Circularity Assessment Protocol
Orlando, Florida

University of Georgia

Circularity Informatics Lab

March, 2024

New Materials Institute
UNIVERSITY OF GEORGIA

Ocean Conservancy

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The Circularity Informatics Lab at the University of Georgia is committed to information sharing, data analytics, empowering communities, and systems change related to circular materials management.

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On behalf of:
The Ocean Conservancy

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Athens, GA, March 2024

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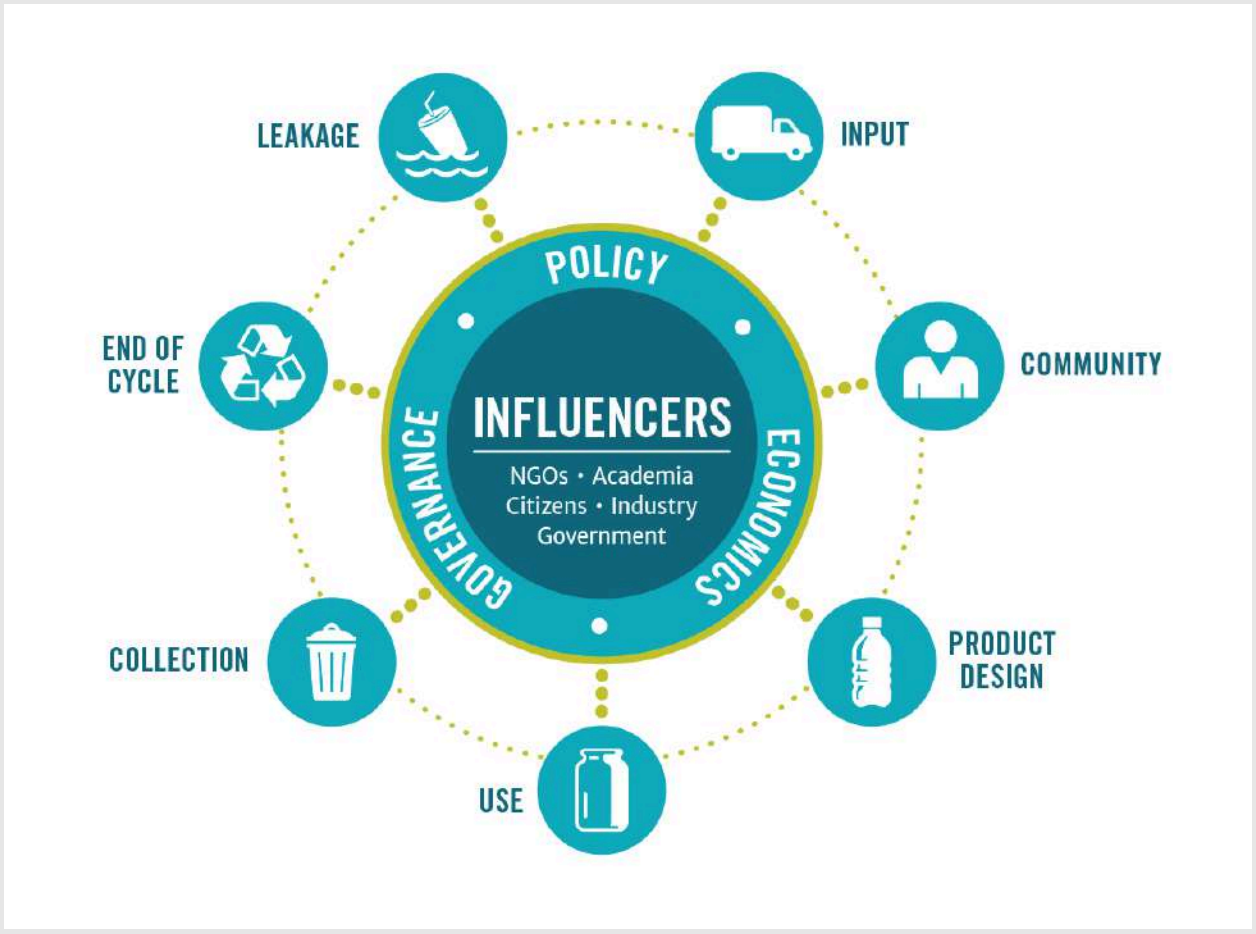
Executive Summary

Developed by the Circularity Informatics Lab (CIL) at the University of Georgia, the Circularity Assessment Protocol (CAP) is a standardized assessment protocol to inform decision-makers by collecting community-level data on plastic usage. Grounded in materials flow and systems thinking concepts, the CAP uses a hub-and-spoke model to holistically characterize how consumer plastic flows into a community, is consumed, and flows out, either through waste management systems or leakage into the environment. The model, shown below, is comprised of seven spokes: input, community, material and product design, use, collection, end of cycle, and leakage. At the center, the system is driven by policy, economics, and governance, with key influencers including non-governmental organizations, industry, and government.



Through the Shores Forward initiative, the Circularity Informatics Lab, Ocean Conservancy, and the City of Orlando partnered to create a CAP. In May of 2023, CIL researchers visited Orlando to conduct fieldwork that included product and packaging assessments in stores across the city; key stakeholder interviews with government staff, industry professional, and representatives from non-profit organizations; material type characterizations for consumer plastic items; cost analysis of reusable products and alternatives to plastic available in the city; visual audits of recycling contamination; identification of public waste and recycling collection bins; and litter transects in three categories of population. Key findings from each spoke are summarized in the table below.

Key Findings & Opportunities

INPUT

Findings: In total, 523 convenience products across 294 unique brands were sampled, including 233 candies (136 unique brands), 110 chips (55 unique brands), 146 beverages (87 unique brands), and 34 tobacco products (16 unique brands). Tobacco products, on average, had the shortest distances to travel for distribution. Though some beverage and candy products originated from both a parent company and manufacturer that were less than 100 km from the City of Orlando, candies traveled the farthest average and median distance of all items. . Furthermore, the overall distribution and spread for all products was higher for Orlando when compared to other cities in Florida.

Opportunities:

- Explore opportunities for Extended Producer Responsibility (EPR), particularly among material types that are the most problematic for litter or lack of substitutes (e.g., packaging)~~multilayer film packaging~~) and/or for products that have manufacturing locations within close proximity to Orlando (e.g., beverages).
- For beverages manufactured or distributed close to Orlando, investigate options for localized bottle collection, bottle deposit, or other types of EPR to optimize waste diversion for top brands.
- Propose potential product pilots ~~could~~ with local brands that could include packaging reuse and collection, particularly for city events.

COMMUNITY

Findings: City of Orlando staff noted that current areas of concern include: the outstanding Request for Proposals (RFP) for a new materials recovery facility (MRF), challenges surrounding the lack of governmental jurisdiction to plan their own solid waste facilities, illegal dumping, and the perception of littering by community members and visitors.

Opportunities:

- Several local organizations (such as Keep Orlando Beautiful,KOB) expressed interest in learning about efforts across Florida, like that of Miami-Dade County and others, to develop voluntary business incentive programs in Orlando to encourage reduction of single-use plastic.
- Efforts should be made to collaborate with the hospitality and tourism industries around communication and outreach to mitigate the challenges around the 'holiday' mentality of visitors that come to Orlando.
- Interviewees expressed desire for enhanced solid waste management (SWM) infrastructure, particularly around the new MRF.

- Open dumping is an issue that resonates with many residents and should be targeted for outreach, education, and policy.

PRODUCT DESIGN

Findings: Multilayer plastic film was the most prevalent packaging type (60%) among fast-moving consumer goods, followed by polyethylene terephthalate (PET; 20%) and aluminum (10%). Across all to-go items sampled – including utensils, straws, food containers, and cold cups from 47 restaurants and food vendors – polypropylene (PP) was the most common material type observed (43.3%), followed by expanded polystyrene (EPS; 26.2%), PET (8.5%), and multi-material containers (8.5%).

Opportunities:

- The transient nature of some food distribution services presents a challenge for collection and management of problematic materials – particularly with EPS items distributed for services.
- Green Event Guide – there is a need for consistent codes, more enforcement and accountability, and potentially a dedicated group for monitoring these events so that these codes can be enforced as needed.

USE

Findings: Common household and personal care products were sampled at 33 grocery stores in the Orlando area and cost per unit was compared across options. In most cases, the alternative options were over 100% more expensive than the single-use plastic counterparts. The most expensive products were those available were reusable snack and sandwich bags. 97% of stores offered predominantly high-density polyethylene (HDPE) plastic takeaway bags, and only 3 stores offered paper bags at check-out free of charge as an alternative option to plastic. Plastic overall comprised 72.1% of all staple packaging and the most common material types were HDPE and plastic film.

Opportunities:

- Expand reuse/refill infrastructure, both bespoke and at-scale (which should be targeted to the most problematic/non-recyclable staple packaging items).
- Explore strengthening regulations or public awareness campaigns to reduce dependence on plastic takeaway bags, or incentives to encourage the use of reusable bags.
- Develop and distribute more affordable, single-use plastic- free alternatives (particularly among refillable and reusable products) for local brands and companies.

COLLECTION

Findings: The City of Orlando's Solid Waste Division oversees all residential and front-end business for waste collection in Orlando. Residents and businesses have a choice of around 20 private and independent haulers for recycling and other collection services. The City recently implemented an ordinance requiring all multi-family homes and commercial properties to have recycling containers and accompanying collection services. Collection rates are high, though challenges still exist in multi-family complexes and high-density population areas.

Opportunities:

- While the city's recent recycling ordinance has helped expand access, implementing mechanisms, such as those in City X and City X, to require and enforce recycling would be beneficial.
- Re-think the autonomy of certain types of waste collection infrastructure.
- Follow-through on the implementation of the Beyond Waste Roadmap will be critical once it is finalized.
- The city should explore creative space solutions for apartments, condominiums, and other multi-family home complexes, potentially learning from other cities in Florida that are addressing this challenge.

END OF CYCLE

Findings: The City of Orlando is part of an inter-local agreement with Orange County whereby garbage is dumped at the Orange County Landfill. There are two transfer stations located on the landfill property, one owned by the County and one owned by Waste Management (WM).. Single-stream recycling from the landfill is sorted and taken to a WM MRF at Cocoa Beach. The landfill receives an estimated 3,800 lbs. of waste/year, and an estimated 3 million lbs. of recycling was processed at the landfill between 1990-2017. The partnership between Orange County and WM for recycling sorting and transport at the landfill recently ended, and the landfill is working on developing a new MRF on-site through another public private partnership.P

Opportunities:

- It is critical to carry out the RFP for the new MRF on-site at the landfill as soon as possible.
- Flexibility at the city level is important – increasing staff and capacity to address local needs and tailor solutions and messaging would be beneficial where possible.
- The city can explore existing c~~C~~reative solutions ~~exist at~~ across multiple scales (e.g., smaller local compost drop-off locations, repair and swap shops, centers for hard to recycle materials, etc.) ~~– the city should continue to pursue opportunities to implement~~ and consider exploring similar ~~these~~ proposals, ~~–~~ through local z~~Z~~ero w~~W~~aste initiatives or otherwise.

LEAKAGE

Findings: In total, 3,792 items were logged across 34 transects spanning 11 different square kilometer areas in Orlando. The largest percentage of litter by category was plastic fragments, followed by similar percentages of tobacco products and food-related plastic packaging. When combined, these three categories of materials comprise nearly ¾ of all litter items documented. Paper items comprised 11.7% of litter and metal comprised 7.1% of litter.

Opportunities:

- Address illegal dumping in a collaborative manner across city departments and districts (e.g., stricter regulations, more enforcement, creative solutions around drop-off locations, etc.).
- Standardize data collection for KOB and other litter monitoring groups (potentially through applications such as the Marine Debris Tracker or other platforms).
- As cigarettes were the most common litter item in Orlando, the city may want to consider a focused public campaign around cigarette butt litter.

Strengths

- There is strong political will and leadership around sustainability, resilience, and circular economy in the City of Orlando.
- The City of Orlando's Office of Sustainability, Resilience, and Future-Ready has set a Beyond Waste intiative with a goal to fully divert waste by 2040 across all departments and there is significant stakeholder awareness of and buy-in for the program.
- Orlando's Beyond Waste Roadmap is underway and and will be a key tool for implementing solutions going forward.
- Orlando has multiple cleanup and beautification efforts through KOB,, Green Up Orlando, and others.
- Local resources have been designed to support the transition away from single-use plastics, such as the Orlando Green Events Guide.
- The city is part of multiple networks, such as the Urban Sustainability Directors Network, Climate Mayors, and others that can cbe utilized to learn about best practices across cities in Florida, the Southeast, and across the country.

Glossary

CAP: Circularity Assessment Protocol

CIL: Circularity Informatics Lab

FDEP: Florida Department of Environmental Protection

EPR: Extended Producer Responsibility

EPS: Expanded polystyrene

FMCG: Fast moving consumer goods

HDPE: High density polyethylene

MLP: Multi-layer plastic

MRF: Material Recovery Facility

MSW: Municipal solid waste

PET: Polyethylene terephthalate

PP: Polypropylene

SUP: Single-use plastic

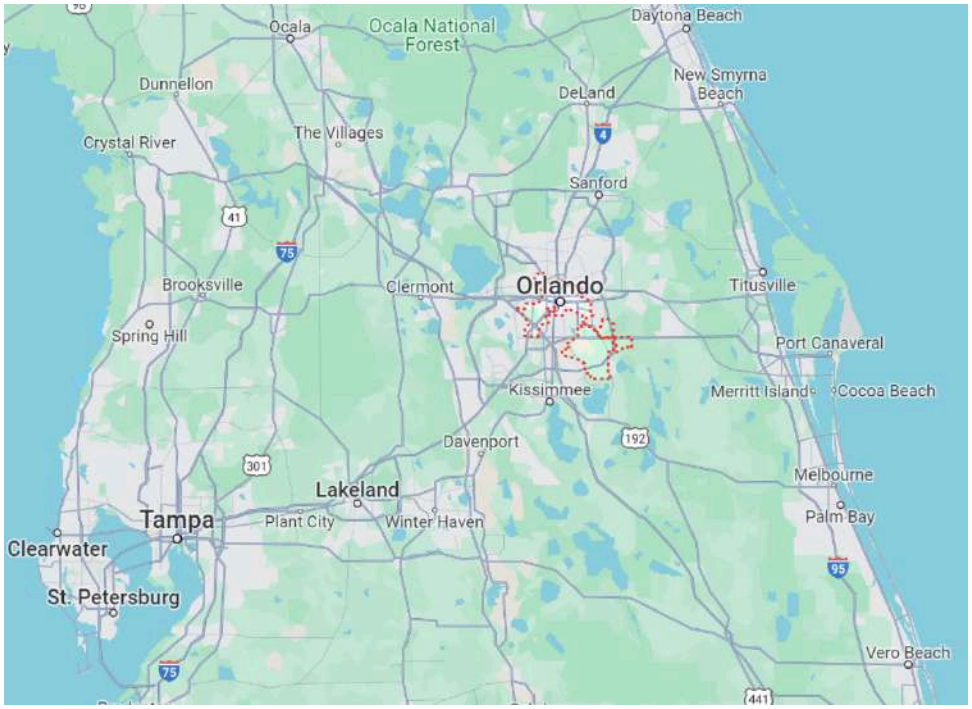
SWM: Solid waste management

UGA: University of Georgia

Introduction

The City of Orlando is one of the most populous cities in Florida, behind Miami, Jacksonville, and Tampa, with a population of 307,683 as of 2020 (US Census Bureau 2020). The city's population has grown 29.07% since 2010 and is projected to grow 1.35% annually. It is located in North Central Florida (Figure 1).

Figure 1: Overview map of survey area in Orlando



Orlando was incorporated on territory once inhabited by Indigenous peoples, including the Ais, Apalachee, Calusa, Timucua, and Tocobago tribes. Today, the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida stand as two of the three federally recognized Seminole nations, alongside the Seminole Nation of Oklahoma (University of Central Florida Office of Diversity and Inclusion). The largest racial/ethnic groups in the City of Orlando today are comprised of 23.3% Black or African American, 34.8% Hispanic, and 48.5% White (US Census Bureau 2020). Over 40% of households in Orlando speak a language other than English, compared to the U.S. average of 21.7% (US Census Bureau, 2022).

Tourism is a major sector of Orlando's economy, with Walt Disney World employing 77,000 people, the largest number of people employed by one company in a single location in the U.S (Magic Guides, 2023). Disney, along with Universal Orlando draws over 74 million people to Orlando annually, with a total economic impact of 87.6 billion dollars (Visit Orlando, 2023). Orlando's other major industries include healthcare, aviation and aerospace, and information technology; with growth of 8% in Orlando's STEM industry according to Forbes (citation?) , three times the national average in 2018 (Kotkin, 2018).

Situated between the Atlantic Ocean and the Gulf of Mexico, near the headwaters of the Kissimmee River, connected to iconic Florida waters including the Econlockhatchee and Wekiva Rivers Orlando is a city surrounded by critical ecosystems. The region's immense tourism and commercial industries mean Orlando's plastic footprint holds major significance within Florida's marine debris challenges as the many

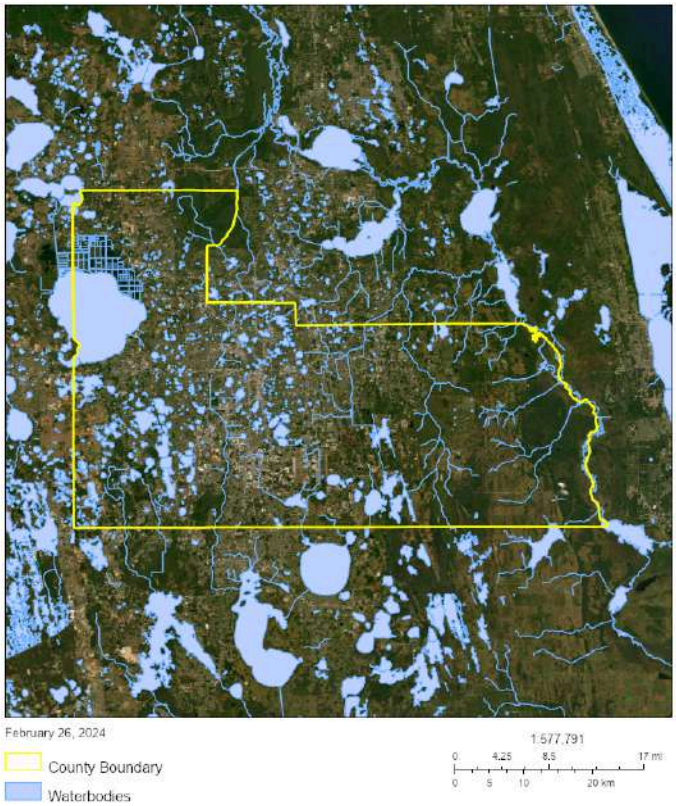
lakes and waterways, such as the Shingle Creek headwaters, provide pathways for potential pollution to travel as far as the Everglades (Environmental Protection Division) (Figure 2).

With Orlando's growing population, efforts to sustainably accommodate the city's growth are a priority in many facets of Orlando's government. Mayor Buddy Dyer first established Green Works Orlando in 2007 as an initiative to make Orlando an "economically vibrant, socially inclusive, and environmentally friendly city". Now known as the city's Office of Sustainability, Resilience, and Future-Ready, the city is continuing and expanding its efforts in pursuit of ambitious mid-century goals, such as becoming a Beyond Waste community; shifting toward alternative modes of transportation across the city, reaching 100% renewable energy, and preserving clean water. To aid in this mission, city leaders continue to search for new and innovative solutions across disciplines and demographics. In 2022, the City of Orlando became the 3rd city in Florida to a become Shores Forward partner with Ocean Conservancy, the nation's oldest non-profit organization dedicated to ocean protection. As partners, Orlando and Ocean Conservancy pledged to shine a spotlight on the issues such as plastic pollution facing the largest municipality on the I-4 corridor and provide an opportunity to highlight the interconnection across Florida's ecosystems

This study and report were commissioned by the City of Orlando and Ocean Conservancy through the Shores Forward partnership to aid and inform ongoing sustainability initiatives in Orlando and identify opportunities for new interventions.

OC, is there anything you would like to add here about Orlando's interest in joining Shores Forward and conducting the CAP?

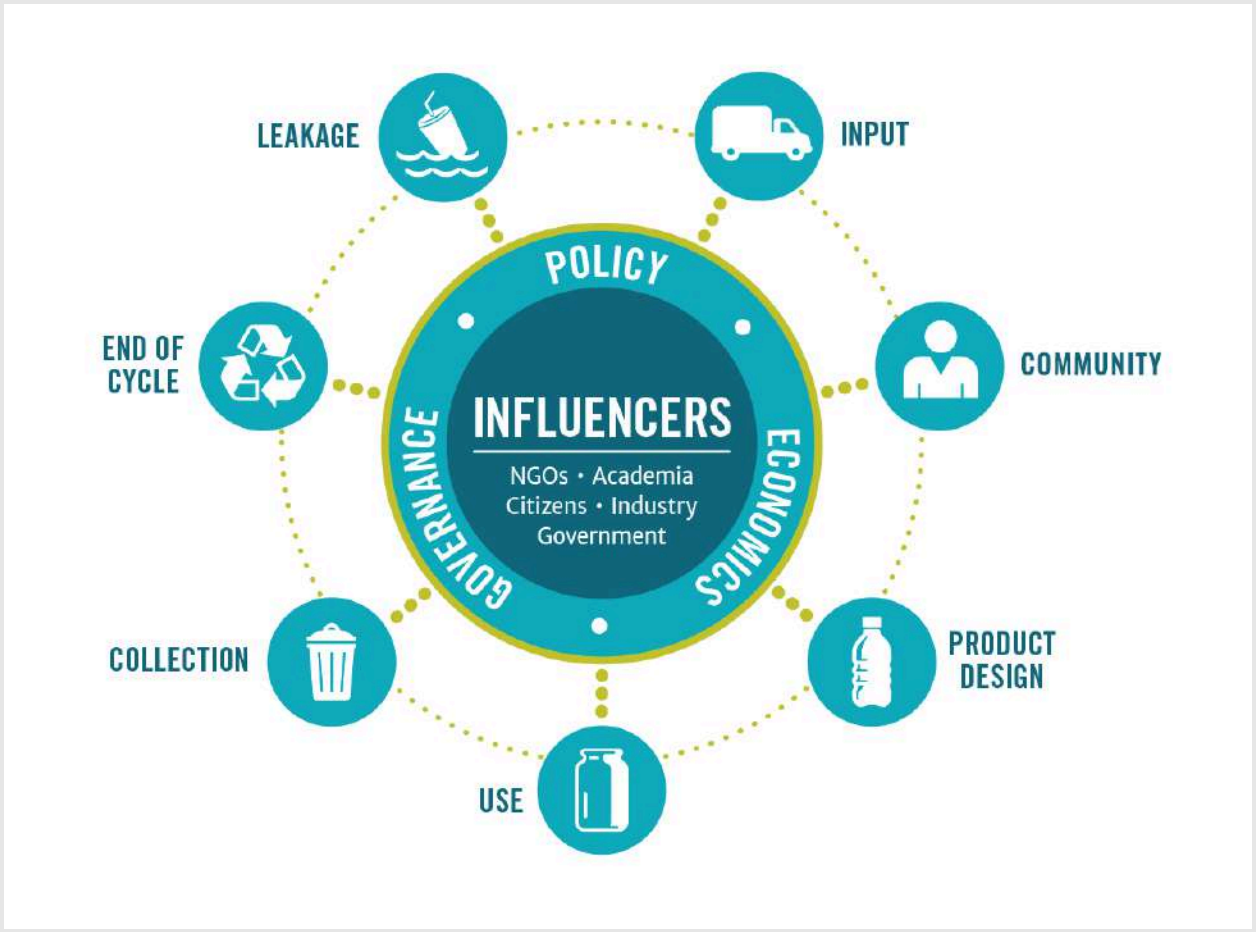
Figure 2: Water atlas of Orange County, Florida (USF Water Institute, 2024)



The Circularity Informatics Lab (CIL) at the University of Georgia (UGA) developed the Circularity Assessment Protocol (CAP) in 2018, which is a standardized assessment protocol used to collect community-level data to inform decision-makers (Figure 3). The CAP characterizes seven community components:

1. **Inputs** – What products are sold in the community and where do they originate?
2. **Community** - What conversations are happening and what are the stakeholders' attitudes and perceptions?
3. **Product design** - What materials, formats, and innovations are found in products, particularly packaging?
4. **Use** – What are the community trends around use and reuse of product types?
5. **Collection** – How much and what types of waste are generated? How much is collected and what infrastructure exists?
6. **End-of-cycle** – How is waste disposed? What is the fate of waste once it is properly discarded? How is it treated?
7. **Leakage** - What waste ends up in the environment? How and why is it getting there?

Figure 3: Circularity Assessment Protocol (CAP) hub-and-spoke model



Through the Shores Forward initiative, the Circularity Informatics Lab, Ocean Conservancy, and the City of Orlando partnered together to create a CAP. In May of 2023, CIL researchers visited Orlando to conduct fieldwork that included product and packaging assessments in stores across the city; key stakeholder interviews with government staff, industry professional, and representatives from non-profit organizations; material type characterizations for consumer plastic items; cost analysis of reusable products and

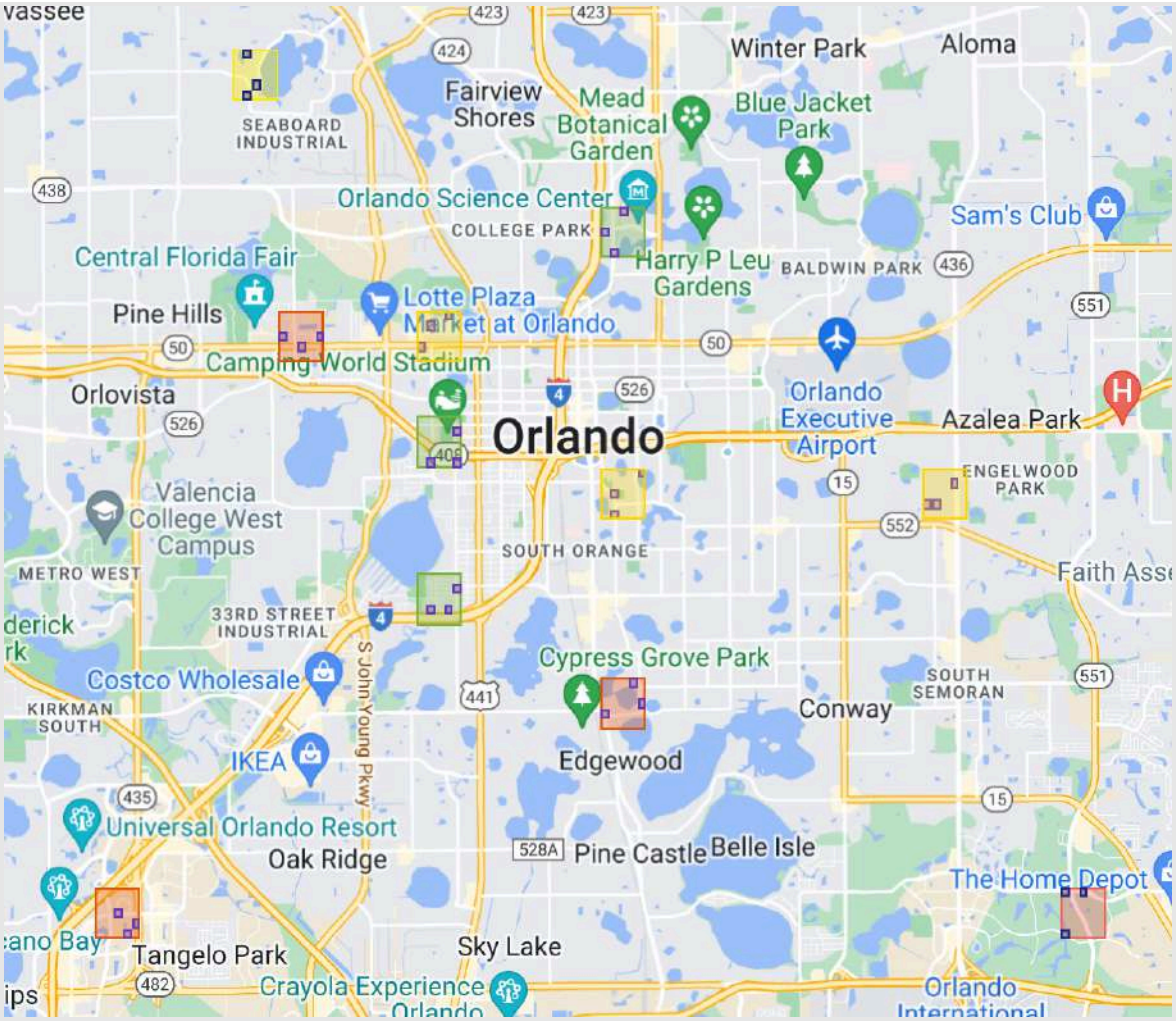
alternatives to plastic available in the city; visual audits of recycling contamination; identification of public waste and recycling collection bins; and litter transects in three categories of population.

The findings from this fieldwork are detailed across the CAP report inthe following sections, which include results and discussion of each: Input, Community, Product Design, Use, Collection, End of Cycle, and Leakage, followed by Opportunities. The intent is for the data in this report to inform ongoing stakeholder engagement around solutions to strengthen the circular economy and waste management in Orlando, FL.

Sampling Strategy

To randomly sample various locations in a city, the CAP typically identifies a 10 x 10km area over the city (with the center of the city in the center of the area). In this area, the ambient population is sectioned into tertiles (three groups) (Figure 4). Ambient population count can be described as "where people go" and "societal activity" — it is not population density of where people live. These three areas typically form samples of different land uses and other socioeconomic factors.

Figure 4: Population tertiles and survey sites in Orlando



Typically, three 1 x 1 km areas for surveying are randomly selected within each population tertile using NOAA's Sampling Design Tool, resulting in a total of nine 1 km^2 areas for surveying. In Orlando, two additional areas were sampled in order to include all six commissioner districts in the survey. The two additional areas were hand selected near the Orlando International Airport and in the Rosemont neighborhood; the rest of the areas were randomly selected. In total, 11 sites were surveyed, three in the high population count tertile and four each in both the low and mid population count tertile. Site selection was intended to provide a

representative distribution across sociodemographic factors, geographic regions, and commercial/residential activity.

CAP Findings

Input

To get a snapshot of the characterization, scope, and source of common plastic packaged items that are entering Orlando, samples of fast-moving consumer goods (FMCG) in four popular categories were taken within the nine 1 km^2 transects (Figure 5). The team selected three convenience or grocery shops to sample within each 1 km^2 transect area, where shops were present and open at the time of surveying. In total, 523 convenience products across 294 unique brands were sampled, including 233 candies (136 unique brands), 110 chips (55 unique brands), and 146 beverages (87 unique brands), and 34 tobacco products (16 unique brands), (Figure 5). Samples of identical brands were not purchased multiple times, even when present in multiple stores. Common brands of tobacco products were also visually assessed in stores, although samples were not purchased for size and weight analysis (see Product Design section).

Figure 5: Typical convenience store packaging in Orlando

For each of the top products documented, the team noted the type of packaging (including polymer, if possible), the brand, and the parent company. From there, the team was able to determine the manufacturing location, which was determined from manufacturing locations listed on product packaging or desktop research, as well as the headquarters location for the parent company of the brand (largely determined by desktop research) (Figure 6 and Figure 7). It should be noted that manufacturing locations for products in US are often difficult to find as companies are not required to provide this information online; therefore, if we were unable to find the manufacturing location of a product, we have used the parent company location as the manufacturing location for the estimations in this study. Manufacturer and parent company distances (Table 1) are utilized to estimate the distance in kilometers between the city and the origin of each product.

Top brands of each category, based on a visual assessment of shelf space in a store, conversations with shopkeepers, and repeated occurrence across stores, included the following:

- **Beverages**: Coca-Cola, Gatorade, Pepsi
- **Candy**: Reese's, M&M's, Hershey's
- **Chips**: Lay's, Doritos, Cheetos
- **Tobacco Products**: Marlboro, Newport, L&M

Table 1: Distances between Orlando city center and manufacturer and parent company locations for top FMCG convenience items

	Distance to Parent Company (km)				Distance to Manufacturer (km)			
	Min	*Max*	*Median*	*Avg*	*Min*	*Max*	*Median*	*Avg*
Beverages	73	12,622	1,553	2,374	23	15,320	1,551	2,341
Candy	0	17,387	3,505	4,390	0	17,387	1,605	4,701
Chips	153	17,387	1,553	2,687	280	17,387	1,547	2,476
Tobacco Products	124	7,391	849	1,594	124	14,116	861	1,540

*Note: Distances were projected using an Azimuthal Equidistant projection. Values have been rounded to the nearest km.

When distances between stores and manufacturing locations and parent companies are observed according to category, tobacco products on average had the shortest distances to travel for distribution. However, beverage and candy products both had certain products with both parent companies and manufacturers less than 100 km from the City of Orlando, though candy products also had the highest average and median distances for both manufacturer and parent company locations. Though some beverage and candy products originated from both a parent company and manufacturer that were less than 100 km from the City of Orlando, candies traveled the farthest average and median distance of all items. While median and average distances for products was fairly similar to other CAP studies in Florida, such as Miami, the overall distribution and spread for products were higher for Orlando. FMCGs found in Orlando were found to have originated in many more South America, European, and Asian countries when compared to CAPs in other cities in Florida.

Among beverages, 82% of products had manufacturing locations within the US. The most common originating countries for importing beverage products were Brazil and Jamaica. Several instances of only one or two products with manufacturers based in a variety of locations were also observed, including Europe (e.g., the UK, France), the Caribbean (Trinidad & Tobago, Puerto Rico), Central and South America (e.g., Colombia, Guatemala, Mexico, Guyana), and Asia and Southeast Asian (e.g., South Korea, Japan, Thailand). Single instances were also observed for beverage products from Iceland and South African.

Similarly, among chip products, 85% of products had manufacturing locations within the US. Importing countries for chip products included South Korea, the Philippines, Jamaica, Indonesia, Honduras, Guatemala, Ecuador, Costa Rica, and Canada.

Among tobacco products, 79% had manufacturing locations within the US. Importing countries for tobacco products included Nicaragua, Honduras, the Dominican Republic, Cuba, China, and Brazil.

Candy products had the largest proportion of imported products, with 62% of products having manufacturing locations within the US. Importing countries for candy products were predominantly China, Brazil, Mexico, South Korea, and Turkey. Other importing manufacturing countries for candy products included Trinidad & Tobago, Thailand, Switzerland, South Africa, Portugal, the Philippines, Pakistan, the

Netherlands, Japan, Indonesia, Greece, Germany, France, the Dominican Republic, Colombia, Chile, and Canada.

Figure 6: World map displaying manufacturing locations for top convenience items in Orlando

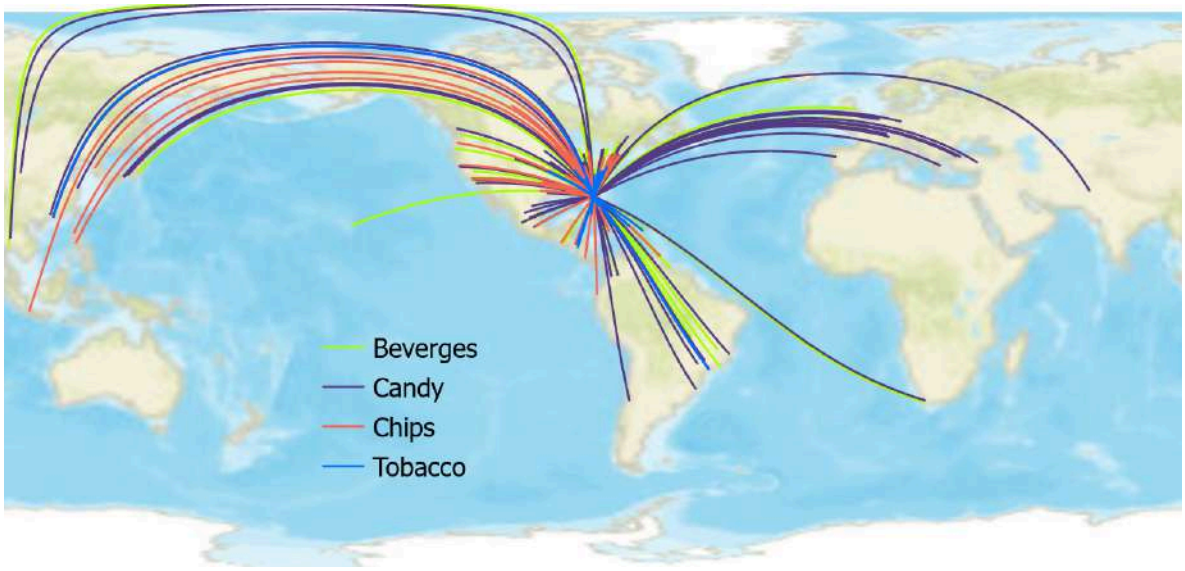
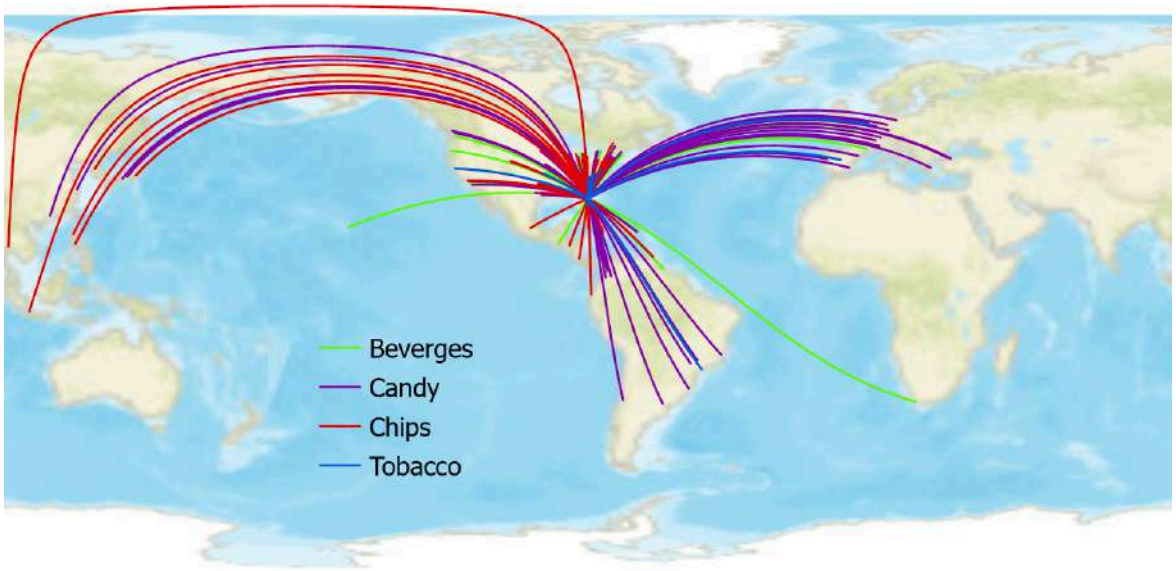


Figure 7: World map displaying parent company locations for top convenience items in Orlando



Tobacco products had the highest percentage of domestic parent companies, with 91% of tobacco product parent companies located within the US. Other tobacco product parent companies among those surveyed were based in Spain, Brazil, and Belgium.

Beverage and chip products had similar distributions of parent company locations. For beverages, 85% of products had parent company locations within the US. The most common international beverage product parent companies were based in Europe (e.g., the UK, France), Asia (e.g., South Korea, Japan), and the

Caribbean (e.g., Jamaica, Trinidad & Tobago). Other single instances were observed for beverages with parent companies based in Guatemala, Guyana, and South Africa. For chips, 82% of products had parent company locations within the US. Other chip product parent companies were based in a range of geographies, including the Caribbean (e.g., Trinidad and Tobago, Jamaica), Central and South America (e.g., Honduras, Ecuador, Costa Rica), Asia and Southeast Asia (e.g., Japan, South Korea, the Philippines), as well as other parts of North America (e.g., Mexico, Canada).

Candy products had the highest percentage of international parent companies, with 62% of parent companies located within the US. The most common international candy product parent company locations were Italy and Switzerland. Other common locations included Japan, Turkey, Brazil, South Korea, Germany, the Netherlands, Colombia, and China. Several instances of one or two products with parent companies based in a variety of locations were also observed, including the Caribbean (e.g., Trinidad & Tobago, the Dominican Republic, Jamaica, Puerto Rico), Asia and Southeast Asian (e.g., Korea, the Philippines, Indonesia), Europe (Spain, Greece, Portugal), and South America (e.g., Argentina, Spain, Chile).

Compared to other cities in Florida and across the US, Orlando had a higher quantity of unique brands from a wider diversity of locations. This speaks to the international and metropolitan nature of the city at-large. While diverse international supply chains could pose a challenge for whole-sector or product-focused change, it may also present a wider range of potential individual corporate partnerships and extended producer responsibility models.

Community

To understand current attitudes and perceptions of plastic use and waste, semi-structured interviews were conducted with seven key stakeholders. Among those interviewed, XX were government staff, XX were from private waste or recycling companies, and XX were from non-profit organizations (Table XX).

The context of policies surrounding single-use plastics and solid waste in the area are important to understand when it comes to community perceptions. Florida was the first state to enact a pre-emptive ban on local ordinances restricting the use of "auxiliary containers, wrappings, or disposable plastic bags" as well as the use of polystyrene (The 2023 Florida Statues). Although several local governments have sought to expand the use of alternative and reusable containers, the bill has remained in effect since 2008. As a result of this bill, Orlando cannot ban plastic bags or the use of polystyrene, but there is no language in the bill to prevent the restriction of plastic utensils, straws, plastic cups, bottles, and plates. The bill's language also indicates that local governments have the right to regulate the use of single-use plastics on their own property such as parks and sidewalks. In 2019, Orlando banned single-use plastic bags, straws, and plastic foam from all city events and venues (City of Orlando, 2024). During stakeholder interviews, some community groups and NGOs expressed interest in learning from other cities in Florida that have been trying to make local change, such as the Plastic Free 305 initiative, to drive business change, voluntary initiatives, and incentive programs.

According to a Florida State Statute, all counties oversee solid waste disposal facilities; local governments cannot develop their own plans for disposal unless approved by the county (The 2023 Florida Statutes). As such, the City of Orlando's Solid Waste Division must collaborate with Orange County to obtain approval to pursue development or plans related to solid waste.The city also has written into their code an exclusive franchise over all front load garbage services:

> **"That means anything collected in the front end load dumpsters, it's mandated that they use city services. It's an essential working monopoly. It's a common government structure to fund and supplement other types of services. They usually do this with solid waste or water reclamation so that you're able to provide that service for residents and then also supplement things that don't make money, like potholes and road maintenance… stormwater maintenance, things like that. Stormwater is an enterprise but other things like that, lake enhancement, lake quality, those things that don't really generate revenue."**
>
> – Government Staff Member

The City of Orlando has also been implementing a mandatory recycling ordinance with all commercial and multifamily properties. The ordinance has been phased in over a four-year period since 2019 to include an estimated 60,000 multi-family units. The introduction and implementation of this ordinance highlights a large success in community outreach and engagement between the city and the community.

> **"It [the recycling ordinance] was already demanded, so that definitely helped the entire outreach process. That's largely our saving grace today because a lot of property managers are very hesitant to move to implement something like that for either spatial reasons or financial reasons or restrictions, but their community wants it. As long as that want or that need exists at the community, they have to implement it."**
>
> – Government Staff Member

> **"In those initial periods, there was not a lot of pushback, but there was definitely some pushback. We're able to assuage a lot of that, and by the time it came to the city like town halls or the readings, like city council readings, passed both readings without any naysayers and was largely embraced by the community."**
>
> – Government Staff Member

The City of Orlando previously partnered with a variety of facilities ranging fromlocalanaerobic digestion to a composting facility to divert of organic waste from the city's jurisdiction. The city would like to restart an organics diversion program, but currently lacks the infrastructure to do so.

> **"We have everything we need to pick that back up once that infrastructure is available…. we are probably getting a grant. One of the things that was suggested was a mini recycling center. This is actually what most people said was going to be the most beneficial thing the city could do, like a mini recycling center, a drop-off center. If we get this grant, our plan is to make compost drop-off locations, three of them. One of them [at the Wastewater Treatment Facility], one at Fleet, one at Southwest Government Center"**
>
> – Government Staff Member

In Orlando, most interviewees agreed that a large issue for the city is the fact that there is no longer a MRF. The city also relies on a privately owned transfer station.

> **"The problem is that we don't have any autonomy, or we don't own our own transfer station, we're not a real stakeholder in that sphere. We used to have a MRF, and we used to have an anaerobic digestion facility**

at our disposal... We don't have either of those now... We're severely limited on our infrastructure which does dictate sometimes that our recycling goes to the landfill."

– Government Staff Member

> **"...we're pretty much at the hostage of private hauling. If they wanted to go much higher, which I believe they are going to, much higher than $65, we have no other way to recycle besides that, unless we start getting a lot more creative or start taking a lot more ownership over that infrastructure which doesn't exist in our area. We really have no options."**

– Government Staff Member

Another issue many interviewees agreed upon was the issue of illegal dumping.

> **"... that's a big issue, code enforcement, solid waste, those are the stakeholders there. I think there's just quite frankly a solid waste infrastructure issue with that, these folks don't have access to a dumpster. They just don't. There aren't many over there and, if there are, they're not using them for one reason or another and there's just not as many. There's not recycling dumpsters in parks anymore, we took those out"**

– Government Staff Member

> **"There used to be more dumpsters out in the open there for a while with solid waste...That invited illegal dumping. One by one, slowly by slowly, those went away. We just learned if they're not being really watched and governed closely, that's what happens."**

– Government Staff Member

When discussing goals for the future, common themes among interviewees included acquiring a MRF as well as creating opportunities for residents to dispose of hazardous materials and hard-to-recycle materials.

> **"My biggest concern for the rest of my duration of the city is going to be to facilitate in any way that I can, acquiring or the production of a MRF. That's something that's largely out of our control. We have some influence, but financially and operationally, we have almost none."**

– Government Staff Member

> **"I think the dream is that one day you can bring your compost, you can bring a tire, you can bring your mattress or electronics, or Styrofoam, we talked about getting a Styrofoam densifier for these locations. They're just like a hub where it's a catchall. The idea is that solid waste is involved but not integral."**

– Government Staff Member

"The city doesn't have household hazardous waste collection. We don't have it from a waste management perspective. We don't even do events for it... [It's] Something we would like to do down the road."

– Government Staff Member

Interviewees often mentioned the ease with which the city is able to work with the community and each other when solving problems or introducing new policies.

"That was a great benefit that the city had that a lot of other haulers don't have, that boots-on-the-ground interface between the community and the hall."

– Government Staff Member

"I have a lot of confidence in the direction that Orlando is going, and I also know that because of our name recognition and because of what security we have in that, it gives us an opportunity or a platform to be able to talk to the programs. I always thought that was the most important thing about the smaller, less impactful programs that we were putting a lot of resources and effort towards."

– Government Staff Member

When asked about public perception of pollution and littering in Orlando, interviewees shared:

[Said as the perspective as a tourist] "I'm on vacation, so I'm entitled I get to do whatever I want to because I'm paying to be here so someone else pick it up. That's a mentality as well"

– Government Staff Member

[In reference to littering] "During the hurricane, everything was full, so it couldn't go anywhere. People really started understanding it doesn't just stay in Orlando. Our stormwater system is headed on over to the river. It really starts at home and it starts with education and just don't put it on the ground."

– Government Staff Member

[in reference to Gen-Z views on pollution] "they have that lack of faith that anything is going to change about it. I personally can bring cloth bags to the store, but they are like, "Why do I care when this company is going to put this much CO2 in the atmosphere anyway?"

– Government Staff Member

"Obviously, in Florida, everything washes into our waterways, making that connection with people, and they're like, "Oh, I didn't realize it goes all the way to the ocean." That helps. That definitely gives them a better reason not to litter."

– Government Staff Member

One example of an initiative that has worked well in Orlando to help support community awareness of the connections between people, waste, and the environment is the Education Center at the city's Conserv II Water Reclamation Facility (Figure 8). Tours are free and the center features interactive educational components on wastewater, stormwater, water quality, conservation, litter, waste, recycling, and other relevant topics. Staff are also able to conduct educational outreach to schools and groups in the community, enabling key messaging to reach a range of ages and audiences across the city.

Figure 8: Example of educational materials at the Conserv II Water Reclamation Facility in Orlando (Photo Credit: CIL)

From these interviews, common issues mentioned by government staff included the lack of a MRF, governmental restrictions when making solid waste infrastructure plans, illegal dumping, and community members' and tourists' perspective on littering. While several suggestions were made regarding future opportunities and potential improvements, stakeholders also frequently mentioned the progress that has been made in Orlando in recent years, particularly related to the Beyond Waste Initiative and other efforts across the Office of Sustainability, Resilience, and Future-Ready, and the general outlook for the future of sustainability in Orlando was overall positive.

Product Design

To characterize material types used in common consumer products, samples of common convenience were obtained, as described in the Input section. The CIL team sampled stores in each of the eleven 1km^2 transects areas. Only unique forms and brands were purchased to obtain packaging weights and exclude duplicates. The average weight of both the packaging and the product itself was collected for all samples (Table 2).

Table 2: Average weight of products and their plastic packaging for common convenience items

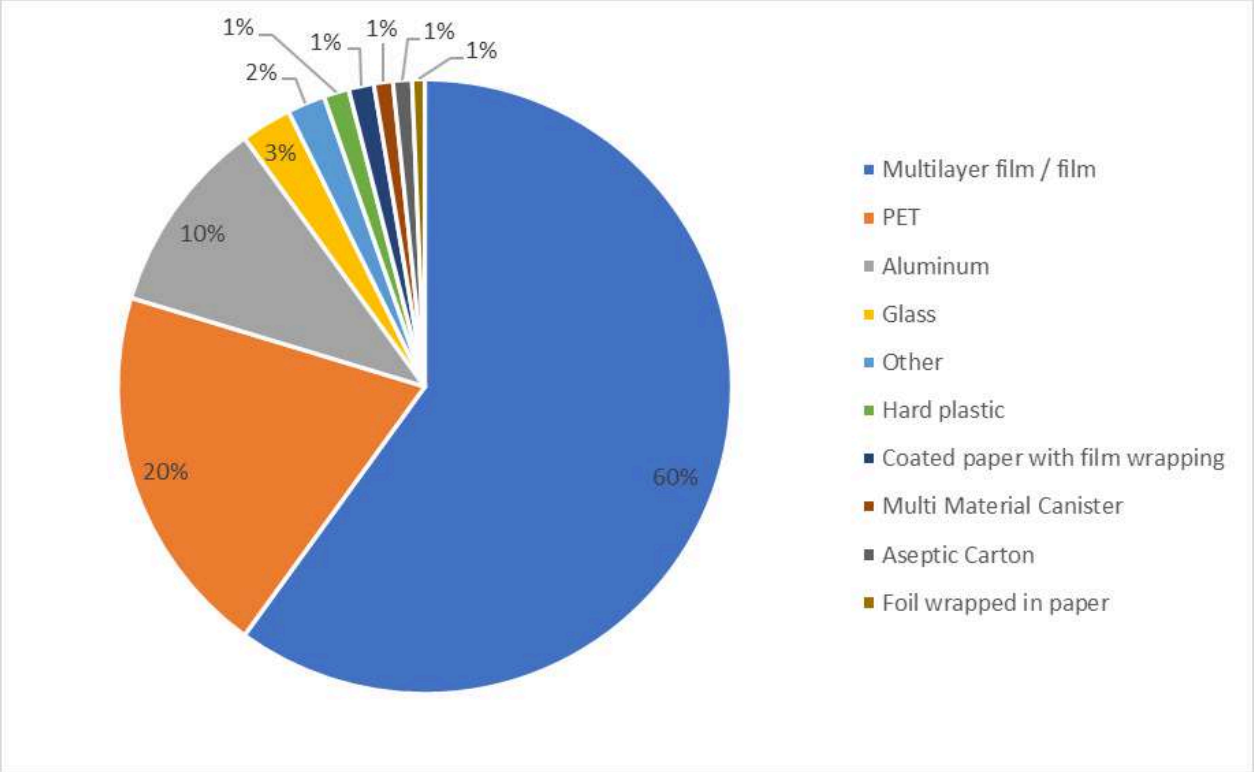
Product Type	Number of Samples	Average Weight of Plastic Packaging (g)	Average Quantity of Product (g or mL)
Beverages	87	29.96	484.6
Candy	136	8.78	45.9

Chips	55	8.12	77.6

Interestingly, candy had a significantly higher average weight of plastic packaging in Orlando than CIL has encountered in other U.S.-based CAP studies. For example, in Miami, the average weight of plastic packaging for candy was 1.4 g relative to the average quantity weight of product of 42.6 g. While the quantity weight was similar in both Orlando and Miami, the weight of plastic packaging was significantly higher at 8.78 g in Orlando. A similar trend was found when assessing the average weight of plastic packaging for chips, with an average of 8.12 g in Orlando, and 4.7 g in Miami. This finding is particularly interesting as the average quantity of product for chips in Orlando is lower than in Miami, with 77.56 g vs 81.7 g, respectively. This means the ratio of packaging weight to product quantity found for chips and candy is higher in Orlando than in Miami. The ratio of plastic packaging to quantity of product for beverage is similar for Orlando and Miami. In Miami, the average weight of plastic packaging for beverages was 27.5 g and the average quantity of product was 458 g.

Cigarettes were excluded from the samples purchased in this case, but they are typically a standard size and we have previously found an average of about 10 g of plastic packaging as compared to about 15 g of product. This relatively high plastic packaging to product ratio means cigarettes generate larger amounts of plastic waste per unit of product, which is likely driven by the cellulose acetate filters in cigarette butts, which typically weigh about one gram each. For each convenience item surveyed, the CIL team documented the polymer type as shown on the label or packaging (Figure 9).

Figure 9: Material breakdown of all convenience item packaging in Orlando

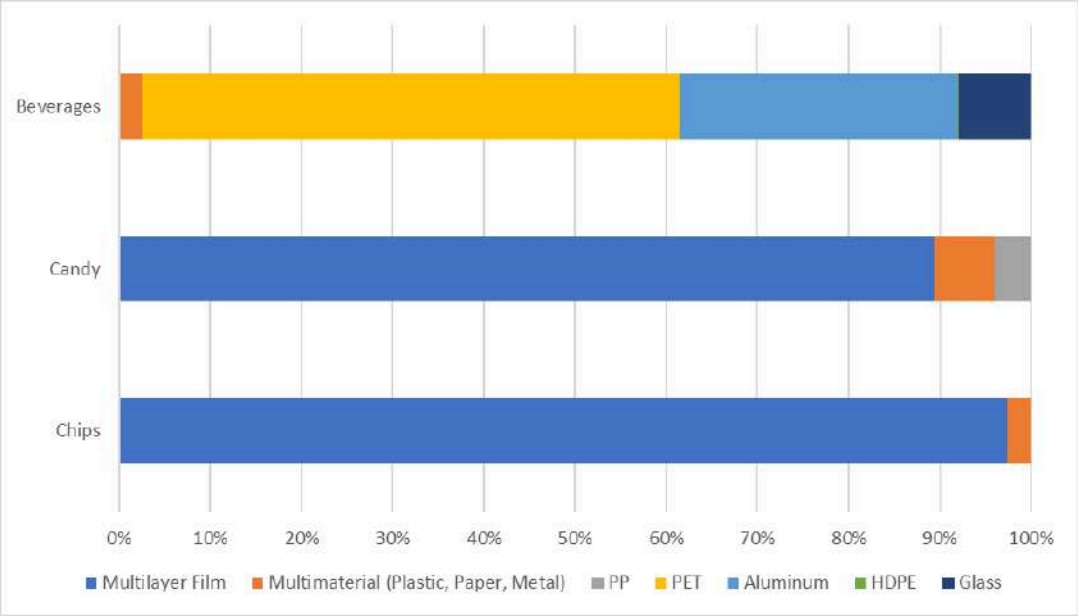


Across all convenience products sampled, multilayer plastic film was the most common packaging type (60%), followed by PET (20%) and aluminum (10%). All other packaging material types, such as aseptic cartons or multi-material packaging, comprised less than 5% of all samples. In Miami, multilayer film/film was also the most common packaging type, making up 61.8% of convenience items, followed by PET (9.8%),

and PP (9.8%), It is important to note that items packaged in non-plastic alternatives, such as aluminum or glass, were not documented among convenience products sampled in Miami.

When observed by product type, multilayer plastic film is still the most common packaging type for chips (97.4%) and candy (84.6%), while PET is the most common packaging type for beverages (58.9%) (Figure 10). Other material types observed in beverage packaging, such as aluminum, glass, and HDPE, are readily recyclable materials. Candy products had the widest diversity of packaging material types and the most common examples of multi-material packaging, such as metal foil with single-layer plastic film or coated paper with single-layer plastic film. Such multi-material items can be difficult to recycle, as they contain not only different materials but a range of adhesives and additives. Lightweight, complex, and difficult to recycle packaging materials such as multilayer plastic or multi-material containers should be prioritized for redesign, EPR schemes, deposit models, and other interventions to minimize their likelihood of escaping the waste stream and ending up in the environment.

Figure 10: Material breakdown of all convenience item packaging surveyed in Orlando by category

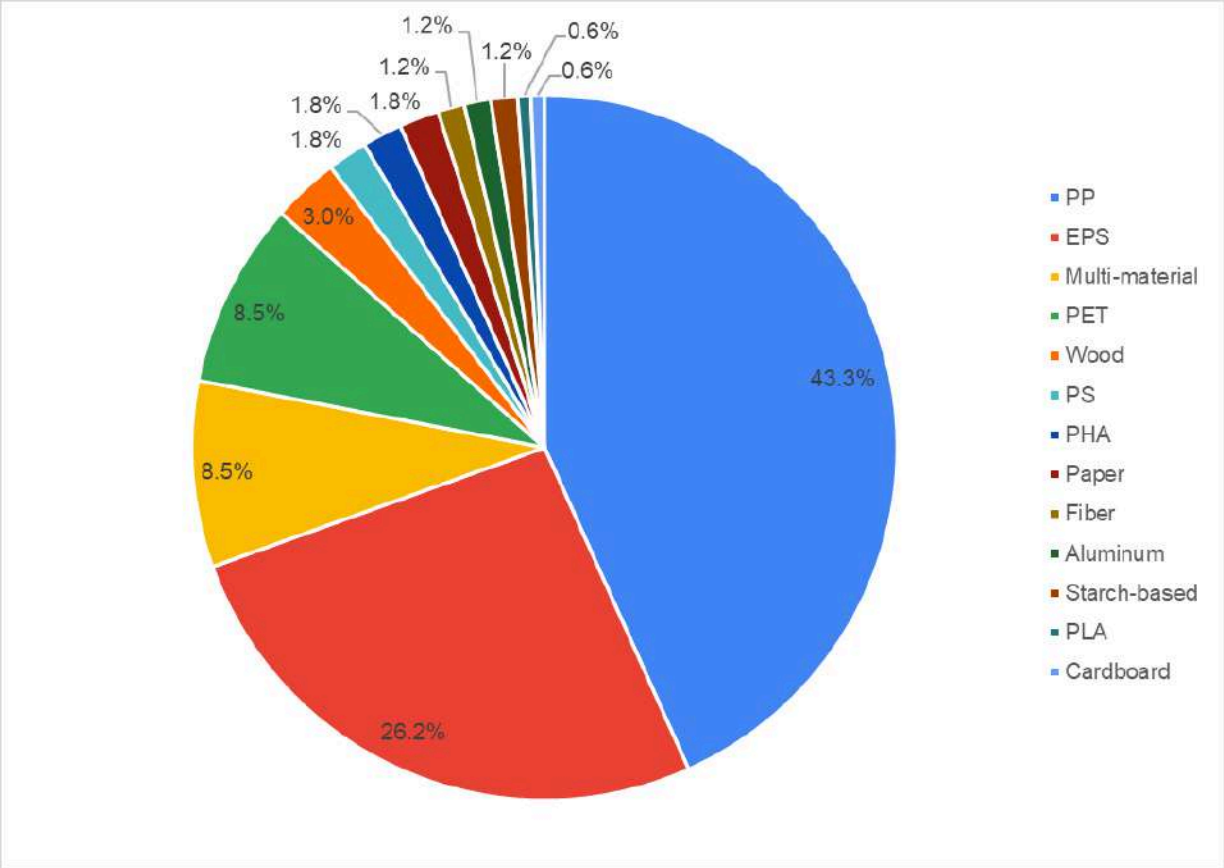


In addition to surveying convenience and grocery stores, the CIL team surveyed restaurants and food vendors in each of the eleven 1 km^2 transects areas. Through visual assessments and discussions with restaurant owners, CIL assessed the material type for to-go food items like containers (including their lids), cups, utensils, and straws. In total, the team characterized a total of 162 items in 47 restaurants (Figure 11).

Figure 11: Example to-go materials surveyed in Orlando

Across all to-go items sampled, PP was the most common material type observed (43.3%), followed by EPS (26.2%), PET (8.5%), and multi-material containers (8.5%) (Figure 12). PP, EPS, and PET were also the top three most common to-go items material types observed among restaurants and food vendors in the Florida Keys. All other material types, such as wood, paper, aluminum, and compostable plastics, represented less than 5% of the materials observed in Orlando, respectively. In total, non-plastic materials comprised around 8% of the to-go items sampled, while those labeled as biodegradable and/or compostable plastic (such as PLA. PHA, and starch-based plastic) comprised around 4% of the to-go items sampled. Comparatively, among plastic alternative to-go items found in both Miami and the Florida Keys, around 10% were categorized as "compostable" plastic products, predominantly PLA, and alternatives such as paper comprised up to 11% of the entire sample of material types.

Figure 12: Material breakdown of all to-go items surveyed in Orlando, FL



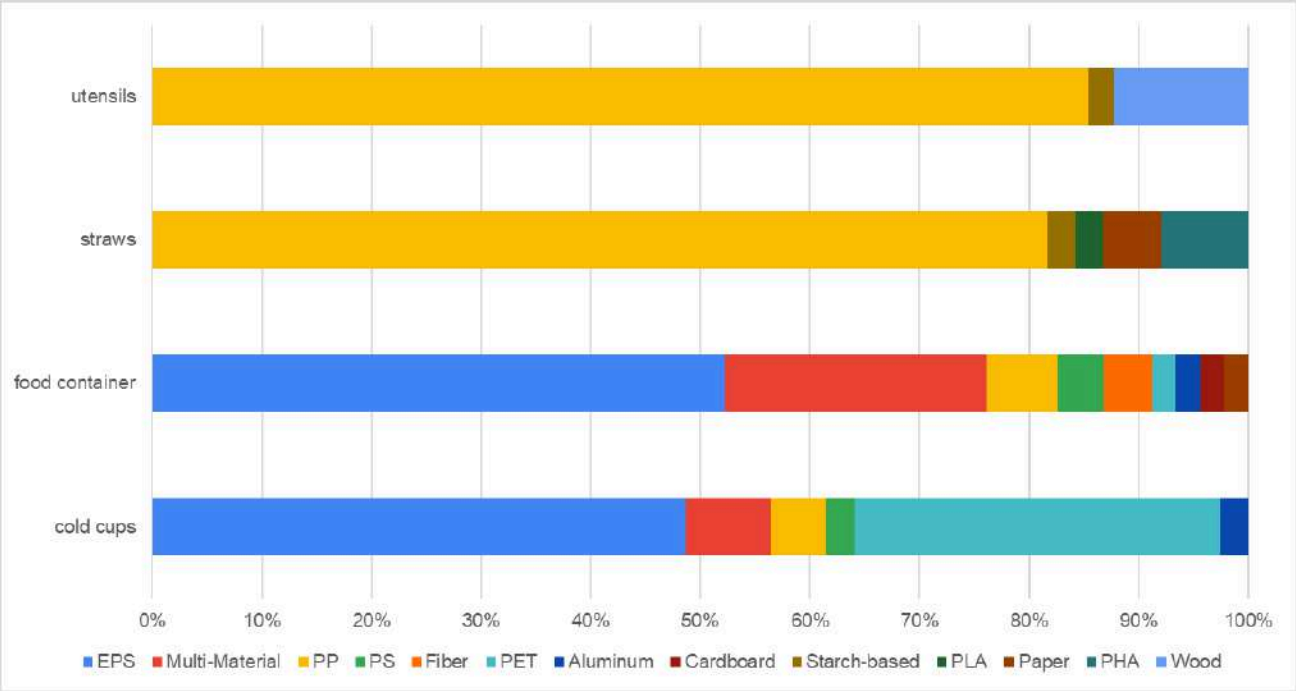
When observed by item type, PP was the predominant material type observed for utensils (85.4%) and straws (81.6%), while EPS was the predominant material type observed for food containers (52.2%) and cold cups (48.7%) (Table 3). Food containers demonstrated the highest diversity of material types, which was also the case for to-go items sampled in Miami. Comparatively, cups sampled in the Florida Keys had a higher percentage of non-plastic and compostable options such as paper and PLA, though innovative materials for utensils were not as commonly observed.

Table 3: Products and material types surveyed in restaurants and food vendors in Orlando, FL

Product	Material Type	Number of Observations
To-Go Food Containers (including lids, if applicable)	EPS (foam)	24
	Multi-material	11
	PP	3
	PS (hard)	2
	Fiber	2
	Aluminum	1
	PET	1
	Paper	1
Cups	EPS (foam)	19
	PET	13
	Multi-material	3
	PP	2
	PS (hard)	1
	Aluminum	1
Straws	PP	31
	PHA	3
	Paper	2
	PLA	1
	Starch-based	1
Utensils	PP	35
	Wood	5
	Starch-based	1

Based on the to-go items sampled in Orlando, there were more plastic alternatives (stemming from a wide variety of material types) available for straws and utensils, while cups and food containers were still largely dominated by single-use plastic (Figure 13). A similar pattern was observed among to-go items in Miami.

Figure 13: Material breakdown of to-go items surveyed in Orlando by category



One challenge referenced in stakeholder interviews was the transient nature of some food distribution services. For example, several churches in Orlando distribute food to homeless communities around the city. This is a service that is needed, though the food is most commonly served in EPS/foam that are later left behind after the event is over and the distributor has departed. Discussions around the type of materials that are distributed in those situations and how they might be managed after they are used would be valuable.

"We have established citywide policies that can be reflected and applied throughout the city. The problem is a lot of that just is pre-empted. The good news is we have that model waiting. The bad news is that sometimes, we can't implement it because of state-level regulations."

– Government Staff Member

For stationary and/or longer-term events, the city has developed a Green Events Guide. Park event permits requires hosts to present a solid waste plan. The permit process also requires there to be no single-use plastics for events with 100+ attendees. However, there aren't measures for consistent enforcement or penalization if these guidelines are not followed. Stakeholders noted that it would be valuable to develop consistent codes, more enforcement and accountability, and potentially a dedicated group for monitoring these events so that penalties can be distributed as needed.

Use

To understand patterns of use and reuse for plastic products in Orlando, alternatives to plastic and their respective prices were documented where available in the area. In addition to convenience products, common household and personal care products were also sampled at 33 large grocery stores in the Orlando area (Table 4). For each product category, the CIL team recorded those packaged in single-use packaging and any options available in alternative packaging, such as refillable containers, biodegradable/compostable packaging, packaging made from recyclable or recovered material, or in concentrated product form. The costs per unit were compared across those options to investigate differences between single-use plastic

options and alternative options. In most cases, the alternative options were over 100% more expensive than the single-use plastic products.

Table 4: Cost comparison of alternatives and single-use plastic packaging at stores in Orlando, FL

Product	Alternative Type	Cost of Alternative (USD/unit)	Cost of Single-Use Plastic Packaging (USD/unit)	Cost Difference for Alternative (Avg %)
Body Wash	Alternative material	$0.03	$0.02	11.12%
	Concentrated	$0.44	$0.53	-17.66%
	Refillable	$0.13	$0.01	974.1%
Bowls	Alternative material	$0.08	$0.06	1,505%
	Compostable	$0.22	$0.05	579.3%
Cleaning Wipes	Alternative material	$0.00	$0.00	32%
	Compostable	$0.16	$0.03	517.5%
Conditioner	Alternative material	$0.16	$0.04	349.4%
	Refillable	$0.03	$0.01	105.4%
Cups	Alternative material	$0.26	$0.05	305.2%
	Compostable	$0.33	$0.09	268.3%
	Reusable	$0.67	$0.12	459.8%
Deodorant	Alternative material	$0.15	$0.12	37.89%
Dinner Plates	Alternative material	$0.13	$0.17	15.31%
	Compostable	$0.17	$0.05	274.3%
Dish Soap	Refillable	$0.01	$0.02	-42.03%
Hand Soap	Alternative material	$0.02	$0.01	59.80%
	Concentrated	$0.06	$0.02	131.7%
	Ocean-bound plastic	$0.01	$0.02	-71.78%
	Refillable	$0.03	$0.01	79.77%
Household Cleaner	Concentrated	$1.63	$1.09	82.31%
	Refillable	$0.01	$0.01	126.9%
Laundry Detergent	Alternative material	$0.01	$0.005	35.02%
	Concentrated	$0.02	$0.005	328.9%
Sandwich Bags	Alternative material	$0.07	$0.06	74.9%
	Compostable	$0.14	$0.02	518.6%
	Reusable	$5.44	$0.03	16,984%
Shampoo	Alternative material	$0.09	$0.03	175.6%
	Compostable	$0.04	$0.01	312.7%
	Refillable	$0.03	$0.01	105.4%
Small Trash Bags	Compostable	$0.18	$0.06	189.6%
Snack Bags	Reusable	$5.37	$0.04	1,3346%

Straws	Alternative material	$0.07	$0.02	254.7%
	Compostable	$0.07	$0.02	330.2%
	Reusable	$1.44	$0.01	10,162%
Utensils	Alternative material	$0.05	$0.02	150%
	Compostable	$0.15	$0.06	161.8%

When compared across use type, the most expensive products were those available in reusable format, such as snack and sandwich bags (Table 5). This is consistent with findings from CAPs in other US cities, including Miami and the Florida Keys. There were only three instances where the alternative option was cheaper than the single-use plastic option in USD/unit on average, and that was from a concentrated body wash, refillable dish soap, and hand soap made from ocean-bound plastic packaging (Figure 14). Costs were more comparable (e.g., 10-60%) for alternative materials as opposed to different formats, such as paper items.

Figure 14: Examples of single-use plastic and alternative use options in a grocery store in Orlando(Photo Credit: CIL)

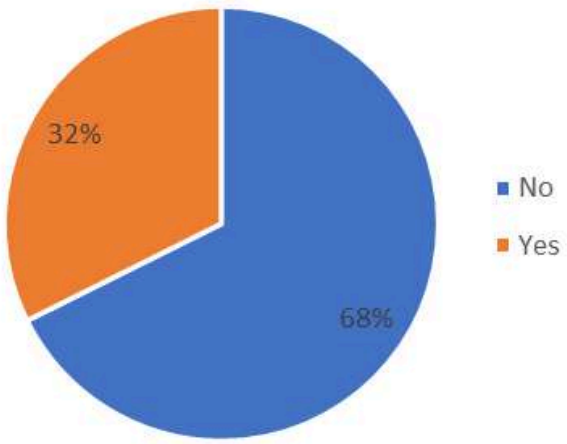
Table 5: Cost comparison between single-use plastic and alternative use types

Use Type	Average Cost Difference for Alternative
Alternative material	13.70%
Compostable material	20.63%
Concentrated formula	7.05%
Ocean-bound plastic material	-4.59%
Refillable format	6.39%
Reusable format	868.3%

For each grocery store and convenience store sampled, it was also noted whether reusable or single-use shopping bags were offered or available at check-out, their material, and the cost differences between the

options. Ninety-seven percent of stores offered predominantly HDPE plastic takeaway bags, and only three stores offered paper bags at check-out free of charge as an alternative option to plastic (Figure 15). Among all stores sampled, only 32% offered reusable bag options, all of which were offered at an additional cost to the consumer between $0.69 and $4.00.

Figure 15: Breakdown of stores and restaurants/food vendors in Orlando that offered a SUP alternative or reusable bag option



Among the reusable bag options available, which included fabric or thicker plastic bags, the average cost was over $2 more per bag than standard single-use plastic shopping bags that were available (Table 6). Film plastic bags were typically available for no extra charge to the customer. A similar pattern was observed for bag surveys in Miami and the Florida Keys, which could be due in-part to the current pre-emption laws related to single-use plastic bans in the state of Florida.

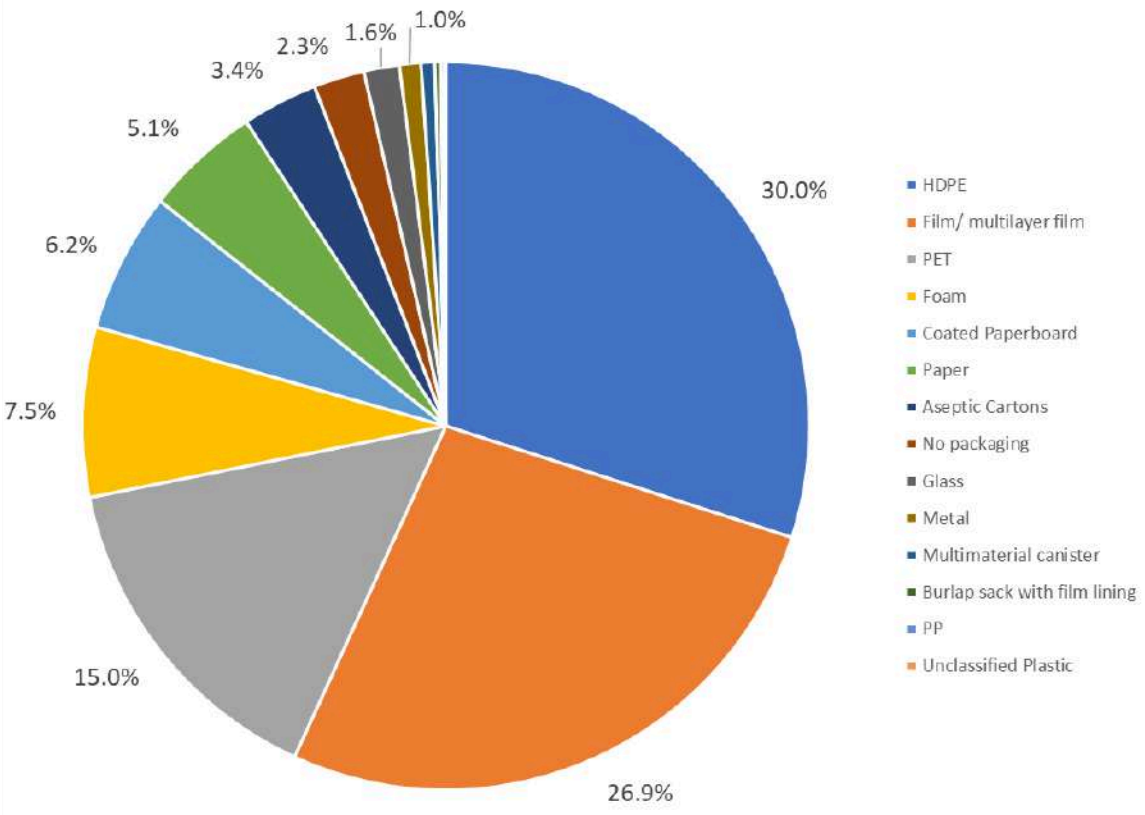
Table 6: Bag Survey for restaurants and stores in Orlando

Reusable Bag Type Offered	Average Cost for Reusable Bag	Count of Reusable Bags Surveyed
Fabric	$3.13	7
Thick Plastic	$1.66	15

Consumer staples are common products in people's lives, such as food and hygiene products (Figure 16). Staple items are in constant demand and the volume of packaging is widespread and consistent. These items also make up a substantial portion of household waste generation. The breakdown of packaging material types for staple products was documented in all 33 grocery stores surveyed in Orlando by visual survey (Figure 17).

Figure 16: Example of staple packaging analysis in grocery store in Orlando (Photo Credit: CIL)

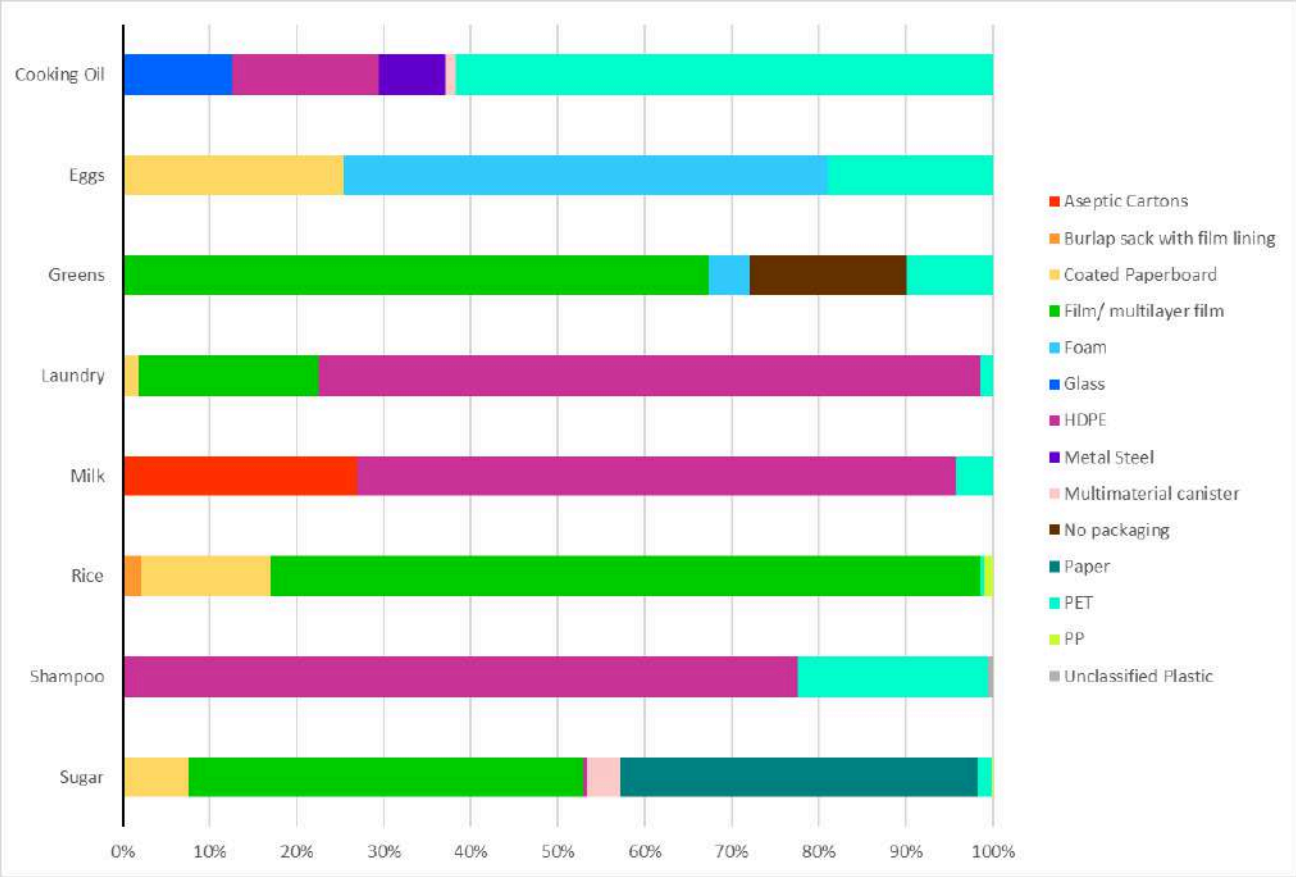
Figure 17: Material breakdown of staple packaging surveyed from grocery stores in Orlando FL



The consumer staples items surveyed in each grocery store were cooking oil, eggs, greens or vegetables, laundry products, milk, rice, shampoo, and sugar. For each product, the CIL team conducted a visual survey on the percentage composition of material types – for example, among all milk products, CIL documented the percentage packaged in aseptic cartons/Tetrapak, glass, HDPE, or other material types based on what

was shown in the shelf space. HDPE, film, and multilayer film comprised most of the packaging for staple products, followed by PET and foam (Figure 18).

Figure 18: Material breakdown of staple item packaging surveyed from grocery stores in Orlando, based on item



The packaging type varied with each staple product; however, plastic overall comprised 72.1% of all staple packaging. Out of the staple products analyzed, HDPE was found in most abundantly in milk, shampoo, and laundry products. Film packaging was also common across greens, rice, and sugar products. PET makes up the majority of cooking oil packaging. Out of all staple packaging, the most unique form of packaging was burlap packaging for large quantities of rice (Table 7).

Table 7: Percentage breakdown of staple packaging by product at grocery stores in Orlando, FL

Staple Product	Packaging Type	Percentage
Cooking Oil	PET	61.8
	HDPE	16.9
	Glass	12.6
	Metal/ steel	7.6
	Multi-material canister	1.1
Eggs	Foam	55.6
	Paper / paperboard	25.4
	PET	19.0

Greens	Film	67.3
	No packaging	18.1
	PET	9.9
	Foam wrapped in film	4.8
Laundry	HDPE	76.0
	Film	20.8
	Paperboard	1.8
	PET	1.4
Milk	HDPE	68.8
	Aseptic Cartons	26.9
	PET	4.3
Rice	Film/ multilayer film	81.5
	Paper/ paperboard	15.0
	Burlap sack with film lining	2.1
	PP	1.1
	PET	0.4
Shampoo	HDPE	77.6
	PET	21.9
	Unclassified Plastic	0.5
Sugar	Film/ multilayer film	45.5
	Paper	41.2
	Coated Paperboard	7.5
	Multi-material canister	3.8
	PET	1.6
	HDPE	0.4
	PP	0.2

There were few opportunities for refillable packaging among staple products in Orlando. Exceptions included smaller boutique stores whose prices were higher than those for single-use plastic or disposable packaging products available in the large grocery stores (Figure 19). Several stakeholders noted that there were very few options for residents in Orlando when it came to reuse stores and that they would like to see more of these types of stores open. However, some also mentioned the difficulties in making businesses such as reuse and refill profitable and said that several had opened and quickly closed in the area in recent years.

Figure 19: Example of plastic-free products available at a reuse/refill store in Orlando

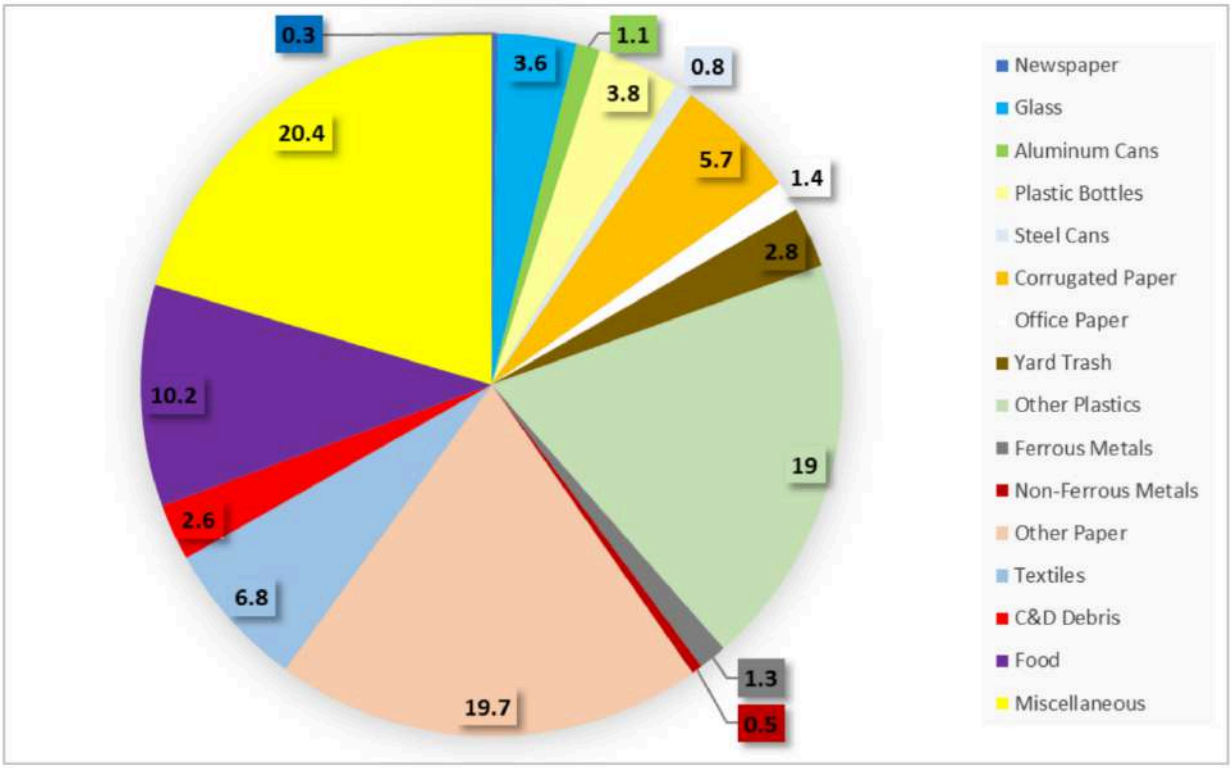
Based on conversations with stakeholders, shopkeepers, and members of the public, there is interest in having more options for reuse and refill, as well as boutique stores that offer plastic-free and packaging-free options. There could be opportunities to foster local entrepreneurship and bolster local brand identities through this work as well. Some of these opportunities are....

Collection

The City of Orlando's Solid Waste Division oversees all residential and front-end business for waste collection in Orlando. A service fee is funded through the local utility bill ($28.70/month), which includes garbage, recycling, bulk, and yard waste pickup once per week. The SWM fleet runs 25-30 routes per week and includes side loaders, claw trucks, and rear loaders. In the surrounding municipalities that are included in Orange County, solid waste collection is handled by the Orange County Solid Waste Division. They offer curbside garbage and recycling, bulky items, and yard waste pick-up once per week. Street sweeping has nine teams that operate during the day and three that operate in the evenings, with a goal to cover every street within the city of Orlando every two weeks.

In 2007, the ~~city~~ City of Orlando collected 91,135 tons of commercial solid waste and 71,292 tons of residential solid waste. The residential solid waste was made up of 46,878 tons of garbage, 20,349 tons of yard waste, and 4,065 tons of recycled waste (Solid Waste Element, 2009). In Orange County at-large, 3,646,696 tons MSW was collected in 2022. Among that, 2,711,600 tons were landfilled, and 935,096 tons were recycled (FDEP, 2023). Based on a waste characterization study conducted at the Waste Management MRF in 2019, plastic products (including a combination of both Plastic Bottles and Other Plastics) comprised nearly 23% of MSW generated in Orange County, which is twice as higher as ~~than~~ the national average of around 12% based on data from 2018 (Figure 20; UF, 2019; EPA, 2023).

Figure 20: Solid Waste Composition of Orange County from University of Florida 2019 (UF, 2019)



Though household hazardous waste is not picked up curbside, residents have a few options for drop-off in Orlando and the surrounding areas. Household hazardous waste is accepted at the Porter Transfer Station and the Orange County Landfill. Yard Waste is accepted at the Porter Transfer Station and the McLeod Road Transfer Station. C&D waste can be brought to the Orange County landfill or the WM transfer station.

For organics, the city provides free backyard composters for single family homes that request it. The composter provided is city property and must stay at the same address if the family moves. More information is provided by the city online for residents; this information includes a composting guide, helpful tips, and videos for composting at home (City of Orlando, 2024). Yard waste comprising of grass clippings, leaves, branches, and twigs is collected curbside once per week through the city as well. As discussed previously, there is strong interest in pursuing a commercial composting facility in Orlando. Recently, the city applied for an EPA Solid Waste Infrastructure Grant to support smaller compost drop-off facilities coupled with other waste diversion efforts such as swap shops, repair facilities, grease recycling, and others.

On the commercial side of waste collection, there is an exclusive franchise over all front-end loading garbage services whereby commercial operations are required to use the city's services. The SWM fleet runs around 13-15 commercial routes daily.

For the roll-off market, including all open-top containers and compactors, there are around 26 different haulers available in Orlando. The city's SWM office is reportedly the fifth-largest hauler in terms of customers and capacity, servicing around 50-60K single family homes, equivalent to about 20% of the county's households. The SWM office pays regular fees to the city's general fund to operate as an independent service provider and must follow all the same rules and regulations as private waste haulers.

The city's SWM office also competes with private and independent haulers for recycling Pin the city. There are around 20 recycling haulers in Orlando that residents and commercial operations can select from. Residents have the option of paying their waste utility bill and having their waste collected through the city or omitting their utility bill and paying through a private company. The city picks up recycling curbside weekly and requires the recyclables to be free of bags. For those who may not have access to recycling, the city has recycling drop-off locations at Dover Shore Community Center, Engelwood Neighborhood Center, Northwest Community Center, and the Solid Waste Management Division (City of Orlando, 2024).

"We [the city] are the recycler of convenience. We see that a lot when we're providing their front- end load service or garbage, they'll be like, "Can you guys add a recycling container to us, too?" Plus, we just recently mandated that for all multifamily and commercial properties that they have to have some sort of recycling.

- City SWM Staff Member

For those outside the jurisdiction of the city, Orange County also offers residential recycling services. They have recycling drop-off locations at the Orange County Landfill, McLeod Road Transfer Station, and Porter Transfer station as well (Orange County Government 2024). Several recycling drop-off sitesare also available at a smaller scale through local public and private entities (Figure 21).

Figure 21: Examples of drop-off locations for different types of materials, publicly and privately, across Orlando (Photo Credit: CIL)

In April 2023, Orlando completed its four-year phasing-in process requiring all multi-family homes and commercial properties to have recycling hauling services. The ordinance requires properties to provide a recycling verification form to the city, to provide access to the property for collection, and establish a hauling service provider. At the individual household level for the city, recycling is still voluntary. Orange County is required by the state to issue garbage and recycling carts to every single-family household, but the city is not mandated for mandatory programs at the state level. As such, city residents for single-family households must opt in for recycling, and the city SWM office found their contamination rates are lower than county-wide rates.

"What we [the city] have found, and again this goes back to our flexibility, it allows us to create that need. If a resident wants to recycle, they have to opt into a program, which in theory would make them a better recycler because they went out of the way to request this and they care enough to learn about the actual guidelines of the program. We've actually have seen lower contamination rates than in the county when you hold it to other mandatory programs. We have lower contamination and not as high of participation."

– City SWM Staff Member

While private haulers often contract out their collection and bin maintenance, the city's SWM office does all their own inventory management. The office also has their own call center to field customer questions and concerns, where a staff of 8 people received between 1,200-1,800 calls per week. Staff cited the benefits of institutional knowledge, updated software to balance asset distribution and maintenance, and in-house operations in optimizing performance of the city's SWM fleet.

"We're flexible enough here with staff and the way our codes are written to be able to introduce new programs at the division level. Often, governments sometimes face authority for initiation type of issues where it's more challenging because it's not as localized even in local government to be able to create a new program or change service days or even purchasing. We're fortunate."

– City SWM Staff Member

The Orlando Office of Sustainability, Resilience, and Future-Ready has set a goal to divert all solid waste by 2040 that has spurred various strategies across related departments in the city. For SWM, staff mentioned that they interpreted this as a need to expand normal activities, such as delivering compost bins to households or implementing commercial food waste programs, as long as they are integrated into existing operations. Some referenced that challenges arise when new activities are proposed under the Beyond Waste Roadmap that SWM has not previously been involved in or that is not within their standard scope of operations. One example was that of technological upgrades that were introduced by the city, but that ended up stressing manual process in operations and were ultimately rolled back. Others cited concerns over establishing ambitious waste elimination goals, but not having the infrastructure or authority required to meet those goals.

"The problem is that we don't have any autonomy or we don't own our own transfer station, we're not a real stakeholder in that sphere. "

- Government Staff Member

In general, stakeholders reported that there was good coverage and participation across stakeholder groups in the consultation process for the Beyond Waste Roadmap. Several "low-hanging fruit" opportunities were referenced when it comes to working towards waste reduction strategies in Orlando, though many mentioned that these would be supplemental to the main need for a new MRF and updated infrastructure. City staff mentioned the excitement around the third-party Beyond Waste Roadmap that has been commissioned:

"That's part of the problem that we have as a city and as a solid waste division, and as one component in a regionwide effort to divert waste, is we don't have really the wherewithal financially, legally, all those aspects on how to approach actual zero waste, whether or not that's doable, or if we have the infrastructure in place to accommodate that. Having that report [third-party roadmap], it is going to be the biggest yield from Beyond Waste."

- Government Staff Member

City SWM has tried to co-locate garbage and recycling bins to try to deter illegal dumping, so that if recycling trucks do not pick up a load that is obviously contaminated then the garbage truck can pick it up. Similarly, some stakeholders noted that standalone recycling dumpsters, particularly in or near public parks, often lead to illegal dumping challenges. Some staff members also mentioned that, in cases where there is an overabundance of trash cans, particularly near parking lots at entrances/exits to parks and venues, people often tend to overwhelm those receptacles by emptying their cars and other trash (Figure 22). There are five public city parks that have recycling bins that are paid for by Keep Orlando Beautiful (KOB). They are the only public recycling bins (on public property) and they often have reportedly low contamination rates. KOB pays a private contractor to collect recycling from those bins.

Figure 22: Public trash cans and collection bins in Orlando

Another challenge with waste collection in Orlando is general lack of space. Some stakeholder referenced "trash butlers" that are used in apartments, condominiums, and other multi-family home complexes. In locations where there is not enough room for a standard dumpster, or for a truck to access a dumpster, creative solutions are needed to ensure that collection services are still available.

Case Study of the Recycling Ordinance from Evan Novell:

- Ordinance process started (phased in over four years, starting in 2019) with 12 City Hall stakeholder events leading up to the presentation/vote - included haulers, businesses owners, processors – the city was able to assuage a lot of negative feedback (but there wasn't much - passed both readings without any naysayers and was largely embraced by the community)
- The original request for the ordinance came from the community, it was a bottom-up process
- Lots of people expressed frustration with state ban pre-emptions, want to be able to ban products, or ban the use of them at events
- Through the ordinance, you have to use the city if you have a front-end loader dumpster, but otherwise there are 20+ private haulers to pick from
- Around 60K single-family and 60K multi-family units in the city
- Department dedicated a staff member (Evan) to find ways to tailor recycling to a specific property
- COVID was a major setback to the ordinance – lots of "commercial" recycling ended up back in people's houses, which threw off the numbers
- CDL shortages – Amazon warehouse nearby, poached a lot of drivers and staff from SWM
- The SW division is going through a period of transition from manual to more digital processes, to include the introduction of cameras, sensors on trucks, carts, and dumpsters."
- Market dictates where we can sell recycling – hamstrung for where we can process – no autonomy, don't own their own MRF (which is a top priority for the city)
- Third party Beyond Waste Roadmap that they have commissioned – need guidance on how to actually get to waste elimination
- "NOW: We're moving into a catchup period or bringing the people who aren't in compliance into compliance and then maintenance. Properties are supposed to submit annually updated information for their property to include any point of contact information, any changes in their recycling program, who their hauler is, what their tonnage is so that we can start tracking some of that data, which unfortunately, solid waste department has not been very good at up till now."

End of Cycle

The Orange County Landfill is based on a 5,000-acre property that started landfilling practices in 1971 (Figure 23). Around 40% of the property is reserved for conservation. They recently added a self-service lane and have a household hazardous waste drop-off location, including for e-waste, through a contract with an environmental firm that picks up the materials. Groundwater wells exist across the property for testing and leachate is collected and pumped to the water reclamation facility at Iron Bridge, where it is cleaned and processed and used for cooling. The landfill services around 230,000 homes from 13 municipalities in unincorporated Orange County for curbside waste. A private Waste Management (WM) landfill also exists on the west side of the county and services a smaller portion. The City of Orlando itself is part an inter-local agreement with Orange County which ensures that the county accepts solid waste generated by the city.

Figure 23: Photo of a portion of the Orange County Landfill (Photo Credit: CIL)

Orlando Utilities Commission utilizes solar farms, coal, natural gas, as well as landfill methane gas at their power plant, and smokestacks can be seen at the landfill for that purpose. Orlando Utilities Commission is able to power around 13,000 homes at peak times from methane from the active Class 1 landfill on the property, and a minimum of around 5,000 homes at low times. Solar arrays have been built on top of the covered goal ash from the power plant, which itself has its own landfill.

Hazardous waste, e-waste, and general household recycling drop-off is all free for residents at the landfill. General household recycling accepts cardboard, paper, plastic bottles and jugs, glass, and all metal cans. Bulky waste drop-off must be paid for and brought to the Class 3 section of the landfill. Single-stream recycling that is transported to the landfill is sorted and taken to a WM MRF at Cocoa Beach. If contamination for a given load is over 35%, then the load remains at the landfill. Within a year, the landfill receives an estimated 3,800 lbs. of waste, and an estimated 3 million lbs. of recycling was processed at the landfill between 1990-2017. A public private partnership between Orange County and Waste Management was previously in place at the landfill, but it has since been closed. The landfill is working on developing a new MRF on-site through another public private partnership and an RFP for that partnership was out at the time of this report. Some stakeholders cited concerns over the entity that ultimately wins the RFP for the new

MRF, as they will be beholden to their rates and infrastructure, and there is a great deal of uncertainty surrounding that facility's operations.

"That sorting center [MRF] will be here. It's like a design build, own, operate agreement. Whoever does respond to that RFP and gets selected, that processor, essentially the county will give them land and they do everything else, including set gate rates."

– City SWM Staff Member

The oldest cell on the landfill was a Class 1 portion filled from 1971–1990, before landfill lining regulations were put into place. They closed a Class 3 portion of the landfill, which is also not lined, and pipes are in place to regularly burn off sulfur gas. The most recently closed portion was a Class 1 landfill that was open from the early 1990s through 2009. The current active Class 1 landfill was opened in 2005 and is projected to have another 15–17 years of capacity. That cell has a double composite liner and covers around 33 acres in total size. The city is currently developing a Solid Waste Master Plan for the next 20 years of the city.

There is a yard waste processing area at the landfill that grounds the waste into mulch that is used as cover. The landfill is required to have at least 6 inches of dirt cover at the end of the day, but that must be reinforced with mulch due to the amount of rain the area receives. There are also two burrow pits on site for excavating dirt for landfill cover. A compost facility existed at the landfill previously, and processed compost was given out to the public for free, but it ended with the COVID-19 pandemic due to low staffing and lack of regular testing.

White goods and C&D material can also be dropped off directly at the county landfill. There is a contractor that is hired to remove Freon from fridges and sell recoverable metals for recycling, to the extent possible. The landfill also has its own mechanic shop on site for repairing and maintaining vehicles.

There are two transfer stations on the property, one owned by WM and one owned by the County. The landfill property contains a transfer trailer staging area, as trailers are used to move waste between the landfill and the transfer stations. "Yard dog" trucks will pick up the loaded trailer, dump it at the landfill, and then the empty truck is moved back to the transfer station (Figure 24). It was reported that in one week, a trailer driver drives the distance from Orlando to New York City.

Figure 24: Transfer trailer staging area at Orange County Landfill (Photo Credit: CIL)

The WM transfer station located in the City of Orlando, separate from the landfill, receives around 80-90% of recycling loads for the city (Figure 25). Waste Connections has their own facility in South Orange. There is a county-owned facility next door to the transfer station that is leased to WM, which was previously the site of an incinerator. The station is required to clear its floor every day and services around 6 haulers that collect single-stream, mixed recycling. The WM transfer station accepts C&D waste, MSW, and recycling. WM then contracts transfer trailers to take the waste from the station to the landfill or to Coco Beach in Broward County for recycling processing.

Figure 25: Portion of WM transfer station located within the City of Orlando (Photo Credit: CIL)

Some stakeholders noted that residents and private haulers alike will sometimes not properly cover their loads when transporting waste, which leads to concentrations of litter around the city. There is currently an ordinance in place requiring loads to be covered, but stakeholders said that it is not consistently enforced.

When it comes to disposal, recycling is much more expensive than garbage/household waste in Orlando. For the city's SWM operations, as municipal haulers they do not pay for any of their own processing, and they are therefore at the mercy of processor fees. The city signs two-year contracts with one-year extensions for up to five-year limits for contracts for processing, but once they expire, they are subject to bids. For standard garbage, haulers will have to pay $49.50/ton at transfer stations, whereas they will have to pay $65/ton for recycling. This is even less ($38/ton) for dumping garbage at the county level.

Add reports from Joe on contamination rates (reportedly contamination rates are generally just under 20% on average. As was observed in other cities in Florida, when there is a high transient and/or tourist population, there is a need to re-educate people on what can and cannot be recycled. The City of Orlando conducted a residential recycling audit and community outreach program to determine the top items contaminating recycling bins and which neighborhoods might benefit from more education about recycling. From an audit conducted between July of 2018 and August of 2019, plastic bags were among the most common contaminants in residential recycling bins (City of Orlando, 2024). The audit was conducted pre and post community education interventions and demonstrated in order to measure impacts. Contamination rates decreased across the majority of residences when they experienced door-to-door education, door

hangers, and personal communication on recycling protocols, particularly for categories such as tanglers and food waste (Figure 26; City of Orlando, 2020).

Figure 26: Example of lid stickers on residential recycling bins in Orlando (Photo Credit: CIL)

While Orange County has expressed interest in building waste-to-energy (W2E) facilities, the city itself does not currently have development plans. Some stakeholders felt that there was not enough capital investment, capacity, or sustained volume of waste to support W2E infrastructure for the city alone.

Waste management for the infrastructure and for the major parks in Orlando largely remain separate. Disney parks lie completely outside of the jurisdiction of the city district and they have their own collection trucks, a private landfill, a full composting facility, source separation operations, and bale, process, and sell their own recycling. Universal parks are within the city's jurisdiction, but they contract with WM for their collection and hauling. The city could in theory compete with WM for that contract, but they historically have not.

Stakeholders often cited the importance of being able to maintain flexibility at the city-level for waste management. This is particularly valuable in the ability to pinpoint problem areas and address them in a timely and efficient manner. For example, when the city has a recycling load that is rejected for contamination, they are able to assign a project manager to go to that particular jurisdiction and do door-to-door education and outreach, provide "oops" stickers for contamination, empower local drivers, and other activities to investigate and mitigate. This is in part due to a dedicated budget for communication and outreach for both the Sustainability office and the SWM office in the city. A large amount of funding is also put into awareness around recycling.

"We spend a lot of money and we put in a lot of effort toward recycling, probably more so than a lot of my colleagues and other local governments. We give it a lot of attention. I think it's because of such a robust sustainability office, because that's pretty unmatched too in our area as far as resources and money and staff."

– City SWM Staff Member

Stakeholders generally expressed confidence in the direction that the City of Orlando is going in terms of SWM infrastructure, capacity, and strategy. Many highlighted the upcoming new MRF contract, increased staff for education and outreach, comprehensive and collaborative planning processes, and dedicated

leadership as benefits that the city has in moving forward with sustainable SWM. They also mentioned the benefits of localized networks of SWM operators, such as Recycle Florida Today, Central Florida Recycles, and the Florida Chapter of the Solid Waste Association of North America (SWANA), for sharing knowledge, ideas, and lessons learned. Orlando has also shared their experiences around SWM and sustainability across national networks, citing one example where the city of Little Rock, AK used Orlando's Green Events Guide for their own Cornbread Festival, which they found through the Urban Sustainability Directors Network.

Within the Office of Sustainability, Resilience, and Future-Ready, the Beyond Waste focus area includes goals to eliminate landfill waste by 2040. The city has implemented several programs over the years to pursue the Beyond Waste initiative's goals. In 2019, Orlando banned single-use plastic bags, straws, and foam at city events and venues. In 2020, the city partnered with Waste Management (WM) to launch a pilot textile recycling program for the City of Orlando logoed shirts with a goal to expand to a community-wide program for textiles that cannot be recycled elsewhere (City of Orlando, 2024). The City of Orlando has shown initiative at engaging both residential/stakeholder perspectives and reliable data into decision-making processes, which has continued to build buy-in for the Beyond Waste initiative and progress in the city.

Case Study of Coca-Cola in Orlando:

- They bale all of their own collected waste and sell straight to buyers
- Have some EPR for bottle to bottle, even if it's not a Coke bottle
- Coke provides around 50 free rain barrels per year to residents that are made from Coke bottles through Florida Recycling

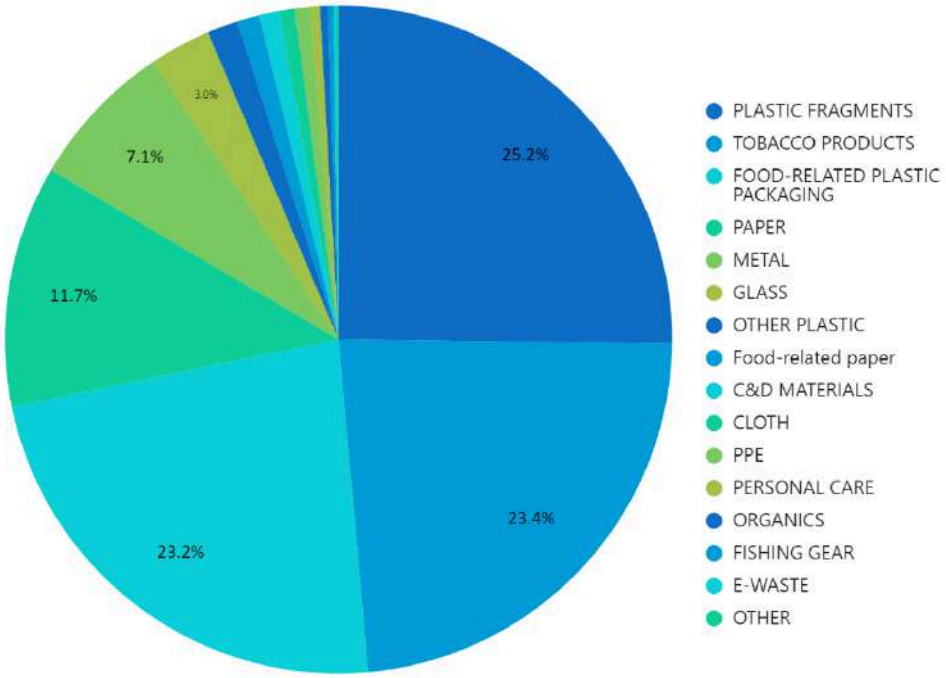
Leakage

In total, 3,792 items were logged in 34 transects (each 100m^2) characterizing 11 different square kilometer areas (Figure 27). Transect locations were selected using a stratified random sampling method, in which transects were randomly selected in eleven square kilometers which were distributed across three groups of population count (upper, middle, lower) based on LandScan ambient population data. Litter items were recorded using the open-source Marine Debris Tracker app. A full list of items available in the app and their associated material categories as well as a map of sample sites and their surveyed litter densities can be found in the Appendix.

Figure 27: Example litter photo from Orlando (Photo Credit: CIL)

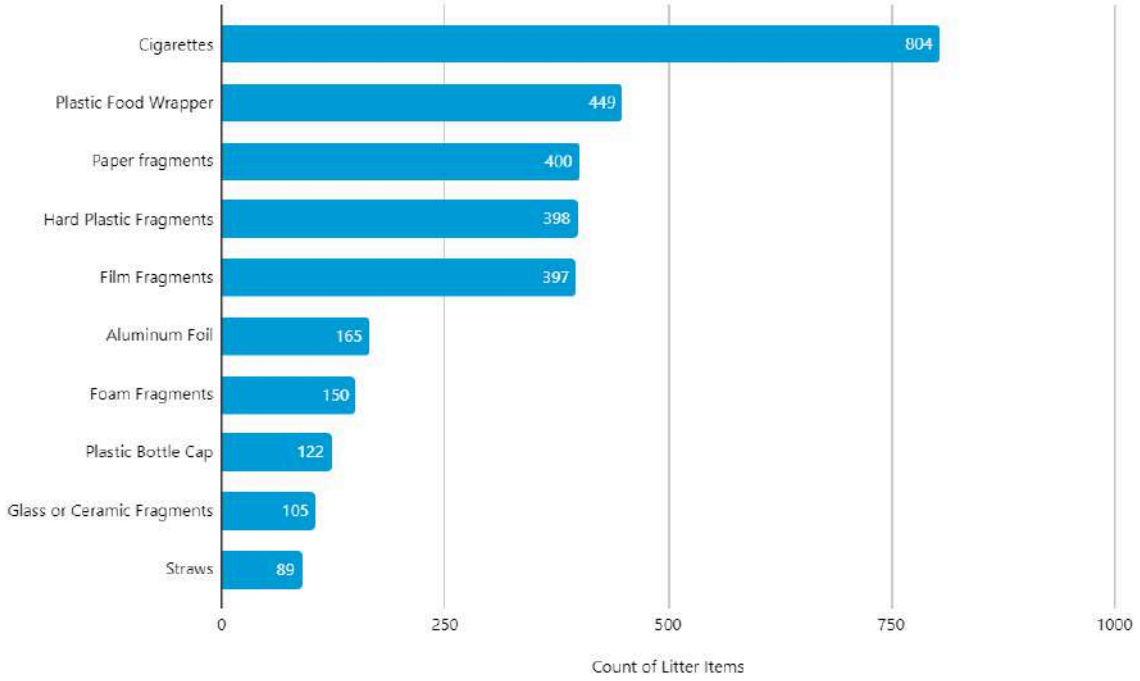
Across all transects, the largest percentage of litter by category was plastic fragments such as (Figure 28). This was also the case for litter items documented during the CAP in Miami. This was followed by similar percentages of tobacco products and food-related plastic packaging. When combined, these three categories of materials comprise nearly ¾ of all litter items documented. Paper items comprised 11.7% of litter and metal comprised 7.1% of litter. All other categories, including glass, C&D waste, cloth, organics, e-waste, and others comprised less than 4% of the total litter respectively. Common plastic items (including food-related plastic packaging, other plastic, PPE, plastic fragments, and personal care items) comprised 51% of all litter items documented in Orlando. This is similar to observations in Miami where common plastic items represented 55% of litter items, and from the Florida Keys where common plastic items represented 48% of litter items.

Figure 28: Litter material breakdown in Orlando



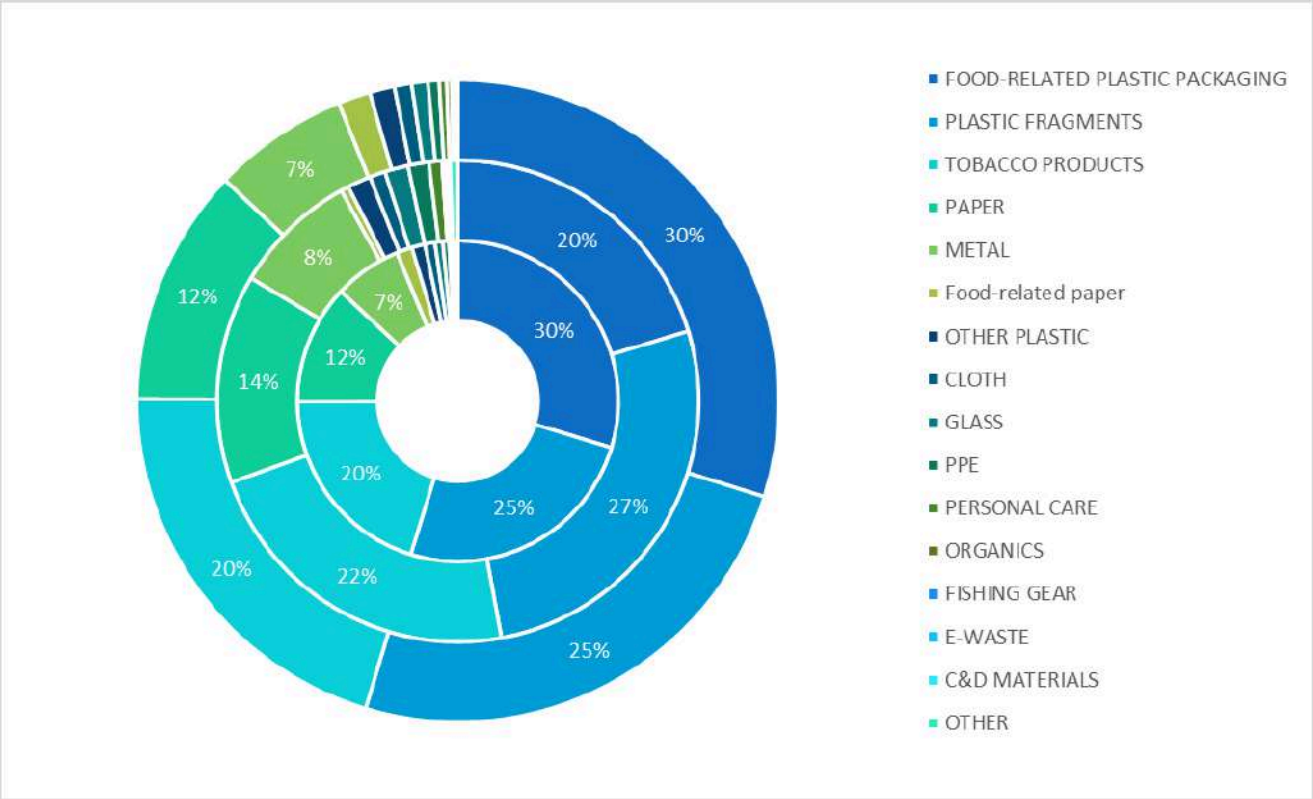
Cigarettes were the most common individual litter item by count (804 items) in Orlando, nearly doubling any other specific type of litter., Meanwhile, there was a relatively similar count of plastic food wrappers (449), paper fragments (400), hard plastic fragments (398), and film fragments (397, Figure 29). However, it's important to note that these fragments likely originate from food items. As such, food packaging items comprised more than double the amount of litter found than cigarettes.

Figure 29: Top 10 litter items by count in Orlando



When examining the litter characteristics based on the ambient population density, there are surprising similarities between the common litter material types (Figure 30). Across high, middle, and low ambient population density areas, the top categories of litter materials were food-related plastic packaging, plastic fragments, and tobacco. Non-plastic items, such as paper and metal, are also among common litter material types observed across all population densities, particularly among lower population count areas. When comparing litter characterization, litter observed in the Miami CAP was also dominated by plastic fragments and food plastic, though glass and tobacco products were more prevalent in Miami than in Orlando, particularly in high population densities.

Figure 30: Proportion of most common plastic items in low (inner), mid (middle), and high (outer) population count areas in Orlando



The average litter density across all transects in Orlando was around 1.12 items/m2. This is slightly higher than some other cities in the United States - such as a density of 0.55 items/m2 in Cape Girardeau, MI, 0.68 items/m2 in Minneapolis, MO, and 0.77 items/m2 in Blytheville, AK – and similar to some others – such as 1.10 items/m2 in Vicksburg, MS, 1.14 items/m2 in Atlanta, GA, and 1.20 items/m2 in Athens, GA. When compared to other cities in Florida, litter density in Orlando is lower than that observed in Miami (2.53 items/m2) and comparable to that observed in the Florida Keys (1.16 items/m2). Observed litter density in Orlando was highest in high ambient population sites (1.73 items/m2) and lowest in middle ambient population sites (0.39 items/m2).

Table 8: Breakdown of litter density and top litter items by ambient population density

Population Tertile	Top 5 Litter Items	Litter Density (count/m2)
Upper (6-849 persons/km^2)	1) Cigarettes, 2) Hard Plastic Fragments, 3) Paper Fragments, 4) Plastic Food Wrapper, 5) Film Fragments	1.73
Middle (849 - 1,415 persons/km^2)	1) Cigarettes, 2) Paper Fragments, 3) Plastic Food Wrapper, 4) Film Fragments, 5) Hard Plastic Fragments	0.39

Lower (1,415 - 16,265 persons/km^2)	1) Cigarettes, 2) Plastic Food Wrapper, 3) Film Fragments, 4) Paper Fragments, 5) Hard Plastic Fragments	0.89

Keep Orlando Beautiful (KOB) is a hybrid affiliate of Keep America Beautiful and a municipal program in the City of Orlando. It is a volunteer-based organization that conducts litter cleanups and characterizations across the city. The organization is also heavily involved in community outreach and engagement. As an example, KOB hosted an annual Trash 2 Trends fashion show fundraiser in partnership with SeaWorld pre-pandemic. KOB also conducts a litter index for the city every summer and their aim is to be able to cover every street in Orlando (Table 9). KOB also conducts assessments of litter from stormwater and street cleaning in the city, most of which is single-use plastic. Another organization mentioned in stakeholder interviews was GreenUp Orlando, which is also a volunteer program that participates in beautification activities such as tree planting, cleanup, landscaping, and others that contribute to litter prevention.

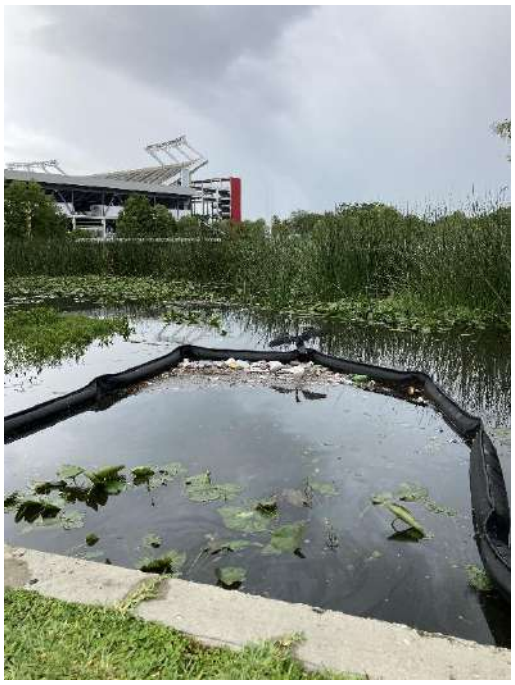
Table 9: Litter data from KOB 2023 reports

CAP Site	Avg Ambient Population	Commission District	Avg CAP Litter Density (items/m^2)	District Avg KOB Litter Index Score (2023)
1	High	5	0.89	2.1
2	High	6	1.95	1.6
3	High	6	2.36	1.6
4	Mid	6	0.53	1.6
5	Mid	3	0.15	1.5
6	Mid	3	1.02	1.5
7	Low	6	1.67	1.6
8	Low	3	0.97	1.5
9	Low	6	2.14	1.6
10	Mid	2	0.21	1.6
11	Low	3	0.19	1.5

Public perception of litter reportedly varies in different parts of Orlando. Typically, when there is a case of open dumping or large litter hotspots, the community reportedly notices. Public characterization of waste has also changed. Stakeholders mentioned that cigarette butts and cigar tips used to be the dominant source of litter, but now plastic food wrappers and containers present a larger problem, especially small things that twist or break off, such as the rings around bottle caps that are more discreet for people to litter in general. Put into perspective: While tobacco products remain among the most common categories of material types among litter items in Orlando, food plastic products are only 0.2% fewer by count when observed overall. This transition has been seen in other cities too, such as Miami, where food plastic and fragments surpass tobacco materials in litter characterizations.

Several stakeholders mentioned that illegal dumping is an ongoing challenge in Orlando. One interviewee mentioned that some public drop-off locations for waste had to be closed recently to deter such behavior. One challenge that can often lead to illegal dumping is access to transportation. KOB has planned e-waste and textile recycling events throughout the city so that more people can have access to those options for disposal. Textiles and e-waste respectively comprised less than 1% of observed litter material, which is a promising sign that these items may not be as likely to leak into the environment in Orlando. Textiles and other tanglers are of particular concern when they block or impede storm drains, waterways, and other important drainage areas in the city (Figure 31).

Figure 31: Collections of litter near storm drains and waterways in Orlando (Photo Credit: CIL)



Studies surrounding plastic pollution in Florida also demonstrate the consequences of the spread of containments threatening both the environment and humans. Studies of the widespread prevalence of microplastics along the Southeast Florida reef tract found samples of plastic polymers to contain substances such as gunpowder, trimethoxyamphetamine, 1,2-diiodoethane, methyl vinyl sulfone, and octane (Wightman & Renegar, 2023). Microplastics already threaten marine life but also endanger aquatic organisms by serving as non-degradable carriers of harmful contaminants and heavy metals that will likely create chronic toxic effects (Brennecke et al., 2016). It is important for the city to understand the main pathways by which items enter the environment, coupled with upstream data, to inform the best prevention and mitigation methods for maintaining the health of local aquatic lakes and waterways, whiel also the health of downstream bodies of water downstream

Opportunities

CIL found the following opportunities to expand and enhance circularity in Orlando based on the findings of this report. These opportunities are categorized based on the seven spokes of the CAP model. Stakeholder engagement with the partners of this project should take place to further expand, refine and prioritize these opportunities based on local context, impact, feasibility, and cost. It is important to note that the opportunities listed below are individualized based on the findings, but solutions cannot be implemented in a vacuum and are most impactful when strategically combined within a holistic system framework.

Input

- Explore opportunities for Extended Producer Responsibility (EPR), particularly among material types that are the most problematic for litter or lack of substitutes (e.g., multilayer film packaging) and/or for products that have manufacturing locations within close proximity to Orlando (e.g., beverages).
- For beverages manufactured or distributed close to Orlando, there may be opportunities for localized bottle collection, bottle deposit, or other types of EPR to optimize waste diversion for top brands. Top convenience brands identified through the CAP could be prioritized for interventions and brand engagement.
- Pilot products could be conducted with local brands for packaging reuse and collection, particularly for city events. There may be precedent to incorporate this into the Green Event Guide for the city.

Community

- Several local organizations (such as Keep Orlando Beautiful [KOB]) expressed interest in learning from other efforts across Florida, like that of Plastic Free 305 and others, to develop voluntary business incentive programs in Orlando to reduce single-use plastic. Learning exchanges or networks could be arranged to share best practices and learnings.
- Challenges around the 'holiday' mentality of visitors that come to Orlando, efforts should be made to target hospitality and tourism industries around communication and outreach. This could be done in collaboration with other locations in Florida where CAP has identified these challenges, such as the Florida Keys.
- Interviewees expressed desire for enhanced SWM infrastructure, particularly around the new MRF. This should be prioritized for implementation and coupled with public outreach on implications once complete, possibly incorporating into landfill tours for student groups, local businesses, and other stakeholders.
- Open dumping is an issue that resonates with many residents and should be targeted for outreach, education, and policy. The city may want to consider a task force, committee, or dedicated staff and/or funding to address the issue across departments and sectors.

Product Design

- The transient nature of some food distribution services presents a challenge for collection and management of problematic materials, particularly with EPS items that are distributed for specific services. The city should consider working with church groups, volunteer organizations, and others that are distributing these materials on disposal, alternative, materials, reuse opportunities, and best practices.
- The Green Event Guide has been a success, but there is a need for consistent codes, more enforcement and accountability, and potentially a dedicated group for monitoring these events so that penalties/violations of the Guide can be distributed as needed.

Use

- Opportunities exist for additional reuse/refill infrastructure, both bespoke and at-scale (which should be targeted to the most problematic/non-recyclable staple packaging items). The city should work to ensure that local businesses interested in this space have the support and/or resources needed.
- Plastic takeaway bags remain a challenge – the city could explore strengthening regulations or public awareness campaigns targeting this issue, incentives related to customers bringing their own bag, or incentives for businesses that move towards BYO structures.
- There may be an opportunity to develop and distribute more affordable alternatives (particularly among refillable and reusable products) for local brands and companies. Top products and brands identified through the CAP could be prioritized for this.

Collection

- While the city's recent recycling ordinance has helped expand access, having further enforceable mechanisms to require recycling would be beneficial. Continuing to engage communities on tailored education and awareness, building on past successes in that space, will also be important for ongoing recycling efforts in the city.
- Opportunities exist around re-thinking the autonomy of certain types of waste collection infrastructure. Given the new RFP for the MRF and other potential upcoming opportunities to rethink contracts and fragmentation of infrastructure, the city may want to prioritize areas where change is possible/needed.
- Implementation of the Beyond Waste Roadmap will be critical once it is finalized. The city should help to ensure that the recommendations and pathways coming out of the Roadmap are supported across departments and have sufficient staff and budget for implementation.
- The city should explore creative space solutions for apartments, condominiums, and other multi-family home complexes. This could be done in collaboration with other cities in Florida that are addressing this, possible through showcases or webinars on innovations and best practices.

End of Cycle

- It is critical to carry out the RFP for the new MRF on-site at the landfill as soon as possible.. This is something for which stakeholders expressed an urgent need and it is evident that this is the top priority for waste management infrastructure in Orlando.
- Having flexibility for community outreach and solutions at the city level is important and has been a demonstrated success when it comes to implementation of the recycling ordinance and other Beyond Waste initiatives. The city and relevant partners may want to increase staff and capacity to address local needs and tailored solutions and messaging would be beneficial where possible.

- Creative solutions to waste management infrastructure exist at multiple scales (e.g., smaller local compost drop-off locations, repair and swap shops, centers for hard to recycle materials, etc.). The city should continue to pursue opportunities to implement these proposals, through local Beyond Waste initiatives or otherwise.

Leakage

- As mentioned above, there is a strong need to address open dumping in a collective manner across city departments and districts (e.g., stricter regulations, more enforcement, creative solutions around drop-off locations, etc.).
- There may be a desire to standardize data collection for KOB and other litter monitoring groups (potentially through applications such as the Marine Debris Tracker or Clean Swell app in addition to other platforms), so that the city can measure potential impacts of the Beyond Waste initiative and other programs over time as it related to decreases in litter.
- As cigarettes were the most common litter item in Orlando, the city may want to consider a focused public campaign around cigarette butt litter. Lessons could be learned from other cities in Florida that have specifically addresses issues around cigarette litter, such as the City of Miami Beach and their ban on smoking in public beaches and parks.

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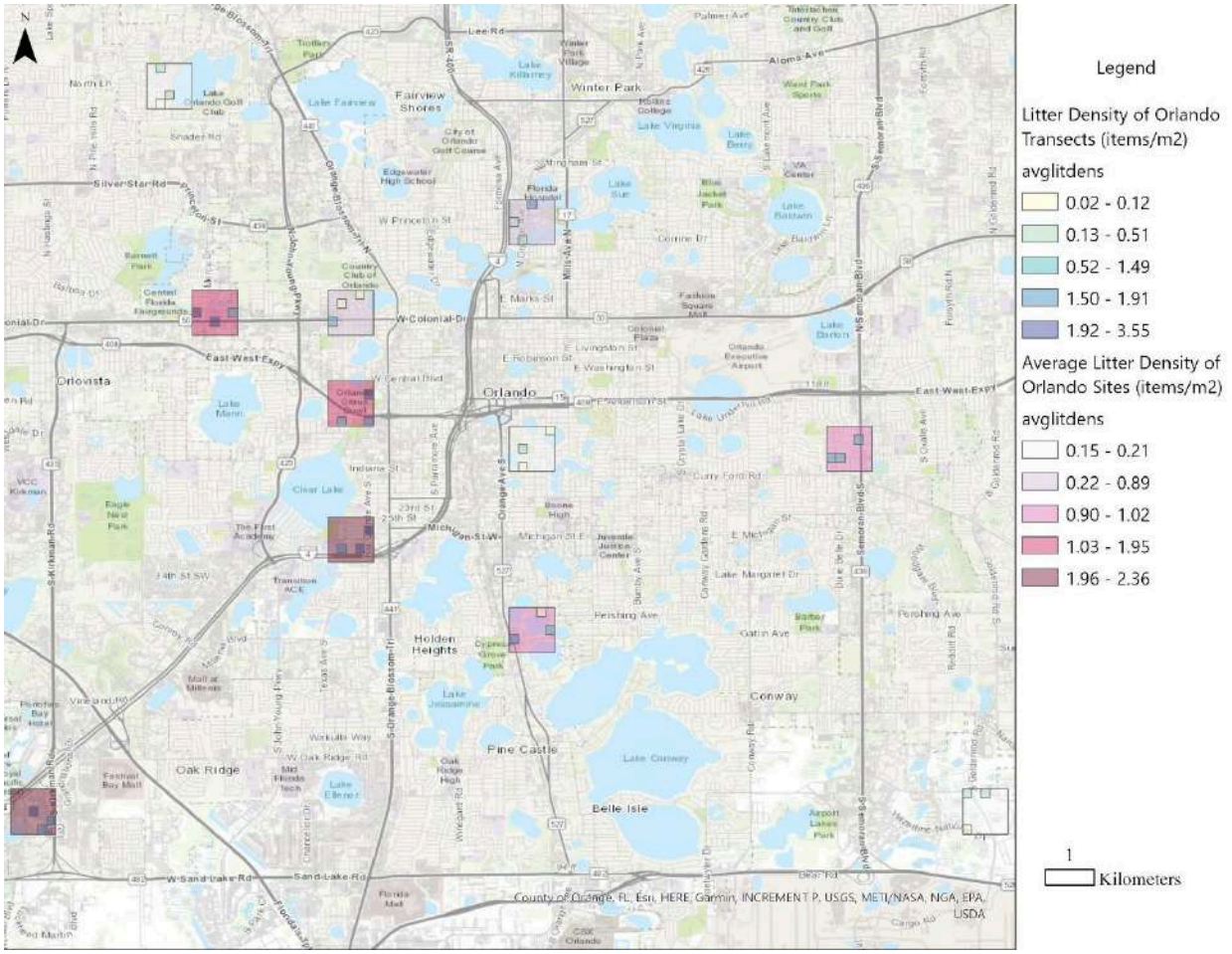
Appendix

Figure 32: Litter densities in transects and sites surveyed in Orlando



An interactive web map version of this map is available at:
https://usg.maps.arcgis.com/apps/mapviewer/index.html?webmap=92d84e3251fa40f2a5a04c041ec718a7

Table 10: Full List of Debris Tracker Litter Items and Associated Material Categories

Material	Items
C&D Materials	Aggregate & Brick Bolts, Nails, and Screws Building Materials Lumber

	Other C&D
Cloth	Clothing Towels or rags Fabric Pieces Other Cloth
E-Waste	Batteries E-Waste Fragments Wire Other E-Waste
Fishing Gear	Buoys and Floats Fishing Line Other Fishing Gear Plastic Net or Net Pieces Plastic Rope
Glass	Glass Bottle Glass or Ceramic Fragments Other Glass
Metal	Aluminum Foil Aluminum or Tin Cans Foil to-go container Metal Bottle Caps or Tabs Metal Fragments Other Metal
Organic Waste	Food Waste Other Organic Waste
Other	Other Popsicle or lollipop Stick
Other Plastic Products	Bulk Bags Flip Flops or shoes Plastic String, Tape, or Packing Straps Rubber Bands Trash bag

	Tires Balloons Plastic toys or balls Car Parts Hard plastic jugs or containers Other Plastic
Food-Related Paper	Paper cups Paper food box or container Paper plates or bowls Compostable paper cups Paper food wrapper Compostable food box or container Napkins Other Food-Related paper
Paper	Office paper and newspaper Tags, tickets, and receipts Corrugated Cardboard Paper fragments Other Paper
Personal Care Products	Blister Pack or other pill packaging Cotton Buds Ear plugs Personal Care Product Sachet or packet Toothbrushes Toothpaste or Other Product Tube Flossers Feminine products Needles and syringes Other Personal Care Product

Food-related plastic	Foam cups Plastic cups Compostable plastic cups Cup Lids Plastic Bottle Aseptic cartons Mini alcohol bottles Plastic Bottle Cap Plastic Food Wrapper Condiment packet or container Plastic Grocery Bag Sandwich or snack bags Plastic Utensils Straws Foam to-go container or clamshell Plastic to-go container or clamshell Compostable plastic container or clamshell Other Food-Related Plastic
Plastic Fragments	Film Fragments Foam Fragments Hard Plastic Fragments Rubber/ tire fragments Other Fragments
PPE	Disinfectant Wipes Disposable Gloves Face Masks Other PPE
Tobacco Products	Cigarette Packaging Cigarettes Tobacco Sachets or packets E-cigarettes and vaping

	Plastic cigar/cigarillo tips Lighters Cannabis-related waste Other Tobacco Product