



## **3<sup>rd</sup> Party Plastic Recycling Certification Pilot**

### **Final Report to Palo Alto City Staff**

**Submitted: May 27, 2022**

#### **Background**

The City of Palo Alto has long been a leader in sustainability, making impressive progress toward reducing its carbon impacts, greenhouse gas emissions, and resource consumption since establishing its first Climate Protection Plan in 2007. As a Zero Waste city, Palo Alto seeks to manage their waste materials sustainably - first and foremost eliminating waste wherever possible, and then managing the discards they do have through reuse and recycling/composting. To reach this goal, over the past several years Palo Alto has worked with the City's contracted hauler, GreenWaste of Palo Alto, to determine what happens to recyclable materials that are sold to secondary markets. Due to multiple factors including 1) materials changing hands many times before reaching the final destination, 2) materials being exported to foreign ports where reporting is not available, and 3) materials brokers who insist on market opaqueness, GreenWaste of Palo Alto has faced many roadblocks to providing adequate accounting for the outcome of Palo Alto's recyclable material.

In late 2021, the City of Palo Alto requested assistance from Kamilo, a mission-driven Public Benefit Corporation that provides 3<sup>rd</sup> party verification of recycling outcomes. The City sought to collaborate with Kamilo on a pilot project supporting one of City Council interests related to the City's solid waste recycling program. Specifically, the City was interested in the feasibility of 3<sup>rd</sup> party verification and accounting for recyclable materials that are sorted at the GreenWaste Recovery (GreenWaste) Materials Recovery Facility (MRF) and then sold to secondary markets.

This project focused on tracking one type of plastic (High Density Polyethylene (HDPE), natural - the plastic used for milk jugs) that is currently marketed by GreenWaste to a processor/recycler in California. The City requested that Kamilo demonstrate that 3<sup>rd</sup> party verification of recycling is technically and operationally feasible so that it can be advanced as a potential solution to the uncertainty that currently exists related to outcomes for recyclable materials. Lessons from this pilot project could help Kamilo and the City design a possible model to track the City's recyclables materials. Lessons could also be incorporated into proposed legislation requiring more rigorous accounting and incentives for recycling to be verified as being performed in California and/or domestically.

## Pilot Description

The desired elements of this project include Kamilo's certification of the sound environmental management of participating facilities, the use of Kamilo's patent-pending technology to capture chain of custody data associated with plastic material moving from recovery to processing, collection of attribute data associated with this verification, and the preparation of reports and dashboards documenting outcomes as defined by the agreement between City of Palo Alto and GreenWaste.

City Staff outlined the following pilot project priorities:

1. Confirm the feasibility of 3<sup>rd</sup> party verifications of shipment, receipt, and processing by a processor at a facility that demonstrates sound environmental management.
2. Design a pilot project incorporating terms and conditions that are acceptable to at least two participants in the recycling supply chain - such that they participate willingly.
3. Prioritize domestic recycling facilities, preferably ones in California.

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### Pilot Project Tasks

The Pilot Project was broken down into 5 discrete tasks.

**Task 1: Pilot Plan.** Develop the overall process for conducting the pilot and executing the work to meet City Staff priorities. Review the plan with City and GreenWaste staff.

**Task 2: Facility Visit - GreenWaste Materials Recovery Facility (MRF).** Kamilo visits the GreenWaste MRF in San Jose where Palo Alto's recyclables are sorted before sale to secondary markets and:

- Performs a desktop review of the facility's publicly available environmental documentation.
- Conducts preliminary phone interviews with facility staff to gather background information, facility description, set expectations for onsite visit, and clarify any questions.
- Performs onsite facility review using Kamilo's proprietary survey system to document a facility description, outcomes of the processes, and best environmental practices.
- Prepares a comprehensive report and review report with facility staff for accuracy and completeness prior to delivery of final report to facility manager.

**Task 3: Facility Visit - Plastic Processor.** Kamilo visits Processor's facility where GreenWaste MRF sends baled post-consumer HDPE for processing into post-consumer recycled (PCR) pellets and:

- Performs desktop review of the facility's publicly available environmental documentation.
- Conducts preliminary phone interviews with facility staff to gather background information, facility description, set expectations for onsite visit and clarify any questions.
- Performs onsite facility review using Kamilo's proprietary survey system to document a facility description, outcomes of the processes, and best environmental practices.
- Prepares a comprehensive report and review report with facility staff for accuracy and completeness prior to delivery of final report to facility manager.

**Task 4: 3<sup>rd</sup> Party Verification of Recycling.** Kamilo tracks up to three separate shipments of plastic material from the GreenWaste MRF to the Processor. For each shipment, Kamilo:

- Tracks shipment from MRF:
  - Enters data about shipment into Kamilo chain of custody app (including resin type, quantity of bales, total weight of bales, and photos of bales, manifest, weight ticket, and any other shipping documentation)

- Attaches Kamilo’s unique identifier to at least one bale in the shipment at the back of the shipping container/truck trailer.
- Recognizes and links the identifier to the shipment in the Kamilo app and records it as being shipped.
- Tracks shipment receiving at Processor:
  - Arrives on-site at the receiving entity, recognizes the unique identifier using the Kamilo app, and marks shipment as received at the destination.
  - Records information as assessed at the destination such as weight, number of bales along with photos of signed received manifests and any other shipping documentation.
  - Removes unique identifier.
- Receives confirmation of successful processing by Processor and records any residuals or contamination to be deducted from the amount of material recycled.
- Delivers Material Recycling Verification Report to GreenWaste and City staff in format agreeable to parties, see examples on page 10-12 of this report.

**Task 5: Final Report to City Staff.** Kamilo delivers a report to City staff on the lessons learned from the project, including any challenges anticipated in any future deployment and suggestions for how the process and future pilots could be improved.

## **Pilot Results**

Over a four-month period, Kamilo successfully executed the pilot project and demonstrated the priorities set by City staff. The project was prolonged by operational challenges from supply chain disruptions that impacted transportation as well as facility staffing and limitations imposed on visitor access at the GreenWaste MRF due to the Omicron variant of COVID-19.

1. Kamilo demonstrated the feasibility of 3<sup>rd</sup> party verifications of shipment, receipt, and processing by a processor and confirmed that the participating facilities exhibit sound environmental management.
  - Kamilo used its mobile app-based technology to track 3 truckloads of High-Density Polyethylene (HDPE) from the GreenWaste MRF in San Jose to a processor.
  - Through a combination of desktop reviews and onsite visits, Kamilo confirmed that the facilities managing this material are doing so in a manner that follows sound environmental practices.
  - Using a combination of one or more unique digital identifiers (QR code, Bluetooth transponder, and GPS) each shipment was tracked in real-time from the GreenWaste MRF to the Processor.
  - The participating processor subsequently attested to the successful processing of the HDPE waste material received from GreenWaste into a valuable raw material.

From the 3 loads that were tracked, a total of 127,440 pounds of HDPE waste material was shipped from the MRF to the Processor - resulting in approximately 108,324 pounds of new raw material, after accounting for materials that were not HDPE (such as residue contained in the jugs, labels, caps and baling wire). The new product made from these bales was small lentil-sized pellets, known in the industry as "nurdles", that can be used in the production of new milk jugs and other forms of plastic products and packaging. Samples of this material were provided by the Processor to Kamilo (see photo to the right). According to the Quality Control Manager for the Processor, the typical yield from baled HDPE is 80-90%. Of the approximately 15% of material (19,116 pounds) that could not be processed into HDPE pellets, most is destined for landfill (primarily labels and residue) while a small portion can be further processed and recycled (primarily metal baling wire and polypropylene caps/lids).



#### A note about Municipal Composition of Material Tracked:

The recyclables tracked by Kamilo were comprised of material aggregated from multiple GreenWaste customers - not just Palo Alto. It is practically infeasible to segregate one City's materials among the over 40 haulers delivering to the GreenWaste MRF. Palo Alto represents approximately 8.5% by weight of the total recyclable materials received at this facility. For the sake of this project, it was assumed that Palo Alto's proportion of the tracked HDPE is also 8.5% of the total loads tracked.

2. Kamilo designed a pilot project incorporating terms and conditions that were acceptable to at least two participants in the recycling supply chain - such that they participated willingly.
  - Managers at both GreenWaste and the Processor were enthusiastic about the opportunity to participate in this pilot project. Both participants understood that the pilot was designed to maintain confidentiality of end markets for GreenWaste's plastic. To that end, Kamilo has not disclosed the identity of the Processor throughout this report or during communication with Palo Alto staff. It is understood that in order to encourage participation in 3<sup>rd</sup> party verification across the recycling supply chain, maintaining confidentiality will be necessary for some parties.
3. Domestic recycling facilities and lower greenhouse gas transport options were prioritized, with the target Processor located in California.
  - The Processor is located in California which supports City objectives of supporting local recycling markets, keeping valuable raw materials domestic and in-state, and minimizing transportation emissions when feasible.

#### Summary of Plastic Outcomes Verified

- Pounds of plastic verified as recycled: 108,324 lbs HDPE natural (Palo Alto portion: 9,207 lbs)
- Carbon emissions avoided from the use of recycled plastic in lieu of virgin: 216,648 lbs carbon emissions avoided (Palo Alto portion: 18,415 lbs) (using 3:1 ratio virgin to recycled plastic.)
- Landfill space saved: 1,666 cubic yards (Palo Alto portion: 142 cubic yards) (Source: flattened HDPE from [https://www.waste360.com/Recycling\\_And\\_Processing/hdpe-bottles-and-containers-201101](https://www.waste360.com/Recycling_And_Processing/hdpe-bottles-and-containers-201101))

Photos from Pilot Project:



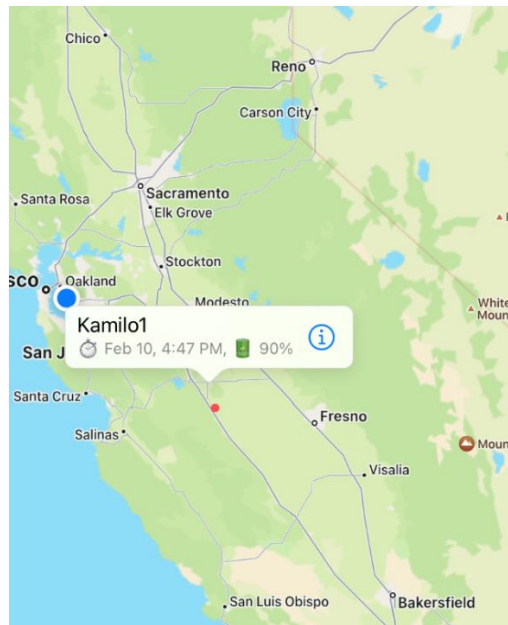
**Photo 1:** Bales of HDPE natural being loaded onto the trailer at GreenWaste MRF before departure to Processor. January 25, 2022.



**Photo 2:** Bales of HDPE seen on the trailer at GreenWaste MRF before departure to Processor. Kamilo's QR & GPS identifiers used to track the shipment can be seen on the last bale. February 10, 2022.



**Photo 3:** 2 Types of electronic transponders used for Pilot: GPS (top) and Bluetooth Low Energy (bottom).



**Photo 4:** Mobile app view of the Feb 10<sup>th</sup> shipment GPS transponder location after departing the GreenWaste MRF en route to Processor.



## Lessons Learned

Lessons Learned:

1. We did not encounter any technological or operational barriers to delivering the desired 3<sup>rd</sup> party verification of the movement and recycling of recyclable materials domestically.

Overall, the Kamilo chain-of-custody solution performed as it was designed. Three different forms of unique identifier were deployed over the course of the project – and all performed as expected for traceability. QR codes are the least expensive of the suite of unique identifiers and are easy to administer as long as the code is visible to the camera. Bluetooth low-energy transponders, like QR codes, are recognized by the Kamilo App and have the advantage that they can be detected if the transponder is not visible – such as when additional material has been added to a truck or material has shifted during transportation. Finally, the GPS device, which (currently) requires manual entry of the identification number into the App, provides valuable information about location of trucks during transit which proved to be very helpful with coordinating delivery timelines.

The time required for capturing information at the facilities is about 2 minutes for a user who is familiar with the mobile app and data recording process. Minimizing the procedural steps necessary to administer the tracking app will be essential to operational success and adoption.

In support of the feasibility of a mobile app tech-based solution, Kamilo observed that GreenWaste personnel are already using hand-held devices to document the loading of certain materials bound for recycling markets. If a tracking system such as Kamilo's were deployed at GreenWaste, it appears that it would not require significant changes in process to what is already being done for the type of material we observed being shipped.

2. Processor verification of recycling is a critical step to complete the chain of custody.

This project to track a material from origin to processing demonstrated that the technology works as intended. The loads tracked were of high-value HDPE which, once collected by the MRF, have relatively low risk of being lost to the environment or landfilled. Considering its value as a raw material (current market rates are over \$0.50/lb), it is unlikely that HDPE, once collected, would not get processed and recycled since it would represent a significant economic loss in transportation and processing costs. So even though the actual HDPE material being tracked in this pilot project is unlikely to be wasted, the use case represented an excellent test case for the traceability platform.

While 3<sup>rd</sup> party verification is valuable for verifying the outcomes of all types of plastics, it is particularly needed for low-value materials where, unlike HDPE, the environmentally sound recycling of the material is less assured. When Kamilo previously tracked low-value materials for recycling in a different project / for a different client, the processor provided Kamilo with a certification of recycling attesting that the material has or will be recycled. The Processors of the high-value HDPE material being tracked in this pilot did not provide Kamilo with this attestation as it was outside the scope of our contract – however we were able to confirm that they accepted the material for processing and authorized payment to GreenWaste. In our discussions with CalRecycle's Sustainable Materials and Data Management representatives they utilize a similar methodology - assuming processors don't pay for feedstock they don't intend to process and sell or use themselves. With the support of GreenWaste staff, we were able to secure copies of Processor's "Material Breakdown Sheet" that confirmed that the bales had been opened and inspected and confirmed the rate to be paid to GreenWaste for the load.

### 3. Transportation logistics continue to be a challenge for the supply chain.

Carrier logistics were one of the largest challenges for the pilot since Kamilo staff had to be onsite until trucks arrived - but often only knew the estimated day of arrival. When there was a specific appointment, trucks often arrived much earlier or later than expected, or not at all. Communication from the independent trucking companies hired to move materials from GreenWaste to the Processor was inconsistent. GreenWaste and the Processor often had limited information about when (or if) trucks would arrive to pick up and deliver materials. While frustrating for staff at those facilities, this did not create a significant hardship for them since they have some flexibility regarding timing (within their business hours). This logistics challenge was largely an artifact of the pilot and Kamilo staff needing to be onsite to administer the mobile app - and will no doubt be less of an issue once the Kamilo system is deployed at the facility.

## **Future Challenges and Suggestions**

Kamilo encourages the City to continue the pursuit of 3<sup>rd</sup> party verification for recycling and promotes the use of digital real-time and granular tracking such as that offered by Kamilo.

Some of the challenges we would anticipate in future deployments include:

**Challenge:** Facility openness to being assessed by 3<sup>rd</sup> party. From the lessons learned in this pilot as well as other projects outside of the scope of this Pilot, Kamilo understands facility operators tend to be hesitant about 3<sup>rd</sup> party assessors that are not a regulatory agency. Facilities carry a heavy burden of the perception by some in the media and public as being dirty, smelly, unsafe, and in some cases, flouting regulations. Without experience and knowledge of the operation of these facilities, visitors' impressions can be uninformed and unduly influenced by smells and sounds at even well-run facilities. Facilities understandably do not like to be subjected to misinformed assessments.

**Suggestions:** Maintain that any assessment will be confidential; while threshold minimum housekeeping, safety, and environmental standards must be met, the details of the assessment will not be shared outside the facility itself. In addition, if there are conditions that will prevent a facility from being certified as environmentally sound, the facility must be given a reasonable amount of time to correct the deficiencies without any loss of certified status. Development of positive rapport, relationships, and trust with facility personnel will go more smoothly if the 3<sup>rd</sup> party performing the assessments has had prior and extensive experience assessing industrial and commercial facilities including those who are part of the solid waste management supply chain.

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**Challenge:** Supply Chain confidentiality. Supply chain participants are concerned that sensitive and competitive information related to their operations will be made public through the participation in a 3<sup>rd</sup> party verification program.

**Suggestion:** Commit to nondisclosure of information. Utilize the 3<sup>rd</sup> party as a "firewall" so that information gathered about specific facilities and markets is sanitized/generalized/aggregated before being shared with municipal staff who could be subject to FOIA disclosure requirements. Sharing sample reports such as those included at the end of this report can demonstrate the degree of granularity made available to the public. Commit to celebrating the work of MRFs and processors - both play a pivotal role in achieving Zero Waste objectives and fighting climate change. Respect their need for confidentiality of end markets when they are willing to have 3<sup>rd</sup> party verification of outcomes.

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Challenge: Multi-node supply chain. The two node, California-based chain for this Pilot was a relatively simple use case. Tracking through multiple nodes is an additional complexity that should be explored. Additional nodes add complexity since there are more parties who may be concerned about maintaining confidentiality. Also, managing inventory through a processor where material arrives in one form, is processed, and then leaves in a different form requires advanced inventory management systems. This type of continuous mass-balance inventory accounting functionality has recently been developed by Kamilo and is actively being tested in the field. This sort of system has been endorsed for the proper accounting of plastic moving through the supply chain by the National Institute of Standards and Technology (NIST) in their recent Special Publication 1500-206. It provides an auditable process whereby feedstock that undergoes one or more processing steps and perhaps generates several product types can be traced from origin into end product. This accounting convention is necessary since materials that enter the processing system are combined and impossible to differentiate from one another.

Suggestion: Commit to celebrating the work of MRFs and processors. Respect their need for confidentiality of end markets as long as they are willing to have 3<sup>rd</sup> party verification of outcomes. Highlight the growing awareness of increasing and inevitable regulatory drivers and that adopting and adapting to a sound verification system before it is a requirement will be a competitive advantage. Support for demand-driven requirements for verification of provenance will create a “pull” that reinforces the “push” from communities such as Palo Alto. A further recommendation would be considering working with Kamilo on a follow-on pilot project to demonstrate the traceability of recyclable material through a multi-node process where Kamilo could track plastic waste from origination/collection through processing and into manufacturing of next product. We could work together to identify potential partners and again show the potential for valid claims of provenance (by end users) and successful recycling outcomes (by upstream generators). This could be accomplished over a 90-day period and could ideally be accomplished in the second half of 2022.

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Challenge: International shipments. Presents issues such as multiple hand-offs, language barriers, and customs inspections that could complicate the continuity of the tracking devices.

Suggestion: Traceability technology should work universally but this will need to be verified in the field. Work on further demonstration with markets open to testing verification and build from these innovators. Language and process localization will be needed as well. Mexico and Canada would be logical candidates for a next phase.

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Challenge: Power imbalance for small municipalities and large waste haulers. Small generators of material relative to the larger haulers and MRF’s may have a challenge getting traction on these sorts of verification efforts.

Suggestion: Enlist participation of other municipalities sending material to the same MRF. Once materials are being tracked once, it does not require much effort to deliver reporting for each community - a beneficial economy of scale. Also, support regulatory commitments for 3<sup>rd</sup> party verification of outcomes, a requirement that diversion goals be verified in order to be counted, extra credit for domestic processing, and/or an expansion of the scope of AB881. The State perhaps could include financial incentives for materials verified as recycled in CA.

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One final observation.

While this project was supply-driven – designed to support waste generators wanting to verify the outcomes of their materials, there is a growing downstream desire for traceability to demonstrate provenance by brands using recycled plastic in their products. At the recent Plastics Recycling Conference, Kamilo was approached by a significant number of recycling processors and intermediaries seeking a solution that would allow them to provide proof of origin for materials they are selling. This is an encouraging development that suggests markets may be open to these sorts of 3<sup>rd</sup> party verification programs.

## **About Kamilo**

Kamilo is a Public Benefit Corporation with a mission to help municipalities and others in the recycling supply chain gain better information about what is happening to their recyclable materials – most importantly that they are not causing harm to the environment. Kamilo’s unique tracking technology provides an immutable chain-of-custody which validates, on a bale-by-bale and real-time basis, the movement of recovered plastic waste from sorting to responsible next-life outcome, with proof of provenance and environmental management. While Kamilo’s initial focus is on plastics, their proprietary chain-of-custody technology can be adapted for use with other recovered materials including fiber/paper, glass, aluminum, and biosolids.

Through these products and services, Kamilo is driving to create a market-driven system which addresses recovery and repurposing needs, provides a closed-loop system for used plastics and provides a validated/verifiable mechanism for companies seeking to offset their virgin plastic use through the purchase of plastics offsets on an existing exchange.

Material Recycling Verification Reports for the shipments tracked as part of this Pilot Project are on the following pages.

# Material Recycling Verification Report

January 25 -27, 2022



	Received	Shipped	Received	Shipped	Received
KFID		CA79172F	CA109653		
Kamilo Certified?		Yes	No		
Date(s)	Jan '22 (est)	01/25/22	01/27/22	2/15 (est.)	
Resin	HDPE, natural	HDPE, natural	HDPE, natural	HDPE, natural	
Amount	42,020 lbs	42,020 lbs	42,020 lbs	35,717 lbs (est.)	
Form	Loose containers	Bales	Bales	Bulk pellets	
Date Processed		--		2/7 (est.)	
Certificate of Processing		--		292683N	
Location	CA	CA	CA	CA	
KCOCID(s)		71214c9c-cfed-46e3-a874-91c0f03bd0a8	71214c9c-cfed-46e3-a874-91c0f03bd0a8	n/a	
Loss Rate (%)		--		15% (est.)	
Loss Amount		--		6,303 lbs	
Loss Result		--		Wire, caps: recycle; residual: Landfill	



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# Material Recycling Verification Report

February 10 -11, 2022



	Received	Shipped	Received	Shipped	Received
KFID		CA79172F	CA109653		
Kamilo Certified?		Yes	No		
Date(s)	Feb '22 (est)	02/10/22	02/11/22	2/18 (est.)	
Resin	HDPE, natural	HDPE, natural	HDPE, natural	HDPE, natural	
Amount	43,340 lbs	43,340 lbs	43,340 lbs	36,839 lbs (est.)	
Form	Loose containers	Bales	Bales	Bulk pellets	
Date Processed		--		2/15 (est.)	
Certificate of Processing		--		293972N	
Location	CA	CA	CA	CA	
KCOCID(s)		9cbd4223-1005-4936-bd3e-6da9081	9cbd4223-1005-4936-bd3e-6da9081	n/a	
Loss Rate (%)		--		15% (est.)	
Loss Amount		--		6,501 lbs	
Loss Result		--		Wire, caps: recycle; residual: Landfill	



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# Material Recycling Verification Report

March 23 -24, 2022



	Received	Shipped	Received	Shipped	Received
KFID		CA79172F	CA109653		
Kamilo Certified?		Yes	No		
Date(s)	Mar '22 (est)	03/23/22	03/24/22	3/28 (est.)	
Resin	HDPE, natural	HDPE, natural	HDPE, natural	HDPE, natural	
Amount	42,080 lbs	42,080 lbs	42,080 lbs	35,768 lbs (est.)	
Form	Loose containers	Bales	Bales	Bulk pellets	
Date Processed		--		3/31 (est.)	
Certificate of Processing		--		293972N	
Location	CA	CA	CA	CA	
KCOCID(s)		F57995a1-bfe5-4026-a8cc-4a1db117	F57995a1-bfe5-4026-a8cc-4a1db117	n/a	
Loss Rate (%)		--		15% (est.)	
Loss Amount		--		6,312 lbs	
Loss Result		--		Wire, caps: recycle; residual: Landfill	



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