

Measuring Recyclables Composition & Contamination at the MRF

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**MRN & SWANA MID-ATLANTIC
ANNUAL CONFERENCE**

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MSW CONSULTANTS**



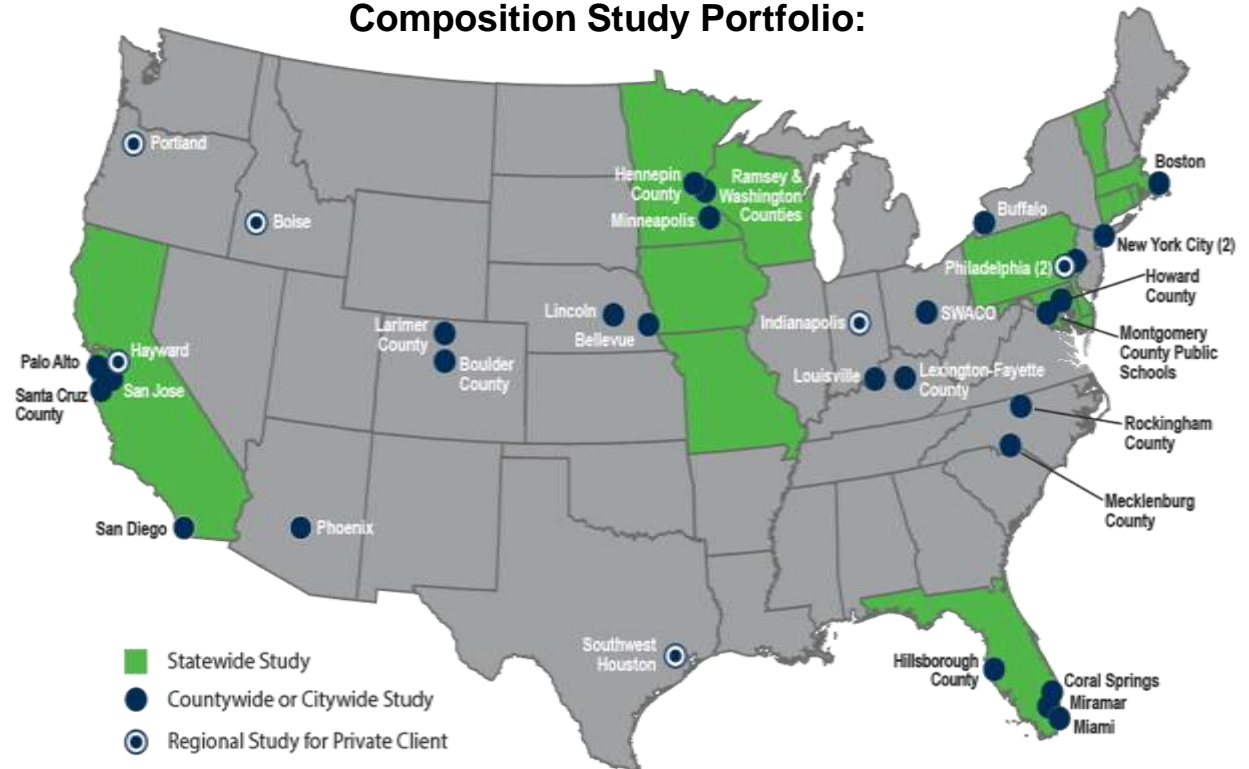
About Us:

Orlando, FL based solid waste management consulting firm with offices in PA & MD. Founded in 2004.

Key practice areas include:

- Solid Waste Planning
- Procurement Support
- Collection optimization
- Cost/Rate Studies
- Waste & recycling composition studies

Composition Study Portfolio:



Note: Florida and Pennsylvania statewide studies were performed by key MSW staff while working for prior employers.

Topics

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- Discuss methods of characterizing mixed recyclables
- Review MRF contamination rates
- Quantify the impact of high contamination rates on materials value
- Briefly describe a new solution for more consistent, cost-effective composition and contamination monitoring

Why Characterize Recyclables?

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- Required (or allowable) by a processing contract
- Quantify the value of your recycling stream
- Understand if recyclers are properly using the recycling program
- Identify and quantify problem materials
- Measure **recycling capture rates** (in conjunction with disposed waste characterization)
- **Understand the “evolving ton”**

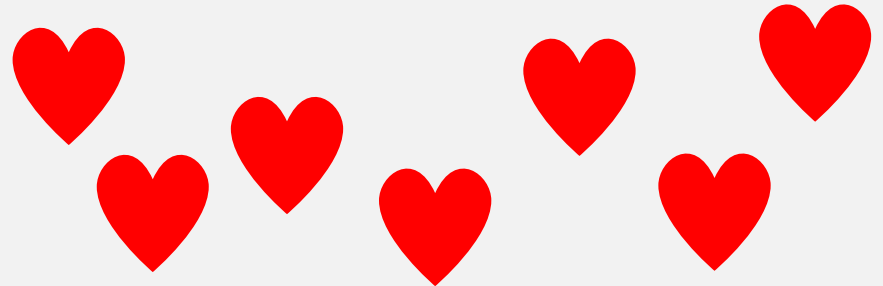


Methods for Characterizing Recyclables

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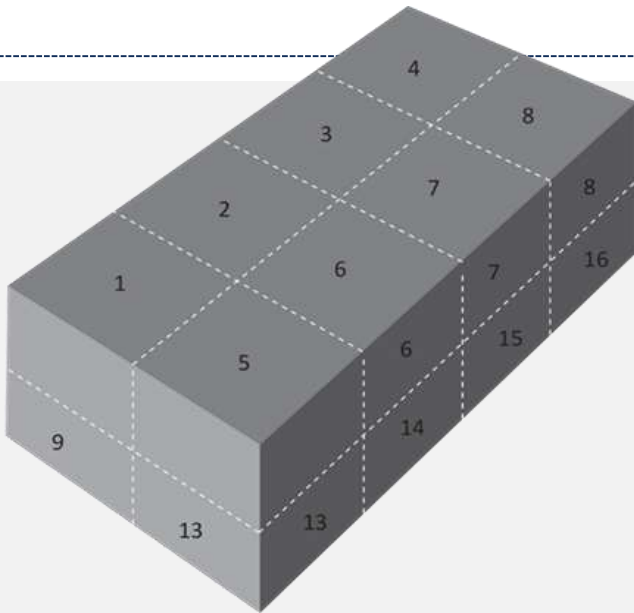


- ✓ Grab Sampling
- ✓ Curb Sampling
- ✓ Run Test with Post-Process Sorting and Mass Balance
- ✓ All methodologies guided by ASTM D5231-92 (Reapproved 2016), Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste
- ✓ All methodologies still require sorting and weighing materials!



Grab Sampling

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- **Pros:**

- Based on published standard for material composition analysis
- Measures composition at the supplier/processor transaction point (on the tip floor!)
- Least expensive
- Relatively many comparable studies

- **Cons:**

- Obtaining representative samples is not trivial
- “Statistics”

Curb Sampling

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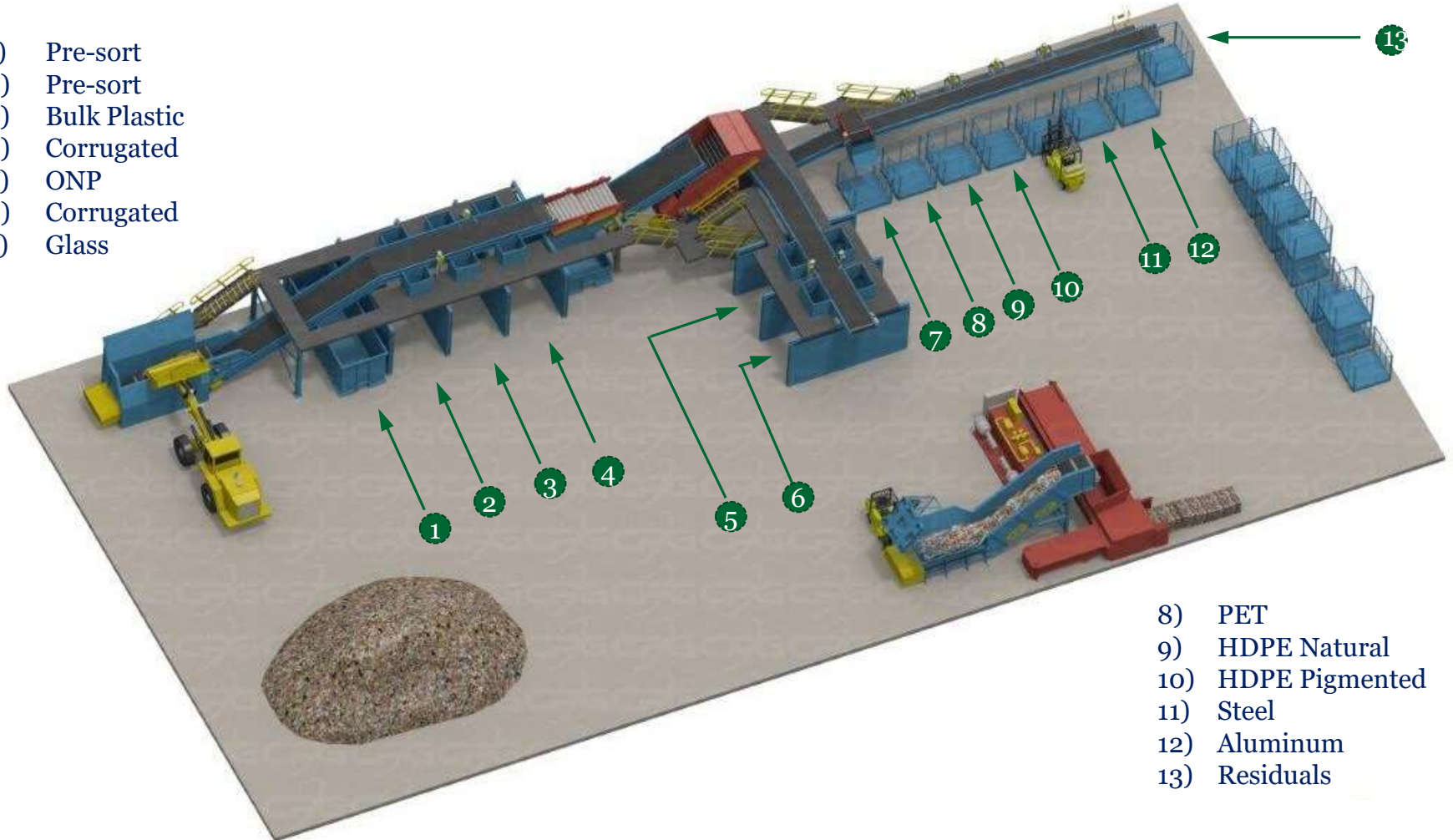


- **Pro:** Provides the best understanding of how effectively residents sort their recyclables
- **Cons**
 - Does not reflect the condition of the recyclables when tipped at the MRF
 - May not capture non-residential and/or multi-family recyclers included in collection program
 - Can be more expensive

Run Test with Mass Balance: Definition

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- 1) Pre-sort
- 2) Pre-sort
- 3) Bulk Plastic
- 4) Corrugated
- 5) ONP
- 6) Corrugated
- 7) Glass



- 8) PET
- 9) HDPE Natural
- 10) HDPE Pigmented
- 11) Steel
- 12) Aluminum
- 13) Residuals

Run Test with Mass Balance

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- **Pros:**

- Provides the best understanding of the effectiveness of material separation
- Tests a large quantity of recyclables

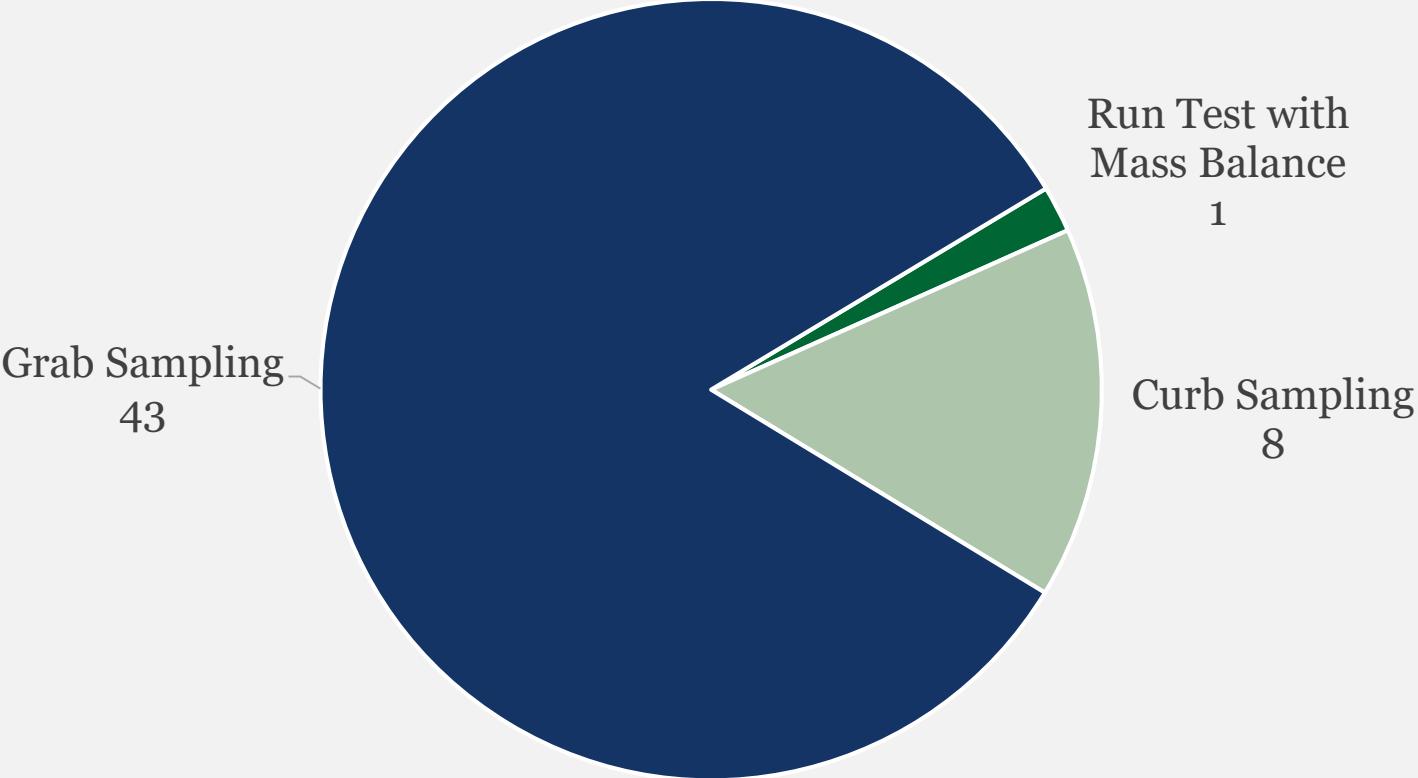
- **Cons:**

- Does not clearly reflect the condition of recyclables as tipped
- Expensive and intrusive on MRF operations



Review of 52 Recyclables Composition Studies

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Review of 52 Recyclables Composition Studies

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Recycling Stream Attributes

- **Collection Method**
 - Curbside
- **Date Range**
 - 2013-2017
- **Generators**
 - Residential
 - Mixed
- **States of Origin: 21**
- **Wastesheds**
 - State
 - Region
 - County/City
 - Facility
- **Material Streams**
 - Single Stream
 - Mixed Fiber
 - Commingled Containers

Overview of Recycling Contamination Rates

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KEEP THESE OUT:



- DONT BAG RECYCLABLES**
no garbage
- NO PLASTIC BAGS OR WRAP**
recycle at local stores
- NO FOOD OR LIQUID**
empty containers only
- NO SCRAP METAL**
no electronics
- NO TANGLERS**
no hoses, cords, chains

Image courtesy of www.recyclebycity.com

Contamination vs. Residue?

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Contaminants

- ❑ Items that are not targeted by the recycling program (or not allowable under the terms of the processing agreement)
 - ❑ **Pre-sort** stations are typically removing larger contaminants

Residue/Residuals

- ❑ Materials that are ejected off the end of the processing line.
 - ❑ May include contaminants as well as targeted recyclables that were not captured by sorting system (yield loss).

Recycling Contamination: 2013-2017 Top-Line

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- **Minimum Contamination Rate:** Less than 4%
 - Curbside fiber stream
 - 2013
 - Pre-carts
- **Maximum:** Almost 40%
 - Curbside, carted single stream
 - 2016

- **Other Contamination Rate Observations**

| Average Contamination | |
|-----------------------|-------|
| Fiber | 5% |
| Commingled Containers | 14.5% |
| Single Stream | 20% |

- 32% of single stream recyclables exceeded 25% contamination
- 68% exceeded 15% contamination

Inbound Recycling Contamination: U.S.

| Year | Region | Jurisdiction Type | Population | Recyclables | Contamination % |
|------|---------------------|---------------------------|-----------------------|--------------------------|-----------------|
| 2014 | Northeast | City | > 500 K | Single-stream | 8.4% - 13.5% |
| 2015 | Northeast | Statewide | > 1 million | Single-stream | 18.2% |
| 2017 | Northeast | City | > 1 million | Dual-stream (fiber) | 8.3% |
| | | | | Dual-stream (commingled) | 19.5% |
| 2017 | Mid-Atlantic | City | > 1 million | Single-stream | 19.2% |
| 2018 | <i>Northeast</i> | <i>City</i> | <i>> 250 K</i> | <i>Single-stream</i> | <i>24.9%</i> |
| 2019 | <i>Northeast</i> | <i>Regional authority</i> | <i>> 500 K</i> | <i>Single-stream</i> | <i>24.3%</i> |
| 2018 | <i>Mid-Atlantic</i> | <i>City</i> | <i>> 500 K</i> | <i>Single-stream</i> | <i>19.2%</i> |
| 2018 | <i>Mid-Atlantic</i> | <i>City</i> | <i>> 250 K</i> | <i>Single-stream</i> | <i>38.6%</i> |
| 2018 | <i>Southwest</i> | <i>City</i> | <i>> 1 million</i> | <i>Single-stream</i> | <i>20.5%</i> |

Italics = data gathered post-study

Inbound Recycling Contamination: Florida

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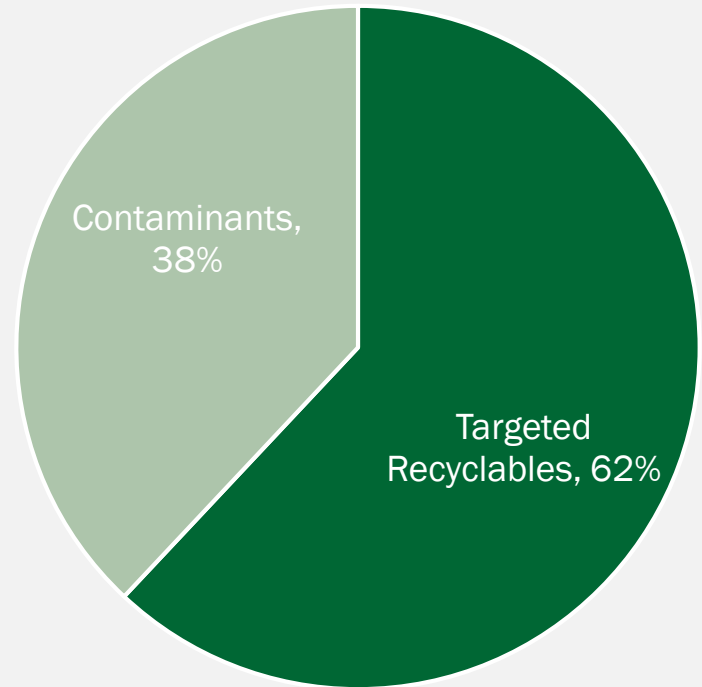
| Year | Region | Jurisdiction Type | Contamination % |
|------|------------------------|-------------------|-----------------|
| 2014 | Central Gulf | County | 19.5% |
| 2014 | South Florida | City | 12.4% |
| 2014 | South Florida | City | 15.3% |
| 2014 | Central Gulf | City | 24.2% |
| 2014 | South Florida | City | 28.5% |
| 2015 | South Florida | City | 23.6% |
| 2015 | Central Florida | City | 13.2% |
| 2016 | South Florida | City | 38.8% |
| 2016 | South Florida | City | 34.4% |
| 2017 | <i>Central Gulf</i> | <i>County</i> | <i>19.9%</i> |
| 2018 | <i>Central Gulf</i> | <i>City</i> | <i>26.4%</i> |
| 2018 | <i>South Florida</i> | <i>County</i> | <i>26.6%</i> |
| 2018 | <i>Central Florida</i> | <i>County</i> | <i>37.9%</i> |

Italics = data gathered post-study

Bagged Materials

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- Bagged materials have averaged 4.6 percent of inbound recyclables
- Over time bagged materials have contained incrementally more contaminants



Impacts of Market Pricing and Contamination on Recycled Value

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Current Single Stream Material Value*: 25% Contamination

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| Material | Materials | Market Value (\$/Ton) | Material % | Weighted Value (\$/Ton) |
|-----------------------------|-------------------------------|-----------------------|----------------|-------------------------|
| Paper | Mixed Paper | -\$2.50 | 19.8% | -\$0.50 |
| | Corrugated Cardboard | \$32.50 | 20.1% | \$6.53 |
| | Aseptic Cartons | \$0.00 | 0.5% | \$0.00 |
| | Sub-Total Paper | | 40.4% | \$6.04 |
| Containers | Glass (3 mix) | \$0.00 | 24.2% | -\$4.84 |
| | PET | \$300.00 | 3.4% | \$10.20 |
| | HDPE Natural | \$415.00 | 1.1% | \$4.57 |
| | HDPE Pigmented | \$270.00 | 1.1% | \$2.97 |
| | PP Post Consumer | \$260.00 | 0.6% | \$1.56 |
| | Mixed Bulky Rigid | \$30.00 | 0.9% | \$0.27 |
| | Other Rigid Plastics (#3-7's) | \$30.00 | 0.2% | \$0.06 |
| | Aluminum Cans | \$1,150.00 | 0.7% | \$8.05 |
| | Steel Cans | \$165.00 | 1.8% | \$2.97 |
| Sub-Total Containers | | 34.0% | \$25.81 | |
| Contamination | | \$0.00 | 25.6% | -\$16.64 |
| | | 100.0 | 100.0% | \$15.20 |

* Market prices from recyclingmarkets.net; Mid-Atlantic Region; average pricing from June 4, 2019

Current Single Stream Material Value:

10% Contamination

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| Materials | | Market Value (\$/Ton) | Material % | Weighted Value (\$/Ton) |
|----------------------|------------------------------------|-----------------------|---------------|-------------------------|
| Paper | Mixed Paper | -\$2.50 | 28.1% | -\$0.70 |
| | Corrugated Cardboard | \$32.50 | 24.3% | \$7.90 |
| | Aseptic/Cartons | \$0.00 | 0.5% | \$0.00 |
| | Sub-Total Paper | | 52.9% | \$7.20 |
| Containers | Glass (3 mix) | -\$20.00 | 24.2% | -\$4.84 |
| | PET | \$300.00 | 5.2% | \$15.60 |
| | HDPE Natural | \$415.00 | 1.3% | \$5.40 |
| | HDPE Pigmented | \$270.00 | 1.2% | \$3.24 |
| | PP Post Consumer | \$260.00 | 0.6% | \$1.56 |
| | Mixed Bulky Rigid | \$30.00 | 1.1% | \$0.33 |
| | Other Commingled Plastics (#3-7's) | \$30.00 | 0.2% | \$0.06 |
| | Aluminum Cans | \$1,150.00 | 1.2% | \$13.80 |
| | Steel Cans | \$165.00 | 1.9% | \$3.14 |
| | Sub-Total Containers | | 36.9% | \$38.28 |
| Contamination | | -\$65.00 | 10.2% | -\$6.63 |
| | | | 100.0% | \$38.85 |

Single Stream Recyclables increase in value by: \$23.65/ton

“High” Single Stream Material Value*: 25% Contamination

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| Materials | | Market Value (\$/Ton) | Material % | Weighted Value (\$/Ton) |
|----------------------|------------------------------------|-----------------------|---------------|-------------------------|
| Paper | Mixed Paper | \$50.00 | 19.8% | \$9.90 |
| | Corrugated Cardboard | \$155.00 | 20.1% | \$31.16 |
| | Aseptic/Cartons | \$85.00 | 0.5% | \$0.43 |
| | Sub-Total Paper | | 40.4% | \$41.48 |
| Containers | Glass (3 mix) | -\$12.50 | 24.2% | -\$3.03 |
| | PET | \$312.60 | 3.4% | \$10.63 |
| | HDPE Natural | \$550.00 | 1.1% | \$6.05 |
| | HDPE Pigmented | \$290.00 | 1.1% | \$3.19 |
| | PP Post Consumer | \$140.00 | 0.6% | \$0.84 |
| | Mixed Bulky Rigid | \$70.00 | 0.9% | \$0.63 |
| | Other Commingled Plastics (#3-7's) | \$30.00 | 0.2% | \$0.06 |
| | Aluminum Cans | \$1,330.00 | 0.7% | \$9.31 |
| | Steel Cans | \$182.50 | 1.8% | \$3.29 |
| | Sub-Total Containers | | 34.0% | \$30.97 |
| Contamination | | -\$65.00 | 25.6% | -\$16.64 |
| | | | 100.0% | \$55.81 |

**Single Stream
Recyclables
increase in
value by:
\$40.61/ton**

* Market pricing from June, 2017

“High” Single Stream Material Value: 10% Contamination

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| Materials | | Market Value (\$/Ton) | Material % | Weighted Value (\$/Ton) |
|----------------------|------------------------------------|-----------------------|---------------|-------------------------|
| Paper | Mixed Paper | \$50.00 | 28.1% | \$14.05 |
| | Corrugated Cardboard | \$155.00 | 24.3% | \$37.67 |
| | Aseptic/Cartons | \$85.00 | 0.5% | \$0.43 |
| | Sub-Total Paper | | 52.9% | \$52.14 |
| Containers | Glass (3 mix) | -\$12.50 | 24.2% | -\$3.03 |
| | PET | \$312.60 | 5.2% | \$16.26 |
| | HDPE Natural | \$550.00 | 1.3% | \$7.15 |
| | HDPE Pigmented | \$290.00 | 1.2% | \$3.48 |
| | PP Post Consumer | \$140.00 | 0.6% | \$0.84 |
| | Mixed Bulky Rigid | \$70.00 | 1.1% | \$0.77 |
| | Other Commingled Plastics (#3-7's) | \$30.00 | 0.2% | \$0.06 |
| | Aluminum Cans | \$1,330.00 | 1.2% | \$15.96 |
| | Steel Cans | \$182.50 | 1.9% | \$3.47 |
| | Sub-Total Containers | | 36.9% | \$44.96 |
| Contamination | | -\$65.00 | 10.2% | -\$6.63 |
| | | | 100.0% | \$90.47 |

Single Stream Recyclables increase in value by: \$75.27/ton

Financial Impact

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| Recycled Material Program Tonnage | Reducing Contamination from 25% to 10% | 25% Contamination @ High Markets | 10% Contamination @ High Market Prices |
|-----------------------------------|--|----------------------------------|--|
| 100 | \$2,364 | \$4,061 | \$7,527 |
| 1,000 | \$23,643 | \$40,606 | \$75,265 |
| 10,000 | \$236,425 | \$406,059 | \$752,652 |
| 30,000 | \$709,275 | \$1,218,177 | \$2,257,956 |

Conclusions: Recycling Composition...

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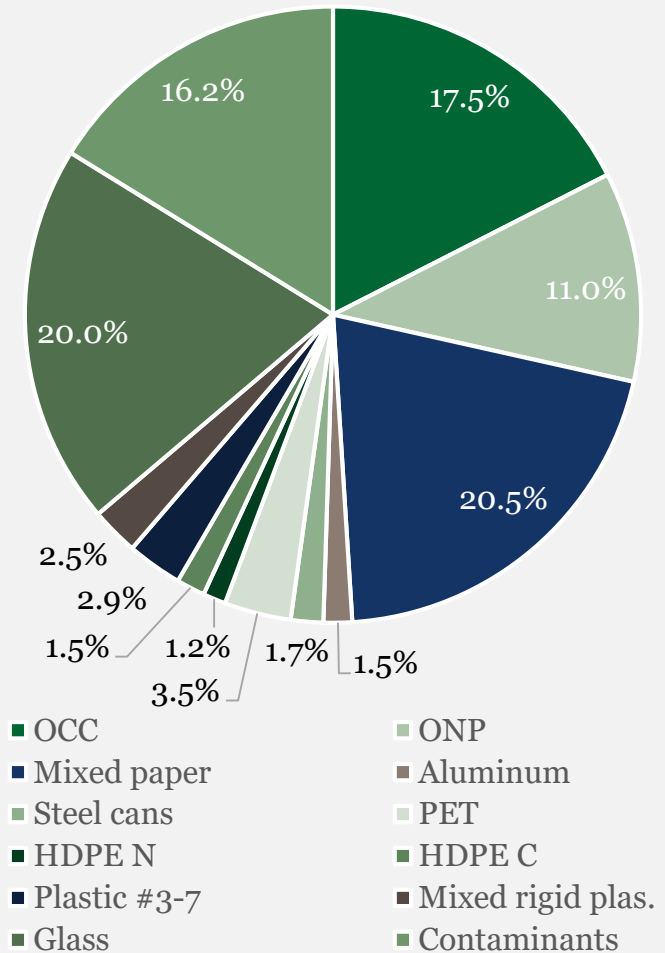
- *Depends on the methodology*
 - *Bagged materials?*
 - *Newspapers in sleeves?*
- *Is influenced by many factors*
 - *Weather*
 - *Routes*
 - *Seasonality*
 - *“The Draw”*
- *Changes over time*
 - *Packaging and the “evolving ton”*
- *Is hard to measure!*

**Is best measured
through routine
audits that capture
material samples over
time from all routes
and all seasons**

Challenges with Monitoring Composition

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- Appropriate sampling protocols
- Sorting equipment
- Data management
- Trained personnel to conduct tests
- Costs



How can audits be easier, cheaper, better?

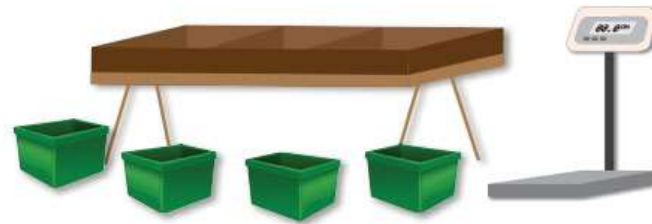
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- Collaboratively developed audit protocol that meets technical standards
- Standardized, proven sorting tools and equipment
- Web-based data management platform
 - Upload and analyze audit data
 - Store pictures of inspected loads and/or audited samples
 - Share data with processor and supplier in real time

The Grading and Purity (GAP) System



Customized Audit Protocol



Specified Equipment
for sorting, weighing, and data recording.



Cloud Based Data Management



Composition, Market Value
& Contamination Report
for You / for Your Supplier

Equipment



Supports Monitoring throughout Process



Inbound materials



In-process



Bale monitoring

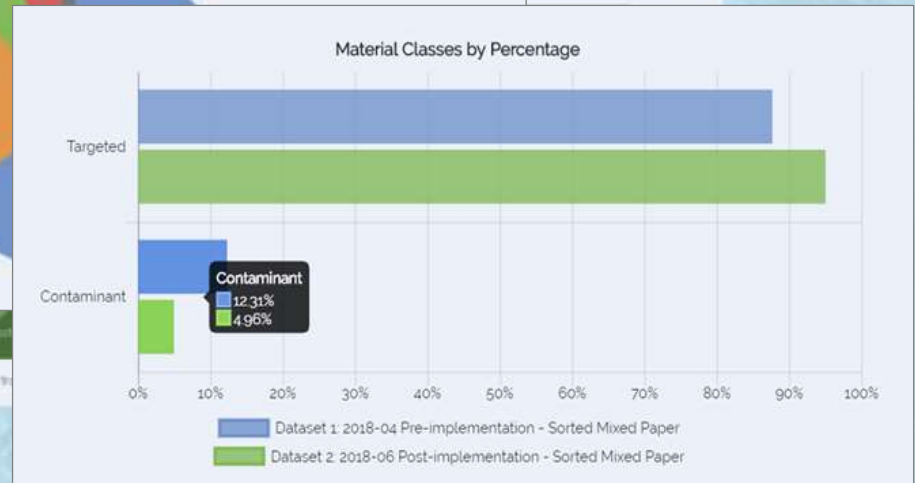
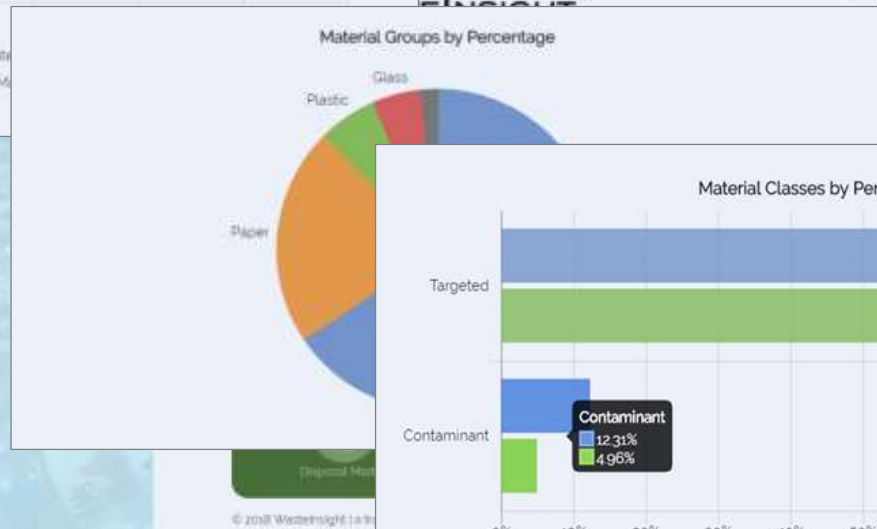
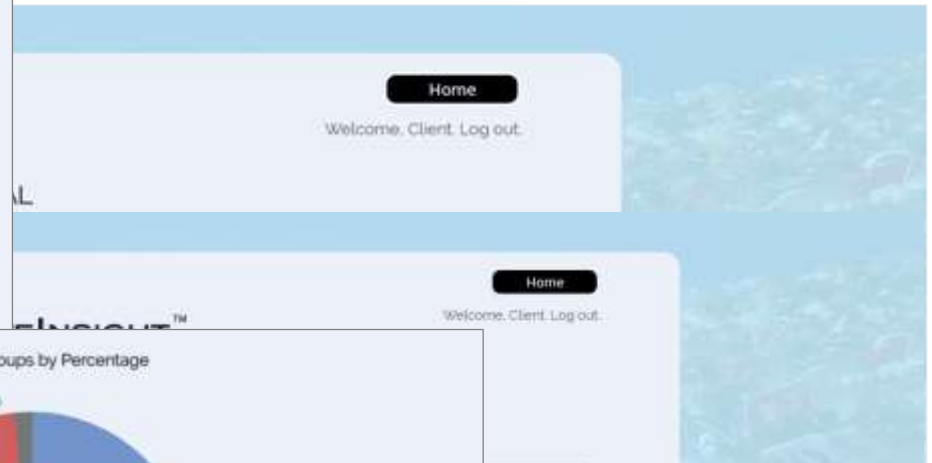
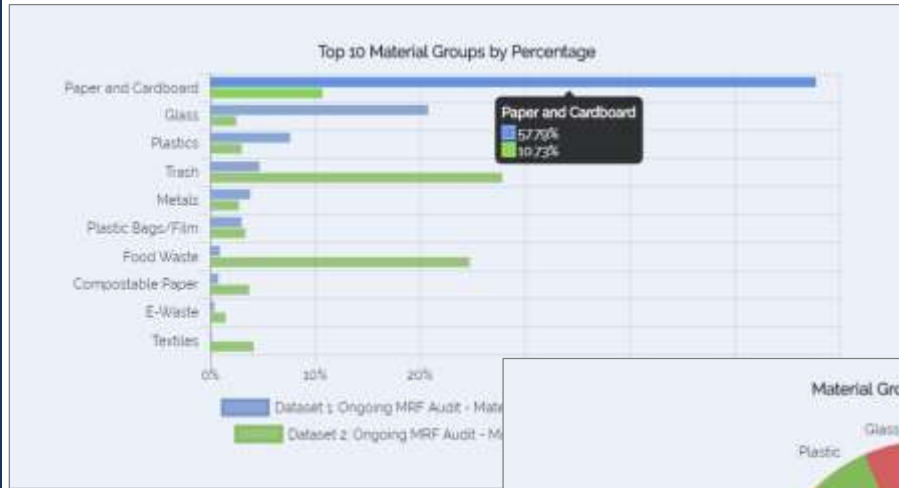


Residue line



Online Platform & Customizable Reporting Tools

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GAP System in Action



Thank You!

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