Contractor's Report to the Board

Executive Summary

Targeted Statewide Waste Characterization Study:

Characterization and Quantification of Residuals from Materials Recovery Facilities

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Produced under contract by:

R.W. Beck, Inc.

Cascadia Consulting Group

The complete study can be found on the Board's website at
www.ciwmb.ca.gov/Publications/default.asp?pubid=1182

California Environmental Protection Agency
Integrated Waste Management Board

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Overview

State Assembly Bill 939 requires that all municipalities divert 50 percent of their solid waste from landfill disposal through source reduction, recycling, and composting. A large portion of statewide diversion is currently achieved through recycling at various types of materials recovery facilities (MRF). Recyclable materials are sorted into specific commodities which will eventually be reused, while nonrecyclable or otherwise undesirable materials, called MRF residuals, are removed for disposal.

The purpose of this MRF residual characterization study was to estimate the quantity and composition of residuals generated from various types of MRFs throughout the state of California. This is the first time a study of this type has been attempted in California. The information can be used for the evaluation of potential processing improvements, through technology and policy alike, with the goal to further increase diversion.

Project Approach

For the purposes of this study, a MRF was defined as a facility in which commingled recyclables or solid waste materials move over a conveyance system which aggregates or segregates recyclable materials by material type or grade and, as a result of the process, produces residuals that are disposed with the municipal waste stream. Four types of MRFs were examined in this study, as described below:

1. **Multi-stream** MRFs that receive and process multiple types of recyclables separately. Incoming recyclables may be collected in a source separated manner or from a curbside dual stream program that separates fiber and container streams.

2. **Single Stream** MRFs that sort individual recyclable materials from recyclables that have been collected in one stream.

3. **Mixed Waste Processing Facilities (MWPF),** (sometimes called "dirty MRFs"), that remove one or more recyclable materials from municipal solid waste (MSW) streams.

4. **Construction and Demolition (C&D)** processing facilities that separate one or more materials from mixed construction and/or demolition debris with or without a conveyance system.

The study was completed through a planned sequence of facility screening/survey, field sampling, sorting, and data analysis.

Various data sources were used to identify any possible MRF within the state. Screening of these facilities was performed to identify and resolve duplicate facilities, eliminate facilities which did not meet the definition of a MRF, and obtain general information about each MRF. A total of 147 facilities were confirmed to meet specific screening criteria and were termed Potential MRFs.

Detailed surveys were solicited from each of the Potential MRFs to obtain detailed data. The original intent of the study was to collect data from the vast majority, if not all, MRFs in the state; i.e., a census of MRFs rather than a sampling. This information was to be used to determine statewide tonnage of MRF residuals from each type of MRF. At the outset of the project, several large waste management companies as well as several independent MRFs declined to participate in the study, and many other facilities did not respond to the survey. Due to the low response to the survey, additional data was requested and received from the Governmental Advisory Associates (GAA) database later in the project. This additional information expanded the body of data available for analysis needed to

estimate statewide tonnage amounts. Facilities that could be characterized by type and for which incoming feedstock and residual quantity data were available, either from the survey or GAA database, were designated as Confirmed MRFs. Ultimately, a total of 77 Confirmed MRFs were identified during the screening process of the 147 Potential MRFs.

Using information from the completed surveys only, sites were recruited to be host facilities for sampling. The Sampling Plan for this study was developed and submitted to CIWMB staff prior to the start of sampling and sorting activities. Samples of MRF residuals were collected over two seasons, winter and summer, from four regions: San Diego Area, Southern California/Los Angeles Basin, Central Valley/Other, and San Francisco Bay Area. Approximately 30 samples were collected from each MRF for each type of processing stream sampled. A total of 390 samples were collected from 13 MRFs, two of which were sampled from two different types of processing lines. The minimum sample weight was 125 pounds. Table 1 presents a summary of the number of samples collected from each MRF type and region.

Table 1 – Sample Distribution by Region and Type, 2005

MRF Type	San Diego Area	So. Cal/ Los Angeles Basin	Central Valley / Other	San Francisco Bay Area	Overall
Single-Stream	28	30	30	30	118
Multi-Stream				62	62
Mixed Waste		60	30	30	120
C&D		30	30	30	90
Overall	28	120	90	152	390

Samples were only collected from multi-stream MRFs in the San Francisco Bay Area because there were no facilities in other regions which met the proper criteria and were willing to host sampling activities. The only responses received from the San Diego Area were from single-stream MRFs.

A majority of MRFs have multiple locations along the processing line which discharge residual. These discharge areas are called ejection points. Common residuals ejection points include presort containers for large, bulky contaminants and end-of-line discharges. The number of samples collected and sorted at each MRF was distributed based on the weight of residual generated at each ejection point. The material within each sample was sorted into 79 material types as defined by the CIWMB (see Appendix B). The weight of material in each category was recorded and entered into a database for analysis.

Average and total statewide residual quantities for each MRF type were developed using data obtained from the screening and survey process. A single and unique residual characterization profile was developed for each MRF type by aggregating the composition data of individual facilities representing that type.

Results and Findings

A total of 77 Confirmed MRFs were identified during the screening process. However, a number of MRFs were identified as processing multiple incoming material streams at the same facility, either at different processing times or on separate processing lines. For example, if a MRF processes both mixed waste and single-stream materials, the facility would have two MRF processing lines. Taking this into account, there are a total of 83 MRF processing lines at the 77 Confirmed MRFs. Table 2 provides a summary of the number of material processing lines listed by MRF type and region. The data for C&D MRFs is based solely on information obtained from the R.W. Beck detailed survey

responses. Data for all other MRF types was based on a combination of the R.W. Beck detailed survey responses and the GAA database.

Table 2 – Regional Distribution of Statewide Confirmed MRFs, 2005

MRF Type	San Diego	Los Angeles	Central Valley / Other	San Francisco	Overall
C&D*		1	2	3	6
Single-Stream**	4	12	12	12	40
Multi-Stream**		2	5	9	16
Mixed Waste**		9	9	3	21
Overall	4	24	28	27	83

* – Data obtained from R.W. Beck detailed survey responses
** – Data obtained from GAA database and R.W. Beck detail survey responses

When determining facility distribution by MRF type, data from the two sources used (R.W. Beck survey and GAA) could not be directly combined because the GAA data did not include any information for C&D MRFs. However, 6 of the 44 facilities, or 12 percent, that responded to R.W. Beck's detailed survey were confirmed to be C&D MRFs. Using that data, we estimate that 12 percent of all MRFs are C&D MRFs. Data from both sources was used to apportion the other three types of MRFs to the remaining 88 percent. Table 3 presents the resulting distribution of statewide MRF types.

Table 3 – Estimated Distribution of Statewide MRF Types, 2005

MRF Type	Percentage
C&D	12%
Single-Stream	46%
Multi-Stream	18%
Mixed Waste	24%
Total	100%

Although the majority of MRFs are single-stream, the distribution of incoming material and residual quantities is quite different. Table 4 presents a summary of the average annual incoming material and residual quantities based on information obtained from the Confirmed MRFs. The table also identifies the percentage of incoming material which is not recovered and therefore becomes residual.

Table 4 – Average Quantity of Incoming Material and Residuals, 2005

MRF Type	Quantity of Incoming Material (tons)	Quantity of Residual (tons)	Residual Percentage
Single-Stream	52,900	7,400	14%
Multi-Stream	20,900	1,300	6%
Mixed Waste	234,700	189,800	81%
C&D	40,000	9,170	23%

As expected, there was minimal residual generated by multi-stream processing facilities, generally due to the quality of incoming material. Less contaminants are present because such curbside programs require customers to separate fiber materials (e.g., paper)from commingled containers. Furthermore, processing can be more efficient because each stream is more homogeneous. Fiber processing typically has less moisture or food contamination.

The incoming material at mixed waste processing facilities is essentially municipal solid waste and the residual percentage is predictably much higher than any other type. Many mixed waste MRFs are increasingly accepting more commercial waste and less residential waste, as commercial waste typically has a higher degree of recoverable materials. Based on information from Confirmed mixed waste MRFs, slightly more residential waste is currently processed. These types of MRFs attempt to remove as many recyclables as possible but there is typically more moisture, food contamination, and more unrecoverable material to sort through. Since incoming quantities are much larger, these types of MRFs often load the processing line at a higher rate.

MRFs processing C&D material are increasingly common throughout the state of California due to the growing number of acceptable uses for the materials and local ordinances requiring C&D recycling. The C&D recycling programs in California are largely accepted as some of the most innovative and effective in the nation. Currently, C&D MRFs represent an estimated 12 percent of the total statewide MRFs by number. Many more C&D recovery facilities were identified but did not meet the specific criteria of a residual-generating MRF, usually because the material was homogeneous and did not require processing. C&D MRFs were estimated to achieve only 23 percent residual. A majority of these MRFs recover wood for bio-fuel at conversion plants and fines for landfill alternative daily cover (ADC).

Residual tonnage data for the 77 Confirmed MRFs identified in this study was used to extrapolate the type and size of the remaining MRFs for which data was unavailable. The total annual quantity of statewide residuals, presented as Table 5, was estimated based on this extrapolation.

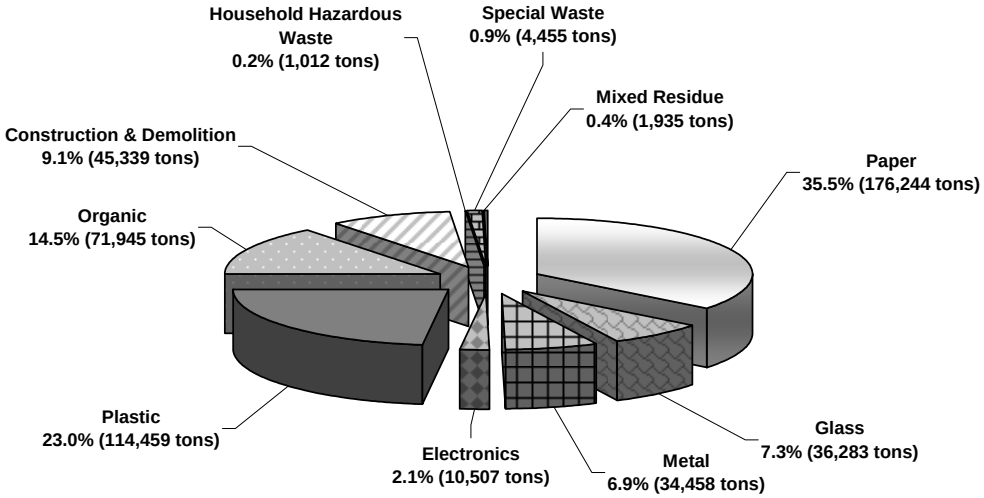
Table 5 – Total Quantity of Statewide Residuals, 2005

MRF Type	Quantity of Residual (tons)	Percentage of Total Residuals
Single-Stream	496,600	6.7%
Multi-Stream	35,900	0.5%
Mixed Waste	6,678,200	90.6%
C&D	161,700	2.2%
Overall	7,372,500	100%

A single and unique residual characterization profile was developed for each MRF type by aggregating the composition data of individual facilities representing that type. Figures A through D present the residual profile charts for each MRF type examined during this study. For summary purposes, only major material categories have been provided. Detailed compositions are provided in the report. The percentage shown represents the average proportion of each material type by weight to the total residual stream. For example, the average percent of paper material within the residual stream from single-stream MRFs was estimated to be 35.5 percent.

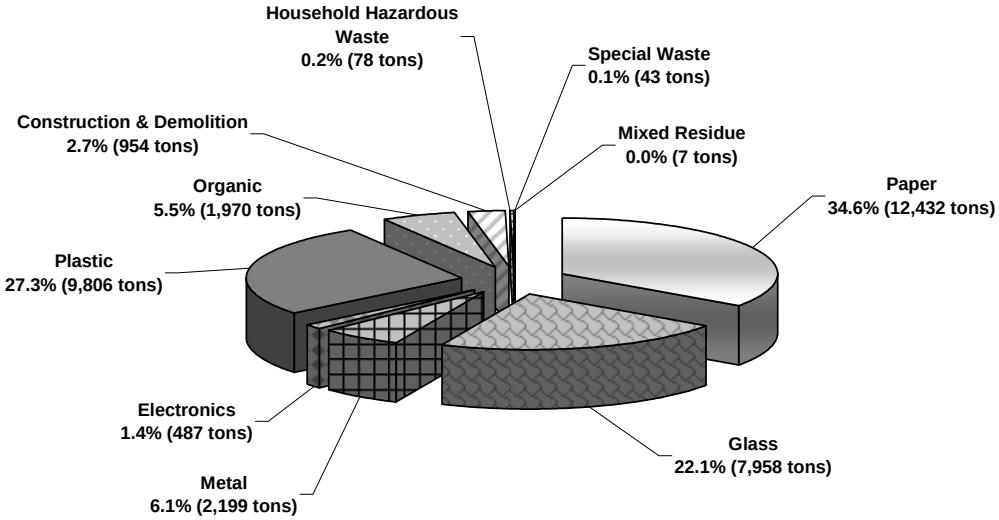
The overall statewide residual characterization, shown as Figure E, was weighted based on the total amount of residual estimated to be produced at each MRF type. Consequently, the overall residual composition largely resembles that of a mixed waste MRF since 90 percent of the statewide residual is generated at this type of facility.

Figure A
Summary of Composition of Residuals - MRFs Receiving Single Stream Recyclables, 2005



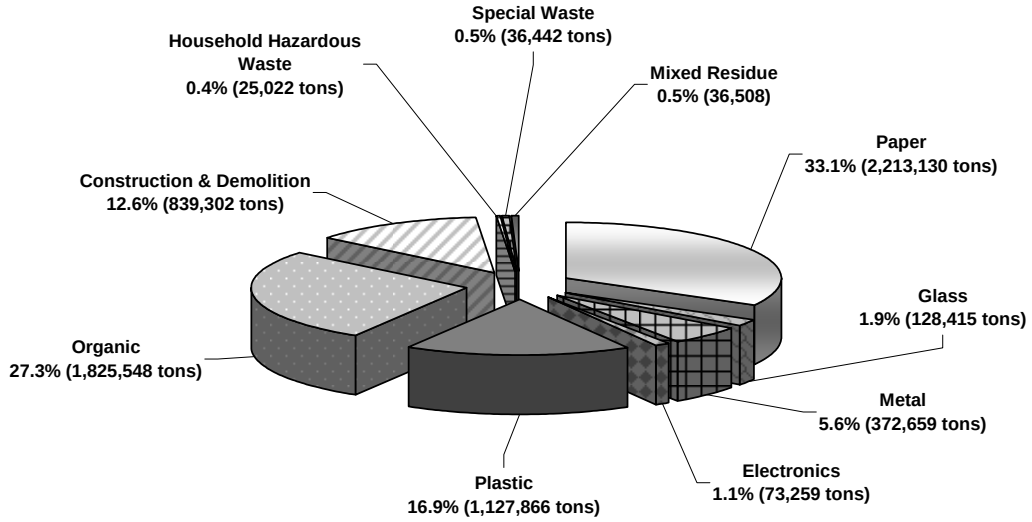
Total Residual Weight is 496,638 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure B
Summary of Composition of Residuals - MRFs Receiving Multi-Stream or Separated Recyclables, 2005



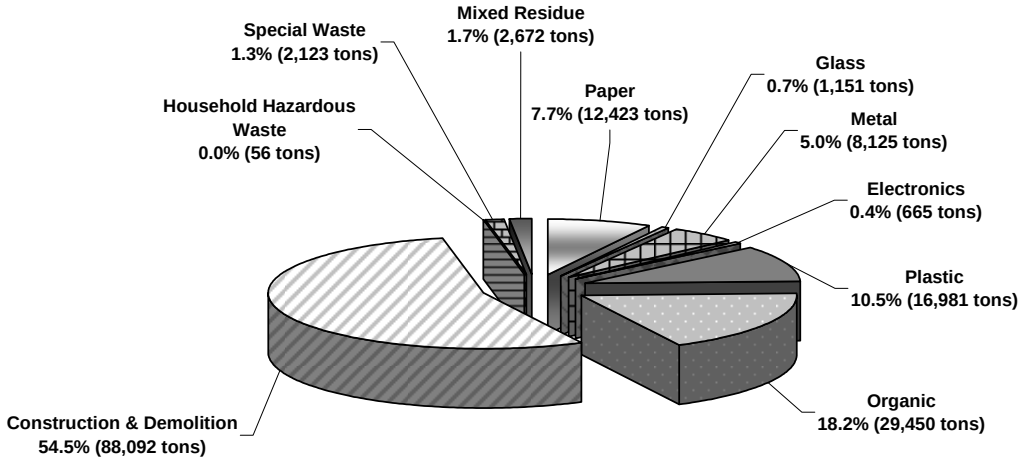
Total Residual Weight is 35,931 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure C
Summary of Composition of Residuals - MRFs Receiving Mixed Waste, 2005



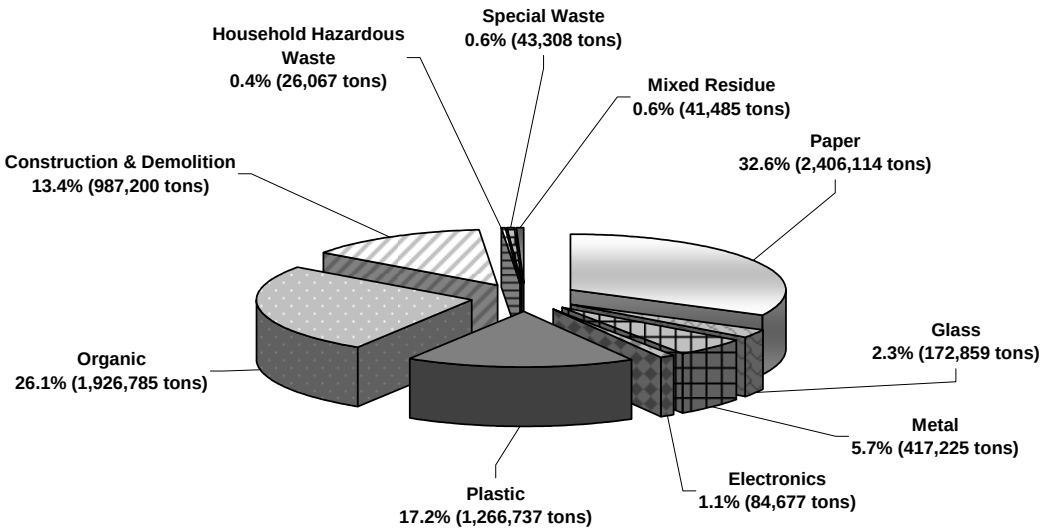
Total Residual Weight is 6,678,151 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure D
Summary of Composition of Residuals - MRFs Receiving Construction and Demolition Materials, 2005



Total Residual Weight is 161,736 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure E
Summary of Composition of Residuals - Overall MRFs, 2005



Total Residual Weight is 7,372,456 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Field observations were made at each MRF sampled regarding the various technologies, targeted recyclables, and operational arrangements or sequences. Large variations were identified in each of these categories along with differences in MRF size and region. It is assumed that by aggregating data from multiple MRFs for each material stream, these variations will be averaged and the resultant data will be representative of the residual throughout the state.