METRO

Options for Establishing Material Recovery Facility Standards

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TABLE OF CONTENTS

BACKGROUND AND PURPOSE

BACKGROUND

Metro is a public sector agency in Portland, Oregon tasked with regional planning and management. Metro sought consulting assistance to develop and implement standards and reporting requirements to improve the technical, social equity, and environmental performance of regulated material recovery facilities (MRFs) within its jurisdiction. The Material Recovery Facility Standards Policy Development Project (MRF Standards Project) is a multi-year planning process led by the Metro Waste Prevention and Environmental Services department, at the direction of Metro Council, to modernize the MRFs regulated by Metro. This effort will advance the implementation of the 2030 Regional Waste Plan and align with statewide efforts to modernize Oregon's recycling system. The intent is to improve the effectiveness, transparency, responsibility, and resilience of the Metro-area recycling processing system.

New performance standards and reporting requirements will advance implementation of the 2030 Regional Waste Plan (RWP) towards the following goals:

- **RWP Goal 3**: Ensure that all jobs in the garbage and recycling industry pay living wages and include good benefits.
- **RWP Goal 4**: Increase the diversity of the workforce in all occupations where people of color, women, and other historically marginalized communities are underrepresented.
- **RWP Goal 15**: Improve the systems for recovering recyclables, food scraps, and yard debris to make them resilient to changing markets and evolving community needs. This includes implementing stronger linkages between recycling collection programs and material recovery facilities through processing performance standards, supply agreements, regulatory oversight, or other means.

Metro intends to develop these performance standards and reporting requirements to complement and align with statewide efforts to modernize Oregon's recycling system through the newly passed Recycling Modernization Act, which establishes statewide requirements related to evaluating, reporting, and managing inbound and outbound contamination of recycling streams and marketing of materials to responsible end markets.

This briefing provides background research and options related to two specific objectives:

1. Develop and implement performance standards and reporting requirements related to material quality.
2. Develop and implement reporting requirements related to worker wages, demographics, and end market destinations to inform future policy.

This report draws from examples found in best practice guidance and operating contracts between communities and MRFs. It also explores how these standards can be integrated into a regulatory framework for Metro's consideration.

CONSIDERATION OF THE PASSAGE OF THE RECYCLING MODERNIZATION ACT

The Recycling Modernization Act was signed into law on August 6th. The bill includes provisions that direct the Department of Environmental Quality (DEQ) and Environmental Quality Commission (EQC) to establish in rule operating standards for facilities that handle Oregon-generated materials. The statute creates a permitting program for in-state facilities and a certification for out-of-state facilities, to establish a level playing field. The statute directs the agencies to establish inbound and outbound quality standards as a part of the permitting and certification programs. DEQ anticipates this rulemaking process to take place in 2023 and early 2024, with the MRF requirements becoming operational as of July 1, 2025.

Figure 1 outlines aspects of the Recycling Modernization Act that may relate to the options presented in this paper:

Permit / Certification	Operating Standards	Cost / Revenue Potential
•All MRFs handling Oregon materials would operate under same standards •Standards for Oregon MRFs set through permits •Standards for out of state MRFS through certification	• Permit and certification programs will establish operating standards related to inbound and outbound contamination, and responsible end markets	• Contamination management fee paid by PRO to MRF to compensate MRFs for the costs of removing and disposing of covered products that are contminants • Commodity risk fee paid by PRO to MRF to cover all eligible processing costs associated with owning and operating a comingled recyling facility (net commodity revenue)

It is important to consider the boundaries and timing of provisions in the Recycling Modernization Act that address MRF quality standards and reporting requirements to ensure that any action taken by Metro complements the forthcoming statewide program. Metro requirements adopted prior to the Recycling Modernization Act implementation can set the stage for the operating standards established through the rulemaking process. The legislation does not include a pre-emption provision, so standards set by Metro would not be overridden by the DEQ Permit / Certification program if they are stronger.

Areas where the Recycling Modernization Act may impact options will be discussed using text boxes throughout the report.

CONTRACTING VS LICENSING

Metro regulates MRFs in their political geography through a common licensing process. The licensing process is an important tool, especially because of the unique operational context in the Metro region in which local governments do not contract with MRFs, and do not direct their materials to specific MRFs for processing. Recycling collection in the Metro region is executed subsequent to franchise agreements between local governments and service providers who take ownership of the recyclable materials and in turn decide which MRF to utilize based primarily on logistics and market conditions. This is an atypical arrangement that limits MRF oversight.

Most municipal recycling programs in North America extend their contractual oversight beyond collection to include MRF processing. Contracting best management practices suggest incorporating clearly itemized operating standards in an RFP and contract. Using this structure, MRF operators enter the engagements and set their costs with those standards in mind – so, the cost of achieving the performance standard is passed on in the contract. This approach typically also includes revenue sharing and other incentives that encourage materials being marketed to their highest and best use.

In principle, local governments and/or their franchise collection service providers in the Metro region could contract with MRFs. Setting performance standards through contracts opens additional tools for compliance. Metro could support local governments by providing resources, such as a standardized contract template.

Since the research did not identify any other jurisdictions that regulate MRF operating standards, many of the options below draw from contractual agreements. As such, the options presented below could be incorporated into either Metro license requirements, or into contracts depending on the direction chosen.

582 Consideration: The processor commodity risk fee is meant to cover processing costs associated with Oregon-generated material by permitted or certified MRFs net of commodity revenue, such that on average, collection service providers would not be charged a processing fee (or tip fee) at the MRF. If local governments contracted with MRFs they would not be responsible for paying processing costs once 582 is fully implemented, as that cost would be borne by producers through the payment of the processor commodity risk fee. The contract could still play an important role in establishing quality and reporting requirements. If local governments do not contract with MRFs, they would still presumably restructure franchise rates once the commodity risk fee is implemented, as rate payers would no longer be responsible for MRF processing costs. These costs are currently baked into rates.

METHODOLOGY

RESEARCH METHODS

The research team focused on two research methods:

1. Literature review including existing MRF operating and contracting best practices, RFPs, and recycling processing contracts between communities and MRFs.
2. Interviews with regulated MRFs in the metro jurisdiction.

A summary of the findings of the literature review can be found in a supporting document. This document provides reference for many of the examples included throughout the report.

RESEARCH OBJECTIVES

Metro asked the research team to identify three to five options for addressing each of the following objectives. The options were designed to meet criteria established through collaboration between the consulting team and Metro:

- Quality standards related to outbound materials (commodities and residual)
- Quality standards related to inbound materials,
- Facility-level measurement and reporting of inbound and outbound quality standards,
- Facility-level measurement and reporting of material destination, and,
- Facility-level reporting of workforce wages and demographics.

CRITERIA FOR SELECTING OPTIONS

The research team evaluated the strengths and weaknesses of each of the options based on the following criteria established in collaboration with Metro. Each report section includes an analysis of how the options identified address these criteria.

1. Enforceable – Can the option be monitored and enforced?
2. Transparent / Accountable – Does the option ask for the right information? Is it measurable, and can it be reported in a timely manner?
3. Effective – Does the option result in the desired outcome? Does it put Metro in a position of industry leadership?
4. Responsible – Does the option align with the social and environmental goals of the 2030 Regional Waste Plan?
5. Operational Impact – What is the relative impact of the option on the MRF operation and logistics compared to other options?
6. Cost Impacts – What is the relative cost impact of the option compared to other options?
7. Competitiveness – Will the option increase marketability of the material sorted by MRFs located in the region and/or impede competitiveness of MRFs in the region against those that are not subject to the standards?

GLOSSARY

- **Capture Rate**: the proportion of incoming recyclable material that is shipped to end markets relative to the quantity of recyclable material that is received by the MRF.
- **Carried Waste**: market residue that is shipped to the (re)manufacturer in the commodity package (baled or loose).
- **End Market**: a manufacturer that uses recovered recyclables to make new products.
- **Inbound:** Recyclable materials coming into a MRF (e.g., inbound contamination, inbound quality standards).
- **Market Residue**: material that is shipped to a manufacturer that cannot use it.
- **Prohibitive**: material that may render a bale or shipment of loose material unusable; a category of market residue.
- **Outbound**: refers to materials leaving a MRF after being sorted and processed (e.g., outbound contamination, outbound quality standards).
- **Outthrow**: undesirable materials that degrade the quality and yield of a bale; a category of market residue.
- **Process Residue**: material that is recyclable but not recovered by the processing at the MRF and is instead discarded because it was not effectively sorted. Process residue also includes materials that were recyclable when set out for collection but were badly contaminated during collection and processing. Process residue does not include non-recyclable materials (contaminants) that may come to the MRF and then are disposed of.
- **Producer Responsibility Organization (PRO)**: Organization established by a producer or group of producers to administer a producer responsibility program under the framework created in the Recycling Modernization Act.
- **Program Material**: materials that are accepted in recycling programs within Metro's geography.
- **Purity Rate**: the percentage of contamination or non-target materials in outgoing commodity shipments.
- **Rejects**: non-recyclable materials that must be disposed in a landfill and are a percentage of material found in Metro collection programs (contaminants, hazardous materials, etc.).
- **Reprocessor:** secondary sorting facility that takes mixed bales and sorts by material type. May also be an end market (see definition above).
- **Residue**: Combination of process residue and rejects that are disposed of.
- **Residue Rate**: The percent of total materials received at the MRF that is sent to disposal as residue.
- **Yield Loss**: The difference between the incoming material purchased by an end market, and the material usable in an end product, typically disposed of at the end market or reclaimer level.

OPTIONS FOR REGULATORY STANDARDS AND REPORTING REQUIREMENTS

This section outlines the regulatory and reporting options for the following topics:

1. Quality standards for outgoing commodities and residuals
2. Quality standards for inbound contamination
3. Facility-level measurement and reporting of quality
4. Facility-level measurement and reporting of material destination
5. Facility-level reporting of workforce wages and demographics

Within each section the options are presented followed by a matrix comparing the options to one another based on strengths and weaknesses relative to the criteria defined in collaboration with Metro.

QUALITY STANDARDS FOR OUTGOING COMMODITIES AND RESIDUALS

MATERIAL CATEGORIES

Defining outbound commodity standards requires the definition of materials that should be subject to the regulation. Key considerations in defining categories and associated standards include:

1. Standards can be specific to certain grades or commodities, or broadly designed to address all recyclable materials processed in regulated MRFs.
2. Standards should support direction of inbound materials to their highest value and/or most sustainable outbound commodity category.
3. A robust regulatory approach would incorporate all commodities processed in MRFs receiving Metro materials, with commodity specific details where necessary and appropriate. MRFs function as integrated systems; performance in one part of the system affects the performance of other parts. A robust approach would consider material flows through the entire system and to all commodity streams to ensure that contaminants and problem materials are not just shifted from one commodity stream to another.

The research team identified two general groupings of materials to facilitate the analysis of options for regulated material categories:

1. Current Outbound Categories Identified by MRFs in the Metro area:
    - #11 Old Corrugated Containers (OCC)
    - #54 Mixed Paper (MP)
    - Baled (Aluminum) Used Beverage Can (UBC) Scrap
    - Steel (Tin) Cans
    - PET Bottles (#1)
    - HDPE Bottles (#2)
    - Comingled Plastic Containers

2. Additional Outbound Categories not typically produced by Metro-area MRFs

The following grades may not be commonly produced now in Metro MRFs. They are generally found in lower quantities in inbound MRF material streams in the region. Changing regional markets (especially paper and plastic) and policy conditions such as the passage of the Recycling Modernization Act may incentivize MRFs to sort to these additional grades of material as scale of volume, regulatory rules, and available end markets change. Many MRFs around the country are producing these grades and they are expected to increase in prevalence, due to targeted industry support from pre-competitive collaborations such as Carton Council, Foodservice Packaging Institute and The Recycling Partnership's Polypropylene Recycling Coalition. This category of additional Grades include:

- Polypropylene rigid containers - typically sorted to comingled rigid plastic containers in Metro MRFs. Many programs outside of Portland Metro and Bend removed rigid PP containers from national list following National Sword around 2018.
- PET Thermoforms – not officially collected in the curbside program, but still appear in Metro MRFs. Currently only formally collected from residences by an independent subscription-based recycling service
- #52 Aseptic Packaging and Gable Top Cartons - typically sorted to mixed paper in Metro MRFs
- #56 Sorted Residential Papers and News (SRPN) - typically sorted to mixed paper in Metro MRFs

For lower-volume materials, such as non-bottle plastics it is not cost-effective to sort at the MRF level. Aggregating scale and consolidating advanced sorting through a mixed plastic reclaimer or secondary sorting facility can be seen as a more optimal approach when looking at the entire system.

OPTIONS FOR ESTABLISHING OUTBOUND QUALITY STANDARDS

Outbound standards can generally be categorized into two groups: Capture rate and Purity Rate. For each group, there are several potential approaches to standard setting, as described below.

1. **Capture Rates-** Capture rates are relevant because they measure how well a MRF performs the core function of sorting recyclable materials into salable commodities.

   The capture rate measures the quantity of incoming recyclable material that is properly sorted and shipped to end markets and compares it to the quantity of recyclable material that is received by the MRF. It is more difficult to meet capture rates with higher inbound contamination rates, as materials become increasingly difficult to separate and systems can only tolerate a finite quantity of rejects before they fail. All capture rate metrics should be adjusted based on the inbound contamination rate measured in the stream. Inbound contamination will be discussed in the following section.

   The project team has identified three options for setting a capture rate standard. Any of these options could be designated as a condition within the processor's license.

1.1 Overall MRF Capture Rate

A. Description: The most general metric to ensure the MRF is not losing recyclables during the process of sorting. It is the minimum capture rate measurement which could be regulated. This option considers quality very broadly, grouping all material streams together without distinguishing the material type (e.g., paper, plastic, metal). Many MRFs utilize this metric as an internal standard. The method for deriving is:
   - Weighing inbound volumes of collected materials, including recyclables and rejects.
   - Weighing outbound volumes of recyclable commodities shipped to end markets.
   - Weighing the outbound volumes of process residue and rejects destined for disposal.

The basic formula for overall MRF capture rate is as follows:

$$\frac{[(\text{process residue} + \text{recyclable commodities shipped to end markets}) - (\text{process residue (missed recyclables and residue from recyclables)}]}{(\text{process residue} + \text{recyclable commodities shipped to end markets})}$$

B. Ranges: MRF capture rates range from 90-98%.

1.2 General Material Capture Rate

A. Description: This option adds a level of complexity by measuring the percent of specific materials captured in general material categories (e.g., percent of paper going into paper bales, percent of plastic going into plastic bales, etc.). The capture rate standard may differ based on material type. Higher rates are required for metals and paper due to better sorting technology and capabilities, and, in the case of paper, volumes. There are generally lower rates required for plastic bottles and the lowest capture rates are required for non-bottle plastics due to sortability challenges. A general material capture rate is used in contracts serving a U.S. community of 1.5 million residents and two Canadian MRF communities, one with nearly 3 million residents [1] and the other with 400,000 residents [2]

B. Ranges: General material capture rates found in contracts include:
   i. 88-98% capture rate for paper, metal, and plastic bottles in respective general material categories.
   ii. 80% for non-bottle plastics in some type of plastic bale (mixed or resin separated).

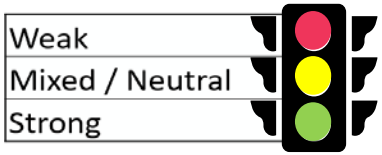
1.3 Combination of General and Material Specific Capture Rate

A. Description: The general material capture rate can be strengthened by adding requirements related to specific commodities to direct materials to their highest value. For instance, it would set a standard for the percent of PET bottles processed into PET bales. This also would incorporate general material capture rate standards for materials, such as mixed paper or non-bottle plastics, where mixed bales are more sustainable in the market. An example of this standard is used in a Canadian MRF contract with a community of 1.8 million residents [10].

B. Ranges: The referenced example sets the following general and material specific capture rate standards:
   i. OCC: 98% in fiber bales, 80% in OCC bales
   ii. Newspaper: 98% in fiber bales, 80% in newspaper bales
   iii. Cartons: 93% in fiber bales, 90% in carton bales
   iv. Clear PET: 95% in plastic bales; 80% in PET bales
   v. HDPE: 95% in plastic bales; 80% in HDPE bales
   vi. UBC (Aluminum cans): 95% in metal bales; 90% in aluminum bales
   vii. Mixed Paper: 90% in fiber bales
   viii. Mixed Rigid Plastics: 80% in plastic bales
   ix. Ferrous Metals: 85% in metal bales

EVALUATION OF CAPTURE RATE STANDARD OPTIONS

The following tables present an analysis of each option presented above based on the criteria defined in the methodology section:



Criteria	Options		
	Overall Capture Rate	**General Material Capture rate**	**General and material specific capture rate**
Enforceable	The option is enforceable	The option is enforceable	The option is enforceable
Transparent / Accountable	Could lead to less visibility into what happens to materials downstream if more mixed bales were produced.	Could lead to less visibility into what happens to materials downstream if more mixed bales were produced.	Metro has visibility into specific grades produced. Competitiveness: Some markets desire mixed bales as part of their business model. This option gives more flexibility to meet market demand.
Effective	May not give visibility into specific grades as it only measures the overall capture rate. Some grades may be higher than the standard, while others are lower.	Desired outcome may not be met the more materials are processed into lower value and quality mixed grades.	These standards result in producing materials that reach end markets, though there may be more yield loss (e.g., materials disposed of at the end market or reclaimer level). Reflects industry best practices.
Responsible	Does not set any requirements around segregated bales, which have higher yield and less disposal downstream.	Does not set any requirements around segregated bales, which have higher yield and less disposal downstream.	These standards result in marketable materials, though the extent that mixed bales are produced may have lower yield and more disposal downstream than segregated bales.
Operational Impact	More flexible about which grades can be produced, including mixed grades, and providing resilience in response to shifting market dynamics.	More flexible about which grades can be produced, including mixed grades and providing resilience in response to shifting market dynamics.	Balances higher value for some grades while allowing for flexibility for lower value and mixed materials.
Cost Impact	There may be investments needed to meet these standards, but likely less than grade specific standards.	There may be investments needed to meet these standards, but likely less than grade specific standards.	There may be increased costs (equipment and/or labor) to meet the grade specific standard.
Competitiveness	Does not promote production of highest value material.	Does not promote production of highest value material.	Some markets desire mixed bales as part of their business model. This option gives more flexibility to meet market demand, while requiring certain materials to meet highest value output.

2. Purity Rates- Purity rate reflects the amount of the target commodity material in a bale, as compared to residue or unusable materials. It measures the extent that each intended commodity grade produced by the MRF meets a level of quality to be considered suitable feedstock for reprocessing into a new product. Purity rates are determined by measuring the percentage of contamination or non-target materials in outgoing shipments. Purity rates are commonly stated in bale specifications and utilized in the marketplace to regulate transactions between buyers and sellers.

The recycling industry relies on two key third-party agencies, Institute of Scrap Recycling Industries (ISRI) and Association of Plastics Recyclers (APR) to define the purity of outbound shipments generally acceptable to reprocessors and remanufacturers. ISRI and APR collaborate on specifications for plastic grades to ensure consistency in the marketplace. ISRI / APR specifications are developed through open processes to engage market participants and are commonly used in the transaction of curbside recyclable commodities and have long histories in the development of the scrap marketplace. Both organizations have used these specifications to support market transactions between buyers and sellers to ensure that each knows what is expected to be present in the bales produced by MRFs in truckload quantities. These outbound shipments are defined by grades of material (bales or loose materials). Each grade has its own specification that can be found in the ISRI Specification Circular [23]. These specifications define the purity requirements, including addressing contamination and non-targeted material.

The presence of contamination in an outbound product is technically referred to as *market residue* [11] which is shipped to the (re)manufacturer as a *carried waste* in the commodity package (baled or loose). All recyclables shipped as commodities by MRFs contain a certain amount of market residue. Market residue is further broken down by ISRI and APR into prohibitives (i.e., material that may render a bale or shipment or loose material unusable) and *outthrows* (i.e., undesirable materials that degrade the quality and yield of the bale). In some cases, other specific residuals (moisture for example) are present in ISRI/APR grade specifications. Each commodity specification has a respective not-to-exceed level of prohibitives, outthrows, or other specified level of residuals.

Interviews with Metro's regional MRF processors indicate that exceeding prohibitive tolerances are likely to lead to the greatest consequences from their buyers. If the tolerance level is exceeded for outthrows and/or prohibitives, the manufacturer or reprocessor may either not be able to utilize the material and must dispose of it or incur an unacceptable cost to use the material which would affect the yield and marketability of the material being manufactured. In these instances, the buyer may reject the commodity load, and in the case of repeat offenders, not buy from the MRF shipping location again. It may, alternatively, downgrade the price paid, or cause delays in payments if the purity level is disputed.

In the current private marketplace, buyers use the threat of potential rejection or economic penalty create a market incentive for MRFs to employ purity rate measurements of outbound commodities as a best practice to reduce costs and increase revenue. To provide oversight and management, public agencies contracting for MRF services generally include purity rate metrics with an economic goal in mind, as commodity revenues are often shared, and thus often impact the net cost of their contract.

In the Metro regional context, where municipalities do not contract for MRF processing, added costs associated with unmet purity standards will reflect in the processing costs charged to franchise collectors and eventually will be reflected in customer rates. In addition, any carried waste is likely to be disposed of by the end market that receives it. If the end market is in developed countries this leads to more disposal. In undeveloped countries this can result in mismanaged waste that is released into the environment or is handled without suitable health and safety considerations. It is in the best interest of all stakeholders, including MRFs, to produce commodities that, at a minimum, meet appropriate market-based purity standards.

Feedback from regional MRFs, consistent with RRS' understanding of the market, is that the most significant aspect of purity is limiting the presence of prohibitives. General purity is also important, as any non-target material may result in yield loss and disposal downstream where Metro is unlikely to have any oversight. Any outbound purity standard should enumerate standards for both general purity and prohibitives specifically.

The project team has identified the following options for setting a purity rate standard:

2.1 Institute of Scrap Recycling Industries (ISRI) / Association of Plastic Recyclers (APR) Specifications

A. Description: ISRI specifications for secondary materials are the most comprehensive current industry standard. These specifications were developed by industry representatives and included input from each commodity working committee (ferrous metals, non-ferrous metals, paper, and plastic) as well as the MRF committee. ISRI also collaborates with the APR to ensure plastics grade specifications are consistent between the two organizations. The standards set thresholds for both prohibitives and outthrows. For example, a U.S. community of 1.5 million identified in the literature review is governed by a contract that requires the MRF to submit a marketing plan for all outbound commodities that maps outbound commodities following respective ISRI grade specifications[1]. Metro could include a condition in the license that all outbound commodities must be categorized and reported as one of the grades defined by ISRI. It requires MRFs to meet the defined standards of each, validated through one of the facility-level measurement and reporting options presented below.

B. Ranges: see ISRI Specifications Circular for the following standard MRF grades that are applicable depending on materials / grades being regulated:
    i. #11 Old Corrugated Containers (OCC)
    ii. #54 Mixed Paper
    iii. #52 Aseptic Packaging and Gable Top Cartons
    iv. #56 Sorted Residential Papers and News (SRPN)
    v. Baled (Aluminum) Used Beverage Can (UBC) Scrap
    vi. Steel Can Bundles
    vii. PET Bottles
    viii. HDPE Bottles
    ix. #1-7 Bottles and Small Rigid Plastic
    x. #3-7 Bottles and small Rigid Plastic
    xi. Tubs and Lids
    xii. Polypropylene small Rigid Plastics
    xiii. PET Thermoforms

2.2 Market-Based Purity Standards[2]

A. Description: According to MRF interviews, best practices guidance, and the research team's knowledge and experience, quality standards in practice are typically defined in bale specifications and are reflected in verbal and/or contractual agreements between buyer and seller. This often creates a circumstance in which custom specifications are determined as a derivative of the ISRI standards. There are many variables affecting a market's tolerance for feedstock purity, prohibitives, and outthrows, including market value, competition for material supply, and end-product demand. Implementing these standards is dependent on MRFs providing detailed reporting of all end market destinations and end markets' willingness to share quality specifications. For the purpose of implementing this approach, Metro could include a condition in the license that requires each facility to report each of their buyer's defined

[1] ISRI is in the process of updating their standards. This should be taken into account and could mean waiting until the new standards are defined.

[2] This is an adapted best practice from Kinsella and Gertman's Single Stream Recycling Best Practices Implementation Guide, 2007

quality specification for all grades of marketed material. The MRF then must meet these standards.

MRFs could also be required to record and report any feedback related to quality from their end markets through required monthly or annual reporting. In addition, Metro might require the right to confirm the standards with the market buyer, in which case MRFs report company-specific data with contact information. As standards change, or if the MRF has a new buyer, they can submit a change request for approval. It should be noted that the identity of end markets is often held confidentially by the MRFs and end-market quality specifications are often not public information. Thus, Metro must provide a method to assure that the information is held in confidence. A section describing confidentiality and its boundaries can be found below.

B. Ranges: Based on industry guidance, MRF operating contracts, and MRF interviews, market-based standards fall into the following ranges depending on grade:
    i. 80-95% purity
    ii. .5-5% prohibitives, with specific material thresholds defined. (e.g. less than .1% of metal or .5% PVC in a PET bale)
    iii. 2-15% outthrows

2.3 Regional Purity Standard Including Both General Purity and Prohibitive Tolerance

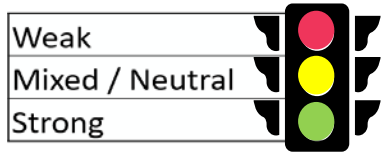
A. Description: Metro could initiate a process to set a regional general purity standard with specific prohibitive tolerance and set as a condition in the license. This could be based on ISRI / APR as a reference point. To be acceptable to a third party MRF licensee who does not have a processing contract with Metro, it would need to be adapted following an extensive review and engagement with MRFs and their end markets. The literature review includes an example of purity standards used in a MRF contract in a Canadian city [10] that is about the same size as the Portland Metro area.
B. Ranges: Metro standards should fall into a similar range as Market and ISRI standards with potential regional market-specific details depending on grade, for example:
    i. 80-95% purity
    ii. .5-5% prohibitives, with specific material thresholds defined. (e.g., less than .1% of metal or .5% PVC in a PET bale)
    iii. 2-15% outthrows and .5 to 2% prohibitives

Recycling Modernization Act consideration. The permitting and certification programs created in the new legislation are directed to establish quality standards, such as capture rates or purity rates, as a part of the rulemaking. As the rules develop, they may:

- Match Metro standards: Metro's standards could be used to inform the DEQ rulemaking process. This would create a level playing field for any MRF that handles Oregon materials.
- Be less stringent than Metro standards: The Recycling Modernization Act does not preempt local governments from having stricter MRF operating standards. Metro standards would only apply to licensed MRFs in the Metro region, while state standards would apply to others in the state, and out of state

EVALUATION OF PURITY RATE STANDARD OPTIONS

The following tables present an analysis of each option presented above based on the criteria defined in the methodology section:



Criteria	Options		
	ISRI/APR	**Market-based**	**Regional**
Enforceable	If the specification is well defined, then it can be enforced.	There are often barriers to getting specifications for all end markets. Reconciliation of competing specifications can be challenging where multiple markets for the same grade that take different stances on specifications.	If the specification is defined, then it can be enforced.
Transparent / Accountable	Material specifications are very detailed and include references to prohibitives and outhrows. They are developed through a transparent process.	Gives metro transparency into market requirements utilized in practice and a possible point of engagement with the end markets to better understand and react to shifting market conditions firsthand.	Metro may not be able to capture the perspective of broad market and supply chain better than an industry developed standard.
Effective	Some view these standards as a tool to define common terms and provide buyers and sellers a starting point from which to conduct negotiations around quality and pricing. Also, may not be a perfect reflection of market requirements for Metro MRFs.	Some markets may not have specifications that are broadly applicable, which result in a challenge, but it may result in more locally relevant specifications.	It has the potential to result in a more locally relevant spec than ISRI/APR standards provide.
Responsible	Regarded as reflecting high quality bales that control hazardous prohibitives and result in a manageable amount of outthrows	Letting the market define the spec does not necessarily match Metro's values. Supply-short markets can be very accepting of poor quality and low yield bales.	Metro defines what is the most important.
Operational Impact	Based on interviews, area MRFs and end markets understand and are comfortable with these standards. They are directionally effective, the most complete set of standards available and are commonly used and referenced.	Allows MRFs to operate under familiar conditions	It is not possible to anticipate the actual specifications and how that might impact the operation. If they are tighter, it likely results in an operational challenge.
Cost Impact	Validating requires significant sampling and auditing of all different outbound streams, which can be very costly.	Requires significant sampling and auditing of all different outbound streams, which is costly.	Considerable effort is required to develop defensible independent standards in a comprehensive, transparent way, which has

	However, using reporting that materials were sold at ISRI specification standards using summary grade or grade exception reports may be cost effective.		already been done by APR/ISRI. In addition, validating purity standards requires significant sampling and auditing of all different outbound streams, which is costly.
Competitiveness	End markets are comfortable with these standards and materials produced to these specifications would are highly marketable.	End markets are comfortable with these standards and materials produced to these specifications are	Assuming the specifications are at least as strong as market specifications the material will satisfy typical market demands. It is unclear if tighter standards provide access to better markets.

OUTBOUND STANDARD REQUIREMENTS AND ENFORCEMENT

The following requirements could be set around outbound quality.

1. **Require MRFs to track and report outbound quality.** In this scenario the MRF would be required to track and report on outbound quality, including capture rate, purity rate or both. The measurement and reporting could follow any of the relevant options presented in the measurement and reporting section below.
2. **Require MRFs to adhere to a set standard.** The capture rate and purity rate options presented in this section could be set as a requirement of a license or contract. These different types of standards could complement each other.

Metro has the following enforcement options for outbound standards:

- Penalty or fine for violations
- License revocation

If local governments or their franchise haulers were to contract with MRFs there would be additional opportunities to incentivize compliance including:

- Payment for processing could be contingent on adherence to the requirements
- Flow of material could be contingent on adherence to the requirements
- Revenue sharing could be integrated into processing fee structure

Metro could support local governments by providing resources, such as a standardized contract template.

QUALITY STANDARDS FOR INBOUND MATERIAL

Inbound quality is an important factor as overall quality standards are considered. The quality of the material deposited on the tipping floor impacts the ability of the MRF to achieve outbound quality and residue standards. More effort is required to produce high quality output if the quality of the input is lower. Optimization of the performance of the Metro-area MRFs and improved quality of the material they produce requires, at a minimum, a measurement and reporting system for incoming material to support efforts to minimize the impact of contamination.

Setting inbound standards for Metro licensed MRFs is one useful tool to help guide these contamination reduction efforts because these standards will set targets, measurement requirements, and regular reporting of inbound contamination. This approach allows determination of a baseline quality level and the opportunity to track progress objectively. For any of the inbound material delivery options, the standard can be adjusted based on the source of material with lower contamination rates required for single family housing and commercially generated material, and higher rates for multi-family housing.

An inbound load exhibits contamination in three ways [11]:

1. Non-recyclable materials (trash or garbage) are placed in with the recyclables by the resident.
2. Potentially recyclable materials that are not listed as acceptable by the community's collection program are placed in with the recyclables.
3. Fully recyclable materials are rendered non-recyclable by being mixed with other materials in such a way that they cannot be adequately cleaned or separated by the processor for reuse by recycled product manufacturers. For example, mixed paper may be soiled with food residue that a resident place in their bin while being transported to the MRF in a compactor truck.

Recycling Modernization Act consideration: Inbound contamination is a clear priority for shared responsibility under the new law. This includes a baseline contamination study period, contamination reduction educational programming targeting residents and businesses, and a contamination management fee paid by the PRO to the MRF to offset the cost of managing contaminants.

A. Description: A standard for acceptable inbound contamination levels, measured as a percentage of incoming materials that are targeted for collection and recycling. This option sets a target for the desired outcome. The standard can be configured with both final and interim goals.
B. Range: An inbound target could range from 6-10% in five years, which, based on the range of contamination rates presented in Appendix A reflects best achievable practices. For a relevant example, see the 9% contamination rate for Rogue Disposal in Jackson County, Oregon, which was measured following a contamination reduction effort that involved cart tagging and possible rejection of contaminated bins at the curb.

2. **Continual Improvement-Based Inbound Quality Standard:**
   A. Description: A goal for inbound contamination reduction that focuses on improving the percentage of incoming materials that is non-program material over time. This option is similar to the first, but focuses on targeted improvement, rather than the targeted rate. There were not any specific examples of this option in the literature reviewed for this project.
   B. Range: Considering the existing contamination rate in Metro region ranging from 9%-21% (see Appendix B) the range of improvement target may be 5-10% reduction over a 5-year period, with interim goals of 1 % per year.
3. **Load Rejection Standard:**
   A. Description: A standard for acceptable contamination above which MRFs are required to reject loads. This example was referenced in an RFP from a U.S. County with 1.5 million residents and a contract between City of Santa Clara and GreenWaste Recovery Inc. [6]. It is also presented as a best practice from The Recycling Partnership [3]. Metro's commercial food waste collection program offers a precedent for load rejection.
   B. Range: This is typically set higher than the inbound target. All three examples referenced set the load rejection standard at 30%.

Recycling Modernization Act Consideration: Feedback from MRFs indicates that they do not currently reject even highly contaminated loads for fear that the hauler will take material to a competitor. The downside of a load rejection standard is the competitive disadvantage that it may cause. If these requirements come as part of the Recycling Modernization Act rules, all MRFs (in and out of state) that handle Oregon-generated materials would be subject to the same requirements. In this level playing field, competition would not be a negative factor.

A fourth option related to inbound standards contemplates the use of outbound residue disposal rates as a means of evaluating inbound material quality:

4. **Residue Rate Standard:**
    A. Description: Percent of total materials received at the MRF that is sent to disposal as residue. This was found in contracts in communities where the MRF operator is also the collection service provider. The approach is presented as a tool for linking inbound contamination with outbound residue. The outbound contamination standard is a requirement for the MRF.
    B. Ranges: The conditions for extension of the San Jose operating contract with a second waste hauler and processor, CalWaste Solutions, requires that no more than 20% of total material processed be sent to disposal. This requirement is adjusted depending on the inbound contamination rate measured by quarterly statistically representative inbound and residue audits.

INBOUND STANDARDS REQUIREMENTS:

The challenge of establishing requirements for MRFs inbound quality standards is that the MRF is not responsible for the parts of the system in which contamination originates (i.e., the education of residents on proper recycling behavior and curbside collection of material). It is difficult to rationalize asking the MRF to take responsibility for the inbound standard. It is more logical for the enforcement of the inbound contamination standard to be the responsibility of the local government, which is responsible for providing recycling access. In addition, franchise agreements set requirements for collection service providers who can also influence incoming contamination. Like outbound standards, inbound standards could be incorporated into contracts between local governments and MRFs. Several ways in which the inbound standard can be translated into MRF requirements include:

1. **Require MRFs to track and report inbound quality.** In this scenario the MRF, although not responsible for adhering to the inbound standard, has the responsibility of evaluating the quality of inbound materials and establishing a feedback loop to the collection service provider and the municipality. The measurement and reporting could follow any of the relevant options presented below.
2. **Require MRFs to set tiered pricing based on inbound contamination rates.** This tool enables the MRF to charge collection service providers more for processing material that does not meet inbound standards. This option is based on the example of the San Jose contract with GreenWaste Recovery, Inc., where there are four quality tiers that determine the cost per ton paid by the city for any given load. This approach requires at least the visual monitoring of every load that is tipped at the MRF.

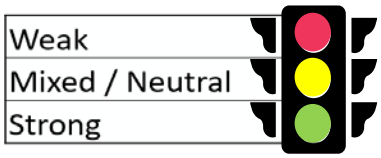
Recycling Modernization Act Consideration: The legislation aims for the processor commodity risk fee to cover the difference between commodity revenues and processing costs, allowing the average fee charged by commingled MRFs to haulers to target a price of $0 per ton. . Once this is instituted, a tiered pricing requirement set by Metro would no longer by relevant.

3. **Require MRFs to reject loads that surpass the load rejection standard.** In this scenario the MRF tracks each load using at minimum a visual inspection. If contamination (defined as non-program material) is found to be greater than the threshold, the load is rejected. Rejected loads are sent to a pre-designated "dry waste" facility for processing. The cost to sort, handle, and dispose of the load becomes the responsibility of the hauler and may require a change in the rate setting during the rate adjustment period.
4. **Set outbound capture rate and/or residue rate standard relative to the inbound standard.** This tool provides a through-line for the MRF between inbound and outbound contamination standards and incentivizes them to engage as an active participant through tracking and providing feedback on inbound contamination. It will closely relate contamination standards to data collected on the tip floor and adjust tip

fees if inbound contamination is higher than the target. This approach recognizes the additional difficulty needed to sort target materials when there is a greater quantity of non-target material in the mix and enables this approach to use the inbound rate as a factor for adjusting the capture rate or residue rate standard. This principle is integrated into contracts with the city of San Jose and its two recyclers. The San Jose contracted recyclers collect and process curbside materials, which is not how Metro-area MRFs operate. That said, the principle could be integrated into Metro's approach.

EVALUATION OF INBOUND QUALITY STANDARD OPTIONS

The following tables presents an analysis of each option presented above based on the criteria defined in the methodology section:



Criteria	Options			
	Outcome-Based	**Improvement-Based**	**Load Rejection**	**Residue Rate**
Enforceable	The Standard is not enforceable by the MRF, which doesn't control inbound material quality. Only the requirement to track and report is enforceable.	The Standard is not enforceable by the MRF, which doesn't control inbound material quality. Only the requirement to track and report is enforceable.	This standard could be enforceable on the MRF.	This standard could be enforceable on the MRF.
Transparent / Accountable	This is an important measurement to understand contamination and guide reduction efforts.	This is an important measurement to understand contamination and guide reduction efforts.	This is an important measurement to understand contamination and guide reduction efforts	This is measuring the right information. If a lot of contamination enters the MRF its appropriate that it is disposed of on the back end.
Effective	If MRFs are required to tier pricing based on standard it has potential to leverage pressure to address contamination.	On its own, does not necessarily lead to lower contamination, as MRFs do not have direct influence over that and its measuring improvement, rather than total contamination rates.	Has potential to leverage pressure to address contamination.	On its own, does not necessarily lead to lower contamination, as MRFs do not have direct influence over that.
Responsible	Tracking and supporting improvement of inbound contamination is a Metro Value, but the MRF alone cannot affect contamination reduction.	Tracking and supporting improvement of inbound contamination is a Metro Value, but the MRF alone cannot affect contamination reduction.	It is appropriate from a material quality and worker safety perspective to handle highly contaminated loads as dry waste rather than recyclable.	It could be a perverse incentive to market residue as recyclable to meet the standard.

Operational Impact	Once the process is familiar, visual inspection is unlikely to impact the flow of the operation unless a load is rejected.	Once the process is familiar, visual inspection is unlikely to impact the flow of the operation unless a load is rejected.	Determining if a load should be rejected and then handling that material is likely to be more costly and logistically challenging than other options. Added costs are passed onto collectors and factor into rate reviews.	It's difficult to predict the operational, or cost impact since its largely contingent on the quality of material coming in. If inbound contamination is high, the cost and operational impact is high, if inbound contamination is low, the impacts would be as well.
Cost Impact	Visual inspection of every load likely requires consistent labor cost	Visual inspection of every load likely requires consistent labor cost		
Competitiveness	This option does not have an obvious impact on MRF cost, operations or competitiveness unless it resulted in MRFs rejecting loads or charging more.	This option has little direct impact on MRF competitiveness unless it resulted in MRFs rejecting loads or charging more.	If MRFs outside of Metro are not required to reject loads they may have a competitive edge for receiving material from outside of the Metro area.	To meet residue standard, it may require rejecting loads, which could be a competitive disadvantage if MRFs outside of Metro don't have the same requirements.

FACILITY-LEVEL MEASUREMENT AND REPORTING OF INBOUND AND OUTBOUND QUALITY STANDARDS

This section presents the range of measurement and reporting options considered for monitoring and validating performance at a facility-level. It is divided into methodologies for inbound only, outbound only, and others that could apply for both inbound and outbound. Wide publication of the collected data in the reports enables residents to understand how individual customers may impact the contamination levels of inbound material and how sorted commodities are derived inbound materials. Attention to this kind of data reporting assists in increasing recycling literacy among Metro-area residents, providing greater trust in the system, and helping to stimulate behavior change to recycle appropriately. In this manner, inbound contamination reduces and overall commodity value increases.

INBOUND AUDITS

The following methods can effectively measure inbound contamination:

1. **Visual / Photo Inspection of All Inbound Loads:**
    A. Description: Metro defines a standard requiring visual inspection of each inbound load and grading of according to the following categories:
        i. meets inbound standard
        ii. above inbound standard but below the rejection standard
        iii. above rejection standard

    This method is based on an example found in a contract between Santa Clara and GreenWaste Recovery, Inc. In that contract, the per ton processing charge paid by the city is based on the grade of inbound material determined through visual inspection. A responsible employee grades each load as it is tipped based on a pre-determined visual inspection methodology. The tiers are divided into 10% or less, 10-20%, 21-30% and 31% or greater. Any load with more than 30% inbound contamination is categorized as mixed solid waste and must be diverted to the company's mixed waste processing facility, which happens to be adjacent to the MRF.
    B. Frequency: Every load of inbound material.
    C. Reporting: Metro develops an inspection log report template that includes date, collection service provider, origin of material (municipality), weight, and material grade category, or accepts an alternative reporting template proposed by the MRF. Any grade determined as not meeting the standard is supplemented with supporting photos. The log forms the basis for MRF ongoing tracking and reporting to Metro. Summary reports are submitted to Metro monthly. The proposed reporting process is similar to reporting requirements described in an RFP issued by the City of Toronto. Publication of the data encourages contamination reduction efforts.
    D. Validation: Metro needs the right to conduct site visits to observe visual inspection processes and review original inspection logs.
    E. Cost: MRF cover costs of inspection, tracking and reporting.

2. **Manual Auditing of Materials that are Graded Above the Rejection Threshold:**
    A. Description: This requires a more rigorous measurement of loads graded for rejection. In this option, if a load is flagged as potentially surpassing the load rejection standard the load in question would be moved to a secure area where a random segment of at least 150 pounds can be placed for sorting by MRF staff.
    B. Frequency: Any time a load is graded for rejection.
    C. Reporting: The daily inspection log referenced in Option 1 to be adapted to include reporting of the manual sampling audit results of rejection grade loads. Audit reports to be submitted monthly along with the visual inspection report, including photos. Details of visual inspection trends should be included to be analyzed in an annual report. Supply data to DEQ and/or publish the data through appropriate means to encourage contamination reduction efforts.

D. Validation: Metro conducts sporadic site visits to observe auditing process and review original audit reports
E. Cost: MRF covers costs of sorting, tracking and reporting.

3. **Random Manual Inbound Composition Audit:**
   A. Description: A manual composition study includes a random sampling protocol to select routes to audit followed by segmenting the load, selecting a segment, and sorting into material categories. Categories can include acceptable program material, specifically identified recyclable non-program material, and not recyclable contamination. The final results of the audit lists the total inbound contamination rate associated with that MRF. Metro defines the sampling protocol and sort categories or accepts approved alternative MRF-proposed protocols.
   B. Frequency: Examples from the literature review include monthly [2], quarterly [8], annually [3], or randomly as determined by Metro.
   C. Reporting: Metro develops a reporting template or accepts an alternative MRF-designed template. Upon completion of each audit the results are published using a designated reporting template provided by Metro. Trends are analyzed in an annual report. Supply data to DEQ and/or publish the data through appropriate means to encourage contamination reduction efforts.
   D. Validation: Metro or a contracted 3rd party representative observes and validates the methodology during the sort.
   E. Cost: Statistically representative manual inbound composition audits require both funding and time. Audits often require a full week entailing at least six sorters and a supervisor to conduct. Options for audit performance leadership include either the MRF or Metro to be performed either directly or utilizing a contracted third party.

OUTBOUND AUDITS

The following method effectively measures outbound capture rates and purity rates, and collectively are able to determine overall residue rates. Note: when measuring residue to determine capture rates, the methodology must include all residue streams. For example, a pre-sort residue stream and post-sort residue stream (e.g., "unders" and/or "fines") may need to be performed concurrently:

1. **Visual / Photo Inspection of Outbound Material Prior to Baling:**
   A. Description: Metro defines a standard requiring random visual inspection of each commodity / residue stream or "line." The MRF periodically conducts random visual inspection of each line, records the findings in an inspection log and takes documenting photos. This example is similar to a methodology described by one of the Metro area MRFs. It is also similar one of several measurement requirements at a MRF RFP for a U.S. county of 1.5 million residents and is used in the Toronto, Ontario MRF operating contract referenced in the literature review.
   B. Frequency: Options reviewed include MRF-led visual inspection of each commodity / residue stream 3[3] to 10 [1] times per month. Alternatively, the frequency is determined as a function of total throughput. For example, the Scottish Environmental Protection Agency requires a sample of each material stream taken between one in every 15 tons of material produced to one in every 60 tons of material produced, depending on the material. See supplemental Literature Review for more detail.
   C. Reporting: Metro develops an inspection log report template that includes time and date for each sample, material stream being sampled, estimated material weight, and a determination of the success or failure of the inspected material to meet the respective standards. Each log includes a photograph of the representative sample. The log forms the basis for ongoing reporting and tracking at MRFs for use in reporting to Metro. In this case the MRF prepares a summary monthly analyzing trends with final compilation into an annual report. The proposed

[3] US County with 1.5 million residents

reporting process is similar to reporting requirements from the Toronto RFP. Publication of the reports and the compiled data allows the community to better understand the commodities into which their recyclables are sorted.

D. Validation: Metro or designated 3rd party conducts announced or unannounced site visit to observe visual inspection process and review original inspection log.
E. Cost: MRF covers cost of inspection, tracking, and reporting. Metro covers cost of validation.

2. Ongoing "Grab Audits" of Outbound Materials Prior to Baling:

A. Description: This option requires the ongoing periodic sampling of each material stream just before going to the baler by taking material from the bunker that it's sorted into or other similar practice. Metro defines the sampling protocol or approved alternative MRF-proposed protocol. For example, each sample requires between 150 [8] and 550 pounds [1] of material. The material is brought to a designated sorting area within the MRF for sortation into categories including target commodity, outthrows, and prohibitives.
B. Frequency: Sampling requirements matches that described in option 1.
C. Reporting: Metro develops an audit report template including name of MRF, time, date, sample number, whether it is measuring capture, purity or residue rate, commodity grade (or residue), weight of target commodity, prohibitives and outthrows, and total capture, purity, or residue rate. Audit reports to be submitted monthly, including photos. Summary of audits and trends to be analyzed in an annual report.
D. Validation: Metro or designated 3rd party conducts announced or unannounced site visit to observe auditing process and review original audit reports.
E. Cost: MRF cover cost of audit, recording and reporting.

INBOUND AND OUTBOUND AUDITS

The following methods could measure all standards:

1. Full System Performance Test at MRFs:

A. Description: In this option a large quantity of program material is isolated on the tipping floor and the plant is cleared of all other material. The program material is processed through the plant and "grab samples" of up to 550 pounds are taken from each commodity / residue stream. When evaluated together, an entire spectrum of measurement is possible, including inbound contamination and outbound purity, capture, and residue rates. This approach is recommended by the Recycling Partnership [3] and is a requirement identified in the City of Toronto MRF [1]. It is extendable as a means of also measuring purity and residue rates. In this case, Metro defines the sampling protocol, sort categories, and provides reporting templates or accepts alternative MRF-proposed protocol.
B. Frequency: In the Toronto example 15 performance tests are required each year with no more than two per month. The Recycling Partnership recommends a full system audit annually.
C. Reporting: Metro develops an performance test report template including tabs for each different test (inbound, capture, purity and/or residue). Results of the performance test are required upon completion of each test and are summarized with trends analyzed and compiled in an annual report.
D. Validation: Metro or a 3rd party representative observe any of the performance tests.
E. Cost: MRF covers cost of performance test, recording and reporting.

2. Central Manual Audit Test Site:

A. Description: A manual audit test line is established at a central location at which all audit materials from all MRFs are audited. The test line is equipped with manual sorters. Like the manual inbound audit, statistically valid random samples of inbound material are collected at each MRF. In this option, however, the material is transported to the test site either in cubic yard boxes or in bales and sorted by the manual sorters following the same protocol as the Random Manual Inbound Sorting Option. This is similar to the RecycleBC model where there is a central audit site funded and operated by the Producer Responsibility Organization (PRO) [16].

B. Frequency: It follows the same frequency as the manual sorts, where examples include monthly, quarterly, annually, or randomly scheduled sorts, as determined by Metro.
C. Reporting: Reporting templates are developed by Metro. Upon completion of each audit the results are shared using the designated reporting template with Metro. Test site staff or Metro provides an annual report showing trends and progress against standards. Published data is used to encourage contamination reduction efforts.
D. Validation: Metro observes audits and reviews original reports as appropriate.
E. Cost: Metro establishes, funds and staffs the test site.

3. Central Audit Test Site with automated artificial intelligence visual recognition software and robotics:

A. Description: Similar to the Central Manual Test Site Option but reliant on emerging automation, artificial intelligence (AI), and visual recognition systems rather than manual sorting. An AI audit line established at a central location scans and audits inbound and outbound materials from all Metro MRFs. The test line is equipped with visual recognition systems and software for automated measurement of material flow.
B. Statistically valid random samples of inbound material is collected at the MRF, transported to the test site, and passed through the test line for evaluation. Sampling methodology mirrors that of the manual inbound composition audit.
C. Frequency: Follows the same frequency as the manual sorts, where examples include monthly, quarterly, annually, or randomly scheduled sorts, as determined by Metro.
D. Reporting: Reporting templates are developed by Metro based on the required data fields determined by the AI software package. Upon completion of each audit results are shared using the designated reporting template with Metro. Test site staff or Metro provide an annual report showing trends and progress. Published data is used to encourage contamination reduction efforts
E. Validation: As the AI equipment includes video, Metro accesses by right. Metro may also observe the audit site and accesses the collected data.
F. Cost: Metro establishes, funds, and staffs the test site.

FUTURE CONSIDERATION:

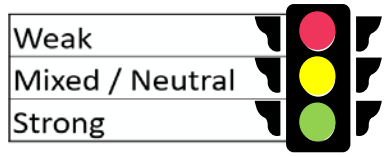
Integrating artificial intelligence (AI) monitoring into each MRF would greatly reduce the cost of each of these measurements. This technology is rapidly advancing and with increasing market availability. AI camera-gathering units placed at each exit or entry position could allow continued monitoring of capture rates in real time within a three-to-five-year time period.

Recycling Modernization Act Consideration: If state regulation allows for cost of compliance with Metro rules, including measurement and reporting requirements, to be part of the eligible processing cost under the processor commodity risk fee, the cost would be passed on to a Producer Responsibility Organization (PRO) through the processor commodity risk fee. This fee will be designed to cover all net processing costs (taking into account commodity revenues) to result in an average $0 tip fee.

The legislation does not provide PRO reimbursement of DEQ or Metro costs to administer and enforce MRF operating requirements. It would not prohibit the PRO from setting up and/or funding a central audit site, though it does not require that action. This is an area that Metro could seek to explore partnership with the PRO, for example, by housing such an audit site at a Metro transfer station in exchange for PRO to pay operating cost.

EVALUATION OF QUALITY REPORTING STANDARD OPTIONS

The following tables present an analysis of each option presented above based on the criteria defined in the methodology section:



Criteria	*Options*			
	Inbound Visual/Photo Inspection	***Manual Audit of Rejected Loads***	***Random Manual Inbound Contamination Audit***	***Outbound Visual/Photo Inspection***
Enforceable	All measurement requirements are enforceable	All measurement requirements are enforceable	All measurement requirements are enforceable	All measurement requirements are enforceable
Transparent / Accountable	Unable to provide statistical basis. This is more of a qualitative method.	This method can achieve statistically defensible results for highly contaminated loads.	This method can achieve statistically representative results.	Unable to provide statistical basis. This is more of a qualitative method
Effective	This gives a directional sense of contamination but does not adequately measure in a conclusive way.	This only applies to loads designate for rejection, not overall inbound contamination. It needs to be paired with visual inspection of each load.	This is the most effective measurement for determining the inbound contamination rate. It does not relate to a rejection standard.	Gives a directional sense of material quality but does not adequately measure in a conclusive way.
Responsible	Ensuring that highly contaminated loads are not entering the sort line supports environmental and worker safety concerns. This is a necessary piece of tracking inbound contamination as part of a load rejection standard.	Ensuring that highly contaminated loads are not entering the sort line would support environmental and worker safety concerns. This measurement is an important part of a rejection standard to validate the decision to reject a load.	Measuring inbound contamination is a step in the right direction but needs to be paired with actions to reduce contamination.	Measuring outbound contamination is a step in the right direction but needs to be paired with actions to increase capture and purity.
Operational Impact	This is not as costly or disruptive as other options, though it does require ongoing efforts by MRF staff.	This is more costly and disruptive than a visual inspection.	Conducting statistically representative audits is costly and impacts MRF operations	Not as costly or disruptive as other options, though it does require ongoing efforts by MRF staff.
Cost Impact				
Competitiveness	There is no clear competitive distinction between the inbound options	If loads become rejected there could be competitive disadvantages unless a level playing field is established.	There is no clear competitive distinction between the inbound measurement options	Measuring and controlling for outbound quality may result in more marketable material.

Criteria	Options			
	Ongoing Grab Audits of Outbound	**Full System Performance Test**	**Central Manual Audit Test Site**	**Central Automated Audit Test Site**
Enforceable	All measurement requirements are enforceable	All measurement requirements are enforceable	All measurement requirements are enforceable	All measurement requirements are enforceable
Transparent / Accountable	Ongoing audits gives the clearest picture of MRF operations.	The level of transparency is dependent on how frequently the Performance test is conducted and when it is conducted. If less than quarterly or if conducted during an atypical period (e.g., holidays, super bowl week) it provides a skewed picture of MRF operations.	Ongoing audits gives the clearest picture of MRF operations.	Ongoing audits gives the clearest picture of MRF operations.
Effective	Provides a statistically representative measure of outbound material quality to support any outbound standard.	Provides a statistically representative measure of inbound and outbound material quality to support any standard except the load rejection standard.	Provides a statistically representative measure of inbound and outbound material quality to support any standard except the load rejection standard.	If proven feasible, this is an effective way of measuring MRF performance relative to any quality standards, except the load rejection standard.
Responsible	Measuring outbound quality on an ongoing basis leads to better MRF performance.	Measuring outbound quality on regularly basis leads to better MRF performance.	Measuring outbound quality on regularly basis leads to better MRF performance.	Measuring inbound and outbound quality on regularly basis leads to better MRF performance.
Operational Impact	This requires ongoing effort to secure samples and conduct audits.	The most disruptive and costliest option, though that impact is lessened if measured less frequently.	Once the test line is set up, this option is imposing lesser impact on MRF operations than any options involving sorting at the MRF. The operational requirements include pulling random samples and coordinating transportation to the test site. This would be an effective way of	Once the test line is set up, this option is primarily relying on automation and avoids significant impact on MRF operations. The operational requirements include pulling random samples and coordinating for transport to the test site. Once at the test site measurement is

			measuring MRF performance relative to the standards.	automated and more efficient than manual sorting
Cost Impact	There are consistent labor costs to continuously pull and sort samples		Lower capital cost to set up than automated test site, but a much higher labor cost to conduct the audits. If this is paid for by a PRO under Recycling Modernization Act rules the cost may not be as significant of a barrier.	Most of the cost is expended on acquisition of the capital equipment and configuration of the test site. Minimal staffing requirements lead to lower operating costs.
Competitiveness	*Having a statistical measure of outbound quality may result in more marketable material if quality is achieved and measurement results are shared with end markets.*	*Having a statistical measure of outbound quality may result in more marketable material if quality is achieved and measurement results are shared with end markets.*	Having a statistical measure of outbound quality may result in more marketable material if quality is achieved and measurement results are shared with end markets.	Having a statistical measure of outbound quality may result in more marketable material if quality is achieved and measurement results are shared with end markets.

FACILITY-LEVEL REPORTING ON MATERIAL DESTINATION

Metro seeks to added transparency about the destination markets for recyclable materials processed in the region. This requirement is also defined by the Recycling Modernization Act [17]. The destination data currently reported through the Solid Waste Information System (SWIS) to Metro is limited in detail. SWIS allows MRFs to interpret destinations and indicate only the destination region. According to initial feedback, material brokers utilized by Metro MRF's show reluctance to participate in destination tracking for proprietary reasons. As a result, MRFs using brokers may not have information about which end market that the material is eventually sold. Metro cannot require brokers to report but could require the MRF to report this information.

Several options exist for reporting recyclable commodity material destinations, including the status quo. It is important to note that MRFs may view their end market relationships as proprietary, and therefore any company-specific market reporting should consider confidentiality. Where regional destinations are reported publicly based on geography in an aggregate fashion the confidentiality concerns diminish significantly.

REPORTING OF OUTBOUND DESTINATION BY GEOGRAPHIC AREA

1. Description: Require destination reporting by geographical area, consistent with the least detailed reporting occurring within current Metro standards.
2. Frequency: Monthly.
3. Reporting:
   A. MRF reports details through the Solid Waste Information System (SWIS) reporting platform.
   B. Suggested destination categories based on observed examples, including Recycle BC, which distinguishes between Organization for Economic Co-operation and Development (OECD) and non-OECD countries [16].
      - Domestic: Oregon
      - Domestic: West Coast
      - Domestic: Other
      - North America: Canada
      - North America: Mexico
      - Export: OECD country- name country
      - Export: Non-OECD country- name country
4. Validation: Metro has the right to audit physical records (e.g., bills of lading / scale tickets)

COMPANY-LEVEL REPORTING OF ALL INBOUND AND OUTBOUND SHIPMENTS

1. Description: Extend detail of SWIS reporting requirements to include company name and unique ID for all inbound and outbound shipments. This example comes from an RFP from a U.S. county with 1.5 million residents and the statewide California Recycling and Disposal Reporting System (RDRS) requires reporting of end markets and brokers including company name and contact info [13]. See Appendix C for RDRS template.
2. Frequency: Annually
3. Reporting: Each inbound and outbound end-market is provided their own unique ID account number. The SWIS reporting form includes company name / ID in SWIS reporting form drop down and defines timely process for requesting new entries.
4. Validation: Metro audits physical records (e.g., bills of lading/ scale tickets) to validate reports.

MASS BALANCE REPORTS WITH COMPANY-SPECIFIC INFO PROVIDED IN AGGREGATE

1. Description: MRFs provide reports every six months listing material received and the downstream flow of each material type, including the buyer's name and address. Instead of providing transaction detail, the aggregate flow of each type of material to each receiving company is identified. This option is taken from e-waste tracking in Connecticut and New Jersey [14]. Studies of state e-waste programs

have identified this as a best practice for reporting [14]. Though this is a new application of that method for use in a MRF, it draws from information that MRFs are likely already tracking.

2. Frequency: Every 6 months.
3. Reporting: Metro develops a reporting template to be used by the MRF for submitting a semi-annual report following secure data protection protocols:
   A. The template collects the following information:
      - Tab 1: Received
        i. Total materials received (tonnage),
        ii. Type of material (comingled single family, comingled multi family, comingled commercial)
        iii. Name of delivery hauler
      - Tab 2: Recycled
        i. Materials shipped (material grade) domestically and to whom (specific company name and location)
        ii. Materials shipped export (material grade) and to whom (specific company name and location)
      - Tab 3: Disposed:
        i. Total materials transported to landfill including name of facility (company name and location)
      - Tab 4: Rejected
        i. In circumstances when the inbound load is rejected that information is identified in this report indicating the collection service provider and weight of the load
      - Tab 5: Stored
        i. Material stored at the MRF at the end of the reporting period is reported , including material grade and stored location (e.g., at MRF or another area)
      - Tab 6: Certification
        i. The veracity of the form is certified to assure validity
4. Validation: Metro audits physical records (e.g., bills of lading/ scale tickets) and validates the reports.

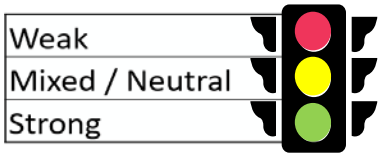
BILL OF LADING REPORTING

1. Description: In this option every transaction is reported and supported by a bill of Lading. This approach is used in the tracking of universal waste in Maine [14]. Although this approach requires a new application of an established reporting method, it draws from information the already collected from the MRF. It may be challenging to acquire complete records and enforce this policy, because each facility has potentially dozens of transactions per day. Studies of state e-waste programs have identified challenges in obtaining complete records and challenges enforcing the policy [14].
2. Frequency: Every 6 months.
3. Reporting: MRFs submit a report including each transaction using scale ticket number (inbound) and bill of lading (outbound) and the grade of material and weight.
4. Validation: Metro audit physical records (e.g., bills of lading/ scale tickets) and validate the report.

Recycling Modernization Act Consideration: Statute requires both MRFs and PROs to report on final destination of materials to responsible end markets. PROs must provide information quarterly and in an annual report. The frequency of MRF end market data will be determined in the rulemaking process. Proprietary information on final end markets is explicitly listed as not subject to public disclosure, though information can be reported in aggregate.

EVALUATION OF DESTINATION REPORTING OPTIONS

The following tables present an analysis of each option presented above based on the criteria defined in the methodology section:



Criteria	Options			
	Reporting by Geographical Area	**Company-Level Reporting**	**Mass Balance Reporting**	**Bill of Lading Reporting**
Enforceable	All reporting requirements are equally enforceable.	All reporting requirements are equally enforceable. Challenge is getting information from brokers.	All reporting requirements are equally enforceable. Challenge is getting information from brokers.	All reporting requirements are equally enforceable. Challenge is getting information from brokers.
Transparent / Accountable	Reporting regionally does not reveal if a market is responsible.	It is transparent/accountable, effective, and responsible to the extent that it captures final destination but limited without ensuring details of destination for materials flowing through brokers.	It is transparent/accountable, effective, and responsible to the extent that it captures final destination but limited without ensuring details of destination for materials flowing through brokers	It is transparent to the extent that it captures final destination but limited without ensuring details of destination for materials flowing through brokers.
Effective				In practice it is very difficult to get the full picture of material flow through bill of lading reporting.
Responsible				It is responsible to the extent that it captures final destination, but limited without ensuring details of destination for materials flowing through brokers
Operational Impact	Least amount of time and effort	Reporting each transaction is more costly and time consuming.	Annual reporting on aggregate requires less effort than monthly reporting of every transaction	Reporting each transaction is more costly and time consuming
Cost Impact	Least amount of time and effort	Reporting each transaction is more costly and time consuming.	Reporting on aggregate requires less effort than reporting of every transaction	Reporting each transaction is more costly and time consuming

Competitiveness	 Destination reporting has no direct impact on competitiveness.	 Destination reporting has no direct impact on competitiveness. Revealing end markets to competitors is a concern if data is not handled securely.	 Destination reporting has no direct impact on competitiveness. Revealing end markets to competitors is a concern if data is not handled securely.	 Destination reporting has no direct impact on competitiveness. Revealing end markets to competitors is a concern if data is not handled securely.

FACILITY LEVEL REPORTING ON WORKFORCE WAGES AND DEMOGRAPHICS

Most MRFs licensed by Metro utilize both temporary and permanent workers. Tracking the use of temporary workers in MRFs is difficult, in part, because turnover is high. However, the interviewed MRFs noted that they have data about employment status, though the data is not organized or compiled into a formal report. Nationally, MRF operators have reported relying on employment agencies to staff their lines with temporary workers. This situation is common even in circumstances where MRF operators prefer to secure more permanent employees [25].

According to interviews for this briefing, some area MRFs report information on workforce wages to the Oregon Refuse and Recycling Association (ORRA) for an annual survey. The research team was unable to verify the level of detail provided, as the survey results are only available to ORRA members.

The lack of workforce reporting is a gap that inhibits Metro's ability to work towards RWP Goals 3 and 4:

- **RWP Goal 3**: Ensure that all jobs in the garbage and recycling industry pay living wages and include good benefits.
- **RWP Goal 4**: Increase the diversity of the workforce in all occupations where people of color, women, and other historically marginalized communities are underrepresented [18].

The following options may be considered for facility-level reporting on workforce demographics and wages at licensed MRFs:

1. **Aggregated Annual Equal Opportunity Employment Commission (EEOC-1) Report With *Component 2* Wage Information:**
    A. Description: This option models itself on one that was passed as federal legislation during the Obama administration to support equal pay – the Lilly Ledbetter Fair Pay Act. Although reversed in 2017, it has since been enacted in California (SB 973 passed in September 2020[4] [21]). Under this approach, licensed MRFs are required to submit an annual Employer Information Report (EEO-1) with component 2 reporting requirements. Component 2 reporting includes information on pay data by job category, gender, ethnicity, and race.
    B. Reporting Details: This option requires MRFs to submit an annual report including the aggregate number of employees by race, ethnicity, and sex separated into the 12 pay bands used by the U.S. Bureau of Labor Statistics in the Occupational Employment Statistics Survey. See Appendix C for a sample report template.
2. **Detailed Monthly Workforce Indicator Report:**
    A. Description: A similar reporting requirement was recently issued by Metro to a contracted Transfer Station Operator. Following that approach, licensed MRFs submit monthly reports with employee-specific information on workforce demographics and wages. Each report includes details of each employee using a unique employee ID number to preserve personal information.
    B. Reporting Details: Metro should develop a standard excel template to collect the following data points:
        i. Sex/Gender
        ii. Age
        iii. Race/Ethnicity
        iv. Full time/ Part time
        v. Status (regular, temp or 3rd party staffing company)
        vi. Job Category (see suggested categories on the following page)
        vii. FLSA Status (hourly or salary)
        viii. Hourly Wages or Salary

[4] The regulation requires pay reporting requirements for employers with 100 or more employees. They must submit the report to the department of Fair Employment and Housing (DFEH)

ix. Average Weekly Hours
x. Non-Cash Benefits
xi. Length of Service (years)

3. **Required Participation in Annual Workforce Survey Conducted by Metro:**
   A. Description: An alternative option for obtaining workforce information suggests that Metro conduct an annual survey. Information elicited during the survey is similar to that detailed in Options 1 and 2. Participation in the survey can be optional or required as a condition of the facility license. There were no specific examples of this approach found in the literature review.
   B. Reporting Details: MRFs provide the details requested in the Metro survey, which could draw from the examples noted in Options 1 and 2.

VALIDATION:
Metro requires that payroll records be available for to audit upon request. This example was found in a processing RFP for a U.S. county with 1.5 million residents.

CONFIDENTIALITY:
All employee-related information must be handled with sound data security protocols. Reports are submitted using a secure, password protected online portal. Data should only be accessible to specifically designated WPES employees. Metro should enter into an NDA agreement with each licensed MRF detailing the security procedures.

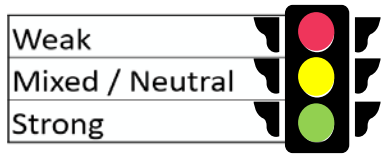
Personal information such as name and social security numbers should always be redacted, and a unique employee ID number should be used where employee-specific data is required.

JOB CATEGORIES
Validation occurs for the following general job categories:

- Sorter / General Laborer
- Custodial
- Equipment Operator
- Engineer / Technician
- Administrator
- Management

THIRD PARTY WORKFORCE PROVIDER:
Based on interviews with Metro-licensed MRFs, at least two of the four companies utilize a 3rd party staffing company to provide labor. This complicates the process of getting complete information, as the MRF needs to seek more detailed information concerning those employees. None of the examples identified through the research effectively addressed this issue. Metro cannot require the 3rd party to report but could require the MRF to report this information.

EVALUATION OF WORKER WAGE AND DEMOGRAPHIC REPORTING OPTIONS
The following tables presents an analysis of each option presented above based on the criteria defined in the methodology section:



Criteria	Options		
	Aggregated Annual Report	**Detailed Monthly Report**	**Annual Workforce Survey**
Enforceable	All reporting requirements are equally enforceable.	All reporting requirements are equally enforceable.	All reporting requirements are equally enforceable.
Transparent / Accountable	Provides desired data on wages and demographics for full-time workers. Does not ensure data on temporary staff provided by 3rd party, nor include details of non-wage compensation or benefits.	Includes more data of interest such as non-wage benefits. Does not ensure information about temporary workers without requirement placed on 3rd party labor provider.	Provides desired data on wages and demographics for full-time workers. Does not ensure data on temporary staff provided by 3rd party, nor include details of non-wage compensation or benefits.
Effective	Provides desired data on wages and demographics for full-time workers. Does not ensure data on temporary staff provided by 3rd party, nor include details of non-wage compensation or benefits.	Uncertain whether reporting of temporary staff hired through 3rd party is possible through the MRF directly.	Provides desired data on wages and demographics for full-time workers. Does not ensure data on temporary staff provided by 3rd party, nor include details of non-wage compensation or benefits.
Responsible			
Operational Impact		Requires more administrative time to complete by the MRF and Metro. It also may be challenging to get detailed information on workers provided by a 3rd party.	
Cost Impact	Less burdensome option to get data on wages and demographics for MRF workers.		Less burdensome option to get data on wages and demographics for MRF workers.
Competitiveness	Workforce wage and demographic reporting has no direct impact on competitiveness.	Workforce wage and demographic reporting has no direct impact on competitiveness.	Workforce wage and demographic reporting has no direct impact on competitiveness.

SEQUENCE OF STANDARD ADOPTION

An implementation schedule could include the following stages[5]:

1. Baseline data collection: In order to measure progress, Metro establishes the baseline. Once the standards are established by the Metro Council, Metro develops data collection sheets and mechanisms, and baseline data collection are planned and executed. Six to twelve months after the adoption of the new requirements are required to develop the data / improve collection system.
2. Initial reporting requirements: MRFs report their baseline data as the initial report under the new requirements. This baseline reporting takes place after baseline data collection, twelve to eighteen months after adoption of the new requirements.
3. Standard implementation and enforcement: Following the initial report, MRFs integrate regular measurement and reporting into all operations using metrics identified in the reporting requirements. Metro reviews reports, identifies areas of improvement, and communicates with MRFs on necessary course corrections. Initial enforcement efforts focus on warnings or other official notifications to ensure appropriate attention by the regulated MRFs. Metro phases more aggressive enforcement (i.e., fines and penalties) after two to three years of measurement and reporting.

Recycling Modernization Act Consideration: All requirements under the permit and certification programs established in the legislation take effect July 1, 2025, following a study period associated with the contamination management fee, commodity risk fee and contamination reduction program, among other things. All MRFs must participate in the study and be permitted or certified if they wish to be eligible for receiving a contamination management fee and processor commodity risk fee. It is likely that the study will include baseline data on inbound contamination rates and outbound quality from Metro licensed MRFs. The specific timing of the contamination study is not listed in the statute, though it must be completed by July 1, 2025.

[5] This timeline is not reflective of Metro's assumptions. It is a recommended approach from the research team's perspective.

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[4] SWANA and NW&RA, "Joint Advisory on Designing Contracts for Processing of Municipal Recyclables," 2018.
[5] SEPA, "Material Recovery Facilities Testing and Reporting Guidance," 2015.
[6] City of Santa Clara, "Agreement for Services Between the City of Santa Clara, California, and Greenwaste Recovery, Inc.," no. 1. pp. 1–9, 2020.
[7] G. Hase, "After City Hall fight, California Waste Solutions wins another year in San Jose," San José Spotlight, Feb. 21, 2019. https://sanjosespotlight.com/after-city-hall-showdown-california-waste-solutions-wins-another-year-in-san-jose/ (accessed Jul. 13, 2021).
[8] City of San Jose, "Agreement Between the City of San Jose and California Waste Solutions, Inc. for Recycle Plus SFD Recycling Collection Services." 2011.
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[20] L. Epps & Coulson, "California Requires Reporting of Pay Data by 3/31/2021," eppscoulson.com, Oct. 12, 2020. https://eppscoulson.com/california-requires-reporting-of-pay-data-by-3-31-2021/ (accessed Jul. 13, 2021).
[21] State of California, "SB-973 Employers: annual report: pay data.," https://leginfo.legislature.ca.gov/, Sep. 30, 2020. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200SB973 (accessed Jul. 13, 2021).

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APPENDICES

APPENDIX A: INBOUND CONTAMINATION RATES FROM US AND CANADA

STATE / PROVINCE-WIDE

EPR for PPP	Jurisdiction	Year	Contamination Rate	Methodology
BC	Province Wide	2018	8.23%	Outbound Residue Calculation of program material[6]
Ontario	Province wide	2018	9.8% for multi-stream 20.3% for single stream	Outbound Residue Calculation of program material [7]
Quebec	Province Wide	2018	18%	Outbound Residue Calculation of program material [8]
Non-EPR	**Jurisdiction**	**Year**	**Contamination Rate**	**Methodology**
Alberta	Province Wide	N/A	10% in multi stream 20% or higher for single stream	Survey of 13 commercial waste management organizations[9]
Oregon	Statewide	2019	11%	TRP inbound contamination survey of select municipalities[10]

[6] http://recyclebc.ca/wp-content/uploads/2019/06/Recycle-BC-2018-Annual-Report-1.pdf. Residue includes material managed by disposal only. There were 6,185 tonnes of material managed by recovery as engineered fuel (3.07%), which is not considered as residue, as the material is accepted in the program.

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[9] *Extended Producer Responsibility for Residential Packaging and Paper Products: Alberta Collaborative Extended Producer Responsibility Study*, Eunomia, March 2020

[10] https://recyclingpartnership.org/stateofcurbside/

Washington	Statewide	2019	9%	TRP inbound contamination survey of select municipalities[11]
US	Nationwide	2019	17.67% cart, 12.67% bin/bag, 16.9% average	TRP inbound contamination survey of select municipalities[12]

CITY / COUNTY

EPR Jurisdiction	State / Province	Year	Rate	Methodology
Vancouver	BC	2017	4.60%	Inbound Recycling Composition Audit [13]
Surrey	BC	2017	10.90%	Inbound Recycling Composition Audit [14]
Sudbury	ON	2017	3.27%	Inbound Recycling Composition Audit [15]
Niagara Region	ON	2016	4.80%	Outbound Residue Calculation[16]

[11] ibid
[12] ibid
[13] https://recyclebc.ca/what-is-contamination/
[14] ibid
[15] https://www.greatersudbury.ca/live/garbage-and-recycling/reports-and-publications/waste-diversion-plan-june-2018/
[16] https://www.niagararegion.ca/government/committees/wmac/pdf/2018/WMPSC-C-14-2018-Appendix-A.pdf

Ottawa	ON	2019	7.5%	Outbound Residue Calculation [17]
Winnipeg	MB	2019	15%	Inbound Recycling Composition Audit[18]
Winnipeg	MB	2017-2019 3-year rolling avg	19%	Inbound Recycling Composition Audit [19]
Brandon	MB	2017-2019 3-year rolling avg	18%	Inbound Recycling Composition Audit [20]
<20,000 pop in Manitoba	MB	2017-2019 3-year rolling avg	13%	Inbound Recycling Composition Audit of 10 communities [21]
Saskatoon	SK	2018	13%	Inbound Recycling Composition Audit [22]
Regina	SK	2019	10%	Recycling Cart Audit[23]
Non- EPR Jurisdiction	**State / Province**	**Year**	**Rate**	**Methodology**
Calgary	AB	n.d.	12-15%	Outbound Residue Calculation [24]
Edmonton	AB	2020	20%	Inbound Recycling Composition Audit [25]
Halifax	NS	2017	19%	Unknown[26]

[17] Email exchange with Cam Neale, City of Ottawa Solid Waste Services
[18] Email exchange with Mark Kinsley, Supervisor of Waste Diversion for the City
[19] Email exchange with Martin Racicot, Director of Field Services, MMSM
[20] ibid
[21] Ibid
[22] https://www.saskatoon.ca/sites/default/files/documents/2018_integrated_waste_management_report.pdf
[23] https://www.regina.ca/export/sites/Regina.ca/home-property/recycling-garbage/.galleries/pdfs/waste-plan-regina-update.pdf
[24] https://www.calgary.ca/UEP/WRS/Pages/Recycling-information/Residential-services/Blue-cart-recycling/How-Recycling-Works.aspx
[25] Email exchange with Michael Robertson, MRF contract manager, City of Edmonton
[26] https://globalnews.ca/news/3952709/almost-19-of-materials-sent-to-halifax-recycling-plant-get-thrown-out/. Follow up attempt was made to the City and will be updated if more information is obtained.

Portland Metro	OR	2014/15 (SF) - 2016/17 (MF)	9% SF; 14% Commercial; 21% MF	Inbound Recycling Composition Audit [27]
Jackson County[28]	OR	2020	9%	Inbound Recycling Composition Audit [29]
Seattle	WA	2015	10%	Inbound Recycling Composition Audit[30]
Spokane	WA	2020	13%	Unknown[31]

[27] https://www.oregonmetro.gov/sites/default/files/2017/08/01/AppendixC_MultifamilyWasteCharacterizationStudy.pdf; https://www.oregonmetro.gov/single-family-recycling-and-waste-composition-studies-2014-15; https://www.oregonmetro.gov/sites/default/files/2020/05/21/commercial-mixed-recyclables-composition-study-20200521.pdf

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[30] https://www.seattle.gov/Documents/Departments/SPU/Documents/2015ResidentialRecyclingStreamCompositionStudy.pdf

[31] https://www.spokesman.com/stories/2020/apr/28/recycling-project-aims-to-help-spokane-focus-on-pu/

APPENDIX B: SAMPLE OUTBOUND REPORTING FORM FROM CALIFORNIA RDRS SYSTEM:

Reporting Entity	Inflow/Outflow	In-state /out-of-state	Must report	What to report	Notes
Recycling and Composting Facilities and Operations	Outflow	In-state	Solid waste disposal	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	In-state	Recycling and composting	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	In-state	End users	Tons by material type and end user category by region	
Recycling and Composting Facilities and Operations	Outflow	In-state	Non-green beneficial reuse	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	In-state	Green beneficial reuse	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	In-state	Brokering/transporting	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	In-state	Designated waste disposal	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	In-state	Disaster debris disposal	Tons by material type and RDRS #/contact information	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Solid waste disposal	Tons by material type and RDRS#/contact information	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Recycling and composting	Tons by material type and region	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	End users	Tons by material type and end user category by region	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Non-green beneficial reuse	Tons by material type and RDRS#/contact information	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Green beneficial reuse	Tons by material type and RDRS#/contact information	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Brokering/transporting	Tons by material type and RDRS#/contact information	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Designated waste disposal	None	
Recycling and Composting Facilities and Operations	Outflow	Out-of-state	Disaster debris disposal	None	

APPENDIX C: SAMPLE EEO-1 COMPONENT 2 REPORT TEMPLATE

*Note: this report could be adapted to include a more inclusive set of gender options, including Male, female, Transgender, Non-binary or Other

Job Category	Salary Compensation Band	Number of Employees (Report Employees in only one category)														
		Race / Ethnicity														Total (col. A-N)
		Hispanic or Latino		Non-Hispanic or latino												
				Male						Female						
		Male	Female	White	Black or African American	Native Hawaiian or Pacific Islander	Asian	Native American or Alaska Native	Two or More Races	White	Black or African American	Native Hawaiian or Pacific Islander	Asian	Native American or Alaska Native	Two or More Races	
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Sorter / General Laborer	1. $19,239 and under															
	2. $19,240 - $24,439															
	3. $24,440 - $30,679															
	4. $30,680 - $38,999															
	5. $39,000 - $49,919															
	6. $49,920 - $62,919															
	7. $62,920 - $80,079															
	8. $80,080 - $101,919															
	9. $101,920 - $128,959															
	10. $128,960 - $163,799															
	11. $163,800 - $207,999															
	12. $208,000 and over															
Equipment Operator	1. $19,239 and under															
	2. $19,240 - $24,440															
	3. $24,440 - $30,680															
	4. $30,680 - $38,1000															
	5. $39,000 - $49,920															
	6. $49,920 - $62,920															
	7. $62,920 - $80,080															
	8. $80,080 - $101,920															
	9. $101,920 - $128,960															
	10. $128,960 - $163,800															
	11. $163,800 - $207,1000															
	12. $208,000 and over															
Engineer / Technician	1. $19,239 and under															
	2. $19,240 - $24,441															
	3. $24,440 - $30,681															
	4. $30,680 - $38,1001															
	5. $39,000 - $49,921															
	6. $49,920 - $62,921															
	7. $62,920 - $80,081															
	8. $80,080 - $101,921															
	9. $101,920 - $128,961															
	10. $128,960 - $163,801															
	11. $163,800 - $207,1001															
	12. $208,000 and over															