GREEN GILBERT

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Rapid urbanization while positively influencing the lifestyles of millions by providing access to vital life amenities has also vastly changed our consumption patterns and inherently the waste we generate. According to the World Bank, 1.3 billion tonnes of solid waste was generated in 2012 which is projected to rise to 2.2 billion tonnes by 2025.

The EPA estimates that out of the average 258 million tons of trash produced by Americans annually, 65% ends up in landfills. Bulk trash[c], waste that doesn't fit into regular household bins, forms a sizeable portion of this generated solid waste due to the sheer volume of discarded items and challenges to management within recovery facilities. The Town of Gilbert, hereafter referred to as Gilbert, hopes to manage its bulk waste properly to ensure a thriving sustainable community, and this could be made possible only through strong waste reduction strategies, efficient material recovery and recycling and diversion of bulk waste from landfills.

This report serves as an advisory document for Gilbert and explores a diverse portfolio of existing programs and best management practices (BMP) on bulk trash management, diversion, and recovery. It addresses all aspects of the life cycle of waste from generation to disposal and addresses this complex urban operation from diverse perspectives such as infrastructure, economics, outreach, policies and regulations, environmental impacts and social inclusion. Finally, selected short and long-term recommendations have been suggested to provide some direction for future planning and execution.

CURRENT PROGRAM

Gilbert, with a population of 237,133 (2016), provides monthly bulk waste pickup services to its residents. The town, with an area of 68.2 mi^2, is divided into Zones A through D that are each covered during one week of the month with a fleet of 15 Rear-load trucks and 10 Tractors owned by the town itself.

Acceptable bulk items include dishwashers, furniture, glass and mirrors, mattresses, televisions, and yard waste. Types of items that are not accepted contain auto parts, construction waste, daily household garbage, hazardous waste, and remodeling debris which are disposed off either as trash in black containers or in designated drop off facilities. Apart from these items, there are drop off facilities available for compost bins, household hazardous waste, and whitegoods.

About 60% of the current bulk waste is directed towards the Germann transfer station in Chandler and the rest to San Tan and Cactus transfer stations in Mesa where the waste cargo is deposited prior to being loaded into larger trucks. After this the town partners with Waste Management and Republic Services, the state's largest private solid waste services companies, to use their fleet and` transport the waste to the designated landfills.

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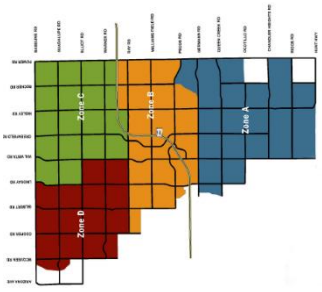
c Bulk trash is a type of refuse that isn't accepted during regular waste collection due to its large size. Waste management bodies usually collect this waste from the streets or pavements in many countries.

Figure 1: Gilbert Service Zones



RESEARCH DESIGN EXPERIMENTS

Two experiments were designed to gauge Gilbert's bulk waste capabilities and the socially inclusive nature of the town's programs. These experiments allowed a better understanding of the waste characterization nature of the town as well as satisfaction levels among the residents.

Experiment 1: In an effort to determine the composition of the waste generated in Gilbert and to explore the potential to divert material, bulk pickup was scheduled for 650 homes on November 6th, 2017. A total of 18.39 tons of waste was collected resulting in an average of 56.58 lbs. of waste per home. Five different trucks were sent on the collection routes for green waste, wood, cardboard, metal and trash in order to segregate at source. The table below presents the different categories of materials found. Diversion material was estimated at **71.62%**.

Table 1: Waste Characterization

Material	Tons	%
Green Waste	8.56	46.55
Wood	3.06	16.64
Cardboard	0.89	4.84
Metal	0.66	3.59
Trash	5.22	28.38
Total	18.39	100

Experiment 2: The team partnered with the Digital Communications division at the Town of Gilbert and rolled out a short survey questionnaire to the residents inquiring about the current state of bulk services and their feedback. This allowed the team to take into consideration the insights of the end consumers of these services. Some of the highlights are presented below:

- 1250 responses were received in a week
- 43% are very interested in expanding bulk pickup service
- 56% are not willing to drop their green/bulk waste off at a facility
- Several people commented additionally that they were satisfied with the current state of the program

Some of the suggestions included establishing a green waste cans service and ensuring better communication of pickup schedules.

BEST MANAGEMENT PRACTICES

While it is important to devise innovative solutions to the evolving problems of solid waste management, it is equally essential to study and mimic BMPs which have proven to be successful and effective. Some of the many such initiatives were identified after researching city wide programs in Arizona and analyzing knowledge databases such as the EPA Region 9 waste management tool and the Maricopa Association of Governments (MAG) solid waste document. Described below are some creative programs that have potential for execution within Gilbert.

- **Chandler**

Trash to Treasure Reuse program for gently used/easily repairable items in collaboration with four nonprofit organizations for collection

Christmas Trees Residents have an option to dispose these trees at any of the 11 sites or schedule a pick up. The chipped material is used in parks and for other purposes.

- **Phoenix**

Curbside Green Organics The city provides containers for yard wastes. This is a great initiative to separate the waste at source.

Compost Facility Started in April, the facility currently processes up to 55,000 tons of compost per year in half the time as traditional composting methods with a future potential of 220,000 tons.

Partnerships Goodwill disassembles mattresses and recycles/reuses the parts. A-Z Equipments provides drop off stations for Christmas trees.

- **Tempe**

Green Organics Yard waste is converted to nutrient rich compost to be used as top soil at parks and schools.

Non-Profit Partnerships Stardust collects building materials from spring cleaning and remodeling projects.

- **Avondale**

Green Waste A separate crew is sent out for curbside green waste apart from the bulk trash crew to divert waste from landfills and saving on tipping fees. The compost is transferred to Duncan Farms.

- **EPA Region 9**

City of Oceanside, CA

The CurbUp program allows the residents to donate their bulky items versus sending it to the landfill by partnering with Goodwill and Waste Management.

Eugene, OR

Certain bulk wastes can be donated to the Bring Recycling Center where community members can purchase these supplies for personal uses.

Olathe and Missions, KS

The cities partner with Goodwill to act as a bulk waste drop off facility. Also, Habitat for Humanity takes donations from the community members and reuse new or gently used furniture, home accessories, building material and appliances.

Duluth, MN

There are six food waste drop-off sites for residents where it is mixed with yard waste for composting at the District's compost facility and is sold as "Green Garden Compost".

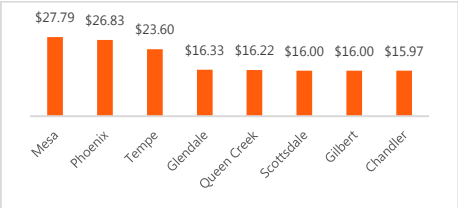
INTER CITIES COMPARISON

At both service and cost levels, Gilbert and Chandler emerge as leaders in the valley offering a wide array of residential waste facilities at cheaper rates as shown in Table 2 and Figure 2. However, it is important to investigate if this cost reduction is achieved through efficient operations, effective fleet management or plainly city investments. The analysis presented below for Tempe, Scottsdale and Chandler discusses bulk waste management logistics including types of fleet vehicles, fuel use, cost per mile and gallon, scheduling of pickups, and briefly discusses revenue streams from recycling.

Table 2: Valley service level comparison

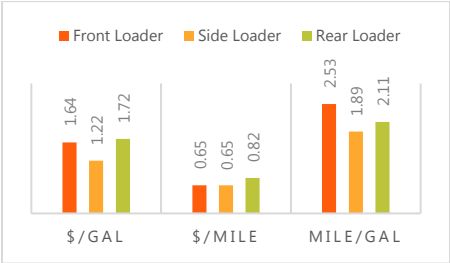
	Weekly/Monthly Pickup	HHW Facility	Free Compost Bin	Free Appliance Pickup	Free Landfill Drop-off
Mesa	✓				
Phoenix	✓				✓
Tempe	✓				✓
Glendale	✓	✓			✓
Queen Creek	✓				✓
Scottsdale	✓				✓
Gilbert	✓	✓	✓	✓	✓
Chandler	✓	✓	✓	✓	✓

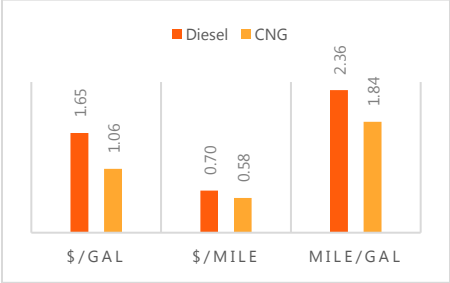
Figure 2: Monthly residential cost



Tempe has a fleet of 36 solid waste trucks which includes 11 front loaders, 19 side loaders, and 6 rear loaders. The fleet is sourced from Peter and Autocar and consists of New Way, Mcneilus, Heil & Scorpion models. When analysing the three types of loaders used by the city, the side loaders had the least cost per mile and gallon for FY 2016-17 primarily due to 70% of side loaders being run on CNG. However, these vehicles also reported lesser mileage when compared to the diesel heavy front and rear loaders. When strictly comparing 15 CNG trucks versus 21 diesel trucks, CNG trucks report 36% reduction in cost per gallon and 20% reduction in cost per mile due to differential in fuel prices.

Figure 3: Cost comparison based on type vehicle and fuel used in solid waste trucks





Scottsdale employs a diverse fleet of vehicles that run on various alternative fuels such as CNG, E85, B-20 (Bio Diesel) apart from the conventional Diesel. The solid waste trucks however run primarily on CNG due to high fuel consumption and the fuel is obtained from Southwest Gas by the city. As far as the supporting infrastructure is considered for these vehicles, there's 1 fueling station for CNG, 1 for E85, 5 for B20 and 2 for Diesel.

Table 3: Quantity of solid waste trucks based on vehicle and fuel type

	Diesel	CNG
Front Loader	4	4
Side Loader	13	17
Rear Loader	4	7

Chandler has a different business model wherein it does not own a fleet of vehicles and neither do their staff perform bulk collections. The work is contracted through Waste Management (WM), a private company, and all pickups are scheduled through call ins. The trash is taken to WM's transfer stations, then Butterfield Landfill. Bulk cardboard is taken to United Fibers and other recycling (appliances, metal and e-waste) are brought to the Recycling-Solid Waste Collection Center. The city earned $72,155 from recycling metal, $15,826 from cardboard and $2,878 from e-waste serving 74000 households in FY 16-17. Every ton of waste recycled also saves the city $47 per ton in hauling and tipping fees which hasn't been factored in the revenue from recycling.

CONCLUSIONS & RECOMMENDATIONS

Based on survey analysis, case studies and interviews performed during the course of this project, selected recommendations for Gilbert are described in this section in order to streamline their bulk waste operations and to explore further avenues to make their program and services more sustainable.

Short-Term Recommendations

Partnership with Nonprofits

Stardust Building Supplies, a non-profit sourcing cheaper gently used materials for home renovation projects, provides quality reclaimed materials for reuse. Town of Gilbert can partner with them to reduce waste at source where Stardust can scout through the bulk waste before collection and divert all the reusable and recyclable items to their storage units. This will not only help reduce the volume of bulk waste

collected but also incur cost savings due to decrease in tipping fees at landfills.

Goodwill Industries partners with multiple cities to support recycle and reuse initiatives. The Town of Gilbert could also start an initiative similar to the City of Phoenix and start diverting their mattresses from the landfill. For certain items, Goodwill could be used as a storing and sorting station from where the items could be recycled and reused.

Presorting

Presorting waste at the household level by the residents would allow waste segregation at the source itself. This practice coupled with Gilbert sending specific trucks for green waste, wood, metal and cardboard instead of a mixed approach would save efforts to recover items from a mix and thereby ease the process of recycling. Also, during the survey residents expressed concerns regarding communication around pickups and that could be another area that the town could work upon. Clear timely communication would provide the residents with ample time and cogent instructions to sort their waste.

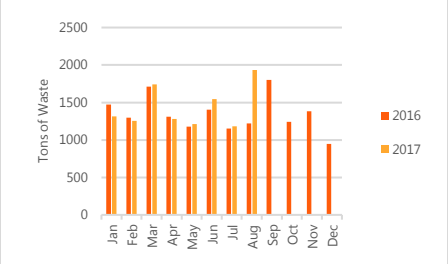
Item Specific Initiatives

Some programs targeting specific high-volume items that produce guaranteed waste streams throughout the year or surge during a particular season must be implemented. Specific to the case of Gilbert, Christmas trees are sent to the landfill each year. These could very easily be diverted towards composting facilities or the wood could be chipped and spread out in parks and other places. Gilbert could also collaborate with the City of Tempe and other East Valley cities/towns to purchase equipment like Phoenix did with A-Z Equipment. Similarly, a mattress recycling program could be started similar to those in Phoenix, AZ and Eugene, OR wherein the mattresses are taken apart and some of the parts are reused.

Education & Outreach

It is important for the residents to be cognizant of the town's initiatives and be aware of the positive impacts of waste reduction and recycling. Therefore, it is critical to improve communication with the residents and take into consideration their insights and feedbacks during the decision-making process.

Figure 4: Tons of waste in 2016 and 2017



The figure above represents monthly tons of waste produced throughout 2016 and 2017. While 2016 showed a downward trend in the volume of waste as the year went by, 2017 has been on a rise and it might be interesting to investigate the reasons and take appropriate action. Also, March and September stand out as high-volume months and therefore it is vital for the city to train and employ a larger workforce during those particular months to manage waste effectively.

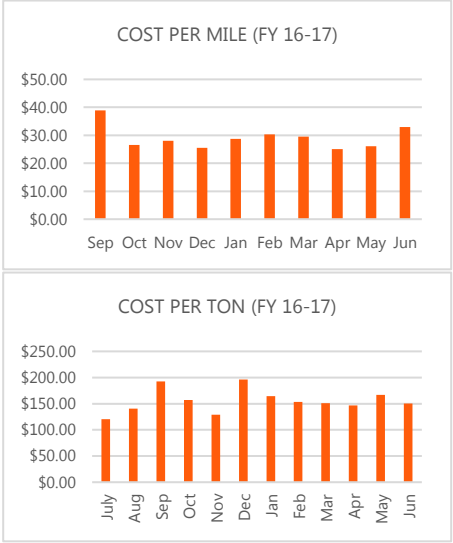
Long-Term Recommendations

Scheduling & Fleet Improvements

Chandler has had good success with a different model for scheduling pickups. Instead of running trucks on fixed schedules, residents are allowed to call in. Due to this, optimized routes can be calculated using various readily available softwares and the trucks can be directed to the exact locations. This process has proven to save on miles driven and productive man hours wasted on driving through streets where there are no pickups.

Figure 5 shows that current waste processing costs Gilbert $29/mile and $156/ton. These costs could be brought down by optimizing routes. One way is to gradually transition older trucks to the newer ones that have better mileage and incur lower fuel costs.

Figure 5: Cost per mile and ton



The same could be seen from the perspective of monthly idle time spent on each vehicle which is represented in the graph below. Idle time is the amount of time the vehicle is stationary on a collection route. It could be due to on field waste collection by the crew, vehicle breakdown or mandatory maintenance, and driver behaviour. Idle time affects not only the costs associated with bulk waste management but also efficiency of collection, fuel use, employee productivity amongst other parameters pertinent to an effective bulk waste program.

Figure 6: Total miles driven by each truck

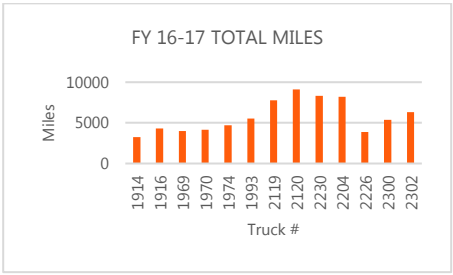
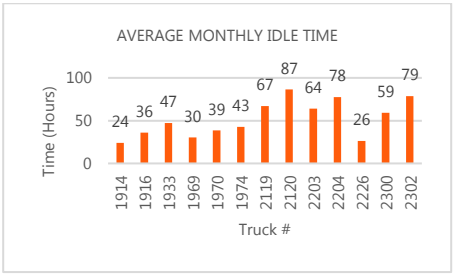


Figure 7: Idle time per truck



Initial analysis suggests that these improvements in fleet management may help reduce costs especially if some of the older diesel engines are gradually be phased out and replaced with new CNG ones.

Strategic Partnerships

Building a new facility isn't always the most feasible option due to economic constraints, insufficient demand, and slow cost recovery. It might be useful for Gilbert to form partnerships with other cities and leverage existing recycling facilities. The City of Phoenix recently opened a compost facility on the 27th Avenue that has potential composting capacity of 220,000 tons per year. Given that a high percentage of Gilbert's bulk consists of green waste, they could potentially partner with Phoenix to combine their efforts and start composting in their compost facility. Other potential composting partnerships could be with regional farms like the Farm at Agritopia situated in Gilbert. Chandler has a recycling facility that could be another option. While the town might incur costs in collecting and transporting all the waste to the appropriate facility, it would be offset by the savings from hauling and tipping fees, and money paid to Waste Management.

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