# EWSWA Container MRF Review

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# 2.0 Processing System Review

## 2.1 Purpose of the Study

To conduct an assessment of the Essex-Windsor Solid Waste Authority existing Container Material Recovery Facility operations;

1. To determine how best to add mixed plastics to the curbside recycling program.
2. To make recommendations on how the Authority can reduce residue and
3. To increase capture of existing materials at this MRF.

## 2.2 Background

The 36,000 square foot MRF handles all containers materials collected by EWSWA and those delivered by contractors. Approximately 5,900 tonnes of recyclables are processed annually into nine different categories. Typically, the MRF operates five days per week Monday through Friday for approximately 8 hours each day.

The on-site equipment consists of a two-ram horizontal auto tie baler, a skid steer and a forklift. A sorting line equipped with a mezzanine with nine storage bays was commissioned in 2009.

As part of the study a number of elements were reviewed including:

1. Tender Requirements
2. Past Optical Sorter Audit results
3. Past Residue Audit results
4. Labour Requirements
5. Process Flow

An on-site examination of the processing systems in operation was also conducted , including manual sorting stations and automated equipment.

A cursory economic analysis of the existing processing operation is presented to frame the current baseline data.

# 3.0 Review of Documentation

## 3.1 Tender Requirements

A review of the tender documents identifies specific sections which are of relevance to this review. In this case, particular areas of interest include:

1) Market Specification
2) Recovery Rates
3) Maintenance
4) Adequate Staffing

## 3.2 Market Specifications

Clauses 3.4.4 and 3.4.5 require the contractor to meet end market specifications. Discussion with authority staff determined that end markets are generally satisfied with the end product sold with little or no rejections and/or downgrades. Observations in the facility concurred with this experience.

## 3.3 Recovery Rate

Specific recovery rates have been identified in the tender document as follows:

**Table 3.3.1 – Tender Recovery Rates**

| Material | Recovery Rate | Allowable Residue |
|---|---|---|
| Aluminum Containers | 97% | 3% |
| Steel Cans | 97% | 3% |
| HDPE Bottles | 93% | 7% |
| PET | 93% | 7% |
| Tubs | 93% | 7% |
| Lids | 75% | 25% |
| All Fibre Products | 98% | 2% |
| Gable Top | 93% | 7% |

Not all commodities are listed in the requirements. It is also believed that the requirements for the fibre products was meant to frame the needs of the Fibre MRF and not any fibres found in the Container MRF.

Serious penalties are outlined in section 3.6 with regards to the failure to meet the required recovery rates. The authority has not used the penalties against the contractor to date. Any residue exceeding the "allowable residue limit" is subject to haulage and disposal costs payable by the contractor otherwise the contractor pays the haulage and the authority pays the disposal costs.

A review of the current recovery rate of existing materials revealed that other than PET and HDPE plastics the current operator does not meet the expected recovery rates outlined in the tender documents. Having said that, one would expect that the level of contamination delivered to the MRF likely exceeds all expectations as well.

**Table 3.3.2 – Actual Recovery Rates**

| Material | Tonnes Processed | Residue | Actual Tonnes | Recovery Rate | Tender Requirement |
|---|---|---|---|---|---|
| Mixed Fibres | 29 | 263.7 | 293.14 | 10.1% | 98.0% |
| Polycoat/Aseptic | 59 | 26.7 | 85.72 | 68.8% | 93.0% |
| Aluminum | 342 | 34.2 | 376.22 | 90.9% | 97.0% |
| Ferrous (steel) | 926 | 84.9 | 1,010.91 | 91.6% | 97.0% |
| PET | 872 | 46.2 | 918.16 | 95.0% | 93.0% |
| HDPE | 492 | 27.2 | 519.21 | 94.8% | 93.0% |
| Tubs and Lids | 57 | 97.3 | 154.30 | 36.9% | 75%-93% |
| Flint Glass | 293 | 2.2 | 295.22 | 99.2% | |
| Mixed Glass | 1,560 | 1.1 | 1,561.07 | 99.9% | |
| Residue | 1,300 | 674.2 | 674.16 | | |
| Film - HDPE | 0 | 42.2 | 42.17 | | |
| **Summary Totals** | **5,930** | **1,299.80** | **5,930.28** | | |

Recovery rates can be affected by many factors as outlined in Tables 3.3.3 and 3.3.4 and in this case, the low recovery rates can be attributed to three main factors:

1) Equipment maintenance
2) Improper use of resources
3) Unusually high residue level in the material mix

Recommendations in those sections will have the most impact on the recovery rate. Only then should additional study be conducted in the other areas outlined in the tables.

**Table 3.3.3 - MRF Operations Efficiency Checklist**

| Category | Questions |
|---|---|
| **A) Administration** | |
| **1.** Training Investment in MRFs | • Were the sorters trained on their materials?<br>• Does the MRF operator know the cost centres in the MRF?<br>• Does the MRF operator know why problems exist?<br>• Do the MRF operator and MRF supervisor/manager and management work together to derive solutions?<br>• Is the public educated on how to recycle? |
| **2.** Full-time vs. Temporary Workers | • Are full-time sorters used or temporary employment agency sorters?<br>• If temporary sorters, is the lead sorter full time?<br>• Are there reasons why full time sorters are not used? |

**Table 3.3.3 (Continued) - MRF Operations Efficiency Checklist**

| Category | Questions |
|---|---|
| **B) MRF Equipment and Configuration** | |
| 1. Infeed Belt Angle | • Is the angle too great?<br>• Does material tumble back down causing peaking on the sorting lines? |
| 2. Screen Placement | • Is it effective where it is?<br>• Should it be/is at the front of the sorting line? |
| 3. Sorting Conveyor Belt Speed | • What is the capture rate of the material?<br>• How many sorters are being used to sort X quantity of material?<br>• Do the sorters have to pull material back in front of them to sort efficiently?<br>• Is it moving too quickly? |
| 4. Materials Movement | • Is there double handling of material?<br>• Is there cross contamination of materials on the tipping floor, or in the storage bunkers? |
| 5. Material Storage | • Is there sufficient storage on the tipping floor without cross contamination?<br>• In the storage bunkers pre-baling?<br>• In the bale storage areas? |
| **C) Sorters/Sorting Function** | |
| **1.** Plastic Film Removal | • Is the plastic film being removed to allow efficient sorting of materials?<br>• Is there a better location to remove the film? |
| **2.** High Volume to Low Volume | • Are the materials being removed from the sorting belt in order from high volume to low volume?<br>• Does the sorting order need to be changed to improve sorting rates? |
| **3.** Re-Sort | • Is negatively sorted material being recirculated for additional sorting?<br>• Are cross contamination problems causing additional sorting?<br>• What is the capture rate for the materials on the sorting belt?<br>• Is the sorting conveyor moving too quickly? |
| **4.** Picking Ergonomics | • Do sorters throw forward or pull back?<br>• Do sorters have to twist to sort material?<br>• Do sorters have to bend forward too far to sort materials?<br>• Is the sorting conveyor too high for the sorters?<br>• Do the sorters complain of bad backs? |

**Table 3.3.4 - Factors Affecting Sorting Rates**

| Factor | Impact on Sorting Rate | Reason |
|---|---|---|
| Number of materials being sorted from a single belt | High | • The more materials on the belt, the harder it is for each sorter to see his/her assigned material(s). Sorters may be required to move material out of the way to get at their assigned material(s). This non-sorting action decreases sorting rates. |
| Plastic film/Bagged Material | High | • Materials still in plastic bags or covered by plastic film caused sorters to take too much time emptying and/or moving bags to "see" the material they were responsible for sorting. |
| Conveyor belt speed | High | • Sorters can only sort material if it is in front of them. If there is no material to sort (e.g., if the infeed conveyor is not kept full), then the sorters cannot sort. |
| "Re-sort" (recirculation of negatively sorted material to be resorted for higher capture rates) | High | • Because there are relatively lower quantities of each of the materials to be sorted from the re-sort and yet, because of line configuration, the same number of people are required to man sorting stations, this activity lowers overall average sorting rates. |
| Picking ergonomics | Medium | • Sorters who have to throw the material to their side or behind them sort at rates slower then those throwing to chutes in front of them. The amount of motion required to sort to the front is lower than to the side or back. |
| Sort Order | Medium | • Picking lower volume (lower quantity) materials ahead of high volume materials results in a lot of wasted (non-sorting) movement moving materials around on the belt looking for smaller quantities of material rather than picking material from the belt. |
| Glass on the sorting conveyor | Medium | • Where workers have to deal with glass on the sorting belt, for fear of being cut, they will tend to sort slower. |
| Full-time vs. temporary workers | Medium | • "Temp" agency sorters generally do not sort as quickly as full time sorters. This is due to the general lack of training provided to temporary workers and the lower level of enthusiasm associated with temporary workers as they may or may not be at the facility from one day to the next. |
| Backsplashes | Low-medium | • Where sorting is forward, without backsplashes at the back of the chutes sorters have to slow down to ensure the material goes into the chute rather than on the floor. With the backsplash, the relative need for throwing accuracy is reduced. |
| Burden depth | Low-medium | • The burden depth generally only affects the first few sorting stations as the total quantity of material may make it difficult to sort the required material. However, this is overcome by sorting the high volume (quantity) material at the first stations (e.g., PETE or HDPE on the container line or OCC on the fibre line). |

## 3.4 Maintenance

Section 3.9 of the tender document discusses the requirements of the contractor to perform regular preventative maintenance on the equipment which is owned by the Authority. Such "circle checks" are required to be reported on a daily basis so the Authority can perform the necessary repair and maintain the equipment in accordance with manufacturers specification.

During the site visit there was evidence that a more stringent preventative maintenance program would be an asset.

Rollers on conveyors had not been cleaned in a long time. Not cleaning the rollers will cause the belts to track improperly resulting in premature wear and belt replacements. Rollers will also stop turning, hold on to sharp objects that will cut the belt.

**Figure 3.4.1 – Dirty Roller**

A large hole was observed in the aluminum pneumatic conveying system.  It creates a safety hazard, reduces the conveying efficiency, and increases the risk of materials getting jammed in the pipe resulting in downtime.

**Figure 3.4.2 – Pipe Hole**

The hydraulic oil in the baler was discoloured which may mean a overheating problem.

**Figure 3.4.3 – Discoloured Oil**

By far, the worst maintenance shortfall observed was on the most expensive piece of equipment in the facility, the optical sorter. This machine is the focal point of the operation and it can perform more sorts than all the sorters combined in the facility if operated in accordance with the manufacturer's instructions. In order to operate efficiently, the optical machine needs to be operating at 17°C with clean air. The camera needs to look at the material on a clean black belt for maximum differentiation of materials. The ejection nozzles should be free of debris.

**Figure 3.4.4 – High Temperature**


**Figure 3.4.5 – Dirty Filter**

**Figure 3.4.6 – Dirty Belt**

**Figure 3.4.7 – Dirty Ejection Bar**

**Figure 3.4.8 – Dirty Reflector Glass**

The condition of the reflector glass was poor with substantial blockages. When the operator was asked if they cleaned the optical system on a daily basis, he claimed they did. When they were asked what tools they used, they referred to a bottle of pressure washer soap and a squeegee. It became evident that basic cleaning duties may require some upgrading.

### 3.4.1 Suggested Daily Maintenance of Optical System

The manufacturer's recommended daily maintenance includes the following activities:

| N° | Maintenance | Duration | Equipment to be used | Precautions to take |
|---|---|---|---|---|
| D1 | Check the functioning of the nozzles and clean them using the software | 5 min | « test all nozzles » button | Manual use Exit sorting if necessary Electro valve button |
| D2 | Clean the jam sensors | 1 min | - Non-greasy window type cleaner<br>- Soft cloth | |
| D3 | Clean the air conditioning filter | 5 min | - Blower | Remove the system filter from inside the system. |
| D4 | Clean the glass panels of the reflectors, the reading unit and/or the camera | 5 min | - Soft cloth<br>- Window type cleaner<br>- Scraper | Wait until it cools down |
| D5 | Perform the halogen brightness test | 2 min | ceramic plate | |

The daily cleaning kit should include, glass cleaner, disposable soft cloths, a scraper equipped with a razor blade to remove any baked residue from the glass. The scraper will also be used to clean the air nozzles so they are free of debris and maintain their ejection pattern.

A basic cleaning of the reflector lens after lunch demonstrated the loss efficiency of the system. During the morning inspection the optical system made an average of 53,136 ejection with a maximum performance of 84,629.

In comparison, in the afternoon after minimal cleaning the optical system ejected an average of 117,208 with a maximum of 140,845. This is an improvement of 120% in performance or the equivalent of up to three sorters if we use an average of six ejections per item. In other words, the operator can have three full time operators at a cost of $90,000 per year to keep up or one person can spend 18 minutes per day to make sure the system is performing as intended.

Furthermore, these machines are highly advanced and only an expert trained in their operation can effectively make sure it is operating in top condition. As such, it is highly recommended that EWSWA seriously consider purchasing a maintenance program with the manufacturer including remote support. The machines are sensitive to environmental conditions and as such their performance will be affected by temperature changes. Since the Container MRF is not tempered, each seasonal change will affect the calibration of the equipment and its performance. Quite often a simple re-alignment needs to be performed to increase the performance of the machine. It can be done online in about five minutes or an expert can be dispatched over the course of a couple days a cost of about $5,000 per visit.

### *3.4.2 Suggested Expert Preventative Maintenance Plan*

The Preventative Maintenance program should include these items a minimum of twice per year.

1. Peripheral equipment inspection

- Compressed air network for leak and pressure drop
- Manometer, filter-regulator, purge nozzle, rotation encoder, air cooling unit

2. Acquisition system

- Inspection and adjustment : Diode offset, reference line, mirror synchronization, biplexor synchronization, scanner focal
- Cleaning and inspection : Scanner mirrors, return mirror, lens, glasses (inside out)
- Inspection and tightening of electrical connection

3. Ejection components

- Inspection of nozzle operation
- Adjustment of nozzle bar geometries
- Mechanical inspection of nozzle bar (air leak, bolts tightening)

4. Electrical cabinet

- Cleaning of electronic card, filter, and inside cabinet
- Inspection and tightening of electrical connection
- Hard drive defragmentation and checkdisk

5. Equipment operation & follow-up

- Inspection of optical sorter event log
- Material recognition test
- Software update if necessary and applicable
- Backup on customer computer

### 3.4.3 Suggested Remote Inspection Plan

The remote inspection option should cover the following options as needed.

1. Acquisition system

- Inspection: Diode offset, reference line, mirror synchronization, biplexor synchronization

2. Ejection components

- Inspection of nozzle operation

3. Equipment operation & follow-up

- Inspection of optical sorter event log
- Material recognition test
- Software update if necessary and applicable
- Backup on customer computer

### 3.4.4 Maintenance Program

The MRF operator should ensure that the processing equipment is in good working condition at all times.

The MRF operator should:

1. Perform scheduled maintenance, inspect, clean, adjust, lubricate, sharpen, repair or replace parts and otherwise maintain the processing equipment in accordance with manufacturers' recommendations or warranty requirements, contract performance requirements, and any required insurance.
2. Properly maintain processing equipment to ensure reliability during each operating day.
3. Perform preventive maintenance outside of normal working hours, and maintain an adequate stock of tools and spare parts at the MRF.
4. Keep detailed records of maintenance, breakdowns, for each piece of equipment.

The Authority has recently instituted a new maintenance program it expects will improve the current operations' efficiency. This program, if successful, is likely to increase the life of the assets but may have little impact of the operation efficiency. Operational efficiency will be achieved if the daily maintenance is done to ensure equipment performance and minimal downtime. Some basic tools will have to be made available to the staff along with the training to go with it. Similarly, the rollers will not get cleaned unless the people responsible have better access to all the rollers. This may necessitate the purchase a snorkel lift.

### 3.5 Adequate Staffing

Section 3.10 identifies the minimum requirements for staffing. A plant manager is shared between the two facilities. The Container MRF is requirement to maintain two equipment operators (one baler/forklift, and one skid steer operator). During the visit there appeared to be only one operator performing both functions.

The contractor is required to maintain a complement of seven sorters on the processing line with the Authority paying for any additional staff required beyond the manufacturer's recommendation. The facility is currently operating with nine sorters on the processing line. Each additional sorter costs the Authority approximately $30,000 per year.

The facility currently utilizes nine sorters in a facility designed to accommodate as many as 18. The current complement is used as follows:

| Position | Location | Picks/hr | Notes |
|---|---|---|---|
| **1** | Pre-Sort North 1 | 1,080 | Primarily Large Plastic |
| **2** | Pre-South South 1 | 1,200 | Primarily Waste |
| **3** | Glass QC 1 | 4,680 | Primarily Flint Glass |
| **4** | HDPE QC | 1,740 | UBC and Tubs left hand |
| **5** | PET QC | 2,440 | PET Trays Right hand sort |
| **6** | PET/HDPE Sort | 2,790 | |
| **7** | Mixed Plastic/Polycoat | 4,300 | |
| **8** | Fibres/Mixed Plastic Sort | 4,970 | |
| **9** | UBC QC | 3,310 | Primarily Beer Cans |

The normal sustainable productivity rates are approximately 3,000 picks per hour or 1,500 per hand. The productivity rates listed are based on short 30 seconds samples where employees were aware of the monitoring thus reflecting in the elevated values in some cases.

Position 1 and 2 at the presort were being under utilized for a number of reasons. The current materials targeted at presort can be handled by one person. The two positions faced each other resulting in conflicts at times where both sorter were reaching for the same items on the belt. The belt is too narrow to have two sorters facing each other. If two position are maintained, they should be scattered. Furthermore, the speed of C3 should be increased to spread the materials further on the belt and facilitate the removal of targeted materials. Currently, the burden depth is too deep requiring the sorter to dig in the material or to activate the pause on the pull cord. As a result, C3 is not running 16% of the time causing flow irregularities throughout the system.

If the pause is still needed after the suggested adjustments, considerations should be given to use a pedal pause activated by foot thereby enabling the sorter(s) to continue to use both hands during a pause.

Position 4 and 5 at the post optical QC stations could be better utilized if their positions were adjusted to permit a drop on each side, hence using both hands. They may be leading to the same takeaway conveyor. The current chute should have back splash on the north side and a partial backsplash on the east (PET) and west (HDPE) side to prevent overshoots that end up on the floor or worst on the baling conveyor contaminating the material.

Position 6 may not be necessary if maintenance was increased on the optical system.

### 3.6 Past Optical Sorter Audit results

A number of optical sorter tests were conducted in the past with mixed results in the efficiency and effectiveness of the equipment. When the equipment was commissioned, it demonstrated its capability to capture 97.4% of the PET containers with an upward ejection with a purity rate of 93.6%. The HDPE, which is using a downward ejection, was measured to have a 92.0% efficiency and effectiveness rate.

**Table 3.6 – Actual Recovery Rates**

| | Startup | | Average | |
|---|---|---|---|---|
| | PET | HDPE | PET | HDPE |
| **Efficiency (Capture Rate)** | 97.4% | 92.0% | 92.9% | 82.8% |
| **Effectiveness (Purity Rate)** | 93.6% | 92.0% | 91.0% | 81.1% |

This performance has not been duplicated since. This is not surprising as the machine is in its optimal condition at startup and the experts are usually on site to make sure it is fully optimized. In general, the technology is expected to perform in the mid 90's range for an upward ejection and in the mid 80's range for a downward ejection.

The study identified that performance in general was better in the morning than in the afternoon except when Machinex's expert was on site. The site visit concurred with the findings of the study that there may be maintenance issues with the optical system which may lead to declining performance as the day progresses. The decline may also be the result of conditions within the plant.

### 3.7 Process Flow

The process flow of the current system was reviewed and reproduced as a flow chart in Appendix A. This Container MRF can be defined as a hybrid MRF using current technology and manual sorting to achieve its sorting objectives.

## 4.0 Residue Management

In theory, material recovery facilities should have no residue since they are designed to receive and process clean recyclables only. Unfortunately, the reality is that every material recovery facility generates some kind of residue.

A review of the past residue audits revealed that up to 22% of the materials delivered to the Container MRF is disposed of as residue and 55% of the disposed materials is actually waste while the remaining 45% is improperly sorted materials.

Three residue audits have been conducted at different times, each with similar results. As such, the average residue composition from these audits has been used to determine what the overall residue composition may look like.

**Table 4.0 – Summary of Residue Composition Audits**

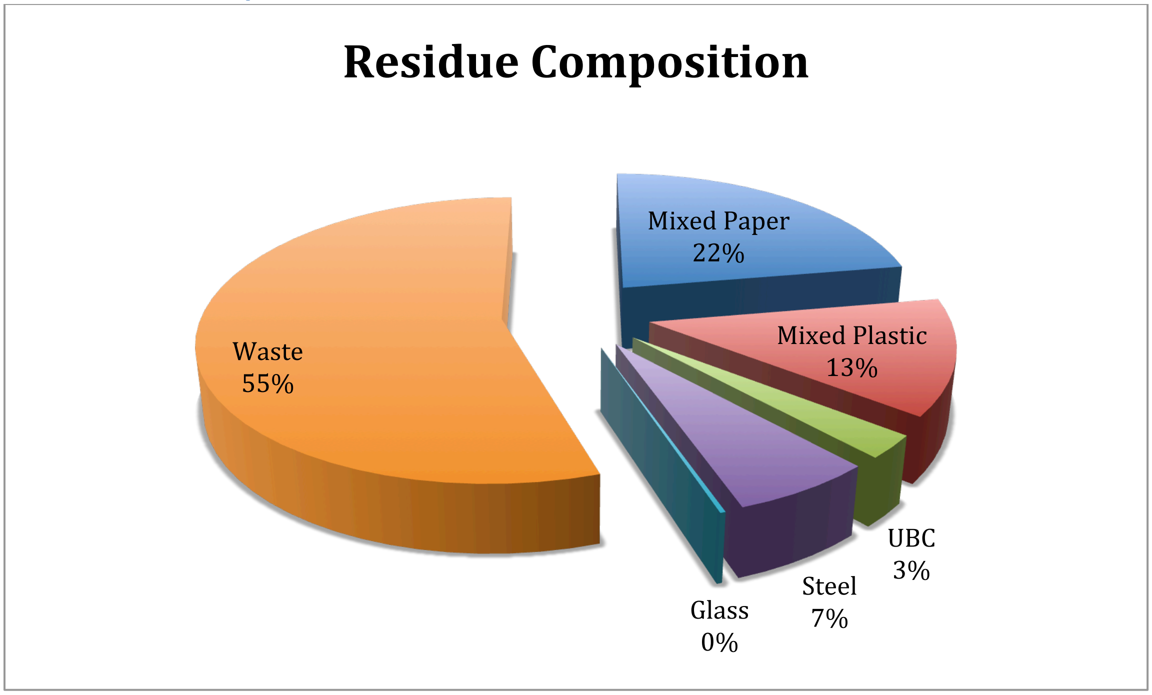
| Material | 2-Feb-09<br>kg | 28-Feb-11<br>AM<br>kg | 28-Feb-11<br>PM<br>kg | Total | % | Projected |
|---|---|---|---|---|---|---|
| Mixed Fibre | 16.40 | 18.50 | 24.50 | 59.40 | 20.3% | 263.66 |
| Polycoat | 3.52 | 1 | 1.5 | 6.02 | 2.1% | 26.72 |
| Aluminum | 2.71 | 1 | 4 | 7.71 | 2.6% | 34.22 |
| Ferrous (steel) | 7.63 | 1.5 | 10 | 19.13 | 6.5% | 84.91 |
| PET | 3.90 | 2 | 4.5 | 10.40 | 3.6% | 46.16 |
| HDPE | 2.13 | 1 | 3 | 6.13 | 2.1% | 27.21 |
| Tubs and Lids | 2.72 | 0.5 | 2.5 | 5.72 | 2.0% | 25.39 |
| PET Trays | 2.50 | 5 | 3 | 10.50 | 3.6% | 46.61 |
| Rigid plastic | 0.20 | 0 | 5.5 | 5.70 | 1.9% | 25.30 |
| Flint Glass | 0.00 | 0 | 0.5 | 0.50 | 0.2% | 2.22 |
| Mixed Glass | 0.24 | 0 | 0 | 0.24 | 0.1% | 1.07 |
| Residue | 62.15 | 14 | 71 | 147.15 | 50.3% | 653.16 |
| Film - HDPE | | 6 | 3.5 | 9.50 | 3.2% | 42.17 |
| Misc. Metal | 0.23 | 1.5 | 3 | 4.73 | 1.6% | 21.00 |
| **Totals** | **104.33** | **52** | **136.5** | **292.83** | **100%** | **1299.79** |

### 4.1 Expected Residue Rate

Analysis of blue box data collected from Ontario's municipal recycling program between 2007 and 2009 revealed an average residue rate of 7% in two stream and 14% in single stream programs. The EWSWA combined facilities generate approximately 10% in residue which is higher than average. The Container facility actually generates nearly 22% in residue.

This residue included both production losses (recyclables lost during processing) and unsolicited contamination (non-recyclable materials, contaminated recyclables and recyclables not solicited in a program). While production losses and contamination levels can vary significantly between programs, it is not uncommon for them to be close to equal to each other proportionally in some programs. This proportion was similar in the container MRF where 55% of the residue was deemed to be waste or 12% of the incoming materials.

## 4.2 Residue Composition




## 4.3 Factors Affecting Residue Generation

Analysis of the unsolicited contamination in the residue stream is a worthwhile exercise for MRF operators and promotion and education staff. Clues to sorter performance and curbside performance issues are often readily apparent in the MRF residue. Whether it's the presence of bagged recyclables in a non–bagged based program, newspapers in plastic sleeves from rural routes or shrink wrapped cardboard from cases of water and pop bottles, they are issues that can easily be resolved with minimal supplementary communications to residents and can take recyclables otherwise destined for landfill and redirect them back towards a municipality's diversion goals.

Several factors can contribute to higher than expected residue rates:

### *4.3.1 Generator Factors*

1. Lack of storage capacity
2. Inadequate promotion and education program
3. Conflicting waste management policies
4. Inadequate collection frequency to meet needs
5. Economic incentive to contaminate

#### *4.3.2 Collector Factors*

1. Improper curbside sorting
2. Lack of trained staff and/or use of temporary workers
3. Clean street policy
4. Possible collection weight incentives
5. Overcompaction on the vehicles
6. Lack of collection fleet capacity
7. Improper volume distribution on the collection vehicle

#### *4.3.3 Processor Factors*

1. Lack of receiving inspections
2. Overburdened conveyors
3. Possible system design conducive to residue generation
4. Lack of residue QC
5. Conflicting interests of collection vs processing contractors
6. Lack of trained staff and/or use of temporary workers

### 4.4 Initial Areas of Focus to Reduce Residue

Currently, 12% of the material delivered at the MRF is materials that does not belong in the load to begin with and another 5% is fibres that are in the wrong compartment. It is critical to address this 17% prior to dealing with the last 5% that is simply misorted.

Let's look at the source. EWSWA uses a long established two stream two box collection system on a biweekly basis. The system is very efficient from a collection perspective but some undesirable effects usually result. Because fibres and containers are presorted by the residents, the collectors typically gets careless in their inspection procedures simply emptying the contents from each bin into the respective compartment in each truck without inspecting. This negates any sort of education program EWSWA may have had with the residents as it is expected from the resident's perspective that any material placed in the box that is collected must be recyclable. Only rejected materials are not recyclable.

Secondly, when the blue box program was launched over 20 years ago a single box was sufficient to "introduce" the concept of recycling to the residents with a menu of five items to be collected. As recycling became mainstream additional capacity was required to keep up with the growing list of recyclable materials. The Authority chose to go with a second box at the time (late 90's). Today, the materials accepted exceed the capacity of the two boxes, which creates some dilemma for the residents. They can buy more containers or stuff what they have in the space available. This leads to unwanted cross-contamination the likes of what is experienced in the Container MRF.

Thirdly, some collectors find that when they run out of room in one compartment, they simply empty all the recyclables in the remaining compartment with capacity especially when there are no consequences or penalties and they can squeeze the remainder of their route on.

### 4.4.1 Inspection and Rejection Protocol

An inspection and rejection protocol should be adopted to eliminate any chronic contamination problems with certain haulers. The Authority should reserves the right to reject any materials not meeting the delivery requirements as outlined below:

1. Without the interference of any excessive compaction (max 2:1)
2. Loose, (ie not bag based program) not contained in bags or tied together with the exception of shredded paper.
3. Without excessive contamination (less than 5%)
4. Without excessive moisture (less than 5%)

A sample Inspection and Rejection Protocol had been provided in Appendix C.

Having an inspection protocol, should improve the quality of materials received, reduce the amount of non-recyclable materials received. It provides a channel to deal with repeat offenders. It will also lead to the identification of sites that are contributing to the problem. These sites may be ICI locations or multi residential buildings where the caretaker is not paying attention to the problem or where the number of containers used is inadequate.

Routes may also be imbalanced causing the fibre overflow.

Once the material delivered to the facility is acceptable by the Authority's standards, the focus will be able to switch to changes in the material handling inside the MRF.

### 4.4.2 Eddy Current

Currently, over $54,000 annually of aluminum containers is missed on the processing line and sent to the residue compactor for disposal.

The eddy current was commissioned with an efficiency rate of 97.6% which is expected from this technology. The rate has since dropped to 90.5% and appears to remain at this level. A number of factors could affect the performance.

1) A dirty belt increases the distance between the magnetic field and the containers targeted resulting in a lower recovery. The belt should be cleaned, scrapped, or replaced on a regular basis.
2) Flattened containers have a smaller surface to which the magnetic field can apply the force necessary to eject them. This could be from the type of education given to the homeowners, type of trucks used, or improperly adjusted perforator.
3) The split divider may have been moved to increase the purity of the aluminum stream in hopes to saves a sorter. Since a sorter is being used to clean the aluminum, the divider should be moved to increase the capture rate since 10% of the aluminum is currently ending up in the residue.
4) Full or frozen containers are too heavy to "fly" over the divider. These will usually be more prevalent in the winter season.

The eddy current should be located earlier in the process to ease the burden on the belt and provide the sorter with the ability to recover this very valuable commodity. One option is to place the old eddy current in line immediately after the optical sorter at either the C20-C21 junction or the C21-C22 junction. Any missed aluminum should be recovered by the sorters in the mezzanine and placed into rubbermaid garbage cans for transfer. This would also provide an opportunity to recover the missing steel that amounts to over $22,000 annually since the eddy current also acts as a magnet.

Alternatively, a sorter could be placed on the residue conveyor preceding the compactor and recover the aluminum and any other recyclables missed in the first sort.

The sorter currently used in position 9 is primarily focused on the recovery of deposit containers. Perhaps the extra handling associated with this activity is justified by the additional revenue received otherwise they should be relocated to the residue line.

#### 4.4.3 Optical System

An optical system relies on advanced technology that requires specialized maintenance beyond what millwright or electrician can provide. Such expertise is only found with factory authorized technicians. Since it can be expensive to bring these experts on site because of the travel expenses and time commitment, it is best to have alternatives in place. There are three things that operators should do to optimize the value of their investment.

1) A remote connection to the machine should be available at all times to enable the factory trained experts to remotely troubleshoot the machine and make the necessary adjustments.
2) Preventative Maintenance should be performed daily with the right tools to maximize the use of the optical machine. An expert should inspect the machine at least twice a year with the potential for four visits annually.
3) The operator should be knowledgeable of the basic principles used by the technology understanding the impact of temperature, cleanliness and vision in its performance. As such, they should be able to identify when an alignment may be necessary.

#### 4.4.4 Ergonomics

Ergonomic design consists of providing working stations that accommodate or work in conjunction with the natural body movements. This means providing adjustable height working stations with acceptable limits for reaching, lifting, bending, twisting, etc. This usually means that tasks are rotated from one employee to another to maintain interest and use varied parts of the body.

Good working conditions include a warm, well lit, dust free environment backed by a training program that clearly identifies everyone's responsibility in a pleasant atmosphere. Motivated and trained employees are more productive and have fewer accidents resulting in lower compensation costs.

Each workstation was designed with crude adjustable working height to minimize musculoskeletal injuries such as tendinitis and lower back pain from a poor working position but some of the staff did no appear to know the proper height adjustment needed to be effective. Training should be provided to the staff.

Backsplashes should be installed on chutes where needed.

The MRF operator may want to consider providing all employees nytrile gloves to provide them with maximum protection, dexterity, and maneuverability.

#### *4.4.5 Methodology*

The current system process flow is one where the default is residue. In other words, any material on the line that is not positively removed by a process or material handler will be delivered to residue at the end of the system. This is a common layout in facilities where a high level of contamination is expected and commodity quality is very important, however, in this system, there is no reason for the contamination levels to be so elevated. Contaminants should be minimal if managed accordingly.

If contaminants are minimal, the system could then be managed differently where all the materials coming off the end of the line could actually be a commodity that is negatively sorted and contaminants are actually positively picked because they are a minority. This option is discussed in the next sections.

# 5.0 Adding Mixed Plastics

## 5.1 Background

The Authority is interested to add mixed plastics to the material list as a result of pressure from the general public. Mixed plastics are still an experimental grade of material with highly volatile markets subject to change without notice. Some recent development in the Ontario marketplace have seen at least two buyers with long term history in the business open their doors to receive this type of material.

## 5.2 Other Considerations

The projections presented in this section are made based on typical sorting rates achievable under normal working conditions.

Manual labour is used in processing facilities to do everything from loading to sorting to baling to shipping and accounts for approximately half of the processing costs. Therefore, it is extremely important to monitor labour costs and their efficiency. The efficiency of the labour force is typically measured in kg processed per staff hour and in most facilities, there is an opportunity to increase the efficiency of manual labour through ergonomic design, or improving working conditions.

Another important productivity factor is the provision of consistent material flow as well as material regulation to maintain a good mix of different types of items to keep all sorters consistently busy. You can have equipment designed to handle 3 tonnes per hour, however, if it is not being "fed" consistently and evenly, it will not achieve its design capacity.

## 5.3 Quantifying Available Mixed Plastics

In order to project the potential amount of material available if Mixed Plastics were added to the recycling program, we refer to the numerous waste composition audits Waste Diversion Ontario has done across the Province.

In this case, the average generation found in programs with more than 500,000 population is compared with the current program recovery to determine available recyclables. Some assumptions on recovery have been made based on experiences from operators. As such, up to 80% of the available PET and HDPE are expected to be recovered. Tubs and Lids are expected to be captured at a 50% rate while the remaining less traditional packaging is expected to hit a 30% success rate.

The end result outlined in table 5.3 is that approximately 7.91 kg/hhld/yr is expected to be recovered. This would result in an increase of 1,214.41 tonnes of mixed plastics added to the existing tubs and lids.

Our experience has been that the amount of mixed plastic collected is usually closer to the same amount as HDPE collected. In this case, a more reasonable conservative number would be 520 tonnes. This lower number is usually the result of the limited capacity of the recycling containers.

**Table 5.3 - Available Mixed Plastics**

| kg/hhld/yr | WDO | Mixed Recyclable | Current | Available | Projected New |
|---|---|---|---|---|---|
| PET | 8.27 | 8.27 | 5.98 | 2.29 | 1.83 |
| HDPE | 6.67 | 6.67 | 3.38 | 3.29 | 2.63 |
| PVC | 0.76 | 0.76 | | 0.76 | 0.23 |
| LDPE and PP | 3.71 | 3.71 | | 3.71 | 1.11 |
| PS | 5.63 | | | - | - |
| Recyclable Film | 8.61 | | | - | - |
| Non-Recyclable Film | 14.27 | | | - | - |
| Tubs & Lids | 2.67 | 2.67 | 1.01 | 1.66 | 1.34 |
| Other Containers | 2.56 | 2.56 | | 2.56 | 0.77 |
| Other Plastics | 15.59 | | | - | - |
| **Totals** | **68.74** | **24.64** | **10.37** | **14.27** | **7.91** |

## 5.4 Current Baseline Data

The assumption is made that the recommendations made in this report with regards to efficiency and residue will be adopted in general. As such, a reduction in the amount of non recyclable materials is expected to drop by 66% and similarly, cross contamination from mixed fibres is expected to drop by a similar amount. For the purpose of this exercise it is assumed that 520 tonnes of mixed rigid plastic containers will be delivered to the facility for processing.

**Table 5.4.1 - Material Distribution from Projected Essex-Windsor Recycling Program**

| Material | Tonnes Processed | kg/hhld/yr | Per Cent Composition | Density of Material (pre-sorting) (kg/m3) | Estimated Average Weight Per Piece (g) | Estimated Average Volume Per Piece (cm3) | Quantity of Material Per Year (m3) | Required Sorting Throughput: Weight Per Week (kilograms) | Weight Per Shift-hr (kilograms) | Pieces Per Week (pieces) | Pieces Per Shift-hr (pieces) | Volume Per Week (m3) | Net Pieces Per Shift-hr (pieces) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed Fibres | 100 | 0.6 | 1.7% | 200 | 150 | 750 | 498 | 1,917 | 48 | 12,778 | 319 | 9.6 | 319 |
| Polycoat/Aseptic | 86 | 0.6 | 1.4% | 250 | 50 | 200 | 343 | 1,648 | 41 | 32,969 | 824 | 6.6 | 824 |
| Aluminum | 376 | 2.5 | 6.3% | 70 | 35 | 500 | 5,375 | 7,235 | 181 | 206,714 | 5,168 | 103.4 | 5,168 |
| Ferrous (steel) | 1,011 | 6.6 | 17.0% | 140 | 50 | 357 | 7,221 | 19,441 | 486 | 388,812 | 9,720 | 138.9 | 9,720 |
| PET | 918 | 6.0 | 15.5% | 60 | 60 | 1,000 | 15,303 | 17,657 | 441 | 294,282 | 7,357 | 294.3 | 7,357 |
| HDPE | 519 | 3.4 | 8.8% | 60 | 80 | 1,333 | 8,654 | 9,985 | 250 | 124,810 | 3,120 | 166.4 | 3,120 |
| Mixed Plastic | 520 | 3.4 | 8.8% | 25 | 30 | 1,200 | 20,800 | 10,000 | 250 | 333,333 | 8,333 | 400.0 | 8,333 |
| Film - HDPE | 42 | 0.3 | 0.7% | 10 | 15 | 1,500 | 4,217 | 811 | 20 | 54,064 | 1,352 | 81.1 | 1,352 |
| Flint Glass | 295 | 1.9 | 5.0% | 330 | 145 | 439 | 895 | 5,677 | 142 | 39,154 | 979 | 17.2 | 979 |
| Mixed Glass | 1,561 | 10.2 | 26.3% | 330 | 145 | 439 | 4,731 | 30,021 | 751 | 207,038 | 5,176 | 91.0 | 0 |
| Residue | 229 | 1.5 | 3.9% | 100 | 70 | 700 | 2,292 | 4,408 | 110 | 62,971 | 1,574 | 44.1 | 1,574 |
| **Summary Totals** | **5,658** | **36.85** | **95%** | **1,575** | **830** | **8,419** | **70,327** | **108,799** | **2,720** | **1,756,926** | **43,923** | **1,352** | **38,747** |

**Assumptions**

| | | | | | |
|---|---|---|---|---|---|
| Year of Review: | 2010 | | | | |
| Population Served: | 609,875 | Processing Shifts | 5 | Residue reduction | 66% |
| Households Served: | 153,529 | Operating days/yr | 250 | Cross-contamination reduction | 66% |
| Tonnes/yr all material | 5,930 | Operating hrs/day | 8 | Mixed Plastic | 520.00 |
| Tonnes/operating hr | 2.97 | Annual operating hours | 2,000 | | |

In the current operation, two sorters are utilized in the presort area to remove large plastic and residue. These sorters are not used to their maximum potential and the burden depth is too high to be effective. One sorter is used in the glass area to recover clear glass and some LCBO deposit containers. Minimal activity is actually spent on non glass containers and residue. While the sorter is busy, the value of the clear glass recovered ($7,381) makes this position questionable unless significant LCBO revenue can be attributed to this position. Two sorters are used after the optical system for quality control. Non bottle materials need to be removed from both the PET and HDPE streams sorted by the optical system. The PET position is busier than the HDPE position and the work to be performed could be significantly different if the optical was maintained properly. In the enclosed sorting mezzanine three sorters are used to sort three pairs of materials; PET and HDPE, HDPE and Polycoat, and Fibres and Tubs and Lids. One more sorter is used on the eddy current for quality control but most of the work is in fact the recovery of deposit eligible beer cans. We are unaware of the value in beer cans recovered with this position. However, over $54,000 worth of aluminum is being missed by the eddy current that could relatively be easily recovered off the residue line. One sorter on that line would most definitely pay for themselves.

This approach generates quality end products as most commodities are positively separated, however, the default is that any missed materials are automatically directed to residue which has the potential to result in high residue levels. Residue levels are primarily dependent on the performance of the manual sorters.

The current process can be summarized as follows.

**Table 5.4.2 - Current Baseline Sorting Model**

| Materials | Tonnes/yr | Kg/hr | Machine (kg/hr) | $/tonne | Revenue | Rest (kg/hr) | $Cdn/tonne | Revenue Remaining | Sort Rate QC (kg/hr) | QC Sorters | Sorters | Missed Revenue | Incurred Disposal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed Fibres | 293 | 146.6 | | 62 | 0 | 147 | 62 | 18,175 | 450 | 0.3 | 0.5 | 16,339 | 30,146 |
| Polycoat/Aseptic | 86 | 42.9 | | 105 | 0 | 43 | 105 | 9,001 | 150 | 0.3 | 0.5 | 2,808 | 3,059 |
| Aluminum | 376 | 188.1 | 171.0 | 1,591 | 544,097 | 17 | 1,591 | 54,470 | 105 | 0.2 | 1.0 | 54,470 | 3,916 |
| Ferrous (steel) | 1,011 | 505.5 | 463.0 | 264 | 244,462 | 42 | 264 | 22,418 | | | | 22,418 | 9,714 |
| PET | 918 | 459.1 | 426.5 | 391 | 333,512 | 33 | 391 | 25,489 | 180 | 0.2 | 1.5 | 16,676 | 4,879 |
| HDPE | 519 | 259.6 | 215.0 | 465 | 199,906 | 45 | 465 | 41,526 | 240 | 0.2 | 1.5 | 10,395 | 2,557 |
| Tubs and Lids | 154 | 77.2 | | 54 | 0 | 77 | 54 | 8,332 | 90 | 0.9 | 0.5 | 5,258 | 11,137 |
| Film - HDPE | 42 | 21.1 | | 13 | 0 | 21 | 13 | 548 | 45 | 0.5 | | 548 | 4,824 |
| Flint Glass | 295 | 147.6 | | 25 | 0 | 148 | 25 | 7,381 | 435 | 0.3 | 0.5 | 59 | 270 |
| Mixed Glass | 1,561 | 780.5 | 780.5 | (15) | (23,416) | 0 | (15) | 0 | 435 | 0.0 | | 0 | 0 |
| Residue | 674 | 337.1 | 337.1 | (114) | (77,117) | 0 | (114) | 0 | 210 | 0.0 | 2.5 | 0 | 77,117 |
| **Total** | **5,930** | **2,965.1** | | | **1,221,443** | **572** | | **187,339** | | | **9** | **128,970** | **147,619** |

**Assumptions**

| | | | | | | |
|---|---|---|---|---|---|---|
| Year of Review: | 2010 | Commodity Pices | CSR Price Sheet | Machine | Efficiency | Efficiency |
| Population Served: | 609,875 | Processing Shifts | 5 | Magnet | 91.6% | 98.0% |
| Households Served: | 153,529 | Operating days/yr | 250 | Eddy Current | 90.9% | 98.0% |
| Tonnes/yr all material | 5,930 | Operating hrs/day | 8 | Optical Up | 92.9% | 91.0% |
| Tonnes/operating hr | 2.97 | Annual operating hours | 2,000 | Optical Down | 82.8% | 81.1% |

## 5.5 Option 1 – Status Quo with Mixed Plastics

The first option to add mixed plastic containers is to use the system as intended by the manufacturer at the moment of conception. This is the closest option to the current operations.

In this option, two sorters are utilized in the presort area in a scattered array to remove large plastic and residue, and fibres and residue on a belt that has been sped to lower the burden depth. Foot controls are also assumed to have been implemented. One sorter is used in the glass area to recover clear glass and some LCBO deposit containers as in the current system. Two sorters are used after the optical system for quality control. Non bottle materials need to be removed from both the PET and HDPE streams sorted by the optical system. In the enclosed sorting mezzanine three sorters are used to sort. PET and HDPE bottles will no longer be sorted at this point. Instead, all mixed plastics will be recovered by two full time sorters. Depending on the volumes received they may not recover all available mixed plastics. The third sorter will concentrate on the polycoat and any remaining fibres not already removed by the presort. One more sorter is used on the residue line (likely C29) to recover missed aluminum and any other recyclables they can handle.

This approach generates quality end products as most commodities are positively separated, however, the default is that any missed materials are automatically directed to residue which has the potential to result in high residue levels. Residue levels are primarily dependent on the performance of the manual sorters.

The current process can be summarized as follows.

**Table 5.5 -Status Quo with Improvements Sorting Model**

| Materials | Tonnes/yr | Kg/hr | Machine (kg/hr) | $/tonne | Revenue | Rest (kg/hr) | $Cdn/tonne | Revenue Remaining | Sort Rate QC (kg/hr) | QC Sorters | Sorters | Missed Revenue | Incurred Disposal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed Fibres | 100 | 49.8 | | 62 | 0 | 50 | 62 | 6,179 | 450 | 0.1 | 1.0 | 618 | 1,140 |
| Polycoat/Aseptic | 86 | 42.9 | | 105 | 0 | 43 | 105 | 9,001 | 150 | 0.3 | 0.5 | 900 | 981 |
| Aluminum | 376 | 188.1 | 176.8 | 1,591 | 562,652 | 11 | 1,591 | 35,914 | 105 | 0.1 | 1.0 | 3,591 | 258 |
| Ferrous (steel) | 1,011 | 505.5 | 475.1 | 264 | 250,867 | 30 | 264 | 16,013 | | | | 1,601 | 694 |
| PET | 918 | 459.1 | 436.1 | 391 | 341,051 | 23 | 54 | 2,479 | 180 | 0.1 | 1.0 | 248 | 525 |
| HDPE | 519 | 259.6 | 220.7 | 465 | 205,218 | 39 | 54 | 4,206 | 240 | 0.2 | 1.0 | 421 | 891 |
| Tubs and Lids | 520 | 260.0 | | 54 | 0 | 260 | 54 | 28,080 | 90 | 2.9 | 2.5 | 8,424 | 17,845 |
| Film - HDPE | 42 | 21.1 | | 13 | 0 | 21 | 13 | 548 | 45 | 0.5 | | 548 | 4,824 |
| Flint Glass | 295 | 147.6 | | 25 | 0 | 148 | 25 | 7,381 | 435 | 0.3 | 1.0 | 59 | 270 |
| Mixed Glass | 1,561 | 780.5 | 780.5 | (15) | (23,416) | 0 | (15) | 0 | 435 | 0.0 | | 0 | 0 |
| Residue | 229 | 114.6 | 114.6 | (114) | (26,220) | 0 | (114) | 0 | 210 | 0.0 | 2.0 | 0 | 26,220 |
| **Total** | **5,658** | **2,828.8** | | | **1,310,152** | **625** | | **109,800** | | | **10** | **16,410** | **53,647** |

**Assumptions**

| | | | | Machine | Efficiency | Efficiency |
|---|---|---|---|---|---|---|
| Year of Review: | 2010 | Commodity Pices | CSR Price Sheet | | | |
| Population Served: | 609,875 | Processing Shifts | 5 | Magnet | 94.0% | 98.0% |
| Households Served: | 153,529 | Operating days/yr | 250 | Eddy Current | 94.0% | 98.0% |
| Tonnes/yr all material | 5,658 | Operating hrs/day | 8 | Optical Up | 95.0% | 95.0% |
| Tonnes/operating hr | 2.83 | Annual operating hours | 2,000 | Optical Down | 85.0% | 85.0% |

## 5.6 Option 2 – Optical Sorter Option

The second option to add mixed plastic containers is to use the existing technology as much as possible and minimize manual labour requirements. This is the furthest option to the current operations.

In this option, two sorters are utilized in the presort area in a scattered array to remove large plastic and residue, and fibres and residue on a belt that has been sped to lower the burden depth. Foot controls are also assumed to have been implemented. No changes to the glass sort area. The optical system would be used to separate #1 PET in an up ejection and #2-7 plastics in a down ejection. Two sorters are used after the optical system for quality control. Non bottle materials need to be removed from the PET and placed across onto the mixed plastic line and non plastic contaminants need to be redirected on the line. Since the PET QC will be sending mixed plastic in front of them, it would be preferable to move the mixed plastic QC station to the north side of the chute . A backsplash can be installed in front of the former station. In the enclosed sorting mezzanine two sorters are used to sort three materials; the first will sort mixed plastics, while the second will sort the Polycoat, and remaining Fibres. One more sorter is used on the residue line (likely C29) to recover missed aluminum and any other recyclables they can handle.

This approach generates quality end products as most commodities are positively separated by equipment, however, the default is that any missed materials are automatically directed to residue which has the potential to result in high residue levels if they equipment is not maintained properly. HDPE materials are devalued to mixed plastic values which is a substantial drop in revenue when oil prices are high. Residue levels are primarily dependent on the performance of the equipment.

The current process can be summarized as follows.

**Table 5.6 - Optical Sorting Model**

| Materials | Tonnes/yr | Kg/hr | Machine (kg/hr) | $/tonne | Revenue | Rest (kg/hr) | $Cdn/tonne | Revenue Remaining | Sort Rate QC (kg/hr) | QC Sorters | Sorters | Missed Revenue | Incurred Disposal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed Fibres | 100 | 49.8 | | 62 | 0 | 50 | 62 | 6,179 | 450 | 0.1 | 0.8 | 5,555 | 10,249 |
| Polycoat/Aseptic | 86 | 42.9 | | 105 | 0 | 43 | 105 | 9,001 | 150 | 0.3 | 0.3 | 2,808 | 3,059 |
| Aluminum | 376 | 188.1 | 176.8 | 1,591 | 562,652 | 11 | 1,591 | 35,914 | 105 | 0.1 | 1.3 | 3,591 | 258 |
| Ferrous (steel) | 1,011 | 505.5 | 475.1 | 264 | 250,867 | 30 | 264 | 16,013 | | | | 1,601 | 694 |
| PET | 918 | 459.1 | 436.1 | 391 | 341,051 | 23 | 54 | 2,479 | 180 | 0.1 | 1.0 | 248 | 525 |
| HDPE | 519 | 259.6 | 220.7 | 54 | 23,832 | 39 | 54 | 4,206 | 240 | 0.2 | 1.0 | 1,239 | 2,625 |
| Tubs and Lids | 520 | 260.0 | 221.0 | 54 | 23,868 | 39 | 54 | 4,212 | 90 | 0.4 | 1.5 | 2,658 | 5,630 |
| Film - HDPE | 42 | 21.1 | | 13 | 0 | 21 | 13 | 548 | 45 | 0.5 | | 548 | 4,824 |
| Flint Glass | 295 | 147.6 | | 25 | 0 | 148 | 25 | 7,381 | 435 | 0.3 | 1.0 | 59 | 270 |
| Mixed Glass | 1,561 | 780.5 | 780.5 | (15) | (23,416) | 0 | (15) | 0 | 435 | 0.0 | | 0 | 0 |
| Residue | 229 | 114.6 | | (114) | 0 | 115 | (114) | (26,220) | 210 | 0.5 | 2.0 | | 26,220 |
| **Total** | **5,658** | **2,828.8** | | | **1,178,854** | **519** | | **59,712** | | | **9** | **18,308** | **54,355** |

**Assumptions**

| | | | | | | |
|---|---|---|---|---|---|---|
| Year of Review: | 2010 | Commodity Pices | CSR Price Sheet | Machine | Efficiency | Efficiency |
| Population Served: | 609,875 | Processing Shifts | 5 | Magnet | 94.0% | 98.0% |
| Households Served: | 153,529 | Operating days/yr | 250 | Eddy Current | 94.0% | 98.0% |
| Tonnes/yr all material | 5,658 | Operating hrs/day | 8 | Optical Up | 95.0% | 95.0% |
| Tonnes/operating hr | 2.83 | Annual operating hours | 2,000 | Optical Down | 85.0% | 85.0% |

## 5.7 Option 3 – Negative Sort Option

The third option to add mixed plastic containers is to use modified manual approach.

In this option, two sorters are utilized in the presort area in a scattered array to remove fibres and large plastic, and large plastic and residue on a belt that has been sped to lower the burden depth. Large plastics are actually sent to the compactor with fibres and residue dropped in self dumping bins below. Foot controls are also assumed to have been implemented. No sorter would used in the glass area as all glass would be managed as mixed glass. Two sorters are used after the optical system for quality control. Non bottle materials need to be removed from both the PET and HDPE streams sorted by the optical system. It is recommended that the eddy current in storage at this time be installed at the C21-C22 transfer point with a pneumatic conveying system to the current UBC bunker. In the enclosed sorting mezzanine two sorters are used to sort. The first will sort the remaining fibres and aluminum missed by the eddy current, while the second will sort the Polycoat, and residue. Residue will be baled. All mixed plastics will remain on the belt to be negatively sorted and collect in the compactor. C31 from the AS9 will have to be diverted into the bunker below.

This approach generates quality end products as most commodities are positively separated, however, the default is that any missed materials are automatically directed to mixed plastics which is a low value commodity with some flexibility for contamination. Contamination and residue levels are primarily dependent on the performance of the manual sorters.

The current process can be summarized as follows.

**Table 5.7 - Negative Sorting Model**

| Materials | Tonnes/yr | Kg/hr | Machine (kg/hr) | $/tonne | Revenue | Rest (kg/hr) | $/tonne | Revenue Remaining | Sort Rate QC (kg/hr) | QC Sorters | Sorters | Missed Revenue | Incurred Disposal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed Fibres | 100 | 49.8 | | 62 | 0 | 50 | 62 | 6,179 | 450 | 0.1 | 0.5 | 5,555 | 10,249 |
| Polycoat/Aseptic | 86 | 42.9 | | 105 | 0 | 43 | 105 | 9,001 | 150 | 0.3 | 0.5 | 2,808 | 3,059 |
| Aluminum | 376 | 188.1 | 176.8 | 1,591 | 562,652 | 11 | 1,591 | 35,914 | 105 | 0.1 | 1.5 | 3,591 | 258 |
| Ferrous (steel) | 1,011 | 505.5 | 475.1 | 264 | 250,867 | 30 | 264 | 16,013 | | | | 1,601 | 694 |
| PET | 918 | 459.1 | 436.1 | 391 | 341,051 | 23 | 54 | 2,479 | 180 | 0.1 | 1.0 | 0 | 0 |
| HDPE | 519 | 259.6 | 220.7 | 465 | 205,218 | 39 | 54 | 4,206 | 240 | 0.2 | 1.0 | 0 | 0 |
| Tubs and Lids | 520 | 260.0 | | 54 | 0 | 260 | 54 | 28,080 | 90 | 2.9 | 1.0 | 0 | 0 |
| Film - HDPE | 42 | 21.1 | | 13 | 0 | 21 | 13 | 548 | 45 | 0.5 | | 548 | 4,824 |
| Flint Glass | 295 | 147.6 | | 25 | 0 | 148 | 25 | 7,381 | 435 | 0.3 | 1.0 | 59 | 270 |
| Mixed Glass | 1,561 | 780.5 | 780.5 | (15) | (23,416) | 0 | (15) | 0 | 435 | 0.0 | | 0 | 0 |
| Residue | 229 | 114.6 | | (114) | 0 | 115 | (114) | (26,220) | 210 | 0.5 | 1.0 | | 26,220 |
| **Total** | **5,658** | **2,828.8** | | | **1,336,372** | **740** | | **83,580** | | | **8** | **14,163** | **45,575** |

**Assumptions**

| | | | | | | |
|---|---|---|---|---|---|---|
| Year of Review: | 2010 | Commodity Pices | CSR Price Sheet | Machine | Efficiency | Efficiency |
| Population Served: | 609,875 | Processing Shifts | 5 | Magnet | 94.0% | 98.0% |
| Households Served: | 153,529 | Operating days/yr | 250 | Eddy Current | 94.0% | 98.0% |
| Tonnes/yr all material | 5,658 | Operating hrs/day | 8 | Optical Up | 95.0% | 95.0% |
| Tonnes/operating hr | 2.83 | Annual operating hours | 2,000 | Optical Down | 85.0% | 85.0% |

## 5.8 Comparative Summary of Options

**Table 5.8 - Selected Data Summary of Options Presented**

| Materials | Current | Option 1 Status Quo+ | Option 2 Optical | Option 3 Negative Sort |
|---|---|---|---|---|
| Tonnes Managed | 5,930 | 5,658 | 5,658 | 5,658 |
| Tonnes Disposed | 1,300 | 469 | 475 | 398 |
| **Tonnes Recovered** | **4,630** | **5,189** | **5,182** | **5,259** |
| Residue % | 21.9% | 8.3% | 8.4% | 7.0% |
| | | | | |
| **Labour Requirement** | | | | |
| Number of Sorters | 9 | 10 | 9 | 8 |
| | | | | |
| **Financials** | | | | |
| Commodity Revenue | $ 1,279,812 | $ 1,403,542 | $ 1,220,258 | $ 1,405,789 |
| Labour Cost | $ 270,000 | $ 300,000 | $ 269,979 | $ 225,000 |
| Disposal Cost | $ 148,670 | $ 53,643 | $ 54,350 | $ 45,571 |
| Additional Handling | $ - | $ - | $ - | $ 73,642 |
| **Net Revenue** | **$ 861,142** | **$ 1,049,899** | **$ 895,928** | **$ 1,061,576** |
| $/tonne | $ 186 | $ 202 | $ 173 | $ 202 |

# 6.0 Recommendations

## 6.1 Residue Management Recommendations

A review of the past residue audits revealed that up to 22% of the materials delivered to the Container MRF is disposed of as residue and 55% of the disposed materials is actually waste while the remaining 45% is improperly sorted materials. These recommendations are intended to reduce the amount of residue generated by the facility.

1. Review preventative maintenance program to ensure optimum performance of equipment.
2. Consider purchasing a maintenance program from manufacturer for specialized equipment such as the optical system.
3. Consider adding a remote access point to the optical for factory trained experts to make alignments as necessary to improve the performance of the optical separator through the seasons.
4. Maximize sorter efficiency by reconfiguring the presort area in a scattered pattern.
5. Consider adding foot controls to the presort area.
6. Increase the speed of C3 without increasing C1 and C2 to spread the load and enable better sorting.
7. Post optical positions should have chutes available for both hands and backsplashes should be added.
8. Implement an Inspection and Rejection Protocol at the MRF.
9. Review actual capacity at the source for the residents to use.
10. Add a sorter on the residue line to recover any missed recyclables. The aluminum recovered will more than pay for that sorter.

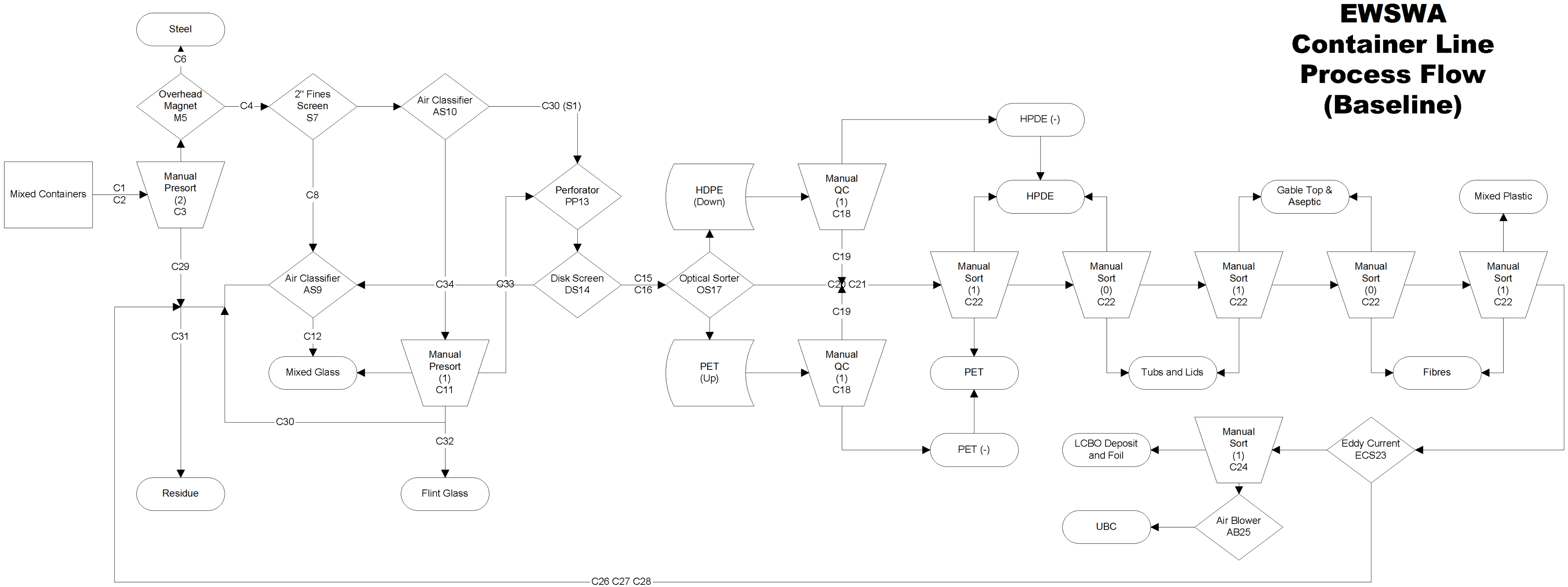
## 6.2 Plastic Addition Recommendations

The Authority wishes to add mixed plastics to the material mix it currently has in the blue box. Based on typical recovery rates approximately 1,214.41 tonnes of mixed plastics are available for collection. In reality, it is likely that only 520 tonnes will be recovered unless the lack of capacity at the curb is addressed.

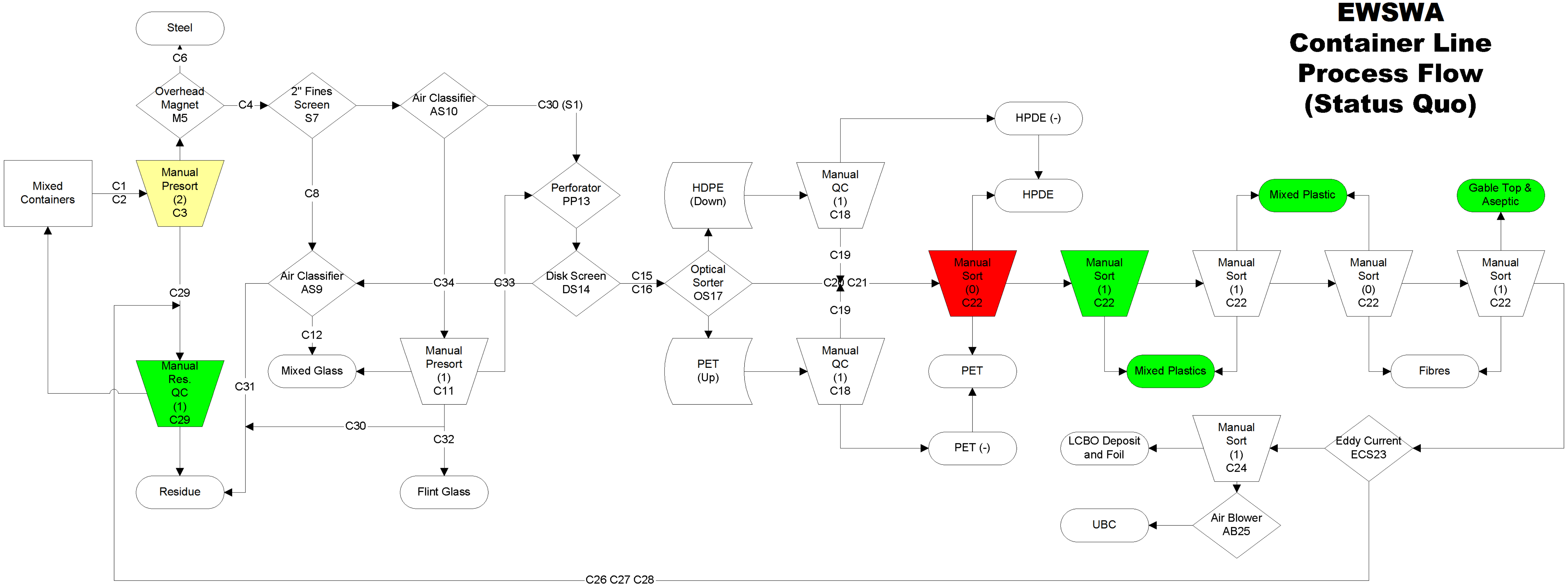
Three options were presented to add mixed plastics to the current operations, the simplest and easiest approach is option 1 to maintain the current process and reallocate some of the sorters while adding one sorter on the residue line. Capital improvements are minimal and the procedure can be implemented anytime.

While the negative sort option has the potential to generate marginally more revenue, these are expected to be quickly lost to operational inefficiencies handling compactors of mixed plastics with varied quality standards.

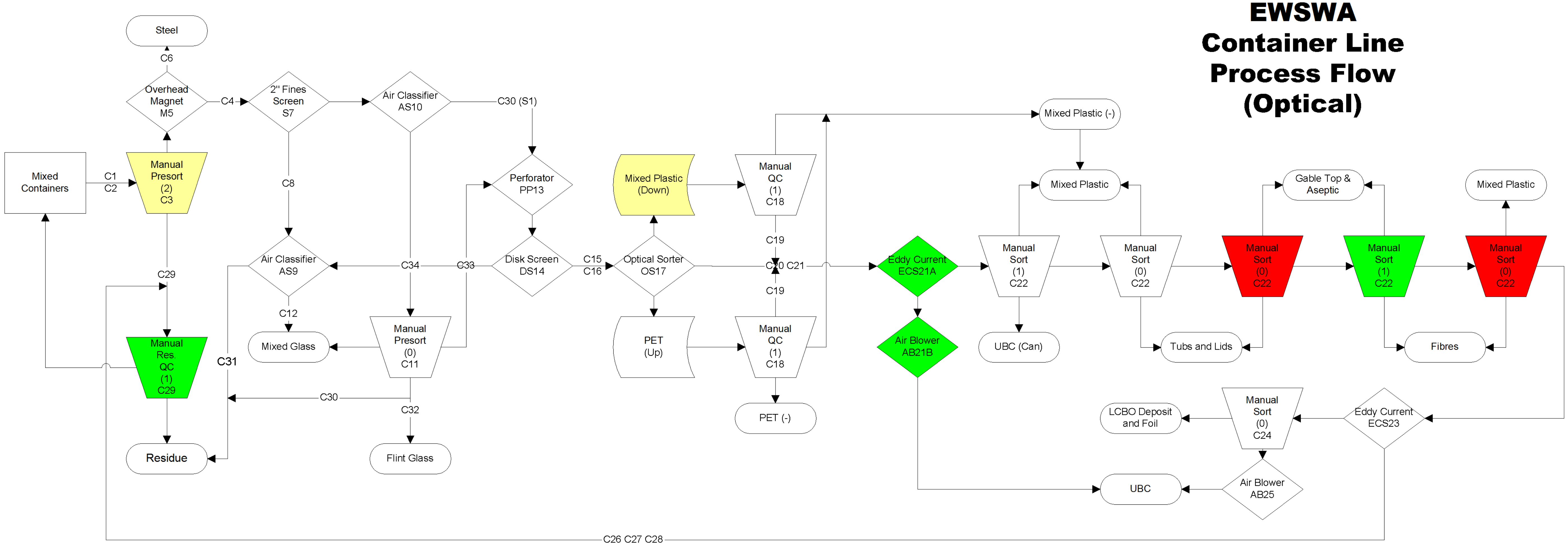
## Appendix A – Process Flow Chart



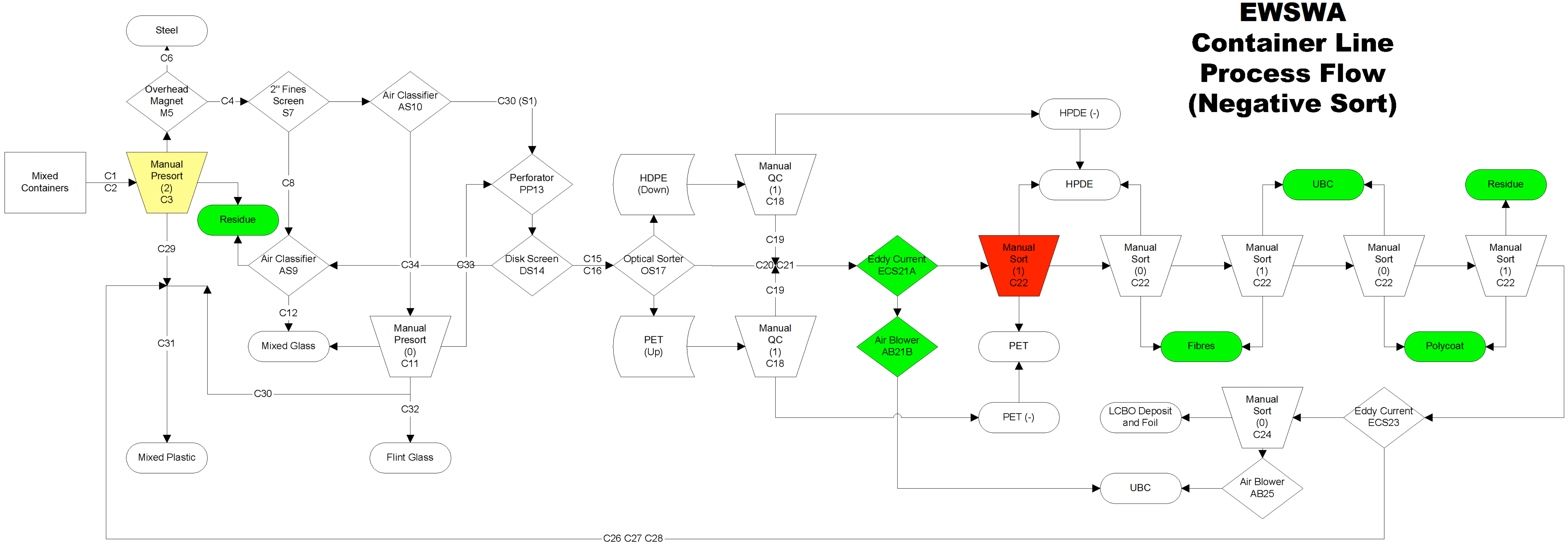
# EWSWA Container Line Process Flow (Status Quo)



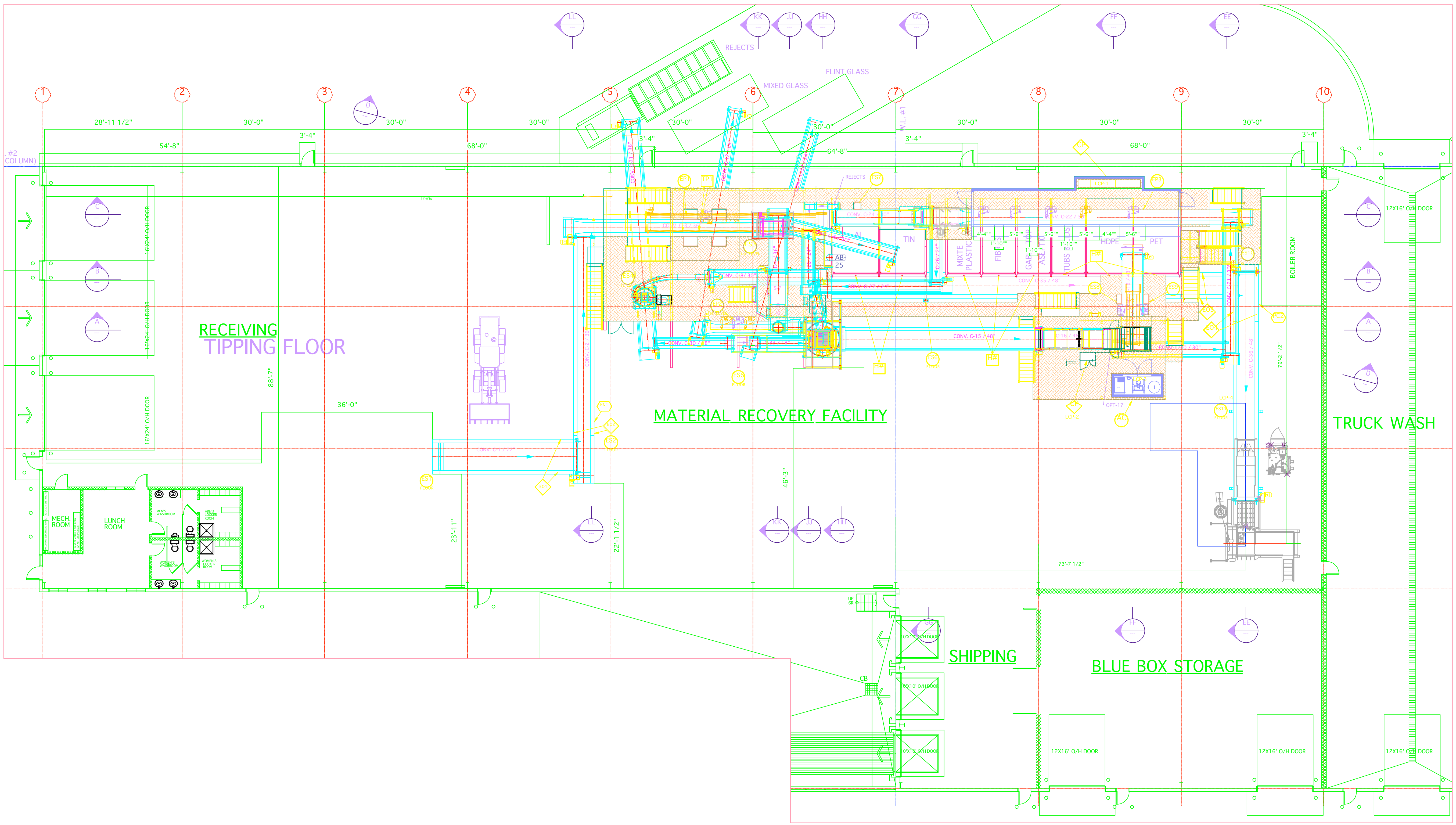
# EWSWA Container Line Process Flow (Optical)



# EWSWA Container Line Process Flow (Negative Sort)



## Appendix B – Material Recovery Facility Layout



## Appendix C – Inspection and Rejection Protocol

### *Criteria*

A load may be declared unacceptable if it contains five (5) percent or more by weight or volume of non-recyclable material.

### *Procedures*

All deliveries shall be inspected by a trained employee of the Authority or its representative as materials are tipped into the appropriate receiving MRF.

If the load is deemed to have more than the allowable amount of residues, the MRF operator will take pictures (date and time stamped) of the contamination. One copy of the pictures will be sent to the collection contractor and one copy will be sent to the Authority, if applicable.

### *Rejected Loads*

The load described below has sufficient contamination that changes its classification from "Recyclable" to "Waste." This load is rejected from the Materials Recovery Facility (MRF), however two options described below may be exercised.

Date:

Time of Rejection:

Drivers Name:

Hauler Company Name:

Vehicle License Number:

Area Material Collected:

(It is critical to identify the area where material was collected so the Authority may be able to target its educational program to the appropriate areas)

Option 1: Have the hauler's driver/operator remove all non-recyclable materials from the load, tip acceptable materials and take the residue away.

Option 2: Take full/partial load back to the hauler's yard, have it sorted out and brought back when load is acceptable.

If Option #1 is exercised, the driver may weigh in a second time once the non-recyclables have been removed. If Option #2 is exercised, the commodity tipping fee will apply to the dumped portion of the load (if any) and the driver/operator will still be required to remove all non-recyclable materials from any partially dumped loads.

The driver/operator is not to leave the MRF until given specific direction to do so. The MRF operator shall make a telephone available for drivers to arrange for rejected loads.

If a dispute arises between the MRF operator and the collection company personnel regarding the amount of contamination, the Authority's staff will make the final decision.

### *Hazardous Materials*

If hazardous wastes are identified in an incoming load, the hazardous material should be clearly marked and isolated in a designated area of the plant until arrangements can be made for the proper removal of the material.

### *Frequent Rejections*

Upon the issuance of a third load rejection notice to the same collection contractor within one year, the collection contractor will be required to meet with representatives of the Authority and the MRF operator to discuss ways to resolve contamination problems.

### *Follow-up Meetings*

Representatives from the Authority and all Contractors will meet a minimum of two times per year to discuss the load rejection protocol and identify any other pertinent issues related to contamination.