

Analysis of Student Water Use in the City of Davis

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Abstract

With an increased sensitivity about global warming and the impacts of climate change on the availability of fresh drinking water, more studies on water consumption from single family households have become available. These published studies do not, however, contribute to a more representative and a comprehensive picture on what the "true" water consumption from an all student household is. Water consumption in six single family student households of Davis was studied to determine water consumption rates and to delineate the factors that affect water use currently and possible future effects of this water consumption pattern. The data collected reflects initial water use values in households whose age of the water systems are unknown.

Introduction

As an incredibly environmentally conscious city, Davis strives to find new ways to protect the environment. One way this can be done is by reducing the overall water use per capita of its residents. Our group decided to investigate how much water students throughout Davis used on a daily basis by a means of gallons per day (GPD) and water use per capita (WUPC). However, this data only shows how much water is being used, and not *how* it is being used. In order to clarify specific water uses, we developed a set of survey questions to determine how students in each house utilize their portion of the total water used. We found that studying the habits of other UC Davis students was a fairly accurate way of replicating our own water usage, as well as the use of the majority of students who live in Davis. From a water efficiency means, we can identify the strengths and weaknesses of the students we studied and apply them to our own actions in order to help preserve water and be more environmentally conscious. Potentially, it also offers a small look into the water usage of other Davis student-residents. One problem of this study is that by gathering data only from college-student occupied homes, we did not take into account the water uses of family-occupied homes. Therefore, unless more data is gathered, we cannot assume student water usage rates are representative of family usage rates.

Objective

The main objective of this research project was to compare the Water Use Per Capita of single-family houses of student occupancy in Davis, specifically comparing those of all female versus all male households. The main task involved locating different households throughout Davis that included only females and only males, ranging from three to six people per household. Through a series of survey questions on their daily water use, we were able to determine how their water was being used and from there, identify sources of water inefficiency and overuse. The survey questions ranged from questions identifying sources of water such as the number of faucets and bathrooms to the estimated uses of washing machines, showerheads, dishwashers, and outdoor sprinklers. Using the information from their respective water utility accounts, we utilized the website, davis.waterinsight.com, and we were able to determine the average GDP for each house and calculate the WUPC of every household. We were also able to acquire graphs depicting the average GPD of each house compared to efficient use and the average use over a seven month period.

Hypothesis

To understand student household water consumption patterns, we took account that water use in an all student household will vary according to how much time they spend at home. As such, the working hypothesis for this research paper is that water use per capita in an all-male houses will be less than in that of an all-female houses due to variables such as number of times they shower and for how long, and how many time they do their laundry. Combined with result from interview questions, we hypothesize that males will use less water due to shorter showers and less showers a week on average compared to the all female household.

Data Sources

To demonstrate the range of intra-household information, the water survey provides water use data of six student households from Davis are presented as a narrative in this section. The table below is of the survey data collected from respondents who live in the six student households we surveyed taking their daily water usage and their respective water utility billing account numbers that we ran through davis.waterinsight.com to retrieve a much more detailed water usage data for a period of one year. The data has been analyzed to a relatively simple level mostly on a daily basis, generally by all households and with an emphasis on gendered use. The data are as readily analyzed on an individual, hourly or daily basis; within and between households of the three occupancy types; all females, all males or mixed. The survey data collected was from two all female households, three all male households, and one coed household that was use as a control.

Data from the City of Davis water division of the City's Public Works department (water.cityofdavis.org, 2013) was used to analyze the patterns of WUPC of the data collected from the households we surveyed with the WUPC of the Davis household as a whole. The surveys we took followed the model of the survey material "Activity handout: How much water do you use?" from EPA website (epa.org, 2013). The other data source used in this group research paper was davis.waterinsight.com, a website that we used to extract the water use data for the households we surveyed. The Davis website [[waterinsight](http://waterinsight.com)] was one of the most valuable resources as well as data source used to collect data from the sample utility accounts numbers of the student households in Davis.

Methods and Assumption

The methods used for this research group project included field work such as the gathering of sample City of Davis utility account numbers from our peers who willingly accepted to provide us with this data and as such this wasn't a random sample. We also conducted several interviews of residents who lived in the households whose water utility account number was used to retrieve water use per capita (WUPC) data. Initially we had planned on collecting data from fraternity households but we encountered a problem, which was that these fraternities had a shared water meter that was used by multiple homes and a couple of business. So we scrapped that plan and decided to do research on WUPC of female and male households. As such, data was to be collected from all female, all male, and coed households whose occupants are students. The data collection process was difficult and took longer than expected to obtain. Retrieving basic information from several different houses was a challenge. Ultimately, it required the persistence of us researchers to follow through and collect the data, as well as survey members of each house with our questionnaire. We had to make assumptions that all faucets and shower heads are generally the same. In our interviews, we asked questions to determine the type of appliances, but since we did not inspect every house, so we generally have to assume some similarities in the flow rate of the water coming out when in use. However, our main assumption was that among students WUPC for females is higher given that all variables are constant, and that none of the appliances were of modern age low-flow technology, since the houses are all several decades old and the residents responded accordingly in our questionnaire.

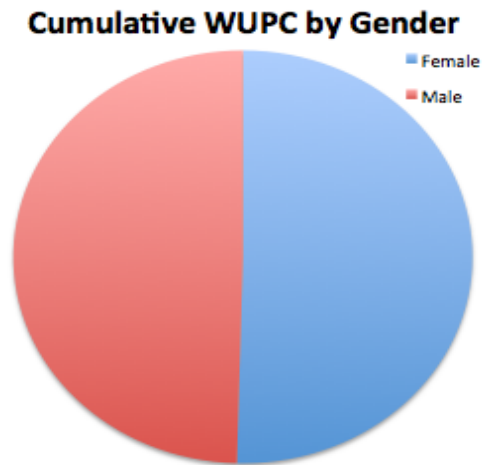
Calculation/Results

The table below summarizes the information we collected from 6 different single-family residential houses. It also includes responses to the survey questions sent to selected members of each house.

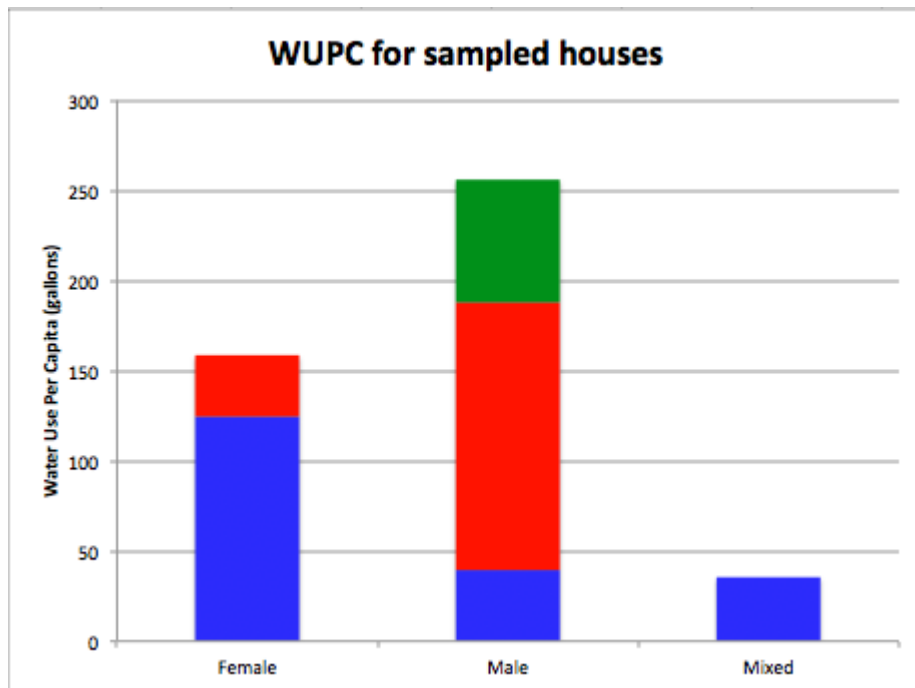
ESM 121 Data table	#1: Sycamore (Laura's). 2 responses	#2: Douglas (Niko's). 1 response	#3: Anderson (Efron's). 2 responses	#4: Douglas (Cibit's). 1 response	#5: Adams (Michael's). 4 responses	#6: 8th St. (Wendy's). 1 response
Occupancy type	All female	All male	All male	All male	Mix two males and females	All female
Number of residents	6	4	4	3	4	4
Avg Total GPD	748	158	594	204	142	136
Avg WUPC	124.66	39.5	148.5	68	35.5	34
Number of bathrooms	3.5	2	2.5	2	2.5	2
Dishwasher use per week	4	1	2	0, by hand	1	1

Landscaping (times per week)	1	0	7	2	0	0
Laundry use per week	4	5	4	3	8	3
Showers per day	7	5	4	4	5	4
Length of showers (min)	15 min	10 min	12 min	6 minutes	15 min/male 30 min/female	15min
# of faucets	5	3	6	3	4	4
Water on when brushing teeth?	No	No	No	No	No	No
Toilet flushes per day	20	10	15	6	10	3
Any low-flow faucets/shower heads?	No	No, but efficient laundry	No, very old	No	No	unknown
Other major water use?	No	Hose patio 1/week	Social events	No	Dishes by hand	No
Estimated primary water use?	Shower	Shower	Shower and lawn sprinklers	Dishes	Shower	Shower and Dishwasher

The pie chart below summarizes the total water use per capita breakdown by gender (mixed house not included). We sampled 3 all-male houses totaling 11 residents, and 2 all-female houses totaling 10 residents. To control for the sample differences, we took the total average gallons per day for the 3 male houses and divided by 11. Then we took the total average gallons per day for the 2 female houses and divided by 10. This gave use the average water use per capita for each male and each female.

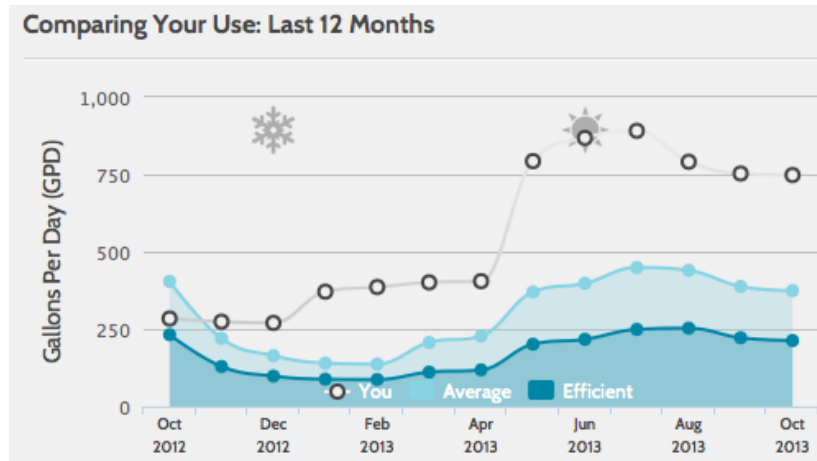


The graph below simply illustrates the breakdown of each house’s water use per capita, separated by gender. This shows that there are massive variations amongst different houses, meaning a much larger sample size would be required for more thorough results in a future study. NOTE: the color do not represent specific, and are only used to distinguish the different houses. There is no relation between the same colors.



The chart below is shown as a sample, illustrating the monthly water usage of house #1, the all-female house on Sycamore with an exceedingly high water use per capita. This graph demonstrates that the demand for water varies greatly with the season. The water usage rate is much higher in the summer. This is likely due to an increase in landscape water use. Thus, while

showers may cause the bulk of water demand, it appears to be outdoor water demand that causes the extreme fluctuation. As the average shows, it is typical for water demand to increase in the summer, but not to the extreme of this house.



Conclusions

From the data, we concluded that it is not necessarily true that female college students use more water than male college students. We had data from two all female houses, three all male houses, and one coed house to use as a control. One all female house used 124 gpd while the other all female house used only 34 gpd. Comparing these values to the water use per capita values of the all male houses, we see that they are quite similar. One all female house, one all male house, and the coed house all used about 40-60 gpd. The water usage for the all male houses did not vary as much as the all female houses. These values prove that our hypothesis that all female houses use more water than all male houses was not true, but we can compare them to other averages.

Now that we have data on college student water usage in the city of Davis, we are able to compare it to Davis' average WUPC and U.S. average WUPC. First, the average water use per college student is 75 gpd calculated from the data we gathered. We then calculated the average water usage per person in the neighboring houses and found that they use 83 gpd. Although some neighbors may be college students as well, these numbers show how our sample college students use less water than their neighbors. This could be due to a decrease in outdoor water usage since many of the houses we sampled had minimal to no landscape water needs.

Lastly, we compared the usage of our sample college students to the average WUPC in Davis and the results are surprising. The average water use per capita in Davis is 150 gpd! The

average of our sample of college students water usage is only 50% of the average water usage per person in Davis. Why is the average water use per person in Davis so high? In our opinion it is mostly due to outdoor water use. Maintaining landscape, washing cars, and other outdoor usage all add up to be more than a majority of a household's water usage. We know that our sample houses do not have a large outdoor water use because, in the interview, many of them stated that they either do not water their landscape or do not partake in any outdoor water usage activities like washing vehicles. Now if we compare this to the national average use of water per capita, we see a significant difference between how much our sample college students used and how much the average person uses in the U.S. The national WUPC is around 180 gpd! This means that our sample houses only used 42% of the national average, which is very impressive. Overall, we concluded that our hypothesis that all female houses was not true, but the comparisons of college WUPC to Davis and national WUPC was very interesting.

Recommendation/Limitations

There are many actions we, as students, can take to conserve water. Some of the recommendations we have for our sample college houses are categorized as water efficiency. Many of the houses we interviewed said they think they use the most water showering, and to these houses we recommend low flow fixtures that will conserve water. Although our houses said they used the most water showering, toilets usually use the most water. With low water water toilets and efficient shower heads, college students could save a lot of water and money. All in all, implementing water efficiency strategies not only conserve water, but it also saves money.

References

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