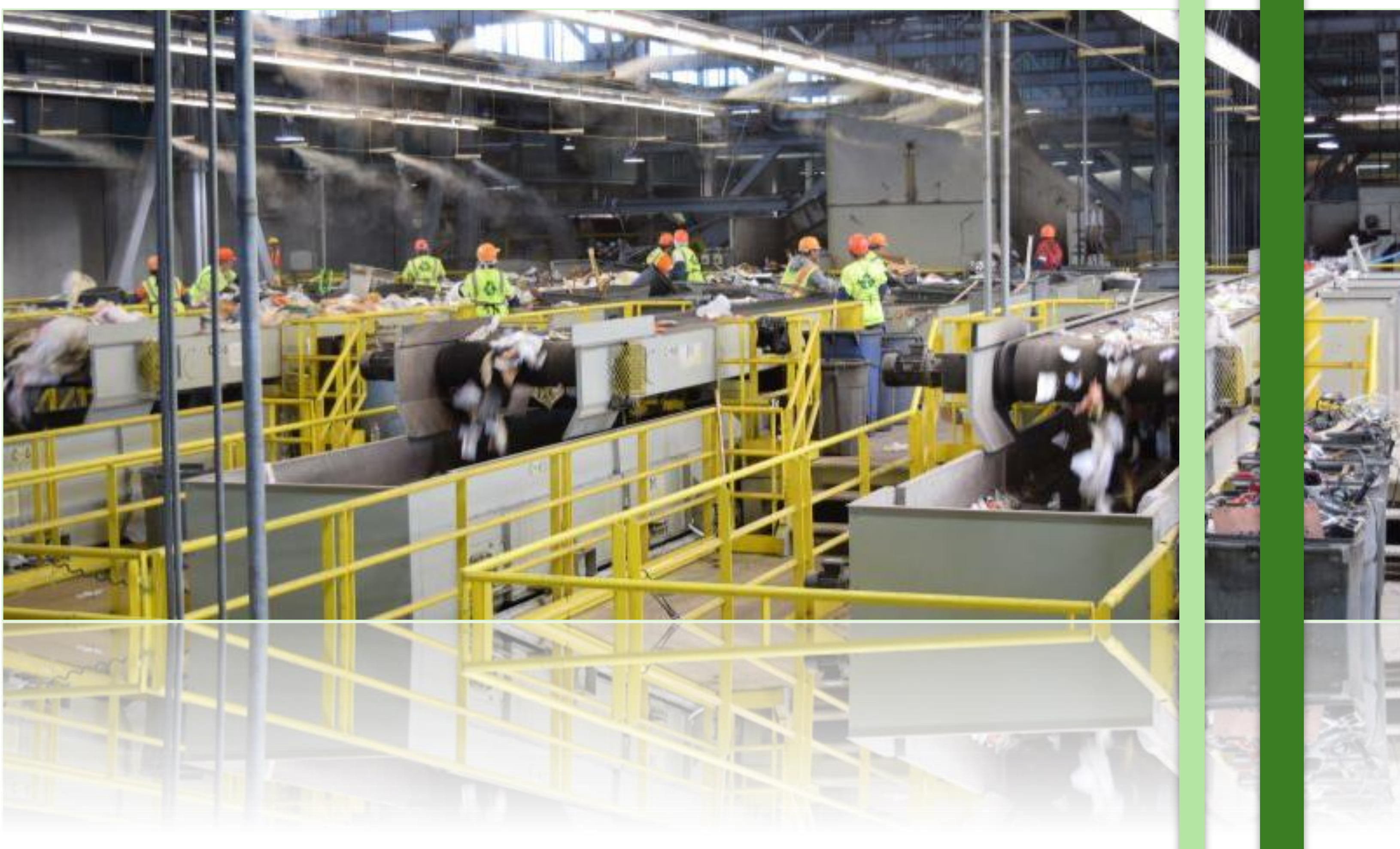
CalRecycle

The Current State of Processing

A Plastic Pollution Prevention and Packaging Producer Responsibility Act Needs Assessment Technical Report

February 2026



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The terminology used in this report is consistent with the definitions set forth in the glossary and is only intended for this report. Terminology used in this report may differ from the definitions used by other organizations or as outlined in the Plastic Pollution Prevention and Packaging Producer Responsibility Act (SB 54, Allen, Chapter 75, Statutes of 2022). The terminology used in this report does not represent or affect the interpretation, implementation, or enforcement of SB 54.

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Executive Summary

The Plastic Pollution Prevention and Packaging Producer Responsibility Act (Senate Bill (SB) 54, Allen, Chapter 75, Statutes of 2022) (the Act) established an extended producer responsibility (EPR) program to manage single-use packaging and single-use plastic food service ware (covered material) in California. The Act requires the Department of Resources Recycling and Recovery (CalRecycle) to conduct a needs assessment to aid its implementation. CalRecycle awarded a contract to investigate the actions and investments needed to meet the law's requirements, with a focus on ensuring that all covered material be recyclable or compostable by 2032 and that single-use plastic packaging and single-use plastic food service ware (plastic covered material) achieve a 65% recycling rate.

This report evaluates the current state of processing for covered material, focusing on access, costs, contamination, community impacts, and environmental impacts from recycling and organics processing facilities. The contractor surveyed recycling and organics processing facilities across the state and conducted additional research. Findings are presented by region (i.e., Coastal, Mountain, Bay Area, Southern, Valley) because processing systems vary across the state.

Recycling Processing Facilities

The contractor identified 89 recycling processing facilities in California that handle covered material and are permitted as medium- or large-volume transfer/processing facilities under California Code of Regulations (CCR) section 17402(a)(8) and (11). These facilities, including material recovery facilities (MRFs), some of which are mixed waste processors (MWPs), receive approximately 5.9 million tons per year (TPY) of covered material and produce an estimated 2.9 million TPY of sorted covered material after removing contamination and accounting for process loss. Of these facilities, 71 are privately owned and operated. The remaining 18 are publicly owned, nine of which are both publicly owned and operated.

Most facilities were built between 1990 and 2017, with at least seven undergoing capital improvements and retrofits in the past 10 years. Smaller, publicly owned facilities with more manual operations tend to serve rural or less densely populated areas, while large, privately owned, more automated facilities tend to serve more densely populated areas and handle higher volumes. Facilities in densely populated areas report space constraints that limit expansion.

Permitted capacity and site boundary vary by facility type and region. MWPs in the Southern region have the highest permitted capacity, reflecting population density. Few facilities operate at full available permitted capacity due to limits such as insufficient inbound materials, outdated equipment, or limited end markets. This suggests some capacity exists to process more covered material, but annual permitted capacity is not a reliable measure of throughput because permits often cover multiple activities at co-located facilities.

The contractor evaluated sortation feasibility and marketability for different types of covered material. The marketability of materials is an important factor influencing which materials a facility processes to send to end markets. Market factors, such as price and availability of end markets, may influence the decisions of a recycling processing facility to change operational configurations, or make capital investments to separate inbound materials for end markets or further processing.

Surveyed recycling processing facilities accept a variety of covered materials depending on the facility type. MWPs are the only facilities that can accept all covered materials; however, not all covered materials can be successfully sorted and marketed. Most recycling processing facilities surveyed that do not manage mixed waste accept only a limited range of materials due to equipment and operational constraints. Materials that are difficult to sort, expensive to handle, or challenging to market (i.e., flexible and film plastics, multi-material laminates, and ceramics) are prohibited by most surveyed recycling processing facilities. All surveyed facilities can sort and market plastic #1 – polyethylene terephthalate (PET) and plastic #2 – high-density polyethylene (HDPE), including clear and pigmented bottles, jugs, and jars. Facility operators expressed interest in finding solutions for plastic #1 – other PET rigid materials (specifically PET thermoforms), plastic #5 – polypropylene (PP) rigid items, and plastic # 7 – other rigid plastics (typically containing mixed plastics #3 through #7).

Organics Processing Facilities (OPFs)

The contractor identified 58 active OPFs that utilize composting and in-vessel digestion and that manage covered materials. OPFs manage the receiving, handling, and processing of inbound material streams that contain organics.

These facilities have a combined maximum permitted capacity of approximately 8.3 million TPY, with an estimated 5.7 million TPY of actual inbound material, leaving up to 2.6 million TPY of available permitted capacity. The majority of organics processing capacity is concentrated in the Southern and Valley regions, while the Mountain region has the lowest capacity.

Surveyed OPFs receive a variety of covered materials. Multiple facilities reported that they currently accept or are interested in accepting fiber-based packaging and food service ware designed for compostability. However, most OPFs reported that they are not currently accepting or interested in accepting plastic packaging designed for compostability. Facility operators shared that packaging designed for compostability, or for organics processing, can be challenging to distinguish from conventional packaging (i.e., plastic packaging not designed for compostability), and therefore, is frequently screened out during pre-processing as contamination.

Community Engagement

Community-based organizations (CBOs), environmental justice groups (EJ groups), and California Native American Tribes (Tribes) were engaged as part of this study. Their expertise and experiences with recycling and composting were gathered through a 46-question Community Recycling and Composting Survey, introductory meetings, and listening sessions. The contractor received 324 survey responses from CBOs and EJ groups, and eight responses from Tribes. A total of 14 CBOs and EJ groups, and three Tribes participated in meetings and listening sessions. Only 20% of survey respondents reported living next to a recycling or composting facility. Of those, 27% stated the facility had a positive impact, 34% reported no impact, and 14% reported a negative impact. Future engagement with more individuals and communities located near recycling and composting facilities is needed to better understand how processing facilities impact surrounding communities.

Positive impacts identified from recycling and organics recycling include recycling plastic waste, producing nutrient-rich compost, and reducing the use of energy and other resources compared to manufacturing new materials. Negative impacts include water pollution from chemicals used in processing and increased energy consumption by facilities. Half of all survey respondents indicated they were financially impacted in some capacity by waste management challenges. CBOs, EJ groups, and Tribes emphasized during listening sessions that their main concern is attaining the goals of the Act while minimizing environmental impacts and disproportionate burdens on vulnerable communities.

1.0 Introduction

1.1 Background

The Plastic Pollution Prevention and Packaging Producer Responsibility Act (Senate Bill (SB) 54, Allen, Chapter 75, Statutes of 2022) (The Act) established an extended producer responsibility (EPR) program to manage single-use packaging and single-use plastic food service ware (covered material) in California. The Department of Resources Recycling and Recovery (CalRecycle) is required to conduct a statewide needs assessment to aid its implementation and to investigate the actions and investments needed to meet the requirements of the Act.

The law requires that by 2032:

- Single-use plastic packaging and single-use plastic food service ware (plastic covered material) be source reduced by 25%.
- Covered material be recyclable or eligible to be labeled compostable.
- Plastic covered material achieve a 65% recycling rate.

1.2 Study Overview

CalRecycle contracted with HF&H Consultants (the contractor) to investigate the actions and investments needed to meet the requirements of the Act. Specifically, by 2032, all covered material must be recyclable or eligible to be labeled compostable, and plastic covered material must achieve a 65% recycling rate.

The Collection, Processing, and End Market Needs Assessment Study (CPEM Study) was conducted under contract (DRR24043) and is one component of the statewide needs assessment. The CPEM Study findings are divided into an analysis of the current state and the needed state of collection, processing, and end markets as they pertain to covered material and meeting the requirements under the Act. It includes three reports for the current state (collection, processing, and end markets) and one combined report for the needed state.

The CPEM Study spans the full value chain for the recovery of material that may be covered and addresses the following:

- **Collection:** Where material (both dry and organic) is collected for recycling and organics recycling, including curbside and alternative collection systems.
- **Processing:** Where the material is sorted, segregated, and prepared to meet specifications for sale to end markets.
- **End Markets:** Where the material is recovered to be used in lieu of virgin material to produce new or reconstituted products.

This report focuses on the current state of processing systems that manage covered material using available 2024 data. This report evaluates the baseline conditions of the processing systems in California that handle covered material.

This report identifies recycling processing facilities and organics processing facilities (OPFs) in California that currently handle covered material, and does not include an analysis of processing that may be occurring out of state, processing of materials delivered directly to brokers for export, or additional processing at end markets (with the exception of in-state OPFs). For OPFs, a single facility often processes organic materials and converts them into a recycled organic product to be used in lieu of virgin material. In this report, the contractor considered only those elements of OPFs related to the processing stage of their operations. The Current State of End Markets Report assesses organics at the point of conversion.

1.3 Processing (Current State) Report

For both recycling processing facilities and OPFs, the following were analyzed:

- **Acceptance of covered material:** This analysis identifies the estimated 2024 annual tons of covered materials that were accepted and processed at recycling processing facilities and OPFs, and annual tons of contamination disposed of. This analysis includes key considerations for the material to be accepted, including technology, contamination, sortation feasibility, and marketability.
- **Contamination:** This analysis identifies contaminants found in both inputs to and outputs from recycling processing facilities and OPFs. Additionally, this includes analysis of impacts from contamination, factors contributing to contamination, types of contamination, and contamination rates.
- **Technology and costs:** This analysis assesses the equipment, efficiency, upgrades, and costs at recycling processing facilities and OPFs.
- **Environmental and public health impacts:** This discussion provides a general overview of the environmental and public health impacts of processing facilities throughout California, including worker safety and environmental health issues. It also covers community, environmental, public health, and employee impacts.

2.0 Methods

The contractor conducted surveys, interviews, and site visits to generate a dataset that is reflective of the current state of processing covered materials at recycling processing facilities and OPFs in each region of California as further defined in Appendix A-3. This dataset, in addition to supplemental information and assumptions, was used as the basis to model statewide and regional estimates. The report highlights assumptions where relevant in the main text, and Appendix A-6 describes limitations in more detail. Sections 2.1 through 2.3 present the approach to the selection of and engagement with processing facilities.

2.5 Processing Facility Identification

The contractor identified potential recycling processing facilities and OPFs to participate in data collection via surveys, interviews, and site visits.

Recycling Processing Facilities

Using the Solid Waste Information System (SWIS), the contractor identified 270 active transfer/processing facilities that were medium or large in size, and managed mixed recyclable materials, source separated materials, or mixed waste material. The contractor then used information from the Recycling and Disposal Reporting System (RDRS), facility permits, and internal and industry resources to further narrow the list to 89 recycling processing facilities that are likely to manage covered material. Neither redemption centers nor consolidation facilities are included in this study. Additionally, facilities that were found to be managing mostly inert or industrial material were removed.

The following characteristics were reviewed in identifying recycling processing facilities:

- **Facility size:** Recycling processing facilities representing medium- and large-volume transfer/processing facilities as identified in the CalRecycle SWIS database, consistent with the definitions contained in Title 14 of the California Code of Regulations (CCR). For the purposes of this study, facilities have been categorized into small (less than 250 tons per day), medium (251 to 500 tons per day), and large (more than 500 tons per day).
- **Facility location/region:** Whether the facility was located in the Bay Area, Coastal, Mountain, Southern, or Valley region (for more detailed information, see Appendix A-3).
- **Materials accepted:** Whether the facility managed covered materials (for more detailed information, see Appendix A-2).
- **Facility technology:** Whether the facility used single stream, dual stream, and mixed waste processing technologies.
- **Operator type:** Whether the facility was operated privately or publicly.

- **Operations co-located with other target operations:** Whether the facility also processes material for organic recycling.

Organics Processing Facilities

Using SWIS, the contractor identified approximately 480 OPFs (as of April 2025). However, many OPFs are not currently active or do not process inbound material types that may include covered material. For this study, the contractor considered composting and in-vessel digestion facilities that are currently shown as active in SWIS and are likely to receive covered material. These facilities may have co-located activities, such as chip-and-grind, that may also receive covered material.

The following characteristics were reviewed in identifying OPFs:

- **Facility size:** OPF facilities permitted as research composting operations, full solid waste facility permit composting facilities, research in-vessel digestion operations and limited, medium, and large volume in-vessel digestion operations as defined in 14 CCR. For the purposes of this study, facilities have been categorized into very small (less than 100 tons per day), small (101 to 500 tons per day), medium (501 to 1,500 tons per day) and large (more than 1,500 tons per day).
- **Site location/region:** Whether the facility was located in the Bay Area, Coastal, Mountain, Southern, or Valley region (for more detailed information, see Appendix A-3).
- **Materials accepted:** Whether the site managed covered materials (for more detailed information, see Appendix A-2).
- **Facility technology:** Whether the facility uses composting and/or in-vessel digestion technologies.
- **Operator type:** Whether the facility was operated privately or publicly.
- **Operations co-located with other target operations:** Whether the facility also processes material for recycling.

Additional details regarding facility selection methodology, outreach approach, data sources, datasets, and engagement participation rates are presented in Appendix A.

2.6 Survey Development and Implementation

The primary data collection methods were electronic surveys, virtual interviews, and in-person site visits. The contractor collected primary data from 57 processing facilities between June and September 2025. The number of surveys, interviews, and site visits conducted for MRFs and OPFs are presented in Table 2-1.

Table 2-1: Primary Data Collection Methods Conducted with Recycling Processing Facilities and OPFs

Facility Type	# of Site Visits	# of Interviews	# of Surveys [1]
Recycling Processing Facilities	15	12	9
Organics Processing Facilities	10	5	6

2.6.1 Survey Development

Two surveys were developed to collect information from processing facilities: the MRF Processing Survey and the OPF Survey. The surveys requested quantitative and qualitative data about the volumes and types of materials received and processed, facility capacity, contamination, operational costs, and environmental and public health impacts. The surveys specifically focused on the equipment, labor, and costs required to process materials in calendar year 2024. The MRF Processing Survey also requested information about the location and usage of secondary processors. Facilities that do not currently accept covered materials (for example, OPFs that do not accept packaging designed for compostability) or facilities that accept covered materials but generally dispose of them (for example, facilities that are contractually required to accept food-soiled paper but use screens to separate them for disposal) were asked to share the resources required to begin accepting and integrating covered materials into their processes.

Survey copies can be found in Appendix B and Appendix D.

2.6.2 Interviews

The contractor conducted 12 interviews with recycling processing facilities and five with OPFs to collect the survey information described in section 2.2.1 and to gain perspective about potential impacts that accepting covered materials may have on facility operations.

The contractor conducted interviews to facilitate survey completion. These interviews provided the benefit of discussing site-specific technical nuances for multi-material facilities (e.g., mixed waste processing facilities).

2.6.3 Site Visits

The contractor conducted in-person site visits at 15 recycling processing facilities and 10 OPFs. During the visits, contractor members requested information included in the relevant survey and discussed site-specific operational complexities.

[1] Represents the number of MRFs and OPFs only participated in electronic surveys.

The site visits enabled the contractor to observe existing infrastructure and equipment, which established the basis for key capital and operational assumptions, as well as to identify potential opportunities for improvement to process covered materials.

2.7 Model Development

The contractor analyzed survey, interview, and site visit data to develop a model to assess the current state of processing for covered materials. This, coupled with analysis of additional data resources described in Appendix A, enabled the contractor to estimate tonnage data for calendar year 2024 of inbound and outbound covered materials at processing facilities.

Tonnage data compiled from surveys, interviews, and site visits were supplemented with RDRS, SWIS, SB 343 (Allen, 2021) Material Characterization Study Final Findings Report (SB 343 Report), and internal data in instances where facilities did not have data available. The information gathered and analyzed formed the basis of the modeling to estimate statewide tonnage results of the amount of covered material processed by MRFs and OPFs for preparation to send to end markets, by covered material category (CMC) processing group. The contractor extrapolated key technical and financial assumptions for processing facilities on a statewide basis to provide the results presented in this report. This analysis does not include material that is received by MRFs that is not further processed (e.g., bales of commercial film received from a business). Appendix A3 contains further details about the methodology.

This report relies upon the CMC list that was published on December 31, 2024, by CalRecycle and contains 94 CMCs that categorize covered material under the Act.[2] However, based on the nature of the recycling system, at each stage in the process, the granularity of the accepted materials will differ. For example, collection contains the least granularity, as it is focused on what postconsumer items are intended to be included in each onsite collection container (or accepted at a drop-off site or alternative collection system), compared to processing facilities that segregate materials into marketable commodities by grade, and facilities that may qualify as end markets that may further disaggregate the materials based on physical and chemical properties. As such, for the purposes of this report, the contractor aggregated the list of CMCs into 54 CMC processing groups that better align with how material is processed by MRFs and OPFs.

Additionally, the information collected was used to assess whether covered materials are generally accepted, tolerated, and prohibited (defined in section 3.2.6) in California’s processing infrastructure due to varying levels of automation and manual sortation, facility age, effectiveness of operating processes, and efficiency of existing equipment at processing facilities.

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[2] CalRecycle, Plastic Pollution and Packaging Producer Responsibility Act – SB 54 Covered Materials Category List, 2025, calrecycle.ca.gov/packaging/packaging-epr/cmclist, (09/27/2025)

2.8 Community-Based Organizations, Environmental Justice Groups, and California Native American Tribes

The contractor engaged with interested parties representing priority populations, including California Native American Tribes (Tribes), as well as Community-Based Organizations (CBOs) and Environmental Justice Groups (EJ groups) through introductory meetings, virtual listening sessions, and an online survey over a four-month time frame. The primary objective was to have these communities share their experiences and provide their expertise related to their waste practices, as well as to understand communities' concerns and suggestions on the impacts of processing facilities, facility development or expansion, and the siting of new facilities near existing ones.

The contractor collaborated with CalRecycle to develop a list of 43 CBOs and EJ groups and 20 Tribes to contact for engagement from the five regions of California defined by CalRecycle's Statewide Waste Characterization Studies. More information on how the CBOs, EJ groups, and Tribes were selected for participation in the study can be found in Appendix A-5.

The Community Recycling and Composting Survey was designed to assess the impacts of activities associated with recycling and composting, barriers and opportunities to access and participate in these programs, and unique challenges and underlying needs in relation to waste management activities for the communities represented by the CBOs, EJ groups, and Tribes. This survey was translated into Spanish and simplified Chinese. A version of the survey was adapted for Tribal communities. Results from the surveys are included throughout this report, as appropriate.

Virtual introductory meetings and listening sessions were held to introduce participants to the project and its objectives, and to provide a space for participants to share some of their lived experiences. These listening sessions were designed to provide a forum for community members to voice their experiences and provide more narrative discussion on the information captured in the survey. These included experiences related to opportunities and barriers to recycling and composting and providing input to shape solutions to increase access and participation while minimizing negative impacts of these systems for their communities. Appendix G presents the responses from the introductory meetings and listening sessions.

3.0 Data Analysis and Evaluation

3.1 Introduction

This section presents an overview of the survey results, interviews, site visits, and analysis from the participant recycling processing facilities and OPFs. The facilities that participated vary in geography, scale, operational practices, and accepted material streams. The contractor extrapolated findings related to acceptance of covered materials, contamination, technology, costs, and environmental and public health impact on a regional basis, providing a snapshot of the current statewide performance and challenges.

Findings from this analysis are presented and organized to illustrate current trends, operational efficiencies, and barriers to meeting the requirements of the Act.

3.2 Recycling Processing Facilities

3.2.1 Recycling Processing Facilities Inbound Material

Recycling processing facilities may accept one or more material streams to meet the needs of generators, compliance requirements, and diversion goals. Recycling processing facilities identified multiple collection methods for inbound materials collected and delivered by recycling service providers (RSP) that contain covered materials.

For this report, the contractor categorized recycling processing facilities into the following facility types:

- **Single stream:** Accepts exclusively single stream materials defined as the combined materials (glass, metal, plastic, fiber) that are deposited into a distinct container for transportation to a recycling processing facility as part of a three-plus or three container collection system (which separately collects solid waste, materials collected for recycling, and materials collected for organics recycling).
- **Dual stream:** Accepts exclusively dual stream materials defined as materials collected for transportation to a recycling processing facility where materials collected for recycling are source separated and delivered in two distinct containers, or a split-body container.
- **Mixed waste:** Accepts combined mixed solid waste defined as material is collected in a single container for transportation to a recycling processing facility to be separated at a processing facility.
- **Other:** Accepts a combination of single stream, dual stream, and/or mixed waste.

Multiple business models are used to operate processing facilities in California. Municipally operated recycling processing facilities are funded through residential fees, reimbursements, or taxes (some managed by Joint Powers Authorities), which is different from the profit-driven financial model of private facilities. Some recycling processing facilities, public or private, are owned by entities that are “vertically integrated,” meaning they both collect and process materials or own multiple facility types (e.g., MRF and landfill). Recycling processing facilities may also source inbound tonnage from several sources, such as collection programs, redemption centers, and wholesale buyers. From those facilities that operate independently, some may also own other operations (e.g., collections, landfills), which are potentially more vulnerable to financial insecurity due to variations in sufficient inbound material and end market stability. These recycling processing facilities currently have less flexibility to accept low-value or nonmarketable materials.

Vertically integrated companies may have exclusive franchise agreements for inbound tonnage generated in the franchise area or flow control for nonfranchise areas. This guaranteed supply of materials for processing generally provides operational stability, supports investment in infrastructure, and can enable vertically integrated companies to manage multiple parts of the solid waste system, including collection, transfer, processing, and disposal.

While not included in the analysis of this processing report, there are facilities in the state operating as redemption centers and consolidation facilities that may handle covered material. Redemption centers are locations where consumers can redeem refundable deposits on beverage containers, such as aluminum cans and plastic bottles. The California Redemption Value (CRV[3]) materials are collected separately by material type via drop-off and baled at the redemption center for end markets and are not processed through recycling processing facilities. CRV material is not considered covered material under the Act.

Consolidation facilities accept material from wholesale customers and CRV redemption centers and bale the materials for distribution to end markets without processing. While these will be primarily CRV, these materials may include small amounts of covered materials. Consolidation facilities may also act as brokers for recycling processing facilities and store material bales on-site prior to sending them to end markets, which is helpful in relieving space constraints and enables processing to proceed at those facilities.

3.2.2 Recycling Processing Facilities Accepting Covered Material by Region

The contractor identified recycling processing facilities in California, including gathering details on ownership and operator type by region based on SWIS, internal data, and discussions with interested parties. Data presented in this report were aggregated and

[3] CRV is a deposit paid by consumers when they purchase certain beverages that are included in the Beverage Container Recycling Program, which they can redeem by returning empty containers.

analyzed by region. The regions are Bay Area, Coastal, Mountain, Southern, and Valley, as defined in CalRecycle's SB 343 Report and shown in Figure 3-1.

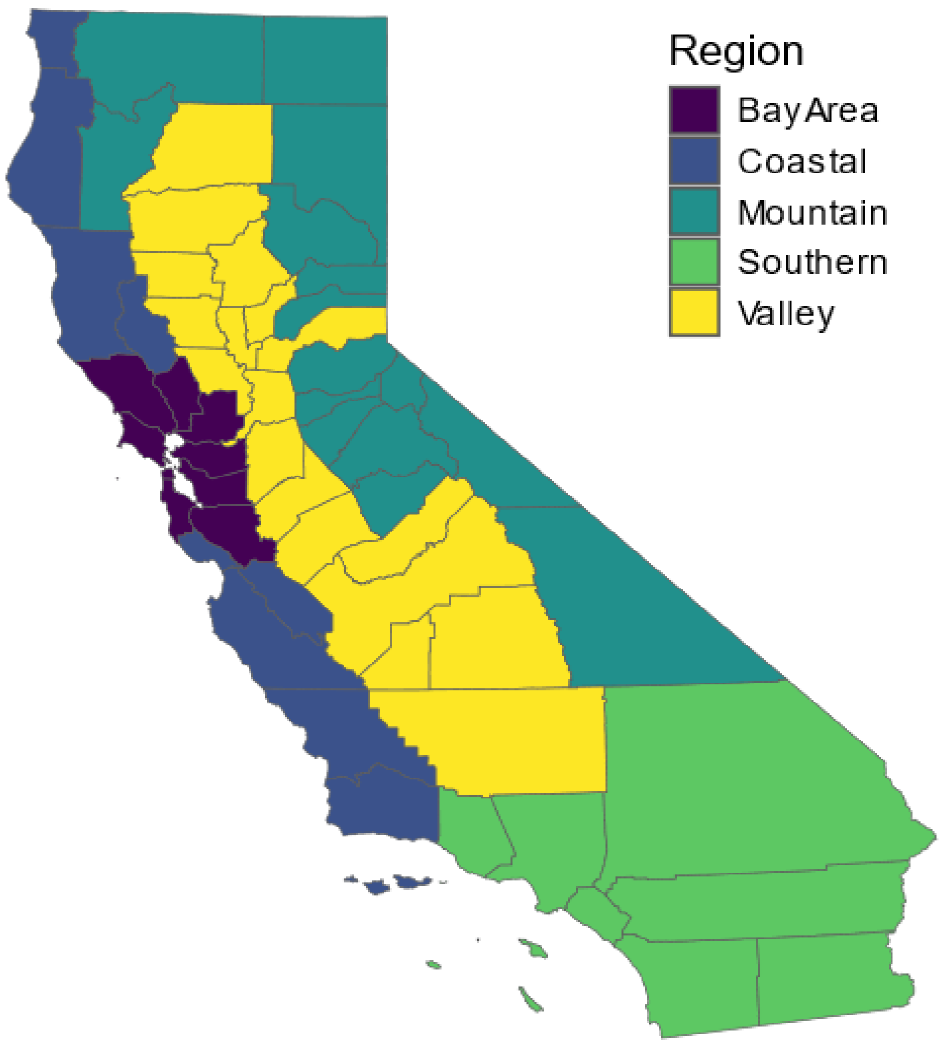

Figure 3-1: Map of California Regions

Across the state, recycling processing facilities have varying ownership and operator types that can determine their approach and capability to source and process covered materials. Table 3-1 summarizes the number of identified recycling processing facilities in each region by owner type, whereas Table 3-2 summarizes the number of identified recycling processing facilities by operator type.

Table 3-1: Summary of Recycling Processing Facilities by Ownership Type

Ownership Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Public	4	3	2	7	2	**18**
Private	19	6	1	27	18	**71**
Total	**23**	**9**	**3**	**34**	**20**	**89**

Table 3-2: Summary of Recycling Processing Facilities by Operator Type

Operator Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Public	1	3	1	3	1	**9**
Private	22	6	2	31	19	**80**
Total	**23**	**9**	**3**	**34**	**20**	**89**

Seventy-one of the identified recycling processing facilities are privately owned and operated, and only 18 are publicly owned, with nine of those being both publicly owned and operated. The remaining nine were publicly owned but privately operated. Based on information from interested parties, permit data, and secondary research, recycling processing facilities in California were primarily built between 1990 and 2017, with many facilities undergoing major capital improvements and retrofits in the past ten years.

Table 3-3 summarizes the number of recycling processing facilities that process covered materials by facility type on a regional basis based on information from interested parties, permit data, and secondary research. The list represents a snapshot as of December 31, 2024, and is subject to change as facilities come online or are shut down. Recycling processing facilities may also adjust their operational approach (e.g., convert from dual stream to single stream) based on varying collection programs, commodity markets, or technology enhancements.

Table 3-3: Total Number of Recycling Processing Facilities that Process Covered Materials by Facility Type and Region (2024)

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Single Stream	16	5	1	16	12	**50**
Mixed Waste	4	3	1	1	2	**11**
Other[1]	1	1	1	10	5	**18**
Dual Stream	2	0	0	7	1	**10**
Total	**23**	**9**	**3**	**34**	**20**	**89**

[1] Facilities classified as "Other" may contain single stream, dual stream, or mixed waste operations.

To classify recycling processing facilities by capacity, the contractor categorized facilities into small, medium, and large based on a facility's permitted capacity.

- Small facilities process less than 250 tons per day (TPD) of material.
- Medium facilities process between 250 and less than 500 TPD.
- Large facilities process 500 TPD or more.

Permitted capacity is not specific to covered material and may reflect multiple activities on the same site (i.e., permitted capacity could include capacity for nonrecycling activities).

Table 3-4 shows the distribution of recycling processing facilities by facility size and region based on SWIS and RDRS to demonstrate where the infrastructure is concentrated in the state.

Table 3-4: Recycling Processing Facilities by Size and Region (2024)

Facility Size	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Large	17	3	2	22	11	**55**
Small	3	4	0	7	7	**21**
Medium	3	2	1	5	2	**13**
Total	**23**	**9**	**3**	**34**	**20**	**89**

The contractor mapped recycling processing facilities based on their addresses in SWIS and/or RDRS and found that small facilities often serve rural or less densely populated areas, providing localized processing capacity, while larger facilities are typically located in more densely populated areas to handle higher volumes and achieve economies of scale. Facilities in densely populated areas consistently reported space constraints as a challenge for future expansion.

3.2.3 Statewide Permitted Capacity for Recycling Processing Facilities Accepting Covered Material

Table 3-5 shows total annual permitted capacity by facility type including both covered and noncovered material and is estimated in tons per year (TPY) as an overall measurement of a facility's capacity to process material. Permitted capacity may not reflect a facility's estimated throughput of single stream, dual stream, or mixed waste streams. Appendix A-3 contains the methods used to determine permitted capacity, which estimates the tons of single stream, dual stream, or mixed waste streams accepted for processing at a recycling processing facility. Population totals (2025) are from the Department of Finance (DOF) E-5 Report.

Table 3-5: Estimated Annual Permitted Capacity by Facility Type and Region for Covered and Noncovered Materials (TPY, 2024)[1, 2]

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Regional Population (people)	7,656,691	1,813,274	597,801	22,100,945	7,360,390	**39,529,101**
Single Stream	5,735,028	1,486,524	249,600	9,551,880	3,338,400	**20,361,432**
Dual Stream	1,815,840	0	0	4,446,000	780,000	**7,041,840**
Mixed Waste	2,402,400	251,160	234,000	356,616	742,560	**3,986,736**
Other	748,800	31,200	115,440	7,809,048	1,324,128	**10,028,616**
Total Permitted Capacity[3]	**10,702,068**	**1,768,884**	**599,040**	**22,163,544**	**6,185,088**	**41,418,624**

[1] Table may not sum exactly due to rounding.

[2] California population estimates are for 2025, whereas recycling processing facility permitted capacity data is from 2024.

[3] Represents annual permitted capacity for all activities at each facility type, including nonrecycling activities. Permitted total capacity does not indicate whether each facility could accept that amount of single stream, dual stream, or mixed waste material currently given potential challenges sourcing materials, technical and operating constraints, and other factors.

The Southern region has the most estimated annual permitted capacity. Based on comparing annual permitted capacity with estimated throughput (see Appendix C, Table C-2), there may be an opportunity to process more materials collected for recycling through single stream, dual stream, or mixed waste facilities. However, there are significant limitations to using annual permitted capacity as an estimate of the maximum tons recycling processing facilities could achieve as annual throughput.

Annual permitted capacity may include inbound materials that are intended to be managed on-site via nonrecycling activities such as transfer operations, construction and demolition (C&D) processing, and is not specific to covered material. Additionally, recycling processing facilities may not be able to process more tons of material, even if there is permitted capacity, due to technical or operational capabilities. Based on discussions with interested parties and the contractor’s review of permit documents, annual permitted capacity may vary between facilities of similar sizes based on site-specific technical and operational assumptions.

Based on site visits, interviews, and surveys, operators indicated that in addition to challenges sourcing inbound materials, the allotted daily permitted capacity for specific inbound materials may constrain the recycling processing facilities from achieving annual permitted capacity. For example, a facility may only be allowed to accept a certain amount of inbound materials in a given 24-hour period and must reject loads after that daily threshold has been reached. As a result, even if the recycling processing facility received the maximum daily tons of inbound material allowed by their permit each operating day, they would not be able to achieve the annual permitted tons.

Through surveys, interviews, and site visits, operators shared insights on their capability and opportunities to increase annual throughput. In some cases, facilities only run a single shift per day. Additional shifts and increased operating hours allow facilities to increase throughput. There are also challenges attracting sufficient inbound materials that contribute to the inability to maximize annual throughput. In some regions, franchise agreements or limited market incentives reduce a recycling processing facility's ability to secure enough material to maximize annual throughput. Facility operators also reported the need to balance maximizing annual throughput with system reliability. Maximizing the annual throughput to the technical or operational limit can create stress on equipment, increase the risk of bottlenecks, reduce yields, and cause challenges in sorting material (inbound loads or baled material) resulting in unplanned downtime.

3.2.4 Level of Automation at Recycling Processing Facilities Accepting CMCs

Throughput at MRFs is influenced by the level of automation at the facilities. Based on site visits, interviews, survey data, and contractor experience, the contractor identified the following automation tiers across California recycling processing facilities:

- **Manual:** Facilities with limited automated sorting capabilities managing an estimated annual throughput between a range of 500–50,000 TPY. Inbound materials contain levels of contamination typical of dual stream collection programs, and facilities have few mechanical screens or conveyance systems. Manual separation of material and low processing speeds result in minimal levels of process loss during sortation (i.e., the amount of target material that was not captured as intended, separate from inbound contamination), typically in the 2% to 5% range as reported by operators of these facilities.
- **Low:** Facilities with low levels of automated sorting capabilities managing an estimated annual throughput between a range of 3,000–40,000 TPY. Inbound materials contain levels of contamination consistent with single stream collection programs, and facilities typically have mechanical screens, conveyance systems, and optical sorters that are balanced with manual separation. The increased mechanical screens, optical sorters, and single stream inbound materials result in some process loss, in the 8% to 10% range.

- **High:** Facilities with high levels of automated sorting capabilities managing an estimated annual throughput between a range of 10,000–70,000 TPY. Inbound materials contain levels of contamination consistent with single stream collection programs, and facilities typically have mechanical screens, conveyance systems, depackaging equipment, magnets, and optical sorters that minimize the need for manual separation. These facilities process higher quantities of materials at faster speeds, resulting in increased process loss in the 10% to 15% range.
- **Mixed Waste:** Facilities with high levels of automated sorting capabilities managing an estimated annual throughput between a range of 35,000–300,000 TPY. Inbound materials can include a combination of mixed waste, single stream, or dual stream and are designed to accept a higher throughput than facilities handling only single stream and dual stream inbound materials. Contamination levels can vary widely depending on the source and composition of the materials processed, and facilities typically have robust mechanical screens, conveyance systems, and optical sorters that minimize the need for manual separation. Mixed waste facilities contain more rugged equipment capable of handling inbound material that is higher density and less homogeneous than single stream or dual stream inbound materials. These facilities process higher quantities of materials, resulting in increased process loss in the 10% to 15% range.

3.2.5 Process Flow of Covered Material at Recycling Processing Facilities

Table 3-6 presents the statewide material flow of covered material by CMC class at recycling processing facilities. The contractor estimated the inbound tons received by recycling facilities as well as the outbound tons that those facilities prepare to send to end markets (e.g., bales). The outbound tons are estimated to have contamination and processing loss removed from inbound tons. The contractor estimated that around 2 million tons of covered material are included in outbound tons from recycling processing facilities. These estimates do not include materials being sent directly to brokers or end markets from commercial generators or facilities that do not process materials.

The contractor evaluated inbound materials by CMC processing groups by referencing Appendix C Tables C-2 and C-4 from the Current State of Collection Report, which present the composition profile of recyclables and solid waste for residential and commercial generators on a combined basis. Projections were based upon best available data, subject to assumptions and limitations further described in Appendix A, Sections 3.1 and 6.1, respectively. Tons collected by CMC collection group were further disaggregated for this report in Appendix C, Table C-3.

Table 3-6: Statewide Process Flow of Material at Recycling Processing Facility by CMC Class (Tons, 2024)[1, 2]

CMC Class	Inbound Tons	Outbound Tons
Ceramic	250	40
Glass	126,113	69,650
Metal	285,005	158,967
Plastic	617,882	136,954
Paper and Fiber	4,748,637	1,695,627
Wood and Other Organic Materials	80,772	164
Total[3]	**5,858,659**	**2,061,404**

[1] Totals may not sum exactly due to rounding.

[2] Inbound tons may differ from outbound tons due to source-separated covered materials (e.g., OCC) that are delivered directly to MRFs and are not included in the traditional collection stream.

[3] Inbound tons may include materials that are collected for recycling but are not actually delivered to a recycling processing facility.

The outbound tons from recycling processing facilities varies slightly from what is included in the Current State of End Markets Report. Details on these differences are provided in Appendix C-3.

Based on modeling, Table 3-7 presents the outbound flow of materials from recycling processing facilities, estimating the amount disposed of either as contamination or process loss and the outbound amount aggregated for end markets. The outbound total represents the estimated tons of covered material reported as prepared to be sent to end markets from recycling processing facilities and mixed waste processing facilities, based on RDRS data and interested party engagement. In the survey, facilities were asked to respond to questions, considering only covered materials for their estimates, though incidental levels of contamination are likely included. These estimates do not include materials sent directly to brokers or end markets from commercial generators or facilities that do not process materials.

Disposal amounts were estimated by considering both contamination and process loss and are based on reported rates of the percentage of operational tons processed that are disposed of. For facilities that did not report contamination or were not engaged, the contractor estimated the total amount disposed of by subtracting the reported tons delivered to end markets in 2024 per RDRS reporting from the total inbound material. The outbound total, containing only covered materials, is less than the inbound because disposed-of tonnage (contamination and process loss) is removed, due to covered materials that may not be recovered from mixed waste processing (which may also be considered tons disposed of) and underreporting by recycling processing facilities in the RDRS dataset.

Table 3-7: Statewide Outbound Flow of Material at Recycling Processing Facilities by Region (Tons, 2024)[1]

Process Flow	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Contamination	244,482	26,203	7,600	432,800	95,798	806,883
Process Loss	206,396	18,396	2,725	238,667	61,909	528,093
Disposed of Total	**450,878**	**44,600**	**10,325**	**671,466**	**157,707**	**1,334,976**
Outbound to End Market Total	**780,866**	**165,620**	**17,334**	**1,554,495**	**414,288**	**2,932,603**

[1] Totals may not sum exactly due to rounding.

3.2.6 Acceptance of Covered Materials

The contractor evaluated each CMC processing group to summarize processing challenges and opportunities to determine why certain groups are accepted and others are sent to disposal. For each CMC processing group, the evaluation considers sortation feasibility and marketability as follows:

- **Sortation feasibility:** The technical capability for inbound materials to be effectively and efficiently sorted by manual separation, magnets, mechanical screens, optical sorters, other equipment, and technology in the facility processing equipment arrays. Sortation feasibility varies by facility type, size, and level of automation. For example, small or manual facilities that do not have mechanical screens or optical sorts require increased manual separation but may lack the requisite number of sorters and storage space to separate and manage bales of specific materials. Conversely, large or highly automated facilities may have the equipment and technology to separate material but have not been designed to target specific CMC processing groups and/or do not operate systems at a speed where new or additional materials can be targeted for separation. A facility’s ability to manage contamination from the inbound material stream can impact sortation feasibility by reducing the efficiency of mechanical screens (e.g., due to wrapping, unplanned downtime) or optical sorters (e.g., unable to identify and separate target materials due to increased contamination). Further discussion of contamination is provided in Section 3.2.7.
- **Marketability:** The availability of buyers to accept bales of separated commodities at a value so recycling processing facility operators can justify the cost of separating and delivering them to end markets. In some cases, the

marketability of a material may depend on a facility's ability to bale materials separately. If marketability depends on end market specifications that a facility is not designed to produce, it may require additional capital or operational retrofits to effectively receive, process, and transport to end markets. Some materials do not currently have consistently available end markets, or limited availability of local end markets may require increased transportation distances and costs. The marketability, or incentive for facilities to market materials, is reduced if the cost of separating and transporting materials to end markets is prohibitively expensive compared to disposal. Additionally, contamination in the inbound material stream can decrease marketability of otherwise clean covered materials (e.g., food soiled paper). Further discussion of contamination is provided in Section 3.2.7.

For clarity, sortation feasibility refers to the technical capabilities of receiving, separating, and storing materials that may be covered, while marketability refers to the ability to justify the cost-effectiveness of separating and marketing bales of materials that may be covered. Sortation feasibility and marketability are linked because recycling processing facilities need a strong basis for marketability to justify operational changes and capital investments. Market factors such as price and availability of end markets may dictate investment decisions by recycling processing facilities to separate inbound materials into bales.

Each CMC processing group's sortation and marketability is characterized as high, variable, or limited as defined in Table 3-8.

Table 3-8: Evaluation Criteria of Sortation Feasibility and Marketability Material at Recycling Processing Facilities

Criteria	Sortation	Marketability
High	Reliably consistent sortation at each facility type, including facilities with a mix of manual or automated processing technologies.	Highly marketable materials with strong, viable, and consistent end markets.
Variable	Mixed levels of consistency in sortation feasibility depending on facility type and size. Materials may have improved sortation if processed with automated systems (e.g., increased numbers of mechanical screening and optical/AI sortation).	Markets for these materials may exist but are either limited or not economically viable for some or all facilities.
Limited	Low sortation at each facility type due to material size, material characteristics, impacts on other materials, or impacts on equipment. Facilities cannot efficiently segregate material into a clean, homogeneous stream with sufficient volumes to justify separate storage of baled materials.	Markets for these materials either do not exist, or facilities must pay to ship material to end markets rather than receiving sales revenue.

The contractor received information from 21 recycling processing facilities for each CMC processing group, including whether the material was accepted, tolerable, or prohibited, which are defined as follows:

- **Accepted:** Materials that can be sorted and are not problematic for processing equipment. These materials are processed through the facilities and are advertised as desirable by operators. Based on surveys, interviews, and site visits, operators indicated that when equipment is temporarily inoperable or parts of a facility have unplanned downtime, some accepted materials may not be processed for recovery temporarily, causing some accepted materials to end up as residue.
- **Tolerable:** Materials that can be sorted but may be problematic for processing equipment or currently have limited marketability, causing bales to be stockpiled at the facility. Tolerable indicates that these materials can be received and processed but may not be advertised widely by facilities or targeted for separation to be marketed.
- **Prohibited:** Materials that cannot generally be sorted and do not currently have end markets. Prohibited materials are rejected by facilities because they may be dangerous or damaging to receive and process. Some prohibited materials, such as batteries or compressed air cylinders, are screened out prior to processing because they would damage equipment or present safety issues for facility staff. Other prohibited materials, such as film plastic, are intentionally separated and sent to disposal.

The designation of material as accepted, tolerable, or prohibited is not mutually exclusive. These designations can change as equipment and staffing are adjusted to increase or improve sortation and marketability of inbound materials.

The following sections provide a summary of acceptance and evaluate the sortation feasibility and marketability of each CMC processing group as indicated by survey respondents. They are organized by CMC class, including plastic, paper and fiber, metal, glass, and ceramic. Wood and other organic materials are discussed in Section 3.3.3.

3.2.6.1 Plastic Material Class

Plastic covered material within the plastic material class is made of a wide range of resin types and material forms. Table 3-9 summarizes the 21 survey respondents that identified plastic CMC processing groups as accepted, tolerable, or prohibited. Not all respondents submitted a reply for each CMC processing group. Plastics designed for compostability are not included in this section because they are discussed with OPFs in Section 3.3.3.

The responses from facilities indicate that there is strong acceptance of PET #1 bottles and jars, HDPE #2 bottles and jars, aluminum, tin/steel, OCC, kraft paper, paperboard, and mixed paper. Based on interviews, the contractor identified these materials as the most marketable in the inbound material stream. Facilities are typically designed to effectively capture these materials, and there are proven end markets for them.

The facilities that indicated they accept flexibles, films, and multi-material laminates are primarily mixed waste processing facilities capable of recovering materials that may be captured in municipal solid waste (MSW). Only one CMC processing group is accepted by all facilities that responded to the survey: plastic #1 – PET clear bottles, jugs, jars – non-CRV.

Table 3-9: Summary of Acceptance of Plastic CMC Processing Groups per Surveyed Facilities (Number of Facilities Surveyed, 2025)

CMC Processing Group	Accepted	Tolerable	Prohibited
Plastic #1 – PET Clear Bottles, Jugs, Jars – Non-CRV	21	0	0
Plastic #1 – PET Pigmented Bottles, Jugs, Jars – Non-CRV	20	0	1
Plastic #1 – Other PET Rigid	15	2	2
Plastic #1 – PET Flexibles and Films	6	1	12
Plastic #2 – HDPE (pigmented and natural) Bottles, Jugs, Jars – Non-CRV	20	1	0
Plastic #2 – HDPE Pails and Buckets	16	2	0
Plastic #2 – Other HDPE Rigid	15	2	0
Plastic #2 – HDPE Flexibles and Films	7	3	10
Plastic #3 – PVC Rigid	8	1	11
Plastic #3 – PVC Flexibles and Films	5	2	13
Plastic #4 – LDPE Bottles and Jugs	11	3	7
Plastic #4 – Mono LDPE Flexibles and Films	5	3	11
Plastic #5 – PP Rigid Items	14	3	4
Plastic #5 – Other PP	11	2	6
Plastic #5 – Mono PP Flexibles and Films	6	1	13
Plastic #6 – EPS Rigid Items	7	2	10
Plastic #6 – PS Rigid Items	7	1	10
Plastic #6 – Other PS	7	2	12
Plastic #6 – Flexibles and Films	5	1	15
Plastic #7 – Other Rigid Plastics	11	2	6
Plastic #7 – Other Flexibles and Films	5	2	11
Small Format – Plastics	6	3	10
Multi-Material Laminate	5	1	11
Plastic-based Textiles	0	0	0

Several surveyed facilities indicated that more material types could be accepted if additional space was available on-site for bunkers, baling, and bale storage. They also indicated that facility expansion may be necessary for additional sorting lines, equipment, and labor. Surveyed facilities were willing to consider these changes if the value of the materials results in revenue, or reimbursements are provided to pay for system changes. These facilities expressed interest in using a third-party location, such as a secondary processor, capable of further sorting mixed plastic bales to minimize encroachment on existing space at the facility.

Based on surveys and interviews conducted, several facilities indicated that operators do not have plans to accept or process new material types at this time. Others noted that their willingness to expand is tied to the development of reliable and economically sustainable markets, suggesting that setting a guaranteed floor price for materials (e.g., $0.07 to $0.10 per pound) could change conditions and help them justify operational or facility adjustments to target material types.

The sortation and marketability of plastics are influenced by resin type and other material characteristics, operations and maintenance costs, and product manufacturing methods. For example, items that are carbon black (of all resin types) are largely unable to be sorted by near infrared (NIR) optical sorters because the black material absorbs the NIR waves. It is possible to use robotics to sort various shapes of black plastics; however, this is not helpful for end markets that want to purchase specific polymer types. Since black is not identified by resin type, it generally goes to residue at the facility or at the pelletizer if included in a mixed PET bale. Facilities did not include flexibles and films, plastic #3 – polyvinyl chloride (PVC), or multi-material laminates when discussing potential additional materials that could be processed due to challenges with sorting technology and impacts on existing equipment. Facilities expressed interest in finding solutions for plastic #1 – other PET rigid (specifically PET thermoforms), plastic #5 – PP rigid items, and mixed plastics #3 through #7 if they are unable to be sorted into further grades.

Table 3-10 summarizes each plastic CMC processing group's sortation and marketability based on surveys, interviews, and site visits.

Table 3-10: Summary of Sortation Feasibility and Marketability of Plastic CMC Processing Groups

CMC Processing Group	Sortation	Marketability
Plastic #1 – PET Clear Bottles, Jugs, Jars – Non-CRV	High	High
Plastic #1 – PET Pigmented Bottles, Jugs, Jars – Non-CRV	High	High
Plastic #1 – Other PET Rigid	Variable	Variable
Plastic #1 – PET Flexibles and Films	Limited	Limited
Plastic #2 – HDPE (pigmented and natural) Bottles, Jugs, Jars – Non-CRV	High	High
Plastic #2 – HDPE Pails and Buckets	Variable	Variable
Plastic #2 – Other HDPE Rigid	Variable	Variable
Plastic #2 – HDPE Flexibles and Films	Limited	Limited
Plastic #3 – PVC Rigid	Variable	Limited
Plastic #3 – PVC Flexibles and Films	Limited	Limited
Plastic #4 – LDPE Bottles and Jugs	Limited	Limited
Plastic #4 – Mono LDPE Flexibles and Films	Limited	Limited
Plastic #5 – PP Rigid Items	Variable	High
Plastic #5 – Other PP	Variable	High
Plastic #5 – Mono PP Flexibles and Films	Limited	Limited
Plastic #6 – EPS Rigid Items	Limited	Limited
Plastic #6 – PS Rigid Items	Variable	Variable
Plastic #6 – Other PS	Limited	Variable
Plastic #6 – Flexibles and Films	Limited	Limited
Plastic #7 – Other Rigid Plastics	Variable	Limited
Plastic #7 – Other Flexibles and Films	Limited	Limited
Small Format – Plastics	Limited	Limited
Multi-Material Laminate	Limited	Limited
Plastic-based Textiles	Limited	Limited

In summary, processing facilities sort and market plastic #1 – PET clear and pigmented bottles, jugs, jars – non-CRV and plastic #2 – HDPE (pigmented and natural) bottles, jugs, jars – non-CRV materials. Carbon black plastic of any resin type has variable sortability and marketability due to limited sorting technology and minimal end markets.

Some types of material were identified as either hard to sort or having limited marketability. Carbon black plastic of any resin type has variable sortability and marketability due to limited sorting technology and minimal end markets. Additionally, PVC #3 quantities are generally too low to incentivize separate sortation at facilities. PVC #3 has a low melting temperature, which makes it incompatible with most other common plastics (Association of Plastics Recyclers 2024).

Plastic #4 – low-density polyethylene (LDPE) – bottles and jugs have been reportedly included in mixed plastics (#3 through #7) bales in the past. HDPE, both natural and pigmented materials, is blow molded, while LDPE is injection molded. HDPE's chemical properties, higher density, and heat resistance reportedly make it more valuable than LDPE. From industry experience, the contractor is aware of other states blending plastic #4 – LDPE bottles and jugs with plastic #5 – PP rigid items; however, this was not observed in discussions with California facilities. Facilities may still receive these materials because communities are generally educated that bottles and jugs are accepted; however, none of the facilities contacted for this study indicated that they incorporate plastic #4 – LDPE bottles and jugs into their bales.

Many facilities indicated that they accept plastic #5 – PP rigid items and plastic #5 – other PP; however, based on overall survey findings, some facilities are not able to secure end markets for these materials. Based on the contractor's experience working with facilities, materials received source-separated generally have improved marketability.

Plastic #6 expanded polystyrene (EPS) and polystyrene (PS) materials are accepted at some recycling processing facilities, but many facilities do not accept these materials due to limited end markets. Plastic #6 EPS rigid items that are collected independently, in dedicated, source-separated distribution center systems and not commingled with single stream recyclables, are reportedly marketable based on the contractor's experience, however, these materials are not sorted with current technology.

Plastic #7 – other rigid plastics have some sorting potential and are generally included in mixed rigid bales. PLA #7 is one of several plastics using the #7 resin identification code and is sometimes combined in a mixed plastics bale when marketed; however, it is generally not marketable on its own.

Emerging research conducted by Closed Loop Partners assesses the viability of recovering small format materials from an operational and economic standpoint. A 2025 report, "Small Materials with a Big Opportunity for Recovery," states that equipment, specifically glass screens that allow for broken glass to fall through the system early in the sorting process, may not be performing optimally to prevent materials from falling into the glass. Glass screens generally range from 2-by-2 to 3-by-3 inches, affecting which small format materials end up in the glass stream. The report found that the most common small format materials found in the glass stream include PP #5 (43%), metals (34%), PET #1 (13%), and LDPE #4 (10%). Existing technology reportedly can recover these small format materials from recycling processing facilities or glass beneficiation facilities. Small format items can potentially be incorporated into regular material bales, minimizing operational changes to recover them. When mixed with regular-sized materials, small format items are often held in place by the larger materials within the bale, reducing the risk of displacement. The report also found market demand for these materials.

3.2.6.2 Paper and Fiber Material Class

Paper and fiber represent a broad range of material types and account for a significant share of the inbound material stream at recycling processing facilities. Table 3-11 summarizes the number of survey respondents that accept, tolerate, or prohibit paper CMC processing groups. Old corrugated containers (OCC), kraft paper, paperboard, and mixed paper are accepted by nearly all facilities.

Table 3-11: Summary of Acceptance of Paper CMC Processing Groups at Surveyed Facilities (Number of Facilities Surveyed, 2025)

CMC Processing Group	Accepted	Tolerable	Prohibited
OCC	21	0	0
Waxed OCC	9	2	9
Kraft Paper	20	0	1
Paperboard	20	0	1
Mixed Paper	21	0	0
Molded Pulp	14	2	5
Aseptic Cartons	13	4	4
Gable-Top Cartons	10	4	6
Other Lined Paper	8	3	7
Small Format – Paper (e.g., shredded)	13	3	2

Paper and fiber items present challenges when processing equipment cannot effectively distinguish between fiber and plastic materials with similar physical dimensions, such as film plastics that become mixed with paper on processing lines or poly-coated paper products that may be less marketable. Table 3-12 summarizes the sortation feasibility and marketability of paper and fiber materials by CMC processing group.

Table 3-12: Summary of Sortation Feasibility and Marketability of Paper and Fiber CMC Group

CMC Processing Group	Sortation Feasibility	Marketability
OCC	High	High
Waxed OCC	High	Limited
Kraft Paper	High	High
Paperboard	High	High
Mixed Paper	High	High
Molded Pulp	High	High
Aseptic Cartons	Variable	Variable
Gable-Top Cartons	Variable	Variable
Other Lined Paper	Limited	Limited
Small Format – Paper	Variable	Limited

In summary, most paper products managed by recycling processing facilities (by weight) can be sorted and marketed. Currently, many recycling processing facilities do not sort aseptic cartons or gable-top cartons into specific carton bales. When aseptic cartons or gable-top cartons are accepted, they generally go into mixed paper bales because there are likely not sufficient quantities to create separate bales. If a facility's paper end market does not allow any quantities of aseptic or gable-top cartons, they are screened out as contamination. These materials have the potential to be sorted and marketed today. In 2011, the Institute of Scrap Recycling Industries created Paper Stock Industries Grade #52 exclusively for food and beverage cartons. While the Carton Council recommends cartons be sorted into carton-specific bales (Grade #52), they can also be sorted with other fiber-based materials into mixed paper, (Grade #54). Other lined paper is poly-coated paper that is not currently marketable as separated bales; however, facilities can market mixed paper bales containing limited quantities.

3.2.6.3 Metal Material Class

Ferrous and nonferrous metals are widely accepted by facilities and retain consistently strong market values. Table 3-13 summarizes the number of survey respondents that accept, tolerate, or prohibit metal CMC processing groups. Other ferrous and small format – metal are the least accepted materials but are still accepted by more than half of facilities because magnets effectively recover them.

Table 3-13: Summary of Acceptance of Metal CMC Processing Groups at the Surveyed Facilities (Number of Facilities Surveyed, 2025)

CMC Processing Groups	Accepted	Tolerable	Prohibited
Aluminum Containers – Non-CRV	20	1	0
Other Aluminum	18	2	1
Other Nonferrous	14	3	2
Tin/Steel/Bimetal – Non-CRV	18	2	0
Other Ferrous	14	3	2
Small Format – Metal	14	4	1

Despite these materials retaining strong end market value, challenges arise when processing equipment cannot efficiently separate metal materials from the broader material stream, which can reduce recovery. In addition, dense or heavy metal items can cause accelerated wear on conveyors and mechanical systems and may pose safety risks to manual sorters. Table 3-14summarizes the sortation feasibility and marketability of metal CMC processing groups.

Table 3-14: Summary of Sortation Feasibility and Marketability of Metal CMC Processing Groups

CMC Processing Group	Sortation Feasibility	Marketability
Aluminum Containers – Non-CRV	High	High
Other Aluminum	Variable	Variable
Other Nonferrous	Variable	Variable
Tin/Steel/Bimetal – Non-CRV	High	High
Other Ferrous	Variable	Variable
Small Format – Metal	Variable	High

In summary, aluminum containers and tin/steel/bimetal – non-CRV materials are more easily sorted and marketed by recycling processing facilities. Challenges arise for other aluminum, other nonferrous, and other ferrous materials due to sizing (too small to sort properly) or contamination (food residue creating less marketability). Other aluminum and other nonferrous contain aluminum foil and less valuable aluminum that reduce the value of aluminum container – non-CRV material. Facilities may attempt to separate these materials through quality control processes at the end of the processing line if there are sufficient quantities to market separately. Small format – metal materials are not typically sorted because they are less than 2 inches, but if captured, can be marketed, which is reinforced by recent research conducted by Closed Loop Partners (discussed in Section 3.2.6.1). The small format – metal materials may end up in the glass stream and could be recovered during the glass beneficiation process, where glass is cleaned and sorted to be turned into cullet.

3.2.6.4 Glass Material Class

Glass presents unique challenges in the recycling stream due to its abrasive physical properties and interaction with processing equipment which wear down screens and tear conveyor belts. Table 3-15 summarizes the number of survey respondents that accept, tolerate, or prohibit glass CMC processing groups.

Most surveyed facilities accept mixed glass bottles and jars – non-CRV – which are generally sent for secondary processing. Other forms of glass are less desirable because facilities prefer food and beverage containers in clear, green, or brown/amber glass and want to avoid receiving other glass products, such as closed- and open-ended tubes, lids, and ampules. Small format glass is likely sorted along with the mixed glass bottles and jars – non-CRV. However, it is less widely accepted because small glass shards pose a risk to sorting staff and create wear and tear on equipment.

Table 3-15: Summary of Acceptance of Glass CMC Processing Groups at Surveyed Facilities (Number of Facilities Surveyed, 2025)

CMC Processing Group	Accepted	Tolerable	Prohibited
Mixed Glass Bottles and Jars – Non-CRV	16	3	1
Other Forms of Glass	9	1	9
Small Format – Glass	10	2	6

When not effectively separated or when broken into pieces too small for equipment to manage, these materials can reduce recovery efficiency and contribute to increased residue tonnage requiring disposal. Table 3-16 summarizes the sortation feasibility and marketability of glass CMC processing groups.

Table 3-16: Summary of Sortation Feasibility and Marketability of Glass CMC Processing Groups

CMC Processing Group	Sortation Feasibility	Marketability
Mixed Glass Bottles and Jars – Non-CRV	Variable	High
Other Forms of Glass	Variable	Limited
Small Format – Glass	Variable	Variable

Glass sortation at recycling processing facilities is largely dependent on advanced technology at the facility, including glass cleanup systems, or the facility must contract with a secondary glass processor to further sort the processed fines for glass beneficiation. Currently, most MRFs in the U.S. send their glass residue to a secondary processor (Glass Recycling Foundation 2025). Glass quantities are lost in this process because the glass is handled multiple times – from collection, to the MRF, to the secondary processor, and finally to end markets. Despite material loss, processed glass has strong marketability, and secondary processors operate to manage these materials. When glass is sent to secondary processing, it contains quantities of other small format materials, such as metal, ceramic, and paper.

3.2.6.5 Ceramic Material Class

Ceramic materials present unique challenges in the recycling stream because they are neither sortable in facilities nor marketable. Table 3-17 summarizes the number of survey respondents that accept, tolerate, or prohibit the ceramic CMC processing group. Most facilities do not accept ceramic material. Facilities that stated they do accept ceramic material include one recycling processing facility and two mixed waste processing facilities.

Table 3-17: Summary of Acceptance of Ceramic CMC Processing Group at Surveyed Facilities (Number of Facilities Surveyed, 2025)

CMC Processing Group	Accepted	Tolerable	Prohibited
Ceramic	3	1	14

Ceramics are not sortable with current technology and, when broken into small pieces at facilities, contribute to increased residue tonnage for disposal or contamination in glass sent to secondary processors and end markets. In addition, sharp or dense fragments can cause wear and tear on equipment and increase the risk of injury for manual sorters. Table 3-18 summarizes the sortation feasibility and marketability of the ceramic CMC processing group, indicating that ceramic materials are not sortable and marketable by facilities.

Table 3-18: Summary of Sortation Feasibility and Marketability of Ceramics CMC Processing Group

CMC Processing Group	Sortation Feasibility	Marketability
Ceramic	Limited	Limited

3.2.7 Contamination

Contamination includes material that is not intended to be recycled but ends up in the recycling stream. Contamination may include materials that incidentally or accidentally end up in the recycling stream or materials that are deleterious to facilities. Contamination refers to various situations and materials, including materials a receiving processing facility does not accept or accepts but later disposes of. Contamination of inbound accepted materials can affect processing operations through unanticipated downtime, accelerated equipment degradation, or rejection of loads. Common sources of contamination include incorrectly discarded items, whether due to consumer error or limitations in collection systems, and can lead to processing inefficiencies and increased operating costs. Overcompaction during collection can also make material difficult to process and may reduce bale values, particularly in mixed waste streams. Product design incompatibility also contributes to contamination, particularly when items are made from multiple bonded materials that cannot be easily separated through manual sorting.

The following sections present information related to the impacts of contamination, factors contributing to contamination, CMC processing groups that may be considered contamination, and contamination rates and composition.

3.2.7.1 Impacts of Contamination

Based on interested party engagement and contractor experience, high levels of contamination in inbound materials can cause significant issues for facilities:

- **Reduced Operational Efficiency:** High contamination levels can impact the accuracy and throughput capacity of both manual and automated sorting of materials. When material streams match equipment and subsystem design, material on the tip floor can be fed into processing lines faster, maximizing the average tons per hour (TPH) throughput **for a** recycling processing facility. When contamination is present at elevated levels, manual sorters, mechanical screens, optical sorters, balers, and other equipment cannot process materials at their designed levels, leading to increased process loss.
- **Increased Maintenance Demand:** Facility equipment not designed to process certain materials may be damaged or temporarily disabled by a high quantity of contaminants. For example, holiday lights, hoses, chains, film plastics, video cassette film, and other tanglers can get caught in disk screens, requiring maintenance staff to enter enclosed spaces to manually unwrap during downtime. Maintenance associated with disabled equipment poses safety risks to workers. Abrasive material such as glass increases wear on belts and grinds down fine screens used to separate glass into multiple size categories.
- **Increased Safety Incidents:** Some contaminants received at facilities can be safety hazards for sorters, such as aerosol containers, lithium-ion batteries, needles, medical waste, diapers, or pet waste. Recycling processing facilities that do not have a bag breaker to open plastic film bags and meter it onto the processing line cannot access potentially high-quality materials and risk injuries to sort-line workers or maintenance crews. When film bags tangle in belts or screens, maintenance crews must climb into or onto equipment to manually remove them.
- **Higher Operational Costs:** Contamination can often result in higher operational costs and increased unplanned downtime. When a facility must

shut down for unanticipated maintenance (e.g., if cardboard or paperboard does not flow correctly through mechanical screens, magnets do not function, optical sorters are unable to pneumatically eject target materials) or catastrophic system failures (e.g., fires on the tip floor, explosions in the baler), the facility incurs costs. The costs can include correcting subsystem operations, paying sorters that are not able to work the line, higher overtime costs, and increasing insurance costs due to worker injuries or equipment repairs.

- **Increased Residue Quantities:** Residue is caused by both contamination (incorrectly discarded materials) and process loss (inefficiency in processing equipment). Residue cannot be sorted into commodity bales and is ultimately disposed of. The cost of residue disposal depends on the tip fee and distance to disposal facilities. Some facilities can internalize the cost of disposal if they own or operate a disposal facility where material can be delivered. Even operators that send material to their own disposal facilities incur staff, equipment, and fuel costs to transfer materials.
- **Reduced Marketability:** Higher contamination in inbound material typically results in higher contamination in outbound material. End markets that purchase sorted commodities have contamination thresholds based on the site-specific plant equipment configurations. Each CMC class may have different contamination thresholds by material specification, varying compliance measures performed by end markets (e.g., compliance inspections), or required purity to sell material types at more valuable classifications (e.g., white office paper instead of mixed paper bales). End markets may vary on what is identified as an outthrow (e.g., material in a bale that is considered out of specification) or adjust acceptable percentages of outthrows by weight. For example, the specification of what constitutes contamination in a mixed paper bale has changed over time based on the levels of compliance in international end markets and the types of paper products included in bales (e.g., newsprint has decreased significantly over time, and the resulting paper end market specifications haves adjusted accordingly). If recycling processing facilities cannot meet end market needs related to bale specifications, they may charge a fee or reduce the commodity pricing. Furthermore, facilities with consistently high contamination may have difficulty maintaining partnerships with end markets.

In summary, facilities noted that downtime is the most significant impact of contamination. Nearly all facilities also stated that end markets will charge a fee or reduce the price for commodities if contamination levels exceed the desired threshold. Table 3-19 provides a high-to-low ranking for contamination impacts based on the survey results from 12 facilities. Contamination in outbound commodities is the second greatest impact for recycling processing facilities because it reduces the value of those materials for sale to end markets and/or creates more work for recycling processing facilities to clean up bales prior to sending materials to end market. Lost revenue is identified as the third greatest impact of contamination, which indicates that not all facilities see revenue loss due to commodity contamination; however, the two impacts are often related. Contamination creates less of an impact for facilities in terms of worker injuries and increased residue costs.

Table 3-19: Contamination Impact Ranking on 1 to 5 Scale by Number of Respondents

Contamination Impact Ranking	1 - High	2	3	4	5 - Low
Lost Revenue	1	2	7	1	1
Contaminated Commodities	4	5	2	1	0
Downtime	6	2	2	1	1
Worker Injuries	0	1	0	6	5
Increased Residue Cost	1	2	1	3	5

3.2.7.2 Factors Contributing to Contamination

Based on engagement with the facilities and contractor experience, inbound contamination can occur for several reasons:

- **Improper Sorting:** This can be due to confusion about what is accepted in the local material stream or can be intentional (for example, if residents or businesses run out of room in their solid waste container and place unacceptable materials into the collection container).
- **Lack of Clear Labeling:** Materials do not have clear labeling indicating whether they can be placed in the collection container.
- **Inconsistent Standards for Accepted Materials Across Collection Programs:** Materials that are accepted may vary by jurisdiction and result in incorrect materials being delivered to processing facilities.

Facilities use a variety of strategies to monitor contamination and reduce the quantity and impact of contamination at their sites:

- **Visual Inspections:** Operations staff will view incoming materials to identify obvious contaminants and initiate the process to reject a load, if necessary.
- **Pre-sort Line:** Operators will remove prohibited items (e.g., garbage bags) from inbound materials prior to entering the processing line. Some processors remove all bagged material without identifying the contents.
- **Recirculation:** Facilities will redirect material at the end of the processing lines to recirculate through the facility to maximize recovery.

- **Facility Cameras:** Cameras at strategic locations through the processing lines can help facility managers identify bottlenecks in the operation and determine opportunities to optimize processing efficiency and minimize contamination of sorted materials.
- **Regular Sampling and Bale Audits:** Facilities will conduct regularly recurring sampling of inbound material and audits of outbound bales.

3.2.7.3 Contamination and Material Types

The contractor compiled feedback from various facility types, assessing which CMC processing groups may be considered contamination at some facilities and acceptable at other facilities. While certain materials are accepted at some processing locations, they can pose operational, quality, or safety issues at others, depending on facility design, equipment, and market conditions.

Materials considered contamination can include plastic bags, tanglers (rope, electrical cords, string lights, film plastics), batteries, propane cylinders, clothing, and bulky items. Materials like plastic bags and tanglers get caught in equipment screens and rotors, resulting in downtime for removal. Batteries and propane cylinders can cause fires during handling and processing. Soiled materials, including containers or bottles with food residue, can reduce marketability of otherwise recyclable materials and contribute to increased process loss and residue disposal costs. Additionally, materials that are not compatible with automated sorting technologies can reduce the quality and value of outbound material.

Table 3-20 summarizes the residue composition at surveyed facilities by material type as reported by six facilities. Percentages are reported as the proportion of total residue. This information was not available by CMC processing group from facilities.

Table 3-20: Residue Composition Ranges as Reported by Respondents

Material Type	Low	High
Nonaccepted paper products	2%	23%
Flexibles and films	5%	40%
Nonaccepted plastic containers	5%	40%
Tanglers	1%	1%
Food waste	1%	6%
Nonaccepted glass	1%	8%
Fabrics	1%	7%
Construction and demolition	1%	5%
Mixed residue	6%	40%

Material Type	Low	High
Other	1%	30%

The material types that are ranked as the most common contaminants are flexibles and films, nonaccepted plastic containers, and nonaccepted paper products. The following list summarizes specific challenges associated with each identified item based on surveys, interviews, and site visits (see Appendix C-2 for further details):

- **Plastic #1 Other PET Rigid:** PET thermoforms, such as clamshell food containers, have variable end markets. Facilities that can effectively sort this material have highly automated systems using optical sorters to separate thermoforms. Processing facilities that use more manual separation processes do not generally have the ability to separate PET thermoforms into a dedicated bale.
- **Mixed Plastics #3–#7:** Includes rigid plastics labeled as #3 through #7 other than plastics designed for compostability. Most facilities have limited bale storage space for this material or do not have the ability to separate rigid plastics due to limited sorting technology options. Most importantly, according to engaged facilities, materials such as plastic #3 – PVC rigid, plastic #4 – LDPE bottles and jugs, plastic #6 – EPS or PS rigid, and plastic #7 – other rigid plastics have limited or no viable end markets.
- **Plastic Flexibles and Films (all resin types):** Film plastic requires a facility to have thick axel screens to avoid wrapping and/or optical sorters to target the resin type accompanied by an additional technology (such as a vacuum system) to limit the material commingling with paper due to its similar physical properties. Additionally, facilities reported that film is often contaminated with food residue that reduces the quality of the bales, limiting end market value. Some facilities handle commercial flexibles by baling them directly rather than running them through the processing system.
- **Plastics and Polymers Designed for Compostability:** Includes rigid, flexible, and film materials. These items may be mistakenly discarded in curbside recycling programs; however, recycling processing facilities generally do not have end markets for these materials.
- **Small Format – Plastics, Paper, Metal, Ceramics, Glass, Wood and Organics:** Includes packaging less than two inches in diameter. This is typically considered residue because its dimensions cause it to fall through screens and miss being sorted by optical sorters, contaminating other material streams at a facility. These materials also commonly end up in the glass streams.
- **Multi-Material Laminate, Waxed OCC, Other Lined Paper, and Poly-coated Paper Food Service Ware:** These materials are challenging to separate from other paper streams and may contaminate paper bales. Multi-

material laminate or lined paper products may act as paper in processing systems and end up in paper bales, reducing the purity of the bales and minimizing value.

- **Aseptic and Gable-Top Cartons:** There are limited technology applications for optical sorters to separate material types by dimension. Pulling cartons by hand is less efficient and more costly for creating dedicated bales using bunker space. Robotics and artificial intelligence (AI) solutions have been deployed to recover cartons; however, this technology is still evolving, and there are limited volumes of these materials to justify the costs of creating and storing distinct bales. Aseptic and gable-top cartons may be incorporated into mixed paper bales. If these materials are not sortable with current technology or not accepted by the end market, they are considered contamination at the facility.
- **Other Nonferrous and Ferrous:** Includes foils and other flexible metal packaging that may not be captured by magnetic screens because they are crumpled or are dimensionally equivalent to paper products.
- **Ceramics and Other Forms of Glass:** Breakable ceramics or other forms of glass cause increased wear on equipment and add limited value to glass streams, often ending up as residue due to their small size.

3.2.7.4 Contamination Rate and Contamination Composition

The contractor compiled data received from recycling processing facilities related to contamination rates and contamination composition for inbound materials. Contamination rates and composition can vary based on the facility type, customer type (e.g., residential single family, multifamily, commercial), and collection program (e.g., single stream, dual stream). One facility noted that routes including multifamily customers can exhibit contamination up to 40%. Multiple facilities noted higher contamination on commercial routes; however, they did not provide a unique contamination rate for those loads.

Facilities reported contamination rates ranging from 5% to 40%, with the majority falling between 20% and 30%. Table 3-21 shows the inbound contamination rate averages by facility type and region. These data are based on facility engagement and permit information and represent approximately half of the identified surveyed facilities.

Table 3-21: Inbound Average Contamination Rate by Facility Type and Region[1]

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Single Stream	24%	19%	25%	23%	20%	**22%**
Dual Stream	14%	15%	Unknown	Unknown	13%	**14%**

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Other	23%	24%	Unknown	21%	17%	**22%**
Average by Region	**20%**	**19%**	**25%**	**22%**	**16%**	**19%**

[1] Mixed waste facility types are not included in this table because they are designed to accept a combination of single stream, dual stream, and mixed waste streams.

Additional information on contamination and the presence of contamination and covered materials within outbound bales can be found in Appendix C-3.

3.2.8 Processing Technology and Costs

The contractor leveraged primary data collection methods including site visits and surveys to gain a deeper understanding of current technology levels across facilities. The following describes the key considerations for equipment and costs associated with processing materials at the recycling processing facilities. Appendix C-4 contains additional details from survey responses related to equipment and operating costs.

3.2.8.1 Equipment, Efficiency, and Upgrades

This section provides an overview of key equipment types and subsystem components currently used to process materials in facilities. Each equipment type plays a role in separating, recovering, and preparing materials for end markets. The ability to accept and effectively process certain materials generally depends on technology limitations, space constraints and layout, facility age, and financial viability.

The following identifies standard equipment types and advanced technologies that can enhance recovery outcomes. Consideration is also given to opportunities for implementing technologies based on facility material flow and technical capacity. Limitations are discussed for each equipment type, including issues such as material compatibility, maintenance demands, and operating conditions that may affect overall performance. Together, these considerations establish a foundation for evaluating how equipment selection and investment can shape a facility's ability to manage covered materials effectively in the statewide recycling system.

- **Screens:** Facility types, from highly automated to manual sorting operations, typically have some version of a screen at the beginning of the sortation process. Disc or star screens are the most common \and separate paper (fiber) from containers. Single stream facilities use OCC screens to separate large cardboard from smaller fiber and containers. These screens often have two or three decks for cleaner OCC product. Smaller non-OCC material falls through to a glass-breaking screen that crushes glass and separates materials less than two inches. Remaining material passes over fiber screens that separate paper from containers. Some screens employ air classification systems to assist in separating lightweight materials from heavier materials. Some systems may use vibrating ballistic screens for some applications. Other systems use vibrating ballistic screens. Ballistic screens can separate glass fines and containers from fiber in one step. A newer concept, the auger screen (i.e., screw press), separates oversized material at the beginning of the sorting process to reduce sorters for cost savings and safety reasons. Screens are reliable, but inflexible for new material types. Screens depreciate and are replaced when worn or replaced with better technologies. Facilities upgrading screens should consider larger shafts, similar to the auger screens, so reduce plastic film tangling. Removing film and tanglers often requires staff to climb into equipment, posting safety risks and in many cases this poses a worker safety concern as they may have to climb on or into equipment.

- **Magnets:** Magnets are considered standard equipment used to capture tin cans and other ferrous (magnetic) materials. They are highly reliable and often have a long lifespan. Additional magnets may be added in some facilities to clean up the glass stream or capture more ferrous materials (including tin/steel/bimetal – non-CRV). When magnets are inoperable, many high-value materials end up as residue. Some facilities indicated they assign manual sorters toe residue lines to recover metal cans.
- **Eddy Current Separators:** Eddy current separators (ECS) are considered standard equipment that capture aluminum and other nonferrous metals near the end of processing. Some ECS units noted during site visits have been in place for many years; however, these units are aging and can be damaged by stray ferrous metals, have torn belts, or lose efficiency, reducing sorting effectiveness. The units require ongoing assessment to monitor efficiency. ECS units can miss material in two ways: 1) flattened aluminum cans (and PET) often sort incorrectly into fiber line because they\ behave like two-dimensional fiber; and 2) small format aluminum often ends up in fines and glass streams that drop out of the system. Some facilities indicated that aging equipment can cause whole cans to enter the glass stream. In cases like this, repairs to glass breakers or other glass processing systems should be considered to limit material size. Although the primary aluminum materials sorted by ECS are CRV materials, additional CMC processing groups such as aluminum containers – non-CRV, other aluminum, and other nonferrous – can be managed effectively by this equipment.
- **Optical Sorters:** Optical sorters are considered advanced labor-saving devices that boost throughput and target specific materials more efficiently than manual sorters. Optical sorters can be configured to separate many material types, including glass, plastic, and fibers. They make hundreds of picks per minute and target multiple plastic resins, paper fibers, and material colors using near-infrared radiation scanning paired with air jets that direct different materials into separate chutes. Small facilities rarely have optical sorters because they are aging or space constrained. The larger facilities use

several optical sorters for containers, paper, and specific plastic resin types. While optical sorters continue to advance and adapt to shifting material types, these large devices require space among the processing system, a dedicated infeed/acceleration conveyor belt, and two or more external conveyor belts to carry the separated materials to subsystems, bunkers, or balers. Retrofitting existing facilities can be challenging for existing facilities due to infrastructure costs (e.g., conveyors, bunkers) building constraints. Facilities seeking to manage additional plastic or fiber CMCs or improve the quality of existing CMCs will likely consider additional or upgraded optical sorters and associated conveyor adjustments.

- **Infeed Metering Bin:** Metering bins are considered advanced equipment allowing a front loader to deposit material into a hopper for metered feeding onto the processing line. This equipment is becoming more common at facilities with optical sorters, which require spread-out layers with less burden depth for accurate identification and sorting.
- **Robotics:** Robotics are advanced technologies recently introduced at facilities. This technology continues to advance, but issues persist with the grabbing function of mechanical robotic arms and the technology’s speed. In theory, modern robots can pick faster than a human, but not every pick is successful, and equipment is prone to unplanned downtime with high maintenance needs. They can also be helpful in quality control applications and cleaning residue lines.
- **Artificial Intelligence (AI):** AI applications are cutting-edge technologies under development and deployed on a pilot scale at the facilities. AI can helps monitor processing lines to identify missed commodities, alerting operators to adjust screens or optical sorters. It can also balance conveyor speeds for maximum processing rates. Optical sorters often include AI to enhance sorting efficiency and conduct real-time data analysis. One of the more promising elements of AI applications is enabling optical sorters to identify materials by dimension (e.g., distinguishing a paper container from a flat sheet of paper). Additionally, AI may enable scanning of product barcodes or branding to provide more granular estimates of covered material volumes at facilities.
- **Bunkers:** Bunkers are necessary for each type of material separation. In most cases, facilities are constrained in how many bunkers they may have or add. Adding bunkers (and baler infeed conveyors) is challenging due to equipment configuration and site constraints.
- **Balers:** Balers are standard equipment that compress and bind commodities for transport. This equipment is critical for maintaining processing lines meeting desired truck and rail load ratings. Some facilities have replaced or plan to replace balers, but smaller facilities often use aging equipment, causing downtime and bottlenecks. Careful equipment selection and

arrangement are essential for productivity. Facilities with redundant balers or baler types that can process multiple material types operate more reliably at optimal capacity. Balers are relevant for paper and fiber, plastic, and metal CMC classes and are essential for efficient material transport.

- **Conveyors:** Conveyors move materials through processing systems and between sorting equipment. Conveyors at the facilities typically include belts, idlers, drives, and pulleys. As processing lines are modified, conveyors are adjusted for alignment and spacing between equipment components. Older systems often have larger conveyors between sorting locations. Picking stations often include enclosures to avoid noise and provide heating, ventilation, air conditioning (HVAC), and lighting as required. Some facilities indicated they face space constraints, limiting upgrades to those requiring minimal additional space. If facilities expand to manage more CMCs or increased quantities of CMCs, conveyors will be critical additions. Existing conveyor equipment may also require adjustments.
- **Fire Protection Systems:** Facilities face high fire risk from combustible materials such as aerosol cans, propane or butane tanks, and lithium-ion batteries. Fires may also result from overheating equipment or human factors (e.g., cigarettes). Inbound material must stay dry and loose for processing, increasing combustibility. Fires endanger workers and communities and can shut down facilities for extended period**s**. For these reasons, fire protection systems should be evaluated and updated with technology to monitor the entire facility – from the tipping floor to bale storage – to proactively address fires. Not all facilities have updated fire protection systems; some larger facilities use thermal detection. Managing increased material quantities, including CMCs, will likely require enhanced fire protection systems.
- **Mobile Equipment:** Each recycling processing facility engaged has mobile equipment for current operations and a replacement program, but equipment needs may change as throughput increases. Examples of mobile equipment include front-end loaders, forklifts, skid steers, roll-off trucks, and pickup trucks. Some facilities indicated that adding optical sorters slowed some sorting labor to shift to mobile equipment operation (e.g., forklifts) as throughput and bale production increased.
- **Other Equipment:** Each recycling processing facility includes support and ancillary equipment. Examples include garage or bay doors; commodity storage bins; loading docks; air compressor systems; concrete wear surfaces (e.g., tip floor); building components; operator support facilities, such as lockers, break rooms, training areas, and offices; truck scales; parking lots; parts storage; and maintenance shops.

3.2.8.2 Costs

Except for some publicly owned facilities, surveyed facilities generally did not provide the contractor with operating and capital cost data. The data obtained are provided as ranges to protect confidentiality for facilities. Appendix C-4 provides a summary of other cost considerations and commodity revenues.

Of the facilities surveyed, 25% provided information about current operating costs. Reported annual operating costs ranged from $2.8 million (more manual facilities) to $60 million (larger mixed waste processing and integrated facilities). Surveyed facilities indicated that operating costs vary significantly by facility based on age, types of equipment used, type and quantity of inbound materials accepted, number of full-time employees (FTE), labor rates, and other factors. Facility labor requires equipment operators, sorters, scale operators, maintenance, supervisors, and office/support staff. Of the facilities, 45% provided the number of FTEs needed to operate the facility, ranging from ten at smaller manual operations to 300 at larger mixed waste processing or integrated facilities. Facilities suggested a range of one to two shifts per day, which greatly impacts costs to and facility throughput. Based on survey responses, single stream facilities are more likely to have two shifts; however, most facilities have one shift.

Table 3-22 shows the range of operating metrics identified by surveyed facilities. Of the 20 responses on throughput, single stream facilities reported operating at approximately 29 TPH on average. Dual stream facilities operate at approximately four TPH due to manual sorting operations, and mixed waste processing facilities operate at approximately 188 TPH on average. Facilities operating shifts range from 8 to 10 hours each (16 responses). Of the 21 responses for operating days per week, facilities operate an average of five to six days per week.

Table 3-22: Average Facility Operating Metrics (MRF Processing Survey, 2025)

Description	Tons per Hour (TPH)	Hours per Shift	Days per week
Single Stream	29	8.9	5.2
Dual Stream	4	8.7	6.0
Mixed	188	8.0	6.0
Other	33	10.0	5.0

Of the facilities surveyed, 55% indicated that the capital costs for facility development ranged from $2.1M to $55M. Many large facilities declined to provide capital cost data, and $55M should not be considered the upper limit of potential facility costs. Facilities indicated that upgrades to buildings and equipment are generally expected to reduce manual sortation, reducing the number of sorters required and shifting some roles to quality control activities or other functions. Capital upgrades being considered by surveyed facilities include completely rebuilding or replacing the existing facility; adding secondary processing capacity; increasing processing automation by adding optical sorters, robotic sorters, and AI software capabilities; and adding a metering bin to control burden depth and material flow. During interviews, facilities indicated that planned improvements could range from as low as $500,000 for individual equipment installation to complete overhauls for $70M or more. Costs associated with permitting were not provided.

3.3 Organic Processing Facilities

The following sections describe the current state of OPFs in California, including types of facilities, inbound materials, current and potential capacity, and costs for improvements.

3.3.1 Organics Processing and End Market Consideration

For this study, facilities that convert covered material into a recycled organic product, including composting and in-vessel digestion facilities, are designated as end markets for such material. Processing that occurs prior to conversion to recycled organic products is the focus of this report, whereas the Current State of End Markets Report assesses material at the point of conversion. Some inbound material at OPFs may not be incorporated into recycled end products. For example, some covered materials are contaminants and are removed during pre- or post-processing. Additionally, untreated wood may be chipped or ground and sold as mulch, animal bedding, or other end products, which do not undergo biological conversion and are therefore not considered recycled organics products.

3.3.2 OPFs and CMC Processing Groups Considered

There are approximately 480 OPFs listed in CalRecycle's SWIS database (as of April 2025). However, many OPFs are not currently active or do not process inbound material types that may include covered material. For this study, the contractor considered composting and in-vessel digestion facilities that are currently shown as active in SWIS and are likely to receive covered material. These facilities may have co-located activities, such as chip-and-grind, that may also receive covered material. Untreated wood is generally not composted or biologically converted and is instead sold as mulch or similar products.

Table 3-23 lists the number of active OPFs that met the criteria. Additional information regarding criteria and facility types considered is included in Appendix A-4.2. Most OPFs that are likely to manage covered materials are in the Southern and Valley regions, with the fewest facilities in the Mountain region. Most OPFs meeting the criteria are permitted as composting facilities rather than in-vessel digestion facilities.

Table 3-23: OPFs by Region Considered[1]

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Composting Facility	6	9	1	19	11	46

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
In-Vessel Digestion Facility	3	2	0	4	3	12
Total by Region	**9**	**11**	**1**	**23**	**14**	**58**

[1] Active facility information was downloaded from CalRecycle's SWIS database in April 2025.

According to facility-specific permitted maximum tonnage included in the SWIS database, there is approximately 8.3 million TPY of permitted capacity at OPFs in California that process relevant material types, as shown in Table 3-24. However, most facilities receive and process less than their permitted maximum tonnage. The contractor used data collected from surveys, interviews, and site visits to estimate the actual inbound quantity statewide (approximately 5.7 million TPY).

Table 3-24: Organic Material Permitted Maximum Tonnage by Region[1]

Facility Type	Bay Area	Coastal	Mountain	Southern	Valley	Statewide
Permitted Maximum Tonnage (TPY)	1,344,200	876,200	15,600	2,350,400	3,720,600	8,307,000
Estimated Actual Inbound Quantity (TPY)	873,600	564,200	7,800	1,513,200	2,761,200	5,720,000

[1] Permitted maximum tonnage by facility may include more than just organics feedstock, depending on the permit type, because a single facility permit may include multiple on-site activities.

The contractor estimated the total quantity of select CMC processing groups that enter OPFs. In many cases, covered materials represent contamination of the organics stream and are screened out for disposal. Some facilities, however, incorporate certain types of covered material into the feedstock for their finished product. CMC processing groups that are not expected to be used in recycled organic products at OPFs were not included in the survey and were instead assumed to be screened out. These material types are listed in Appendix E and generally include glass, metal, and ceramics material classes as well as plastics other than those designed for compostability.

The estimated total inbound quantity for selected CMC processing groups is shown in Table 3-25. The inbound quantity of CMC processing groups was calculated using the actual estimated inbound data from selected OPFs (shown in Table 3-23) and inbound material composition data from the 2023/2024 Alameda County Waste Characterization Study. Information on the proportion of facilities incorporating the material into end products was based on data collected from OPFs surveyed, interviewed, and visited for this study. As shown in Table 3-25, a majority of surveyed OPFs do not incorporate covered material into their end products, with the exception of OCC, kraft paper, molded pulp, and untreated wood.

Notably, untreated wood had the highest proportion of covered material and is the only CMC processing group considered that is generally chipped and ground and does not undergo composting or in-vessel digestion. Therefore, the products generated from untreated wood (e.g., mulch, or animal bedding) are not recycled organic products. The final column of Table 3-25 includes the total number of facilities that provided a response for whether or not they incorporated that CMC processing group into their end product. Some facilities did not respond for certain groups.

Table 3-25: Covered Material Quantities for Select CMC Processing Groups at OPFs

CMC Class[1]	CMC Processing Group	Estimated Total Inbound Quantity at Organics Facilities Statewide (TPY)[2]	Proportion of Facilities Incorporating into End Product[3]	Number of Total Survey Respondents
Paper and Fiber	OCC	77,400	44%	18
Paper and Fiber	Kraft Paper	13,400	56%	18
Paper and Fiber	Mixed Papers	73,600	35%	17
Paper and Fiber	Molded Pulp	42,000	50%	18
Plastic	Plastics and Polymers Designed for Compostability - Flexibles and Films	25,100	20%	20
Plastic	Plastics and Polymers Designed for Compostability - Rigid Items	1,200	5%	19
Wood and Other Organic Materials	Wood - Untreated	80,700	75%	16

CMC Class[1]	CMC Processing Group	Estimated Total Inbound Quantity at Organics Facilities Statewide (TPY)[2]	Proportion of Facilities Incorporating into End Product[3]	Number of Total Survey Respondents
Total		**313,400**		

3.3.3 Acceptance of Covered Materials

The contractor evaluated CMC processing groups based on material-specific characteristics to assess the capacity of OPFs. The following list summarizes key considerations, processing challenges, and opportunities that inform whether CMC processing groups are currently accepted at OPFs or sent to disposal. For each material type, the evaluation considers processing technology, contamination risk, compostability performance, and end-use marketability. Given the differences in how compost systems and in-vessel systems operate, the evaluation considers each separately. For example, performance of how items disintegrate and biodegrade in a compost facility will differ because composting facilities undergo aerobic decomposition while in-vessel digestion facilities undergo anaerobic decomposition.

- **Compostability Performance – Compost Systems:** Composting systems, such as windrow and aerated static pile (ASP), rely on aerobic processes and specific environmental conditions to effectively break down organic materials. The performance of products designed for compostability in these systems depends on several factors, including the material's breakdown rate, compatibility with the temperature and moisture conditions typical of the process, and ability to biodegrade completely without leaving behind harmful substances or visible residues. The physical and chemical design of a product, such as thickness, the presence of additives, and the use of coatings, plays a critical role in determining whether it will fully compost in the standard processing time frames used by these facilities. Based on discussions during roundtables with processing facilities and haulers, operational experience indicates that actual breakdown can vary due to diverse incoming material streams, screening practices, and facility-specific conditions.
- **Compostability Performance – In-Vessel Digestion Systems:** In-vessel digestion systems, particularly those that use anaerobic digestion (AD), differ from composting by operating in oxygen-free environments, often at lower temperatures and over shorter durations. For products designed for compostability to perform well in in-vessel digestion systems, they must be capable of breaking down under these conditions without disrupting the microbial activity essential to the digestion process. Many products designed for traditional aerobic systems do not fully biodegrade in anaerobic environments, which can result in fragments remaining in the digestate (the residual output) or grit settling to the bottom of vessels (which leads to downtime for cleaning). This may necessitate additional post-processing to remove contaminants. To be suitable for in-vessel digestion systems, materials must biodegrade within the system's

operational timeline, support microbial health, and leave behind clean, usable outputs.

- **Marketability of End Products – Composting Facilities:** The marketability of finished compost is directly linked to the quality and purity of the incoming organics stream. Physical contaminants such as plastic film and glass shards can compromise the integrity of the finished product, rendering it unsuitable for many end markets. Additionally, materials that do not biodegrade during the composting process can limit the application of compost in sensitive markets, such as agriculture or landscaping. Stakeholders noted that even small amounts of plastics can negatively impact aesthetics, consistency, and market acceptance.

  Compost products must meet applicable regulatory standards (e.g., pathogen reduction, metal content, plastic fragment limits) and customer expectations regarding consistency, odor, texture, and visual cleanliness. Facilities are more likely to accept material streams that support the production of a high-quality, mature compost product with strong market demand. Maintaining reliable markets for finished compost is an important factor in the financial viability and long-term success of composting operations.

  Further information about the marketability of compost and related end products can be found in the Current State of End Markets Report.

- **Marketability of End Products – In-Vessel Digestion Facilities:** In-vessel digestion facilities primarily produce digestate and biogas as end products. The marketability of digestate depends heavily on its level of contamination and the post-processing systems used to treat the material. Digestate contaminated with plastics, metals, or other residuals often requires additional screening, stabilization, or cleaning to become suitable for beneficial use. Digestate that meets regulatory standards (e.g., pathogen reduction, stability, and contamination thresholds) can be marketed as a soil amendment or compost feedstock. However, market demand for raw or partially treated digestate remains limited, especially when quality assurance is inconsistent. Facilities that implement robust contaminant removal and digestate management systems are better positioned to maintain access to agricultural and commercial end markets.

- **Contamination Risk:** Some materials labeled as compostable may not have third-party compostability certifications or may be indistinguishable from non-compostable counterparts, posing contamination risks. This can result in facilities rejecting loads, screening out a large portion of material, increasing inspection requirements, or creating finished compost that does not meet quality standards. Participants in the roundtables with processing facilities and haulers noted that distinguishing compostable plastics from conventional plastics at scale is often infeasible, which reinforces the need for stringent sorting and screening practices to maintain end-product quality.

The processing feasibility, referring to how well CMC processing groups fit with existing processing systems, are described as follows:

- **High:** Materials that consistently disintegrate and biodegrade under typical composting or in-vessel digestion conditions, pose minimal contamination risk, and do not detract from the production of high-quality end products. These materials are accepted at a wide range of facilities using standard organics processing technologies.
- **Variable:** Materials that may disintegrate and biodegrade only under specific conditions (e.g., high heat or longer processing time), are inconsistently labeled, or lead to operational challenges. Facilities may accept these materials on a case-by-case basis, often requiring verification of third-party certification or from a route/venue that has a low tolerance threshold for contaminants or known clean inbound materials.
- **Limited:** Materials that present significant barriers to processing due to slow disintegration and biodegradation, raised contamination concerns, or lack of applicable third-party certifications. These materials are typically not accepted and are diverted to landfill or other disposal methods.

Table 3-26 compares the processing feasibility and marketability of CMC processing groups as described by respondents and based on contractor experience. Other noncovered material, including green material, mixed green material and food material, food material, vegetative food material, and manures typically have higher processing feasibility compared to CMC processing groups. For this evaluation, marketability of materials is the value of commodities from which OPFs can profit by processing and delivering them to end markets.

Table 3-26: Processing Feasibility and Marketability of CMC Processing Groups at Surveyed OPFs (2025)

CMC Processing Groups	Processing Feasibility	Marketability
OCC	Limited	Limited
Kraft Paper	Variable	High
Mixed Papers	Variable	Limited
Molded Pulp	Variable	Limited
Plastics and Polymers Designed for Compostability - Flexibles and Films	Variable	Limited
Plastics and Polymers Designed for Compostability - Rigid Items	Limited	Limited
Wood - Untreated	Variable	Limited

Accepted material types varied by surveyed facility. Paper and fiber, and wood and other organic materials are often accepted at OPFs. Metals, glass, and ceramics are not accepted for organics processing. Most facilities accept materials from both residential and commercial sources, with fewer facilities accepting agricultural and industrial materials.

3.3.3.1 Plastic Material Class

This section presents a summary of the number of survey respondents that accept plastic CMC processing groups in their organics process and the number of facilities that consider those materials contaminants or screen them out before processing. This analysis is specific to plastics designed for compostability. As shown in Table 3-27, most survey respondents considered these materials contaminants. Multiple surveyed facilities stated that they accepted the CMC processing group materials listed, and the contractor specifically sought those out to gain their insights for this report. Therefore, the proportion of survey respondents that accept these materials is not necessarily representative of the proportion of facilities that accept these material types statewide. Additionally, facilities that reported that they screen out the CMC processing group after processing were not included in this evaluation because postprocessing is considered an end market consideration (see Section 3.2.1).

As shown in Table 3-27, some facilities, including both in-vessel digestion and composting facilities, indicated that they accept and incorporate some CMC processing groups into their finished product. From the survey results, it was found that flexible and film plastics and polymers designed for compostability were accepted by four of the surveyed facilities, paper and fiber or paperboard with a plastic coating or lining were accepted by two, and rigid plastics designed for compostability by one. The remaining respondents indicated that they screened out the material. Discussions during roundtables with processing facilities confirmed that a majority of organics processing facilities, especially wet anaerobic digestion systems, screen out all plastics, even if they are designed for compostability due to issues of lookalike products and the impacts plastics can have on machinery and the finished product.

Table 3-27: Summary of Acceptance of Plastic CMC Processing Groups at OPFs by Category (Number of Facilities Surveyed, 2025)

CMC Processing Group	Material Accepted and Incorporated into Finished Product	Contaminant or Screened Out During Pre-Processing[1]	Number of Survey Respondents
Plastics and Polymers Designed for Compostability - Flexibles and Films	4	12	20
Plastics and Polymers Designed for Compostability - Rigid Items	1	14	19

CMC Processing Group	Material Accepted and Incorporated into Finished Product	Contaminant or Screened Out During Pre-Processing[1]	Number of Survey Respondents
Paper and Fiber or Paperboard with a Plastic Coating or Lining	2	11	19

[1] Facilities that reported that they screen out the CMC processing group after processing were not included in this evaluation because post-processing is considered an end market consideration (see Section 3.2.1).

3.3.3.2 Paper and Fiber

Table 3-28 summarizes the number of survey respondents that accept paper and fiber CMC processing groups and the number of facilities that consider those materials contaminants or screen them out before processing. In general, most surveyed facilities accept some paper and fiber materials in their organics processing. Both composting and in-vessel digestion facilities reported accepting paper and fiber materials that may be covered material. Compared to materials in the plastic CMC processing groups, more facilities accept paper and fiber materials. Of the paper and fiber materials that may be covered, kraft paper, and molded pulp were accepted most often; at least half of the respondents accepted those materials and incorporated them into finished products. Paperboard and waxed cardboard were accepted by the fewest number of facilities. Participants in the roundtables with processing facilities and haulers noted while these material types may be accepted, their acceptance is generally confined to paper and fiber items without plastic components.

Table 3-28: Summary of Acceptance of Paper, Fiber, and Wood CMC Processing Groups at OPFs by Category (Number of Facilities Surveyed, 2025)

CMC Processing Group	Material Accepted and Incorporated into Finished Product	Contaminant or Screened Out During Pre-Processing[1]	Number of Survey Respondents
Cardboard/OCC	8	6	18
Waxed Cardboard	2	10	19
Kraft Paper	10	5	18
Mixed Paper	6	7	17
Molded Pulp	9	7	18
Paperboard	4	7	19
Small Format – Paper	5	7	16
Untreated Wood	12	3	16

[1] Facilities that reported that they screen out the CMC processing group after processing were not included in this evaluation because as post-processing is considered an end market consideration (see Section 3.2.1).

3.3.3.3 Wood

While untreated wood is accepted and incorporated into a finished product, it is generally not incorporated into composting and in-vessel digestion processing. Instead, it is typically chipped or ground into end products like mulch or animal bedding. See Table 3-29 summarizes the number of survey respondents that accept the wood CMC processing group s and the number of facilities that consider those materials contaminants or screen them out before processing.

Table 3-29: Summary of Acceptance of Paper, Fiber, and Wood CMC Processing Groups at OPFs by Category (Number of Facilities Surveyed, 2025)

CMC Processing Group	Material Accepted and Incorporated into Finished Product	Contaminant or Screened Out During Pre-Processing[1]	Number of Survey Respondents
Untreated Wood	12	3	16

[1] Facilities that reported that they screen out the CMC processing group after processing were not included in this evaluation because as post-processing is considered an end market consideration (see Section 3.2.1).

3.3.4 Contamination

Contamination poses a significant operational challenge for OPFs. It consists of materials that have been incorrectly disposed of or are undesirable in organic material collection streams. Such contamination poses major difficulties for processing facilities because contaminants that cannot be converted into end products, such as compost and digestate, must be manually removed or screened out. Notably, a material considered acceptable at one facility might be deemed a contaminant at another, depending on factors such as processing technology, permitting restrictions, and end market and certifications (e.g., organic compost certifications). When levels of nonorganic or otherwise unsuitable materials are high, the operational, economic, and safety impacts can be significant.

3.3.4.1 Impacts of Contamination

The following list outlines the primary consequences associated with elevated contamination levels, as reported by 16 survey respondents. Survey respondents were allowed to select more than one response.

- **Contaminated Commodities, with Negative Impacts on Product Quality and Revenue (12 respondents):** Contamination compromises the quality of finished compost or other end products and may impact customer interest in facilities’ end products. Additional information about marketability of end market products is included in the current state of end markets report.

- **Increased Residue Disposal Costs (10 respondents):** Materials that cannot be processed or turned into commodities must be disposed of in landfills or other waste management systems. As contamination increases, so does the volume of residue, leading to higher disposal costs. Facilities are typically charged tipping fees based on weight or volume.
- **Increased Operational and Processing Costs (seven respondents):** Contaminated loads often require additional labor and equipment to separate or remove nonorganic materials before processing can proceed. Facilities may need to deploy more staff to conduct manual sorting or invest in specialized equipment such as screening or shredding systems to handle contaminated materials. These interventions increase overall operational costs and can reduce processing efficiency.
- **Operational Downtime (five respondents):** Contamination can cause significant interruptions to facility operations. Equipment may be damaged by hard or unmanageable materials (i.e., plastic, metal, glass), requiring unscheduled maintenance or repairs. In other cases, contaminated materials may need to be manually removed, resulting in temporary shutdown of equipment or diversion of staff resources. Such downtime affects throughput and can disrupt scheduled processing cycles.
- **Health and Safety Risks (one respondent):** Certain contaminants can pose serious safety risks to facility personnel. Sharp objects, hazardous chemicals, biomedical waste, or other inappropriate materials can cause injuries or exposure to harmful substances. These risks not only jeopardize worker safety but can also lead to compliance issues with occupational health and safety regulations.

3.3.4.2 Strategies to Manage Contamination

Interested parties indicated that there are numerous ways to mitigate contamination in both compost and in-vessel digestion, including education and outreach, clearer labeling, and consistent standards.

OPFs use many strategies to monitor contamination and reduce the quantity and impact of contamination at their sites, including the following:

- **Visual Inspections:** Operations staff view inbound materials to identify obvious contaminants.
- **Manual Sorting:** Operators remove contaminants from inbound materials.
- **Screening Equipment:** Equipment separates contaminants from organic material.
- **Regular Sampling and Testing:** Staff pull compost batches and send them to a lab to test for chemical or physical contaminants.
- **Documentation and Tracking of Contamination Levels:** Audits can aid in identifying trends and improve processes.

- **Rejecting Loads:** Operators turn away loads that exceed contamination thresholds to maintain organics material stream quality.

3.3.4.3 Contamination and CMC Processing Groups

Some OPFs currently consider packaging designed for compostability to be a contaminant, regardless of material class and type. Facilities reported the following reasons that these materials are considered contaminants:

- Materials may not break down sufficiently during the active composting process or within the operational time frames required by facilities.
- Materials with a plastic component are synthetics that are not allowed as an agricultural organic input under the United States Department of Agriculture (USDA) National Organics Program (NOP), which prevents the resulting compost from being marketed as suitable for organic use or Organic Materials Review Institute (OMRI) Listed.
- Physical contaminants can compromise end product quality and raise concerns about microcontaminants, such as microplastics and chemical residues.
- Potential Per- and polyfluoroalkyl substances (PFAS) contamination is a growing concern for facilities due to health and regulatory risks.

As discussed in section 3.3.3, surveyed facilities generally considered plastics and polymers designed for compostability to be contaminants and considered some paper and fiber CMC processing groups to be contaminants (particularly fiber or paperboard with a plastic coating or lining).

3.3.4.4 Contamination Rates and Contamination Composition

Surveyed facilities were asked to estimate the contamination rates of inbound residential, commercial, agricultural, and industrial materials (if accepted by each facility).

Most facilities do not accept agricultural or industrial inbound materials. However, facilities reported the lowest contamination rates from these generators. All facilities that reported contamination data for agricultural and industrial materials estimated that incoming contamination is less than 2%.

Contamination from commercial and residential generators was more varied. Several facilities reported that they have less than 10% contamination from these generator types, but two facilities reported that their residential contamination rates ranged from 21% to 30%, while another facility reported a residential contamination rate of 31% to 40%.

3.3.5 Technology and Costs

Organics processing facilities across California use an array of technologies and equipment to manage incoming organic materials. These facilities vary in scale, layout, and processing approach. The following includes a brief overview of the technology types that respondents reported using:

- **In-Vessel Digestion – Low Solids:** Low solids (i.e. wet) AD systems generally accept food waste, fats, oils, and grease only. They cannot accept yard waste or contamination. The material is depackaged, diluted into a slurry to remove floatable materials (such as plastics and paper), and degritted to remove glass, grit, rocks, or metal fragments. The slurry is diluted further or metered (fed) into a low solids digestion vessel, for a retention time of about one month. Biogas and digestate are generated and collected from the low solids digestion vessel.
- **In-Vessel Digestion – High Solids:** High solids (i.e., dry) AD systems primarily accept food waste. Minimal yard waste can be included if it goes through a grinder for pre-processing. The organic material is blended into a mash. Some contamination is acceptable for these systems if it does not impede the ability to pump the material. The material is diluted to a pumpable, paste-type consistency and pumped into a vessel for at least one week and sometimes up to several weeks, where biogas is generated and collected.
- **Windrow Composting:** Windrow composting systems can accept both yard waste and food waste. The inbound organic material is typically ground or shredded to reduce size and increase surface area. Contamination may be screened out during pre-processing or post-processing. Material is placed in windrows for the active compost phase, where it is periodically turned to introduce oxygen into the windrow. The active compost phase is typically 21 to 50 days, and the material is cured for approximately 30 to 90 days to produce finished compost.
- **Aerated Static Pile (ASP) Composting:** ASP composting systems can accept both yard waste and food waste. ASP systems use forced air to introduce oxygen rather than turning manually, as in a windrow. Air is forced into the pile via either positive or negative pressure. Contamination may be screened out during pre-processing or post-processing. ASP systems can speed up the composting process and reduce the footprint needed for a compost site. The active compost phase is typically 15 to 40 days, and the material is cured for approximately 30 to 90 days to produce finished compost.

To assess the current state of technology, the contractor reviewed facility survey responses and conducted interviews and site visits. This assessment captured the types of equipment currently in use, the role of each system component in managing organics, and how facility design influences processing efficiency, contamination control, and the ability to scale for additional feedstocks.

Facilities reported using a range of equipment to handle organics processing and technology types, from receiving and pre-processing to composting and post-processing. The equipment observed and reported includes the following:

- **Screens:** Separates contaminants, oversized materials, or residuals from compost or feedstock streams. Most commonly used post-processing to improve finished product quality.
- **Grinders and Shredders:** Reduces particle size and homogenizes incoming materials for composting or in-vessel digestion. Critical for processing green waste, wood, and other bulky organic inputs. Grinders and shredders may also be used to process untreated wood into mulch, animal bedding, and similar related products.
- **Scales:** Installed at most facilities to track incoming and outgoing tonnage for operational planning and regulatory reporting.
- **Front-End Loaders and Skid Steers:** Commonly used for daily material handling, including loading, pile management, and equipment feeding across the site.
- **Windrow Turners:** Employed in open-air composting operations to aerate and mix compost piles, ensuring proper oxygen levels.
- **Roll-Off Trucks:** Transports inbound materials and outbound products, particularly in transfer-based systems or at facilities co-located with collection operations.
- **Depackagers:** Specialized machinery designed to separate organic content from packaging materials.
- **Screw Presses:** Removes excess moisture from digestate or certain organic materials, supporting improved material handling and volume reduction.
- **Ammonia Extraction Systems:** Installed in some facilities to manage air emissions and reduce odor, especially in high-nitrogen feedstock or enclosed composting systems.
- **Water Trucks**: Deployed to maintain optimal moisture content in compost piles, control dust, and support fire prevention onsite.
- **Air Separators and Cyclone Trommels**: Applied in pre- or post-processing to remove light film plastics, floatable material, and other contaminants from the organic stream.
- **Sorting Lines:** Manual or semi-automated lines that remove visible contaminants from organic materials prior to processing.
- **Mobile Windrow Cover Systems:** Deployed at some facilities to support compost pile moisture control and minimize stormwater impacts or odor emissions.
- **MSW Trommels:** Installed at facilities receiving mixed waste loads; assists in recovering organics from MSW prior to composting or digestion.

- **Compostable Fiber Optical Sorters:** Advanced systems that identify and remove non-compostable items from fiber-based products designed for compostability using optical detection and air jets.
- **Magnetic and Eddy Current Separators:** Occasionally used at facilities that handle MSW or contaminated organic streams to remove ferrous and nonferrous metals prior to processing.

3.3.6 Technology Suitability and Considerations

The equipment employed at OPFs reflects a range of operational strategies and infrastructure capabilities. Key considerations impacting equipment selection include the following:

- **Facility Size and Type:** Larger, integrated operations are more likely to use advanced systems such as depackagers, screw presses, and ammonia capture systems, while smaller, open-air composting sites rely on equipment such as windrow turners and loaders.
- **Feedstock Characteristics:** Facilities accepting postconsumer food waste or packaged organics require pre-processing systems to manage contamination and packaging materials.
- **End Product Specifications:** Compost facilities aiming to produce high-quality, marketable products invest in screening and separation equipment to meet standards for contamination and particle size.
- **Site Constraints:** Many facilities face physical constraints such as limited space or site design limitations, which may restrict the ability to add new equipment or expand existing operations.
- **Regulatory Compliance:** Air quality, odor management, and stormwater permitting requirements drive the need for emission control systems, enclosed processing areas, or covered composting systems.

3.3.7 Costs

Cost data reported by facilities was limited, particularly among privately owned operators. However, based on available responses and industry knowledge, the following observations can be made:

- **Capital Costs:** Significant equipment investments include depackaging units, compostable fiber optical sorters, ammonia capture systems, and densiometric separators. These technologies often require substantial installation and supporting infrastructure (e.g., conveyors, bunkers, electrical upgrades).
- **Operating Costs:** Vary widely by facility and are influenced by factors such as equipment age, labor needs, energy use, and material throughput. Labor remains a substantial cost driver, especially for more manual operations.

- **Maintenance and Replacement:** Several facilities reported aging grinders, turners, and sorting equipment that contribute to operational inefficiencies and downtime. Replacing these systems is a high priority but often delayed due to capital constraints.
- **Contamination Management:** Facilities accepting highly contaminated streams (e.g., postconsumer organics) reported increased costs related to pre-processing, residue handling, and disposal.

Appendix E-4 includes cost data received from facilities.

3.4 Secondary Processing Facilities

Secondary processing facilities are operations that accept commingled or residual materials from recycling processing facilities and reprocess to further separate into individual commodity types to meet more restrictive contamination thresholds or material specifications as required by end markets. This serves to increase the yield of recovered materials from the materials that are currently recovered for recycling. These facilities can play a key role in refining and preparing materials that may not meet the quality standards necessary for direct shipment from recycling processing facilities.

Through engagement with recycling processing facilities and OPFs, the contractor identified no active secondary processing facilities accepting covered materials, except for glass. The only secondary processing facility in California for plastics ceased operations in 2020. Prior to closing, that operation accepted mixed materials from equipment process loss, mixed plastics #3 through #7, mixed bulky rigid plastics, and flexibles and films from recycling processing facilities. The material was further mechanically sorted at a slower rate (13 to 16 TPH) than the recycling processing facilities where they originated. Secondary processing for plastics requires significant contract and feedstock security to justify the investment because only approximately half of the inbound material is marketable according to interested party engagement. Of that, 30 to 50% of marketable materials were sent to pyrolysis.

In 2025, CalRecycle approved $10 million in funding for secondary processing facilities for plastics #2 through #7, among other grant funding for retrofits and facility collection containers. A $10 million grant was awarded to GreenWaste Recovery, a San Jose-area recycling processing facility and compost facility operator. In the grant description, GreenWaste proposes to create a “secondary plastic plant system dedicated to sorting and processing mixed plastic bales (types 2-7),” sourced from GreenWaste’s own single stream facilities and other facilities. The project comes after GreenWaste bale audits showed additional high-quality deposit containers were available for recovery (Staub 2025). This additional sorting capacity may be useful for materials that may be covered as well.

Many surveyed facilities do not have sufficient capacity for bale storage and benefit from larger facilities, which serve as large warehouses for storing bales before shipping to end markets. For example, Ming’s functions as a broker and manages CRV materials but serves to highlight the importance of needing to move bales out of sites to process more material through those facilities.

3.5 Public Health, Environmental, and Community Impacts

To evaluate environmental and public health impacts processing in California, the contractor compiled information from facility surveys and interviews, desktop research, engagement with regional and national trade associations (e.g., National Waste & Recycling Association 2025), results from the Community Recycling and Composting survey (Appendix F), and introductory meetings and listening sessions with CBOs, EJ groups, and Tribes. The 332 responses to the Community Recycling and Composting Survey, four introductory meetings, and 10 listening sessions identified concerns and suggestions regarding overall impacts to communities and facility development or expansion – including community feedback on the cumulative impacts of siting new facilities near existing ones. Tribal members who participated had a vested interest in the topic and were responsible for implementing programs such as Solid Waste Technicians and Environmental Coordinators. They responded to the survey because they are trusted, experienced members of these communities and actively working on these issues.

Overall feedback and research results highlighted several challenges in equitable solid waste management:

- A systemic lack of representation in decision-making. As further discussed, local community members and Tribal populations with knowledge of environmental impacts and considerations that could be shared with decision-makers are often not included or face barriers to being heard. Conversely, people with a higher socioeconomic status have the access to advocate for policies and decisions that will positively impact them (EPA 2023, 2023a).
- Solid waste management rules and policies can be enacted nationally but can be challenging to carry out on a local level if local authorities have limited capacity.
- In some places, marginalized communities, such as women, people with disabilities, immigrants, and formerly incarcerated people, are not considered regarding the implementation and impacts of solid waste management policies (EPA 2023, 2023a).

3.5.1 Community Impacts

3.5.1.1 Living Near a Recycling or Composting Facility

The Community Recycling and Composting Survey asked respondents whether they currently live near a recycling or composting facility. While most reported they did not or were unsure, 20% of respondents from CBOs and EJ groups reported that they live near this type of facility (Table 3-30). Note that “near” was not defined in the question.

No respondents from Tribes reported living near a recycling or composting facility, and two were unsure.

Table 3-30: Percentage of CBOs, EJ Groups, and Tribal Respondents Living Near Recycling or Composting Facilities

Organization	Yes (% and # responses)	No (% and # responses)	Unsure (% and # responses)
CBOs and EJ Groups	20% (64)	68% (219)	13% (41)
Tribes	0% (0)	75% (6)	25% (2)

Participants living near a processing facility were asked whether the facility had a positive, negative, or no impact on them. The survey question did not define what a positive or negative impact is, leaving survey takers to their own interpretation. Of the 64 respondents from CBOs and EJ groups that reported that they lived near a processing facility, 14% said there was a negative impact on them, 27% said they saw a positive impact, 34% did not see an impact, and 25% were unsure if they were impacted living near a facility (see Table 3-31).

Table 3-31: Reported Impact of Living Near Processing Facility According to CBO and EJ Group Respondents (by percentage and number of responses)

Positive Impact	Negative Impact	No/Neutral Impact	Unsure
27% (17)	14% (9)	34% (22)	25% (16)

3.5.1.2 Financial Impacts

The survey asked CBOs, EJ groups, and Tribes if they were financially impacted by waste management challenges. Roughly half of all respondents indicated they were financially impacted or somewhat impacted (see Table 3-32). The survey did not define or use examples as to what “financially impacted” means; this was left to each survey respondent to interpret individually. CBO and EJ group participants were spread across many income levels, with 39% of respondents below the $50,000 income level, 36% of respondents between the $50,000 and $100,000 income level, and 26% above the $100,000 income level.

Table 3-32: Number of Respondents Financially Impacted by Waste Management Challenges

Organization	Yes (% and # responses)	Somewhat (% and # responses)	No (% and # responses)	Unsure (% and # responses)
CBOs and EJ groups	22% (71)	23% (76)	33% (106)	22% (71)
Tribes	25% (2)	25% (2)	50% (4)	0% (0)

Feedback from the listening sessions included comments from CBOs and EJ groups regarding the financial impacts from the current state of recycling:

- The current system inequitably places the greatest burdens of plastic pollution onto disadvantaged communities. Participants shared that their greatest concern with implementation of the Act is that these burdens will not be shifted away from communities and toward producers.
- Compensation is a big incentive for residents when it comes to recycling, with potential to increase access and participation.
- Some communities without access to onsite curbside collection services must transport recyclables to the transfer station in town, which accepts recyclables for free but does not compensate individuals for CRV material. Transportation of material also presents challenges to communities, as it relies on individuals having consistent, reliable access to transportation and may require traveling long distances.
- There are several compensation recycling programs in the Monterey Bay area, and individuals use them; however, the hours of operation can be limited.
- Insufficient funding has caused a delay in many services being rolled out.
- Scaling services is difficult without proper funding.

Most of the survey respondents that indicated they were financially impacted by waste management challenges are located in rural areas of California.

Tribal communities also reported having to transport material long distances, which has the aforementioned challenges and is potentially cost prohibitive, resulting in limited access to services and increased potential for illegal dumping. It was also mentioned that most people will not participate unless there is a financial incentive and that implementing solid waste services is expensive and has been mostly supported by grants, which can be inconsistent and are often time-bound.

3.5.1.3 Waste Management Challenges

Table 3-33 and Table 3-34 show the survey results from respondents when asked if they or their community had been impacted by the challenges related to waste management.

Table 3-33: Number of CBO and EJ Group Responses Indicating Respondent is Impacted by Listed Waste Management Challenges

	Yes	Somewhat	No	Unsure
Illegal dumping	144 (44%)	68 (21%)	78 (24%)	34 (10%)
Littering	184 (57%)	91 (28%)	39 (12%)	10 (3%)
Unreliable waste collection schedule	43 (13%)	62 (19%)	190 (59%)	29 (9%)
Loss of waste management service providers	44 (14%)	46 (14%)	173 (53%)	61 (19%)

Table 3-34: Number of Tribal Responses Indicating Respondent is Impacted by Listed Waste Management Challenges

	Yes	Somewhat	No	Unsure
Illegal dumping	3 (38%)	2 (25%)	2 (25%)	1 (13%)
Littering	2 (25%)	6 (75%)	0 (0%)	0 (0%)
Unreliable waste collection schedule	1 (13%)	1 (13%)	5 (63%)	1 (13%)
Loss of waste management service providers	1 (13%)	2 (25%)	4 (50%)	1 (13%)

Illegal dumping is a top concern for CBOs and EJ groups and a contributing source of contamination and environmental pollution. Participants reported that much of the public dumping that occurs is due to the lack of availability of recycling and composting bins and inadequate container sizes for the amount of trash produced by families in large complexes. Tribes reported during listening sessions that some reservations do not have access to recycling services, and illegal dumping does occur.

3.5.1.4 Impacts from Collection

Survey respondents were asked whether they believe collection and processing of materials for recycling and composting had a negative community impact (Table 3-35). The top negative impacts identified by CBOs and EJ groups were noise pollution, which was indicated by 34% of respondents, litter (33%), and reduced space in streets (27%). Of respondents from CBOs and EJ groups, 33% reported no negative neighborhood and community impacts associated with the collection and processing of material.

These numbers do not add up to 100% because survey respondents were able to select multiple impacts.

Table 3-35: Percentage and Number of CBO, EJ Group, and Tribal Respondents Indicating Negative Neighborhood and Community Impacts from Collecting Materials for Recycling and Composting

Environmental Impact	CBOs and EJ Groups	Tribes
Noise pollution	111 (34%)	2 (25%)
Traffic congestion or accidents	70 (22%)	1 (13%)
Reduced space for driving, parking, and biking in the streets on collection day due to containers in the way	89 (27%)	0 (0%)
Reduced space for walking, wheelchairs, and strollers in the sidewalks and streets on collection day due to containers being in the way	73 (23%)	1 (13%)
Pedestrian safety	60 (19%)	2 (25%)
Collection worker safety	79 (24%)	3 (38%)
Litter	108 (33%)	3 (38%)
None	107 (33%)	3 (38%)
Other	6 (2%)	0 (0%)

The top negative impacts of collection materials for recycling and composting for Tribes were collection worker safety and litter, with both identified by 38% of respondents. The same proportion of respondents (38%) indicated there being no negative impact.

3.5.1.5 Neighborhood and Community Benefits

Table 3-36 shows what CBOs, EJ groups, and Tribes indicated are the most positive neighborhood and community benefits of recycling and composting. The top community benefit identified by CBOs and EJ groups is the collection of materials to reduce litter and pollution, which helps create cleaner neighborhoods (86% of CBO and EJ group respondents). Tribal respondents indicated that if a CRV collection facility is present, it can provide supplementary income for local residents (100% of Tribal respondents), and that recycling and composting programs create green jobs that can provide employment in local communities (88% of Tribal respondents).

Table 3-36: Percentage and Number of CBO, EJ Group, and Tribal Respondents Indicating Positive Neighborhood and Community Benefits

Positive Neighborhood and Community Benefits	CBOs and EJ Groups	Tribes
Recycling and composting programs create green jobs that can provide employment in local communities.	216 (67%)	7 (88%)
Collection of materials can reduce the number of materials that end up as litter and pollution, which helps create cleaner neighborhoods.	279 (86%)	6 (75%)
Fosters a culture of environmental responsibility among community members.	220 (68%)	5 (63%)
If a CRV collection facility is present, it can provide supplementary income for local residents.	199 (61%)	8 (100%)
None	7 (2%)	0 (0%)
Other	3 (1%)	0 (0%)

3.5.2 Environmental Impacts

Additional questions in the Community Recycling and Composting Survey asked if respondents were concerned about the listed environmental impacts from recycling and composting facilities on their communities or neighborhoods (Tables 3-37 and 3-38). The top environmental concerns related to facilities are water quality and contamination (70% of CBO and EJ group respondents and 75% of Tribal respondents), neighborhood cleanliness (68% of CBO and EJ group respondents), and soil contamination (63% of Tribal respondents). CBOs, EJ groups, and Tribes mentioned that protecting the environment is important to their communities, but more education is needed to increase awareness of how to prevent negative impacts to the environment, such as education on products that are harmful to the environment.

Table 3-37: Percentage and Number of CBO, EJ Group Respondents Indicating Negative Neighborhood and Community Impacts from Recycling and Composting Facilities

Environmental Impact	Yes	No	Unsure
Water quality and contamination	227 (70%)	65 (20%)	32 (10%)
Neighborhood cleanliness	221 (68%)	86 (27%)	17 (5%)
Air pollution from traffic or industry	210 (65%)	93 (29%)	21 (6%)
Soil contamination	180 (56%)	95 (29%)	49 (15%)

Environmental Impact	Yes	No	Unsure
Lack of plants and animals	153 (47%)	143 (44%)	28 (9%)
Neighborhood safety	182 (56%)	124 (38%)	18 (6%)

Table 3-38: Percentage and Number of Tribal Respondents Indicating Negative Neighborhood and Community Impacts from Recycling and Composting Facilities

Environmental Impact	Yes	No	Unsure
Water quality and contamination	6 (75%)	2 (25%)	0 (0%)
Neighborhood cleanliness	2 (25%)	5 (63%)	1 (13%)
Air pollution from traffic or industry	0 (0%)	7 (88%)	1 (13%)
Soil contamination	5 (63%)	2 (25%)	1 (13%)
Lack of plants and animals	2 (25%)	4 (50%)	2 (25%)
Neighborhood safety	2 (25%)	5 (63%)	1 (13%)

According to the Environmental Protection Agency's (EPA) Best Practices for Solid Waste Management report (2023), land near waste disposal, processing, or treatment facilities is often more affordable. However, surrounding communities may be exposed to environmental and health risks associated with waste treatment and disposal facilities that are not well managed, such as chemical leaks or harmful air pollutants that could lead to illness. Also, nearby residents may be exposed to noise pollution and vehicle emissions from heavy equipment used at facilities. Additionally, if these communities are not provided with sufficient waste management services, they may feel their only options are to burn or dump their waste nearby and could be exposed to dangerous materials in the process. Improperly managed waste can impact soil quality and water quality.

There are a number of technologies that can improve recycling and compost facilities (Oladimeji et al. 2023).

- **AI and robotics:** AI can efficiently detect kinds of waste based on visual characteristics, such as shape and color. This technology, when installed in cameras on waste collection trucks, has the potential to spot illegal waste dumping, a problem that can have a serious impact on our health and environment. In MRFs, robotics may be used to handle repetitive tasks with greater speed and precision than human workers, leading to faster production, fewer errors and less health impacts on workers, improving worker safety and product consistency. This technology is still evolving in the collection and processing industries.

- **Aerated Static Pile (ASP): Technology** This technology is used at facilities to reduce odors and pathogens, minimize stormwater contamination, handle large volumes of material, and reduce emissions of volatile organic compounds and odors, contributing to better air quality (Woods 2022).
- **Advanced odor control solutions:** Odors can result in complaints, regulatory issues, and negative impacts on surrounding communities. Using misting systems with odor-neutralizing solutions, odor and dust suppression systems and other odor control systems will reduce odors, improve worker health and safety, and improve air quality (Ritter 2025).

Out of 324 total CBO and EJ group respondents, the most frequently cited negative environmental impact from recycling and composting facilities is water pollution by chemicals from material processing, selected by 180 respondents (56%). This is followed by 151 respondents who selected litter caused by material falling out of containers and trucks (47%), and both the production of GHGs by collection vehicles and increased energy consumption by processing facilities were selected by 144 respondents 44% (Table 3-39). The most frequent selection by Tribes was GHG emissions (50%).

Table 3-39: Percentage and Number of CBO, EJ Group, and Tribal Respondents Indicating Negative Environmental Impacts Associated with Composting and Recycling Processing Facilities

Environmental Impacts	CBOs and EJ Groups	Tribes
GHG emissions produced by collection vehicles	144 (44%)	4 (50%)
Increased energy consumption by processing facilities	142 (44%)	3 (38%)
Litter caused by materials falling out of containers and trucks	151 (47%)	3 (38%)
Water pollution by chemicals from material processing	180 (56%)	3 (38%)
Other	10 (3%)	0 (0%)
None	61 (19%)	1 (13%)

In addition to engaging with these surrounding communities directly, there are a number of tools available to assess a facility's impact on surrounding communities:

- Environmental Impact Assessment: A process used to identify, predict, and evaluate the environmental effects to help guide decision-making and implement mitigation plans.

- Health Impact Assessment: A structured process used to evaluate the potential public health effects of a project or policy before it is approved.
- Toxics Release Inventory Program: The EPA compiles data on toxic chemical releases and waste management from industrial facilities, which helps track pollution trends.

According to the National Center for Biotechnology Information, conventional transportation systems are among the largest contributors to GHG emissions and air pollution globally (Ma et al. 2025), with road vehicles responsible for most of this impact (Intergovernmental Panel on Climate Change 2022).

Waste management technologies have evolved in recent years, motivated by the desire to minimize the environmental impact of waste and enhance the effectiveness of waste management procedures. There are a number of technologies that assist transportation (transfer trucks/heavy equipment) and improve recycling and compost facilities (Oladimeji et al. 2023).

- **Routing software:** Transportation routing involves using advanced technologies such as GPS, mapping software, and data analytics to identify the best routes and schedules for transportation.
- **Electric transfer and collection trucks:** Electric trucks are becoming more of a reality with large manufacturers; however, while the technology is advancing and offers benefits like lower emissions and noise pollution, the technology is not used extensively yet and is currently being piloted in some communities (Cross et al. 2023).
- **Electric forklifts and bulldozers:** Electric forklifts are excellent in providing zero tailpipe emissions and lower overall maintenance; however, they require a higher initial investment and battery charging. They also are more susceptible to temperature changes than traditional equipment (Livingston 2020).
- **Electric bulldozers:** The environmental impact is less than diesel equipment, produces less noise and vibrations, and are cheaper to operate. However, electricity brings the same challenge to heavy equipment production as it does to vehicles in general. Logistics for charging stations means infrastructure must be reconfigured, which can be expensive (Contractor’s Machinery 2023).

3.5.2.1 Environmental Benefits

Community Recycling and Composting Survey respondents were also asked to identify positive environmental benefits of recycling and composting (Table 3-40). According to the CBOs and EJ groups, collecting and recycling plastic waste to reduce the amount of plastic that ends up in the environment as litter was the top benefit (77%). This was followed closely by composting producing nutrient-rich compost, which enhances soil quality, improving water retention, and reducing the need for chemical fertilizers (75%); and recycling materials consuming less energy and resources than producing new materials, leading to lower carbon footprint and protection of natural resources (72%). The three most frequently selected positive environmental impacts from Tribes were composting producing nutrient-rich compost (100%), followed by recycling materials consuming less energy and resources than producing new materials (88%), and recycling programs helping raise awareness about environmental conservation (88%).

Table 3-40: Percentage and Number of CBO, EJ Group, and Tribal Respondents Indicating Environmental Benefits of Recycling and Composting

Environmental Benefits	CBOs and EJ Groups	Tribes
Reduced GHG emissions by diverting recyclable and compostable materials from landfills (helps address climate change).	218 (67%)	6 (75%)
Composting produces nutrient-rich compost, which enhances soil quality, improves water retention, and reduces the need for chemical fertilizers.	242 (75%)	8 (100%)
Recycling materials consumes less energy and resources than producing new materials, leading to lower carbon footprint and protection of natural resources.	232 (72%)	7 (88%)
Collecting and recycling plastic waste helps reduce the amount of plastic that ends up in the environment as litter.	250 (77%)	2 (25%)
Recycling programs help raise awareness about environmental conservation, fostering a culture of environmental responsibility in communities.	218 (67%)	7 (88%)
None	4 (1%)	0 (0%)
Other	4 (1%)	0 (0%)

3.5.3 Public Health Impacts

The contractor analyzed the public health impacts of processing through a combination of qualitative results from engagement with interested parties and data-driven mapping. The maps, as seen in Figure 3-2 through Figure 3-5, were created by using GIS mapping on a representative sample of facilities to help understand and illustrate communities experiencing impacts.

Figure 3-2 and Figure 3-3 utilize SB 535 List of Disadvantaged Communities Geodatabase (2024) to identify these communities in relation to recycling processing facilities and OPF locations respectively. There was a limited intersection between disadvantaged communities and recycling processing facility locations. Proportionally to recycling processing facilities, OPFs were less likely to be located in DAC areas.

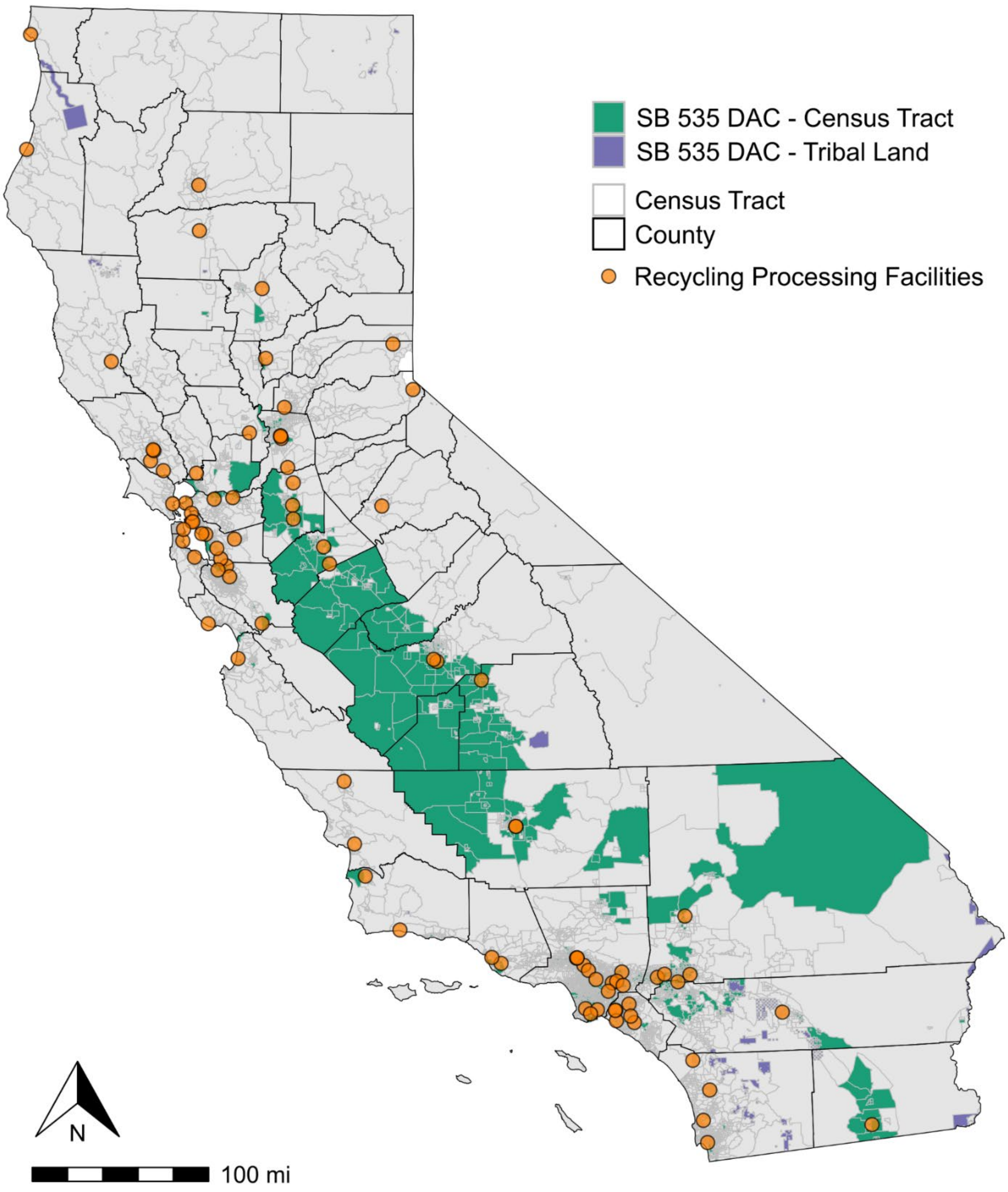

Figure 3-2: Recycling Processing Facility Locations in Relation to SB 535 Disadvantaged Communities

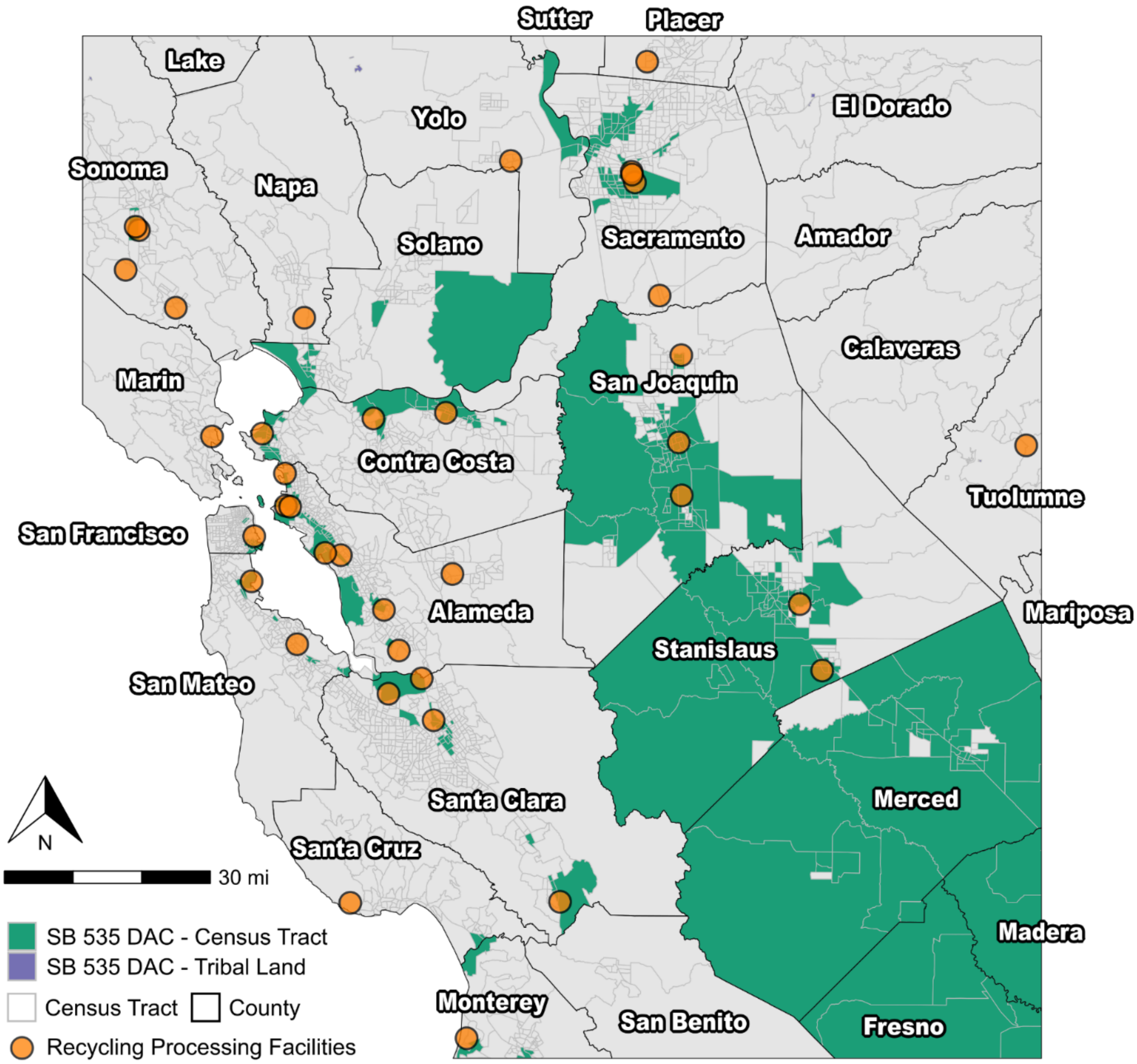

Figure 3-2A: Northern California Recycling Processing Facility Locations in Relation to SB 535 Disadvantaged Communities

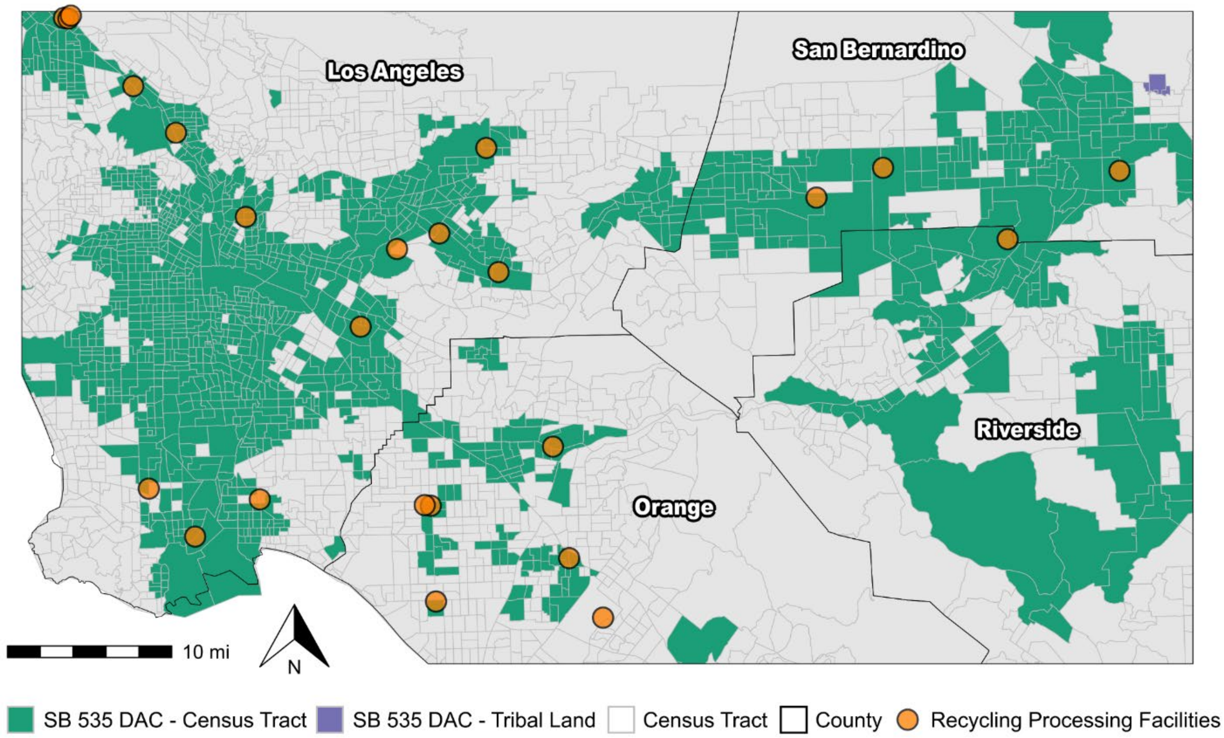

Figure 3-2B: Southern California Recycling Processing Facility Locations in Relation to SB 535 Disadvantaged Communities

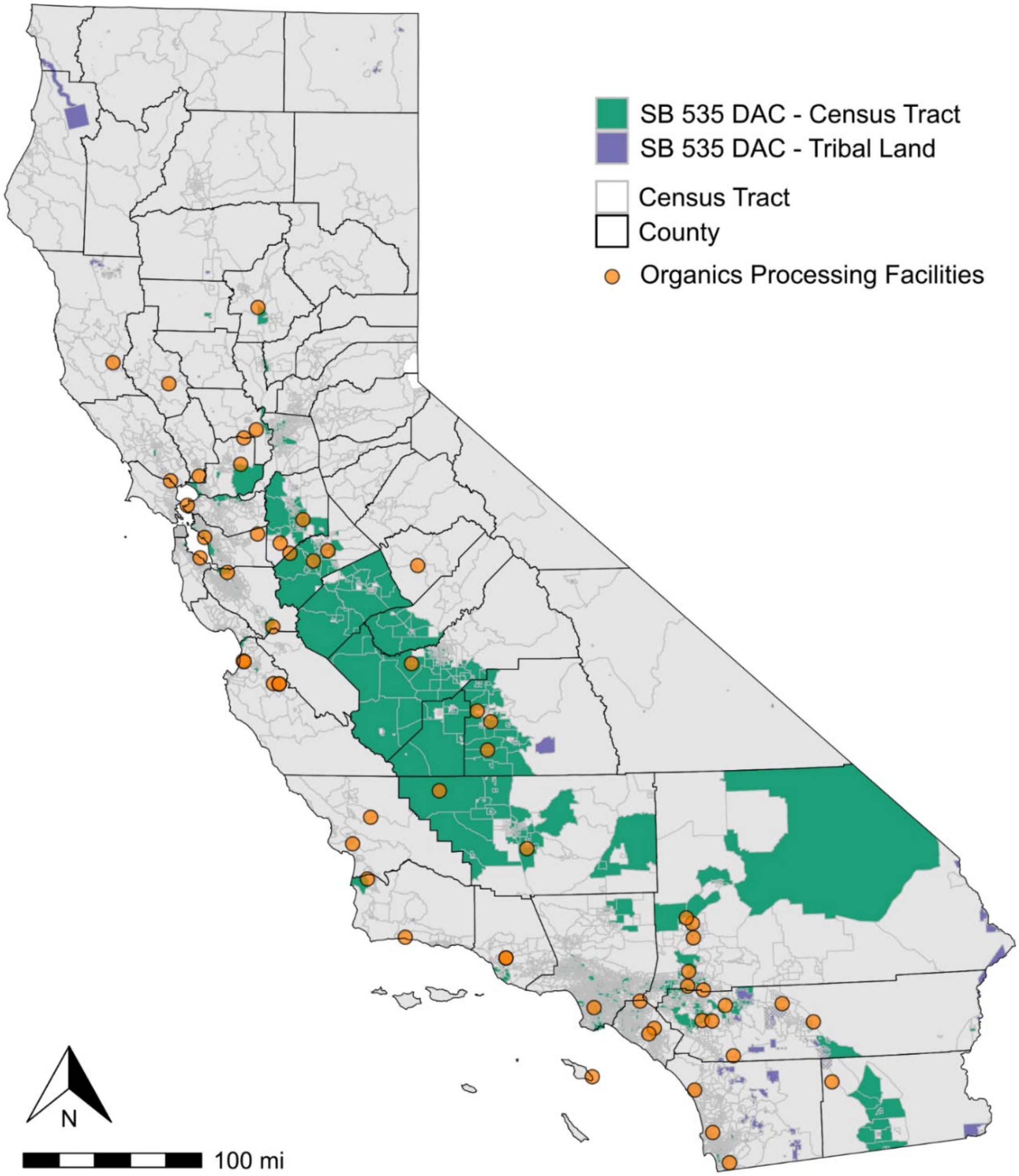

Figure 3-3: OPF Locations in Relation to SB 535 Disadvantaged Communities

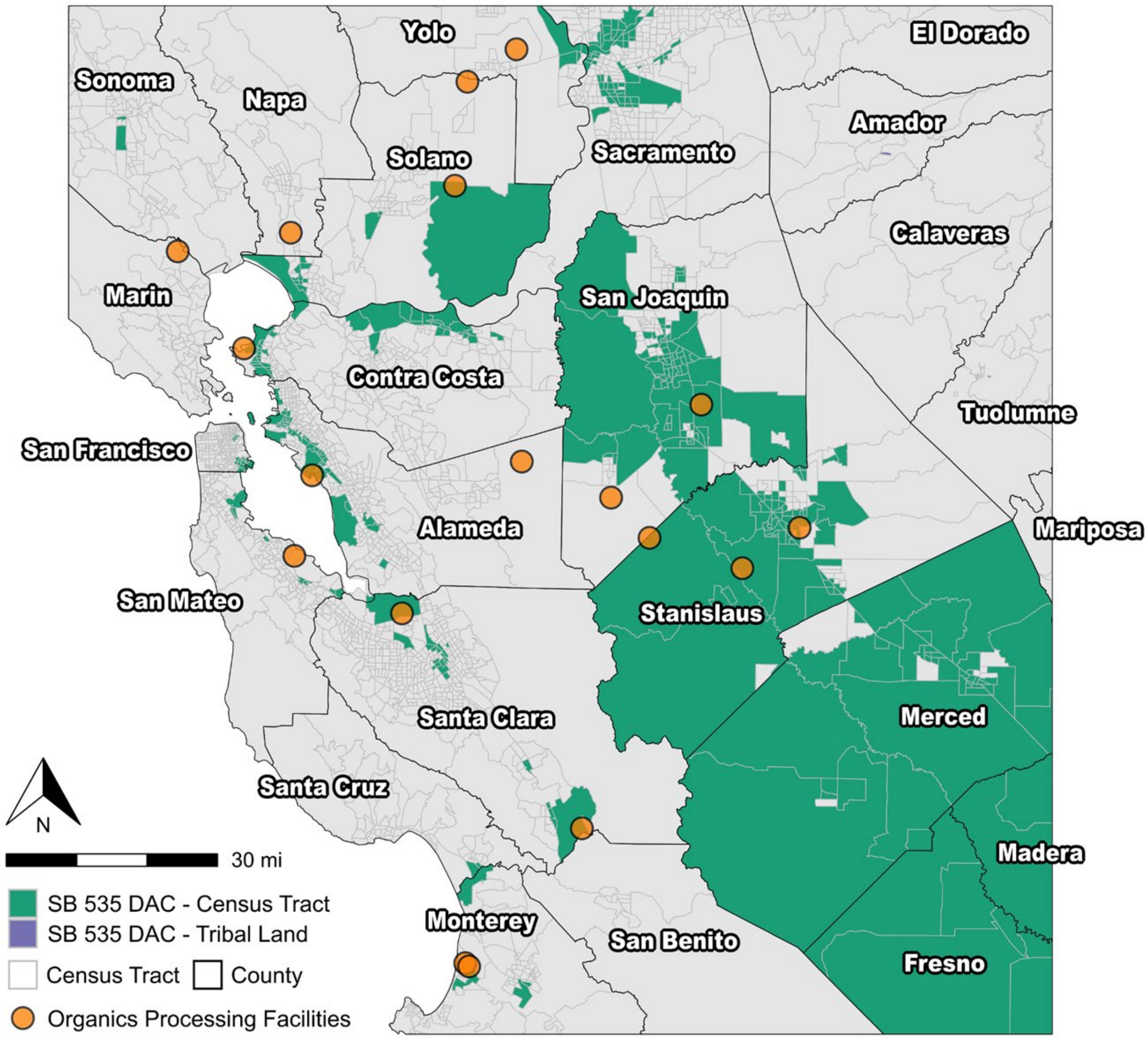

Figure 3-3A: Northern California OPF Locations in Relation to SB 535 Disadvantaged Communities

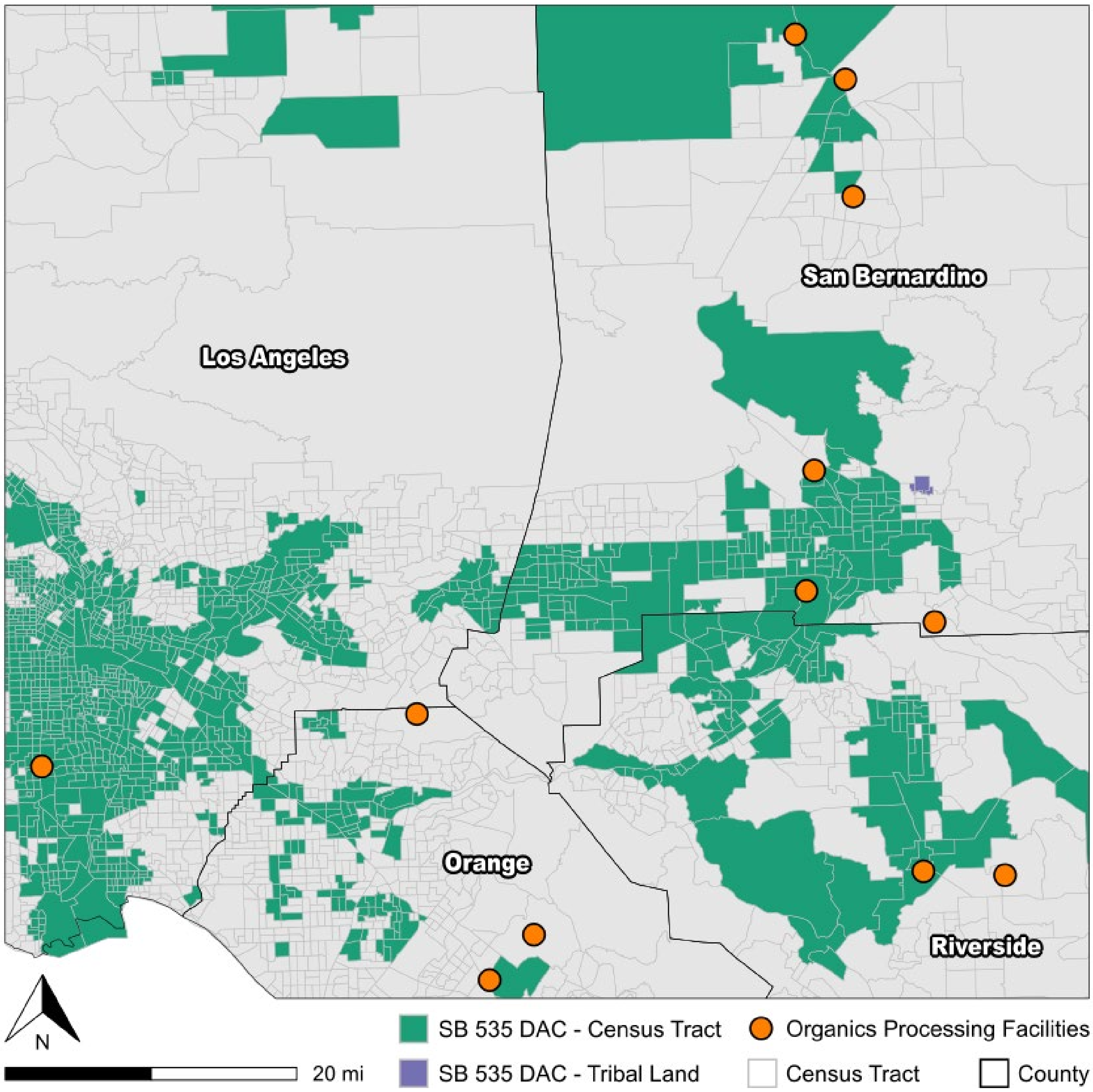

Figure 3-3B: Southern California OPF Locations in Relation to SB 535 Disadvantaged Communities

Figure 3-4 and Figure 3-5 overlay recycling processing facilities and OPFs with urban and rural areas. The vast majority of MRFs are located within urban areas, with those located in rural areas primarily located directly adjacent to urban areas. Comparatively, OPFs are more likely to be located in rural areas. However, again it is noted that the majority of OPFs in rural areas are within a reasonable proximity to urban areas. As noted in section 3.2, feedstock volumes are essential to facilities' financial viability and security. With the majority of feedstock volume generation occurring in urban areas, locating facilities in proximity to sources of material reduces transportation costs.

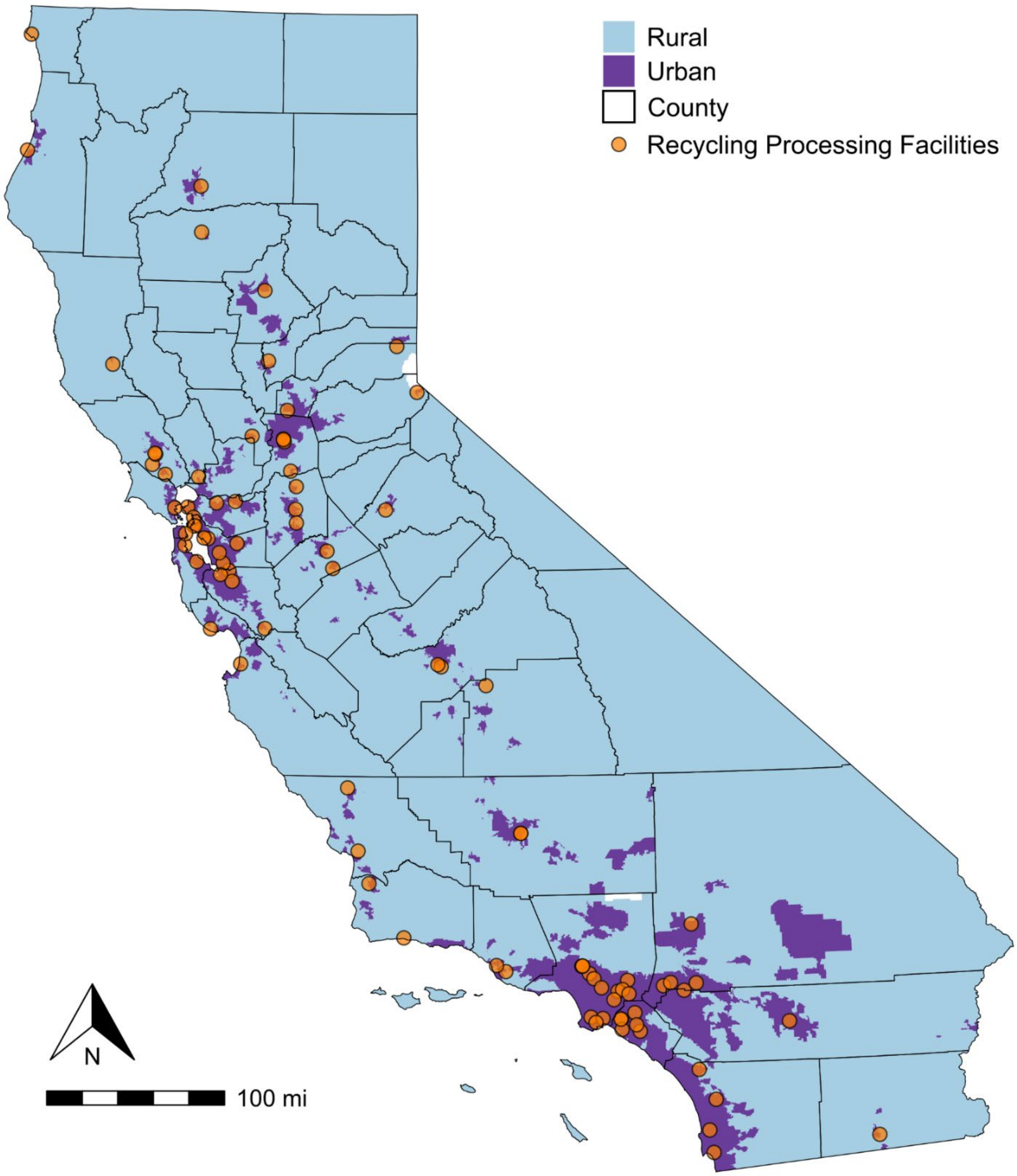

Figure 3-4: Recycling Processing Facility Locations in Relation to Urban versus Rural Communities

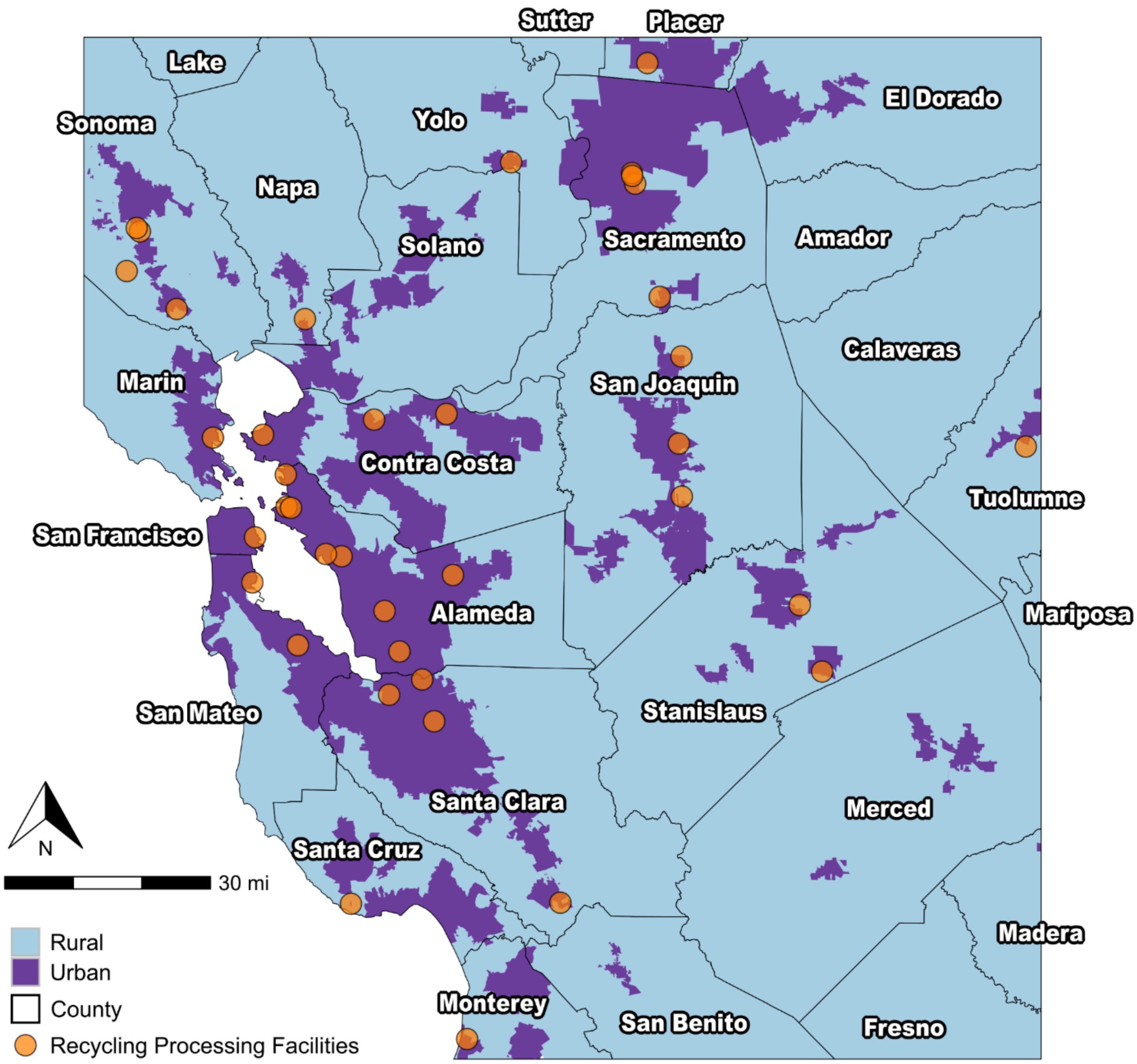

Figure 3-4A: Northern California Recycling Processing Facility Locations in Relation to Urban versus Rural Communities

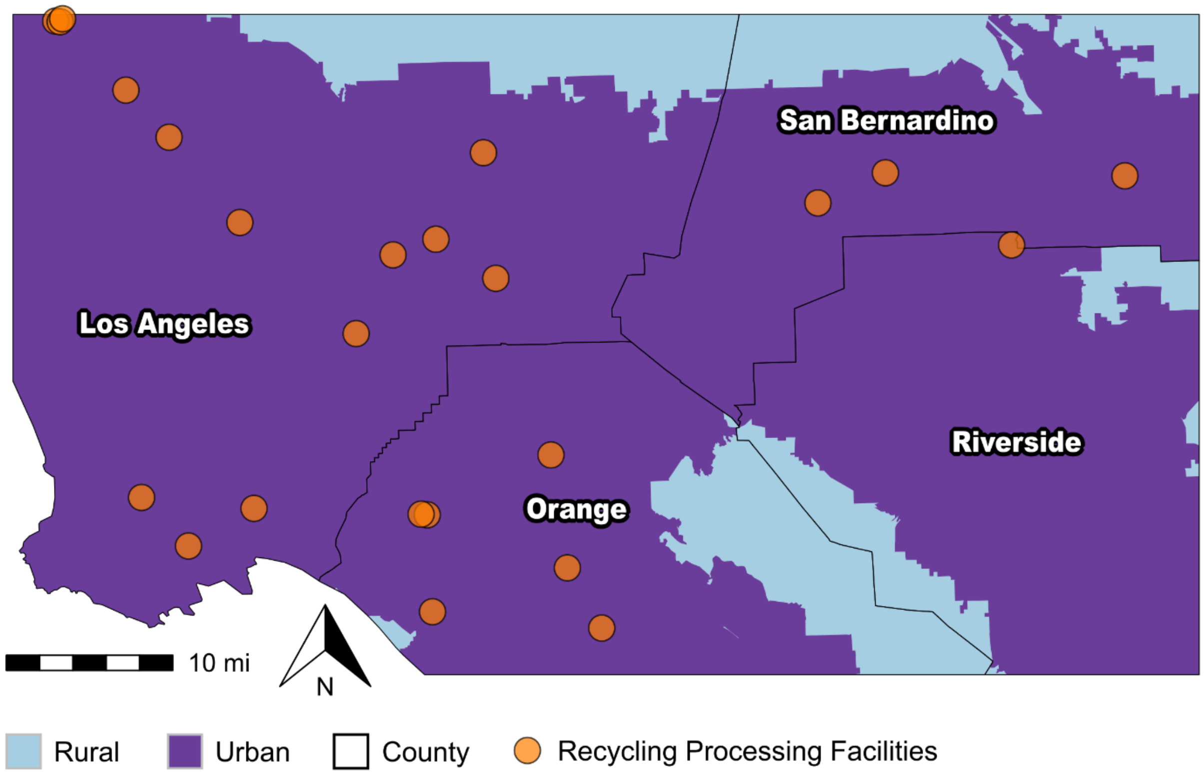

Figure 3-4B: Southern California Recycling Processing Facility Locations in Relation to Urban versus Rural Communities

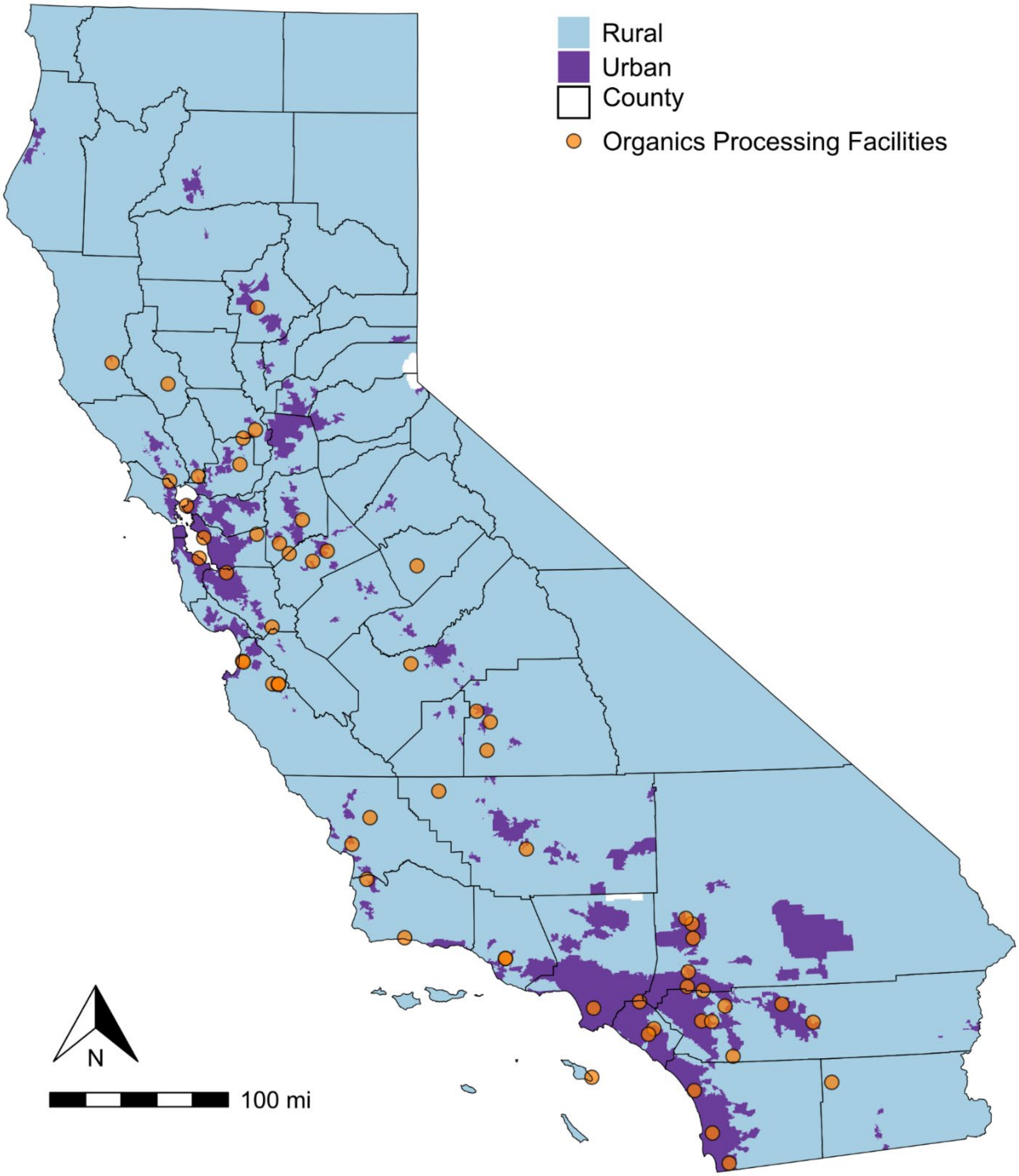

Figure 3-5: OPF Locations in Relation to Urban versus Rural Communities

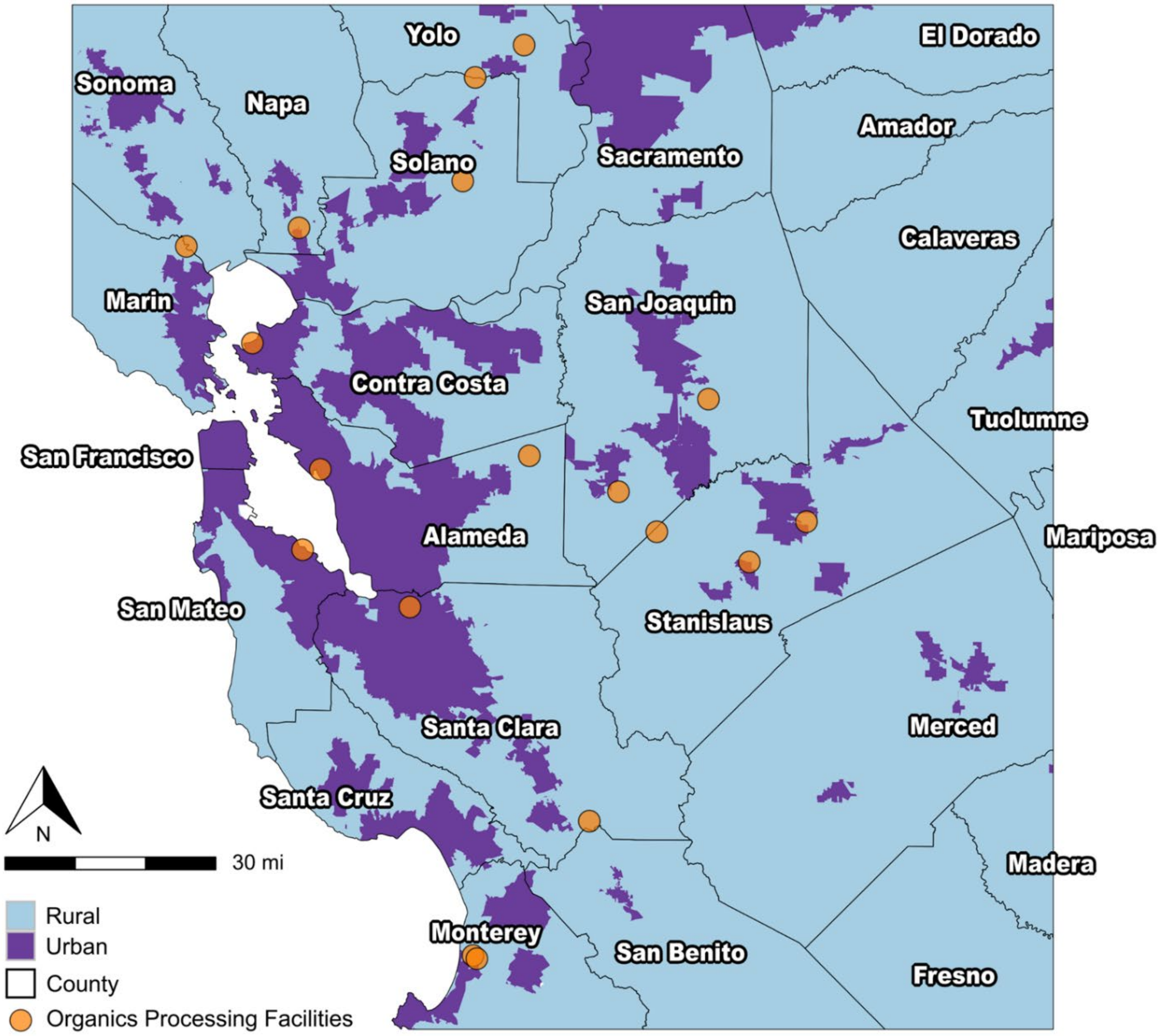

Figure 3-5A: Northern California OPF Locations in Relation to Urban versus Rural Communities

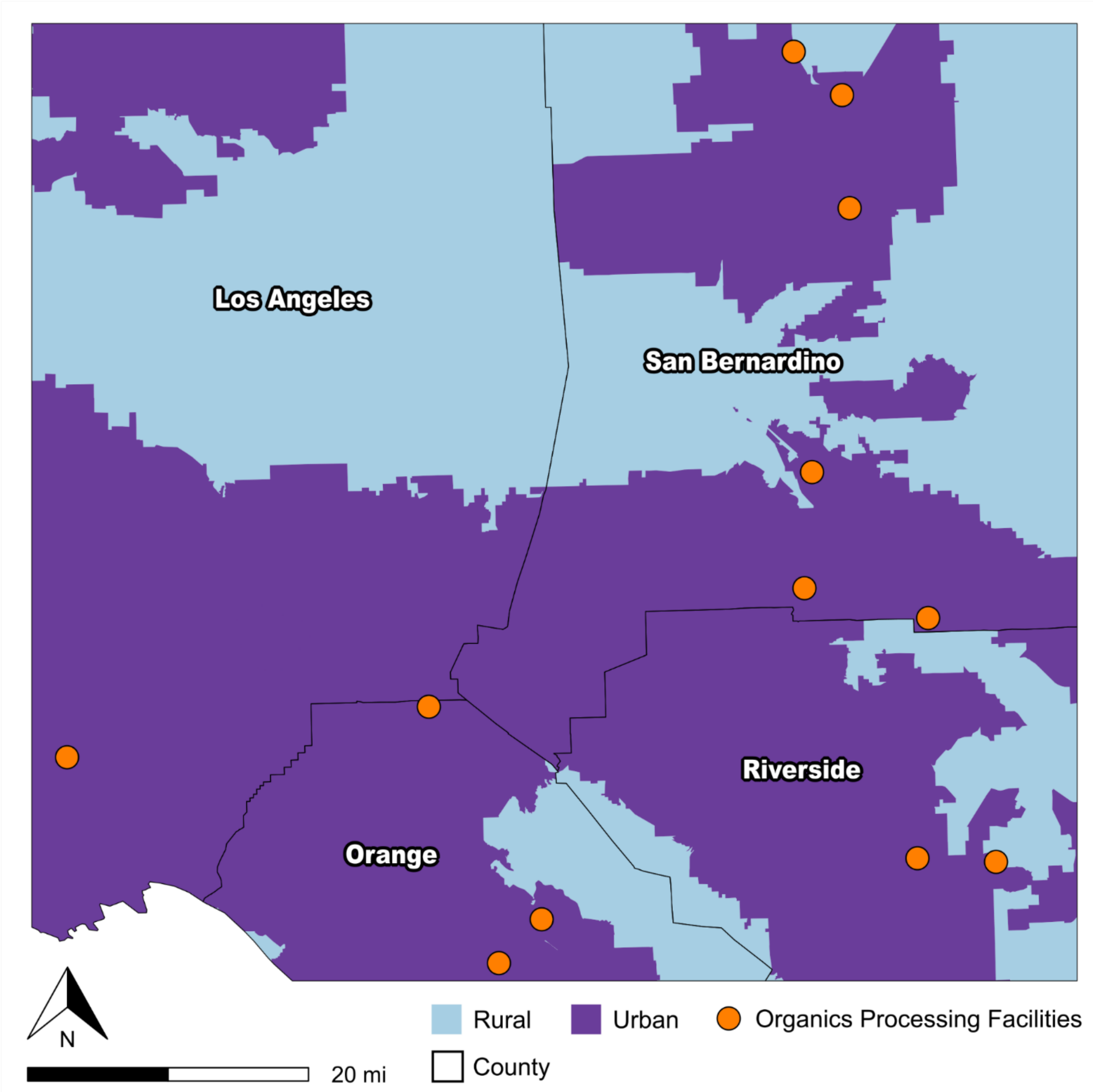

Figure 3-5B: Southern California OPF Locations in Relation to Urban versus Rural Communities

The impacts of processing facilities on communities vary depending on the facility's location, size, volume of material delivered and processed at the facility, and impact management methods (i.e., odor control, traffic queuing on property, interior versus exterior unloading). The population density surrounding the facility may influence impacts on the community as well. For example, in rural areas, facilities may face less opposition but can strain local resources and infrastructure, such as roads and water supply, and cause noise disturbances and odor impacts. It could also create an economic boost through job creation in an area with fewer employment opportunities. In an urban or suburban area, facilities are located near a dense population area, which creates greater potential for negative health and quality-of-life impacts, such as noise, traffic, and air pollution. However, proximity to facilities is helpful for ease to transport materials.

3.5.4 Employee Impacts

Safety is critical for all aspects of the solid waste industry, as lack of safety contributes to challenges related to workforce development, employee recruitment and retention, and insurance costs. Workforce development and employee recruitment encompasses the entire hiring process from initial screening to integrating new workers into an organization. The solid waste industry aims to have a high retention rate, meaning workers stay at their jobs for long periods of time. Worker recruitment and retention is difficult in the solid waste industry, and these challenges illustrate potential opportunities for improvement in areas with high recycling service demand (Rosengren 2023). The contractor compiled key findings of the following employee impacts at recycling processing facilities (including MRFs) and OPFs based on surveys, interviews, and site visits. According to the EPA's Best Practices for Solid Waste Management report (2023), if workers are not given proper health and safety equipment, they are at risk of physical injuries and illness.

Safety challenges related to specific CMC processing group materials have been identified as applicable.

- **Facility Fires:** Recycling processing facilities (including MRFs) and OPFs are prone to fires due to the types of materials being managed and improper disposal of hazardous materials, including common items like lithium-ion batteries. Lithium-ion batteries are a significant safety concern across the industry, particularly in facilities where they can catch fire in equipment or on the sorting line. Consumers are placing batteries in their recycling bins due to public misconceptions of how to properly dispose of them (Resource Recycling Systems 2023). Batteries can ignite fires in all areas of the system, including trucks, facilities, and landfills if not removed and disposed of properly. Appropriate fire control, including necessary equipment and fire-fighting equipment (e.g., fire rovers), is necessary to fight fires.
- **Unsafe Working Conditions:** Older recycling processing facilities (including MRFs) and OPFs with fewer automated processes require more temporary labor and hand-picking materials from conveyor belts or inbound tip floors, resulting in increased potential dangers from having workers on the sorting

line or in heavy equipment operating areas. The ergonomics can be challenging at the facilities, where staff stand for long periods of time, reaching over conveyor belts and searching for contaminants or hazards to remove from the processing line. At some facilities, materials delivered in bags require sorters to open bags, exposing them to potential hazards. Additionally, sortation of bulky plastic items (e.g., plastic #7 – other rigid plastics) or other metals (e.g., other ferrous) can cause injury to workers who manually remove these materials from fast-moving conveyor belts. Daily maintenance operations of unclogging machinery may result in hand injuries. Worker conditions in the facilities include concerns related to facility age, fires, and injury. Contamination at OPFs represents similar hazards, as employees manually remove contaminants from inbound loads or during material processing.

- **Space-Constrained Operation:** Many recycling processing facilities (including MRFs) and OPFs have limited storage capacity for baled or market-ready materials. Without sufficient space, material may be stored outdoors or in locations that cause safety hazards. Bales stacked too high can result in crushing injuries if they fall on facility operators or laborers. While many materials pose a risk of fueling potential facility fires once ignited, storing additional materials in constrained building envelopes (e.g., bales stored in undesignated areas of the building or property) decrease the ability for facilities to proactively identify and respond to fires. Additionally, when materials identified as tanglers wrap in screens or other operating equipment at facilities, employees must enter confined spaces to manually remove wrapped materials.

Abbreviations and Acronyms

Abbreviation	Description
AB	Assembly Bill
AD	Anaerobic digestion
AI	Artificial Intelligence
APR	Association of Plastic Recyclers
ASP	Aerated Static Pile
BCRP	Beverage Container Recycling Program
C&D	Construction and demolition
CalRecycle	California's Department of Resources Recycling and Recovery
CBO	Community-based Organization
CCR	California Code of Regulations
CMC	Covered Material Category
CPEM	Collection, Processing, and End Market
CRV	California Redemption Value
DOF	Department of Finance
DRR24043	CalRecycle Contract Number
ECS	Eddy Current Separators
EJ Groups	Environmental Justice Groups
EPS	Expanded Polystyrene
EPR	Extended producer responsibility
FTE	Full-time Employee
GHG	Greenhouse Gas
GPS	Global Positioning System
HDPE	High-Density Polyethylene
HVAC	Heating, Ventilation, and Air Conditioning
LDPE	Low Density Polyethylene
MRF	Material Recovery Facility

Abbreviation	Description
NIR	Near infrared
OCC	Old Corrugated Cardboard
OPF	Organics Processing Facility
PET	Polyethylene
PLA	Polylactic acid
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl Chloride
RDRS	Recycling and Disposal Reporting System
RSP	Recycling Service Provider
SB	Senate Bill
SB 343 Report	SB 343 Material Characterization Study Final Findings Report
SWIS	Solid Waste Information System
TPD	Ton Per Day
TPH	Ton Per Hour
TPY	Ton Per Year
Tribes	California Native American Tribes

Glossary of Terms

Glossary of Terms are either referenced definitions from the Act or specifically used for the purposes of this study by CalRecycle or the contractor. If a referenced definition is from the Act, the Public Resources Code (PRC) is provided in the definition.

Term	Description
Alternative Collection Program	Alternative collection programs refer to the programs that are not operated by or under contract with a local jurisdiction regardless of the manner and location of collection and usually tailored to the unique challenges of handling difficult-to-recycle materials.
Beverage Container Recycling Program	CalRecycle administers the California Beverage Container Recycling & Litter Reduction Program (BCRP) in which consumers pay a refundable deposit every time they purchase an included beverage and then receive – California Refund Value (CRV) – when they return the empty container to a certified recycling center, registered dealer cooperative, or participating retail location. Californians may instead choose to forfeit their deposit by donating beverage containers to certified community service programs, or giving them to a registered curbside or certified drop-off or collection program for recycling.
Collection Program	Refers to curbside single family, multifamily, and commercial, as well as non-curbside options such as residential and commercial drop-off, take-back, public space collection, and other options for the collection of covered materials. Depending on the collection program, single family, multifamily, and commercial sources may be mixed (e.g., a single hauler route may pick up curbside recycling from both commercial and multifamily locations). The definitions of single family, multifamily, and commercial may also differ between collection programs.
Commercial	Of, from, or pertaining to nonresidential premises where business activity is conducted, including but not limited to retail sales, services, wholesale operations, institutions, manufacturing and industrial operations, hotels, motels, other similar hospitality premises, and any and all facilities operated by governmental entities, but excluding businesses conducted upon premises that are permitted under applicable zoning regulations and are not the primary use of the property.

Term	Description
Community-Based Organization (CBO)	Refers to a public or private nonprofit organization of demonstrated effectiveness that: 1. Has deployed projects and/or outreach efforts within the region of one or more impacted priority populations in California. 2. Has an official mission and vision statements that expressly identify serving priority populations (e.g., disadvantaged communities, low-income communities, and/or communities in rural areas). 3. Currently employs staff member(s) who specialize in and are dedicated to diversity, equity, or inclusion, or is a 501(c)(3) nonprofit.
Composting	The controlled biological decomposition of organic solid wastes that are either source-separated from the municipal solid waste stream or separated from the municipal solid waste stream at a processing facility.
Contamination	Contamination occurs when material that is not intended to be recycled enters the recycling stream. This may include materials intentionally included in a product that are removed during the recycling process, and materials that incidentally or accidentally end up in the recycling stream (or in the incorrect recycling stream). It may also include materials that are deleterious to facilities or consumers. Contamination may encompass various situations and materials: ● A material that a collection program does not accept. ● A material that a receiving processing facility or end market does not accept or is not designed, permitted, or authorized to recycle. ● A material that a receiving processing facility or end market accepts but that is destined for disposal.

Term	Description
Covered Material	The Act applies to "covered material," which PRC section 42041(e) defines as: Single-use packaging [PRC section 42041 (e)(1)(A)] that is routinely recycled, disposed of, or discarded after its contents have been used or unpackaged, and typically not refilled or otherwise reused by the producer. Plastic single-use food service ware [PRC section 420241 (e)(1)(B)], including, but not limited to, plastic coated paper or plastic coated paperboard, paper, or paperboard with plastic intentionally added during the manufacturing process, and multilayer flexible material.
Covered Material Category (CMC)	A category that includes covered material of a similar type and form, as determined by the department [PRC section 42041(f)]. This report uses the CMCs that CalRecycle published on July 1, 2024. The list and other supplementary material can be found at www.CalRecycle.ca.gov/packaging/packaging-epr/cmclist/.
Covered Material Category (CMC) Processing Group	A group that includes CMCs, as determined by the contractor for the purposes of this contract.
CRV Materials	See definition for Beverage Container Collection Program.
Curbside Collection (or Curbside)	A program that includes the collection of material, including but not limited to covered materials, by a local jurisdiction or recycling (including composting) service provider under contract with a local jurisdiction (PRC 42041(g)).
Disposal (of Covered Material)	Material landfilled, used for alternative daily cover (Title 27, CCR, section 20690), used for alternative intermediate cover (Title 27, CCR, section 20700), combusted, incinerated, used for energy generation, or used for fuel production, except for anaerobic digestion of source-separated organic materials. Material that does not enter the managed disposal system or is lost from the recycling and waste management system through open burning, illegal dumping, or other forms of leakage.
Disposed of	Material sent to any activity meeting the definition of disposal, such as landfill or incineration.

Term	Description
End Market	For material sent to a composting or in-vessel digestion facility for the creation of compost, digestate, or biogas, the end market is that facility. For other material, the end market is the entity that converts the material into feedstock to be used in lieu of virgin material to produce new or reconstituted products. Example end markets include: ● Glass: a beneficiation plant that produces cullet. ● Metal: an entity that smelts metal to produce ingots, sheets, or coils. ● Paper: a beneficiation plant that repulps material into a pulp product. ● Wood: an entity that chips and grinds wood material. ● Plastic: an entity that creates pellet.
Exclusive	Refers to a type of agreement or service arrangement between a local jurisdiction and a recycling service provider for solid waste handling services in which the recycling service provider has the sole or exclusive right to collect designated material(s) within the local jurisdiction or designated part(s) of a local jurisdiction.
Food Waste	A subset of organic waste including: food scraps (discarded food that will decompose and/or putrefy including: [i] all kitchen and table food; [ii] animal or vegetable waste that is generated during or results from the storage, preparation, cooking or handling of food stuffs; [iii] fruit waste, grain waste, dairy waste, meat, and fish waste; and, [iv] vegetable trimmings, houseplant trimmings, and other organic waste common to the occupancy of residential dwellings and some commercial kitchen operations).
Franchise Service	A type of agreement or service arrangement in which a recycling service provider may conduct collection services in a local jurisdiction, as memorialized in a franchise agreement between the jurisdiction and recycling service provider. Franchise Service may be exclusive or nonexclusive.
Kraft Paper	Stiff, sturdy paper derived from wood pulp, usually brown but can be white or colored.

Term	Description
Landfill Stream	Solid waste that is accepted by a local jurisdiction for collection, transfer (if applicable), and transported to a disposal facility. The exact list of solid waste accepted for collection in the landfill stream varies by local jurisdiction and is therefore not specifically listed herein. This does not include disaster debris or designated waste sent to landfill.
Leakage	Refers to the loss of materials from various stages of the recycling and waste management process, such as during collection, transportation, sorting, or processing. Leakage results in these materials failing to reach the intended processing, end market, or disposal facilities.
Local Jurisdiction	A city, county, city and county, regional agency formed pursuant to Chapter 5 (commencing with section 6500) of Division 7 of Title 1 of the Government Code or Article 3 (commencing with section 40970) of Chapter 1 of Part 2, or special district that provides solid waste collection services (PRC section 42041(m)).
Materials Collected for Organics Recycling	Organic waste that is accepted by a local jurisdiction for collection, transfer (if applicable), and transport to a facility(ies) for composting, in-vessel digestion, or other organic waste processing permitted under applicable law. The exact list of materials collected for organics recycling will vary by local jurisdiction and is therefore not specifically listed herein.
Materials Collected for Recycling	Materials accepted by a local jurisdiction for collection, transfer (if applicable), and transport to a facility(ies) for recycling, in accordance with applicable law. The exact list of materials collected for recycling will vary by local jurisdiction and is therefore not specifically listed herein. For the purposes of this report, materials collected for recycling do not include organic waste intended for composting or in-vessel digestion.
Material Recovery Facility (MRF)	A permitted solid waste facility that sorts or separates mixed waste, solid waste, or materials collected for recycling for the purpose of recycling or composting.
Mixed Waste	Solid waste that includes landfill stream material and may additionally be combined with materials collected for recycling and/or materials collected for organics recycling. The exact list of mixed waste accepted for collection will vary by local jurisdiction and is therefore not specifically listed herein.

Term	Description
Multifamily	Of, from, or pertaining to Residential premises with five (5) or more dwelling units. Multifamily premises do not include hotels, motels, or other transient occupancy facilities, which are considered commercial businesses.
Clear/Natural	Referring to glass or plastic, without coloring.
Nonexclusive	A type of agreement or service arrangement between a local jurisdiction and a recycling service provider for solid waste handling services in which the recycling service provider does not have the exclusive right to collect materials within the local jurisdiction or a designated part of a jurisdiction.
Organic Materials or Organics	Organic Waste that is accepted by a Local Jurisdiction for collection, transfer (if applicable), and transport to a facility(ies) for composting, anaerobic digestion, or other Organic Waste processing permitted under applicable law. The exact list of Organic Materials accepted for collection will vary by Local Jurisdiction and is therefore not specifically listed herein.
Organics Processing Facility	Refers to any “designated source separated organic waste facility” as defined by 14 CCR section 18982(a)(14.5). This includes facilities that process organic material via composting or in-vessel digestion.

Term	Description
Packaging	PRC section 42041(s): means any separable and distinct material component used for the containment, protection, handling, delivery, or presentation of goods by the producer for the user or consumer, ranging from raw materials to processed goods. “Packaging” includes, but is not limited to, all of the following: (1) Sales packaging or primary packaging intended to provide the user or consumer the individual serving or unit of the product and most closely containing the product, food, or beverage. (2) Grouped packaging or secondary packaging intended to bundle, sell in bulk, brand, or display the product. (3) Transport packaging or tertiary packaging intended to protect the product during transport. (4) Packaging components and ancillary elements integrated into packaging, including ancillary elements directly hung onto or attached to a product and that perform a packaging function, except both of the following: (A) An element of the packaging or food service ware with a de minimis weight or volume, which is not an independent plastic component, as determined by the department. (B) A component or element that is an integral part of the product, if all components or elements of the product are intended to be consumed or disposed of together.
Paper	A material made from cellulose pulp derived mainly from wood, for the creation of consumer products.
Paperboard	A thicker paper material used for the production of packaging containers such as folding cartons, paper cups, and coated boards.
Plastic	PRC section 42041(t): means a synthetic or semisynthetic material chemically synthesized by the polymerization of organic substances…. “Plastic” includes, without limitation, polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), polylactic acid (PLA), and aliphatic biopolyesters, such as polyhydroxyalkanoate (PHA) and polyhydroxybutyrate (PHB). “Plastic” does not include natural rubber or naturally occurring polymers such as proteins or starches.

Term	Description
Plastic Component	PRC section 42041(u): Plastic component means any single piece of covered material made partially or entirely of plastic. A plastic component may constitute the entirety of the covered material or a separate or separable piece of the covered material.
Plastic Covered Material	Plastic covered material includes any item of covered material with a plastic component.
Priority Populations	Disadvantaged communities, low-income communities, communities in rural areas, and Tribes.
Processing	To sort, segregate, break or flake, and clean material to prepare it to meet the specification for sale to a responsible end market (PRC section 42041(v)).
Processing Facility	Any facility that engages in the statutory definition of processing (PRC section 42041(v)) – that is, to sort, segregate, break or flake, and clean material to prepare it to meet the specification for sale to an end market.

Term	Description
Producer	A person who manufactures a product that uses covered material and who owns or is the licensee of the brand or trademark under which the product is used in a commercial enterprise, sold, offered for sale, or distributed in the state (PRC section 42041(w)(1)). If there is no person in the state who is the producer for purposes of paragraph (1), the producer of the covered material is the owner or, if the owner is not in the state, the exclusive licensee of a brand or trademark under which the covered product using the covered material is used in a commercial enterprise, sold, offered for sale, or distributed in the state. For purposes of this subdivision, a licensee is a person holding the exclusive right to use a trademark or brand in the state in connection with the manufacture, sale, or distribution of the product packaged in or made from the covered material (PRC section 42041(w)(2)). If there is no person in the state who is the producer for purposes of paragraph (1) or (2), the producer of the covered material is the person who sells, offers for sale, or distributes the product that uses the covered material in or into the state (PRC section 42041(w)(3)). “Producer” does not include a person who produces, harvests, and packages an agricultural commodity on the site where the agricultural commodity was grown or raised (PRC section 42041(w)(4)). For purposes of this chapter, the sale of covered materials shall be deemed to occur in the state if the covered materials are delivered to the purchaser in the state (PRC section 42041(w)(5)).
Producer Responsibility Organization (PRO)	An organization that is exempt from taxation under section 501(c)(3) of the federal Internal Revenue Code of 1986 and is formed for the purpose of implementing a plan to meet the requirements of this chapter (PRC section 42041(x)).
Recycled Organic Product	Digestate used for land application, biogas, and compost produced by a process that meets the definition of recycling.

Term	Description
Recycling	PRC section 42041(aa) defines recycle or recycling as the process of collecting, sorting, cleansing, treating, and reconstituting materials that would otherwise ultimately be disposed of onto land or into water or the atmosphere, and returning them to, or maintaining them within, the economic mainstream in the form of recovered material for new, reused, or reconstituted products, including compost, that meet the quality standards necessary to be used in the marketplace. Recycling does not include combustion, incineration, energy generation, fuel production (except for the anaerobic digestion of source-separated organic materials), or other forms of disposal. Recycling includes both traditional recycling processes (e.g., recycling steel cans) and organic recycling processes (e.g., composting organic materials). For material to be considered recycled, it must be sent to a responsible end market (PRC section 42041(aa)(3)).
Recycling Rate	Weight of material recycled / (weight of material recycled plus weight of material disposed of).
Recycling Service Provider (RSP)	A solid waste enterprise that provides solid waste handling services on behalf of a local jurisdiction (PRC section 42041(ac)). Note: For the purposes of this report, RSP refers only to the collection service provider (i.e., does not include material processing).
Redemption Center	Recycling centers that buy back empty California Redemption Value (CRV) beverage containers.
Region or Regional	Mutually exclusive and collectively exhaustive geographic areas of the state as determined by CalRecycle's Agreement DRR24043 and Statewide Waste Characterization Study. There are five distinct regions: Bay Area, Coastal, Mountain, Southern, and Valley (Regions). A map and further description of each unique region is included in the methodology section of this report.
Rejects	Materials not accepted by processing facilities and/or end Markets, for any reason, including physical contamination of the material or the inability of the material to be processed due to its design.
Residential	Of, from, or pertaining to single-family and multifamily properties used for human shelter, irrespective of whether such property units are rental units or are owner-occupied, excluding hotels, motels, or other similar premises.

Term	Description
Responsible End Market	A materials market in which the recycling and recovery of materials or the disposal of contaminants is conducted in a way that benefits the environment and minimizes risks to public health and worker health and safety (PRC section 42041(ad)).
Self-Hauler or Self-Haul	A person who transports solid waste, organic waste, materials collected for recycling or recovered material they have generated to another person.
Single-Family	Of, from, or pertaining to a residential premises with less than five units.
Single-Use Packaging	Packaging that is routinely recycled, disposed of, or discarded after its contents have been used or unpackaged, and typically not refilled or otherwise reused by the producer (See the definition of covered material).
Solid Waste	Means and refers to the definition of “solid waste” in California PRC section 40191, as it may be amended or superseded from time to time.
Source Separated	The generator segregated the discarded materials into separate collection containers for collection by the recycling service provider, such that all solid waste was placed in a solid waste collection container, all materials collected for recycling were placed in a collection container for recycling, and all organic materials were placed in a collection container for organics recycling.
The Act	Refers to The Plastic Pollution Prevention and Packaging Producer Responsibility Act (The Act, Senate Bill 54, Allen, Chapter 75, Statutes of 2022).
Thermoform	A manufacturing process in which a plastic sheet is heated to a pliable forming temperature, formed to a specific shape in a mold, and trimmed to create a usable product. The sheet, or film when referring to thinner gauges and certain material types, is heated in an oven to a high enough temperature that it can be stretched into or onto a mold and cooled to a finished shape.
Yard Waste	A subset of organic waste including grass, lawn clippings, shrubs, plants, weeds, branches, and other forms of organic waste generated from landscapes, yards, or gardens.
White Paper	Generally refers to white or cream-colored paper packaging recovered from offices, homes, schools, and other sources (e.g., white envelopes).

Bibliography

Agrawal, Shreya. 2023. "The Future of the Trucking Industry: Electric Semi-Trucks (2023)." Environmental and Energy Study Institute. May 11. Accessed 9/26/2025. https://www.eesi.org/papers/view/fact-sheet-the-future-of-the-trucking-industry-electric-semi-trucks-2023#:~:text=Electric%20trucks%20can%20reduce%20GHG%20emissions%20while,zero%2Demission%20vehicles%2C%20including%20electric%20models%2C%20by%202030.

American Forest & Paper Association. 2021. *Design Guidance for Recyclability*. March 16. https://www.afandpa.org/sites/default/files/2022-05/AFPADesignGuidanceforRecyclability_FINAL_051622.pdf.

Anenberg, Susan C., Joshua Miller, Daven K. Henze, Ray Minjares, and Pattanun Achakulwisut. 2019. "The global burden of transportation tailpipe emissions on air pollution-related mortality in 2010 and 2015." *Environmental Research Letters* (14 094012). https://iopscience.iop.org/article/10.1088/1748-9326/ab35fc/pdf.

Association of Plastics Recyclers. 2024. *Packaging That Does Not Meet Access Requirements (PLA, PVC, EPS and PS)*. September 9. https://plasticsrecycling.org/wp-content/uploads/2024/09/Packaging-That-Does-Not-Meet-Access-Requirements.pdf.

Boogaard, H., E. Samoli, A.P. Patton, R.W. Atkinson, J.R. Brook, H.H. Chang, B. Hoffmann, M. Kutlar Joss, S.K. Sagiv, A. Smargiassi, A.A. Szpiro, D. Vienneau, J. Weuve, F.W. Lurmann, F. Forastiere, and G. Hoek. 2023. "Long-term exposure to traffic-related air pollution and non-accidental mortality: A systematic review and meta-analysis." *Environment International* 176 (June). https://www.sciencedirect.com/science/article/pii/S0160412023001897.

California Department of Technology. 2023. "Federally Recognized Tribal Lands." California State Geoportal. February 13. https://gis.data.ca.gov/datasets/CAEnergy::federally-recognized-tribal-lands/explore?location=36.930740%2C-119.935127%2C7.95.

California Office of Environmental Health Hazard Assessment (OEHHA). SB 535 List of Disadvantaged Communities Geodatabase 2024. https://oehha.ca.gov/calenviroscreen/sb535

CalRecycle. *SB 1335 Composter Survey.*

CalRecycle. 2023. "Public Notice: AB 1201 Bifurcated Collection Determination." December 5. https://www2.calrecycle.ca.gov/PublicNotices/Details/5291

CalRecycle. 2024. "SB 54 Covered Material Categories List." December 31. https://calrecycle.ca.gov/packaging/packaging-epr/cmclist/.

CalRecycle. 2025. *SB 343 Material Characterization Study Final Findings 2023/2024*. DRRR-2025-1750. April 4. https://www2.calrecycle.ca.gov/Publications/Details/1751.

CalRecycle. 2025a. “SWIS Facility/Site Definitions.” https://www2.calrecycle.ca.gov/SolidWaste/Definition.

Carton Council. 2023. *Food and Beverage Cartons: Design Guide for Recyclability*. https://recyclecartons.com/wp-content/uploads/2023/11/Carton-Council-Design-Guide-2023-v2.pdf.

Closed Loop Partners. 2025. *Small Materials with a Big Opportunity for Recovery*. February 19. https://www.closedlooppartners.com/wp-content/uploads/2025/02/Updated-Final_Small-Plastics-Recovery-Report_2025.pdf.

Contractor’s Machinery. 2023. “Electric or Diesel?” June 1. https://www.cmi-case.com/wp/2023/06/01/electric-or-diesel/.

EPA (Environmental Protection Agency). 2023. *Best Practices for Solid Waste Management: Solid Waste Management and Climate Change.* EPA 530-R-23-012. July.

EPA. 2023a. *Best Practices for Solid Waste Management: Recycling Markets*. EPA 530-R-23-010. July. Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries - Recycling Markets.

EPA. 2025. “Carbon Pollution from Transportation.” April 25. Accessed 9/26/2025. https://www.epa.gov/transportation-air-pollution-and-climate-change/carbon-pollution-transportation.

Glass Recycling Foundation. 2025. *MRF Best Practices: A Detailed View*. https://static1.squarespace.com/static/61b12c4e31f2761943c9622d/t/6838845bc3f20c3abb40a1a5/1748534363762/mrf-best-practices.pdf.

Hamilton, Marsha. 2023. “Composting for the Climate and Environmental Justice.” The Rockefeller Foundation. November 22. https://www.rockefellerfoundation.org/grantee-impact-stories/composting-for-the-climate-and-environmental-justice/.

Integrated Waste Management Consulting, LLC. 2019. *SB 1383 Infrastructure and Market Analysis*. DRRR-2019-1652. April 29. Prepared for CalRecycle.

Intergovernmental Panel on Climate Change. 2022. “Climate Change 2022: Mitigation of Climate Change.” IPCC Sixth Assessment Report. https://www.ipcc.ch/report/ar6/wg3/.

Livingston, Dan. 2020. “The Pros and Cons of Electric Forklifts.” MidColumbia Forklift Blog. January 28. https://www.midcoforklift.com/blog/the-pros-and-cons-of-electric-forklifts.

Ma, Clara, Cristina Penasco, and Laura Diaz Anadon. 2025. “Technology innovation and environmental outcomes of road transportation policy instruments.” *Nature Communications* (May 14). https://pmc.ncbi.nlm.nih.gov/articles/PMC12078554/pdf/41467_2025_Article_59111.pdf.

National Waste & Recycling Association. 2025. “Chapters & Regions.” https://wasterecycling.org/chapters-regions/.

Oladimeji, Damilola, Khushi Gupta, Nuri Alperen Kose, Kubra Gundogan, Linqiang Ge, and Fan Liang. 2023. “Smart Transportation: An Overview of Technologies and Applications.” *Sensors* (April 11). https://doi.org/10.3390/s23083880.

Pollution Sustainability Directory. 2025. https://pollution.sustainability-directory.com/.

Potts, Ellie, Michael Rodriguez, and Tony Peterson. 2023. *Report on Washington State Recycling: Part 3 – Equity Analysis of Recycling*. Publication 23-07-013. April. Prepared for the Washington Department of Ecology. https://apps.ecology.wa.gov/publications/UIPages/documents/2307013.pdf.

Resource Recovery Coalition of California. 2025. https://resourcecoalition.org/Index.aspx.

Resource Recycling Systems. 2023. *Metrics on the Lithium-based Battery Threat to U.S. Single Stream Material Recovery Facilities (“MRFs”) Summary Opinion*. September 28. https://resource-recycling.com/recycling/wp-content/uploads/sites/3/2024/01/RRS-Lithium-battery-opinion-final-2.pdf.

Ritter, Brad. 2025. “Advanced Odor Control Solutions For Waste Management Facilities.” Waste Advantage. March 31. Accessed 9/26/2025. https://wasteadvantagemag.com/advanced-odor-control-solutions-for-waste-management-facilities/.

Rosengren, Cole. 2023. “As some labor strains ease, the waste and recycling industry has further opportunity to grow its ranks.” WasteDive. January 19. Accessed 9/26/2025. www.wastedive.com/news/waste-recycling-labor-retention-wages-women-union/640670/.

Rynk, Robert, Ginny Black, Jane Gilbert, Johannes Biala, Jean Bonhotal, Mary Schwarz, and Leslie Cooperbrand eds. 2021. *The Composting Handbook: A how-to and why manual for farm, municipal, institutional and commercial composters*. Academic Press. https://www.sciencedirect.com/book/9780323856027/the-composting-handbook.

SCS Engineers. 2024. *Alameda County 2023-24 Waste Characterization Study.* September 30. Prepared for Alameda County StopWaste.

Staub, Colin. 2025. "CalRecycle to fund mixed plastics facility, other projects." Resource Recycling. May 6. https://resource-recycling.com/recycling/2025/05/06/calrecycle-to-fund-mixed-plastics-facility-other-projects/.

Sustainability Directory. 2025. "How Does Waste Management Impact Communities?" May 2. https://pollution.sustainability-directory.com/question/how-does-waste-management-impact-communities/.

Woods, Scott. 2022. "Why Positive ASP Composting Is the Future of Organics: For the Environment and for the Economy." Waste Advantage. May 29. Accessed 9/26/2025. https://wasteadvantagemag.com/why-positive-asp-composting-is-the-future-of-organics-for-the-environment-and-for-the-economy/.