



CIF Project # 1090: Inbound Contamination Definition & Impact Analysis



2020

Project Overview

Blue Box contamination presents a challenge for both collection and processing contracts. It is an issue that is central to most contract performance discussions.

EcoCompass Consulting was retained to develop contamination definitions along with considerations for audit methodologies and a financial impact assessment. Members of the Regional Public Works Commissioners of Ontario's (RPWCO) Waste Subcommittee, who acted as a steering committee on this project, were consulted for input on these as they were developed.

The initial project scope contemplated phases of work including the development of a compensation model and the ground truthing of that model. Ultimately these phases were not actioned as a common set of modelling principles could not be arrived at due to the complicated variables associated with such an exercise. The modelling exercise was also considered to be of limited utility because municipalities were constrained by their existing contracts and unable to introduce new payment adjustment mechanisms. Municipalities were satisfied with limiting the scope to the definitions and audit methodology consideration work.

Summary of Project Learnings

Typically, contamination is classified into one of three categories:

1. Prohibitive and unsolicited materials (e.g., dirt, rubber hoses, wood waste)
2. Recyclable but difficult to sort or market materials (e.g., black plastics, polystyrene, bottle caps, coffee cups, pods, small fibre size, wet strength fibre, laminated/poly-lined fibre, plastic/laminated pouches, and tissue/wrapping paper)
3. Degraded or contaminated recyclable materials (e.g., wet fibre, fibre coated with organic material, product in a container)

The three "contamination" categories are used interchangeably for various purposes and that contributes confusion between operators, contractors, and end markets. Therefore, the key takeaways of this study are that: 1) consensus is needed on definitions before engaging in contamination related discussions, and 2) careful consideration should be given to how audits at the curb and MRF are carried out.

What follows are two appendices which contain the research outcomes:

- Phase 1: Contamination Definitions
- Phase 2: Audit Methodology Considerations, Part 1 & Part 2

Important note:

- Part 1 outlines different methodologies used.
- Part 2 outlines specific purposes of each methodology (i.e., one approach will not suffice). Municipalities must pick the methodology that works for them and factor in the "materials without consensus" and "MRF equipment limitations".

PHASE 1: CONTAMINATION DEFINITIONS

CIF Defining and Measuring Contamination Study

Background

The packaging mix supplied into Ontario, and globally, continues to evolve as producers lightweight their packaging and develop more complex multi-layered packaging in an effort to conserve resources (and therefore reduce costs), while also maintaining the integrity and safety of their products. However, this complexity has resulted in increasing sorting costs and greater challenges for municipalities and MRF operators to produce high quality bales.

In addition, China's implementation of its National Sword (2017) and Blue Sky (2018) Policies, which banned the importation of various postconsumer recyclables, resulted in export and domestic markets tightening their specifications for post-consumer commodities. Municipalities and MRF Operators have identified high levels of incoming contamination as the leading cause of increasing sorting costs and are seeking solutions at identifying and measuring their impacts.

The Continuous Improvement Fund (**CIF**) and Regional Public Works Commissioners of Ontario (**RPWCO**) have retained EcoCompass Inc. and Circular Matters LLC (**the Project Team**) to consult with key stakeholders on providing a consistent understanding of what contamination is and to develop a methodology for measuring it. This information will be valuable for all stakeholders as Ontario transitions to Individual Producer Responsibility (IPR).

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Based on this understanding, the Project Team surveyed municipalities and also reviewed key documents provided by various organizations including Institute of Scrap Recycling Industries (**ISRI**), the Association of Plastic Recyclers (**APR**), and Novelis on key issues around contamination within commodities. The following section outlines the preliminary findings.

Preliminary Findings

As a starting point, the Project Team recognized the term “contamination” is used interchangeably for various purposes that contributes to additional confusion in the market. The following terminology has been provided based on ISRI definitions for unwanted and/or undesirable materials within the inbound stream or within commodities.

Terminology

Contamination (Inbound)

- Defined as any material not considered acceptable in the specification unless specifically agreed to in writing between buyer and seller.

Outthrows

- Defined as materials that are undesirable for consumption for the grade specified. Typically consists of other compatible recyclables found within a grade.
- Examples: Corrugated cardboard within Sorted Residential Paper #56

Prohibited / Prohibitive Materials

- Defined as items never allowed and includes any material that contains medical, organic, food, hazardous, poisonous, radioactive, or toxic waste and other harmful substances or liquids.
- Examples: Sharps and Needles, batteries, hazardous materials, etc.

Inbound Contamination Materials (General Consensus)

There was consensus that the following materials were considered as Inbound Contamination regardless of municipal program characteristics:

<ul style="list-style-type: none"> • Sharp and Needles • Batteries • Tanglers (includes electrical cords, VHS Tapes, garden hoses, caution tape, streamers, and chains) • Medical waste • Compressed gas cylinders • Pesticides, poisons, biohazards • Electronics 	<ul style="list-style-type: none"> • Radioactive materials • Hazardous materials • Corrosives • Refrigerants • PCB containing capacitors, transformers, ballast • Asbestos • Materials that may be damaging to equipment 	<ul style="list-style-type: none"> • Wood • Ceramics • Large items • Rock, dirt, concrete • Wax • Food Waste or other items that can otherwise be composted
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Commodity Specific Contamination (General Consensus)

The following table focuses on common materials typically found within commodities, and whether they are Outthrows or Prohibitive Materials in the identified commodities.



Accepted in commodity



Not desired within commodity
(Outthrows)



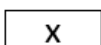
Contamination and/or not commonly
found within commodity
(Prohibitive Materials)

Market Grades	OCC	Mixed Paper	Sorted paper/ news	Cartons	Bulky rigids	PET bottles	HDPE bottles	PP	Mixed rigid plastics	Film	Scrap metal	Food cans	UBCs	Foil	Glass
GRADE-SPECIFIC CONTAMINANTS															
Newspapers	X														
Magazines & Telephone Directories	X														
Sunburned newspapers or > four months	X	X	X												
Waxed OCC	X	X													
Boxboard	X		X												
Papers/containers/pizza boxes with "excess" grease or food residue	X	X	X												
Polycoated paper cups, refrigerated boxboard	X	X	X	X											
Cartons	X	X	X												
Wet paper (>12% moisture)	X	X	X	X											
Containers with residual contents					X	X	X	X	X			X	X		

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GRADE-SPECIFIC CONTAMINANTS															
Plastics with degradability additives					X	X	X	X	X	X					
Plastic containers that have held motor oil or hazardous chemicals					X	X	X	X	X	X					
Addition of mineral fillers					X	X	X	X	X	X					
#7 Other						X	X	X	X						
PETG containers or labels						X									
Colors other than clear, green, light blue						X									
Full bottle sleeve labels						X	X	X	X						
Film other than polyethylene										X					
Non-packaging scrap metal															
Aluminum foil and trays													X		
Aluminum foil and trays with food contamination													X	>5%	
Aerosol cans under pressure												X			
Aluminum cans with plastic components or sleeve labels													X		
Aluminum can moisture													>4%		



Accepted in commodity



Not desired within commodity
(Outthrows)



Contamination and/or not commonly
found within commodity
(Prohibitive Materials)

Materials without Consensus

The following table summarizes several materials where municipalities provided inconsistent messaging on whether they are considered contamination within their programs. The variations in responses were typically linked to specific program characteristics.

Material	Response
Bagged Recyclables	Most programs will not accept opaque or black garbage bags, only clear bags; some will not accept bagged recyclables at all.
Black Plastics	Varies by municipal program. Large programs tend not to accept it
Shredded Paper	Some programs accept bagged shredded paper; some do not accept it curbside but will accept it at drop-off depots. Some programs accept Shredded Paper within organics program.
EPS and rigid PS packaging	Varies by municipal program; some programs only accept at drop-off depots.
Beer and LCBO Containers	Most encourage residents to return to The Beer Store, but also accept it in their curbside program.
Small Materials	Some programs indicate materials should be bigger than 2-3 inches
Bottle Caps	Most programs encourage residents to leave bottle caps on. Note: Raises concerns of containers not being emptied or not compacting in truck.
Pizza Boxes	Larger programs indicate grease should not exceed a certain threshold; mid-size programs indicate it has not been an issue.

PHASE 2: AUDIT METHODOLOGY CONSIDERATIONS

PART 1



CIF # 1090 – Inbound Contamination Definition & Impact Analysis

Deliverable #2 – Developing an Audit Methodology
STATUS UPDATE

Prepared by:



ECOCOMPASS

Agenda

- Project Update
- Material Flows
- Audit Methodologies
 - Visual Inspections at the Curb
 - Curbside Waste Audit
 - Visual Inspections at Transfer Stations / MRFs
 - Inbound Audit
 - Bale / Bunker Audit
 - Time and Motion Study
 - MRF Mass Balance and Efficiency Audit
- Next Steps

Project Update

- On-going discussions to define contamination:
 - Service Providers;
 - Brokers;
 - End Markets;
 - Industry Associations; and,
 - Other Stakeholders.
- Currently developing a draft audit methodology.
- Several key considerations to be discussed:
 - Identifying the Issue;
 - Ownership / Responsibility of Material;
 - Impact on Sorting;
 - Impact on Commodity Revenue

Material Flow



Resident



Collector



Transfer
Station



MRF

Visual Inspections at the Curb

- **Description:** Staff are deployed on days of collection to visually inspect materials placed out by residents. Bins can be tagged and left behind if visible contamination crosses a certain threshold.
- **Audit Location:** Curbside
- **Responsibility for Materials:** Resident
- **Pros:**
 - Relatively inexpensive, no equipment needed.
 - Can (should) be done frequently.
 - Can correct disposal behaviour at the source.
 - Provides insight into all waste streams.
- **Cons:**
 - Staff can only see the “surface” of the bin.
 - Doesn’t consider impact collection has on materials (i.e. breaks glass, rips bags).
 - Doesn’t identify how contamination may impact sorting or commodity value.

Curbside Waste Audit

- **Description:** An audit crew is deployed to collect all materials placed by residents at the curb (typically over a one or two-week period). Households are typically selected based on specific demographic criteria to represent the average mix within the municipality.
- **Audit Location:** Curbside
- **Responsibility for Materials:** Resident
- **Pros:**
 - Provides detailed breakdown of materials placed at the curb.
 - Provides insight into disposal habits within other waste streams.
 - Can correct disposal behaviour at the source.
- **Cons:**
 - Can be expensive.
 - Limited in the number of households to be audited.
 - Doesn't identify how contamination may impact commodity value.

Visual Inspections at Transfer Station / MRF

- **Description:** Staff visually inspect the materials tipped at the transfer station or the MRF. If contamination is observed, the materials can be manually pulled off or rejected.
- **Audit Location:** Transfer Station / MRF
- **Responsibility for Materials:** Collector
- **Pros:**
 - Fairly inexpensive to implement.
 - Removes contamination before being sorted and improves material quality.
 - Prevents damage to sorting equipment.
- **Cons:**
 - Staff typically can only see larger materials.
 - Doesn't identify how contamination may commodity value
 - Doesn't provide insight into other waste streams (if done at the MRF or transfer station for recyclable materials only).
 - May not represent the materials sorted at MRF (if done at the transfer station).
 - May not identify residual materials left within recyclable materials.

Inbound Audit

- **Description:** Samples can be taken directly from collection trucks or from materials already tipped onto the tip-floor.
- **Audit Location:** Transfer Station / MRF
- **Responsibility for Materials:** Collector
- **Pros:**
 - Less expensive than curbside waste audits while providing similar level of detail.
 - Closest representation of the mix of materials to be sorted (clear transfer of ownership).
- **Cons:**
 - May need multiple samples to get same representation as curbside audit.
 - Doesn't provide insight into other waste streams.
 - Doesn't identify how contamination may impact sorting or commodity value.

Bale / Bunker Audit

- **Description:** Samples are taken from bales/bunkers after the materials have been sorted under normal operations.
- **Audit Location:** MRF
- **Responsibility for Materials:** MRF Operator
- **Pros:**
 - Quantifies contamination found within commodities.
 - Quantifies cross-contamination of materials into commodities.
 - Relatively inexpensive to undertake.
 - Allows for estimating impact to commodity value.
- **Cons:**
 - Doesn't measure the impact contamination has on sorting operations.

Time-and-Motion Study

- **Description:** Each manual sorter is observed as they positively pick through targeted materials. This is done over a specific time period (2 - 3 minutes).
- **Audit Location:** MRF
- **Responsibility for Materials:** Collector and/or MRF Operator
- **Pros:**
 - Quantifies effort to manage and remove contamination.
 - Fairly inexpensive to undertake, only requires timer and a counter (i.e. click counter).
- **Cons:**
 - Can only measure positively picked materials (not negatively sorted).

MRF Mass Balance and Efficiency Audit

- **Description:** A sample is pulled from the tip floor and run through the entire MRF to represent normal operations. Each bale / bunker is emptied before and after the study to measure inbound composition, bale / bunker composition, as well as effectiveness of MRF equipment and sorters.
- **Audit Location:** MRF
- **Responsibility for Materials:** Collector and/or MRF Operator
- **Pros:**
 - Combines multiple studies into one.
 - Quantifies impact of contamination on sorting and commodity value.
- **Cons:**
 - Cost is similar to curbside waste audit.
 - Requires downtime at the MRF (half a day to a full day).

Responsibility



Resident

- Visual Inspection
- Curbside audit

Collector

- Visual Inspection
- Inbound Audits

Transfer Station

- Visual Inspection
- Inbound Audits

MRF

- Visual Inspections
- Inbound Audits
- Bale / Bunker Audits
- Time-and-Motion Studies
- MRF Mass Balance and Efficiency Audit

Addressing the Issue

- Identifying Contamination
 - Visual Inspection at the Curb
 - Visual Inspection at Transfer Stations / MRF
- Measuring Contamination to be Managed
 - Curbside Audits
 - Inbound Audits
 - MRF Mass Balance and Efficiency Audit
- Measuring Impacts of Contamination on Sorting
 - Time-and-Motion
 - MRF Mass Balance and Efficiency Audit
- Measuring Impacts of Contamination on Commodity
 - Bale / Bunker Audits
 - MRF Mass Balance and Efficiency Audit

Next Steps

- Develop standardized protocols for auditing
 - Review municipal methodologies
- Identify variations based on program characteristics
 - Single vs. Dual Stream
 - Bin vs. Bag vs. Cart
- Address Proactive vs. Reactive Approaches (i.e. include in contract as required)

PHASE 2: AUDIT METHODOLOGY CONSIDERATIONS

PART 2



CIF # 1090 – Inbound Contamination Definition & Impact Analysis

Developing an Audit Methodology



Prepared by:

ECOCOMPASS

Agenda

1. Project Update
2. Developing an Audit Methodology
3. MRF Equipment Limitations
4. Developing A Financial Model
5. Next Steps

1. Project Update: Problem Statement

What are the questions this project sets out to answer?

- What is contamination?
- Who is responsible for it (i.e. chain of custody)?
- How & where do we measure it?
- How do we calculate its cost?
- What are the Better Practices for ongoing measurement & cost sharing?

1. Project Update: Organizations Surveyed

Municipalities	Service Providers (2 out of 3)	Brokers/End Market (5 out of 10)	Other Stakeholders (6 out of 7)
City of Toronto (SS)	Emterra/ReVital	Continental Paper Grading	Canadian Stewardship Services Alliance (CSSA)
Peel Region (SS)	Miller Group	ReMM	Stewardship Ontario (SO)
York Region (SS)		Triple M	Machinex
Niagara Region (DS)		EFS	Van Dyk Recycling Solutions
Bluewater Recycling Association (SS)		NORPAC Paper	Canadian Plastics Industry Association (CPIA)
City of Guelph (SS)			Paper and Paperboard Packaging Environmental Council (PPEC)
Region of Waterloo (DS)			

1. Project Update: Defining Contamination

- Unwanted/undesired inbound and/or outbound materials.
- Stakeholder goals compete against each other.
 - Maximize diversion
 - Reduce collection times
 - Maximize commodity revenue
 - Minimize capital investments
 - Minimize labour costs
 - Etc.
- Competing goals result in varying definitions for certain materials.



2. Developing an Audit Methodology: “Don’t Reinvent the Wheel!”

- Service providers are supportive of conducting curbside and tip floor audits
 - Both service providers contacted indicated they follow existing CIF/SO methodologies.
 - Concerned more about material categories than audit methodology.
- Brokers **stressed** the need to do **visual inspections** after a material has been baled **AND** when it’s load onto the trailer.
 - Multiple occasions of where the last bales loaded (first ones visible) are visibly contaminated.
- Most end markets will conduct an initial audit at the start of the relationship.
 - Audits rely on breaking open a bale and taking multiple samples throughout the bale, similar to a bale audit.

2. Developing an Audit Methodology: Follow-up on Non-Consensus Materials

Materials	Stakeholder Issues
Bagged Recyclables	<ul style="list-style-type: none">• Collectors do not prefer 'garbage-size' bagged recyclables as they increase risk of injury; also additional handling time for cart based programs.• Can create significant issues in MRF's without bag breakers (both grocery- and garbage-sized bags)
Black Plastics	<ul style="list-style-type: none">• End markets typically want the black PP (#5) plastics only. Will accept other black plastics as they recognize it cannot be optically sorted at MRFs.
Shredded Paper	<ul style="list-style-type: none">• Difficult to manage at the MRF. Even bagged shredded paper can rip, leading to increased glass contamination
EPS and rigid PS packaging	<ul style="list-style-type: none">• EPS is bulky and can cube out trucks/carts faster, increasing collection operation costs.• EPS has similar issue to shredded paper at the MRF; prone to breaking into smaller pieces and ending up in glass.• Rigid PS is not desired by end markets; Combined amounts of rigid #1, #3, #6, and #7 plastics should not exceed 20% in Mixed Plastic bales.



2. Developing an Audit Methodology: Follow-up on Non-Consensus Materials

Materials	Stakeholder Issues
Beer and LCBO Containers	<ul style="list-style-type: none">Issue from MRF operators around Beer and LCBO containers are directly related to the abrasive nature of glass. Would prefer to see all glass collected separately.
Small Materials / Bottle Caps	<ul style="list-style-type: none">MRF equipment vendors indicate materials smaller than 2.5 – 3” will likely end up in glass
Pizza Boxes*	<ul style="list-style-type: none">Recent study from West Rock, indicates “no significant technical reason to prohibit post-consumer pizza boxes from the recycle stream.” CAUTION: The study indicates that most Pizza boxes currently found in the recycling stream have an average grease content of approximately 1 - 2% by weight level

* Link to report: <https://www.westrock.com/greasecheesestudy>

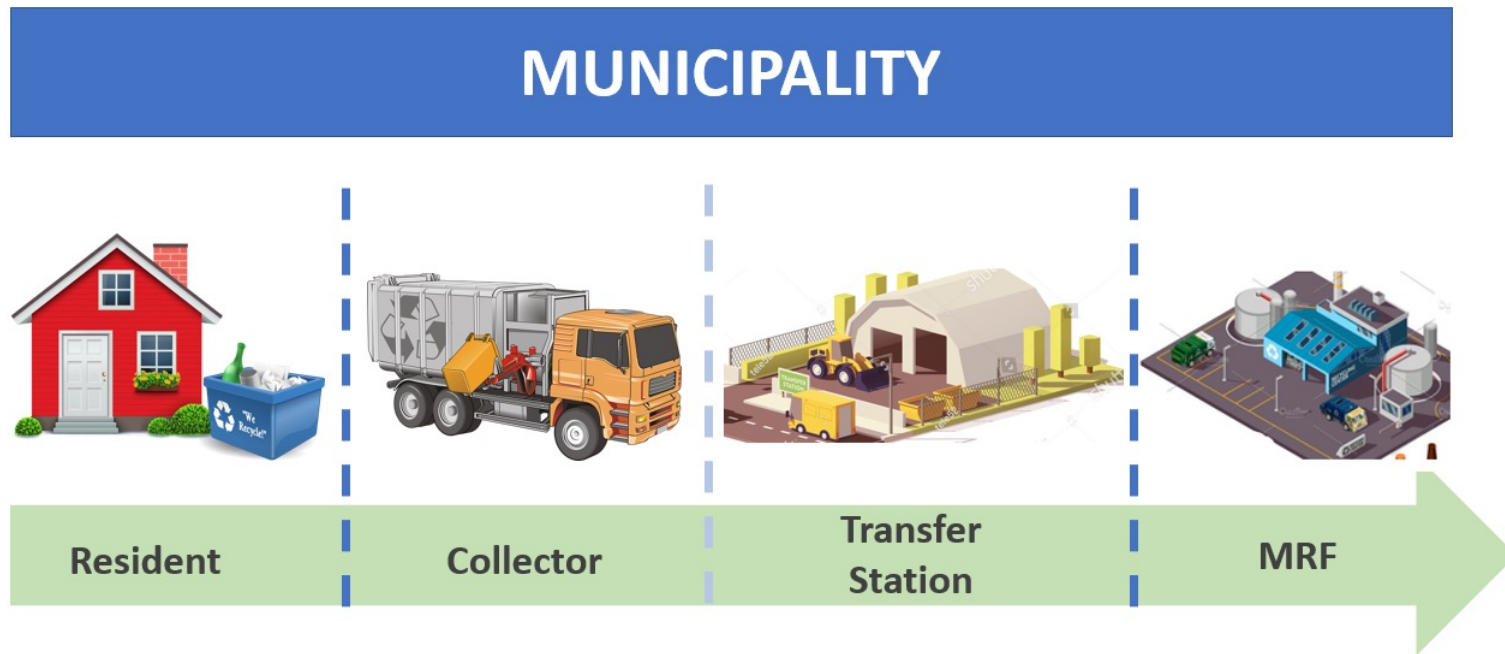
2. Developing an Audit Methodology : Greasy Pizza Box Study

GREASE & CHEESE CONTENT* (% OF BOX BY WEIGHT)	1.4%	4.4%	12.1%	34.5%
	 <p>Figure 1. Meat Pizza: Pan crust – Cheese side up – with insert</p>	 <p>Figure 2. Meat Pizza: Pan crust – Cheese side up – no insert</p>	 <p>Figure 31. Cheese Pizza: Pan crust – Cheese side up – no insert</p>	 <p>Figure 1. Cheese Lover's: Pan crust – Cheese side DOWN – no insert</p>

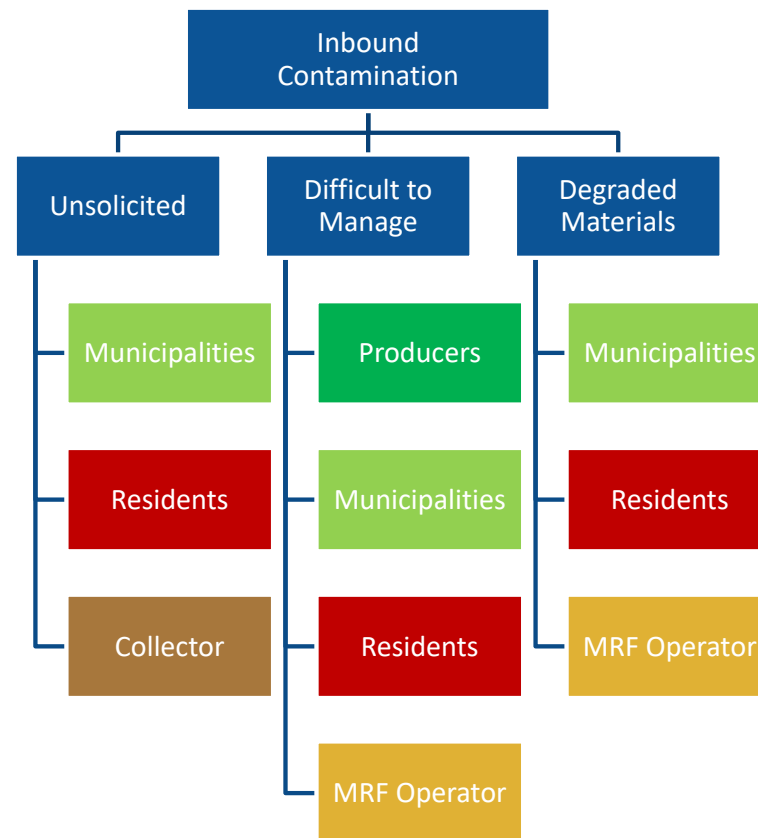
3. MRF Equipment Limitations

- Materials smaller than 2.5 – 3” will likely end up in glass
- Long, slender materials are not recovered easily
- Optical Sorters cannot see “dark materials”; black plastics, dark greys, etc.
- Multi-layer materials are evaluated based on the surface visible to the optical sorter.
- Rolling objects cannot be ejected optimally
- Optical sorters can typically eject about 1lb of material; unless, otherwise specified
- Clear PET fraction may include opaque white PET
- Minimum of 20% of targeted materials needs to be visible

4. Determining Responsibility



4. Determining Responsibility: Perceived Priority of Responsibility



5. Developing A Financial Model: Visibility and Recoverability of Contamination

Visible Contamination	Limited Visibility/Recoverability
Large contamination (e.g. propane tanks, hoses, etc.)	Material buried in collection containers
Incorrectly placed recyclables (cross-contamination in dual-stream program)	Sharps, medical waste, etc.
Medical waste (* processing side)	Greasy pizza boxes
Incorrectly sorted recyclables (outthrows in commodities)	Partially filled containers
Etc.	Etc.

- Municipalities share a greater portion of the responsibility on Limited Visibility/Recoverability Items. Financial implications will likely fall more onto the municipality.
- Visible contamination are more the responsibility of municipal service providers (collector and/or processor).

5. Next Steps for Municipalities

- Model Structure
 - List Full Range of Materials (allows customization for different programs)
 - Materials will be identified as Visible vs. Limited Visibility Contamination (will establish responsibility)
 - Financial Cost Associated with Managing Contamination