167)
Steel/tin cans	$283	$132,802	$199,204	$299,210	$398,144
Plastics #1 PET	$270	$204,689	$307,033	$461,173	$613,661
Plastics #2 HDPE natural	$770	$250,609	$375,913	$564,633	$751,330
Plastics #2 HDPE color	$290	$89,085	$133,627	$200,711	$267,077
Plastics #3–7	($10)	($474)	($711)	($1,068)	($1,421)
Aluminum UBCs	$1,630	$250,358	$375,537	$564,068	$750,579
Glass	$5	$12,753	$19,129	$28,732	$38,233
Total potential revenue		**$835,989**	**$1,253,984**	**$1,883,521**	**$2,506,313**

* Estimating trailer haul costs to markets at $30 per ton.

Table 6-6 below shows all estimated operational costs for the baseline and each scenario. The annual debt service assumes a MRF life of 20 years and an equipment life of 10 years, using a 4% annual interest rate, beginning in 2018. Labor and revenues from the above tables are included. Other operational costs include insurance for general liability, fire, and building repair and destruction. A contingency of 10% was included to account for unknown operational issues that may arise. The operation and maintenance (O&M) cost opinion is presented in 2018 dollars. These costs would need to be escalated for inflation when estimating the O&M cost for future years.

The net cost per ton for the Baseline Scenario, Scenario 1, Scenario 2, and Scenario 3 is $168, $110, $78, and $74, respectively. Scenarios 2 and 3 are most economical on a per-ton basis due to the additional tonnage commitments. Scenario 3, however, has a higher capital cost because of the additional equipment required.

Table 6-6. Potential O&M Cost Opinion Summary (2018$)

Component	Baseline	Scenario 1	Scenario 2	Scenario 3
Annual debt service (20 years) – MRF	$987,000	$987,000	$987,000	$987,000
Annual debt service (10 years) – Equipment	$1,030,000	$1,030,000	$1,037,000	$2,055,000
Labor	$1,049,000	$1,217,300	$1,628,600	$1,809,700
Insurance	$131,000	$131,000	$131,000	$191,000
Facility maintenance & utilities	$574,000	$585,300	$726,900	$854,500
Equipment O&M	$276,000	$355,300	$473,000	$710,100
Residuals haul & disposal	$111,000	$165,900	$249,100	$331,500
Contingency (10%)	$214,000	$245,500	$320,920	$389,700
Annual total O&M cost opinion with debt service	**$4,372,000**	**$4,717,300**	**$5,553,800**	**$7,328,500**
Potential net revenue	$836,000	$1,254,000	$1,884,000	$2,506,000
Net O&M cost	**$3,536,000**	**$3,463,300**	**$3,669,800**	**$4,822,500**
Net cost per ton	**$171**	**$112**	**$79**	**$78**

O&M assumptions include:

- Operations assumed 5 days per week (260 days per year) and one shift 8 hours per day. Scenario 2 assumes 1.5 shifts per day.
- Material sorters, mobile and process equipment operators, and maintenance personnel increases as estimated with the increase in recyclables throughput.
- Hourly labor rates estimated plus 35% fringe benefits.
- Insurance 1% of raw buildings and equipment capital cost.
- Site maintenance 2% of raw sitework capital cost.
- Building maintenance and repair 3% of raw building capital cost.
- Utilities based on building size, operating hours and number of personnel.
- Processing equipment O&M based on 2% of raw capital cost.
- Mobile equipment O&M based on estimated hours of equipment operations, fuel consumption and $3.25 per gallon diesel fuel.
- Rejects and residuals haul and disposal at $51 per ton (transport cost assumed similar to NWTS).
- 10% contingency.

The vendors offered some “rules of thumb” for the cost of maintenance, but all said that the costs are highly technology and location-specific. Some vendors noted that they are not operators and that their knowledge is limited to the feedback they receive. A cost of about $1.25 per ton of feedstock was offered as a target cost for parts, service, and general upkeep for the processing equipment. Costs should be expected to increase as the equipment ages. This cost does not include labor, building upkeep, rolling stock, balers, or compactors not normally considered part of the sorting line. Another vendor said that an assumption of about

1.5% of the equipment capital cost is a good number for the first 3 years, 2% for years 4–7, and 2.5% to 3% for years 7–10.

Spare parts for the equipment can range from about $37,000 to $45,000 for a 15-tph line. The vendor said that this range was for a 46-week year and goes up as the equipment gets older. A key factor is glass. Several vendors commented that glass is one of the biggest impacts on maintenance costs.

Costs will vary, with some vendors' costs being higher due to the design and equipment selection. For instance, rubber star disc screens are quite expensive compared to optical sorters on a percentage of capital cost, but the optical sorter will also have costs for maintenance and operation of an air compressor. Rubber disc screens could require total star change-out every 3 months, adding about $1.50–$2.00 per ton over steel discs (but might have better sorting characteristics). Another vendor said that star replacement costs about $15,000–$20,000 per change-out, or about $80,000 per screen per year. Optical sorters cost about $2,000 per year for the sorter plus the increased cost for compressed air and compressor maintenance.

A vendor said that, in his experience, total O&M costs range from a low of about $2.65 per ton of feedstock to about $7 per ton with an average of about $4 per ton. These numbers are subject to economies of scale and do not include electricity, building costs, HVAC (heating, ventilation, and air conditioning), labor, rolling stock, and balers. Costs for balers can vary significantly due to wire costs. Another vendor said that, in their experience, O&M costs have generally been in the $3–$6 per ton range, noting that glass is a major factor in wear and tear.

Regarding labor costs, several vendors said that a good starting point is to plan for about one sorter per ton of feedstock processed. This number would be higher for smaller plants and lower for larger ones. Higher-technology plants will also cut these numbers. The head count discussed by most vendors does not include rolling stock operators, maintenance personnel, and shift foremen and might not include baler operators and general laborers.

A vendor said that, in the past for larger plants, an all-in cost range of $60–$80 per ton processed could be expected. This cost included labor, rolling stock, parts, debt service, etc. These costs were prior to the new China standards and should be expected to increase significantly for today's higher-technology, higher-quality MRFs. If a plant has the luxury of nearby markets, shipping fiber loose can significantly reduce baling costs. At this time, loose shipping would not be practical in Des Moines due to underweight loads.

Commodity revenue prices are almost all at historically low values due to the recent influence of China's actions on the markets. HDR anticipates that commodity prices will improve eventually, however the timing of the improvement is very unpredictable. Not all commodity prices will recover at the same rate. To understand the sensitivity of the net cost per ton processed to the recycling revenue, we completed a sensitivity analysis shown in Table 6-7 with modest increases if commodity pricing showing the relative impact of a 5%, 10%, 15% and 20% revenue increase in commodity prices. These percentages result in prices well below historical highs or averages for most commodities. Certain commodities such as No. 54 Mixed Paper has been extremely deflated. Due to the volume of mixed paper, its influence on MRF operating costs is much greater than other commodities. The price of mixed paper has significant room for improvement and thus greater potential to reduce the net cost per ton for a MRF facility. While recycling markets may never again achieve the historic commodity price peaks, there is room for growth and the recycling revenue sensitivities shown below are conservative.

Table 6-7. Recycling Revenue Sensitivity on Net Costs

Recycling Revenue Increase	Baseline	Scenario 1	Scenario 2	Scenario 3
0%	$167	$109	$77	$76
5%	$165	$107	$75	$74
10%	$163	$105	$73	$72
15%	$161	$103	$71	$70
20%	$159	$101	$69	$68

In the cost opinions above for Scenario 3, the O&M costs assume one shift operation and debt service on a second full processing system and additional mobile equipment. HDR evaluated the sensitivity within Scenario 3 of the one shift operation / two process lines compared to a two-shift operation / one process line. This sensitivity is shown in Table 6-8.

Table 6-8. Potential Cost Impact from Multiple Shifts

Component	Scenario 3, One Shift	Scenario 3, Two Shifts
Annual total O&M cost opinion with debt service	$7,245,900	$6,388,100
Potential net revenue	$2,506,000	$2,506,000
Net O&M cost	**$4,739,900**	**$3,882,100**
Net cost per ton	**$76**	**$63**

Other Site Facilities

In addition to the MRF, an HHW receiving facility and an Administration and Education Building are included in the facility layout. The costs for these facilities are not included in the cost for the MRF which allows for a better comparison of costs to those of other MRFs. Costs for an HHW facility can vary significantly depending on its design and function. We have assumed that the HHW facility might be a 30-foot by 30-foot enclosed building and associated equipment. HDR anticipates that the cost for an HHW facility would likely range between $100,000 and $350,000.

Similarly, the Administration and Education Building could also vary based on final design requirements. Usually such buildings contain facilities such as several offices for MWA, a kitchenette, restrooms, a conference room, and display areas. We have assumed a standalone single-story building size of about 100 feet by 45 feet. The facility could be incorporated into the MRF building or could be standalone. HDR anticipates that the cost for the Administration and Education Building could cost between $1.25 million and $2 million.

Development Schedule

The development of an MRF is expected to take approximately 36 to 48 months to complete. The steps involved in the MRF development include:

- Feasibility study 3 months
- Design and permitting 12 months
- Construction bidding and equipment procurement 6 months
- Construction 18 months
- Commissioning and start-up 3 months

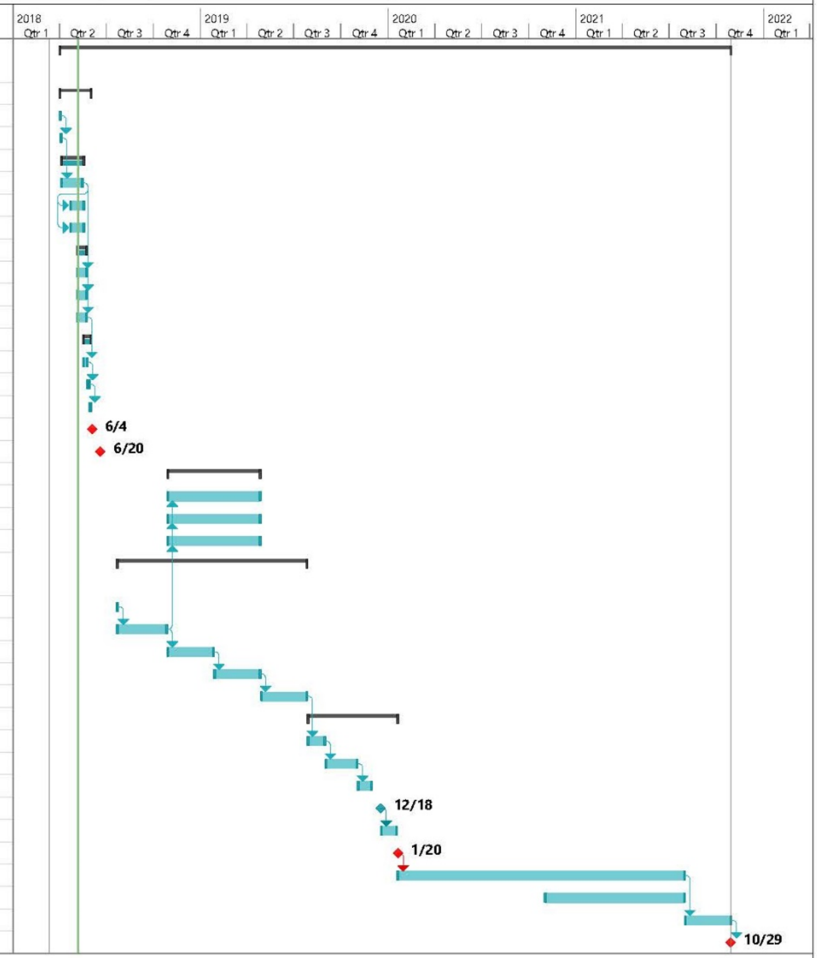
Figure 7-1 below is a Gantt chart showing the development of the proposed MRF.

Figure 7-1. MRF Development Schedule

Metro Waste Authority

Materials Recovery Facility (MRF), Household Hazardous Waste (HHW) and Education Center Development Schedule

ID	Task Name	Start	Finish
1	**Materials Recovery Facility (MRF), Household Hazardous Waste (HHW) and Education Center Development Schedule**	**Mon 4/2/18**	**Fri 10/29/21**
2	**Feasibility Study**	**Mon 4/2/18**	**Fri 6/1/18**
3	Notice to Proceed	Mon 4/2/18	Mon 4/2/18
4	Kick-off Meeting	Wed 4/4/18	Wed 4/4/18
5	**Phase 1 Material and Revenue Projections**	**Thu 4/5/18**	**Fri 5/18/18**
6	Task 1.1 Service Market Evaluation	Thu 4/5/18	Tue 5/15/18
7	Task 1.2 Processing Capacity & Technology Evaluation	Mon 4/23/18	Fri 5/18/18
8	Task 1.3 Assess Materials Market	Mon 4/23/18	Fri 5/18/18
9	**Phase 2 Cost Projections and Conceptual Design**	**Mon 5/7/18**	**Wed 5/23/18**
10	i. Facility Tours (optional)	Mon 5/7/18	Wed 5/23/18
11	ii. Operational Costs & Projections	Mon 5/7/18	Wed 5/23/18
12	iii. Capital Cost Projections	Mon 5/7/18	Wed 5/23/18
13	**Phase 3 Project Viability Determination**	**Fri 5/18/18**	**Fri 6/1/18**
14	Draft Feasibility Study	Fri 5/18/18	Thu 5/24/18
15	MWA Review	Fri 5/25/18	Tue 5/29/18
16	Final Feasibility Study	Wed 5/30/18	Fri 6/1/18
17	**Presentation to MWA Executive/Finance**	Mon 6/4/18	Mon 6/4/18
18	**Presentation to Board of Directors**	Wed 6/20/18	Wed 6/20/18
19	**Local Approvals**	**Mon 10/29/18**	**Fri 4/26/19**
20	Zoning	Mon 10/29/18	Fri 4/26/19
21	Siting (incluidng possible traffic study)	Mon 10/29/18	Fri 4/26/19
22	Local Permitting	Mon 10/29/18	Fri 4/26/19
23	**Design of MRF, HHW and Education Center (assuming traditional design, bid, build)**	**Mon 7/23/18**	**Fri 7/26/19**
24	Notice to Proceed	Mon 7/23/18	Mon 7/23/18
25	30% Design	Mon 7/23/18	Fri 10/26/18
26	60% Design	Mon 10/29/18	Fri 1/25/19
27	90% Design	Mon 1/28/19	Fri 4/26/19
28	100% Design	Mon 4/29/19	Fri 7/26/19
29	**Construction Bidding and Equipment Procurement**	**Mon 7/29/19**	**Mon 1/20/20**
30	Preparation of Bid Documents	Mon 7/29/19	Fri 8/30/19
31	Publication of Bid	Mon 9/2/19	Fri 11/1/19
32	Bid Reviews	Mon 11/4/19	Fri 11/29/19
33	Board of Directors Approval	Wed 12/18/19	Wed 12/18/19
34	Contract Negotiation	Thu 12/19/19	Fri 1/17/20
35	Notice to Proceed	Mon 1/20/20	Mon 1/20/20
36	**Construction Phase**	Mon 1/20/20	Fri 7/30/21
37	**Optional Operator Procurement**	Mon 11/2/20	Fri 7/30/21
38	**Commissioning and Start-up**	Mon 8/2/21	Fri 10/29/21
39	**MRF Complete**	Fri 10/29/21	Fri 10/29/21



No contingency is included in the current schedule.
Revised 5/8/2018

Project Risks

Developing a MRF will involve some risk for MWA. There will be financial risks associated with the development and operation of the MRF. There will be risks associated with material quantities and quality coming to the facility. There will be risks associated with the performance of the MRF. And there will be risks associated with the marketability of the materials from the MRF.

Likewise, there are risks to MWA associated with the existing MAR contract. The number of times MAR has come to MWA for revisions to the contract has been concerning to MWA. There are risks associated with the potential future contract terms between MWA and MAR. There is a risk that MAR might not invest in the facility and eventually not be able to process commingled recyclables due to the tightening market standards. And there are therefore financial risks to MWA due to the uncertain future of the MAR contract, operations and facility.

Provided in Table 8-1 is a matrix of the risks associated with the current MAR contract and a new MWA MRF.

Table 8-1. Comparison of Future Risks

Risk Key

High Risk	
Medium Risk	
Low Risk	

Risk	Staying with MAR Contract	Developing a MWA MRF
Contract		
Volatility of Business Conditions		
Administrative Time and Involvement		
Business Relationships		
Operational		
Ability to Meet Future Market Conditions		
Potential Service Interruptions		
Quality of Materials from Customers		
Quality of recyclables		
Financial		
Capital Costs		
Operating Costs		
Rate Payer Impacts		

Summary of Feasibility Considerations

MWA has decided to evaluate the possibility of developing their own MRF. There are many considerations when evaluating the feasibility of a project. The following sections provide some of the considerations for MWA in developing a single stream MRF.

Project Champion

Every successful project needs to have a champion to see the project through. A project champion is an individual who has the authority to use resources within or outside an organization for completion of a given project. Although MWA is the project sponsor, MWA will need to identify the project champion.

Project Site

The MRF is proposed to be built on MWA's Metro Northwest Transfer Station site in Grimes. To be feasible, the site needs to have adequate size, have proper zoning, remain outside floodplains and wetlands, have sufficient utilities (such as water supply, wastewater discharge, electricity, and gas), be reasonably accessed by trucks, not be near sensitive receptors (such as homes, schools, or hospitals), and be acceptable to the general population. At this point, the Northwest Transfer Station site appears to be feasible for a MRF.

Commingled Recyclables Supply

Through the Curb It! program, MWA currently collects, and therefore controls, approximately 20,000 tpy of recyclables. Between the City of Des Moines and the surrounding region, additional volumes of recyclables could be directed to an MWA MRF. Greater volumes of recyclables received at an MRF would reduce the net processing cost of an MRF due to the economies of scale. To ensure the additional volume of recyclables, MWA would need to engage the City and the surrounding region, including local communities and private haulers, to determine whether MWA could attract additional volumes to the MRF. Generally, a primary consideration of a customer delivering recyclables to an MRF is price. If necessary, MWA could subsidize the cost to customers to attract greater volumes of recyclables to the MRF.

There is a national debate on the future of recycling collection—namely, whether glass should be included with single-stream collection and whether programs such as dual-stream collection should be considered instead of single-stream collection. Removing glass from the single stream is being considered due to broken glass contaminating other recyclables, especially paper. Dual-stream collection is being considered due to the generally improved commodity quality from the collection program. Note that the public generally prefers single-stream programs and the inclusion of glass with recycling collection programs. MWA can consider the options of changing the Curb It! program during MRF design.

MRF Technology

Several companies supply equipment for the separation and processing of commingled recyclables. Each of the companies was contacted as part of this feasibility study. The technologies used by the companies are considered commercially viable technologies, especially in the scale that would be considered for an MWA MRF. One of the big challenges currently facing MRF technology is meeting the current 0.5% contamination standard established by China's National Sword Policy. The recycling industry in general, and the companies in particular, are working diligently to address the market standards, and there should be confidence that program modifications (such as education), technology and operating standards, and markets will continue to evolve into sustainable recycling systems.

Markets for Sorted Recyclables

The current markets for recycling commodities in Iowa and across the United States are in crisis in large part due to China's National Sword Policy. While significant, it is not expected that recycling commodity markets will continue to remain at their current historic lows. Markets for glass and mixed #3–7 plastics are of greater concern than for other commodities due to the poor quality of broken glass that comes from MRF processing and generally poor markets for the mixed plastics. Nevertheless, it is expected that markets for recycling commodities will remain viable in the future.

Economics

MWA's current contract price with MAR for recyclables processing cost is approximately $50 per ton, which is expected to increase to $55 per ton with Consumer Price Index (CPI) adjustments. However, it is understood that MAR will negotiate a higher processing cost estimated at $65 per ton with 60% of revenues to MWA and 40% to MAR. Additionally, the current contract provides for revenue-sharing provisions of 100% mixed paper, 65% aluminum, and 50% plastic and glass to MWA.

The projected net operating costs of an MWA-sponsored MRF range from $168 per ton (based on the 20,000 tpy from the Curb It! program alone) to $68 per ton at a regional expanded capacity of 60,000 tpy assuming an improvement in recycling commodity values. These net operating costs assume that the recycling revenues are already applied to the operating costs. Lower net operating costs might be realized if multiple operating shifts are used.

The economics of an MWA-sponsored MRF also depend on the potential risks associated with the MRF. Given the number of times that MAR has come to MWA with contract amendment requests, and the perceived lack of investment in the MAR MRF, there is a greater perceived risk of continuing with the MAR MRF.

Risks

Mitigating risks is an important consideration when considering the development of a MRF. MWA needs to ensure that the recyclables collected under the Curb It! program will be able to be reliably, efficiently, and cost-effectively processed and marketed. The public has come to want and expect reliable recycling services and will be very dissatisfied if the program ceases to exist due to the loss of a market for the recyclables. There are risks associated with MWA developing a MRF, including financial and operating risks. But there are also risks associated with continuing with the existing MAR contract, including the concerns with the viability of the MAR contract facility in the future.