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Summer 2012 Archy 205 Garbology Project
Final Report

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Introduction and Project Goals

As part of the summer offering of Archaeology 205: Principles of Archaeology, a class garbology project was undertaken. Founded in the early 1970's, garbology is a sub-discipline of archaeology which examines modern trash to gain insights about patterns of consumption, waste, and landfill management[1]. This summer's project examined trash collected from the University of Washington campus for 6 weeks between July 10th and August 14th in cooperation with Emily Newcomer, the UWFS Manager of Recycling and Solid waste. Ms. Newcomer graciously provided trash collection services, facilities for sorting and analysis, and expertise in training and the process of sorting. Supplies and safety equipment for sorting were mostly provided by Archy 205 student course fees, and labor for sorting and analysis was provided on a volunteer basis by Archy 205 students and by me, the project organizer and course instructor.

The primary goal of this project was to further the education of Archy 205 students by examining the intersections between waste, human consumption, archaeology, the modern world, and the local UW community. This broad theme was an important part of the overall class, much of which was devoted to the discussion of ways in which archaeology can be useful in addressing practical problems in contemporary society. The degree to which this goal was achieved is difficult to measure (although course evaluations may shed further light once they become available from the UW Office of Educational Assessment), but generally speaking the students involved seem to have benefitted substantially from participating. Several students commented on how participation in the project significantly altered their perceptions of waste and waste disposal, for example, so at very least the project seems to have inspired students to think differently about their world and their consumption habits. From a teaching perspective, the project was also successful in fostering camaraderie between students, as well as between students and the instructor. This camaraderie – primarily generated outside the classroom at weekly trash-sorting events – carried over to the traditional classroom environment, and helped make the class as a whole a more productive atmosphere for learning. In other words, this project helped engage students in one aspect of the class, and this engagement enhanced all aspects of the class as a result. The project was therefore broadly successful in achieving its primary goal, and this fact alone will hopefully be enough to encourage the continuation of this program beyond the summer of 2012.

Because this project is in many ways the first of its kind at UW, a secondary goal of this summer's work was to explore and confront any logistical issues inherent in conducting an academic course-affiliated garbology project on the UW campus. As such, this summer's effort can largely be seen as a pilot project intended to inform and refine the administration of similar projects in the future. Although not fully reported here, efforts to meet this goal produced detailed information on the money, materials,

[1] *Rubbish!: The Archaeology of Garbage*, by W. Rathje and C. Murphy. Harper Collins, NY, 1992.

labor, and time required to undertake a project of this sort. Additionally, because this project was a first-time collaboration between UWFS and the Department of Anthropology, inter-departmental contacts were fostered as a result of this summer's work. Future projects will therefore benefit from both the contacts and logistical information generated this summer.

Another secondary goal of this project was to produce something useful to UW in its efforts to improve waste management on campus. In other words, we – both Ms. Newcomer and myself – wanted this project to have some sort of practical result which would be helpful to the UW community. Our options for working towards this goal were limited somewhat by the exploratory nature of the project, but we were nonetheless able to achieve this goal in three main ways. First, a number of students independently created a range of potentially useful products, including papers outlining ideas for future garbology work on campus, GPS locations of all outdoor trash cans on campus, garbology-themed videos, and a website[2] (navigable, but still under construction) to publicize the project and host the products thereof. In this way, student efforts on behalf of the project are directly feeding the resources we have available to disseminate project results and to help perpetuate and expand the project itself. Second, we have begun to successfully recruit a corps of future project participants, as multiple undergraduates have expressed a desire for continued active involvement, and a small group of archaeology graduate students (including the instructor of Archy 205 for Autumn 2012) and faculty are beginning to explore active project participation for both teaching and research. This interest bodes well for the continued life of the project. Third, we addressed a specific research question of practical importance to UWFS with data generated from the sorting and analysis of campus trash. Details of this contribution of the summer 2012 garbology project comprise much of the remainder of this document, which is focused on reporting our research conclusions to Ms. Newcomer's office.

Research Overview

After discussion and consideration of logistical constraints and educational goals, our research this summer was narrowed down to one central question: How well do the BigBelly Solar kiosks (recently installed around Red Square[3]) divert compostable and recyclable material from landfill-bound trash?

Answering this question is important because the implementation of these kiosks represents part of an initial push to directly reduce the amount of compostable and recyclable materials the UW sends to landfills each year[4]. Limited data suggest that these materials comprise well over 60% of the mass of the UW's annual landfill waste[5], and given the fact that the UW's annual landfill costs run well into the hundreds of thousands[6], significant financial motive exists to find ways to more effectively eliminate these materials from landfill-bound trash. Some available information suggests the BigBelly kiosks are in some way helping to reduce the overall accumulation of landfill waste in outdoor areas on campus[3], although little information is currently available as to how well these kiosks prevent compost and recyclables from ending up in this landfill waste. In other words, we currently have little evidence as to whether these kiosks are effective in changing the composition of our landfill-bound waste. Measurement of this landfill-bound waste therefore has the potential to yield valuable insights that can

[2] http://uwgarbology.weebly.com/index.html
[3] http://www.washington.edu/facilities/building/recyclingandsolidwaste/
[4] http://dailyuw.com/news/2012/apr/26/uw-sees-decrease-waste-through-solar-powered-compo/
[5] http://www.washington.edu/facilities/building/recyclingandsolidwaste/trashin
[6] Derived from FY 2010-2011 data provided by Emily Newcomer, UW Recycling and Solid Waste Manager, personal communication

help guide the purchasing, placement, and implementation of the BigBelly Solar kiosks in outdoor campus areas, by extension contributing in some small way to burgeoning efforts to address the composition of landfill waste produced campus-wide.

Methods

There is more than one way to address the given question through the analysis of kiosk waste. A comprehensive approach would both 1) compare kiosk landfill-bound trash with landfill-bound trash from comparable non-kiosk collection points on campus, and 2) compare kiosk landfill-bound trash accumulation rates with kiosk compost and recycling accumulation rates. The former analysis would show if kiosks are having an effect by changing the *composition* of trash which is actually landfill-bound, while the latter would show *how much* waste is being diverted from landfills as a result of the simple availability of composting and recycling options available at kiosks. Given the logistical considerations and exploratory nature inherent in this summer's project, we elected to adopt the former approach exclusively for the time being[7]; this was a cautious approach intended to avoid over-extension of the project as we got up and running. As a result, this summer's project was limited to examining the effect of kiosks on the *composition* of landfill-bound trash.

In general, our strategy was therefore to sample trash – that portion of the waste destined for landfills – from all 7 Red Square BigBelly kiosks, and compare that trash with samples derived from 7 other outdoor trashcans (called Smartcans) as a means of measuring whether the composition of the kiosk trash was distinct from that of the Smartcans. If the trash in the kiosks showed lower percentages of compost and recyclables than the Smartcan trash, this would constitute evidence to support the idea that the kiosks were helping remove these materials from landfill-bound waste. If, however, the kiosk trash and the Smartcan trash were found to be compositionally identical, the overall effectiveness of the kiosks could be called into question. Here it is worth noting that the latter result would not demonstrate that the kiosks are *totally* useless, since they confer some clear inherent functional benefits[3] such as 1) helping make trash collection more efficient, and (again) 2) providing separate bins where at least *some* compost and recyclables are accumulating. Instead, this latter result would demonstrate a situation in which the potential utility of these kiosks is not being maximized with current strategies of implementation, distribution, etc.

The 7 Smartcans sampled were those closest to Drumheller Fountain, and these were selected to help ensure sampled areas were generally comparable in terms of variables which were deemed most likely to significantly affect trash accumulation. For example, both Drumheller Fountain and Red Square are outdoor areas with nearby sources of food and beverage and abundant furnishings for outdoor seating, and both are areas of high pedestrian traffic and a high number of picnickers and loungers during times of clement weather. Admittedly, the two areas are likely not totally identical in terms of traffic, use, and trash accumulation, but they are arguably as comparable as can be currently examined on campus, and they are therefore ideal comparators for this study.

Kiosk and Smartcan trash was sampled every Tuesday morning during the 6-week course of the project. Kiosk and Smartcan trash was kept separate during sampling and all subsequent sorting and analysis. Each Tuesday afternoon, volunteers would sort the trash from each source into 4 categories: trash (those materials which actually belong in a landfill), compost, paper recyclables, and all other

[7] We intend to employ the latter approach during Autumn 2012 to complement the summer's work and provide a more comprehensive perspective.

recyclables. Paper was separated from general recyclables at the request of Ms. Newcomer as a way to start investigating the possibility that certain subsets of recyclable materials were more effectively isolated from landfill trash than others. Sorting followed guidelines on posters provided by Ms. Newcomer (Figure 1), and distinguishing between categories was sometimes a confusing process given the frequency of apparent similarities between materials of distinct categories. Carry-out containers such as coffee cups and lids, for example, were often superficially very similar, yet belonged to the compostable, paper recyclables, or even the trash categories depending on brand or retail source. As a result, some error was likely involved in sorting. On the other hand, sorting errors are likely to be somewhat random within sources as well as uniformly-imposed between sources (since we applied the same standards to both kiosks and Smartcans), and these errors are therefore unlikely to have differentially affected results by source. In other words, even if there were a few minor errors in sorting, these errors are extremely unlikely to prevent valid comparison between kiosks and Smartcans.

After sorting, separated categories of waste were then weighed on a balance to 1-pound precision. Higher precision was initially desired, but our high-precision balance failed to function the first week of sorting, forcing the use of the less precise balance; subsequent weeks also used this balance to keep results congruent. Importantly, this lack of precision also prevented the independent measurement of sorted waste from each receptacle (i.e. all weekly kiosk waste was treated as a single source rather than 7 different sources; the same is true for Smartcan waste) since such subdivision would have resulted in immeasurably low weights of some categories given the precision limitations of the balance used. Eight weights were therefore recorded for each sorting session – one per sorted category per source type. These weights form the basis of the results reported below in Tables 1 and 2. Because the weights of the paper recyclables were likely inflated from contact with (and absorption of) liquids from the compost, the weights of the paper recyclables category are likely to be somewhat systematically over-estimated, and the weights of the compost under-estimated. This is unfortunate but unavoidable given the materials examined, but again this issue is not likely to have differentially affected kiosks vs. Smartcans, and it should therefore not prevent valid comparison between the two sources.

Figure 1: Visual guides provided for trash sorting. Photo courtesy of Alex Credginton.

Results presented below therefore provide a valid basis for the comparison of the composition of BigBelly kiosk trash with that Smartcan trash, at least within the limited scope (both in terms of numerical and temporal dimensions) of the of the sampling undertaken.

Results and Analysis

Tables 1 and 2 show the results of weekly trash sorts, divided by source type and by waste category. Table 1 reports the raw weights (in pounds) of the trash, as well as total weights at right. Table 2 shows percent weight of each sorted category (taken as a percent of each source's total weight for the week) divided by week, along with simple descriptive statistics for all weeks combined. Means and standard deviations were used to conduct t-testing of within-category differences between sources, allowing formal statistical analysis of the degree to which the abundance of each sorted category differed between kiosks and Smartcans. Figure 2 shows a graphical comparison of the 6-week mean percent composition of each source, divided by waste category.

Table 1: Sorted Weights (lbs.)

	Week	1	2	3	4	5	6	Mean	SD	Total
Smartcan Trash	Trash	5	10	8	9	8	3	7.2	2.6	43
	Recyclable (Paper)	2	3	5	8	6	2	4.3	2.4	26
	Recyclable (Other)	2	2	4	8	5	5	4.3	2.3	26
	Compost	14	20	37	23	25	16	22.5	8.2	135
	Total	23	35	54	48	44	26	38.3	12.4	230
Solar Kiosk Trash	Trash	11	7	13	16	15	11	12.2	3.3	73
	Recyclable (Paper)	4	4	8	8	4	5	5.5	2.0	33
	Recyclable (Other)	9	13	8	10	8	6	9.0	2.4	54
	Compost	34	48	34	44	37	36	38.8	5.8	233
	Total	58	72	63	78	64	58	65.5	8.0	393

Table 2: Sorted Weights (%)

	Week	1	2	3	4	5	6	Mean	SD
Smartcan Trash	Trash	21.7	28.6	14.8	18.8	18.2	11.5	18.9	5.9
	Recyclable (Paper)	8.7	8.6	9.3	16.7	13.6	7.7	10.8	3.6
	Recyclable (Other)	8.7	5.7	7.4	16.7	11.4	19.2	11.5	5.4
	Compost	60.9	57.1	68.5	47.9	56.8	61.5	58.8	6.8
Solar Kiosk Trash	Trash	19.0	9.7	20.6	20.5	23.4	19.0	18.7	4.7
	Recyclable (Paper)	6.9	5.6	12.7	10.3	6.3	8.6	8.4	2.7
	Recyclable (Other)	15.5	18.1	12.7	12.8	12.5	10.3	13.7	2.7
	Compost	58.6	66.7	54.0	56.4	57.8	62.1	59.3	4.5

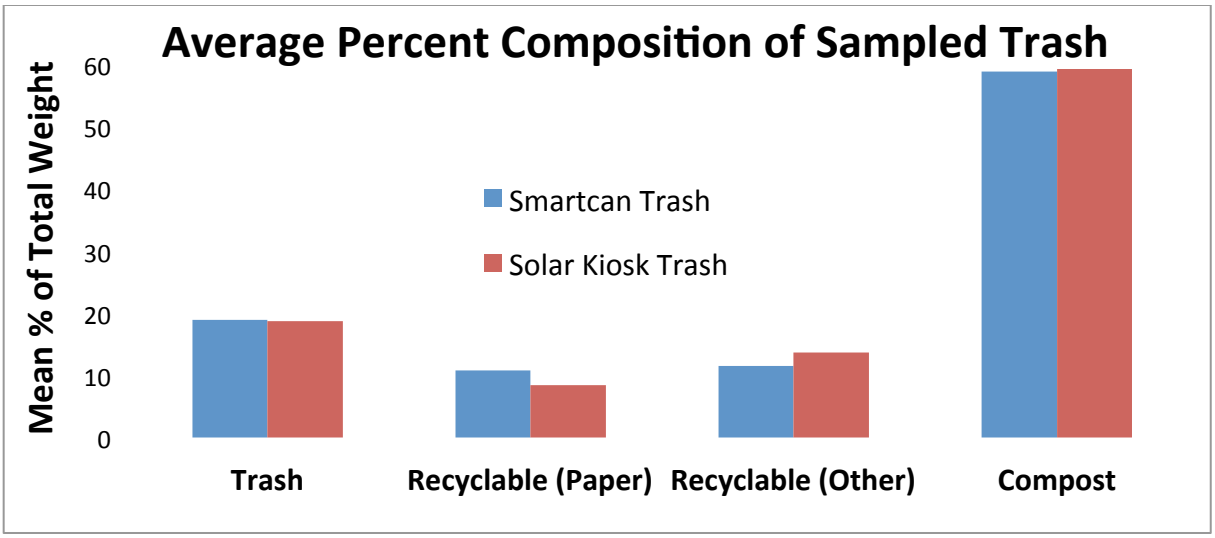

Figure 2: A comparison of the 6-week mean percent composition of trash sampled from each source.

Overall, analysis shows that the trash sampled from the BigBelly Solar kiosks differs very little compositionally from the trash collected from Smartcans. The kiosks are accumulating trash at a much higher rate than the Drumheller Smartcans (about 1.7 times faster), but the makeup of the trash itself is remarkably consistent between the two types of collection container, as is readily apparent upon comparison of 6-week mean percentage composition values between the two sources (Table 2, Figure 2). Formal statistical comparison between the two sampled sources using t-testing verifies this assertion, as no single category of sorted trash statistically differs between sources at the 95% level of confidence. In other words, at 95% confidence Smartcan trash is compositionally indistinguishable from kiosk waste. The abundance of recyclable paper significantly differs between the two sources at 90% confidence – with kiosks having a lower relative amount of paper ending up in landfill trash – so it is probably fair to assert that the kiosks do a slightly better job of removing paper from landfill-bound waste than do Smartcans. No other category significantly differs at 90% confidence. As such, it is not valid at present to assert that the BigBelly Solar kiosks are significantly changing the overall composition of the waste we pay to send to landfills[8].

Instead, the evidence shows that – across the board – about 59% percent of our landfill waste is compostable, 22% is recyclable (13% is paper), and only about 19% actually belongs in a landfill. We therefore still have plenty of room for improvement in our system of waste disposal at UW, including our implementation of the BigBelly kiosks. Further, if we extrapolate the above numbers to encompass the roughly 4,900 tons of annual landfill waste generated by the UW[5], it is also clear we have plenty of incentive to push for more improvement, since (according to these numbers) full elimination of compost and recyclables from the waste stream would result in a reduction of our annual landfill waste by roughly 3,990 annual tons, as well as an annual savings of roughly $225,000 in landfill costs. This extrapolation is admittedly a huge leap in logic given the obvious sampling limitations of this study (6

[8] Here it is worth reiterating that the kiosks may, however, be reducing the absolute amount of compost and recycling ending up in landfills, even if the relative proportion of these materials in the trash remains the same. This situation would be expected if two distinct subsets of users exist; one that composts and recycles with very high efficiency and another for which kiosk trash bins and Smartcans are used interchangeably. As discussed above, a simultaneous analysis of kiosk trash, compost, and recycling bins would help test this proposition by documenting the accumulation of separated compost relative to the trash. We will undertake this type of analysis during Autumn 2012's project.

summer Tuesdays and 14 trash locations is hardly definitive as an annual campus-wide proxy), but in light of the remarkable consistency in trash composition between sampled areas it seems likely that the trash studied gives a reasonable basis for very rough generalization, at least until more data becomes available to demonstrate otherwise. As such, the broad assertion that we have a long way to go in reducing the compostables and recyclables in our landfill waste is on relatively solid ground, and given the potential benefits of even a marginal improvement in our waste systems, it is clear that such improvements are well worth pursuing.

Student Insights

With this in mind, the challenge becomes how best to systematically eliminate compost and recyclables from our landfill waste. Student volunteers were asked for input on this topic, and as a result of their experiences sorting trash they were able to provide many observations, insights, and recommendations. These are loosely discussed below.

Insight 1: Properly sorting waste into trash, compost, and recycling is a really confusing task.

This is perhaps the most common comment heard during sorting; confusion as to what materials belong in which waste category often engendered discussion and debate, even after several weeks' worth of experience in sorting, and even when we had visual references readily available. As such, students identified this confusion as a major issue for the average campus citizen faced with a decision as to how to dispose of their waste. When pressed, the students pointed out that the more the average person has to think about what waste goes where, the less likely it is that they will even make an attempt to assign their waste to the correct category. In other words, it has to be really easy to make the right decision or the average person-on-the-go will simply eschew an informed decision altogether, instead defaulting to throwing everything in the trash.

Importantly, even the signage found on the kiosks (and the posters we used for sorting) was found to be too complicated for the average campus citizen. Instead, students recommended a simple color-coding/labeling scheme be implemented for all containers, coffee cups, etc. (items that often end up in the trash; see below) sold on campus. As a rough example, brown would label compostable material, green for recyclable, and blue for trash. They suggested that the extra effort and cost required to place stickers and/or stamps on these materials (and advertise the system) would likely be offset by savings in annual landfill cost, as only a small percentage reduction in the compost and recycling ending up in trash (say, reducing compost and recycling to comprise only 75% of our landfill waste instead of 80%) would confer significant savings to the UW (using the numbers above, an annual savings of around $14,000). Perhaps ultimately this system would not be cost-effective, but short of such a simplified system, the students had little faith that most waste-producers on campus would significantly alter their behaviors.

Insight 2: Available compost and recycling bins are unevenly distributed on campus, as well as inconsistent with municipal programs.

There are a couple of significant points to be made here. First, bins for compost are not consistently available across campus, especially in outdoor areas and in indoor areas where cafes are absent. In Denny Hall, for example (the home of the Department of Anthropology, a VERY green-friendly group philosophically) I am not aware of a single compost bin, even though there are lots of people who eat lunch there every day, and even though most carry-out containers on campus are compostable. Students pointed out that this lack of availability of bins in certain places can have a profound effect on

our waste disposal habits, which in turn can have a profound effect on the decisions we make even in cases where more waste disposal options are available. In other words, we get in a rhythm in terms of how we throw stuff away, and that rhythm is typically tailored to the minimum set of options we can expect to encounter in the areas we frequent most.

Second – and related to the first point – most of our waste-disposal habits are built around Seattle's municipal waste program, but UW's program is different, and the students feel this leads to confusion as to how to best dispose of waste on campus. For example, recycling at home doesn't require distinguishing between paper recyclables and other recyclables, and the individual doesn't have to be as informed as to what goes where. On campus, the system requires you to make additional decisions when sub-dividing recyclables, which is incongruent with most people's experiences and expectations. In other words, more than one category of recyclables on the UW campus doesn't fit Seattle's recycling "culture," and students thought that reform and standardization of campus recycling to fit this larger culture would broadly improve the user-friendliness of campus systems.

Insight 3: Some sources/types of waste are really prevalent in the trash.

Some items kept turning up in the kiosk trash, even though they should have been composted or recycled. These items were carry-out containers and food wrappers (from on-campus and The Ave.), especially paper cups (for beverages and for frozen yogurt). It is therefore highly probable that we are failing to effectively communicate that these items do not belong in the trash.

In seeking to better communicate this fact, students pointed out that our current strategies are almost entirely dependent on signage at the point of deposition, while communication at the point of acquisition is almost completely absent. In other words, it might be worthwhile to approach the commercial sources of most campus waste – the relatively small number of local vendors of food and beverage – and work with them on ways to get the point across more effectively. That way, consumers will hopefully be made more conscious of waste issues at the time of purchase, helping to lead to better decision-making from acquisition to disposal.

Looking Forward

At present, the value of the above suggestions is primarily conjectural; we cannot know in the abstract whether their implementation will have a positive impact on our waste systems at UW. On the other hand, continued use of garbology will give us the ability to directly measure the efficacy of any waste-reduction strategies implemented in the future, including those discussed above. Further, because key project collaborators (i.e. Ms. Newcomer) also have the ability to *enact* systemic institutional changes in our waste strategies, it will be possible to implement waste policies, test their efficacy, and then undertake strategic revisions. In other words, with the continued use of garbology in connection with Ms. Newcomer's office, we will be able to create a feedback loop which should allow the incremental refinement and demonstrable improvement of our strategies of waste disposal. Such an application of garbology should therefore be uniquely powerful and productive over the long term, as it will allow us to "experiment" our way towards positive change in waste management at the UW.

On a shorter term, our team is exploring ways to productively continue the project this autumn. A productive first step will be to further examine kiosk trash, compost, and recycling in conjunction with one another, as discussed above. Other potential topics of interest include examining the labeling, sourcing, and geography of campus trash (identifying areas of high inefficiency in waste deposition as

well as potential causal factors), among others. In addition, we are exploring the possibility of expanding the types of data we collect through the possible implementation of interviews, questionnaires, and pedestrian surveys. We are also expanding our analytical framework, as we are attempting to incorporate geographic information systems (GIS) to explore the spatial dimension of campus waste. Lastly, we are trying to bring in new collaborators and resources, most notably by reaching out to undergraduates enrolled in autumn quarter archaeology classes and to administrators in the UW Program on the Environment. Ultimately, the success of the above initiatives will hinge on this recruitment. For the present, however, the primary challenge lies in re-conceptualizing the project to fit with both our evolving goals and the resources available to us this autumn. While this is a significant challenge, it is my sincere hope that Ms. Newcomer and I can find a way to meet it, especially given the obvious benefits of success for the UW, its students, and our environment.