Spanish Fork Irrigation-Water Conservation Study
Project ID: CEEn_2018CPST_004

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Capstone Project
submitted to

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Spanish Fork City Public Works

Department of Civil and Environmental Engineering
Ira A. Fulton College of Engineering and Technology
Brigham Young University

Executive Summary

PROJECT TITLE: Spanish Fork Irrigation-Water Conservation Study
PROJECT ID: CEEn_2018CPST_004
PROJECT SPONSOR: Spanish Fork City
TEAM NAME: JAW

Spanish Fork City began a water conservation program in June, 2018 that provided residents a Rachio irrigation controller professionally installed for free. This report discusses the effects of the water conservation program and is evidenced by data from 2,000 homes.

Installing irrigation controllers led to a decrease in pressurized irrigation usage. Excess watering was reduced as the controllers use precipitation, temperature, and wind data from adjacent weather stations to constantly update watering schedules in consideration of the weather. This is called weather intelligence. Other factors that may have added to this decline in water usage per household may be the provision of real-time flow data at the household level through the smartphone application, increased popularity of water conservation, and change in weather. The average household saved 4,620 gallons per summer month (June through August) when a controller was installed; this represents a 17% drop in average monthly usage.[1] This result contributed to increased capacity in the Spanish Fork City water system for 2018: despite a 4% growth in connections, there was only a 1.2% increase in supplied water for both drinking water and pressurized irrigation.[2]

Another goal of the program was to reduce peak daily demand. This was attempted by scheduling the controllers to water during different time intervals organized according to address and how much wind occurs around the home. With the 933 controllers installed, the highest daily peak demand was reduced from 7.49% to 7.11% of total daily water usage. We expect this reduction to be more significant with more installations and unified rescheduling of the controllers at the beginning of summer 2019. To maintain positive perception of the conservation program, the recommended schedules are designed to be convenient and reasonable. If desired, citizens can opt out of their recommended schedule.

As discussed above, a major benefit of the program was increased capacity of the system. For every six homes with a sprinkler controller, one home can be incorporated into the Spanish Fork water system with no effect on pressurized irrigation demand; with the target 3,000 controllers installed, this would amount to 500 additional homes. As Spanish Fork continues to expand and new areas are developed, reducing peak demand and usage has the potential to reduce the size of new mains that are installed and delays investment in new system storage; both represent considerable financial savings.

[1] Average monthly pressurized irrigation usage in 2017 was approximated to be 26,540 gallons
[2] December drinking water was estimated. The annual measurements of usage were 10,230 acre-feet in 2017 and 10,345 acre-feet in 2018.

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Introduction

In 2018, Spanish Fork began installing irrigation controllers provided by a grant to the city from the Central Utah Water Conservancy District (CUWCD). As per the grant agreement, the controllers serve as part of the city water division water conservation program to help residents conserve water and reduce system peaks. Having quantifiable results of controller installation supports CUWCD in awarding Spanish Fork the grant and provides an example for other cities that are working towards improving their secondary water systems.

The portion of the project that was scheduled for 2018 was achieved with the training and hiring of 3 technicians and the installation of 933 controllers. Rachio was selected by the city to provide the controllers, and the contract covered the purchase of 3000 controllers, 300 outdoor enclosures, and training for installers. The first delivery of sprinkler controllers came on June 1, 2018, and installations began that week. As controllers were installed, they were programmed to water during different time intervals than their neighbors, organized according to address and how much wind occurs around the home (Figure 1 depicts the wind area that provided the basis for wind scheduling). It is anticipated that in 2019 the city will install at least 1,000 more controllers and work to improve the scheduling.

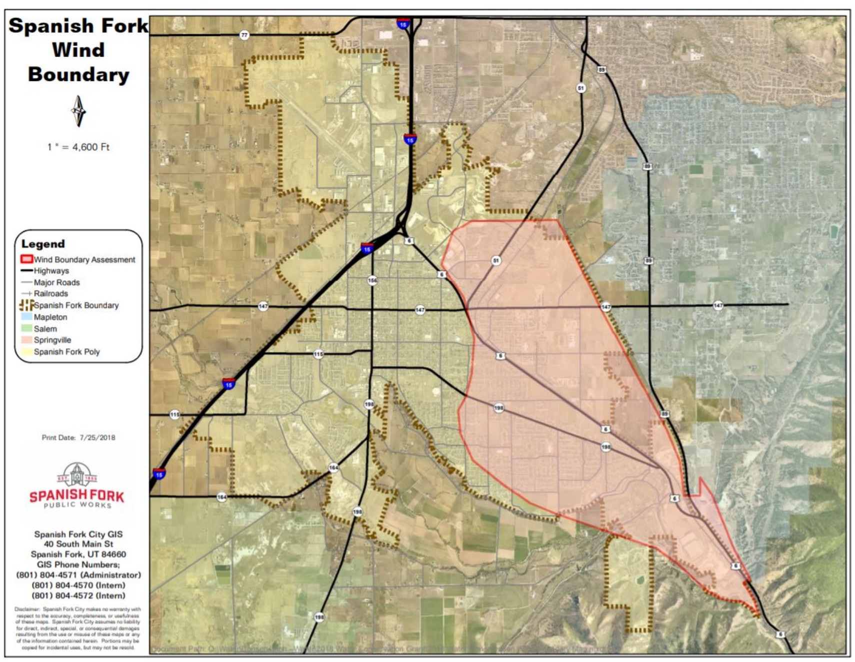

Figure 1. Map of wind fan area

Team Schedule

The team met together once a week, usually Monday afternoons, to discuss the project and what tasks needed to be accomplished in coming weeks. These meetings allowed team members to share results and any issues encountered the previous week. Group text messaging was used throughout the project to aid in additional communication outside of these meetings. At the time of this conservation analysis, all team members were engineering interns at Spanish Fork City, which allowed easy communication with Chris Thompson, Public Works Director, and John Waters, Water

Division Manager, when other questions aroused. The team regularly met with Dr. Williams, a BYU faculty mentor, who helped with the project, especially statistical analysis.

Timeline with milestones and accomplishments:

September 17, 2018	Team formed and project assigned
September 24, 2018	First team meeting with Chris, John, and Dr. Williams
September-October 2018	Team starting collecting historical usage data for previous 10 years
October 2018	Due to more accurate readings in more recent years, the team decided to collect and analyze data from June through September of 2017 and 2018
November 2019	Meeting with Dr. Williams where the team decided to form a control and treatment group composed of 1,452 homes and 542 homes, respectively, that would be used to compare usage between 2017 and 2018
January 28, 2019	After organizing data, met with Dr. Williams who suggested to apply Student's t-tests to the data
March 2019	All data analyzed and differences of average water usage were ruled as either significant or not
April 11, 2019	Project presented
April 15, 2019	Final report completed

Procedure

Peak Demand

A study conducted previously by the city proved that daily demand curve for Spanish Fork follows the same general shape, with peaks at 5 AM and 10 PM, regardless of high or low total volume of water usage that day. To analyze the effect of controller installation on the demand curve and on the peak demand, hourly average usage for the whole city was determined for a 3-day period before controllers were installed[3] and a 3-day period after the majority of controllers were installed[4] (approximately 900 controllers).

Potential changes in environment, such as climate and population differences, were addressed by comparing each hour's percentage of daily total volume instead of usage. For example, before the controllers were installed, total daily usage for the city was determined to be 239 M gallons and average hourly usage at 9:00 PM was 0.67 M gallons. In August, after the controllers were installed, the average daily usage was 260 M gallons and average hourly usage at 9:00 PM was 0.68 M gallons. Instead of directly comparing 0.67 M to 0.68 M, the percentages 0.28% and 0.26%. This accounts for changes in the city unrelated to controller installation and shows a reduction in usage during the hour 9:00 to 10:00 PM after controller installation. Comparing hourly percentages was the method for determining changes in hourly demand.

Water Usage

For the water usage analysis, meter data was collected for homes in 2017 and 2018 and compiled into two tables: one table held data for a group of 1,452 homes with no controller in either year and the other a group of 542 homes that had no controllers in 2017 and controllers installed in 2018. The group of homes with no controller in ether year became the control group, defined here as the group in the study that did not receive any controller and was used as a benchmark to measure how the other tested households responded to controller installation. The dataset was truncated according to considerable difference in usage between the specific month of 2017 and its counterpart in 2018. If a household's usage for a month in 2017, when compared to its counterpart in 2018, differed by more than 80,000 gallons, this home was removed from the dataset. For example, a home with the following usage would be removed from the dataset:

Example	June (gallons)	July	August
2017	66,000	164,000	29,000
2018	21,000	74,000	52,000

Table 1. Example of usage data

Because of the unexpected disparity in usage in July (a difference of 90,000 gallons), and more subtle fluctuations in the usage of other months, this home was removed from the dataset based on the assumption of an inaccurate meter reading in July.

Once monthly usage (June to September) for all 2,000 households was organized, the mean monthly values were determined for both the control group (no controller in either year) and treatment group (no controller in 2017, controller installed in 2018). To verify that the monthly averages were statistically different between the two years, Student's t-tests were used. Once the averages were calculated, the control and treatment group were compared to see how usage differed after installation.

Determining how much water was saved after installation required knowing how much water an average household used during the summer months. The *annual* measurement of

[3] June 1, 2018 - June 3, 2018
[4] August 27, 2018 - August 29, 2018

pressurized irrigation usage was used in calculating this. Considering that pressurized irrigation is only available for part of the year (April to October), and the months of interest for the project were June to August, the monthly usage was determined on a pro rata basis. With this value of monthly usage, the team was able to determine the percent reduction in usage given the installation of the sprinkler controllers.

Assumptions & Limitations

Early in the project, it was assumed that data extending back 10 years would be required to determine if there was correlation the conservation program and peak reduction. In addition, it was thought that having daily and monthly historical meter readings would be optimal for these 10 years. However, because the city has medium resolution meters that were installed incrementally over the past few years, the data available was limited and grew more accurate approaching 2018. Currently, readings are reliable and are generated every hour. Because the most accurate years of metering are those closest to the present, only 2017 and 2018 were analyzed.

Another issue developed because of the change in environmental and population conditions over the 2 years. The team could not assume that homes with a controller installed were not influenced by any external factors that might affect their water consumption. The team overcame this by comparing a group of 542 homes which received a controller to a group of 1,452 homes with similar characteristics that did not. The 1,452 homes that had no controller installed served as a standard to which the homes with irrigation controllers were compared. The team defined this group that received no treatment (no irrigation controller was installed) as the control group; the group that had an irrigation controller installed was defined as the treatment group. Another tactic in dealing with disparate conditions was comparing *percent* of total daily volume of usage instead of hourly amount in gallons per minute.

Results

Peak Demand

To find if the peak demand was reduced with the Rachio controllers, the team collected hourly water usage data from the following 2018 dates: June 1-3 (Figure 2; for table see appendix) and August 27-29 (Figure 3; for table see appendix).

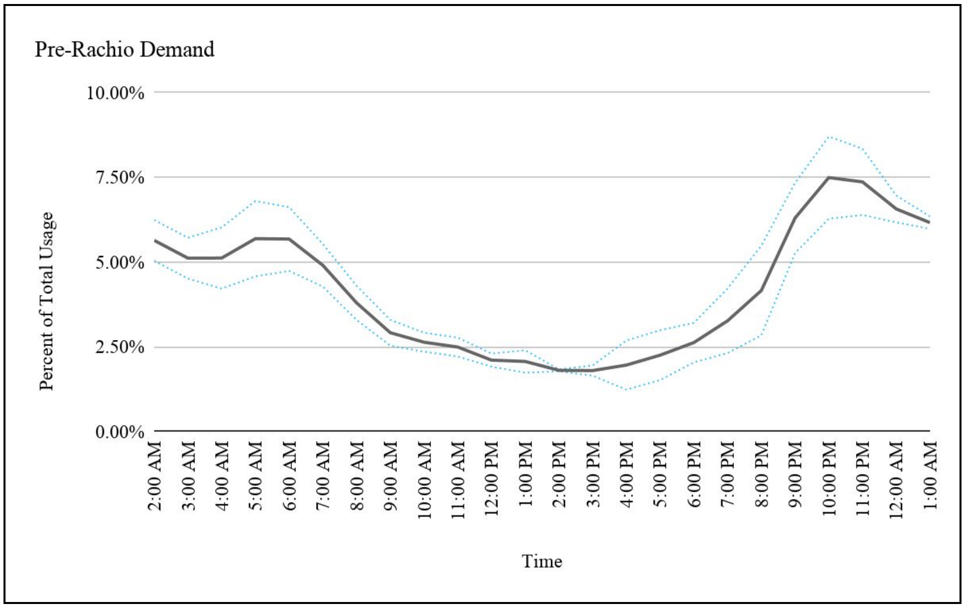

Figure 2. Hourly percentage of average daily flow before controller installation with standard deviation

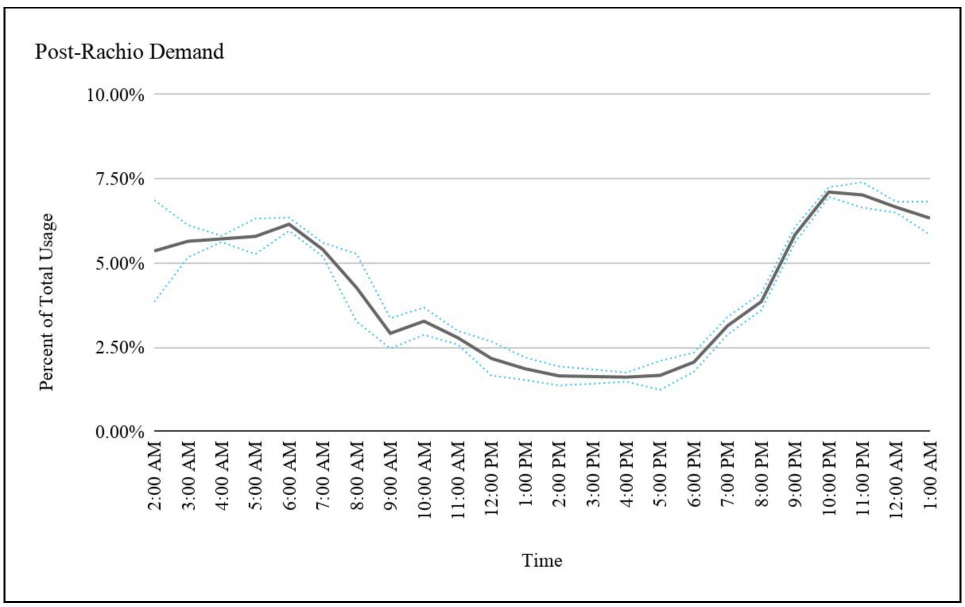

Figure 3. Hourly percentage of average daily flow after controller installation with standard deviation

Figures 2 and 3 display the error boundaries (one standard deviation) to show the variance in the data. For the demand curve before the controllers were installed (Figure 2), there is greater spread of the error boundaries, especially surrounding the peak demand times. This indicates that there is greater variation of water usage data during this time. The demand curve created after the majority of controllers were installed (Figure 3) shows a smaller spread of the error boundaries, demonstrating that the water usage behavior was closer to the average, or expected value.

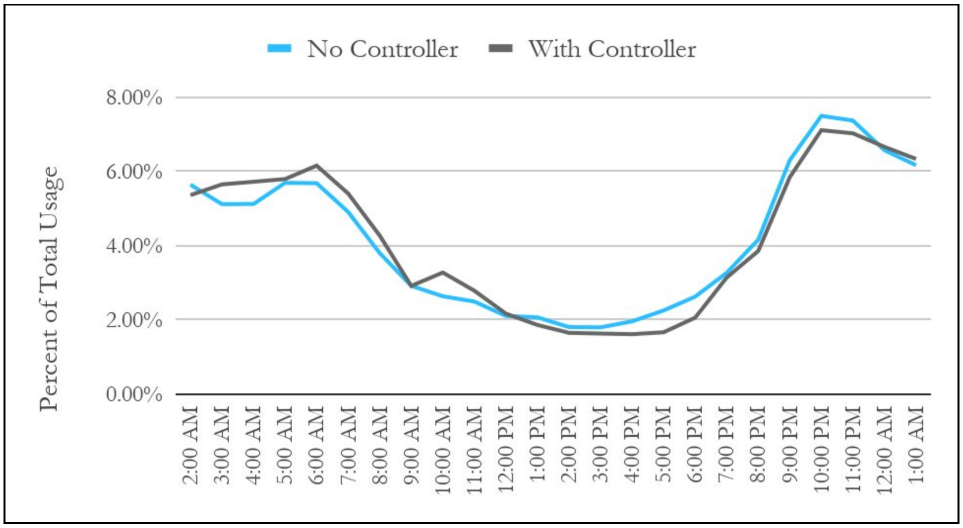

Figure 4. Comparison of average daily flow before and after controller installation

As shown in the figures, the peak demand occurred around 10:00 PM. After analyzing, a peak demand reduction of 0.5% was found. Installing more controllers and encouraging residents to water at their recommended time will further lower this high volume usage. Balancing the diurnal water usage by discouraging water consumption during peak demand times helps one of Spanish Fork's main irrigation sources, the Spanish Oaks reservoir, to adequately serve the city for a longer lifespan without needing costly capacity expansions. Residents would also find an increase in their water pressure if they watered outside of the peak demand.

Water Usage

To determine how much water was saved by installing the Rachio controllers, pressurized irrigation usage data from 1,994 randomly selected homes was collected for 2017 and 2018. 1,452 of these homes had no controllers in either year and the other 542 homes had no controllers in 2017, but had them installed in 2018. These are respectively referred to as the control group and the treatment group. The data from these two samples were analyzed with a Student's t-test—a test which determines whether the difference in means of two unequal-sized, but same underlying populations can be deemed as statistically significant.

Controllers were not installed prior to June, so the team focused on data from June through September. All monthly 2017 values, when compared to their counterparts in 2018, were determined to be statistically significant using t-tests, excluding September for the treatment group. Because September did not meet the requirement for statistical significance, it was omitted from later calculations. The results of the t-tests for both groups are summarized in Tables 2 and 3.

	June	July	August	September
p value	0.007	0.000	0.005	0.000
Statistically Significant	Yes	Yes	Yes	Yes

Table 2. Results of Student's t-test for control group

	June	July	August	September
p value	0.000	0.000	0.000	0.727
Statistically Significant	Yes	Yes	Yes	No

Table 3. Results of Student's t-test for treatment group

Figures 6 and 7 display the comparison of average monthly water usage (2017 to 2018), in thousands of gallons, of the control and treatment groups. They show that the treatment group had a decrease in usage attributable to the use of sprinkler controllers of roughly 17%. There was an increase in water consumption of 955 gallons per month for those households that didn't have a controller installed. The average water saved per Rachio controller household per month was 4,620 gallons ($3.79/month). As a result, only 1.2% of Spanish Fork's supplied water for drinking and irrigation increased in 2018, despite the city having a 4% increase in water connections.

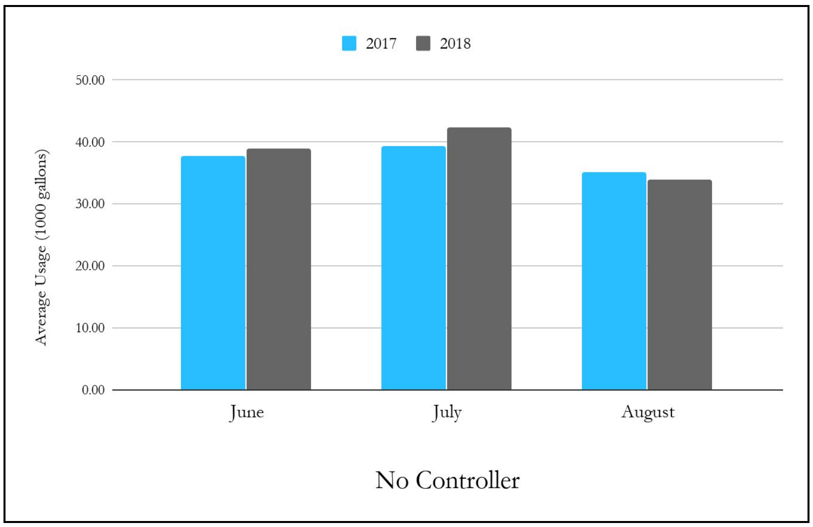

Figure 5. Comparison of usage between 2017 to 2018 of control group

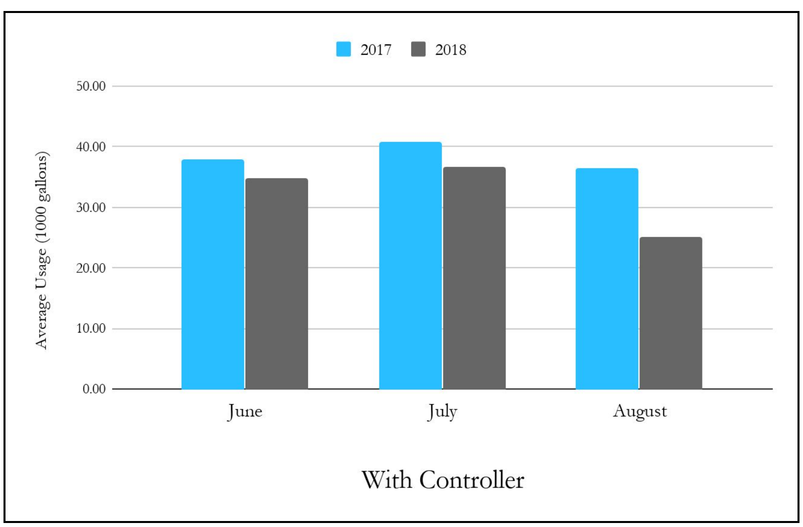

Figure 6. Comparison of usage between 2017 to 2018 of treatment group

Lessons Learned

Importance of Large Data Sets

Because previous years' data was not as accurate or organized as recent data, and had missing values, the team didn't know how useful it would be for analysis. Dr. Williams directed the team in finding and gathering all the water usage data possible because of the importance of having a robust data set. In collecting data, the team used all data even when values were missing; in places of missing information, estimated values were used.

This was especially beneficial in the analysis of the amount of water conserved based on the comparison of the average monthly usage of the control and treatment groups. The team reached a point where, for both groups, the monthly averages from 2017 and 2018 were not statistically different. The issue arose because initially the team had separated the treatment group into five groups based on watering schedule, and the sample groups had become too small. To mitigate this, the sample size needed to be larger. The team decided to combine the five groups to form one larger group of homes classified as having controllers, with no consideration of individual start times given. With the larger sample size, the team could make more accurate assumptions about how usage changed. In future years as more controllers are installed, it may be possible to create large groups differentiated by schedule and see how each group impacts conservation based on watering schedule.

Improvements to Recommended Start Times

The purpose of a system of staggered start times for the controller users is to distribute the peak load throughout the day. Designing this system was not difficult from a technical perspective. To achieve load shift, the recommendation would have most people water in the late morning and afternoon. After a team discussion with Dr. Williams, the team learned the importance of social factors that would need to be taken into consideration for residents to be motivated to adhere to the recommended schedule. Such adherence is valuable because if the schedule was perceived by users as inconvenient or difficult to adopt, they could easily opt-out of the recommended schedule and negatively impact conservation. For this reason, the team decided to change the start time of those households outside the wind fan area from 8:00 AM to 5:00 AM, a time that is more common for sprinkler systems to start at and therefore a less drastic change.

Recommendations

Further Research

Spanish Fork will provide the installation of 3,000 Rachio controllers, free to the residents. Only 542 of the 933 installed in 2018 were examined in this analysis since the water usage measurements of these households had the most reliable data measurements. As previously discussed, larger datasets provide a more accurate representation of the city's water usage, so as more controllers are installed in coming years the team suggests further analysis be done.

Another study which focuses on the correlation between weather and the city's water usage would also be useful. This research would reveal how effective the Rachio controllers are at adjusting schedules according to precipitation and temperature. Also, a study could be done that evaluates the capacity of the different recommended schedules to conserve water (Table 3). These studies would assist Spanish Fork in determining the practicality of these sprinkler controllers for the city and whether to continue encouraging their installation after the project is expended.

Schedule Suggestions

The Rachio irrigation controllers are installed with a set schedule depending on the location of the address. Previous research has found that, due to Spanish Fork's wind fan, some areas would better conserve water if their sprinklers ran during the day, rather than a typical early morning or evening schedule. While the schedules can be altered by the user, the team hopes the city can provide adequate information to the community about the importance of the recommended sprinkler schedule in hopes that the residents will accept the change.

Some information that will be important to the community relates to scheduling the controllers to water during the evening or day. Sprinklers often run during night hours to allow the ground to absorb the water before it would evaporate from the sun. However, some residents live in areas that have high winds at night which also interrupt water absorption. Informing residents about this would perhaps motivate them to keep a recommended daylight watering schedule. Some residents may garden or participate in other activities on their lawn which may interfere with a daytime watering schedule. Rather than residents defaulting to their own schedule, Spanish Fork City provides residents with time windows that provide flexibility if residents have a lifestyle issue. If the city works well with the public in addressing scheduling conflicts, it will help others be open to having Rachio sprinklers installed.

A copy of the current recommended watering schedule for residents based on their address is shown in Table 1. For those that live in wind fan areas, the time span for a watering time is larger, which hopefully provides a time that works for the residents. The city wants this water scheduling to be as convenient as possible.

The team suggests providing letter to residents that explains the benefits of the Rachio sprinkler system and schedule recommendations. An example of this letter can be seen on the following page in Figure 8.

Acronym	Description	Time Block Start	Time Block End
NFO	Non-Wind Fan Area Odd Address	3:45 AM	6:00 AM
NFE	Non-Wind Fan Area Even Address	5:00 AM	8:00 AM
F12	Wind Fan Area Addresses ending with 1 or 2	10:00 AM	3:00 PM
F34	Wind Fan Area Addresses ending with 3 or 4	11:00 AM	4:00 PM
F56	Wind Fan Area Addresses ending with 5 or 6	12:00 PM	5:00 PM
F78	Wind Fan Area Addresses ending with 7 or 8	1:00 PM	6:00 PM
F90	Wind Fan Area Addresses ending with 9 or 0	2:00 PM	7:00 PM
NA	Non-Adjustment Requestees	-	-

Table 4. Recommended schedules based on wind and address

SPANISH FORK
PRIDE & PROGRESS

04, 2019

RE: Smart Controller Watering Schedule

Resident,

We appreciate your participation in the water conservation program. The benefits of the program in 2018 are summarized below.

- The average household saved 4,500 gallons per summer month (June through September). This represents a 17% drop in average monthly usage.
- Despite a 4% growth in connections to the Spanish Fork City water system in 2018, there was only a 1.2% increase in supplied water for both drinking water and pressurized irrigation.
- The highest daily peak demand was reduced from 7.49% to 7.11% of total daily water usage.

Because of your efforts, the city will experience improved pressure during peak times and increased capacity of the pressurized irrigation system. In an attempt to increase capacity further, we are recommending a new watering schedule to you this summer. This schedule will automatically adjust to alternate watering with your neighbors to maximize your water pressure. We hope this new schedule will be convenient for you, but if desired, you may override this adjustment at any time.

The recommended schedule is based on if your home is located within the wind fan and the final number of your address.

Figure 7. Example of informational letter to resident

The team believes that schedule adherence and water conservation would likely be achieved through sharing additional information with residents, including: marginal cost information; education of benefits of the program and water conservation; provision of personalized consumption information; and warnings of excess usage (e.g. leaks, watering during precipitation).

Conclusion

Overall, the team found correlations between water conservation and the use of Rachio controllers. The daily watering peak demand was reduced by 0.5% and the water usage decreased by 17% for those homes that had controllers installed. These reductions will help Spanish Fork's current irrigation water sources to serve the city for longer than projected. Expansion of these water systems have high expenses, so the delay of these renovations represents significant savings for the city. The team believes that additional controller installations will continue to increase potential savings.

Appendix A

Table 1. Hourly Flows for 6/1/18 - 6/3/18

Hours	No Controller
2:00 AM	5.64%
3:00 AM	5.12%
4:00 AM	5.12%
5:00 AM	5.69%
6:00 AM	5.68%
7:00 AM	4.91%
8:00 AM	3.80%
9:00 AM	2.92%
10:00 AM	2.64%
11:00 AM	2.50%
12:00 PM	2.11%
1:00 PM	2.07%
2:00 PM	1.81%
3:00 PM	1.80%
4:00 PM	1.96%
5:00 PM	2.26%
6:00 PM	2.63%
7:00 PM	3.27%
8:00 PM	4.16%
9:00 PM	6.30%
10:00 PM	7.49%
11:00 PM	7.37%
12:00 AM	6.57%
1:00 AM	6.17%

Table 2. Hourly Flows for 8/27/18 - 8/29/18

Hours	With Controller
2:00 AM	5.36%
3:00 AM	5.65%
4:00 AM	5.72%
5:00 AM	5.79%
6:00 AM	6.16%
7:00 AM	5.40%
8:00 AM	4.27%
9:00 AM	2.92%
10:00 AM	3.28%
11:00 AM	2.79%
12:00 PM	2.17%
1:00 PM	1.87%
2:00 PM	1.65%
3:00 PM	1.64%
4:00 PM	1.62%
5:00 PM	1.67%
6:00 PM	2.06%
7:00 PM	3.14%
8:00 PM	3.86%
9:00 PM	5.85%
10:00 PM	7.11%
11:00 PM	7.02%
12:00 AM	6.66%
1:00 AM	6.34%

Josephine Paxton

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Education

Bachelor of Science in Civil and Environmental Engineering — **Dec 2019**
Brigham Young University — *Provo, UT*
- GPA: 3.77

Relevant Skills and Coursework
- Mathematics Minor
- Passed Fundamentals of Engineering Exam (EIT)

Work Experience

Engineering Intern — **Sep 2017 – current**
Spanish Fork City Public Works — *Spanish Fork, UT*
- Participate in the implementation and analysis of a city-wide water conservation program to reduce peak demand by 0.5% and lower water usage
- Improved the Capital Improvement Plans for 4 city departments
- Conducted studies for determining accurate recycling rates, comparing fees between nearby cities, and evaluating traffic compliance at a local intersection

Research Assistant — **Apr 2017 – Dec 2018**
Dr. Dawn Teuscher, Ph.D. — *Provo, UT*
- Used the video analysis platform Studiocode to analyze 6 middle grades teachers' decisions to help improve how geometric transformations are taught
- Presented personal research on student misconceptions at the Utah Council of Teachers of Mathematics conference

Research Assistant — **Aug 2013 – Apr 2014**
Dr. Daniel P. Ames, Ph.D., P.E. — *Provo, UT*
- Conducted user study of 75+ students for the Vuepod, BYU 3D/stereoscopic immersive visualization system to promote the use of Lidar data sets
- Prepared and offered a presentation on the Vuepod at Utah's Conference for Undergraduate Research

Accomplishments and Activities

Service

Religious
- Joint leader over female group (ages 18 to 29) in local congregation and as missionary volunteer

Community
- Member of Utah Healing Arts, a program for providing music to nursing homes (25 hours) — **Dec 2013 – Apr 2014**, *Provo, UT*
- Volunteer at food drives organized by The Salvation Army in Grandview, Washington (18 hours) — **Oct 2015 – Dec 2015**, *Grandview, WA*

Educational
- Phi Eta Sigma Honor Society inductee, 2014
- Intermediate proficiency in Spanish, writing and speaking
- Recipient of BYU Academic Scholarships, Fall 2014 to Winter 2020

Character
- Completed 3 marathons
- Managed 2 jobs for 3 semesters as a full-time student

Whitney Robison

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Education

Bachelor of Science in Civil and Environmental Engineering **April 2019**
Brigham Young University *Provo, UT*

- GPA: 3.44
- Mathematics Minor

Certification/Skills

- Passed Fundamentals of Engineering Exam (EIT)
- Practice with ArcGIS, AutoCAD, and surveying equipment
- Proficient in Microsoft Office

Work Experience

Administrative Engineering Intern **January 2019 - current**
Spanish Fork City Public Works *Spanish Fork, UT*

- Created and formatted spreadsheets for certifications of 70+ employees
- Developed spreadsheets to organize city water credits

Hydraulics Teacher Assistant **September 2018 - December 2018**
BYU Civil Engineering Department *Provo, UT*

- Helped 20+ students with hydraulic equations and concepts
- Graded assignments and communicated regularly with professor

Line Server and Catering Driver **Summers 2017 - 2018**
Cafe Zupas *Orem and Spanish Fork, UT*

- Interacted with and amicably assisted a high volume of customers
- Paid strict attention to details, including memorization of ingredients for 35+ menu items
- Followed precise prepping, serving, and cleaning procedures

Calculus Teacher Assistant **September 2015 - December 2015**
BYU Mathematics Department *Provo, UT*

- Graded assignments and used excel for the data reporting of 50+ students

Receptionist **Summers 2012 - 2014**
Caldera Engineering *Provo, UT*

- Organized and archived numerous customer related documents
- Arranged and coordinated annual company events and foreign business trips
- Answered and directed phone calls for 40+ employees

Miscellaneous

- Student member of ASCE and ITE
- Interests: travel, games, hikes, puzzles

Angie Ayaviri Dominguez

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Education

Bachelor of Science in Civil Engineering **December 2019**
Brigham Young University *Provo, Utah*

- GPA: 3.66
- ASCE membership

Associate of Science **July 2014**
Brigham Young University- Idaho *Rexburg, Idaho*

- Full Academic Scholarship
- Magna Cum Laude Honors

Skills

- Proficiency in InfoWater and ArcGIS programs
- Basic Knowledge on AutoCAD
- Writing, speaking and reading in Spanish (Native)

Education

Civil Engineer Intern **September 2017 – Present**
Public Works *Spanish Fork, Utah*

- Co-design the main city drinkable water model using InfoWater.
- Conducted 10+ traffic counts during select time periods. as directed.
- Learned to provide customer service by attending to customers needs through phone calls and personal interactions

MTC Seminar Specialist **July 2018 – August 2018**
Provo Missionary Training Center *Provo, Utah*

- Ushered 30+ meetings in Spanish, English and Portuguese
- Maintained very professional agenda for religious leaders.

MTC Spanish Interpreter Trainer **September 2016 – July 2018**
Provo Missionary Training Center *Provo, Utah*

- Interpreted for up to 25+ different meetings that Non- English missionaries experience during their stay at the MTC.
- Translated 100+ documents from English to Spanish and vice versa for their distribution around other MTC's around the world

Teacher's Assistant **April 2014 – July 2014**
BYU-Idaho Geology Department *Provo, Utah*

- Conducted pre-tests with hands-on demonstrations
- Tutored groups of up to 15 students which led increased knowledge of material

Service

Full-Time Religious Missionary **November 2014 – May 2016**
The Church of Jesus Christ of Latter-Day Saints *Saint George, Utah*

- Organized 50+ tours per day through visitor centers.
- Communicated with people in person, over the phone, through e-mail, and online chat in Spanish and English.

Volunteer Tutor **January 2014 – July 2014**
BYU-Idaho Spanish and Physics Department *Rexburg, Idaho*

- Tutored one to one students once a week for 2+hours