Chapter 7: Recycling

7.1 Introduction

7.1.1 Recycling in the U.S.

In 2010, Americans generated over 250 million tons of MSW (Municipal Solid Waste) and of that material over 85 million tons of it was composted or recycled, equivalent to a 34.1% recycling rate. The average American recycles and compost about 1.51 pounds of the 4.43 pounds of waste generated per day. While the U.S. continues to be one of the World's leading producers of MSW, the nation has seen a dramatic increase in the rate of recycling. In fact the percentage of recycled material from the MSW generated in the U.S. has increased from less than 10% in 1980 to 34.1% in 2010 (2010 U.S. EPA MSW Report, 2010)(**Appendix A, *Figure 7.8.1)***.

7.1.2 Importance and Benefits of Recycling

As the human population continues to grow exponentially so does the generation of MSW (**Appendix A, *Figure 7.8.2***) and with it the need to recycle and reuse materials and resources is essential. Recycling in today's world is a popular sustainable practice that holds many benefits both ecologically and economically.

Not only does recycling reduce GHG (green house gases) that contribute to global climate change, but it also reduces air and water pollution as well as energy consumption associated with making new products from raw materials. The 85 million tons of MSW recycled and composted in the U.S. in 2010 yielded a reduction of over 186 million metric tons of carbon dioxide from the earth. That's equivalent to removing the emissions of over 36 million passenger vehicles. To add, recycling can significantly helps recover many MSW items and reduces the amount of recyclable items such as plastic bottles, aluminum cans, paper and textiles in landfills (**Appendix A, *Table 7.8.1)***. In fact since 1990, the total amount of MSW going to landfills dropped by almost 10 million tons, from 145.3 million to 135.5 million tons in 2010 (**Appendix A, *Table 7.8.2***) (2010 U.S. EPA MSW Report, 2010)

As for the economic benefits, recycling and reusing can have many financial implications as recycling is a billion dollar industry and many recyclable items hold monetary value. Recycling and converting MSW into valuable raw materials can create jobs, build a more competitive manufacturing industry and add significantly to the U.S. economy. According to the U.S. Recycling Economic Information (REI) Study conducted by the EPA, the recycling and reuse industry nationwide includes more than 56,000 establishments. Together the businesses employ 1.1 million people, generate an annual payroll of $37 billion and gross $236 billion in annual sales. The study also found that 1.4 million jobs are "indirectly" supported by the recycling and reuse industry, resulting in an annual payroll of about $52 billion and about $173 billion in annual receipts. Spending by employees of the recycling and reuse industry leads to another 1.5 million jobs with an annual payroll of $41 billion and annual receipts of $146 billion. In addition, the recycling and reuse industry generated about $12.9 billion in federal, state and local taxes (DHEC).

7.1.3 Recycling within Universities

Universities across the nation are taking the initiative to become more sustainable and as this movement continues to gain momentum, the communities that surround these institutions continue to benefit both ecologically and economically. Large institutions like the University of Colorado at Boulder, the University of Oregon, the University of Nebraska-Lincoln and the University of California-

Irvine have made significant steps towards improving recycling within their campus communities. These large state schools have created recycling programs that have allowed them to successfully track and improve their diversion rates and analyze their financial benefits (Jones J. , 2010), (Kreighoff, 2012))(***Figure 7.1***). According to Columbia Analytical Services, inc. the diversion rate is the percentage of waste materials diverted from traditional disposal such as land filling or incineration to be recycled, composted, or re-used (ALS Environmental)

It's important for higher education institutions such as Chapman University to continue to develop and practice sustainable methods and policies in order to reduce its carbon footprint and benefit financially. As the university continues to grow, so will its waste production and if Chapman can steadily improve its waste diversion rate it will help ensure a sustainable future for the school.

7.1.4 Goals of this chapter

Practices and policies such as, but not limited to, proper recycle container placement, improving and implementing technologies that support sustainable recycling behavior, creating recycling programs, promoting recycling awareness among students and faculty through events and

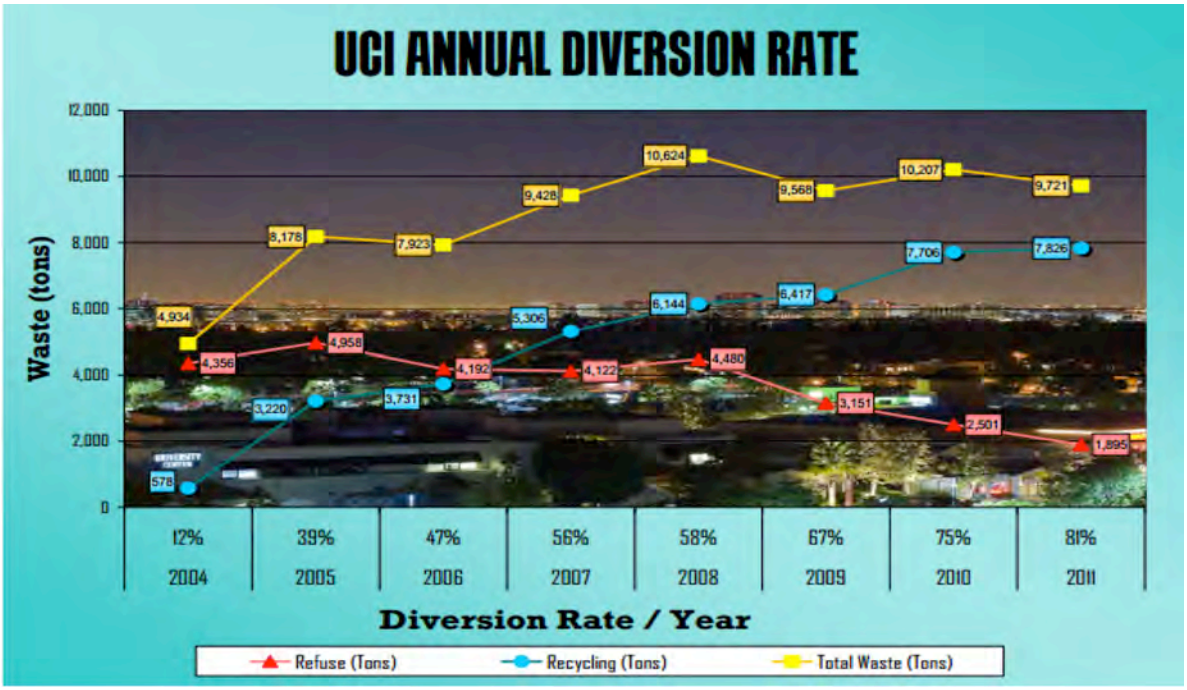

Figure 7.1. *UCI (University of California-Irvine) annual diversion rate. 2004-2011. Diversion rate increased from 12% to 81% between 2004-2011. Source* (Kreighoff, 2012)

visual aids like recycling procedure posters, and even possibilities of banning plastic bottle sales on campus are all taken into consideration in conducting analysis for this chapter and suggesting recommendations that will improve recycling efficiency at Chapman University.

7.2 History of Recycling at Chapman

7.2.1 Recycling Management

Prior to 2010 the city of Orange including Chapman University's waste and recycling services was provided by Waste Management, inc. Waste Management, inc. is North America's leading

provider of integrated environmental solutions. They are an inventive, eco-oriented company that provides waste and recycling services for more than 20 million residential, industrial, municipal and commercial customers throughout North America (WM, 2013). In 2010 the switch was made from WM to CR&R Waste and Recycling services. The switch was made, because CR&R provided waste collection services to the city at a cheaper price than WM. CR&R is one of Southern California's most innovative and successful waste collections companies (CR&R Waste Management Services, 2013). They pride themselves on great waste and recycling management and strive for sustainable practices. All of their collection vehicles run on natural gas.

Though CR&R is an environmentally friendly and community-oriented company, it is still difficult for Chapman to acquire waste data and information from them needed to perform and utilize important analysis regarding recycling. This is due to the fact that it is not normal practice for CR&R to release this data to the public or its customers and they are not required by contract to collect and share this information. Thus, a gap in information exists and almost all of Chapman's waste and recycling data comes from independent research.

What is known is that the university's waste and recycle stream is tied into the city of Orange's waste and recycle stream, meaning CR&R makes no distinction between collections from residential areas surrounding Chapman and the school itself. Therefore, no specific waste and recycling information can be determined from these collections. In addition, the frequency of these waste and recyclable collections vary throughout the campus. There are 31 separate areas at Chapman from which CR&R collects waste and recyclables. These areas range from the residential area to the West Palm Ave. office buildings. The rate of collection varies from everyday to about once a week depending on the location and amount of usage. For example the Argyros Forum large waste bins get collected every day, while the Partridge Dance Center large waste bin are attended to once a week. After recycling is picked up from Chapman and the surrounding community it is transported to CR&R's recycling center, which is located in Stanton just 12 miles from the university. CR&R charges Chapman for waste collection, refer to Chapter 9 on waste management, but recycling collection is free (Jones L. , 2013).

Figure 7.2. *Blue recycling bin*

7.2.2 Overview

Up until about 2005 Chapman been decent at recycling. While Chapman's waste and recycling provider, Waste Management, inc. did a good job sorting and collecting the universities waste and recyclables, the school itself had a necessity to improve its recycling behaviors and policies. Within the past 8 years Chapman has made some major improvements that have helped contribute to an increased recycling rate. With the hiring of Karen Swift, Chapman's first ever Environmental Health and Safety Manager in 2005, the creation of the Faculty Environmental Committee in 2007, the addition of the Environmental Science and Policy Major to the university in 2009, the hiring of Mackenzie Crigger as the new Sustainability Manager in 2011, and the past accomplishments seen below Chapman has begun to devote itself to a sustainable future and recycling has been and will be one of the major beneficiaries of these improvements.

7.2.3 Past accomplishments

2006: Chapman University received a grant from the city of Orange to buy small blue recycle bins for classroom and office use (***Figure 7.2***). This grant money was also used to train custodial staff on proper waste disposal procedures. The recycling rate at Chapman increased shortly after the purchasing of these blue bins and as a result a number of the 3-yard waste dumpsters were replaced with 3-yard recycling dumpsters (***Figure 7.3***) (Graves, 2013).

2008-2009: An extensive audit led by Chapman's Faculty Environmental Committee was conducted to observe if Chapman classrooms and offices were sufficiently equipped with small blue recycle bins. Finding that many classrooms and offices lacked small recycling bins they were successful in deploying more than 900 recycling bins to classrooms and offices throughout campus (Kim, 2013).

2010: The first refillable water bottle station was installed in the Doy-Henley Dormitory (***Figure 7.4a and 7.4b***). Within the two years that followed (2011-2012) seven more water bottle refill stations were installed throughout campus. Current locations include: Doy-Henley Residence Hall, Hashinger Science Center, Argyros Forum 2nd floor, three in the Hutton Sports Center (one located across from student gym, and one each in both the men's and women's lower locker rooms), Doti Hall, and the ETC (Entertainment Technology Center) building. More are projected to be installed in campus buildings in the next couple of years. Each station is equipped with a meter that counts the number of 12 ounce bottles saved by using the stations (***Figure 7.4a***)

Figure 7.3. *Location: Hashinger Science Center. Large waste (blue) and recycling (white) dumpsters can be found in many areas throughout the campus.*

Figure 7.4a. *Refill station meter.*

Figure 7.4b. *Location: ETC Refill station with motion activated sensor and display showing number of 12 ounce bottles saved by refill station.*

2011 Feb.-March.: Chapman University competed in its first ever Recyclemania. Recyclemania is a friendly 8-week long competition and benchmarking tool held every spring semester for college and university recycling programs to promote waste reduction activities to their campus community. Over the 8 week period Chapman's per capita recycling baseline amount was 21.30 pounds. Since this analysis was conducted in only Chapman's residential area this baseline amount does not represent the school as a whole.

Figure 7.5. *(Left) BigBelly recycle/waste receptacles. (Right) BigBelly procedure poster on side of receptacles.*

2013 March: Three sets of pilot BigBelly trash and recycle containers were deployed on the Chapman campus (see ***Figure 7.5***). These containers have compacting capabilities powered by solar panels located on the tops of the containers. Each container has a transmitter installed within it that alerts the custodial staff when the container is to capacity. The purpose of these containers is to reduce the frequency of loads necessary to be taken to the large dumpsters. (See section 7.3 on current status to learn more about the BigBelly waste program).

Posters with labeled examples of recyclables can be

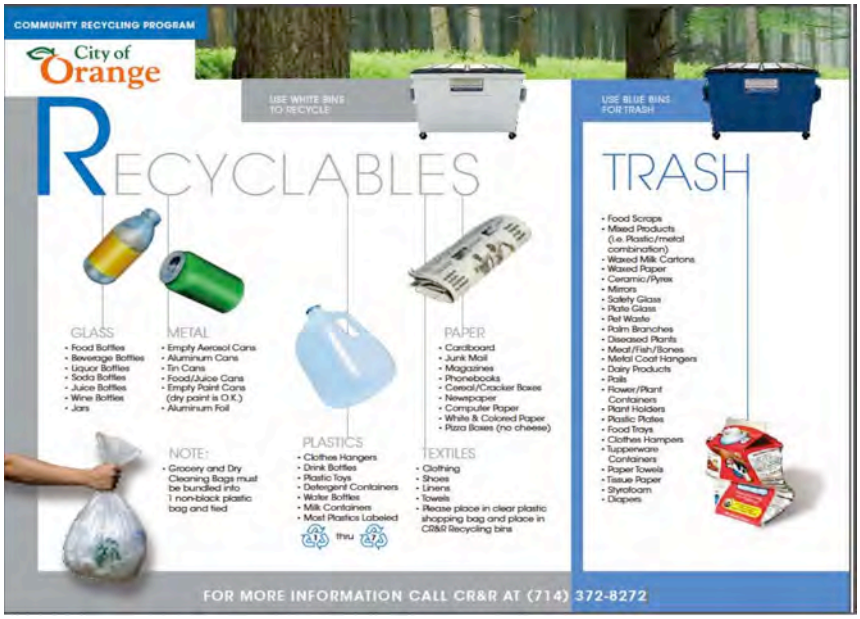

Figure 7.6. *An informative poster that can be seen around Chapman as well as the Orange community. This poster essentially explains what items are recyclable and what*

seen hanging on walls above recycling containers and in dormitory waste disposal rooms. These posters give reference to what items should and shouldn't be recycled (***Figure 7.6)***.

Many of these past accomplishments along with their current status will be further discussed in the following sections and will serve as a basis for further improvement to sustainable recycling at Chapman University.

7.3 Current Status of Recycling at Chapman

Chapman University is taking steps in the right direction to improve recycling. The environmental movement at Chapman continues to gain momentum and with it a sense of responsibility to be more eco-oriented. The next step for the university is to provide and practice more sustainable methods and programs in order to reduce its carbon footprint. The recycling aspect alone has seen some major improvements over the last 8 years and continues to improve as the university grows. Listed below are some of the current recycling initiatives at Chapman University.

Installation of eight additional water bottle refill stations (***Figure 7.3)*** has already made a large impact on the number of 12 ounce plastic bottles eliminated from the environment. Since observation began on March 4th, 2013, the meters on the 8 refill stations have counted more than 220,000 total 12 ounce water bottles removed from the environment. This number does not account for bottles eliminated prior to filter replacement which occurs every 3-6 months depending on the location and frequency of usage. Additionally, according to the 2013 Chapman Environmental Sustainability Survey 77.1% of the 977 students who took the survey reported they use a refill station on campus at least once a week, with 25.3% of these students using a refill station every day (2013 Chapman University Environmental Audit Survey, 2013). See **Appendix B, *Table 7.8.3*** for more information on specific water bottle refill station use. See **Appendix B, *Figure 7.8.3*** for current locations of refill stations on Chapman main campus.

Double-sided trash/recycle bins have been implemented in the Argyros Forum student lounge (***Figure 7.7***). These receptacles give individuals the easy option to recycle. There are currently 7 of these bins scattered throughout the Argyros Forum student lounge and they are collected and taken to the Argyros Forum dumpsters every day. Observational analysis has shown that while students generally use these receptacles efficiently by placing plastic bottles and paper materials in the recycling side and food waste items in the litter side these receptacles can sometimes have one or both sides overflowing at the end of the day leaving students to use other receptacles to dispose of waste or in some cases place litter items in the recycling side and vice-versa.

Three sets of trash and recycle BigBelly receptacles are currently in use on the Chapman campus (***Figure 7.5***). They are part of a pilot program created by Mackenzie Crigger to see the effects they have on collection frequency and efficiency. The current locations are as follows: One set is located in front of Beckman Hall, one set is located in Jazzman's outdoor dining area and one set is located in between Lastinger Athletic Complex and Hutton Sports Center. With compacting capabilities powered by solar panels that sit on top of the receptacles as well as transmitters alerting custodial staff when capacity is reached or nearly reached. The purpose of these BigBellys is to reduce collection frequency and improve collection

Figure 7.7. *Location: Argyros Forum Double-sided trash/recycle container.*

efficiency, while collecting information on both. Current recycling receptacles are unloaded once or twice a week depending on location, while the new BigBelly recycling receptacles need only to be unloaded about every week and a half, and sometimes only once every two weeks. Once full, facility members collect the waste or recycling and transport them on a flat-bed dolly to large waste dumpsters. This job usually requires two people due to the increased weight of the compacted material (Crigger, 2013). See **Appendix B, *Figure 7.8.3*** *for current BigBelly locations on Chapman main campus.*

Currently data is being collected on the BigBellys to see their effectiveness. ***Figure 7.8*** is a bar graph that shows the average combined collection frequency and efficiency of the BigBelly trash and recycle receptacles. The average weekly collections per component is 1.3. This means that the trash receptacles are collected about 1.0 time per week (about once a week), while the recycling receptacles are collected about 0.3 times per week (about every week and a half). In a 36 week school year, assuming that current recycling receptacles are collected every week, that amounts to be 36 collections from recycling receptacles in an average school year. Comparing those numbers to BigBelly recycling receptacles, in an average school year of 36 weeks at a collection rate of every week and a half, it amounts to be 24 collections in an average school year. That's 12 less collections needed for the BigBelly recycling receptacles than current recycling receptacles in an average school year. As for the efficiency of the collections, the red in the graph represents collection when receptacles are to capacity, yellow represents collections at near capacity and green represents collection at well below capacity. Over the four week period of collection a trend in the graph shows a shift from collections in the green to more collections in the yellow and red. This is most likely due to

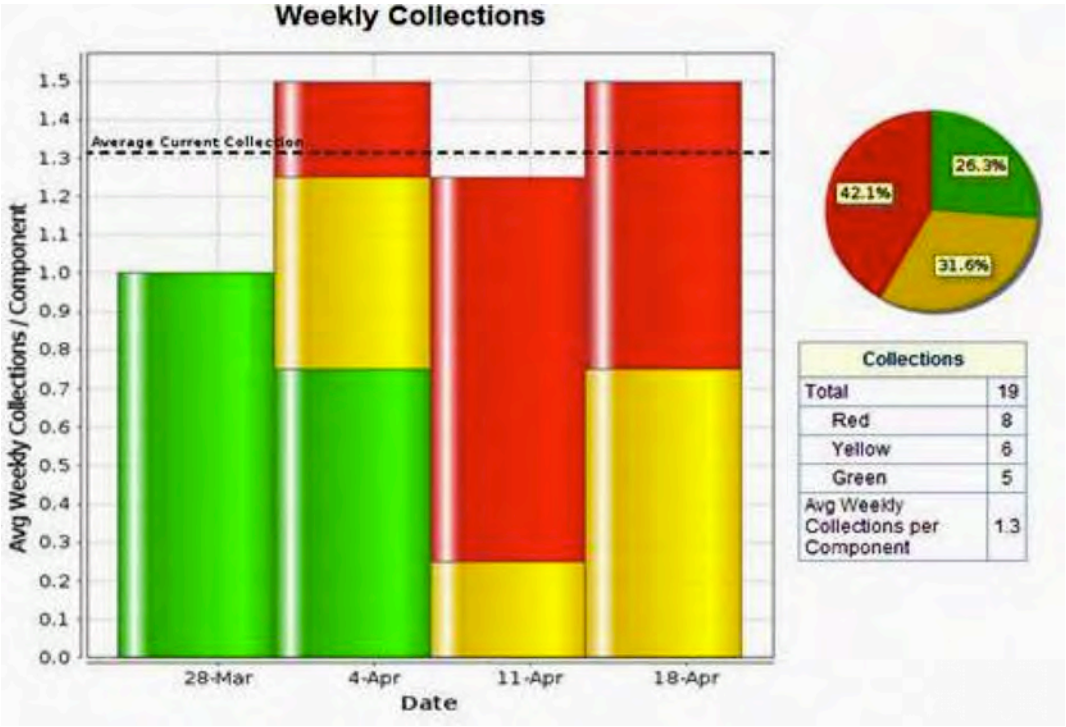

Figure 7.8. *BigBelly waste and recycling weekly average collection data over a four week period. March 28th, 2013-April 18th, 2013.*

the custodial staff becoming more acquainted with the BigBelly receptacles. If these BigBelly receptacles continue to have success they may very well be the future of waste receptacles at the university.

Facilities does a good job of providing proper trash receptacles, but they lack an adequate number of recycling receptacles to allow for consistent recycling on the main campus (the area between Walnut ave., Glassel st., Palm ave. and Center st.). There are approximately 56 white metal trash receptacles and 24 blue metal recycling receptacles on the main campus. This gives a ratio of slightly more than 2 trash receptacles for every 1 recycling receptacle. Not only is this ratio not even, there also seems to be a spatial issue in which the recycling cans are not always placed next to a trash can. Some recycling cans are located within a yard of a trash can while some sit more than fifteen to twenty or more yards away from a trash can (***Figure 7.9***). See **Appendix B, *Figure 7.8.3*** for locations of current recycle and trash bin locations on Chapman main campus.

Figure 7.9. *(left) Location: Hashinger Science Center. Proper placement of recycle and trash cans about 2 yards from each other. (right) Location: Reeves Hall. Improper placement of cans more than 25 yards away from each other. Recycle can circled in yellow.*

Every student dormitory room receives a blue recycle bin (***Figure 7.1***) upon check-in at the beginning of every school year. A $25 is charged if these bins are not returned at the end of the school year. Students are responsible for taking their waste and recycling from their rooms to waste disposal areas where larger trash and recycling receptacles. These areas are conveniently located for each residence hall in Chapman's residential area. Waste and recycling is picked up from waste disposal areas by custodial staff and taken to large waste and recycling dumpsters to be picked up by CR&R. It's also important to note that all waste disposal rooms are equipped with signage regarding proper recycling procedures (***Figure 7.6***). In addition to this, Sandhu Residence Hall has a sustainability living learning community which promotes students to be more environmentally conscious (Yates, 2013).

7.4 Concluding Assessment

7.4.1 Areas of progress

Chapman is doing well in adopting technologies that effectively help improve recycling and waste management. Technologies such as the refillable water stations have already made contributions in reducing plastic bottle waste from the environment. The BigBelly waste and recycling receptacles have the capability to significantly reduce collection frequency and increase collection efficiency (***Figure 7.7***). In larger numbers these big belly receptacles could reduce the frequency of pick-ups by CR&R by reducing individual contribution to large waste and recycling dumpsters. Again CR&R picks up recyclables at Chapman free of charge, but if these receptacles could encourage a greater amount of recycling by the campus community this could reduce total waste production of the

university, increasing its diversion rate which could reduce waste collection frequency by CR&R ultimately reducing waste collection cost. Chapman also does a good job labeling receptacles and employing informational posters regarding proper recycling procedure (see ***Figure 7.4)***.

7.4.2 Areas in which to improve

As can be seen in **Appendix B, *Figure 7.8.3*** there is an adequate number of heavy white trash receptacles on Chapman's main campus, 56 to be exact, but there is still a need to increase the number of heavy blue recycling cans, of which only 24 exist, so that they match the number of trash cans. Additionally, many of the blue recycle cans are placed in good places along walkways and in front of building entrances, but it would benefit recycling efficiency if the recycle cans were placed next to trash cans. This is important, because poor receptacle placement can cause contamination in both trash and recycling containers as well as increased mixed recyclables ending up in dumps. For example, food waste thrown into a recycling container can contaminate paper and cardboard items, while recyclable items thrown into trash receptacles are hauled off to landfills.

Chapman could benefit from collecting information on its waste diversion rate and setting goals to improve it. If the recycling diversion rate continues to improve the university could benefit by significantly reducing its carbon footprint and reducing its waste collection cost (Learn more about waste management in Chapter 9. While Chapman may not control the end result of where its recyclables go, the university could easily improve its initial recycling capabilities. The programs and technologies already in place have already helped the recycling cause, but there is still a necessity to continue to improve recycling around the university. Modeling recycling practices of neighboring university programs such as Santiago Canyon Community College, Orange Coast Community College and UCI would be a great start to help improve Chapman's recycling management. As mentioned before UCI currently has an 81% diversion rate of its total waste production (Kreighoff, 2012) (***Figure 7.1***)**.** Chapman should try to set a goal to reach this statistic in the next decade.

7.4.3 Existing gaps in knowledge

Currently Chapman does not keep track of the its waste diversion rate and lacks data on its waste production statistics aside from the BigBelly receptacles. This may be partly because CR&R does not commonly share waste collection data with the university and partly because only within the last decade has Chapman begun to work towards more sustainable waste and recycling management practices.

7.5 Recommendations

7.5.1 Low cost/effort

All outdoor heavy trash and recycling receptacles should be maintained so that a recycling receptacle is always located within four yards of a trash receptacle. This should occur weekly and permanent locations for all receptacles should be strategically established so that they are of most ease to be used by individuals on Chapman campus premises. The areas on campus most frequented by students, such as between Leatherby Library and Agyros Forum and Atallah Plaza should be adequately supplied with an even ratio of recycle containers to trash containers. Paired containers should be located along walk-ways for convenience to passer-bys. According to the 2013 Chapman Environmental Audit Chapman students do a generally good job at placing their recyclable items in correct receptacles around campus. When asked "If you have to dispose of an item that is recyclable, do you hold on to it until you find a recycle bin or do you place it in the nearest trashcan?" 28% of the 978 students who took the survey responded they always hold on to it to throw it into a recycling can when they find one, 53% sometimes hold on to it, 12% place it the first bin they see and 7% will at

times place it in a trashcan (2013 Chapman University Environmental Audit Survey, 2013) (***Figure 7.10***). We may find that if more recycling cans existed around campus and were placed near trash receptacles, students would more than likely throw almost all their recyclable items in recycling receptacles. Additionally, in order to even the ratio of trash receptacles to recycling receptacles on Chapman's main campus, 10-15 trash receptacles should be painted blue and used as recycling receptacles. This would be the most cost efficient solution rather than buying new recycling receptacles.

When hosting an event within Chapman premises the event holder should have an equal numbers of recycle containers to trash containers. These containers should be readily available for use for events on campus. Each recycling receptacle should be placed next to its paired trash container. Chapman is usually efficient at doing this, but events vary and are not always consistent in having enough recycling equipment. To aid and promote good recycling practices at these events, interested students, members of various environmental clubs and/or environmental majors could volunteer to assist event-goers in source separation. This could mimic the "trash-talkers" program that has been very successful at UCI (Kreighoff, 2012)

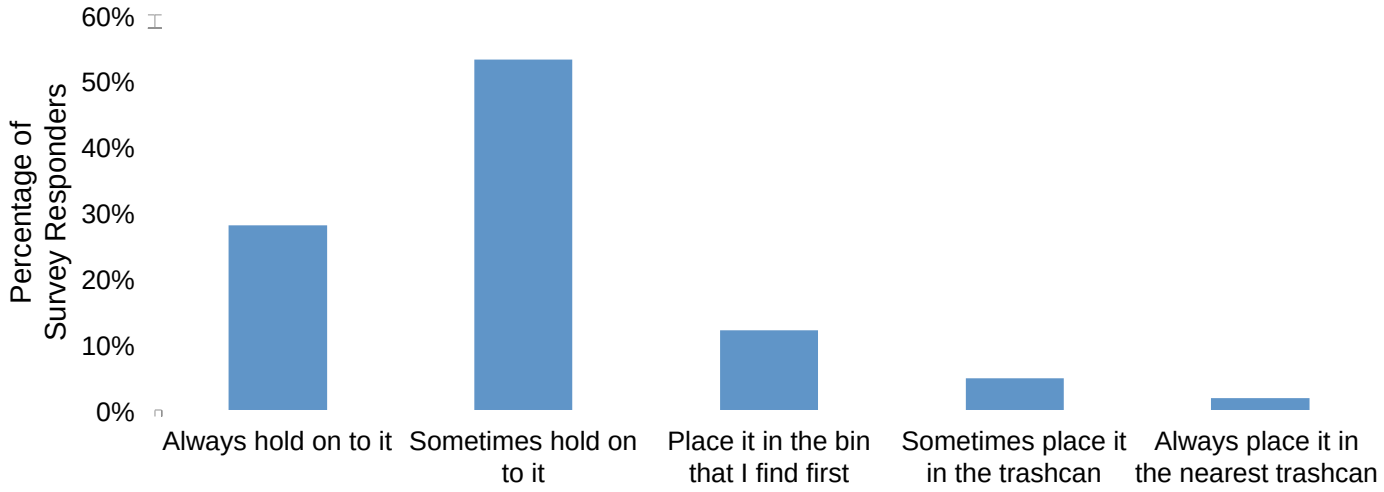

Figure 7.10. *Behavior of students when they have to dispose of a recyclable item at Chapman.*

7.5.2 Moderate cost/effort

Devote a portion of the custodial crew to work directly with recycling. Have this specified team handle all recyclable items, sort mixed recyclables and collect data on their findings. If they can produce hard data on amounts and types of recyclables produced on a temporal basis than they could provide substantial opportunities for Chapman to save money through smart recycling and reduce its carbon foot-print. This could help pave the road for a future Chapman recycling program.

Create recycling projects within 100 and 200 level environmental classes such as environmental science 101 and environmental policy 102. Recycling projects can consist of exploring what percent of Chapman's waste could potentially be diverted from landfills or how double-sided trash/recycle bins compare in waste diversion to regular trash and recycle bins that are side by side. Students are not limited to these suggestions and are encouraged to think outside the box to improve recycling at Chapman. Even the geographic information class could conduct a project to determine spatial efficiency of recycling/trash containers. (See Chapter 2 on Curriculum to learn more about this).

7.5.3 High cost/effort

Institute a ban of all plastic bottles sales on the campus of Chapman University. The eight water bottle refill stations as well as soda fountains already located at almost every merchant on campus except Jamba Juice, inc., Einsteins Bagels, inc., and the Rotunda Café located in Leatherby Library, are conveniently available for students to if plastic bottled beverages were banned from the campus. According to the 2013 Chapman Environmental Audit Survey students were asked "If Chapman were to ban plastic bottled beverage sales on campus, would replacing them with additional soda fountains and water refill stations suffice for the ban of bottles?" More than half, 62%, of the 978 students surveyed were in support of the ban responding Yes to the question, 22% were indifferent on the topic and 16% said No, it would not suffice (2013 Chapman University Environmental Audit Survey, 2013) (***Figure 7.11***). In addition there could be some major environmental impacts included in banning plastic bottle sales on campus. Assuming that SODEXO, who owns and supplies all merchants and dining areas on campus, sells approximately 500 12 ounce plastic beverage bottles per school day (Monday through Friday). In one week that's 2500 12 ounce plastic beverage bottles sold. In a 36 week school year plus or minus days where school is not in session, that's about 90,000 +/- 2,500 12 ounce plastic bottles sold. If an average empty 12 ounce plastic bottle weighs about 19 grams, over the course of the school year that amounts to be 1,710,000 grams or 1.71 metric tons of plastic from the 12 ounce bottles sold on campus. If the ban were to be instituted, Chapman could possibly eliminate about 1.71 metric tons of plastic bottle waste from the environment per school year. This analysis does not take into account the growing student population at Chapman.

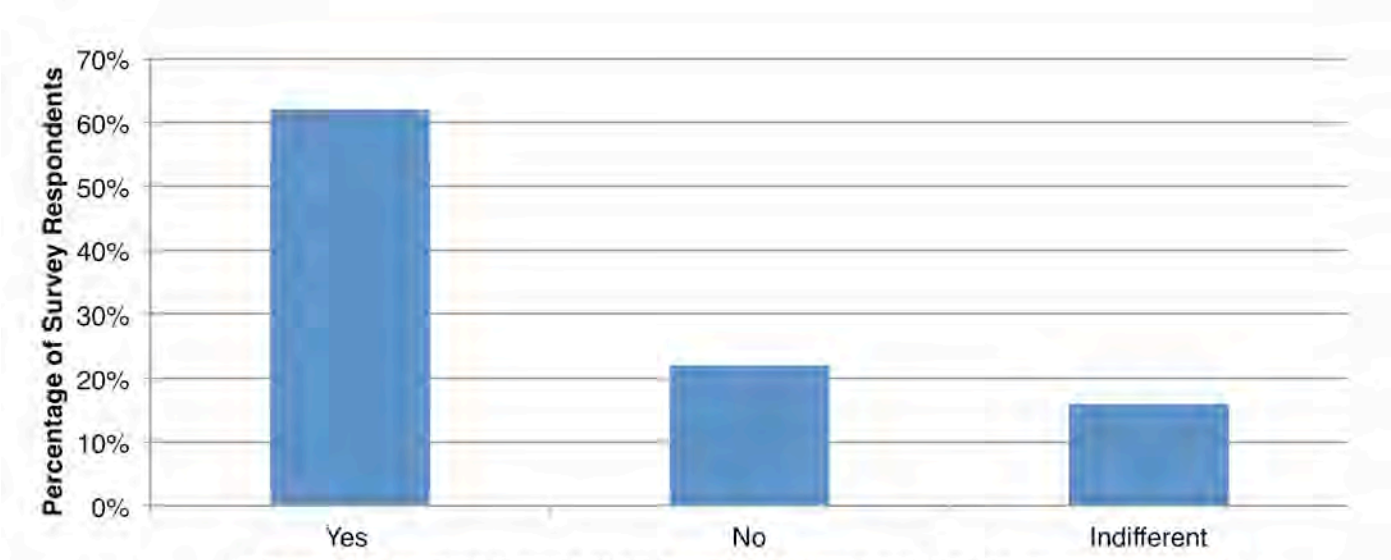

Figure 7.11. Student support of the banning of plastic bottle sales on campus (n=977).

7.5.4 Future areas of research

If Chapman were to find a merchant who would buy recyclables directly from them, then they could likely gain a profit of a couple thousand if not tens of thousands o dollars over an average school year. This would also allow for hard data to be collected by the university which could benefit future recycling analysis.

Creating a recycling program may not be too far off from what Chapman wants to achieve already. Mackenzie Crigger, the sustainability manager at Chapman, should hire a team of experts or

devote a team from the custodial crew to focus specifically on Chapman's recycling. They could collect data on waste stream diversion as well as current waste and recyclable contamination. This data could eventually help Chapman increase its waste diversion rate and reduce its carbon footprint.

7.6 Contacts

Anne Kreighoff, Manager-Solid Waste and Recycling, UC Irvine, akreigho@uci.edu, (949) 824-9097

Dr. Christopher Kim, Associate Professor, Former Chair of the Chapman Faculty Environmental Committee, Chapman University, cskim@chapman.edu. 714-628-7363

Lawrence Jones, Community Relations Compliance Specialist, CR&R waste management services, LawrenceJ@crrmail.com, (714) 372-8261.

Mackenzie Crigger, Sustainability Manager, Chapman University, crigger@chapman.edu.

Madison Yates, Senior Department Assistant, Office of Housing and Residence Life, Chapman University, myates@chapman.edu.

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7.8 Appendices

Appendix 7.A: MSW and Recycling in the U.S.

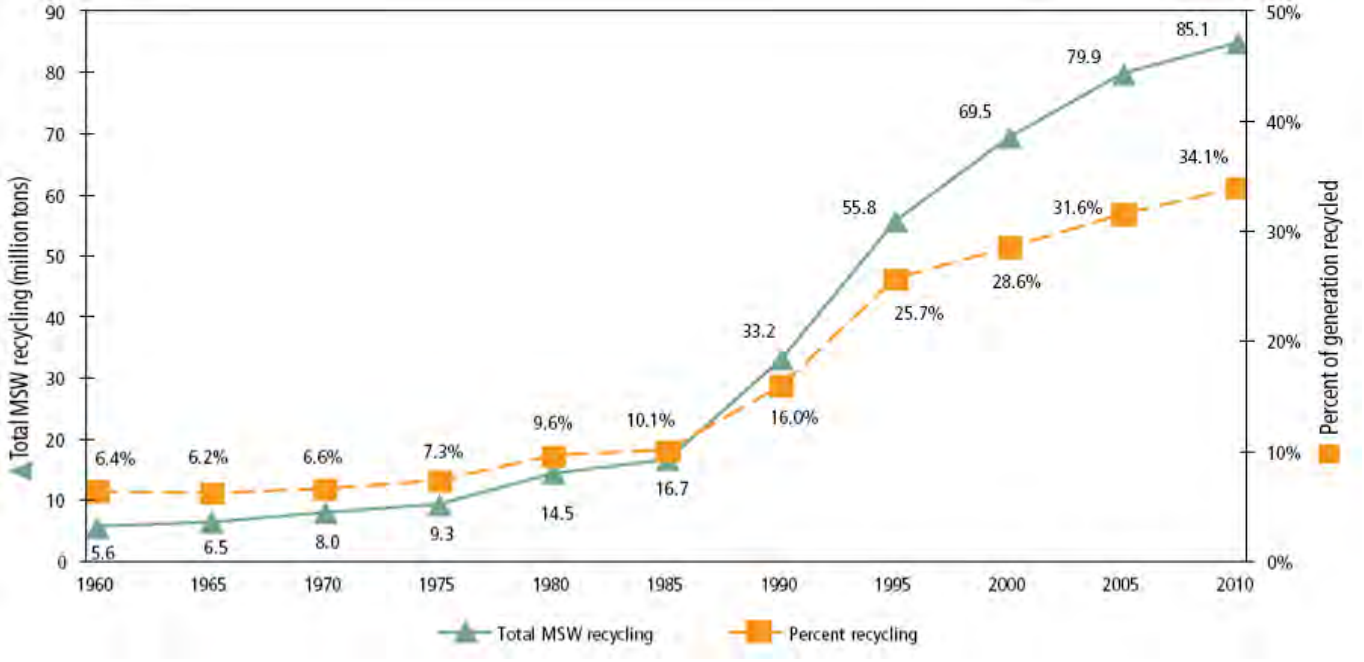

Figure 7.8.1: *MSW recycling rate in the U.S., 1960-2010. The percent of MSW recycled (represented in orange) increased 28.5 % in the 50 year time span. Source: EPA MSW Report, 2010.*

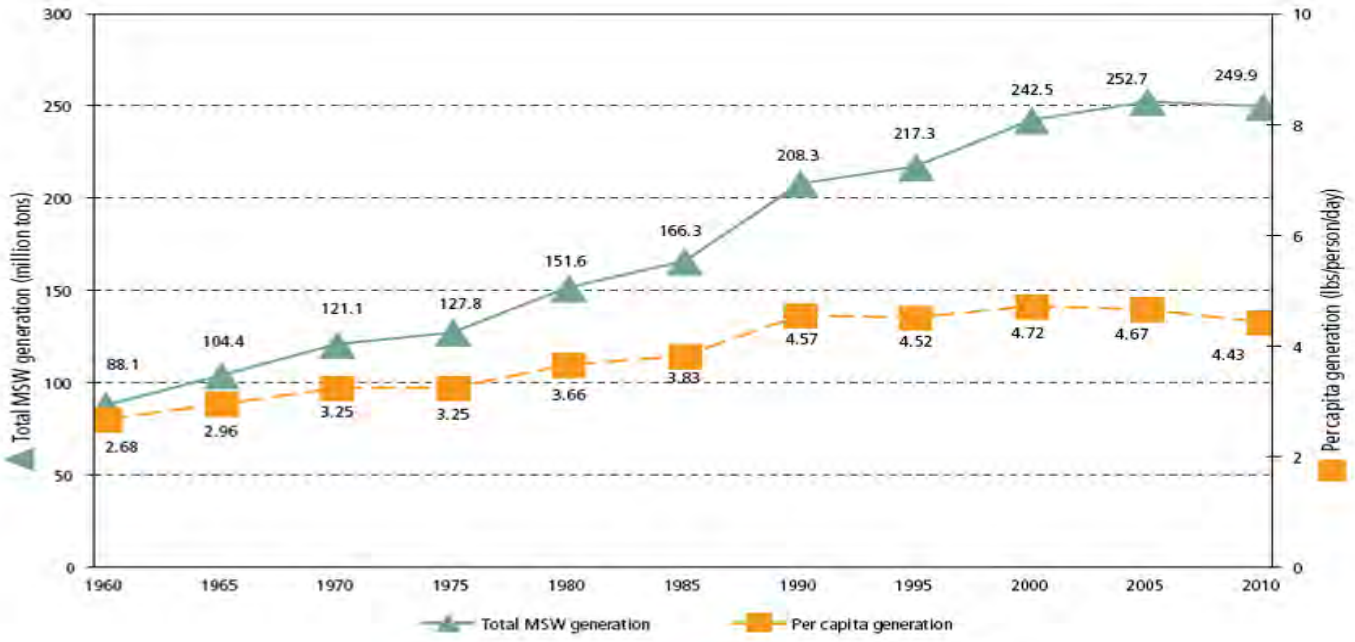

Figure 7.8.2: *MSW generation rates, 1960-2010. Total MSW generated has increased due to an increase in the human population. Per Capita MSW generation has stayed more consistent as factors like recycling, smart waste management and limited resources have influenced this rate. Source: EPA MSW Report, 2010.*

Table 7.8.1: *Generation and Recovery of Materials in MSW, 2010* (in millions of tons and percent of generation of each material). Source: U.S. EPA MSW Report, 2010*

Activity	1960	1970	1980	1990	2000	2005	2007	2008	2009	2010
Generation	2.68	3.25	3.66	4.57	4.72	4.67	4.64	4.53	4.35	4.43
Recovery for recycling	0.17	0.22	0.35	0.64	1.03	1.10	1.15	1.11	1.10	1.15
Recovery for composting*	Negligible	Negligible	Negligible	0.09	0.32	0.38	0.39	0.40	0.37	0.36
Total Materials Recovery	0.17	0.22	0.35	0.73	1.35	1.48	1.54	1.51	1.47	1.51
Combustion with energy recovery†	0.00	0.01	0.07	0.65	0.66	0.58	0.58	0.57	0.52	0.52
Discards to landfill, other disposal‡	2.51	3.02	3.24	3.19	2.71	2.61	2.52	2.45	2.36	2.40
Population (millions)	179.979	203.984	227.255	249.907	281.422	296.410	301.621	304.060	307.007	309.051

* Composting of yard trimmings, food scraps, and other MSW organic material. Does not include backyard composting.

† Includes combustion of MSW in mass burn or refuse-derived fuel form, and combustion with energy recovery of source separated materials in MSW (e.g., wood pallets, tire-derived fuel).

‡ Discards after recovery minus combustion with energy recovery. Discards include combustion without energy recovery.

Details might not add to totals due to rounding.

** Source: For 2002 data: *BioCycle* 2006.
For 2010 data: EPA, *Municipal Solid Waste in the United States: 2010 Data Tables and Figures.*

Table 7.8.2: *Generation, Material Recovery, Composting, Combustion With Energy Recovery, and Discards of MSW, 1960 to 2010 (in pounds per person per day).*

Material	Weight Generated	Weight Recovered	Recovery as Percent of Generation
Paper and paperboard	71.31	44.57	62.5%
Glass	11.53	3.13	27.1%
Metals			
Steel	16.90	5.71	33.8%
Aluminum	3.41	0.68	19.9%
Other nonferrous metals†	2.10	1.48	70.5%
Total metals	**22.41**	**7.87**	**35.1%**
Plastics	31.04	2.55	8.2%
Rubber and leather	7.78	1.17	15.0%
Textiles	13.12	1.97	15.0%
Wood	15.88	2.30	14.5%
Other materials	4.79	1.41	29.4%
Total materials in products	**177.86**	**64.97**	**36.5%**
Other wastes			
Food, other‡	34.76	0.97	2.8%
Yard trimmings	33.40	19.20	57.5%
Miscellaneous inorganic wastes	3.84	Negligible	Negligible
Total other wastes	**72.00**	**20.17**	**28.0%**
Total municipal solid waste	**249.86**	**85.14**	**34.1 %**

* Includes waste from residential, commercial, and institutional sources.

† Includes lead from lead-acid batteries.

‡ Includes recovery of other MSW organics for composting.

Details might not add to totals due to rounding.

Negligible = Less than 5,000 tons or 0.05 percent.

Appendix 7.B: Chapman recycling data.

Table 7.8.3: *Chapman water bottle refill station plastic bottle replacement numbers (12 ounce bottles)*

Location/Collection Date	3/11/2013	3/18/2013	4/2/2013	4/9/2013	4/16/2013	4/22/2013
Argyros Forum (2nd Floor)	22,529	24,057	25,278	27,383	28,182	29,414
Doti Hall	1,496	1,755	2,078	2,463	2,705	3,016
ETC	*NDC	*NDC	255	280	307	345
Hashinger Science Center	44,908	**614	2,029	3,074	4,378	5,641
Henley Residential Hall	*NDC	7,235	8,876	11,346	12,894	14,556
Hutton Sports Complex	82,181	86,988	91,659	95,241	100,014	103,554
Mens Locker room	26,788	27,160	27,463	27,568	27,996	28,186
Womens locker Room	*NDC	10,635	10,715	10,870	10,963	11,076
					Total Sum	**195,788**

**NDC: No data collected*

***Filter replaced (occurs every 3-6 months)*

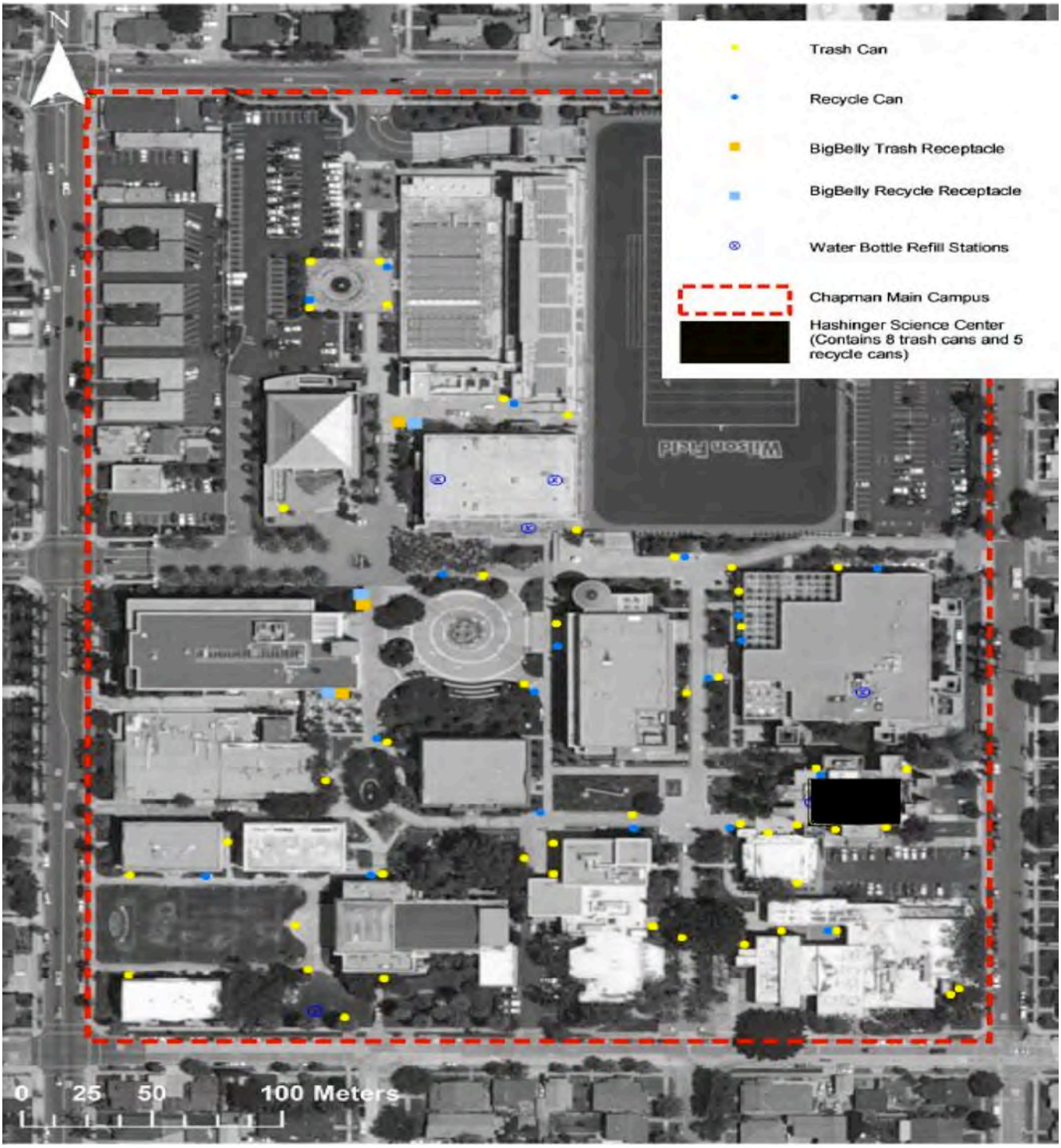

Figure 7.8.3: *Map of Chapman University main campus. Locations of all trash (56 total) and recycle receptacles (24 total), BigBelly trash/recycling receptacles (3 total pairs) and water bottle refill station (6 shown here on main campus, 2 located off main campus, Doy-Henley Dormitory, and ETC building).*
**Missing: Doti Hall classroom building and construction site of new performing arts center.*