

The effect of source contamination on the market pricing of paper/fiber processed through a Materials Recovery Facility (MRF)

A review of recent and current literature

Compiled by Texas Disposal Systems

April 9, 2011

The purpose of this analysis is to determine and describe the effect of contamination attributable to residential single-stream collection of paper/fiber as distinguished from paper/fiber which are from source-separated commercial flow of discarded materials and a commercial, single-stream flow of recyclable materials. The analysis is based on literature currently available.

The importance of this analysis exists in the context of the estimates by the Solid Waste Services Department of the City of Austin which seek to illustrate the market pricing for materials processed through the Materials Recycling Facilities (MRFs) of Balcones Recycling(BR) and Texas Disposal Systems (TDS).

THE DIFFERENCE BETWEEN THE ESTIMATED MARKET PRICING INVOLVING BR / TDS

If there were no difference between the quality of paper/fiber used by BR and TDS in estimating market pricing, then there would be no reason for this comparison. However, BR's estimates for the revenues which would ensue from sales of paper/fiber are not consistent with the quality of materials which BR would process from the city's residential, single-stream recycling program. It is clear that BR's estimates utilize newspaper, mixed paper and cardboard which are not the result of a single-stream collection process but rather are acquired from sources where residential single-stream type contamination is not a concern. For example, newspaper typically is acquired by BR from the bundled overprint of the *Austin American-*

Statesman and other similar customers Office-use paper typically is acquired by BR from business and institutional establishments which generate that stock as a single commodity. The same is true for cardboard fiber from industrial and large distribution and retail operators.. None of the sources for these materials as acquired by BR is subject to the kind of contamination that these materials would incur if they were from residential, single-stream sources and subjected to the compactor-truck, single-stream collection process. On the other hand, the scenario involving the recyclable collection and MRF processing pertinent to the City of Austin recycling contract would mean that BR, should it be awarded the contract, would face market pricing for *contaminated* newsprint, mixed paper and cardboard fiber, not the market pricing it is promoting in its contract negotiations which utilize materials from commercial sources.

Given this premise, the question occurs regarding whether or not the contaminated newsprint, mixed paper and cardboard fiber resulting from a residential, single-stream collection would achieve the same level of market pricing as the non-residential, source-separated and commercial single-stream materials which BR has utilized for its proposed, future, actual sales price in attempting to negotiate the pending recycling contract with the City of Austin.

Another problem with the BR estimate is that the specific, recent sales prices for newspaper, mixed paper and cardboard used as the basis for the promised future sales price and BR's sales documentation regarding these actual sales prices have not been made available and are not verifiable.

CONCLUSION EVIDENCED BY THE LITERATURE

The Solid & Hazardous Waste Recycling Center (Extension Service) at the University of Wisconsin has evaluated the contamination issue and concluded:

Single stream recycling typically saves money on collection while increasing the cost of processing. The economics of single stream has demonstrated that:

- *Average savings for a collector using single stream was 5-25%*
- *Total increase in costs to paper mills if single stream was universally employed is estimated to be about \$50 million per year.*
- *The net cost "total value chain" of single stream = collection savings per ton (~\$15); cost increase for processing per ton (~\$10); COST INCREASE PER TON FOR PULPING/PAPER MAKING (~\$8) = overall system net cost increase of ~\$3 per ton.*

The entire article is provided as Attachment A and is also available at:

<http://www4.uwm.edu/shwec/> .

The *best practices* manual of the Conservatree and Environmental Planning Group of California states:

It is not uncommon for materials arriving at a processing facility to already be contaminated in one of three ways:

Non-recyclable materials (trash or garbage) are placed in with the recyclables by the resident,

Potentially recyclable materials that are not part of the community's collection program are placed in with the recyclables, and

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.

The applicable pages of this lengthy manual are provided as Attachment B, and the complete manual is available at:

<http://www.calrecycle.ca.gov/BevContainer/Publications/SingleStream/Manual.pdf> .

A detailed paper on various aspects of recycling published by researchers at the University of Oregon states:

A major benefit of single stream collection is that a higher volume of material is collected. However, this material may be highly contaminated and often unfit for use in manufacturing.

This is why the waste stream needs to be carefully assessed. Single stream collection may be more viable in a municipal setting as the recyclable materials that are collected are often of a low quality to begin with. This is not the case on a college campus where copious amounts of high quality paper can be collected and will only retain a high quality level if separated from other materials. Paper is an easy material to collect, separate, and sell in order to generate revenue for a college recycling program.

Including paper in single stream collection can greatly inhibit a recycling program's ability to profit from recyclable sales. As the market fluctuates, varying degrees of paper quality will be acceptable, but producing a high quality product regardless of market trends will be beneficial in the long term. It is easier to switch to commingling or single stream collection than to begin with single stream and switch to source separation because participants will not be accustomed to separating materials and contamination will occur.

The complete text from which the above quote is taken is provided as Attachment C and is also available at:

http://pages.uoregon.edu/recycle/Book/HTML/chapter_9.htm .

A study guide by the Environmental Protection Agency, “Contamination in Comingled Recycling Systems Standards & Guidelines Initiative” discusses problems associated with contamination in a comingled stream. The guide states:

In the report, Single Stream Recycling Best Practices and Implementation Guide (PDF), Gertman and Kinsella note several challenges facing manufacturers as a result of comingled recycling systems, including:

- *Poor quality recovered materials that they must use as production feedstocks;*
- *Reduced operating and energy efficiencies from poorly sorted materials that include many contaminants to their manufacturing systems;*
- *Dramatically increased internal costs because poorly sorted materials demand new and upgraded feedstock cleaning systems, increased maintenance, and more frequent equipment repair and replacement;*
- *Lost access to recyclables needed for manufacturing when they are sent to the wrong types of manufacturing mills;*
- *Increased raw material costs to replace those too contaminated to use; and*
- *Increased costs from landfilling unusable materials included in the bales bought to make recycled products.*

The publication is provided as Attachment D and is also available at:

<http://yosemite.epa.gov/R10/homepage.nsf/topics/ccrs> .

An article in the April 2006 issue of *Resource Recycling* magazine discusses the presence of prohibitives in contaminating paper in a study conducted in Portland, Oregon. The article, “Putting quality back in the recovery equation,” stated on Page 2 that after co-mingling was allowed, “Paper mills were reporting declining quality of scrap paper, particularly contamination from the presence of broken glass and plastic bags.”

The article is provided as Attachment E and is also available at:

http://library.oregonmetro.gov/files/mrf_article_april_2006.pdf .

An article in *Recycling Today* (May 22, 2002) discusses the adverse impacts of contaminants on paper and cardboard. The article states:

According to Jerry Powell, editorial director of Resource Recycling Magazine, studies have found that the residue generated through single-stream recycling averages around 16.6 percent, compared to residual amounts of 6.6 percent for dual sort systems, and 4.3 percent for source-separated material.

The disparity in quality levels achieved through each of these collection/sortation system is a cause for concern for many end consumers. George Elder, vice president of materials management for SP Recycling, the collection arm for SP Newsprint, Atlanta, Ga., notes that the quality issue is very important. SP Newsprint operates 25 collection plants and two recycled-content newsprint mills.

Broken glass is one of the biggest concerns. Broken glass shards being mixed in with the collected and processed fibers creates tremendous problems for consumers. "Generally speaking paper companies don't like it," Elder noted. As for glass, the material is "bad, bad, bad." In addition to the damage done to the equipment, there are safety concerns that arise.

Supporting this concern, Elder pointed out that even a minimal of contaminants being mixed in with the fiber can be destructive to the equipment. Additionally, having the contaminants being mixed in with the paper increases the chance of the finished product not meeting the quality levels required by end consumers.

The article is provided at Attachment F and also is available at:

http://www.recyclingtoday.com/Article.aspx?article_id=25326 .

An article in the January 10, 2010 issue of *American Recycler* ratifies this conclusion, stating that adverse impacts can ensue from contamination. The article states:

The Container Recycling Institute (CRI) has undertaken a study of the impact of single stream collection of residential recyclables. CRI selected Clarissa Morawski, principal of CM Consulting, to research the issue. Morawski reviewed 60 previously published studies, reports and articles in trade publications. The report finds that there are many negative downstream impacts of contaminated stock due to the mixing of the materials at curbsite.

"Basically, the report confirms that you can't unscramble an egg," explained CRI executive director Susan Collins. "Once the materials are mixed together in a single-stream recycling system, there will be cross contamination of materials and glass breakage. These issues then result in increased costs for the secondary processors."

The article is provided as Attachment G and is also available at:

<http://www.container-recycling.org/media/newsarticles/archives/2010/1-CRIReleasesStudy.htm> .

Brenda Sullivan, in the July 19, 2008 issue of *Mansfield Today* (Mansfield, Connecticut), writes:

The downside is that single-stream recycling usually results in high contamination. Residents put recyclables in the cart; they also tend to put trash in it, as well. This means that the sorting plant has to pull out anything that's not part of the recycling shipment, which can include plastic bags and regular garbage. This becomes a liability to them, since they now have trash to haul away.

The more serious problem, though, is glass bottles and jars placed together with paper products. When they are dumped into the recycling truck and then dumped at the recycling plant, the glass gets crushed, and crushed so finely, it's like grit. And that grit gets caught in the paper.

When the paper is sent to a papermill, it takes the grit along with it. This glass grit is disastrous at a paper mill. The equipment ends up being sandblasted by the very fine glass particles. And North American mills don't want this poor quality paper, so a lot gets sent overseas to Asia. They have a cheaper labor force that can hand-sort the bales of paper. This contaminated paper often gets recycled into lower-grade paper such as cereal boxboard, instead of higher-quality paper such as office paper. In other words, it's down-cycled. As a result, North American paper mills are having a difficult time meeting the demand for recycled office paper.

The article is provided as Attachment H and is available at:

<http://mansfield.htnp.com/2008/07/19/column-the-pros-and-cons-of-a-new-trend-called-single-stream-recycling/> .

The City of Phoenix publishes an online newsletter (*Recycle Together*), and the current issue states:

Last year, the City collected nearly 110,000 tons of recyclable material from Phoenix households, more than 560 pounds collected per household served. All 1-5 family households are served with weekly recycling and households living in 5 – 30 dwelling unit structures can sign up for the recycling collection service. Close to 90% of those on the City refuse service have voluntarily accepted curbside recycling. However contamination in recycling set-outs continues to be a problem for Phoenix with between 10 to 20% of materials set out being unacceptable for recycling.

The article is provided as Attachment I and also is available at:

<http://www.together.com/cities/arizona/phoenix-arizona> .

The City of Sedona, Arizona, has a recycling news publication for citizens, and the current issue states:

Single-stream MRFs also make less money selling baled recyclables for remanufacturing due to high contamination. It is nearly impossible to fully separate commingled recyclables, so bales of paper end up with plastic bottles in them, bales of cans end up with cardboard in them, and bales of cardboard are filled with broken glass.

Approximately 4% of the material sold by single-stream MRFs will be rejected and landfilled due to such high levels of contamination. So single-stream MRFs not only make less money selling the recyclable material they had to painstakingly separate, they have to pay to throw some of those recyclables in the garbage.

Single-stream MRFs aren't the only ones that have to throw away precious recyclables. The recyclables these MRFs do sell to mills for remanufacturing contain hidden contamination that might not be noticeable until the bales are opened.

Mills incur an added cost of \$8 per ton when recycling single-stream materials because of all these contaminants. As much as 27% of the recyclables that actually make it to the mill will end up as garbage. Combined with the rejected materials returned to MRFs, 31% of single-stream recyclables end up in the landfill!

The article is provided as Attachment J and also is available at:

http://www.sedonarecycles.org/recycle/news_archive.php?id=74# .

CONCLUSION

Based on the consistency of these reports from diverse sources, it is a clear and unambiguous conclusion that the newsprint, mixed paper and cardboard which are processed through a MRF from residential, single-stream sources are going to suffer a higher level of contamination as compared to the same kinds of materials which are acquired via a source-separated commercial flow of discarded materials, or via a commercial single-stream flow of recyclable products from offices and institutions.

BR's promised actual sales prices and market value of these materials as compared to published market indexes are artificially high because they do not reflect the more-contaminated character of materials that would be acquired from the single-stream,

residential sources and processed relative to the City of Austin recycling contract. The attempt on the part of BR to project pricing based on different (cleaner), non-residential single-stream sources distorts and inflates BR's pricing estimates which should reasonably be expected to be sorted from residential, single-stream materials from the City of Austin.

Attachment A

Single Stream Recycling

Single stream, or fully commingled recycling, is a system in which all paper fibers and containers are collected in the same bin instead of being sorted into separate commodities in separate bins (source separated) such as newspaper, cardboard, plastic, glass, etc. (WDNR, 2005). Single stream recycling typically collects a greater variety of materials than do source separated or dual-stream (paper in one bin; glass, plastic, and cans in another). Single stream processing facilities also range in setup and the amount of material they can handle. Some Material Recovery Facilities (MRFs) were built for dual-stream recycling and have been retrofitted for single stream as popularity increases, while others were specifically built to handle single stream collection.

Who is doing it?

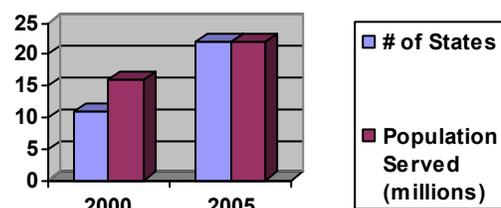
The idea of single stream recycling took hold in California in the late 1990s. Since then, single stream programs have been springing up all over the nation, steadily moving eastward. Today, an estimated 100 city and regional single stream programs are in operation in 22 states serving about 22 million people; this is compared with 11 states and 16 million people five years ago, according to Government Advisory Associates (CBS, 2005). As of March 2002, there were 88 materials recovery facilities handling single stream recycling: 41 in the West, 32 in the South, 13 in the Midwest, and two in the Northeast (Conservatree, 2003). In Wisconsin, several levels of local governmental units are participating in single stream recycling. These include cities (Madison and Whitewater), villages (Ashwaubenon and Mukwonago), towns (Genessee), and counties (Monroe).

What are the motivating factors to switch to single stream?

The major reasons for switching to single stream recycling are cutting costs for the local governmental service provision and increasing recycling rates. Motivating factors include:

- * Simplified recycling as all recyclable materials are collected in one container, making collection easy and convenient for participants. This typically increases the number of participants, tonnage collected, and material diverted from landfills
- * Reduced collection costs by using single-compartment trucks. These are cheaper to purchase and operate; can be used for garbage collection as well, and allow for larger loads and fewer trips to the recycling center than two-compartment trucks

Growth in Single Stream Recycling



With staff in Green Bay, Madison, Milwaukee and Stevens Point, SHWEC has been providing quality environmental education and technical assistance throughout Wisconsin since 1990. To contact a SHWEC Specialist go to

www.shwec.uwm.edu

SHWEC -UW-Extension 610 Langdon Street, Room 528 Madison WI 53703 608.262.0385 tel 608.262.6250 fax



- * Increased cleanliness as there is a decrease of loose material blowing through streets and alleys. Hinged lids on carts that are often distributed keep recyclables dry.
- * Increased collection efficiency and reduced injuries since wheeled carts used in automated collection eliminates heavy lifting for residents and workers.
- * Switching to single stream offers the opportunity to update the collection and processing system, including adding more paper grades such as junk mail, telephone books and mixed residential paper; a good opportunity considering about 35% of all municipal solid waste is paper (EPA, 2005)

Does Single Stream Save Money?

Single stream recycling typically saves money on collection while increasing the cost of processing. The economics of single stream has demonstrated that:

- * Average savings for a collector using single stream was 5-25%
- * Total increase in costs to paper mills if single stream was universally employed is estimated to be about \$50 million per year
- * The net cost "total value chain" of single stream = collection savings per ton (~\$15); cost increase for processing per ton (~\$10); cost increase per ton for pulping/paper making (~\$8) = overall system net cost increase of ~\$3 per ton.

Case Studies

Chula Vista, California

The City of Chula Vista, California, began its recycling program in 1990 with a dual-stream program serving about 130,000 people, collecting newspaper in a bag and bottles and cans in an 18-gallon container; this had about 2.5–3% residuals. This program provided about \$300,000 of revenue for local public education. By 2002, the program collected from about 200,000 people, picking up four streams: newsprint, mixed paper, corrugated cardboard, and food and beverage containers; they also had weekly yard waste collection. In 2002, the City switched to single stream after determining that the potential benefits of single stream outweighed the downsides. In the new system, residents received a 96-gallon cart for recycling (blue), and had the choice of a 32, 64, or 96-gallon cart (black) for trash. Although residuals have increased to about 9%, recycling has more than doubled to about 1,500 tons per month, and trash pounds per household has decreased (this may be due in part to the pay-as-you-throw rule which charges for the amount of trash thrown out). The City takes recycling seriously, and attaches fines after three violations of finding trash in with recyclables; the city places a lien on the property of the resident until the fines are paid.

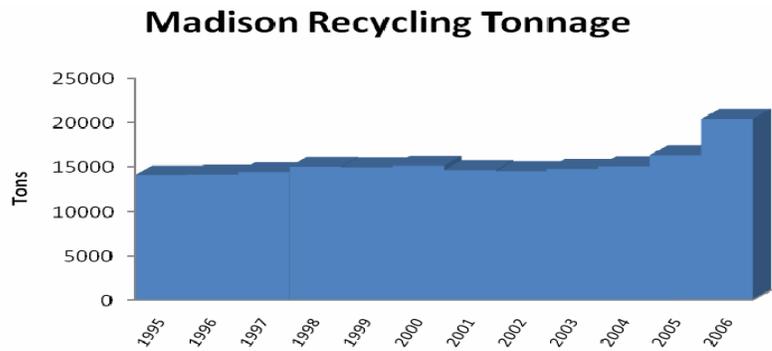
City of Madison, Wisconsin

The City of Madison began single stream recycling with automated collection in September, 2005, following two years of planning. The time was right for this changeover, since recycling trucks needed to be replaced; the transfer station needed redesign, and the recycling contract was up for renewal. Despite a significant capital cost, political support was strong to develop additional capacity due to population growth projections and a history of high recycling rates.

2006 was the first full year of implementation of single stream recycling and Madison experienced a significant increase in tonnages (see figure 2). As can be seen in the chart below, the City increased overall recycling by 25% from 2005 levels.

Additionally, the City achieved over \$103,000 in landfill tipping fees savings in 2006 as compared to 2005.

Finally, net cost per household was projected to only slightly more expensive than the previous system, as is illustrated in the chart below.



Recycling System Cost Annual Comparison

Category	Current System Manual Dual Stream	Proposed System Automated Single Stream
Wages and Benefits	\$600,744	\$529,344
Worker's Compensation	\$88,000	\$61,600
Time Lost	\$85,821	\$60,074
Equipment Debt Service	\$341,712	\$292,287
Equipment Maintenance	\$478,656	\$430,764
Cart Debt Service	\$0	\$305,784
Net MRF Revenue	(\$20,164)	\$0
Net MRF Cost	\$0	\$108,905
Tip Fee Savings	\$0	(\$62,048)
Total Annual Cost	\$1,574,769	\$1,726,710
Annual Cost Per Household	\$25.52	\$27.98
Recycling Bag Cost Per Household	\$3.40	\$0
Net Annual Cost Per Household	\$28.92	\$27.98

Note: Material recovery facility (MRF) revenue is subtracted from other items under the Manual System column. Tip fee savings are subtracted from the other items in the Automated System column. The tip fee savings includes only those savings associated with the estimated 10% increase in diversion associated with automated collection. Source Dreckmann (2004).

Source: Jamelske and Kipperberg, *A Contingent Valuation Study and Benefit-Cost Analysis of the Switch to Automated Collection of Solid Waste with Single Stream Recycling in Madison, Wisconsin*, Public Works Management & Policy, Vol. 11 No. 2, October 2006 89-103.

What are end users (manufacturers) looking for?

The following are industry specifications for single stream recyclables:

- * Paper industry - paper sorted by grade, with unwanted paper removed (Poly-coated, waxed, food soiled, brite-dyes) and no contamination (glass, plastics, metal, or food/organics).
- * Plastics industry - clean material sorted by composition, free of glass, paper, or garbage.
- * Aluminum industry - clean sorted material, with no glass, paper, plastics, or food in it.
- * Glass industry - clean material, with containers sorted by color when possible; no heat sensitive glass (such as Pyrex), rocks, ceramics, mirror glass, or plate glass. (Conservatree, 2006b).

Have there been problems for end users of the materials resulting in a decrease of recycling revenue?

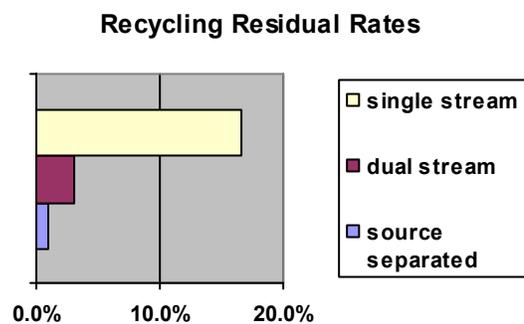
Single stream recycling tends to increase costs for processing and re-manufacturing. For example, the paper industry may experience cost increases due to:

- * Not being able to use all of the fiber, since up to 15% of the bale of fiber may be plastic, glass, and metal residue, meaning that only 85% of the bale is usable to the paper company.
- * Degradation of machinery due to other materials mixed in with fiber. Increased costs for parts and maintenance resulting in increased shut-downs and cleanings.
- * Potential loss of customer base due to possible decrease in paper product quality

Are there other disadvantages to single stream recycling?

Additional downsides to single stream include:

- * An increase in residuals, or recyclable materials that are contaminated. This includes paper or plastic contaminated by broken glass. These materials are landfilled and not recycled. The chart below illustrates residuals rates for various recycling collection systems.
- * A good dual-stream program can be around 2-3% residuals, while source separated can produce slightly more than 1% residuals (CBS, 2005). Single stream can be significantly higher; a study conducted by Government Advisory Associates (GAA) on 36 programs shows a residual rate of 16.6%, close to the number acquired by the St. Paul case study at 14.2% when not including mixed glass (27.2% when including mixed glass).
- * Initial capital costs of setting up a single stream system or switching from a dual-stream system: new carts, new collection vehicles, construction of or upgrading of processing facility, and education of residents (mail-outs, door-to-door education). Processing costs may increase, commodity prices may decrease due to contamination, and there is the potential of loss of public participation or lack of belief that the single stream method works due to the increase of landfilling of residual materials due to contamination or unmarketability (WDNR, 2005).

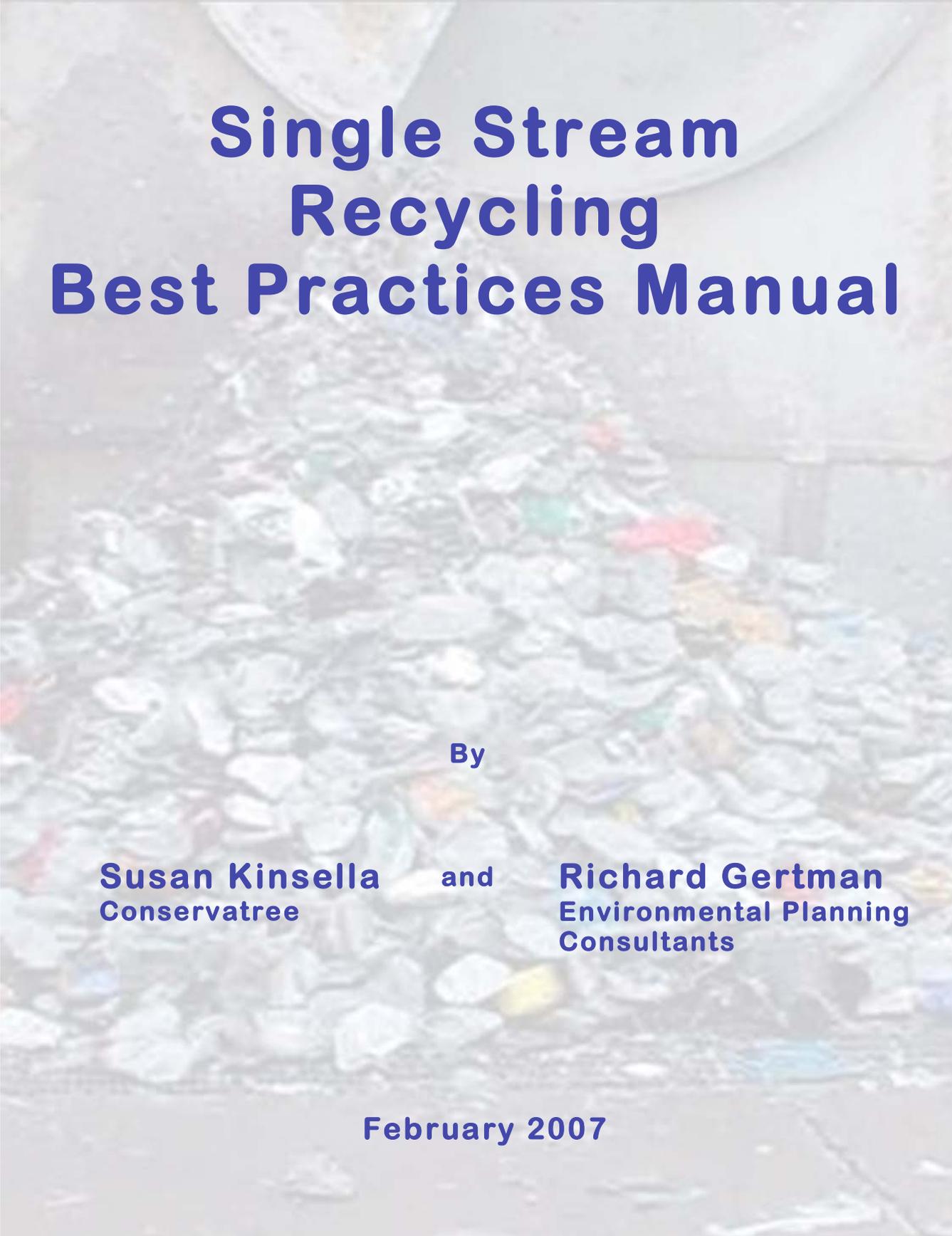


Summary

Single stream recycling is gaining popularity across the United States. Many residents prefer it because of convenience in terms of not having to sort materials and often having carts that can be wheeled instead of carrying materials to the curb in bins. Municipalities and collectors prefer the method due to increased ease and efficiency of collection with mechanized lifting of carts, associated cost savings, reduced injuries on the job, and increased overall participation and tonnage collected. Single stream, however, is not always cheaper than current systems. Cost increases can come in the form of new carts/bins, new trucks, education of residents, and the construction or renovation of a MRF or recycling center.

Single stream recycling could be aimed at areas where there currently are not strong recyclers or could be implemented in the attempt to dramatically increase tonnage collected. Areas that already have successful programs that achieve high participation and diversion rates may choose to continue with source separated or dual-stream recycling. Communities should analyze their individual situations in order to decide which type of program is best for them. Municipalities, collectors, processors, and manufacturers should work together to realize which method of recycling is best for their area, so that costs are equally shared and the highest amount and percentage of quality recyclables can be recovered.

Attachment B



Single Stream Recycling Best Practices Manual

By

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February 2007

Cover Photo: Plastics, glass and metal contaminants pouring out of a drum pulper at a newsprint mill.

The statements and conclusions in this report are those of Environmental Planning Consultants and Conservatree and are not necessarily those of the California Department of Conservation or its employees. The DOC makes no warranties, express or implied, and assumes no liability for the information contained in the succeeding text.

The statements and conclusions in this report are those of the Authors, and not necessarily those of any of the organizations that provided funding for this Manual.

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Keep in mind that all the materials that are collected mixed together in a single stream system must be sorted back out at the processing center. The more complex the load, the more extensive, and expensive, the processing required.

If the materials are to be processed at a MRF that has not yet been constructed, then there is an opportunity to design the facility to specifically handle the full range of materials the community wants to recycle. If the materials are to be processed at an existing facility, then either the materials to be collected should be matched with the capabilities of this facility or the community and processor should develop a plan to upgrade the facility to handle the additional material types.

Communities should also consider matching their program to those of surrounding communities, especially if the program will share a processing facility with other recycling programs.

This will also make the public education and promotion program easier to communicate to residents.

PUBLIC EDUCATION AND CLEAN RECYCLABLES

Most residents want to recycle more materials than are collected by their recycling program. In many cases, when they are in doubt about whether or not a material is collected – such as garden hoses, pizza boxes, light bulbs, and plastic toys – the residents put them into the recycling cart, expecting the processor to recycle them.

To maintain recovered material quality it is essential to:

- ***Keep the list of acceptable materials simple and easy to understand,***
- ***List materials that are not acceptable,***
- ***Provide clear and easy-to-understand informational materials at every opportunity, and***
- ***Give immediate feedback to residents who set out non-recyclable (or non-targeted but recyclable) materials.***

The more extensive the list of collected materials, the more extensive the on-going promotional program must be. So if your community is not prepared to support a major promotions program, the list of collected materials should be simple rather than complex. (See Chapter 5: *Promotion and Public Education* for more detailed information.)

COLLECTING CLEAN MATERIALS

It is not uncommon for materials arriving at a processing facility to already be contaminated in one of three ways:

- 1) Non-recyclable materials (trash or garbage) are placed in with the recyclables by the resident,

- 2) Potentially recyclable materials that are not part of the community's collection program are placed in with the recyclables, and
- 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.

The first two categories are primarily contamination caused by residents incorrectly sorting their recyclables from trash. But the third category should be prevented by the collector's methods of recovering recyclable materials and the processor's handling techniques.

The community should be very specific about materials handling requirements, and the collection company should spell out how it will ensure these requirements are to be met.

The community should require a sampling program to monitor the quality of collected loads when they reach the processor, in order to identify and address problems as early as possible.

The community may also choose to provide the collection company financial incentives for clean loads and penalties for loads that are contaminated.

If the program intends to collect any of the following materials, special consideration should be given to their handling:

- Flat plastic bags are hard to remove from paper and are easily contaminated by the left-over liquids in beverage containers. If plastic bags are to be collected in a program, residents should be required to place the bags within other bags and only set out full bags, not loose individual ones.
- Poly-coated and waxed cartons, wet strength packaging (beer and soda boxes) and food-contaminated paper cannot be recycled by most paper mills, but are compostable. Therefore, they should not be included in single stream programs, unless they will be sorted from the mix and shipped as a separate commodity to a mill that is designed to handle them or to a compost facility.

PROCESSING FOR CLEAN MATERIALS

The contract between the community and the materials processor should be very specific about processing requirements and specify the quality of the materials to be marketed.

The community may choose to provide financial incentives for the processor to ship clean materials and financial penalties for loads that are contaminated.

To verify the quality of the materials, the contract should require manufacturers to provide reports to the community and the processor on the quality of the loads received.

A processor may declare that they achieve quality that is "good enough" for the mills that buy materials from them. But in recycling, "good enough" is not really good enough.

Attachment C

Commingling and Single Stream Collection

Many options exist for collecting recyclable materials, but commingling and single stream collection strategies are becoming increasingly common amongst both municipal recycling programs and campus recycling programs. The terms “single stream” and “commingling” are sometimes used interchangeably to refer to all recyclables (bottles, cans, paper, etc.) being collected in a single bin. “Commingling” may also refer to materials grouped together by category. Office-grade white paper, colored paper, and low-grade paper collected together, or PET, HDPE, PC, and other plastic resins collected together, but still separated from other types of materials are examples of commingled collection systems. For the purpose of this book, single stream collection and commingling will not be used interchangeably. Single stream collection will signify all materials being collected together, while commingling will signify separating materials into similar groups.

On the opposite end of the spectrum from single stream collection is source separation. This method separates materials by type and grade (i.e. quality) prior to collection. Commingling can be thought of as somewhat of an intermediary between specific source separation and single stream collection. There are benefits and drawbacks to each system depending on the composition of the waste stream, previous success with collection techniques, amount of community support and participation, and available work force and technological options. One size does not fit all when it comes to recycling collection systems, so all of the pros and cons of the entire lifecycle of the system should be evaluated before making a decision.

There are a few key points to keep in mind when establishing a collection system. Remember that there is a difference between recycling and collecting recyclables. Most colleges are involved in collection, whereas manufacturers are actually recycling materials. This ties into the second point: remember the recycling mobius when determining which system is best for the campus and the environment as a whole. The three arrows chasing one another have traditionally stood for reduce, reuse, recycle. Now, the mobius can also signify collection of recyclable materials, manufacturing using recycled materials, and purchasing and using recycled products that can be collected at the end of the life cycle to begin the recycling process again. In order for this process to continue, the materials collected need to be of a high enough quality to feed back into the manufacturing cycle and prevent “downcycling.” Otherwise, the materials may be diverted temporarily from landfills, but will not truly be recycled.

A major benefit of single stream collection is that a higher volume of material is collected. However, this material may be highly contaminated and often unfit for use in manufacturing. This is why the waste stream needs to be carefully assessed. Single stream collection may be more viable in a municipal setting as the recyclable materials that are collected are often of a low quality to begin with. This is not the case on a college campus where copious amounts of high quality paper can be collected and will only retain a high quality level if separated from other materials. Paper is an easy material to collect, separate, and sell in order to generate revenue for a college recycling program. Including paper in single stream collection can greatly inhibit a recycling program's ability to profit from recyclable sales. As the market fluctuates, varying degrees of paper quality will be acceptable, but producing a high quality product regardless of market trends will be beneficial in the long term. It is easier to switch to commingling or single

stream collection than to begin with single stream and switch to source separation because participants will not be accustomed to separating materials and contamination will occur.

Contamination of recyclables, due to single stream collection, can take on a variety of forms. Trash or organics can be mixed into the recyclables. Another major concern is the effect of single stream collection on valuable paper sources. Broken glass shards are a major hazard to the paper manufacturing process because they significantly increase wear and tear on equipment. If the glass is not fully separated out during the manufacturing process, it may become embedded in the paper and pose a hazard both for employees and future customers. Paper can also become contaminated by liquids left in containers collected as part of a single stream system. Although all plastic and glass containers would preferably be cleaned by the consumer prior to being placed in a recycling bin, there is often leftover liquid in these containers. This skews the weight measurements as wet paper is heavier than dry and also lowers the quality of the paper, sometimes rendering it completely unsuitable for recycling. In this event, what was originally high quality paper becomes waste. While single stream collection may increase the quantity of material collected, it also increases the amount of contamination and therefore trades quality for quantity.

Due to lower quality, costs will be increased at some point in the recycling process. If paper recyclers are receiving huge amounts of low quality materials, they will need to remedy this by placing some of the financial burden back onto the recycling collectors. This could be in the form of increased pick up fees, extra charges to help compensate for damage to equipment from contaminated material, or lower prices per pound of material collected.

Contamination will also make tracking systems more difficult and less reliable. Recyclables are generally measured in weight and volume, but high levels of contamination will skew these results. The weight and volume of contaminants need to be subtracted from the total weight at the time of collection in order to determine the percentage of contaminants and the percentage of recyclable materials. In a single stream system, the collectors (campus recycling programs) will have to rely on manufacturer receipts in determining contamination levels and will not be able to determine which materials to target for increased recycling. Clear material tracking is essential to proving the cost effectiveness of a recycling program as well as identifying educational needs based on what is already being recycled on the campus and what could be recycled, but ends up as waste. Single stream collection also skews tracking systems by counting contaminants as recyclables. There is a major difference between landfill diversion and recycling. Recycling is an ongoing process, whereas waste diversion is temporary. Contaminants will still be landfilled, but will be diverted temporarily. Single stream collection undermines the valuable aspects of material tracking.

It is also important to track where the recyclables from campus are going after being collected. Are materials processed locally? Or, are materials sent overseas for processing? Paper manufacturers in the U.S. are less likely to accept contaminated material, but manufacturers in China have recently been buying lower quality material, which needs to be supplemented by virgin resources due to high contamination levels. [\[15\]](#) Consider the total environmental impact of collecting paper, shipping it thousands of miles away, putting energy into processing the paper, landfilling that which cannot be recycled, then selling some locally and shipping the rest abroad. This practice is clearly unsustainable and requires enormous amounts of energy and natural resource consumption. Work with local paper manufacturers whenever possible to meet their quality specifications. If manufacturers are not receiving enough high quality material, they may resort to using virgin fiber sources, breaking the recycling chain. [\[16\]](#)

Another factor to keep in mind is confidential documents. These cannot be included in single stream collection because they need to remain private. It is inefficient to collect only one type of item separately while single streaming the rest.

Despite the numerous quality and life-cycle drawbacks to single stream separation, many college administrators across the country are clamoring for recycling programs to switch from source separation to single stream collection in order to save upfront collection costs, simplify the system for consumers in order to increase participation, and decrease worker injuries through automating collection processes. While these reasons are valid, they may not be sufficient to justify changing a fully functional source separation system which produces high quality materials to a seemingly simpler system which leads to lower quality items and waste. If pressured or required to switch to a single stream system, compromising with commingling may be an option. For example, paper could be commingled (office grade/white paper, colored paper, and low grade all together) but separated from glass and plastics. While commingling may still lead to a decrease in quality, it will not lead to as significant a decrease as single stream collection.

Commingling should also be considered in composting processes. Just as quality of recyclable materials varies, the quality of compostable materials varies as well. For example, food scraps and yard waste will produce a much higher quality end product than compost made primarily of paper food boats and polylactic acid (PLA) containers. See [Chapter 14: Bioplastics](#) for more information about PLA containers. Again, the type of collection depends on the destination of the end use product. If the campus is planning on producing an extremely nutrient rich compost to be used as a soil amendment in campus gardens, it may make sense for food scraps to be collected separately and composted on campus. Since PLA containers will not decompose quickly in a basic compost system and require industrial processes to biodegrade, they could be collected separately from food scraps and sent to an industrial composter. Again, the size of the campus is a major factor in determining the best system. Source separation of organic materials would be feasible on a small or medium sized campus, but sending all organic waste (from food scraps to yard waste to PLA containers) to an industrial composting facility may be the only cost and time effective option on a larger campus.

Resources

Container Recycling Institute

<http://www.container-recycling.org/>

Recycling Today

<http://www.recyclingtoday.com/>

Conservatree 2003 Report: Single Stream: “An Investigation into the Interaction Between Single Stream Recycling Collection Systems and Recycled Paper Manufacturing”

<http://conservatree.com/learn/SolidWaste/SingleStreamReport.pdf>

Conservatree: “Single Stream Collection: Done Deal or Good Deal?”

<http://conservatree.com/learn/SolidWaste/singlestream.shtml>

EPA Commingled Recycling System Improvement

<http://www.deq.state.or.us/lq/pubs/docs/sw/CommingledRecycleIntro01.pdf>

EPA Region 10: The Pacific Northwest- Contamination in Commingled Recycling Systems Standards & Guidelines Initiative

<http://yosemite.epa.gov/R10/homepage.nsf/topics/ccrs>

Friends of the Earth Briefing: “Recycling Collections- source separated or commingled?”

http://www.foe.co.uk/resource/briefings/recycling_collections.pdf

“Single Stream Best Practices Manual and Implementation Guide”

<http://www.conservatree.com/learn/SolidWaste/bestpractices.shtml>

Attachment D

U.S. EPA Region 10 convened the Contamination in Commingled Recycling Systems Standards & Guidelines Initiative to develop regional solutions to the growing problem of contamination in commingled recycling systems.

National Information	
●	Municipal Solid Waste
●	Recycling

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- [Next Steps](#)
- [Additional Resources](#)

For more information, contact [Melissa Winters](mailto:winters.melissa@epa.gov) (winters.melissa@epa.gov).

Summary

On July 11, 2007, the Contamination in Commingled Recycling Systems Standards & Guidelines Initiative stakeholders met in Seattle, Washington to kick off their workgroup. The workgroup's vision was to develop standards and guidelines for commingled recycling systems that will reduce cross-contamination of recycled materials, increase the quality and quantity of materials recycled, and capture the highest percentage of materials that are intended to be recycled.

To accomplish its vision, the workgroup broke into three subgroups. The Standards & Guidelines Subgroup drafted processing goals for Material Recovery Facilities (MRFs) and collection guidelines for collectors of commingled materials. The Evaluation Subgroup developed a protocol and system for evaluating whether the processing goals and collection guidelines are being met. The Marketing Subgroup developed tools to ensure that the standard and guidelines are incorporated into contracts, purchasing, policy, and permitting.

This Initiative was a result of the Washington Beverage Container dialogues. The dialogues convened to address how to increase beverage container recycling in Washington State. It resulted in a request for proposals to increase recycling through incentives, as well as the Contamination in Commingled Recycling Systems Standards & Guidelines Initiative to address contamination of recyclables in commingled systems.

The timeframe for this work was approximately one year. The first stakeholder meeting was held in July 2007, and the final stakeholder meeting was held in September 2008. Stakeholders involved in the process included collectors, MRFs, mills, non-governmental organizations, and local and state government agencies. The U.S. Environmental Protection Agency Region 10 served as a convener.

In September 2008, EPA Region 10 handed off deliverables to states, Oregon and Washington, for their implementation processes. The Oregon Department of Environmental Quality and Washington State Department of Ecology will be leading individual implementation processes (see [Next Steps](#)).

What are the issues?

Commingled, or single stream, recycling systems involve the mixing of recyclable materials for the purpose of efficient collection. Depending on the recycling program, commingled recycling systems may include just a few recycled materials or a wide range. A commingled system allows customers to put all recyclables into the same cart or bin with no sorting. These commingled recyclables are collected, loaded into a single truck compartment, and transported to a processor or a material recovery facility (MRF). The MRF is tasked with sorting all the recyclables back into high quality feedstock streams, with limited contamination by OUTTHROWS and PROHIBITIVES.

While the move to commingled recycling systems has a number of advantages, including increased participation in recycling programs by households and businesses and reduced collection costs, there are significant disadvantages. In particular, commingled recycling systems cause problems for manufacturers of products with recycled content and result in losses of collected recyclable materials, thus preventing the full environmental benefit of recycling to be realized.

In the report, [Single Stream Recycling Best Practices and Implementation Guide \(PDF\)](#) (104 pp, 1.3MB, [About PDF](#)) Gertman and Kinsella note several challenges facing manufacturers as a result of commingled recycling systems, including:

- Poor quality recovered materials that they must use as production feedstocks;
- Reduced operating and energy efficiencies from poorly sorted materials that include many contaminants to their manufacturing systems;
- Dramatically increased internal costs because poorly sorted materials demand new and upgraded feedstock cleaning systems, increased maintenance, and more frequent equipment repair and replacement;
- Lost access to recyclables needed for manufacturing when they are sent to the wrong types of manufacturing mills;
- Increased raw material costs to replace those too contaminated to use; and
- Increased costs from landfilling unusable materials included in the bales bought to make recycled products.

Several assessments of local MRFs have documented the loss rate of recyclables in commingled systems. The [2006 King County MRF Assessment \(PDF\)](#) (76pp, 380K, [About PDF](#)) found that 7,000 tons of recyclables were lost from Puget Sound MRFs as residual and additional recyclables ended up in the wrong product stream (e.g., 4,200 tons of non-paper recyclables in newspaper). [Portland Metro's study](#) [] found a loss rate of 6,230 tons of recyclables. By material type, there was a loss rate of 26% incoming cardboard, 14% metal, 24% plastic bottles, and 1% newspaper. In general, paper loss rates are low because paper is the bulk of the incoming material and most Pacific Northwest MRFs use a NEGATIVE SORT for paper.

Loss rates are of concern because the environmental benefit of recycling, particularly in the Pacific Northwest, does not derive from reduced landfilling but the reduction of virgin material inputs. More precisely, most "upstream" impacts are larger than "downstream" impacts. Upstream impacts may include, for example, the energy use, habitat impacts, and pollution and wastes resulting from the extraction and harvesting of raw materials. Downstream impacts, on the other hand, may include the leachate, methane, and other air

emissions from landfills.

[U.S. EPA's Waste Reduction Model \(WARM\)](#) allows comparison of different waste management options in terms of energy units, million BTU. For example, recycling PETE or PET rather than landfilling it saves approximately 53 million BTUs per ton, which is equivalent to nine barrels of oil or 429 gallons of gasoline. Recycling aluminum cans rather than landfilling is an even greater energy savings – 207 millions BTUs per ton, which is equivalent to 36 barrels of oil or 1,665 gallons of gasoline.

Pacific Northwest MRFs are motivated to do quality sorting to meet the demands of their customers, but the quality demanded varies in the global marketplace. Export markets often pay more than domestic markets and for lower quality materials. MRFs must also operate efficiently. They have spent millions on sorting equipment and must efficiently utilize that equipment to survive financially. There is strong pressure to speed up the sort line and to reduce costs by minimizing sorters. Despite these pressures, the compelling environmental benefits of recycling warranted a stakeholder process focused on increasing recovery rates.

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Stakeholder Process

- [Stakeholders](#)
- [Vision Statement](#)
- [Mission Statement](#)
- [Subgroups](#)
- [Stakeholder Meetings](#)

Stakeholders

Stakeholders involved in the process include collectors, MRFs, mills, non-governmental organizations, and local and state government. Organizations represented at some or all of the stakeholder meetings include:

Association of Oregon Recyclers
Blue Heron Paper Company
Clark County, Washington
City of Auburn, Washington
City of Corvallis, Oregon
City of Eugene, Oregon
City of Gresham, Oregon
City of Olympia, Washington
City of Portland, Oregon
City of SeaTac, Washington
City of Seattle, Washington
City of Sedro Woolley, Washington
City of Vancouver, Washington
Deschutes County, Oregon
Douglas County, Washington
Far West Fibers
Fibres International

Garten Services, Inc.
Glass Packaging Institute
Idaho Department of Environmental Quality
JMK Fibers
Kahut Waste Services
King County, Washington
LeMay Enterprises
Metro (Portland)
Nippon Paper Industries
NORPAC
Northwest Recycling
Tacoma Recycling Company, Inc.
Oregon Department of Environmental Quality
Oregon Recycling Systems
Oregon Refuse & Recycling Association
RABANCO | Allied Waste Industries
SP Recycling Corporation
Smurfit-Stone Recycling Company
Solid Waste Association of North America (SWANA)
Washington County, Oregon
Washington Refuse & Recycling Association
Washington State Department of Ecology
Washington State Recycling Association
Washington Utilities & Transportation Commission
Waste Connections
Waste Control Recycling
Waste Management
Weyerhaeuser

Vision Statement

To develop standards and guidelines for commingled recycling systems such that:

- (1) Cross-contamination of recyclable materials would be reduced;
- (2) The quality and quantity of materials recycled would be increased;
- (3) The highest percentage of materials that are intended to be recycled would be captured.

Mission Statement

To agree to clear and measurable standards and guidelines that:

- (1) Allows governments and other contracting entities to easily and consistently specify that their materials are collected and processed according to the standard and guidelines for haulers and MRFs;
- (2) Allows haulers and MRFs to achieve a higher market value by meeting the standard and guidelines;
- (3) Increases the overall quantity and quality of material recycled;
- (4) Reduces the quantity of recyclable material lost as either outthrow or prohibitive materials in other recycling streams;
- (5) Has a consistent measurement and evaluation system that is cost effective and transparent;
- (6) Encourages and rewards more effective and efficient collection systems.

Subgroups

- [Standards & Guidelines](#)
- [Evaluation](#)

- [Marketing](#)

Standards & Guidelines

Purpose: To develop draft standards and guidelines for approval by the larger group that does the following:

- (1) Clearly defines the acceptable level of contamination for incoming material to MRFs from collection processes or specifies Best Management Practices for collectors of commingled materials.
- (2) Clearly defines levels at which materials processed at MRFs are considered not cross contaminated by other recyclable materials and are considered usable for high end products.
- (3) Reflects the larger mission of work group.

Desired Outcomes:

- (1) Determine and use common terminology.
- (2) The guidelines and standards should consider employee safety.
- (3) The guidelines and standards should establish a procedure for their revision in response to markets.
- (4) Draft collection guidelines to present to larger stakeholder group for review and approval. Collection guidelines should clearly define the acceptable levels of contamination for incoming materials and/or specify best management practices for collectors of recyclable materials.
- (5) Draft MRF standards to present to larger stakeholder group for review and approval. MRF standards should clearly define levels at which materials processed at MRFs are considered (1) non-contaminated by prohibitives, outthrows, and other recyclable materials and (2) usable for high quality end products.
- (6) Draft guidelines and standards that allow adherence to guideline or standard to be measured. Evaluation Subgroup will design evaluation system.
- (7) Draft guidelines and standards that can be incorporated into contracts, purchasing, policy, and permitting. Market Value Subgroup will develop and propose a plan to accomplish such incorporation.

Evaluation

Purpose: To develop and propose an evaluation system for standards and guidelines that includes financing, roles, and accountability.

Marketing

Purpose: To develop and propose a plan to ensure that the standard and guidelines are incorporated into contracts, purchasing, policy, and permitting.

Stakeholder Meetings

- [July 2007](#)
- [February 2008](#)
- [September 2008](#)

July 2007 – Project Kick-Off

Stakeholders convened to discuss whether they wanted to work together over the next year to develop and implement a processing level standard for Material Recovery Facilities (MRFs) that would reduce the contamination levels leaving the MRF and directly increase the recycling of materials in Washington, Oregon, Idaho, and Alaska. Stakeholders agreed that the quality of incoming materials to MRFs also needed to be considered and collection guidelines developed. Stakeholders drafted and agreed to the vision and mission statements and formed three

subgroups to carry out its goals – Standards & Guidelines, Evaluation, and Market Value (name later changed to Marketing Subgroup).

[July 2007 Agenda \(PDF\)](#) (3pp, 41K)

[July 2007 Minutes \(PDF\)](#) (3pp, 46K)

February 2008 – Stakeholder Meeting #2

Stakeholders reconvened to discuss the Standards & Guidelines Subgroup's work product and launch the next phase of the process, developing an evaluation protocol and marketing tools. The collection guidelines and MRF standard (now processing goals) were discussed and revised for handoff to the Evaluation and Marketing Subgroups.

[February 2008 Agenda \(PDF\)](#) (2pp, 46K)

[February 2008 Minutes \(PDF\)](#) (6pp, 50K)

September 2008 – Final Stakeholder Meeting

In the final meeting of the stakeholder process, stakeholders met to discuss the Evaluation and Marketing Subgroups' work products. The collection guidelines, processing goals, evaluation protocol, and marketing tools – white paper, fact sheets, and PowerPoint presentation – were approved for handoff to Oregon and Washington's individual state-lead implementation processes.

[September 2008 Agenda \(PDF\)](#) (2pp, 33K)

[September 2008 Minutes \(PDF\)](#) (5pp, 57K)

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Deliverables

[Common Terminology \(PDF\)](#) (2pp, 26K)

[Collection Guidelines \(PDF\)](#) (3pp, 33K)

[Processing Goals \(PDF\)](#) (2pp, 24K)

[Evaluation Protocol \(PDF\)](#) (1pp, 20K)

Marketing Tools: [White Paper \(PDF\)](#) (2pp, 137K) | [Informational Slide Show \(PDF\)](#) (37pp, 736K) | [Collection Sample Format \(PDF\)](#) (1 pp, 25K) | [Material Recovery Facility Sample Format \(PDF\)](#) (2 pp, 26K)

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Next Steps

In September 2008, the U.S. Environmental Protection Agency Region 10 handed off deliverables to states, Oregon and Washington, for their implementation processes. The Oregon Department of Environmental Quality and Washington State Department of Ecology will be leading individual implementation processes. Contacts for more information on the next steps for Oregon and Washington implementation are:

Oregon Department of Environmental Quality
[Peter Spendelow](mailto:spendelow.peter@deq.state.or.us) (spendelow.peter@deq.state.or.us)
(503) 229-5253

Washington State Department of Ecology

[Shannon McClelland](mailto:mcs461@ecy.wa.gov) (mcs461@ecy.wa.gov)
(360) 407-6398

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Additional Resources

- [2006 King County MRF Assessment \(PDF\)](#) (76pp, 380K, [About PDF](#))
- Portland Metro:
[Commercial Commingled Recycling Study](#)
[Residential Commingled Recycling Study](#)
- [Single Stream Recycling Best Practices and Implementation Guide \(PDF\)](#) (104 pp, 1.3MB, [About PDF](#))

Attachment E



Putting quality back into the recovery equation

Research at six MRFs reveals that performance varies significantly and improvements could reduce the landfilling of recyclables.

by Steve Apotheker

It happens every time. Someone asks me what I do, and when I tell them "recycling," the first question out of their mouths is always the same: "Aren't we supposed to have one of the best recycling programs in the country? So, what's with this mixing of paper and containers in our yellow recycling bins? Is recycling still happening?" Although some of this skepticism comes from people not understanding the recycling business, some also stems from a report of commingled recyclables actually being taken to the landfill.

In 2005, the Oregon Department of Environmental Quality (Portland) fined Smurfit-Stone Recycling (Chicago), the largest recycling company in the world, for landfilling recyclables. The Portland plant disposed of its curbside plastic bottles and cans with its processing residue for 18 months because the company claimed it was "uneconomic" to separate them further. In addition to the DEQ fine, Metro (Portland), the regional government responsible for regional solid waste and recycling system planning, required the processor to file an operations plan to show how it would comply with full separation of commingled curbside recyclables.

Although it is easy to dismiss Smurfit-Stone as an extreme, the performance of materials recovery facilities (MRFs) does vary significantly and poor performance can result in unnecessary landfilling of recyclables. For

example, MRF X, in another part of the country, reported 30-percent residue from the single-stream curbside recyclables it received from one large urban area. At first blush, such a high residue level would suggest that the community needed to educate residents better; however, the plant operator then audited the residue and found that 50 percent of it was recyclable. Thus, the solution went beyond education and involved both the community and MRF X changing their procedures to prevent 9,000 tons of recyclables from going to the landfill each year.

To address concerns about processing quality expressed by local governments and end users (and to a lesser degree, residents), the region's six MRFs voluntarily agreed to participate in a benchmarking study. Metro conducted sampling at MRFs to see how well they handled their two basic tasks: sorting recyclables into correct commodities and removing prohibitives (i.e., materials that should not have been set out for the generator). MRFs would also report monthly on the amount of residue they disposed.

Background

Residents of the Portland metropolitan region are proud of their recycling program. All 550,000 households and 43,000 businesses

have the opportunity to recycle and they pay more than \$40 million annually for this service, which is embedded within separate solid waste bills. More than 90 percent of the region's 400,000 households with curbside garbage service set-out recyclables.

In order to reach the region's goal of 62-percent waste reduction by 2005 however, more paper from households and businesses needs to be recovered. Despite a regional paper recycling rate already 25-percent higher than the national rate, commingling was seen as a strategy that could increase the recovery of paper and containers.

Mixing recyclables, particularly containers with paper, seems counter to decades of education. People were taught that separating materials by type at the curb was necessary so that high-quality recyclables could be delivered to end-use markets. Now more than ever, successful recycling is a team effort that involves not only the households and haulers, but also the MRFs and mills. The MRF is the point at which prohibitives are removed and this recycling mixture is turned into separate commodities.

In 1998, local governments were interested in moving to a system of collecting commingled recyclables from households. At the request of local governments, Metro con-

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ducted a field study that looked at how effectively MRFs were able to process different mixes, using the quality of the existing source-separated five-sort mix as a control. At the time, sorting of commingled recyclables was entirely manual (i.e., no disc screens), except for magnets that removed ferrous scrap and a trommel used by one MRF for mixed-container separation.

The results of the study found that:

- ◆ Old newspapers (ONP) sorted from a commingled, two-sort collection (i.e., either paper/containers or paper-plastic-metal/glass) had a quality almost equal to source-separated ONP from a five-sort collection. Both grades had five-percent other paper by weight, such as magazines or junk mail. There was no brown fiber in either sample. The only difference was that recyclable containers comprised 0.1 percent in the two-sort ONP.
- ◆ Glass could be color-mixed, but it had to be kept separate from other recyclables in order to be shipped to California where an intermediate processor would prepare it for fiberglass manufacturers.

With those assurances, commingled recycling collection began in 2000. The resulting program was a success. Households still put out their recyclables using their existing two 14-gallon bins, but they could commingle the paper, metal and plastic bottles. Glass was kept separate. In the first full year of commingling, curbside recyclables sent to end-markets jumped 21 percent to 127,000 tons.

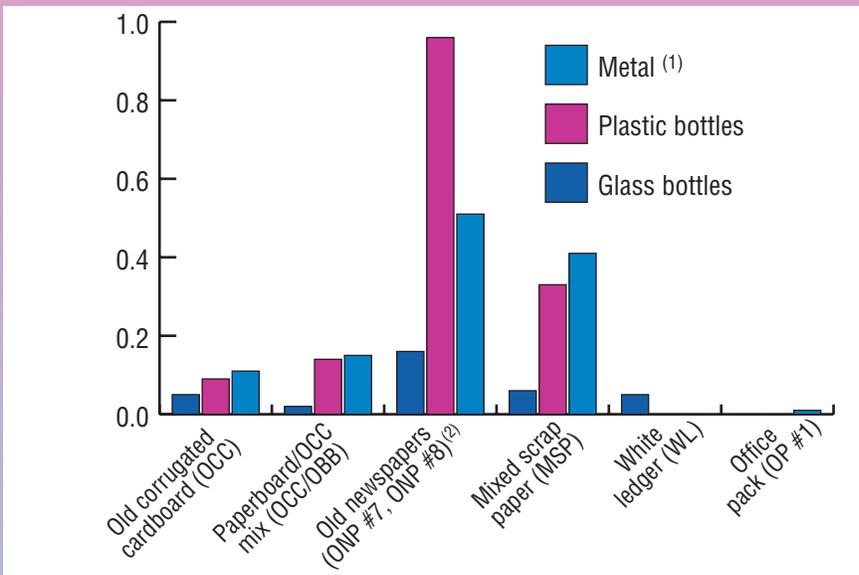
In 2002, Metro and local governments revisited the issue of the MRFs' capacity and capability to handle more commingled paper and containers. Metro wanted to be assured that MRFs had the ability to process the additional 100,000 tons of paper and containers to be recovered from businesses. In particular, quality concerns resulted in the question of setting performance standards on material quality. Reasons behind these quality concerns were:

- ◆ Paper mills were reporting declining quality of scrap paper, particularly contamination from the presence of broken glass and plastic bags.
- ◆ Some haulers had moved to single-stream collection for businesses.
- ◆ MRFs had shifted from manual sorting to mechanical screening.

The MRFs proposed a benchmarking field study to see how effectively they were handling commingled materials and to determine whether they could handle increased volumes. The 2002 field study focused on commingled recyclables from businesses because most of the increased paper would come from this sector.

This study targeted MRFs that handled any commingled material and sampled plastic bot-

Figure 1 Percentage of recyclable containers and prohibitives in paper after sorting



(1) Includes cans and scrap metal.

(2) Contribution of samples from Processors B and C calculated using weighted averages, which reduces contamination levels. Averages for other ONP samples and other commodities are not weighted.

Source: Metro Commingled Recyclables Processing and Quality, 2004.

ties and all major paper grades, including two grades of ONP, two grades of corrugated cardboard, mixed paper and white ledger. This study's approach was repeated in 2003. The major findings from two years of sampling were:

- ◆ Commingled paper and containers were a challenge for MRFs to sort correctly, while commingled paper mixes had little contamination.
- ◆ The negatively sorted paper grade had six times the contamination from recyclable containers as the positively sorted grades (see Figure 1). For MRFs that accepted commingled paper and containers, ONP was negatively sorted. For MRFs that took only commingled paper, mixed paper was the negative sort.
- ◆ Reloads between MRFs were common, but sampling them would overestimate contamination. Reloads took place when capital-intensive MRFs would run commingled commercial paper quickly to separate the corrugated cardboard and then would ship the remaining mixed office paper to a labor-intensive plant where it was more cost-effective to sort out white ledger and produce an office pack. Since the second sort also removes contamination, reload grades were identified and were not included in future sampling efforts.

Current study

Based on this previous fieldwork, the current, ongoing field-sorting program targets only the six MRFs that handle commingled paper

and containers from curbside collectors. In addition, the number of paper grades sampled was trimmed to just ONP. Hand-sorted plastic bottles and residue continued to be sampled.

At the suggestion of the MRF operators, the pre-scheduled sorts became "surprise visits," with notification being given at 8 a.m. on the day of the sort. In addition, sample sizes were increased from the 150 pounds in the previous study to 300 pounds, which matched the same size samples being taken by some paper mills in their quality-sort monitoring of suppliers.

To look at a MRF's ability to perform in a variety of conditions, each plant is visited at least four times over a six-month period that spans wet and dry weather. Each MRF provides 24 samples, or eight samples per material. Over the course of six months, more than 21 tons of commodities and residue were sampled. Each visit records how many sorters are working compared to a full crew (not loaders, spotters or rovers) and if the equipment is working correctly.

Sorting residue

Average annual residue reported by the six MRFs ranged from one percent to two percent, which does not appear to be a great amount compared to some MRFs that report double-digit residue. However, when Metro looked at the composition of the residue from the local MRFs in 2002, it found that 44 percent consisted of recyclable paper and containers, which was similar to the 50 percent of recyclables that MRF X found in an audit

of its residue.

The lesson learned is that a MRF's residue level, whether a low two percent of the local MRFs or the higher 30 percent of MRF X, does not tell you anything about the MRF's effectiveness. Only an audit of the percentage of recyclables in residue indicates how effective the MRF is in doing its job.

Figure 2 shows the progress MRFs have made since the 2002 study, reducing recyclables in residue to 20 percent. An average, however, can hide a wide range of performance. Figure 3 shows that the best local MRF in 2004-05 had less than five-percent recyclables in its residue, whereas several other MRFs saw more than 30-percent recyclables in their residue. Only one MRF consistently did a great job keeping recyclable paper out of residue.

Some of the improvement is due to increased communication with the MRFs. In the 2002 study, one MRF was disposing of all its scrap metal in residue because it did not know this was a curbside recyclable that had to be sorted out by law. In addition, scrap metal prices were low, so the MRF was not motivated to market this material instead of disposing it.

With the knowledge that scrap metal was a curbside recyclable, it is now doing a better job of sorting scrap metal. In addition, when Metro does its residue sampling at a MRF, the plant supervisors can see the results of the sort and get immediate feedback on what is being mistakenly thrown away.

Sorting plastic bottles

Plastics are the major prohibitive found in curbside recyclables, up to 30 percent by weight of prohibitives in residue. However, the export market's specification for mixed-bottle bales has been widening to accept a larger percentage of rigid plastic containers.

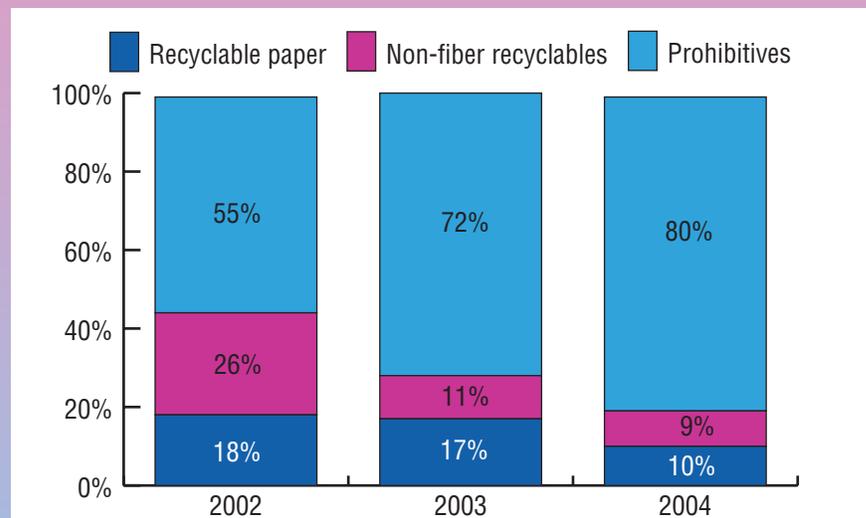
Up to 20 percent of a mixed plastic bottle bale can be rigid plastic. If a MRF has to sort these rigid plastics out of the paper, then it would much rather receive revenue of \$150 per ton from a plastic market than pay \$100 per ton to have them picked up and disposed of in a landfill.

In order to fully characterize the type and amount of plastic prohibitives and track the changing nature of the export market, Metro decided to sample plastic bottles. MRFs have made progress lowering the contamination of non-plastic recyclables and prohibitives in plastic bottles. Although performance among processors varies, between the 2003 and the 2004-05 study, contamination was cut by almost two-thirds, from 9.0 percent to 3.5 percent.

Sorting old newspapers

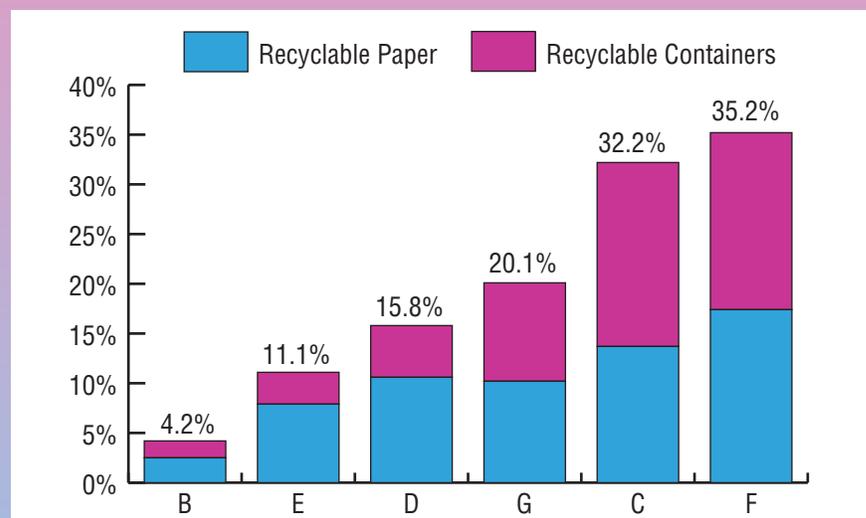
Metro's sampling of ONP found the composition shown in Figure 4. Acceptable paper accounts for 90 percent; however, of the 10

Figure 2 Residue composition in sampling studies



Source: Metro Commingled Recyclables Processing and Quality, 2004.

Figure 3 Recyclables in residue by processor



Source: Metro Commingled Recyclables Processing and Quality, March 2004.

percent contamination, most (80 percent) is recyclable cardboard and containers that has not been separated out by the MRFs.

Metro's experience is supported by a study by the North Pacific (NORPAC) newsprint mill in Longview, Washington published in the January 2006 *TAPPI Journal*. The average NORPAC supplier of ONP from single-stream curbside recyclables averaged contamination of 15 percent, compared to less than 0.5 percent in ONP produced from source-separated materials. The mill noted that pulper rejects increased every time a supplier switched to commingled collection. By the first quarter of 2005, pulper rejects were at 10 percent.

Although MRFs in the Metro region have made progress in removing recyclables from

residue and in reducing plastic bottle contamination, the contamination in ONP has risen. Between the 2003 and the 2004-05 studies, the percentage of recyclable containers and prohibitives increased one percentage point to four percent.

Contamination varies almost two-fold between the best and the worst MRFs, at six percent and 11 percent, respectively. The biggest contributor to contamination, and the one with the greatest variation among the MRFs, is the amount of brown fiber from corrugated cardboard and old boxboard, such as cereal boxes. Paper mills would like to see the amount of brown fiber lowered, and some MRFs have experimented with adding 25-percent more sorters.

However, additional sorters cannot always

deal with the brown fiber contamination. Three weeks of daily rain recently resulted in soggy brown bags, because the majority of the region's curbside recyclables are collected from open bins. The brown bags were mushed up going across the star screens, causing greater than usual contamination. As a result, some MRFs have resorted to additional hand-sorting of ONP or moving the fiber as mixed paper to an export market. At times like this, roll carts with lids appear more attractive because they would have kept the paper dry.

The six MRFs in the Metro study averaged 0.34-percent glass contamination, which was double that of the previous year. Although this contamination level is very small, the NORPAC mill found that glass contamination of 0.5 percent was enough to shut the mill down, sometimes for a few days. It can have a major effect on mill process and repair-and-maintenance costs, estimated at several million dollars annually.

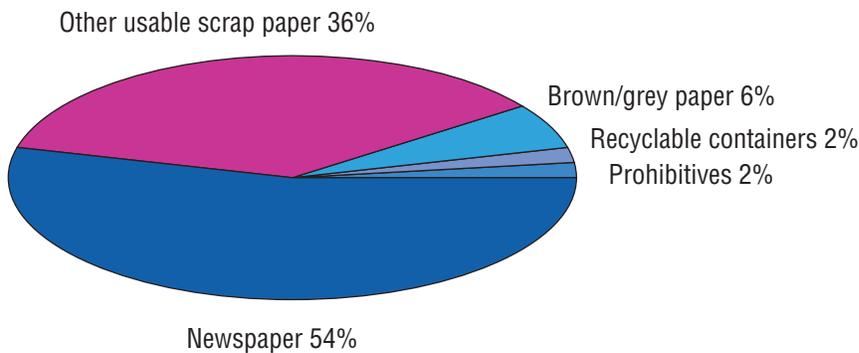
There is room for improvement. Two MRFs saw a decrease in glass contamination, with the greatest decrease at the MRF located in a county that targeted residents with a "keep glass separate" mailer. Three MRFs saw glass contamination increase substantially, with one MRF averaging one-percent broken glass in its ONP samples. One MRF saw its level unchanged.

Analysis of MRF results

The MRF sorting results were used to evaluate how effective MRFs were in removing prohibitives from commodities and sorting commodities correctly. About 60 percent of prohibitives are correctly sorted by the MRFs into either disposed residue or marketed in film or plastic bottle bales, but 40 percent of the prohibitives stay in the ONP (primarily) and other recyclables. Adding up the different prohibitive streams, one can estimate that prohibitives comprise about four percent of incoming recyclables. The best MRF diverts about 75 percent of incoming prohibitives.

This incoming contamination level agrees with the findings of the Oregon Department of Environmental Quality, which sorted recycling setouts in bins and roll carts. It found prohibitive levels between 2.5 percent and 10 percent, respectively. As more local governments move to roll carts (see side bar), with their higher contamination levels, MRFs will see higher contamination levels in delivered loads. MRFs will see costs increase if they have to add more workers, run more slowly or add more equipment to process more highly contaminated roll cart material to the current level of quality. The alternative is for communities and haulers to reduce the amount of prohibitives in roll carts.

Figure 4 Old newspaper commodity composition, in percent



Source: Metro Commingled Recyclables Processing and Quality, 2004.

A similar material flow analysis could look at incorrectly prepared materials. In the Metro region, glass is supposed to be set out separately from other recyclables so it is not mixed with the paper going to the MRF. Sampling of selected MRFs indicates that between 20 percent and 25 percent of the glass bottles end

ONP. Because the amount of ONP is ten times larger than the collected bottles and cans, every one-percentage-point of containers in ONP translates into a 10-percent loss in collected recyclable containers. Individual MRFs saw non-fiber recyclables range from one percent to almost four percent in ONP, which corresponds to a loss of 10 percent to 40 percent of incoming containers.

By material, the 20 percent of non-fiber recyclables landfilled by the newsprint mill or MRF translate into a loss of:

- ◆ Plastic bottles, 24 percent of collected bottles.
- ◆ Aluminum and steel cans, and scrap metal, 18 percent of collected metal.
- ◆ Glass bottles, 3 percent of collected glass.

MRFs saw non-fiber recyclables range from one percent to almost four percent in ONP, which corresponds to a loss of 10 percent to 40 percent of incoming containers.

up in the commingled recyclables because households mix them with other recyclables or haulers incorrectly collect them together. If the incorrectly prepared glass were included in the above analysis, the average effectiveness of MRFs to remove prohibitive materials would increase to just over 70 percent.

Table 1's material recovery rate figures answer the second question on the MRFs' ability to sort recyclables correctly. The good news is that 99 percent of newspapers and bleached scrap paper correctly ends up in the ONP grade shipped to the newsprint mills. Very little ONP, less than one percent, is sorted out incorrectly and ends up in disposed residue, cardboard or container commodities. By contrast, only about 95 percent of the cardboard and old boxboard is recovered, with most of the five-percent loss occurring in the ONP.

Finally, the recovery of plastic bottles and metal averages about 80 percent. The 20 percent of lost containers end up mixed with the

Roll carts: Pro versus con

Although roll carts definitely have more contamination, they have increased the amount of collected recyclables in the Metro region by 10 percent to 15 percent or more after contamination and population growth are netted out. Roll carts also provide drier recyclables, which allows a star screen to effectively sort year-long with minimal adjustments.

Sort data of prohibitives in roll carts suggest the additional contamination is from bagged waste, textiles, wood, organics and inerts, which are heavier and larger than the average bin contamination and thus easier to remove. Finally, glass contamination in the commingled recyclables from roll carts appears to be less than half that coming into the MRFs from bin collection programs.

This landfilling of 20 percent of non-fiber recyclables, mostly by newsprint mills, is equivalent to disposing of the recyclables generated by 80,000 households in one year. Thus, the current operation of the six MRFs is disposing of recyclable containers in an amount four times greater than the amount of containers deliberately landfilled by Smurfit-Stone in one year. To put this loss in another perspective, the amount of curbside recyclable containers sent to end-use markets has remained flat with the implementation of commingled collection, so even though households have set out 20-percent more recyclable containers, these additional containers have ended up in the landfill and their substantial environmental benefits have not been realized.

One consequence of the contamination in ONP is that Metro's true recovery becomes exaggerated. Because almost half of the region's recovered paper is shipped to newsprint mills, the 10-percent contamination is equivalent to overstating regional paper recovery by 23,000 tons or one percentage point in the recovery rate. Similarly, state and national paper recovery rates will increasingly overstate true paper recovery as commingled recycling collection and contamination rates increase.

Do it right

Metro, local governments, haulers, processors and end users have worked together through the field sort program to understand how the current recycling system is working and to identify ways in which each partner can help improve the system.

First, it is the responsibility of local governments working with haulers to educate households about prohibitive materials and to keep glass separate. This will allow MRFs to focus their resources on the important job of sorting out commodities correctly.

Metro will spend \$170,000 on a residential outreach campaign asking households to keep glass separate at the curb and keep loose plastic bags out of curbside entirely. The MRFs and newsprint mills identified these issues as among their largest problems.

Second, MRFs have voluntarily made changes that should improve their effectiveness in removing prohibitives and correctly sorting recyclables, especially ONP. These changes include:

- ◆ *More workers.* Three MRFs have increased the number of sorters by 25 percent or more to remove more brown fiber and non-fiber recyclables; this enables the MRFs to absorb absenteeism and turnover without sacrificing quality.
- ◆ *Adjusted conveyor speed.* One MRF slowed down its infeed conveyor by 10 percent. Other MRFs are experimenting

with increasing the speed of take-away conveyors to reduce burden depth and make more visible those items to be sorted.

- ◆ *Better training of workers.* One MRF did not know scrap metal was recyclable.
- ◆ *Better expectations.* One MRF has started a program to monitor how many "picks" per minute are made, which can range from 15 to 60. Pick rates at the lower end indicate a need to adjust the worker's targeted materials or to identify a worker who is not sorting effectively. This approach has been useful at plants that have high work-

Table 1 Material recovery in tons

Materials	Collected	Loss	Recovery rate
Newspaper	70,349	650	99%
Cardboard	15,015	804	95%
Metal	3,456	611	82%
Plastic bottles	3,496	839	76%

Source: Metro Commingled Recyclables Processing and Quality, 2004.

The biggest contributor to contamination in ONP, and the one with the greatest variation among the MRFs, is the amount of brown fiber from corrugated cardboard and old boxboard.

er turnover.

- ◆ *Equipment searches.* MRFs are looking for screens or other technology to better separate containers from paper. Five of the six MRFs have processing systems that are less than five years old.

Lastly, the field sort program suggests quality benchmarks that MRFs could strive to reach. The two best MRFs are averaging six percent to eight percent ONP contamination. However, the other four MRFs have levels half-again higher, in the 10-percent range. Clearly, substantial gains in quality could be realized if all MRFs performed at the same

level as the best ones.

MRF X had a goal to have less than four-percent contamination in its ONP. It found that contamination levels in the ONP from the large urban single-stream curbside program ranged from five percent to eight percent, which fluctuated as MRF X's throughput increased from 20 tons per hour to 35 tons per hour. The MRF is working with an equipment vendor to design a new, more automated system with additional screens and optical sorting for removal of brown fiber and plastic containers, but with half the labor. The MRF has asked the equipment vendor to guarantee no more than two-percent contamination in the ONP when the MRF is fully staffed.

As the nexus between collection and end use, MRFs are the linchpin to ensuring that recyclables end up at the right market. Working with MRFs and mills, government can identify benchmarks that can help MRFs improve their performance so that environmental benefits are fully realized and costs are reduced. Although Metro wants more recovery, it also wants it "done right" through the entire system, so residents can remain confident that their investment actually realizes those environmental benefits. **RR**

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Four quality benchmarks for communities and MRFs

These benchmarks should result in material recovery rates of more than 98 percent for all paper grades and 95 percent of recyclable containers. These benchmarks were all met or exceeded with source-separation curbside programs with bins.

1. Community – Prohibitives should be two percent or less of delivered recyclables.

2. MRF – Recyclables in residue less than five percent.
3. MRF – Contamination⁽¹⁾ in ONP less than four percent.
4. MRF – Prohibitive removal from delivered recyclables greater than 90 percent.

(1) Contamination is brown and gray paper, recyclable containers and prohibitives.

Attachment F

From Recycling Today - 5/22/02

SINGLE-STREAM RECYCLING GENERATES DEBATE

5/22/2002

The pros and cons over single stream recycling generated significant debate during a WasteExpo session.

The debate over single-stream recycling continues to be one of the most widely discussed topics in the collection and processing side of the business. During the WasteExpo program this topic generated a fair amount of discussion as a recycling center and a paper mill bandied about the opportunities, as well as pitfalls of using this system.

From its modest start, more single-stream recycling MRFs are now operating in the United States. At the present time around 80 single-stream units operate in the United States, with the majority being located on the West Coast.

According to Mike Benedetto, vice president of Tidewater Fiber Corp., a Chesapeake, Va., recycling company, the benefits to this procedure include lowering the cost of collecting the material; reducing the number of compartments that need to be filled, lowering the number of times that collection trucks need to be unloaded, and the ability to standardize the fleet of vehicles.

For communities, the participation rate often increases due to setting up a single-stream program. For Virginia Beach, participation increased from 50 percent with a multi-stream container and 75 percent with the 95 gallon container used for single-stream collections.

While the collection figures increase significantly with single-stream programs, the trade-off is often in the reduction in quality.

The cost to build the different types of MRFs vary: a single-stream system may cost as much as \$6.8 million; around \$4.8 million for a dual system; and \$2.3 million for a pre-sort system.

According to Jerry Powell, editorial director of Resource Recycling Magazine, studies have found that the residue generated through single-stream recycling averages around 16.6 percent, compared to residual amounts of 6.6 percent for dual sort systems, and 4.3 percent for source-separated material.

The disparity in quality levels achieved through each of these collection/sortation system is a cause for concern for many end consumers. George Elder, vice president of materials management for SP Recycling, the collection arm for SP Newsprint, Atlanta, Ga., notes that the quality issue is very important. SP Newsprint operates 25 collection plants and two recycled-content newsprint mills.

Broken glass is one of the biggest concerns. Broken glass shards being mixed in with the collected and processed fibers creates tremendous problems for consumers. "Generally speaking paper companies don't like it," Elder noted. As for glass, the material is "bad, bad, bad." In addition to the damage done to the equipment, there are safety concerns that arise.

Supporting this concern, Elder pointed out that even a minimal of contaminants being mixed in with the fiber can be destructive to the equipment. Additionally, having the contaminants being mixed in with the paper increases the chance of the finished product not meeting the quality levels required by end consumers.

In conclusion, Elder said that single-stream with the current technology is not great. Also, while glass continues to be a major problem, if the single-stream collection continues to grow, other materials could also pose problems. Materials like textiles, electronics, and batteries could become future problems for consumers.

While Benedetto acknowledges that broken glass can be a problem, the increased amount of material being collected, as well as new technology, will continue to reduce the concerns over quality of the processed material.

Attachment G

JANUARY 2010



CRI releases study on impact of single stream recycling

The Container Recycling Institute (CRI) has undertaken a study of the impact of single stream collection of residential recyclables. CRI selected Clarissa Morawski, principal of CM Consulting, to research the issue. Morawski reviewed 60 previously published studies, reports and articles in trade publications. The report finds that there are many negative downstream impacts of contaminated stock due to the mixing of the materials at curbsite.

“Basically, the report confirms that you can’t unscramble an egg,” explained CRI executive director Susan Collins. “Once the materials are mixed together in a single-stream recycling system, there will be cross contamination of materials and glass breakage. These issues then result in increased costs for the secondary processors.”

The report describes the evolution of single-stream recycling in the United States, the recent downturn in the scrap market for all recyclable materials, and explains factors affecting collection costs. The real purpose of the study, however, is to examine the impacts of single stream recycling, as compared to other methods, on every step of the recycling process, including:

- Initial ease of collection and collection costs;
- Contamination rates and overall material yield at material recovery facilities (MRFs);
- Impacts on material yield at paper mills;
- Impacts on yield at plastics processors;
- Impacts on paper mills, on quality, quantity, equipment maintenance and costs;
- Impacts on aluminum processors on contamination levels, resulting equipment shutdowns, and profit losses;
- Impacts on glass, including color mixing, suitability for certain end-uses, and increased operating costs; and,
- Impacts on plastic quality and costs.

Recycling’s real purpose is remanufacturing and end use. Most lay people, and perhaps most local officials, assume that all recycled items go to their best use. They are shocked to learn that the materials they dutifully put in a recycling bin may in fact wind up in a landfill. The key to achieving the environmental and economic benefits of recycling is to keep the material circulating for as many

product lives as possible. This is the closed loop that reduces the need for virgin materials, thus avoiding the energy consumption and greenhouse gas emissions associated with primary materials extraction, transportation and processing.

Ensuring that secondary recovered recyclables are utilized for the highest possible end-use is a critical part of successful diversion. For plastic, high-end uses can have ten to twenty times the environmental benefit in terms of the replacement of virgin materials and those avoided upstream impacts. Using glass to make containers saves much more energy than using recycled glass for other purposes.

The historical focus of residential recycling (in the 1990's) has been on keeping materials out of landfills. This led to creating systems that could collect the greatest volume of material, with less of a focus on final end-use of the materials.

In an effort to increase recycling volumes and reduce high recycling collection costs, the waste management sector created single stream recycling collection, which increases efficiencies by collecting more material with less labor and less distance traveled. Automated single stream collection can reduce the number of employees, improve route efficiency, and reduce workers compensation costs. Single stream can encourage residents to place more material in their recycling bin by giving them a larger bin and by simplifying the system.

Glass is the material most affected by the amount of breakage in each type of collection system.

In single-stream programs, it is virtually impossible to prevent glass from breaking as it goes to the curb, is dumped in the truck, gets compacted, gets dumped on the tipping floor of the MRF, is driven over by forklifts, and is dumped on conveyor belts to be processed by the MRF. On average, 40 percent of glass from single-stream collection winds up in landfills, while 20 percent is small broken glass used for low-end applications.

Only 40 percent is recycled into containers and fiberglass. About one third of the non-recyclable glass is broken glass, too small to separate for recycling, some of which can be used for sandblasting base, aggregate material, or Alternative Daily Cover (ADC). These —down-cycled uses do not have the same savings in terms of energy conservation and avoided emissions. In contrast, dual-stream systems have an average yield of 90 percent, and container-deposit systems yield 98 percent glass available for use in bottlemaking.

In general, the final commodities from single stream programs will be more contaminated than those that are collected in a dual-stream system or sorted at the curb. This contamination increase often results in the commodity being worth less than cleaner material, and can create problems at paper mills, leading to equipment failure, lost productivity and expensive repairs. In other words, the cost savings for a municipality from single-stream collection show up as cost increases for the processors and remanufacturers. The contaminants are thrown away by the paper mills. So an item, such as a plastic bottle that was recyclable when it was placed at the curb, becomes trash by the time it is sorted as a contaminant by the paper mill.

A study conducted in 2002 by Eureka Recycling (of St. Paul, Minnesota) compared five different collection methods, and found that single-stream collected 21 percent more material than the baseline method. However, the study did not ultimately recommend a single-stream system, because the lower collection costs were outweighed by higher processing costs and lower material revenues.

In another study, Daniel Lantz of Ontario, Canada-based Metro Waste Paper Recovery analyzed recovery rates for three single-stream and four dual-stream programs in that province. The study found that a drop in collection costs sees a commensurate rise in processing costs. In a recent article, Lantz concluded that the supposed benefits of single-stream systems over dual-stream do not outweigh their costs.

—In summary, with increased processing costs and lost revenues in total far exceeding collection savings in most instances (and zero under alternating-week collection), overall single-stream recycling does not show the cost advantage that was originally anticipated. As well, the expected increases in capture rate are also not apparent. Overall, dual-stream recycling still appears to be more advantageous.

In spite of these challenging conditions and their impact on the current demand for recyclables, recycling continues to be a vital component of a national strategy to conserve resources, supply the manufacturing base and reduce greenhouse gas emissions, toxics and waste going to landfills and incinerators.

Manufacturers of new glass, metal, plastic and fiber products continue to encourage clean collection so that they can use secondary feedstock instead of virgin material for remanufacturing. While manufacturers will continue to invest capital into their systems to increase recycled inputs, these investments will remain contingent upon a regular supply of clean material.

The upstream environmental benefit of remanufacturing materials is 10 to 20 times greater than downcycled or disposal options.

More simply put, when a product is made from recycled material, the use of virgin materials is not required. Therefore, all the upstream energy and associated environmental impacts from the extraction, transport and processing of those virgin materials are not required, or —avoided.

Attachment H

Mansfield, Connecticut

Column: The Pro's and Con's of a new trend called 'single-stream' recycling

by: Brenda Sullivan | HTNP.com Editor Saturday, July 19th, 2008



Mixing glass and paper trash may encourage more people to recycle and save on labor, but it also has some big-time problems.

The latest news in the world of recycling is something known as "single-stream recycling." What does this mean? Let's start by talking about what we do now in Mansfield.

What we have is "dual-stream recycling." Cans, glass bottles, milk and juice cartons, No. 1 and No. 2 plastic containers all go in one category; in the second category, we have newspapers, junk mail, magazines, office paper, paperboard (such as what's used for cereal boxes) and corrugated cardboard. Your recyclables are sorted into two groupings. A recycling truck comes by and it is emptied into the truck by hand.

The system that began in California and has worked its way across to the East Coast is "single-stream recycling," which means the cans and bottles, paper and cardboard can go together in one container, usually a 60- or 95-gallon cart. A recycling truck with a semi-automatic arm comes along and

lifts the cart overhead and dumps it.

The recyclables, whether single-stream or dual-stream, then go to a processing plant. In our case, that would be Willimantic Waste Paper Co., where the materials are sorted into different product categories. For instance, all newspaper would be baled and shipped to a papermill or No. 1 plastic would be sorted, baled and shipped to a plastics manufacturer.

The trash collectors love the single-stream system because it really cuts down on their costs. There's only one person needed in the recycling truck, so there are fewer employees on the payroll. And the person on the truck doesn't need to lift anything, so there are fewer worker injuries.

Single-stream recycling has been hailed as a way to get more people to recycle because the resident doesn't have to do the extra work of keeping papers and cardboard separate from bottles and cans. There's higher participation. Because there is more stuff in the recycling cart and less in the trash can, a town can save money - it costs more to incinerate trash and less to recycle. In fact, some recyclables earn revenue for the town.

It seems like a benefit to everyone, doesn't it?

The downside is that single-stream recycling usually results in high contamination. Residents put recyclables in the cart; they also tend to put trash in it, as well. This means that the sorting plant has to pull out anything that's not part of the recycling shipment, which can include plastic bags and regular garbage. This becomes a liability to them, since they now have trash to haul away.

The more serious problem, though, is glass bottles and jars placed together with paper products. When they are dumped into the recycling truck and then dumped at the recycling plant, the glass gets crushed, and crushed so finely, it's like grit. And that grit gets caught in the paper.

When the paper is sent to a papermill, it takes the grit along with it. This glass grit is disastrous at a paper mill. The equipment ends up being sandblasted by the very fine glass particles. And North American mills don't want this poor quality paper, so a lot gets sent overseas to Asia. They have a cheaper labor force that can hand-sort the bales of paper. This contaminated paper often gets recycled into lower-grade paper such as cereal boxboard, instead of higher-quality paper such as office paper. In other words, it's down-cycled. As a result, North American paper mills are having a difficult time meeting the demand for recycled office paper.

It all gets very complicated, doesn't it?

Willimantic Waste Paper Co. recently bought sorting equipment for "single-stream" recycling. They did their homework and bought equipment that uses three screens, rather than the standard single screen, to capture fine particles. They are pretty confident that the quality of the material will be just as high as "dual-stream." Once their single-stream process is up and running, we will check out the quality of the materials.

The point I want to make is that the materials we recycle are made into new products. They show up on the grocery store shelf as a box of cereal or a laundry detergent bottle. The quality of what we put into our recycle bins is important, how the

material is collected is important, how the material is sorted by Willimantic Waste Paper is important. If one of these pieces is faulty, the end result is waste.

Attachment I

Model City Profile

Phoenix, Arizona (2011)

Population: 1,512,986

Bottle Bill: No

Collection Method: Municipal employees

Funding: Monthly user fee

Households Served: 389,000

Truck Type: Side loading fully automated

Container Type: Two 90 gallon rolling carts

Materials Processing Facility: Single stream processing

Contact: pwsolve@phoenix.gov

Website: <http://phoenix.gov/menu/resutilgarbrec.html>



Phoenix is the 5th largest US City and spread over 516 square miles. They have nearly 15,000 City employees and routinely City departments and private contractors compete in a bidding process to determine who can best provide services to customers at the lowest cost. Currently City employees provide refuse and recycling collection in all but one of six service areas. (In September 2009, they will service all six areas.) All City refuse customers have the opportunity to recycle and roughly 90% currently receive curbside recycling service.

The City launched Phoenix Recycles in 1989, which grew from an initial pilot recycling program of 4,000 households to serve 389,000 households today with weekly, automated, single stream recycling collection. The city originally designed "Phoenix Recycles" to use existing trucks and personnel on the same twice-a-week collection schedule. Recycling became part of the City's plan to handle growth in the late 1980's after dwindling landfill capacity and a University of Arizona study of the composition of Phoenix's residential refuse showed that 50 percent by weight (and 63 percent by volume) was recyclable.

In 1992, the City contracted with New England CRInc. to sort and market materials collected in the City at one of the first, single stream recycling facilities in North America. In 1995, New England CRInc was sold to Waste Management, and then in 1998 to Hudson Baylor West. In 1998 the City of Phoenix opened another MRF to help handle the large volume of material collected from Phoenix and today uses both facilities.

Last year, the City collected nearly 110,000 tons of recyclable material from Phoenix households, more than 560 pounds collected per household served. All 1-5 family households are served with weekly recycling and households living in 5 – 30 dwelling unit structures can sign up for the recycling collection service. Close to 90% of those on the City refuse service have voluntarily accepted curbside recycling. However contamination in recycling set-outs continues to be a problem for Phoenix with between 10 to 20% of materials set out being unacceptable for recycling.

Attachment J

The hidden costs of single-stream recycling

Meghan Kincheloe, Sedona Recycles
Sedona Red Rock News
September 15, 2010

Everywhere you look a new trend in recycling is popping up: single-stream recycling collection. This type of collection allows the public to place all recyclables in one bin without doing any separation. Single-stream curbside collection is becoming increasingly common, but at what cost?

Many people switch to single-stream curbside collection because they like the convenience of throwing everything in one bin. But is single-stream really more convenient? Let's follow the waste stream and find out if this popular new form of recycling is actually beneficial.

Waste Haulers

Single-stream recycling collection is lauded and promoted by those that reap its biggest rewards - the companies that pick it up at the curb. Waste haulers that offer single-stream recycling save money and look "green" at the same time. Waste haulers have to pay the landfill for every ton of trash they dump, but dropping recyclables at a recycling center is usually free and some centers even pay haulers for the recyclables they deliver.

Compared to multi-stream curbside collection, in which the hauler hand-separates recyclables into different compartments on the truck, single-stream recycling costs much less for the hauler. So, in addition to the cost savings at the landfill, the waste hauler saves money on wages by eliminating extra employees and increasing the number of bins that can be serviced per shift.

These cost savings add up for single-stream recyclers. Curbside haulers save an average of \$15 per ton by collecting recyclables using single-stream methods. But recycling isn't just throwing stuff in a bin, so do these cost savings extend to other steps in the recycling process?

Material Recovery Facilities

Once your recycling is picked up at the curb or taken to a drop-off site, it heads to a material recovery facility (MRF) where it is sorted and baled so it is ready for remanufacturing.

If this facility is a single-stream MRF, the cost of processing recyclables increases \$10 per ton! It is more expensive to process recyclables at a single-stream MRF because these facilities require more complicated and expensive equipment and sometimes require more staff to separate the multitude of mixed materials.

Single-stream MRFs also make less money selling baled recyclables for remanufacturing due to high contamination. It is nearly impossible to fully separate commingled recyclables, so bales of paper end up with plastic bottles in them, bales of cans end up with cardboard in them, and bales of cardboard are filled with broken glass.

Approximately 4% of the material sold by single-stream MRFs will be rejected and landfilled due to such high levels of contamination. So single-stream MRFs not only make less money selling the

recyclable material they had to painstakingly separate, they have to pay to throw some of those recyclables in the garbage.

Mills

Single-stream MRFs aren't the only ones that have to throw away precious recyclables. The recyclables these MRFs do sell to mills for remanufacturing contain hidden contamination that might not be noticeable until the bales are opened.

Mills incur an added cost of \$8 per ton when recycling single-stream materials because of all these contaminants. As much as 27% of the recyclables that actually make it to the mill will end up as garbage. Combined with the rejected materials returned to MRFs, 31% of single-stream recyclables end up in the landfill!

Why recycle if the items you collected are going to become garbage? Some proponents of single-stream say that the increase in recycling participation outweighs the loss of recyclables due to contamination, but this is simply not true. Even though single stream recycling can increase the amount of recyclables collected by as much as 20%, 31% of this material is thrown away, so the amount of material that is actually recycled is decreased by 11%.

The remaining 69% of single-stream recyclables still don't fare well because contamination has reduced their quality. So, instead of glass being recycled infinitely into new bottles, the glass from a single-stream process is more likely to become fiberglass, road fill, or other "down-cycled" items that cannot be recycled again.

Recycling is supposed to be a closed-loop process - the arrows of the recycling symbol chase each other in a never-ending circle - but this cycle is defeated when the loop is broken and products that could have been continually recycled become end-use products.

The alternative - multi-stream collection

At Sedona Recycles, 100% of the recyclable items you drop-off are sent to mills for remanufacturing. By requiring the public to sort recyclables, and performing a secondary sort as we bale the material, we make sure that our bales are clean, uncontaminated, and 100% recyclable. Next time you stop by, ask for a tour and we'll show you how it's done.

So although it may sometimes seem like a hassle to sort your recyclables into different bins, remember that your efforts are ensuring that the items you're sorting will actually get recycled into new recyclable items. In the end, treating something like garbage by mixing it all in one bin means there's a good chance it will end up as garbage.

To learn more, read the report "[Understanding economic and environmental impacts of single-stream collection systems](#)" by the Container Recycling Institute on our website, www.sedonarecycles.org or call (928) 204-1185.