

CHARACTERIZATION STUDY TO DETERMINE THE PLASTIC CARRYOUT BAG CO-MINGLED RECYCLING RATES



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Executive Summary

Background

California's At-Store Recycling Program was established in 2006 through the passage of AB 2449 (Levine, Chapter 845, Statutes 2006). This law requires all stores (supermarkets with \$2 million or more in annual sales and retail establishments with a pharmacy that have at least 10,000 square feet of retail space and generate sales tax) that provide plastic carryout bags at the point of sale to customers to establish a plastic carryout bag recycling program. Other retail establishments that do not fall under the law may also choose to participate in this statewide program (Public Resources Code sections 42250-42257).

In 2007, the California Integrated Waste Management Board (now known as the Department of Resources Recycling and Recovery, or CalRecycle) adopted regulations that require store operators to maintain records about the collection, transportation, and recycling of plastic carryout bags. Using the previous calendar year's information, the stores submit an annual report to CalRecycle including relevant plastic carryout bag recycling information (California Code of Regulations, Title 14 (14CCR), Division 7, Chapter 4, Article 6).

The regulations allow operators to report the weight of plastic carryout bags recycled or the weight of the bags co-mingled with other film plastic that is being recycled. Further, the regulations require CalRecycle to develop and publish a recycling rate for the co-mingled plastic film.

Study Objective

The purpose of this study is to estimate a Co-Mingled Recycling Rate for the At-Store Recycling Program and to conduct a plastic carryout bag characterization study. The Co-Mingled Recycling Rate will be used to determine the percentage of plastic carryout bags recycled relative to the percentage of plastic film and other materials collected for recycling by regulated stores. The plastic materials measured in this study include regulated bags, non-regulated bags, ineligible bags, film and shrink wrap, and other plastic materials.

This study has two objectives. The first is to provide CalRecycle with statewide and regional Co-Mingled Recycling Rates for the purpose of estimating the weight of plastic carryout bags recycled by stores with At-Store Recycling Programs. The second is to provide CalRecycle with data for developing methods and processes for determining more accurate Co-Mingled Recycling Rates to use to calculate an annual plastic carryout bag recycling rate.

Additionally, this study will gather information that may enhance the quality of estimated percentages of plastic carryout bags and other film materials disposed at solid waste disposal facilities. This data will assist CalRecycle with its separately conducted statewide characterization study that provides information on how the types and amounts of materials disposed in the State's plastics recycling stream has changed over time.

Study Methods

The data collection was conducted by sort teams consisting of a team leader and up to three assistants at stores and distribution centers identified by CalRecycle. The goal was to collect 200-

pound samples of Bags-Only or Co-Mingled plastic. Materials included in Bags-Only samples were sorted into three categories:

- Regulated Bags: Plastic carryout bags on which “Return to a participating store for recycling” was printed.
- Non-Regulated Bags: Plastic carryout bags on which no return request was printed.
- Other Plastic Material: Durable plastic items such as, but not limited to, bottles, hangers, tubs and pails.

Co-Mingled samples were sorted into five categories:

- Regulated Bags: Plastic carryout bags on which “Return to a participating store for recycling” was printed.
- Non-Regulated Bags: Plastic carryout bags on which no return request was printed.
- Ineligible Bags: Plastic trash bags, shopping bags, and other merchandise bags. Also included were sandwich bags, zipper bags, produce bags, bread bags, and newspaper bags.
- Film and Shrink Wrap: Plastic agricultural film, drop cloths, stretch and shrink wrap used to transport merchandise, packaging, bubble wrap, and other plastic wrap.
- Other Plastic Material: Durable plastic items such as, but not limited to, bottles, hangers, tubs and pails.

The results are reported by sample type (Bags-Only or Co-Mingled) and region (Northern, Central, or Southern California). To obtain the statewide recycling rate, the results of the two sample types (Bag-Only and Co-Mingled) are combined and referred to as the Total Combined sample throughout the report. The purpose of this study is to estimate a Co-Mingled Recycling Rate for the At-Store Recycling Program and to conduct a plastic carryout bag characterization study. The Co-Mingled Recycling Rate will be used to determine the percentage of plastic carryout bags recycled relative to the percentage of plastic film and other materials collected for recycling by regulated stores.

Limitations of the Study

Operator participation in this study was voluntary. Eighteen out of 32 CalRecycle identified operators agreed to participate, and 14 operators declined to participate. Five of the 14 operators who declined to participate were among the largest store chains within California. Collectively, these 14 operators reported to CalRecycle the collection and recycling of 40.0 percent of the total Co-Mingled film plastic reported and 36.0 percent of the Total Combined plastic reported during the 2007 and 2008 reporting years. The relatively high rate of non-participation raises potential concerns regarding the generalizability of the current results to all operators of At-Store Recycling programs.

Additional studies would need to be conducted to assess whether the non-participating operators statistically differed from the current results. However, it is possible that the recycling methods of the operators who declined to participate and of those who were not selected under the target-sampling plan may be similar to the methods of the participating operators. The CSUS research

team and CalRecycle made several revisions to the sampling plan to minimize possible adverse impacts on the survey results due to the non-participation of operators.

Study Results

Statewide Recycling Rates

A total of 385 samples (which includes both Bags-Only and Co-Mingled samples) were collected in 24 locations from 18 participating operators throughout California for a cumulative weight of 77,447.2 pounds. The mean sample weight was 201.2 pounds (Standard Deviation (SD) = 30.1). Ineligible bags, film and shrink wrap, other plastic materials, and contamination, accounted for 90.6 percent of the total sample weight. Regulated Bags comprised 7.4 percent, and Non-Regulated Bags comprised the remaining 2.0 percent.

To provide an estimate for the total amount of plastic (in pounds) recycled in a given year, calculations were performed based on the average reported weight of plastic recycled for Bags-Only, Co-Mingled, and Total Combined samples in 2007 and 2008 provided by CalRecycle. These calculations can provide an estimate of the pounds of recycled plastic material per year for each category: Regulated Bags (2,225,000 lbs.), Non-Regulated Bags (601,000 lbs.), and Other Plastic Material (27,241,000 lbs.). As indicated above, the vast majority of the plastic material recycled is composed of Other Plastic Material.

When examined by region, Northern California samples contained 5.8 percent of Regulated Bags, 2.0 percent of Non-Regulated Bags, and 92.2 percent of Other Plastic Material. Central California samples contained 8.0 percent of Regulated Bags, 1.0 percent of Non-Regulated Bags, and 91.0 percent of Other Plastic Material. Southern California samples contained 9.1 percent of Regulated Bags, 2.8 percent of Non-Regulated Bags, and 88.1 percent of Other Plastic Material.

Bags-Only Sample

There were 115 Bags-Only samples collected from 16 participating operator locations. The mean weight for the Bags-Only samples was 193.4 pounds (SD=37.1). Bags-Only samples contained 11.0 percent of Regulated Bags, 4.1 percent of Non-Regulated Bags, and 84.9 percent of Other Plastic Material.

When examined by region, Northern California Bags-Only samples contained 12.0 percent of Regulated Bags, 4.7 percent of Non-Regulated Bags, and 83.3 percent of Other Plastic Material. Central California samples contained 10.3 percent of Regulated Bags, 2.2 percent of Non-Regulated Bags, and 87.5 percent of Other Plastic Material. Southern California samples contained 10.0 percent of Regulated Bags, 3.9 percent of Non-Regulated Bags, and 86.1 percent of Other Plastic Material.

Co-Mingled Sample

There were 270 Co-Mingled samples collected from 14 participating operator locations. The mean weight for the Co-Mingled samples was 204.5 pounds (SD=26.0). Co-Mingled samples contained 5.9 percent of Regulated Bags, 1.1 percent of Non-Regulated Bags, 5.9 percent Ineligible Bags, 63.2 percent Film and Shrink Wrap, and 23.9 percent of Other Plastic Material.

When examined by region, Northern California Co-Mingled samples contained 3.3 percent of Regulated Bags, 0.9 percent of Non-Regulated Bags, 5.1 percent of Ineligible Bags, 51.5 percent Film and Shrink Wrap, and 39.2 percent of Other Plastic Material. Central California samples

contained 7.9 percent of Regulated Bags, 0.9 percent of Non-Regulated Bags, 2.6 percent of Ineligible Bags, 77.0 percent Film and Shrink Wrap, and 11.6 percent of Other Plastic Material. Southern California samples contained 8.4 percent of Regulated Bags, 1.8 percent of Non-Regulated Bags, 12.1 percent of Ineligible Bags, 67.0 percent Film and Shrink Wrap, and 10.7 percent of Other Plastic Material.

Summary

Regulated Bags comprised almost twice as much of the final weight in Bags-Only samples (11.0 percent) as in Co-Mingled samples (5.9 percent). There was an almost four-fold difference between Bags-Only and Co-Mingled samples with Non-Regulated Bags making up 4.1 percent of Bags-Only samples and only 1.1 percent of Co-Mingled samples. Finally, when Ineligible Bags, Film and Shrink Wrap, and Other Plastic Material are combined, it is clear that the majority of all samples are composed of these types of plastic materials.

Recommendations

Given the objectives of the study, the issues encountered in the field, operator participation, and the data analyses, recommendations were divided into two sections: *Improving Field Work* and *Establishing Co-Mingled Recycling Rates*.

Recommendations for Improving Field Work

- Increase participation among operators so that a wider sample can be obtained. This is especially important for determining the extent of regional differences.
- Take seasonal samplings to document any variation that may occur. For example, operators may generate more recyclable plastic material during holiday seasons.
- Environmental factors should be taken into consideration when scheduling field work. For example, sorting plastic material in the rain added variability to the sample weights.
- Make sure that the participating operators have enough material on hand to sample.

Recommendations for Establishing Co-Mingled Recycling Rates

- Definitions of Bags-Only and Co-Mingled samples need to be standardized. There was considerable variability across operators in the plastic material contained in both types of samples.
- Develop a better method of working with operators who separate bags from film and shrink wrap and then bale film and shrink wrap separately or dispose of these materials in other ways. Although some of these operators report Bags-Only, the field work shows that they contribute other materials to the plastic recycle stream in addition to bags.
- Treat all recycled plastic material as Co-Mingled. Although some locations had Bags-Only samples, contamination occurred in these samples such that the majority of the sample was often composed of Other Plastic Material.
- Discard the category of Ineligible Bags and classify those bags as Non-Regulated Bags. The distinction between Ineligible Bags and Non-Regulated Bags, while clear in theory,

is very subjective in practice. More accurate rates will be achieved by using a single category of Non-Regulated Bags.

- Develop a way to minimize non-plastic materials, such as cardboard and trash, in the Bag-Only and Co-Mingled recycle streams. This may be accomplished by increasing public awareness of plastic recycling standards and recycling opportunities at participating operators.
- Additional sampling is needed to clarify the observed regional differences. Samples from a greater distribution of operating categories from all three regions (Northern, Central, and Southern California) are needed.

Section One: Introduction

Background

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Study Background

In order to develop a representative sample, CalRecycle evaluated recycling data reported by store operators through the 2007 and 2008 report years (See Appendix A). Operators annually report the total pounds recycled on a Bags-Only basis (plastic carryout bags only) or on a Co-Mingled (a variety of plastic film types including plastic carryout bags) material basis. Upon evaluation of this data, CalRecycle developed a target-sampling plan for the current study. The plan was based on the geographic distribution of operators and the contribution of each operator to the plastic recycle stream.

The target-sampling plan consisted of a total of 32 operators to be visited by the California State University, Sacramento (CSUS) research team. These 32 operators account for 97 percent of reported plastic carryout bags and film plastic recycling based on the information submitted to CalRecycle at the time of this report. The geographic distribution of the operators in the target-sampling plan included 11 operators with locations throughout California, 10 operators in Northern California only, and 11 operators in Southern California only. Further, CalRecycle estimated the number of samples, both Bags-Only and Co-Mingled, to be collected at each operator's location.

CalRecycle categorized operators according to the total number of pounds reported recycled per year based on data received in the 2007 and 2008 reports received at the time of this study (See Appendix A). The following six operator categories were determined:

Super Large Operators: Recycled 1,000,000 pounds or more per year.

Very Large Operators: Recycled 500,000 to 1,000,000 pounds per year.

Large Operators: Recycled 100,000 to 500,000 pounds per year.

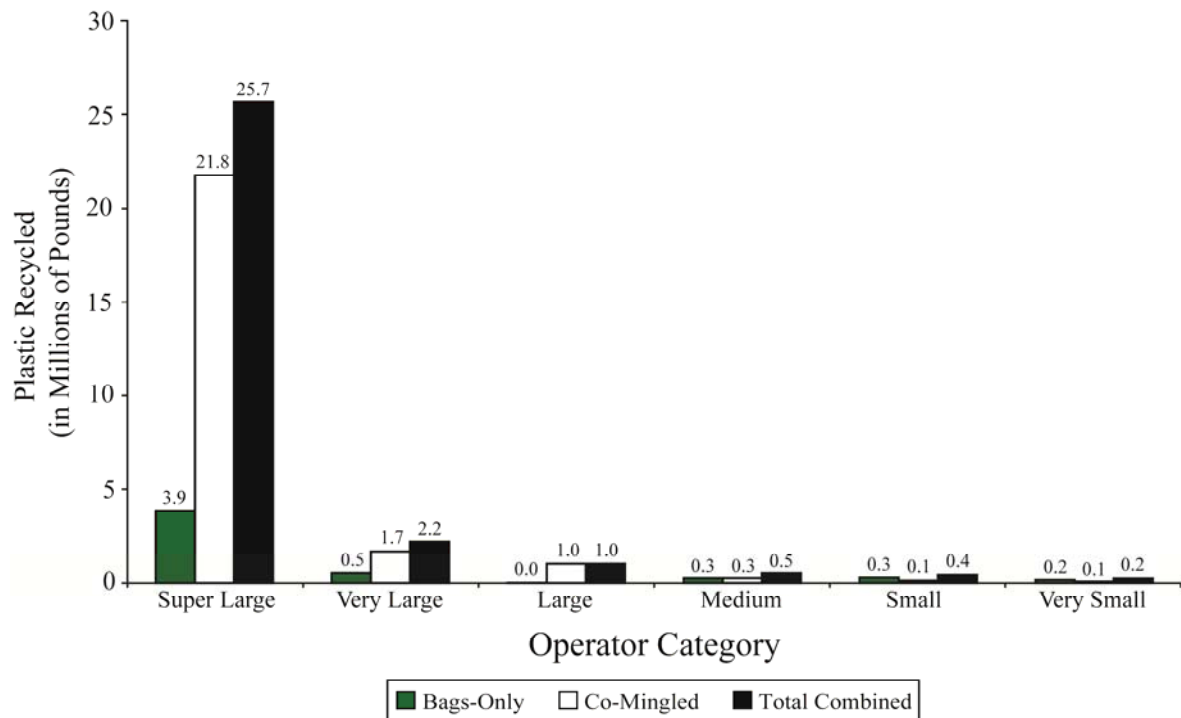
Medium Operators: Recycled 50,000 to 100,000 pounds per year.

Small Operators: Recycled 10,000 to 50,000 pounds per year.

Very Small Operators: Recycled up to 10,000 pounds per year.

Figure 1.1 summarizes data from the reported average number of pounds of plastic recycled for 2007-2008 by Bags-Only, Co-Mingled, and Total Combined recycled plastics. Specifically, Figure 1.1 illustrates the pounds of recycled plastics as Bags-Only or Co-Mingled for each operator category (Super Large, Very Large, Large, Medium, Small, and Very Small). The data show that the vast majority of plastics recycled by Super Large Operators are reported as Co-Mingled plastics. Similarly, Very Large and Large Operators also report the majority of recycled plastics as Co-Mingled. Medium Operators report approximately the same amount of Bags-Only and Co-Mingled plastics. Finally, Small and Very Small Operators report the majority of recycled plastics as Bags-Only.

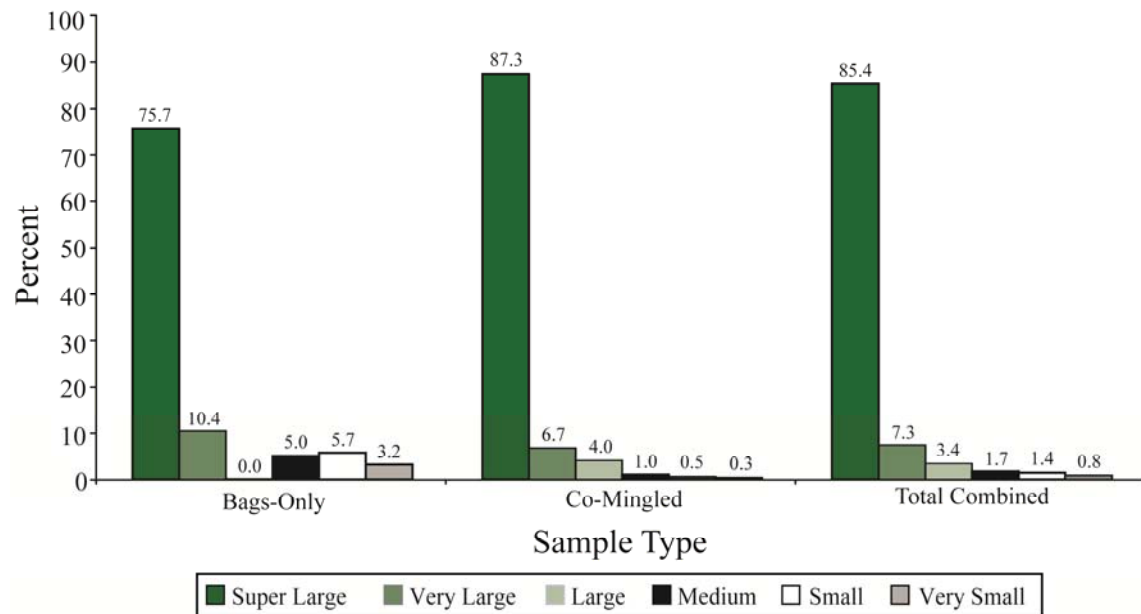
Figure 1.1
Average Pounds of Plastic Recycled in 2007-2008*
By Operator Category



*Based on information supplied by CalRecycle at the time of this study. (See Appendix A)

Figure 1.2 compares the percentage of recycled plastic material reported from each operator size by sample type (Bags-Only, Co-Mingled, and Total Combined). The data demonstrate that Super Large Operators account for the vast majority of Bags-Only and Co-Mingled plastic material. The Total Combined data show that Super Large Operators account for the largest percentage of recycled plastics, followed by Very Large Operators, Large Operators, Medium Operators, Small Operators, and then Very Small Operators.

Figure 1.2
Percent of Plastic Recycled in 2007-2008*
By Sample Type



*Based on information supplied by CalRecycle at the time of this study. (See Appendix A)

The operators listed in the target-sampling plan were contacted by CSUS and asked to participate in the current study. Table 1.1 contains the total number of operators contacted and the number of participating and non-participating operators in the study. The operators in the table are listed by geographic location (operators with locations throughout California, in Northern California only, and in Southern California only) and by operator category (Super Large, Very Large, Large, Medium, Small, and Very Small).

Table 1.1

**The Distribution of Operators Participating and Not Participating in the Study
By Region of Operation**

Location/Category	Target Sampling Plan		Participating Operators		Non-Participating Operators	
	Number	Percent	Number	Percent	Number	Percent
Throughout California	11	34.4	5	27.8	6	42.9
Super Large	3	27.3	1	20.0	2	33.3
Very Large	0	0.0	0	0.0	0	0.0
Large	3	27.3	0	0.0	3	50.0
Medium	4	36.3	3	60.0	1	16.7
Small	1	9.1	1	20.0	0	0.0
Very Small	0	0.0	0	0.0	0	0.0
Northern California	10	31.2	5	27.8	5	35.7
Super Large	1	10.0	1	20.0	0	0.0
Very Large	2	20.0	1	20.0	1	20.0
Large	2	20.0	0	0.0	2	40.0
Medium	1	10.0	1	20.0	0	0.0
Small	4	40.0	2	40.0	2	40.0
Very Small	0	0.0	0	0.0	0	0.0
Southern California	11	34.4	8	44.4	3	21.4
Super Large	4	36.4	3	37.5	1	33.3
Very Large	0	0.0	0	0.0	0	0.0
Large	0	0.0	0	0.0	0	0.0
Medium	2	18.2	2	25.0	0	0.0
Small	5	45.4	3	37.5	2	66.7
Very Small	0	0.0	0	0.0	0	0.0
Total	32	100.0	18	56.3	14	43.7

The data in Table 1.1 show for operators with store locations throughout California:

- 45.5 percent participated in the study.
- Of those that participated, the majority (60.0 percent) was categorized as Medium.
- Of those that did not participate, the majority (50.0 percent) was categorized as Large.

The available data show for Northern California operators:

- 50.0 percent participated in the study.
- Of those that participated, the majority (40.0 percent) was categorized as Small, and the remainder was divided between Super Large, Very Large, and Medium.
- Of those that did not participate, the majority was evenly divided between Large and Small (each at 40.0 percent).

The available data show for Southern California operators:

- 72.7 percent participated in the study.
- Of those that participated, the majority was evenly divided between Super Large and Small (each at 37.5 percent).
- Of those that did not participate, the majority was categorized as Small (66.7 percent).

Overall:

- The largest groups of participants were evenly divided between Medium and Small Operators (each at 33.3 percent).
- The greatest participation was among operators in Southern California (44.4 percent).
- The 14 non-participating operators recycled 40.0 percent of the co-mingled film plastic and 36.0 percent of the Total Combined film plastic during 2007 and 2008.
- The relatively high rate of non-participation raises potential concerns about how representative the sampling results from the participating operators are for all operators of the At-Store Recycling programs.

Based on the distribution of participating operators illustrated in Table 1.1, only four operator categories were represented in this study: Super Large, Very Large, Medium, and Small. These four categories will be used throughout the report.

Condition of the Materials Sampled

The condition of the material sampled varied between sample sites. In some cases, the samples had to be presorted. For example, some bales of recyclable plastic materials had cardboard interspersed (or sandwiched) at regular intervals. In these instances, cardboard was removed because this was not commonly experienced during the field work and would have seriously skewed the results.

In some cases the sample contained material consisting of spoiled food or, in rare cases, bio-hazardous material. Bags with these materials were removed from the sample because the bags could not be extricated from the contaminants. The removal was also necessary for health and safety reasons.

The decision to remove contaminated materials was made on a case-by-case basis by the sort team leader. While training protocols required contaminated bags to be removed from the

samples, ultimately these decisions may have had an impact on the variability in the composition of the samples collected.

At many places, the pre-sorted material was kept outside, and for many sorts, the material was extremely wet. This did have an impact on the weight of the samples, but scheduling did not permit rearranging the visits so that all samples could be uniformly dry.

Contamination issues were encountered at all participating operator sites. Our experience indicated that operators were consistent in how their samples were contaminated; however, the specific contaminants were not consistent between locations. For instance, the samples collected at one operator systematically included books and shredded paper. Consequently, the weight of the Other Plastic Material category collected at this operator's locations was more likely to exceed the weight commonly found for that category at other locations.

Study Limitations

Of the 32 operators selected for the sample, 18 (56.2 percent) agreed to participate in the study. The reasons for not participating include the following:

- Not enough space available to sort materials.
- Interference with the operator's staff at the store or warehouse.
- Security reasons.
- Liability reasons.

In the field, the sort teams' access to materials was limited. In almost every case, the operator selected the sample and delivered the material to the area in which the sort team worked. The operators preferred this procedure for safety reasons. In only one location, the sort team was given access to a compactor and had to extract materials with hoes.

Very early in the study, the sort teams reported that the status of the material from which the samples were selected was not consistent from sample-to-sample and from location-to-location. In general, some of the material was sampled just as it was delivered, directly from the stores to the warehouse. In other stores, operators saved up material, sometimes for a whole week.

To further complicate the situation, the material received for sampling was delivered in varying quantity and quality.

- In some locations, samples were selected from bales, some from loose materials in a trailer, and others from cardboard containers containing large plastic bags which had a range of plastic materials and garbage.
- In some locations, the material had already been separated into bales of Bags-Only, Shrink Wrap, or Film. In almost every case, these bales contained at least some contaminating materials.
- In some locations, Shrink Wrap and Film were placed in the trash by the operator and were not part of the materials sampled.

Additionally, some difficulty arose in determining the difference between the Non-Regulated Bags and Ineligible Bags sort categories. Some Ineligible Bags are clearly identifiable while

others resembled Non-Regulated Bags. An example is that some plastic bags in which merchandise is sold are clear plastic, with no handles and no flap, and no identifying name. Consequently, they could have fallen into any of the bag-type categories other than regulated. This may contribute to some of the variation observed in the characterization of the two categories.

Overall, the limitations imposed on the study could be divided into two categories: theoretical and physical.

Theoretical Limitation

The erosion of the target-sampling plan raises the issue of how representative the data are of the study population. Given the volunteer nature of the study, the results can be considered representative of the participating operators but may not reflect all operators in California. Additional studies would need to be conducted to assess whether the non-participating operators statistically differ from the current results. However, it is possible that the recycling methods of the operators who declined to participate and of those who were not selected under the target-sampling plan may be similar to the methods of the participating operators. The CSUS research team and CalRecycle made several revisions to the sampling plan to minimize possible adverse impacts on the survey results due to the non-participation of operators.

Physical Limitation

The lack of enough material provided by some of the participating operators limited the number of samples that could be taken. Therefore, we were not able to adhere to the original sampling framework. Also, the lack of enough material in some places limited the number of samples that could be taken, again distorting the original sampling framework.

Section Two: Methods

Categorizing the Sampled Operators

As discussed in the previous section, CalRecycle identified the operators to be visited by the CSUS research team. Of the 32 operators originally contacted, 18 operators participated and can be categorized as follows (where n denotes the number of operators; statistical terms are defined in the glossary):

- Super Large Operators (n=5)
- Very Large Operators (n=1)
- Medium Operators (n=6)
- Small Operators (n=6)

Given the operator refusal rate (43.8 percent), CSUS and CalRecycle discussed the sampling plan. The outcome of those discussions was to revise the sample framework based on the participating operators.

Based on the new sample framework, the research team designed, pre-tested, and printed data collection sheets. An example of the data collection sheet is contained in Appendix B.

CSUS staff contacted each operator to be a participant in the study, requested permission to conduct the materials sort on-site, scheduled visits, and arranged travel for the sort teams. Three sort teams consisting of a team leader and assistant sorters were assembled and trained. Each team was supplied with a calibrated scale, safety equipment, and rented vans for travel. The team leaders were responsible for making on-site contact with the operator's representative, setting up the work space, supervising the sort team, weighing and recording the weight of the sorted plastics, submitting a weekly report, and transferring the data to the CSUS research team for entry into a database.

According to the study protocol, the sort teams were to attempt to draw 200 pound samples from the materials supplied by the operators. The sort teams separated the plastic material according to the categories discussed and agreed upon with CalRecycle. The material categories were defined as:

- Regulated Bags: Plastic carryout bags on which "Return to a participating store for recycling" was printed.
- Non-Regulated Bags: Plastic carryout bags on which no return request was printed.
- Ineligible Bags: Plastic trash bags, shopping bags, and other merchandise bags. Also included were sandwich bags, zipper bags, produce bags, bread bags, and newspaper bags.
- Film and Shrink Wrap: Plastic agricultural film, drop cloths, stretch and shrink wrap used to transport merchandise, packaging, bubble wrap, and other plastic wrap.
- Other Plastic Material: Durable plastic items such as, but not limited to, bottles, hangers, tubs, and pails.

The samples were selected from material supplied by the operator and sorted into pre-weighed plastic bins. Prior to weigh-in, the material was packed as tightly as possible into the bins to minimize the variation in the weight of the air. The weight of each material category (minus the weight of the bin) was recorded on the data collection sheet, the bins were emptied, and the weighed plastic materials were repackaged and stored as directed by the operator.

Sampled Operators by Region

The participating operators were coded by region and by type of sample collected (Bags-Only or Co-Mingled). The regions were based on the location the sample was collected from so that regional recycling rates could be developed. The study sample was divided into the following three regions of California: Northern, Central, and Southern. Northern California included all sampling locations north of Manteca. Central California included all sampling locations from Manteca through Bakersfield, and Southern California included all sampling locations south of the Tehachapi Mountains. If an operator had multiple locations statewide but was sampled only in Southern California, then the operator would be coded as a Southern California operator. If an operator was sampled in Central and Southern California, the operator would be included in each region—one for Central California data and one for Southern California data. Consequently, the number of sampling locations is greater than the number of operators.

Also examined were the types of samples collected at each location. Table 2.1 shows that the sampled locations were distributed across the two sample types, Bags-Only and Co-Mingled. As previously discussed, for 2007 and 2008 some operators reported Bags-Only samples and others reported Co-Mingled samples. For those operators reporting Bags-Only, the sort categories were Regulated Bags, Non-Regulated Bags, and Other Plastic Material. For operators at which Co-Mingled samples were collected, the sort categories were Regulated Bags, Non-Regulated Bags, Ineligible Bags, Film and Shrink Wrap, and Other Plastic Materials. As indicated in Table 2.1, the majority of Bags-Only and Co-Mingled samples were from Southern California.

Table 2.1**Locations by Operator Category, Region, and Sample Type****(N*=24)**

Operator Category	Number of Participating Locations	Region	Number of Locations by Sample Type	
			Bags-Only	Co-Mingled
Super Large	2	North	2	2
	2	Central	0	2
	4	South	3	3
Very Large	0	North	0	0
	1	Central	0	1
	0	South	0	0
Medium	4	North	4	1
	0	Central	0	0
	5	South	4	1
Small	1	North	1	0
	2	Central	1	2
	3	South	1	2
Total	24	Statewide**	16	14

*N = the total number of participating locations.

** The term "Statewide" represents the total number of samples collected throughout California

Section Three: Characterization of Recycled Plastic Material

This section of the report contains the characterization of the recycled plastic materials collected throughout California by sample type. Detailed data for the Bags-Only samples are contained in Appendix C, and data for Co-Mingled samples are contained in Appendix D.

Total Combined Samples

A total of 385 samples were collected in 24 locations from 18 participating operators for a cumulative weight of 77,447.2 pounds. * Table 3.1 illustrates the data by operator category, region, and sample type.

Table 3.1

**Number of Samples by Operator Category, Region, and Sample Type
(N=385)**

Operator Category	<u>Northern California</u>		<u>Central California</u>		<u>Southern California</u>		<u>Statewide</u>
	Bags-Only	Co-Mingled	Bags-Only	Co-Mingled	Bags-Only	Co-Mingled	Total
Super Large	3	115	0	41	22	41	222
Very Large	0	0	0	22	0	0	22
Medium	40	6	0	0	33	11	90
Small	8	0	5	23	4	11	51
Total	51	121	5	86	59	63	385

Table 3.2 contains the weights of the samples by sample type: Regulated Bags, Non-Regulated Bags, and Other Plastic Material. Cumulative totals required that the Co-Mingled categories of Ineligible Bags, Film/Shrink Wrap, and Other Plastic Material be collapsed into one category, collectively called Other Plastic Material, in order to facilitate the comparison between Bags-Only and Co-Mingled samples. The data in Table 3.2 clearly show that the weight of Other Plastic Material far outweighs that of the Regulated and Non-Regulated Bags. Just as important, the weight of Non-Regulated Bags is extremely small and only accounts for 2.0 percent of the total collected weight.

* The supporting data for this section is contained in Appendixes C and D.

Table 3.2
Total Combined Sample Weight by Sample Type
(N=385)

Plastic Type	Weight (lbs.)	Percent
Regulated Bags	5,706.7	7.4
Non-Regulated Bags	1,528.6	2.0
Other Plastic Material*	70,211.9	90.6
Total	77,447.2	100.0

*Other Plastic Material contains ineligible bags, film and shrink wrap, rigid plastic, and other extraneous non-plastic material.

The sample weights ranged from 42.1-332.6 pounds with a mean sample weight of 201.2 pounds (Standard Deviation (SD) = 30.1). The mean sample weight exceeds 200 pounds because more than 200 pounds were collected in some places for some samples. In particular, large samples were collected at sites where large quantities of material had to be divided into several 200 pound subsamples. Rather than pre-weigh 200 pounds of unsorted material, the team sorted and weighed the material at the same time. Occasionally, this lead to instances where more than 200 pounds of material was sorted before being weighed. To avoid biases in deciding what to remove from a sample, the entire sample was used in the study. Conversely, a few operators had less than 200 pounds of material to be sampled. A summary of the data[†] for all samples collected during the study period is shown in Table 3.3.

Table 3.3
Total Combined Sample Descriptive Statistics
(pounds)
(N=385)

Plastic Type	Mean Sample Weight	Range of Sample Weights	Standard Deviation	Standard Error	95% Confidence Interval
Regulated Bags	14.8	0.0-173.1	20.2	1.0	12.8-16.8
Non-Regulated Bags	4.0	0.0-47.1	6.5	0.3	3.3-4.6
Other Plastic Material	182.4	11.3-332.6	38.7	2.0	178.5-186.2
Total	201.2	42.1-332.6	30.1	1.5	198.1-204.2

[†] The samples were collapsed into three categories so that Bags-Only and Co-Mingled data could be combined.

The samples recorded as zero in the ranges listed in Table 3.3 does not necessarily indicate that the operator did not provide materials. Instead, zero represents the way in which the material was delivered to the sort team. At times, samples containing only shrink wrap were delivered and at other times samples composed of bags alone were examined. Usually, this material came directly from individual stores to the distribution centers. Only two operators provided samples that contained only plastic carryout bags. One of these did not recycle shrink wrap, and the other operator baled bags and shrink wrap separately prior to the field work.

Analyses indicate that the study has a 95 percent confidence level that the population mean would fall between the calculated confidence intervals. In other words, if the study were repeated, there would be a 95 percent chance that the means would fall within the confidence intervals indicated on Table 3.3.

Bags-Only Samples

Table 3.4 contains data for individual operators who provided Bags-Only samples. The percentage of each sort category is given. The data represents 16 operator locations: five Super Large Operators, eight Medium Operators, and three Small Operators.

Table 3.4
Characterization of Samples by Operator Category
Bags-Only
(n=115)

	Super Large Operators (Coded by Number)								
Percentage of:	1	2	3	4	5	Average*			
Regulated Bags	4.5	7.8	6.7	8.4	12.9	8.1			
Non-Regulated Bags	0.6	2.8	3.2	1.2	2.5	2.5			
Other Plastic Material	94.9	89.4	90.1	90.4	84.6	89.4			
	Medium Operators (Coded by Number)								
Percentage of:	1	2	3	4	5	6	7	8	Average*
Regulated Bags	4.8	2.0	3.9	30.3	33.4	14.4	9.0	13.4	13.5
Non-Regulated Bags	0.0	0.7	0.9	14.2	10.2	1.6	2.9	9.4	5.5
Other Plastic Material	95.2	97.3	95.2	55.5	56.4	84.0	88.1	77.2	81.0
	Small Operators (Coded by Number)								
Percentage of:	1	2	3	Average*					
Regulated Bags	10.3	1.1	2.3	4.5					
Non-Regulated Bags	2.2	0.1	1.0	1.2					
Other Plastic Material	87.5	98.8	96.7	94.3					
Percentage of:	Statewide Average*								
Regulated Bags	11.0								
Non-Regulated Bags	4.1								
Other Plastic Material	84.9								

*Since the number of samples at each location varied, averages were calculated based on the raw data and may not reflect an average of the store averages.

The data in Table 3.4 show that, on average, the Bags-Only samples contain 11.0 percent Regulated Bags, 4.1 percent Non-Regulated Bags, and 84.9 percent Other Plastic Material.

Compared to the Total Combined sample, shown in Table 3.2, these data indicate that:

- Regulated Bags accounted for 11.0 percent of the Bags-Only sample weights, which was higher than the 7.4 percent shown for the Total Combined sample.
- Non-Regulated Bags comprised 4.1 percent of the Bags-Only sample weight, which was twice as high as the 2.0 percent shown for the Total Combined sample.
- The weight for the Other Plastic Material category was 84.9 percent for Bags-Only, compared to 90.6 percent for the Total Combined sample.

According to the data in Table 3.4, the recycled plastic materials from Medium Operators contain a higher percentage of Regulated Bags and contain less Other Plastic Material than from Super Large and Small Operators.

A summary of descriptive statistics is shown in Table 3.5. The sample weights for Bags-Only samples ranged from 49.0-260.2 pounds with a mean sample weight of 193.4 pounds (SD = 37.1).

Table 3.5
Bags-Only Descriptive Statistics
(pounds)
(n=115)

Plastic Type	Mean Sample Weight	Range of Sample Weights	Standard Deviation	Standard Error	95% Confidence Interval
Regulated Bags	21.2	0.0-76.5	19.3	1.8	17.6-24.7
Non-Regulated Bags	8.1	0.0-47.1	9.7	0.9	6.3-9.9
Other Plastic Material	164.1	28.5-247.5	43.9	4.1	156.0-172.3
Total	193.4	49.0-260.2	37.1	3.5	186.5-200.2

Finally, Bags-Only samples were examined by region (Table 3.6). The data demonstrate that samples from Northern California contained a higher percentage of Regulated and Non-Regulated Bags than samples from Central and Southern California. Conversely, samples from Central and Southern California contained a higher percentage of Other Plastic Material.

Table 3.6
Characterization of Samples by Region
Bags-Only
(n=115)

Region	<u>Regulated Bags</u>	<u>Non-Regulated Bags</u>	<u>Other Plastic Material</u>
	Percent	Percent	Percent
North	12.0	4.7	83.3
Central	10.3	2.2	87.5
South	10.0	3.9	86.1

Co-Mingled Samples

Table 3.7 contains data for individual operators who provided Co-Mingled samples. The percentage of each sort category is given. The data represent 14 operator locations: seven Super Large Operators, one Very Large Operator, two Medium Operators, and four Small Operators.

Table 3.7
Characterization of Samples by Operator Category
Co-Mingled Samples
(n=270)

	Super Larger Operators (Coded by Number)							
Percentage of:	1	2	3	4	5	6	7	Average*
Regulated Bags	8.5	12.2	5.5	9.4	2.3	0.4	6.9	4.3
Non-Regulated Bags	2.1	4.2	0.6	3.1	0.5	0.2	1.2	1.0
Ineligible Bags	11.2	6.0	3.0	4.0	5.4	0.4	18.0	6.2
Film and Shrink Wrap	70.5	71.8	83.2	77.7	45.1	59.3	47.4	57.2
Other Plastic Material	7.7	5.8	7.7	5.8	46.7	39.7	26.5	31.3
Percentage of:	Very Large Operator							
Regulated Bags	21.3							
Non-Regulated Bags	1.6							
Ineligible Bags	3.7							
Film and Shrink Wrap	72.3							
Other Plastic Material	1.1							
	Medium Operators (Coded by Number)							
Percentage of:	1	2	Average*					
Regulated Bags	5.4	2.2	4.3					
Non-Regulated Bags	1.0	0.7	0.9					
Ineligible Bags	4.3	5.0	4.5					
Film and Shrink Wrap	87.8	83.7	86.3					
Other Plastic Material	1.5	8.4	4.0					

	Small Operators (Coded by Number)							
Percentage of:	1	2	3	4	Average*			
Regulated Bags	4.0	13.9	1.3	12.1	6.5			
Non-Regulated Bags	1.1	2.0	1.9	3.7	1.5			
Ineligible Bags	2.9	18.4	3.8	10.5	6.4			
Film and Shrink Wrap	88.6	60.1	93.0	67.6	81.6			
Other Plastic Material	3.4	5.6	0.0	6.1	4.0			
Percentage of:	Statewide Average*							
Regulated Bags	5.9							
Non-Regulated Bags	1.1							
Ineligible Bags	5.9							
Film and Shrink Wrap	63.2							
Other Plastic Material	23.9							

*Since the number of samples at each location varied, averages were calculated based on the raw data and may not reflect an average of the store averages.

The data in Table 3.7 show that, on average, the Co-Mingled samples contain 5.9 percent Regulated Bags, 1.1 percent Non-Regulated Bags, 5.9 percent Ineligible Bags, 63.2 percent Film and Shrink Wrap, and 23.9 percent Other Plastic Material.

Compared to the Total Combined sample, shown in Table 3.2, these data demonstrate that:

- Regulated Bags accounted for only 5.9 percent of Co-Mingled sample weight, which was lower than what was found in the Total Combined sample (7.4 percent).
- Non-Regulated Bags accounted for 1.1 percent of Co-Mingled sample weight, which was about half the amount seen for Total Combined samples (2.0 percent).
- If Ineligible Bags, Film and Shrink Wrap, and Other Plastic Material were combined, the total equals 93.0 percent, which was higher than what was found in the Total Combined samples (90.6 percent).

The recycled plastic materials from Small Operators contain a higher percentage of Regulated Bags than from Super Large, Very Large, and Medium Operators. The recycled material from Super Large Operators contained the highest percentage of Other Plastic Material, and the material from Medium Operators contained the highest percentage of Film and Shrink Wrap.

A summary of descriptive statistics for Co-Mingled samples is shown in Table 3.8. The sample weights for Co-Mingled samples range from 42.1-332.6 pounds with a mean sample weight of 204.5 pounds (SD = 26.0).

Table 3.8
Co-Mingled Descriptive Statistics
(pounds)
(n=270)

Plastic Type	Mean Sample Weight	Range of Sample Weights	Standard Deviation	Standard Error	95% Confidence Interval
Regulated Bags	12.1	0.0-173.1	20.0	1.2	9.7-14.5
Non-Regulated Bags	2.2	0.0-20.1	3.3	0.2	1.8-2.6
Ineligible Bags	12.1	0.0-82.9	14.7	0.9	10.3-13.9
Film and Shrink Wrap	129.2	0.0-212.3	55.4	3.4	122.5-135.8
Other Plastic Material	48.9	0.0-332.6	57.0	3.5	42.0-55.7
Total	204.5	42.1-332.6	26.0	1.6	201.4-207.6

Co-Mingled samples were also examined by region (Table 3.9). The data demonstrate that samples from Southern California contained a higher percentage of Regulated and Non-Regulated Bags than samples from Northern and Central California. Ineligible Bags comprised two-to-five times as much of the sample weight in samples from Southern California as from samples from Northern and Central California, respectively. Film and Shrink Wrap made up the majority of all samples, but contributed the greatest amount of sample weight in Central California. Samples from Northern California contained the highest percentage of Other Plastic Material.

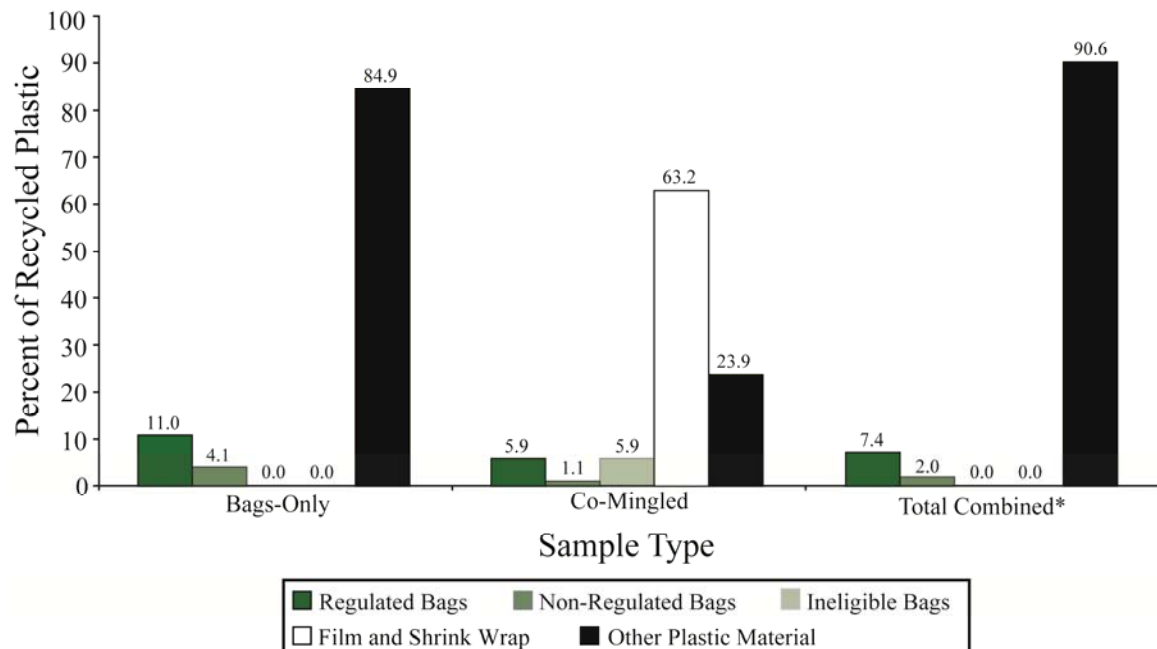
Table 3.9
Characterization of Samples by Region
Co-Mingled
(n=270)

Region	Regulated Bags Percent	Non- Regulated Bags Percent	Ineligible Bags Percent	Film and Shrink Wrap Percent	Other Plastic Material Percent
North	3.3	0.9	5.1	51.5	39.2
Central	7.9	0.9	2.6	77.0	11.6
South	8.4	1.8	12.1	67.0	10.7

Summary

There were a total of 385 samples collected in 24 locations from 18 participating operators throughout California. The samples were divided by sample type into Bags-Only (n=115) and Co-Mingled (n=270). A summary of the data can be seen in Figure 3.1.

Figure 3.1
Recycling Rates by Sample Type
(N=385)



* Total Combined cumulative data required that the Co-Mingled categories of Ineligible Bags, Film/Shrink Wrap, and Other Plastic Material be collapsed into one category, collectively called Other Plastic Material, in order to facilitate the comparison between the Bags-Only and Co-Mingled samples.

Based on the data in Figure 3.1, we found that Regulated Bags comprised almost twice as much of the final weight in Bags-Only samples (11.0 percent) as in Co-Mingled samples (5.9 percent). For Non-Regulated Bags, there was an almost four-fold difference with Non-Regulated Bags making up 4.1 percent of Bags-Only samples and only 1.1 percent of Co-Mingled samples. Finally, when Ineligible Bags, Film and Shrink Wrap, and Other Plastic Material are combined, it is clear that the majority of all samples were composed of Other Plastic Material.

An analysis of the data suggests that the results were influenced by the following:

- Regulated Bags are the easiest to identify because they are printed with a return to operator message.
- Non-Regulated Bags differed in their recycling rates between the Bags-Only samples and the Co-Mingled samples. This difference could be due to the fact that Non-Regulated and Ineligible bags were the most difficult to identify. Some Ineligible Bags are clearly identifiable while others resembled Non-Regulated Bags. An example is that some plastic bags in which merchandise is sold are clear plastic, with no handles and no flap, and no identifying name. Because of this ambiguity, they could have fallen into either the Non-Regulated or the Ineligible category.
- The variation in the percent of Regulated Bags to Other Plastic Materials is substantial between sample types. The results could accurately depict variability across operators. For example, Super Large, Very Large, Medium, and Small Operators may differ in the types and amount of plastic materials used in their daily operations. Alternatively, the variation may be indicative of consumer awareness and/or of the location of plastic bag recycling collection sites. Some communities may not be aware of the recycling opportunities at their local operator locations and/or plastic recycling receptacles may not be conveniently located.
- The variation in the ratio of other material to Regulated and Non-Regulated Bags was large. That variation may depend on whether the operator permits or is unaware that other materials are disposed with the recycled plastics.

Section Four: Recycling Rates Statewide and Regional

The proportions of the sorting categories were used to approximate the actual amount of material being recycled by operators statewide. Analyses were conducted to evaluate the applicability of statewide recycling rates to defined regions within California.

Statewide Recycling Rates

The data in Table 4.1 provide an estimate for the total amount of plastic (in pounds) recycled for each sample type in a given year. The calculations were done by multiplying the proportions of the sorting categories (denoted as Percent of Total Plastic Recycled) times the average reported weight of plastic recycled for Bags-Only, Co-Mingled, and Total Combined recycled plastic material in 2007-2008. These data can provide an estimate of the pounds of Regulated Bags, Non-Regulated Bags, and Other Plastic Material recycled per year. Based on the findings of this study, Regulated Bags comprise 7.4 percent of the total plastic recycled, and Non-Regulated Bags comprise 2.0 percent of the total plastic recycled. Nevertheless, the vast majority of the plastic material recycled is composed of Other Plastic Materials (90.6 percent).

Table 4.1

Statewide Estimated Annual Recycling Rates (2007-2008)

Statewide Bags-Only Rates	Percent of Total Plastic Recycled	Estimated Weight * (in pounds)
Regulated Bags	11.0	562,000
Non-Regulated Bags	4.1	210,000
Other Plastic Material	84.9	4,340,000
Statewide Co-Mingled Rates		
Regulated Bags	5.9	1,472,000
Non-Regulated Bags	1.1	275,000
Film Plastic	63.2	15,772,000
Ineligible Bags	5.9	1,472,000
Other Plastic Material	23.9	5,964,000
Statewide Total Combined Rates		
Regulated Bags	7.4	2,225,000
Non-Regulated Bags	2.0	601,000
Other Plastic Material	90.6	27,241,000

* Estimated weights determined by multiplying the group percentage by the 2007-2008 reported average weight (in pounds) from Appendix A. Bags-Only: 5,112,000; Co-Mingled: 24,955,000; Total Combined Plastic: 30,067,000. For estimation purposes, weights have been rounded to the nearest thousand pounds.

Regional Recycling Rates

Further analyses were required to determine whether statewide recycling rates could be applied to the defined geographic regions. For all analyses, an Independent Samples Kruskal-Wallis Test was used to compare data between regions. Nonparametric analyses were applied since a normal sample distribution could not be assumed. As defined in Section Two, Northern California included all sampling locations north of Manteca. Central California included all sampling locations from Manteca through Bakersfield, and Southern California included all sampling locations south of the Tehachapi Mountains.

For Bags-Only samples, the results show no significant difference in the percent of Regulated Bags, Non-Regulated Bags, or Other Plastic Material between regions. These results indicate that for all regions the Bags-Only plastic recycled material may be composed of the same proportions of plastic materials (Regulated Bags, Non-Regulated Bags, and Other Plastic Material) as estimated for the state (Table 4.1).

For Co-Mingled samples, there was a significant difference in the percentage of Regulated Bags, Non-Regulated Bags, Ineligible Bags, Film and Shrink Wrap, and Other Plastic Material between regions ($p < 0.02$, for all comparisons; Table 3.9). These results indicate that the regions significantly differ in the proportions of plastic materials and that statewide numbers are not necessarily applicable to a specific region. However, additional sampling is needed to clarify the observed regional differences.

Finally, for Total Combined sample data, there was a significant difference in the percent of Regulated Bags, Non-Regulated Bags, and Other Plastic Material between regions ($p < 0.01$, for all comparisons; Table 4.2).

Table 4.2
Characterization of Total Combined Samples by Region
(N=385)

Region	<u>Regulated Bags</u>	<u>Non-Regulated Bags</u>	<u>Other Plastic Material</u>
	Percent*	Percent*	Percent*
North	5.8	2.0	92.2
Central	8.0	1.0	91.0
South	9.1	2.8	88.1

* Significant difference between regions at $p < 0.01$.

The differences seen in Table 4.2 may reflect true regional differences between operators in Northern, Central, and Southern California in the proportions of plastic materials that are being contributed to the plastics recycling stream. However, given the limitations discussed previously, these data should be interpreted with caution. It is also possible this finding is an artifact of the sampling method. For example, 44.7 percent of the 385 samples came from Northern California, 31.7 percent came from Southern California, and only 23.6 percent came from Central California. A greater number of samples from Southern and Central California may be needed to determine whether the geographic distribution of the samples influenced these results. Alternatively, the

regional differences in the proportions of plastic materials may be a reflection of known differences in operator categories. Table 4.3 breaks down the number of samples taken in each region by operator category. The vast majority of samples came from Super Large Operators in all regions, which may not reflect the distribution of operator categories across the state.

Table 4.3

**Number of Samples by Region and Operator Category
(N=385)**

Operator Category	Northern California	Central California	Southern California	Total
Super Large	118	41	63	222
Very Large	0	22	0	22
Medium	46	0	44	90
Small	8	28	15	51
Total	172	91	122	385

Section Five: Recommendations

The purpose of this study was to determine a co-mingled recycling rate for At-Store Recycling Programs, which will be used to determine the proportions of Regulated Plastic Bags, Non-Regulated Bags, and Other Plastic Materials. Given the issues encountered in the field, operator participation, and the data analyses, recommendations were divided into two sections: *Improving Field Work* and *Establishing Co-Mingled Recycling Rates*.

Recommendations for Improving Field Work

- Increase participation among operators so that a wider sample can be obtained. This is especially important for determining the extent of regional differences.
- Take seasonal samplings to document any variation that may occur. For example, operators may generate more recyclable plastic material during holiday seasons.
- Environmental factors should be taken into consideration when scheduling field work. For example, sorting plastic material in the rain added variability to the sample weights.
- Make sure that the participating operators have enough material on hand to sample.

Recommendations for Establishing Co-Mingled Recycling Rates

- Definitions of Bags-Only and Co-Mingled samples need to be standardized. There was considerable variability across operators in the plastic material contained in both types of samples.
- Develop a better method of working with operators who separate bags from film and shrink wrap and then bale film and shrink wrap separately or dispose of these materials in other ways. Although some of these operators report Bags-Only, the field work shows that they contribute other materials to the plastic recycle stream in addition to bags.
- Treat all recycled plastic material as Co-Mingled. Although some locations had Bags-Only samples, contamination occurred in these samples such that the majority of the sample was often composed of Other Plastic Material.
- Discard the category of Ineligible Bags and classify those bags as Non-Regulated Bags. The distinction between Ineligible Bags and Non-Regulated Bags, while clear in theory, is very subjective in practice. More accurate rates will be achieved by using a single category of Non-Regulated Bags.
- Develop a way to minimize non-plastic materials, such as cardboard and trash, in the Bag-Only and Co-Mingled recycle streams. This may be accomplished by increasing public awareness of plastic recycling standards and recycling opportunities at participating operators.
- Additional sampling is needed to clarify the observed regional differences. Samples from a greater distribution of operating categories from all three regions (Northern, Central, and Southern California) are needed.

Glossary of Statistical Terms

Confidence Interval – A range of values used to estimate a population parameter with a specific level of confidence. In the report, a 95 percent confidence interval was used when examining the sample mean.

Kruskal-Wallis Test – A nonparametric hypothesis test used to compare three or more independent samples.

Mean – The sum of a set of scores divided by the number of scores; used to refer to the arithmetic mean throughout this report.

Nonparametric Methods – Statistical procedures for testing hypotheses or estimating parameters that are not based on population parameters and do not require many of the restrictions of parametric tests, such as the assumption that the data are normally distributed.

n – The number of values in a sample

N – The number of values in a finite population; also used as the number of all groups combined.

Normal Distribution – A bell-shaped probability distribution that has a mean of 0 and a standard deviation of 1.

P-Value – The probability that a test statistic in a hypothesis test is at least as extreme as the one actually obtained.

Range – The measure of dispersion that is the difference between the highest and lowest scores.

Standard Deviation – The measure of dispersion equal to the square root of the variance.

Standard Error – Refers to the standard error of the mean in this report. The standard deviation of all possible sample means.

Variance – The measure of dispersion found by calculating the sum of the difference of each data point from the mean, squared, and divided by the total number of samples minus 1.

Appendix A

Average Reported Annual Plastic Recycling Amounts for 2007-2008*

Operator Category	Reported Bags-Only <u>Recycled</u>		Reported Co-Mingled <u>Recycled</u>		Total Combined Reported Plastic <u>Recycled</u>	
	Weight	Percent	Weight	Percent	Weight	Percent
Super large	3,868,000	75.7	21,796,000	87.3	25,664,000	85.4
Very large	530,000	10.4	1,678,000	6.7	2,208,000	7.3
Large	1,000	0.0	1,010,000	4.0	1,011,000	3.4
Medium	258,000	5.0	261,000	1.0	519,000	1.7
Small	293,000	5.7	130,000	0.5	423,000	1.4
Very small	162,000	3.2	80,000	0.3	242,000	0.8
Statewide Total	5,112,000	100.0	24,955,000	100.0	30,067,000	100.0

* Data provided by CalRecycle based on information reported by the regulated operators.
Weights have been rounded to the nearest thousand pounds.

**Co-mingled Recycling Rate of Plastic Carryout Bags
(2009-10)**

[illegible]

Appendix C

Bags-Only: Weight and Percent of Recycled Plastics by Operator Category and Region (n=16)

Operator Category	Region	Weight (in pounds)						Percent				
		Total	Regulated Bags	Non-Regulated Bags	Ineligible Bags	Film/Shrink Wrap	Other Plastic	Regulated Bags	Non-Regulated Bags	Ineligible Bags	Film/Shrink Wrap	Other Plastic
Super Large	North	207.3	13.8	6.7	0.0	0.0	186.8	6.7	3.2	0.0	0.0	90.1
	North	404.2	52.3	10.0	0.0	0.0	341.9	12.9	2.5	0.0	0.0	84.6
	South	206.3	9.4	1.2	0.0	0.0	195.7	4.5	0.6	0.0	0.0	94.9
	South	3,509.1	273.9	98.5	0.0	0.0	3,136.8	7.8	2.8	0.0	0.0	89.4
	South	811.0	68.4	10.0	0.0	0.0	732.7	8.4	1.2	0.0	0.0	90.4
Medium	North	260.2	12.6	0.1	0.0	0.0	247.5	4.8	0.0	0.0	0.0	95.2
	North	178.6	6.9	1.6	0.0	0.0	170.1	3.9	0.9	0.0	0.0	95.2
	North	2,005.8	607.1	285.1	0.0	0.0	1,113.6	30.3	14.2	0.0	0.0	55.5
	North	5,588.0	504.1	162.4	0.0	0.0	4,921.4	9.0	2.9	0.0	0.0	88.1
	South	1,593.3	32.5	11.8	0.0	0.0	1,549.1	2.0	0.7	0.0	0.0	97.3
	South	602.5	201.2	61.2	0.0	0.0	340.1	33.4	10.2	0.0	0.0	56.4
	South	1,385.7	200.0	22.7	0.0	0.0	1,163.0	14.4	1.6	0.0	0.0	84.0
	South	2,320.7	310.2	218.4	0.0	0.0	1,792.2	13.4	9.4	0.0	0.0	77.2
Small	North	1,657.7	38.6	15.9	0.0	0.0	1,603.2	2.3	1.0	0.0	0.0	96.7
	Central	969.0	99.4	20.9	0.0	0.0	848.7	10.3	2.2	0.0	0.0	87.5
	South	540.9	6.0	0.5	0.0	0.0	534.5	1.1	0.1	0.0	0.0	98.8
Total		22,240.3	2,436.2	927.0	0.0	0.0	18,877.1					

Appendix D

Co-Mingled: Weight and Percent of Recycled Plastics by Operator Category and Region (n=14)

Operator Category	Region	Weight (in pounds)							Percent				
		Total	Regulated Bags	Non-Regulated Bags	Ineligible Bags	Film/Shrink Wrap	Other Plastic		Regulated Bags	Non-Regulated Bags	Ineligible Bags	Film/Shrink Wrap	Other Plastic
Super Large	North	3,408.7	321.6	104.6	136.7	2,648.2	197.5		9.4	3.1	4.0	77.7	5.8
	North	20,349.4	471.8	103.1	1,088.8	9,184.2	9,501.5		2.3	0.5	5.4	45.1	46.7
	Central	4,654.8	255.6	29.6	138.5	3,873.5	357.6		5.5	0.6	3.0	83.2	7.7
	Central	3,743.0	16.5	6.3	16.4	2,218.0	1,485.8		0.4	0.2	0.4	59.3	39.7
	South	5,337.1	452.6	110.8	598.8	3,763.1	411.8		8.5	2.1	11.2	70.5	7.7
	South	207.3	25.4	8.6	12.5	148.9	11.9		12.2	4.2	6.0	71.8	5.8
	South	2,910.3	200.3	33.6	523.5	1,380.1	772.8		6.9	1.2	18.0	47.4	26.5
Very Large	Central	4,433.9	943.3	71.9	165.7	3,206.5	46.6		21.3	1.6	3.7	72.3	1.1
Medium	North	1,228.9	26.8	8.4	61.1	1,028.2	104.4		2.2	0.7	5.0	83.7	8.4
	South	2,196.4	119.5	21.1	93.4	1,927.6	34.9		5.4	1.0	4.3	87.8	1.5
Small													
	Central	4,655.1	185.9	50.8	133.0	4,126.3	159.2		4.0	1.1	2.9	88.6	3.4
	Central	206.3	2.6	3.9	7.8	192.0	0.0		1.3	1.9	3.8	93.0	0.0
	South	1,186.3	165.2	23.7	218.0	713.1	66.3		13.9	2.0	18.4	60.1	5.6
	South	689.5	83.5	25.2	72.7	466.2	41.9		12.1	3.7	10.5	67.6	6.1
Total		55,206.9	3,270.4	601.7	3,266.8	34,875.9	13,192.1						