SPRINGVILLE TIERED RATE WATER SYSTEM

Project ID: CEEn_CPST_010
by

JDG Engineers and Co.
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Logan Sowards

A Capstone Project Final Report

Submitted to

Bradley Stapley
Springville City

Department of Civil and Construction Engineering
Brigham Young University

April 11, 2022

Executive Summary

PROJECT TITLE:	Springville Tiered Rate Water System
PROJECT ID:	CEEn_CPST_010
PROJECT SPONSOR:	Springville City
TEAM NAME:	JDG Engineers and Co.

The Springville Tiered Rate Water System project was initiated in hopes to improve the current Springville rate system and provide data analysis using rates, payments, lot sizes and climatological information. Our goal was to create an adjustable tiered rate system in which Springville Executives could experiment with the impacts of rates on revenue. Recent years of Springville data were used to form a model. We were required to collect and organize the necessary data, compile this data into R, run analyses that compare lots, water usage, and payments, and determine possible tier arrangements from our model. We began this project in October of 2021 and achieved results on April 7th, 2022. Major graphs of our analysis are displayed in the results section, and three tier options are shown under recommendations.

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Introduction

The project objective is to suggest a solution to improve the current Springville tiered water rate system. We came to our solution through a data analysis of water rates, GIS data, and user payments. Data was to be gathered from Springville records and data available from the Utah County GIS page. Throughout the project, we delivered a monthly report to the city, and have prepared this paper as a final report as well as a final presentation. The project was completed on April 11, 2022.

In order to complete the project, the most important aspects to finish were the compilation of data, and the proposed solutions of tiered rates. The project prioritized several different results (i.e. options) based on the importance of desired changes, such as average monthly payment of specific income brackets, conservation of water, or increased income to the city's fund. Delivered in this report is also the breakdown of factors that lead to a citizen being more likely to have increased water use and payment to income bracket ratios.

The schedule to complete these objectives was as follows:

January 3rd, 2022: All Data Collected
January 17th, 2022: Machine Learning Model Created
January 24th, 2022: Data breakdown by income brackets accessed
January 31st, 2022: Data breakdown by plot size accessed
February 7th, 2022: Data breakdown by location accessed
February 16th, 2022: Scenario 1: System to optimize payment to income ratio completed
February 28th, 2022: Scenario 2: System to optimize water conservation completed
March 9th, 2022: Scenario 3: System to optimize city income completed
March 21st, 2022: Scenario 4: System to optimize water infrastructure growth completed
April 4th, 2022: Presentation completed

These goals were mostly met, with some slight skew of systems being developed slightly later than expected. The actual schedule encountered has been recorded in the "Schedule" section of this report. As of the submission of this report, the project has been finished in its entirety and given to the Springville Water Board.

JDG Engineers has delivered a monthly status report to the sponsor of the project, including challenges faced, how it was overcome, our progress, and if we were still on schedule. Upon completion of the project, we have delivered a report and presentation with the findings of our research with our recommendations. We have determined a time on April 12th to visit Mr. Stapley in Springville to present our project. We have created a short slideshow presentation in preparation for this meeting.

The idea of a deliverable model experimentation tool was not feasible in the time that was given, nor with the amount of data given. This may be a potential project for a future capstone group.

Note: The team has provided work for this Capstone project “as is” using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved, and stamped by a qualified and relevant licensed professional engineer. The Capstone Team responsible for this report is not responsible for any risks assumed by using the recommendations herein.

Schedule

Oct 18, 2021 -	Capstone Dinner with Sponsors and Faculty Mentors
Jan 6, 2022 -	Lot size data from GIS collected, later determined insufficient
Jan 10, 2022 -	Received Springville water analysis R scripts for previous years
Jan 26, 2022 -	Acquired lot size data through GIS with the help of Roger Dunn, GIS Administrator for Springville
Mar 2, 2022 -	Compiled data, discovered about 13% of lot data was missing
Mar 21, 2022-	Report update completed. 90% confident we could complete the project
March 31, 2022-	Found that the model was useful for some aspects of the project but couldn't predict all wanted fields. Poster submitted.
April 7, 2022-	Results from the model were achieved
April 11, 2022-	Report and Presentation submitted

Assumptions & Limitations

In order to keep the study limited in its scope to variables that we can accurately predict and model, several assumptions had to be made. The first assumption that we made was that no one in the city wanted a decrease in the quality of their public works, or a loss of the water rights that the city held. This was used as an influencing factor in the rest of our assumptions. The next was that all citizens of springville would respond rationally to increases or decreases in price. This meant we had to assume two things, as follows.

First, we assumed that every citizen had an amount of water that they had to use as a bare minimum, and that they would have an absolute maximum that they would care to use in the opposite situation. Whether the minimum was for drinking, bathing, cooking, or other essential uses, increasing the price of water did not mean they would use less than this necessary amount, as it was their minimum water used. If price was decreased, there was a maximum amount of water they would use, whether that was for lawn care, longer showers, or recreational activities, there was a maximum that one citizen could use. These minimum and maximums were not standard, and would vary by citizen.

Second, we assumed that citizens would respond appropriately for price increases and decreases. If prices were to increase, they would attempt to conserve water, and use less for non-essential activities. If prices were to decrease, they would be less conservative in their use, and use more on non-essential activities. These were the assumptions we made for usage.

Another assumption we made was that the different parties involved desired different outcomes, and so what was good for one group may be bad for another. By this logic, a balance between them was most likely to achieve the most satisfaction between the groups. The groups we considered were lower-income households, upper-income households, city accounting, city works management, and city politicians. We assumed that each of these groups desired the following:

Lower-income households: Most of these citizens would desire a lower price for them, with a higher amount for the upper-income households.

Upper-income households: Most of these citizens would desire a more generalized rate, with people paying what they see as a “fair share”.

City accounting: This group would desire the highest amount of income to the city funds.

City works: This group would desire enough funds to keep the public works functioning properly, with enough people using enough water to stimulate more growth in the sector.

City politicians: This group would desire the most amount of voters to perceive their works as beneficial to them in order to remain in office.

These are the main assumptions that we have made in our design. Of course, each of these assumptions can be compounded in much more depth, with conflicting and converging interests between the groups. However, we are limited by the amount of processing power we have, and the time we have to create an interworking model of the elements. To work with these limits, we have to compare each group separately, and then return to results afterwards to evaluate the impact on specific groups.

Along with this limitation, one of the most drastic limitations we encountered was the lack of data. Four years of information does not give as much information as we would like for trends by year, and monthly trends are little more than interpolation at values of four. It would have been highly beneficial to have several more years, especially summers. Because of this, the effects of changing seasons may not be as anticipated as would be preferable.

Design, Analysis & Results

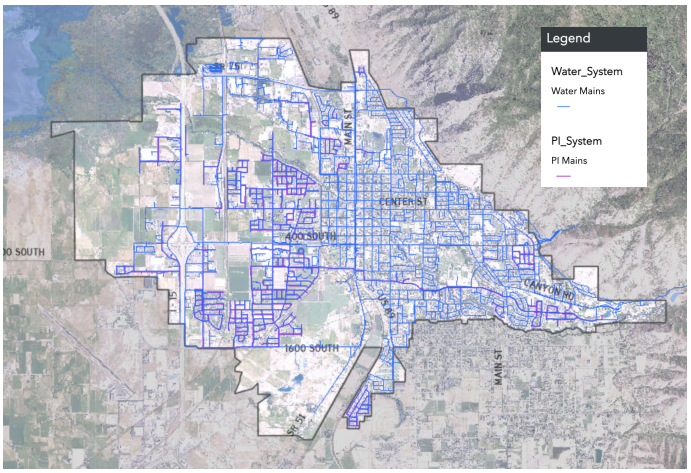

Figure 1: Springville Pi and CW Mains

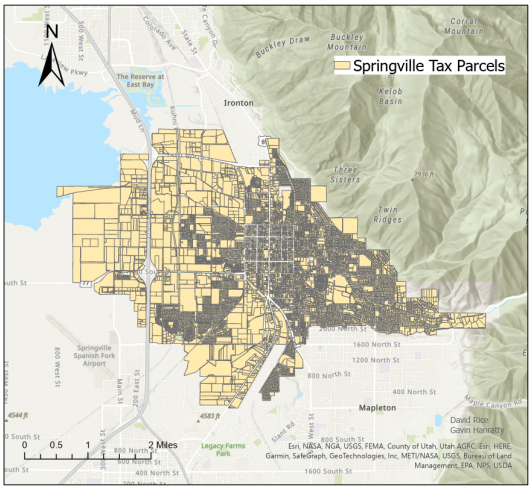

Figure 2: Springville Parcels

Figure 1 to the left shows a map of the current pipe network running through Springville city limits. Figure 2 shows a map of the parcels in Springville created on GIS. We used the parcel map to get lot sizes for each parcel in Springville and combined the available lot data with each resident's address. We have lot-data for 84.7% of current residents.

Table 1: Springville Tiered Water Rates

Springville Tierred Water Rates				
Tier	CW (No PI)	CW w/PI	PI	Description
Base	$ 13.72	$ 13.72	$ -	Base Water fee up to 5,000 gallons
1	$ 1.00	$ 1.13	$ 0.91	For each 1, 000 gallons or portion thereof between 5, 001 and 12, 000 gallons.
2	$ 1.32	$ 1.49	$ 0.91	For each 1, 000 gallons or portion thereof between 12, 001 and 20, 000 gallons.
3	$ 1.64	$ 1.85	$ 1.43	For each 1, 000 gallons or portion thereof between 20, 001 and 40, 000 gallons.
4	$ 1.95	$ 2.20	$ 1.43	For each 1, 000 gallons or portion thereof between 40, 001 and 60, 000 gallons.
5	$ 2.22	$ 2.50	$ 1.90	For each 1, 000 gallons or portion thereof between 60, 001 and 100, 000 gallons.
6	$ 3.01	$ 3.39	$ 2.38	For each 1, 000 gallons or portion thereof between 100, 001 and 150, 000 gallons.
7	$ 3.43	$ 3.87	$ 2.85	For each 1, 000 gallons or portion thereof between 150, 001 and 200, 000 gallons.
8	$ 4.22	$ 4.76	$ 3.80	For each 1, 000 gallons or portion above 200, 000 gallons.

Table 1 above shows the Springville Tiered Water Rates for 2022. There are three categories consisting of rates for culinary water (CW) without access to pressurized irrigation (PI), CW with access to PI, and PI only. There are eight tiers with their brackets explained under the description section.

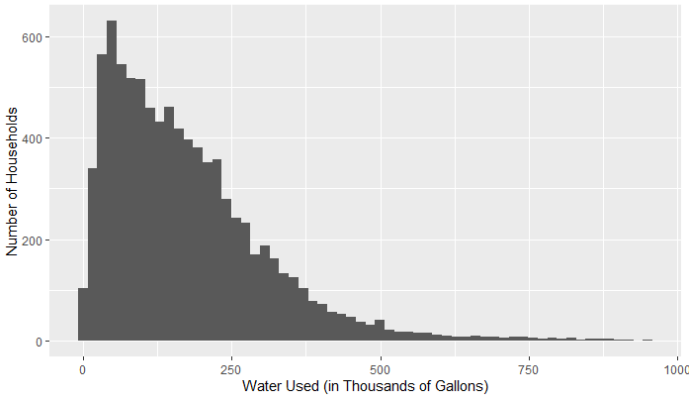

Figure 3: Household Annual Usage (2021)

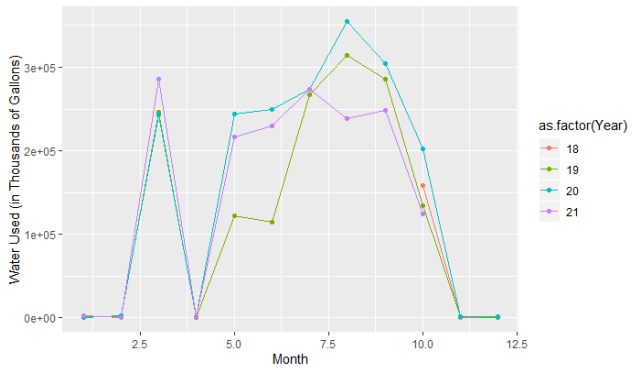

Figure 4: Monthly Water Usage

Figure 3 shows the water usage in 1,000 gallons and the amount of households that are using the amount for the year of 2021. Figure 4 shows the monthly water usage for the years 2018 to 2021. There is little change in usage between each year.

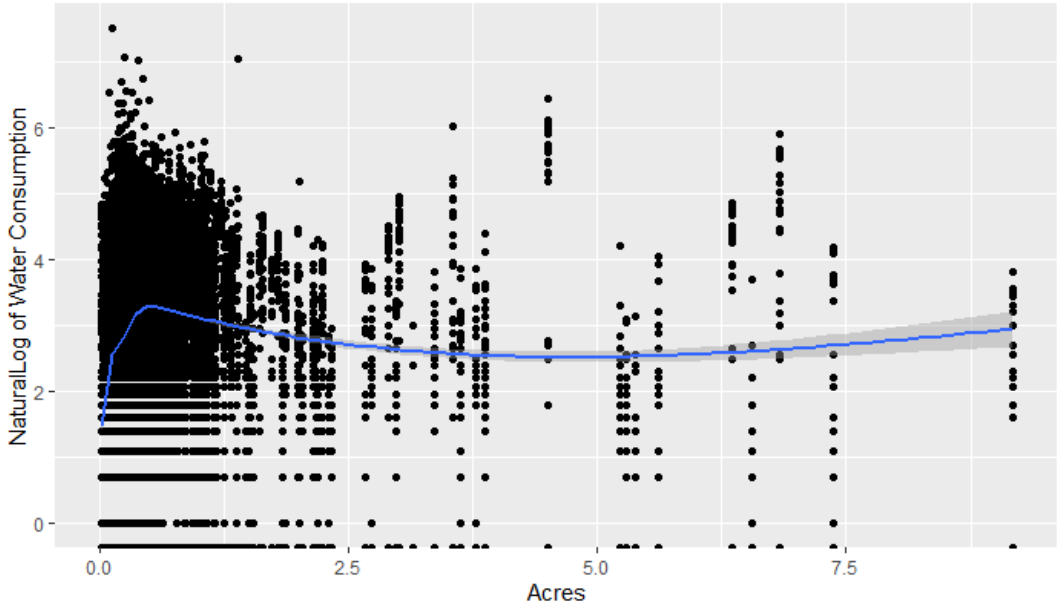

Figure 5: Water Consumption in Relation to Lot Size

The most unanticipated result of our analysis was that lot size has no significant correlation to water consumption. One of our original assumptions was that if a citizen had a larger lot, they would use more water, but average water usage actually peaked at around .45, with the largest users of water being around .25 to .35 acres. This is in direct contrast to our assumption, and seems to indicate that water usage is more significant inside the house.

This discovery was crucial to our recommended plan, as those with smaller lots still are generally in need of lower water rates, however, it would not be wise to encourage the bracket to use even more water.

With this in mind, it may be wise to institute a lot-sized base tier system. The system would need to vary less than the water usage system does currently. This would have pros and cons, as this may appear to some as less of a fair system. In pure terms of water, it is not the most fair, there is no question about that. However, it would help in the welfare aspect, for reasons described in the related issues section below.

Related Issues

Due to the fact that water is necessary for all life, water has a substantial impact on several far-reaching issues. Those that we will outline here will be public health, welfare, global factors, cultural factors, social factors, environmental factors, and economic factors, in that order.

In regards to public health, accessible and affordable clean water is necessary for the health of all Springville residents. Households rely on acceptable drinking and irrigation water to maintain human and plant health. Although our project does not focus on the quality of this water, our model allows for adjustments in its cost. Clean water is only as useful as it is accessible, and so an acceptable meeting point between quality and quantity must be met where the city does not spend too much on filtration and other means of purifications where it affects affordability or amount of water available. This variable is included in this report, as our team and the City Council members want water to be reasonably affordable to all residents in Springville.

In regards to welfare, as stated before, water is not a commodity, it is a necessity. No matter the income bracket of the resident, they will all have a price to pay for their water. It is the opinion of JDG engineers that water for necessity and water for commodity should be charged at different rates, which is the purpose of the tiered water system.

In this definition, water for necessity includes water which is essential for daily living– such as showering, cooking, and drinking water. These needs are immutable in humans, and so a tiered water system would ideally be much cheaper at the lower stages of usage to allow for these needs not to punish those who can only afford this. Those in lower income brackets are more likely to only use this level of water usage, although in addition this will mean that all income brackets would be equal in payment for their basic needs.

Water for commodity defines water which is used for non-essential purposes– such as recreational use and lawn care. These uses are more of a luxury use, in the literal sense of “not being required for survival”. Higher-income households are much more likely to use these services, making the increase in tiers for these uses not a burden on the welfare of the citizens. These are the uses that the tiered system hopes to charge more for. With this distribution, those in lower income brackets, who welfare aims to target, bear less of a burden for their daily needs while the usage of larger amounts helps support Springville City’s ability to expand their ability to service residents.

In regards to global factors, the effects of one local government can be far reaching. Springville has a fair bit of influence throughout Utah valley, and that influence

can start domino effects that are hard to imagine from our little Utah towns. Adjustable tiered water rate systems, if they are successful here, can be established in cities around the world. Information on lot sizes, costs, water usage, and supply would be required as input values to run an appropriate model. Money and resources can be saved as cities experiment with optimizing their rates. This type of model can be especially useful in countries that experience water supply stresses, and in countries that experience severe income inequality.

In regards to cultural factors, JDG Engineers is well aware of the cultural importance that the uses of water indicate. A green lawn in the front yard is a symbol of wealth and work ethic in America, and people are not quick to give that up. Charging middle class America a higher rate for this symbol does not always sit well with them, as many equate it with a necessity. This is exacerbated by the “American Dream” of a picket fence house with a green yard for the kids to play on in the backyard. The idea of paying more for this dream will always be met with resistance, though only temporarily in most cases.

In regards to social factors, one of the greatest impacts tiered water rates have is on the social welfare of the community being served. If water rates are too high, negative social consequences will follow. Residents will become upset, which will spur social and political issues. If water rates are too low, the quality of water services will decrease, and water will be overused, which will also cause negative social repercussions. A balance needs to be met where customers are willing to pay the given amount while still feeling a need to conserve. There are current customers that are using a large excess of water, but this is seen as socially acceptable by the city since the current water supply can handle the excess use, and their use generates excess revenue for the city.

In addition, Springville has guidelines that require residents to have a certain amount of landscaping, which increases water usage for upkeep. This requirement presents a conflict with those who believe conservation is more important, and in times of drought, may present the city as a scapegoat for the lack of water.

In regards to environmental factors, Springville city has a finite amount of water that can be used to supply residents. This amount of water fluctuates depending on the drought season and the production from springs and wells in the area. Springville is currently in a healthy spot as far as their water consumption, as currently there is an excess of water versus consumption, which allows the city to draw less water out of their wells and store more water for future use. Springville is located in a desert, making it important to conserve water since droughts are fairly common. Raising water rates could potentially encourage water conservation, which is a benefit to Utah’s dry environment. Without a balanced water tiered rate system, difficulties in conserving water may arise. In times of serious drought, Springville must be prepared to maintain

its water supply. It may be wise to institute a “drought rate”, in which the city prepares for times where when the Utah Drought Review and Reporting Committee (DRRC) declares a drought, the tiers above basic will increase in price, relieving the stress on the system. This model is not included in this report, but an adjustable rate system can help mitigate challenging times and provide the city with safety.

In regards to economic factors, tiered water rates can be seen as a control of economic factors that would affect the others. As it stands, the city of Springville needs to reach a revenue cap to maintain their current water rights. The tiered water structure has a heavy influence on how much that revenue is. Springville is currently meeting its revenue requirements but more revenue for the city is ultimately a positive thing for public works, though it may have negative effects in other areas. The city has reported that there is no issue in water supply to the current residents, but due to the excess in water supply, there can soon be a need for more revenue. This could come from adjusting the tiered water rates or selling portions of water rights to other cities that may be in need. Our project should be able to help determine economic gains that can be made from the city. The issues that result though come from making a structure that charges the right amount for water usage per customer while getting enough revenue and conserving water.

Lessons Learned

During data collection, we learned a very simple yet important lesson. We learned that contacting specialists who are familiar with GIS and Springville data yields the best results. It is sometimes tempting to try to collect all of the data we can on our own, but the Springville representatives had access to information that sped up the process. We also had difficulty obtaining and organizing the data into R. Some of the address data was not listed in a consistent format, so we used coding string manipulation to better organize this dataset for use in R. This allowed us to list the addresses effectively without needing to change our tabulated information one by one.

In the process of creating the model for the tiered rate system, we found that fluctuations in rate prices and water usage both depend on each other. This meant that we could not analyze a direct cause and effect. One of the things we were asked to do was to predict the amount of water used if we were to change the tiered price. However, the price is determined by the amount of water used in each household. If we give a model a tier in order to predict the amount used, the machine learning model will assume that the tier causes the amount of water used, not the true relationship where the amount used causes the amount of water used. The machine learning models will

almost always erroneously conclude that the higher you raise the price, the more water will be used, contrary to the basic economic principles of supply and demand.

Conclusions

Through our analysis of collected water usage and lot size data, we found that on average, households with smaller lot sizes tend to use more water than those of larger lot sizes. This was an unexpected result, and could affect the decision in how changes are made to the tier rates. We also determined that a flat rate option with a base of $13.72, shown below, could result in a revenue reduction of only .2%. This was determined by selecting rates and running them through our model which calculated the overall revenue from the water usage. Additional results are shown in Appendix B.

Recommendations

We have proposed the following options for the tiered rate structure depending on what the city decides is more important. Option 1 shows a flat rate that can be charged for all water consumption, Option 2 shows Revenue if only the third tier rate is used and Option 3 shows a three tiered system. The percentage in bold shows the difference in revenue gained compared to 2022 tier rates. These options could eliminate concern of overcharges from individuals that tend to consume more water.

Option 1 (Flat Rate)	**Option 2 (Tier Three Rate)**	**Option 3 (Three Tiers)**
Base (No PI) = $13.72 All Tiers (No PI) = $2.61 Base (w/PI) = $13.72 All Tiers (w/PI) = $2.82 PI Base = $0.0 All PI Tiers = $2.40 **0.2% Less Revenue**	Base (No PI) = $13.72 T1(No PI) = $1.64 Base (w/PI) = $13.72 T1(w/PI) = $1.85 PI Base = $0.0 All PI Tiers = $1.43 **31.1% Less Revenue**	Base (No PI) = $13.72 5,000-40,000(No PI) = $1.64 40,001-100,000 (No PI) = $2.22 100,001+ (No PI) = $3.01 Base (w/PI) = 13.72 5,000-40,000 (w/PI) = $1.85 40,001-100,000 (w/PI) = $2.50 100,001+ (w/PI) = $3.39 PIBase = $0 5,000-60,000 = $1.43 60,001-150,000 = $2.38 150,001+ = $2.85 **10.6% Less Revenue**

Appendix A

Gavin Hanratty

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EDUCATION

Brigham Young University — Apr 2022
Bachelor of Science: Civil Engineering — Provo, UT

- Member of BYU Institute of Transportation Engineers
- National Member of American Society of Civil Engineers
- Relevant coursework: AutoCAD, Civil3D, Revit, and ARCGIS
- Intramural volleyball team participant

EXPERIENCE

LEI Surveyors and Engineers — May 2020-Present
Civil Engineering Intern — Spanish Fork, UT

- Designed grading plans for 100-unit village plans to direct storm water into drains for containment
- Reviewed site plan designs to be approved by cities for future development
- Developed an irrigation calculator to display available water for new households
- Constructed boundary descriptions for Final Plats of 200-unit villages

Harold B Lee Library — Sep 2018-Apr 2020
Shelver and Clerk — Provo, UT

- Sorted, organized, and shelved books across 5 floors of the library
- Categorized and distributed mail to faculty members
- Repaired and constructed office equipment and furniture for staff
- Assisted Patrons with questions and provided supplies and needed information

Thomas Doll: Tax, Retirement, and Wealth Advisors — May 2019-Apr 2020
Administrative Assistant — Walnut Creek, CA

- Collaborated with Tax Managers and Partners on projects that aided company clients
- Collected and input survey data from clients to improve company image
- Handled and shipped sensitive documents that were requested by Bookkeepers

VOLUNTEER EXPERIENCE

Church of Jesus Christ of Latter Day Saints — Jul 2016-Jul 2018
Full-time Volunteer Representative — Alabama, USA

- Led a group of 8 volunteers, conducted weekly trainings on productivity, followed up on goals, sent weekly progress report to area leaders
- Provided community service for over 20 families and assisted 4 food / shelter agencies

Dogs4Diabetics — Apr 2016-Jul 2016
Part-time Volunteer — Concord, CA

- Assisted in training dogs to sniff out low blood sugar for owners with diabetes
- Collaborated with other volunteers on training methods, improving skills learned by dogs

INTERESTS/ACHIEVEMENTS

- Rock climbing and hiking in the Sierra Nevada
- Eagle Scout – project consisted of selecting a site to install 2 benches on city property, constructing benches, leveling out the site, and coordinating volunteer efforts

Isaac G Kelley

916.778.9229 • Provo, UT • isaacgkelley@gmail.com

EXPERIENCE

Data Analyst - AdvisX | Provo, UT — **May 2021 - Present**

- Perform compliance validations for Banks/Credit Unions by performing large-scale data analysis in **SQL, R, Python, and Excel**
- Design and implement analytics solutions software to help clients track key business metrics and **provide actionable insights**
- Introduced new **data wrangling techniques**, leading to increased efficiency for the data analysis team
- Identify actionable insights, suggest recommendations, and influence the direction of the business **by effectively communicating** results to cross-functional groups

Computer Science Instructor - Juni Learning | Remote — **June 2020 – August 2021**

- Developed and taught curriculum that includes **fundamental coding principles**

Research Assistant - Brigham Young University | Provo, UT — **July 2020 – February 2021**

- Utilized **project management** and effective researching procedures to propose innovative research approaches
- Developed and studied **Python** code to analyze planning, activity, and intent recognition using **Machine Learning** in multi-agent AI environments

Volunteer/Leader - The Church of Jesus Christ of Latter-Day Saints | Madagascar — **September 2017 – August 2019**

- Instructed other volunteers in the language and necessary skills
- Actively engaged with a wide variety of people to **increase productivity** in service efforts

Teller - Key Bank | Utah Valley, UT — **September 2015 – August 2017**

- Developed proficiency with systems/applications utilized by the bank to increase efficiency and service clients more effectively

EDUCATION

Brigham Young University | Bachelor of Science in Statistics — **Expected April 2022**

- Emphasis in Data Science
- Computer Science Minor
- Philosophy Minor

SKILLS

Software Development : C++, Java, Python | Statistics/Data Science : SQL, Apache Spark, Hadoop, MATLAB, R, Pandas, Excel
Qualitative/Quantitative Analysis | Machine Learning | AWS | Logical reasoning | Collaboration | Friendly with a Warm Smile

PROFESSIONAL SUMMARY

While earning a degree in **Data Science** and working as a **Data Analyst**, I've gained skills that I'm eager to apply in increasingly effective ways. With a double minor in **Computer Science** and **Philosophy** as well, I have the coding skills you're looking for and the logical training to solve our problems effectively and efficiently.

BAR RAISER | CRITICAL THINKER | LOGICIAN

Logan Sowards
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linkedin.com/in/logan-sowards/ · github.com/lzsour/LoganSowardsPortfolio

EDUCATION

Brigham Young University Apr 2022
Bachelor of Science: Statistics, Emphasis in Data Science Provo, UT
Minor in Business
- GPA 3.85

EXPERIENCE

Progressive Leasing May 2021-Aug 2021
Data Science Intern Draper, UT
- Developed a machine learning model to segment out risk, predicted to save $6 million
- Performed feature engineering to boost model performance
- Created data visualizations and presented findings to higher level managers

Brigham Young University: Economics Department May 2020-Sep 2021
Research Assistant: Computer Vision Team Provo, UT
- Helped develop system utilizing neural networks to segment and perform handwriting recognition on specific fields of thousands of historical documents
- Created documents teaching how to use specific programs and packages (e.g. labelme, Detectron2)
- Oversaw a small team to complete a variety of research projects
- Learned Python and UNIX Shell on the job (with no prior experience), eventually training other team members in these skills

Galorath Incorporated Jan 2017-Apr 2017
BYU: On-Campus Internship Provo, UT
- Presented SWOT analysis on company and competitors to company executives
- Constructed survey to analyze consumer base
- Identified potential markets for company growth

SKILLS

Coding Experience
- Intermediate: R, Python, SAS, UNIX Shell, GitHub, Pandas, Seaborn, Detectron2
- Beginner: SQL, C++

Other Skills
- Mandarin Chinese (Intermediate)

RELEVANT COURSEWORK

- Data Science in Business
- SAS Base Programming
- Applied R Programming
- Intro to Linux and Shell
- Intro to Python
- Data Structures
- Analysis of Variance
- Introduction to Regression
- Probability and Inference
- Spreadsheets and Business Analysis
- Principles of Finance
- Principles of Accounting
- Marketing Management
- Economic Principles
- Communication in Organizational Settings

VOLUNTEER EXPERIENCE

The Church of Jesus Christ of Latter-day Saints Jun 2017-Jul 2019
Missionary Auckland, New Zealand
- Maintained 80+ hour work week for two years, teaching and serving families and individuals
- Trained other missionaries one-on-one in conflict-resolution, teaching, and leadership skills
- Learned Mandarin Chinese and interacted with people from many different cultures and socioeconomic backgrounds

David Rice

602E 600N Provo, UT, 84606 (760) 822-2715 riceda97@gmail.com

Education

BS, Civil Engineering, Brigham Young University, Provo, UT Dec. 2022

- 3.77 GPA
- Classwork focused on structural, hydraulic, geotechnical, and transportation engineering

Civil Engineering Experience

ASCE's Utah Infrastructure Report Card, Provo, UT 2019-2020

- Researched conditions, funding, public safety, and future needs for the roadways in the state of Utah
- Coordinated with professional engineers to form a report on the overall conditions of the roads in Utah

Computer Skills

- Completed coursework in ArcGIS, Autodesk Inventor (CAD), and Revit programs
- Proficient in Excel, Microsoft Word, Google Docs, and Google Slides
- Obtained 2 years of experience with Adobe Photoshop

Leadership and Communication Experience

Missionary Volunteer, The Church of Jesus Christ of Latter-day Saints, New York City, NY
June 2017- May 2019

- Conducted 12 weekly training meetings with 5 other volunteers
- Addressed questions and concerns from those who had interest in religion
- Organized group goals and action plans to improve communication skills
- Visited hospitals and nursing homes to provide encouragement and comfort to the sick and elderly

Store Associate, In-N-Out, Oceanside, CA June-August 2021

- Maintained high standards of restaurant cleanliness and friendliness
- Processed POS transactions and served hundreds of customers

Boy Scout, Boy Scouts of America troop 729, Oceanside, CA 2005-Present

- Managed 10 workers in a service project to construct and transport an armadillo enclosure for a small, nonprofit zoo
- Directed service projects as a Service Project Manager for 2 years, including gifting treats to the elderly

Languages

- Completed 4 years of Spanish language education

Joshua Peterson

72 W 400 S Santaquin, UT, 84655 (480)-390-5933 jpeterson178@gmail.com

Design and Drafting Experience

Petersons Drafting Services
Owner and Lead Technical Drafter April 2020- Current

- Managed dozens of projects concurrently, including client relations and product quality
- Designed residential refabs and new construction
- Developed an architectural, structural, and CAD section

Brigham Young University
Research Assistant September 2021- Current

- Assisted in figure creation for presentation of results
- Compiled raw data into evidence for against hypothesis
- Currently assisting in the writing of an academic paper on soil liquefaction

Peterson Geotechnical Group
Technical Assistant and Drafter June 2013 - July 2019

- Surveyed and drafted floor level surveys
- Worked with project engineers to complete the design to their specs
- Completed forensic soil reports complete with cross sections and reconstructed floor plans

Brigham Young University
AutoCAD and Revit TA July 2019- March 2020

- Taught a group of 30 students at a time the basics of AutoCAD
- Assigned and graded a class-worth of homework and tests
- Held TA hours for students to come and ask any questions

Education

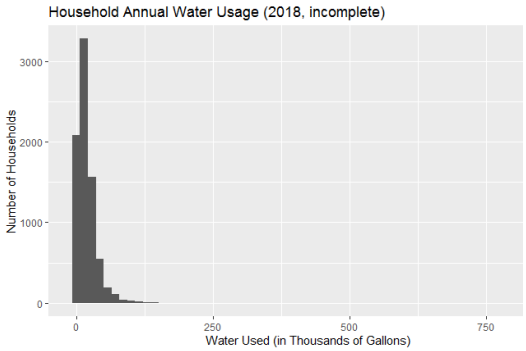
General Education
Chandler-Gilbert Community College Winter 2017-Summer 2018

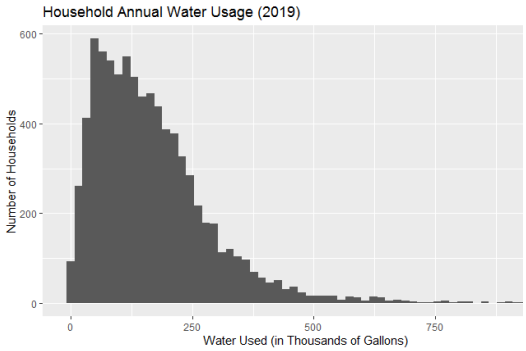
Civil Engineering
Brigham Young University Summer 2018-Current
Current Student- Civil Engineering - 3.05 GPA
Projected Graduation - May 2021

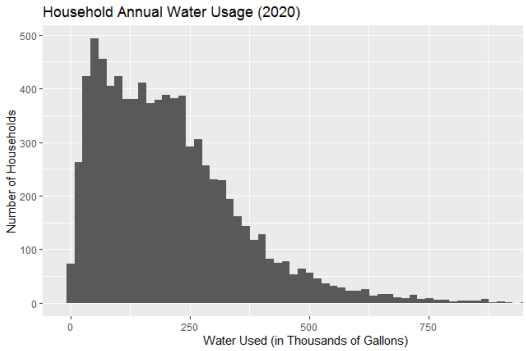
Professional Skills

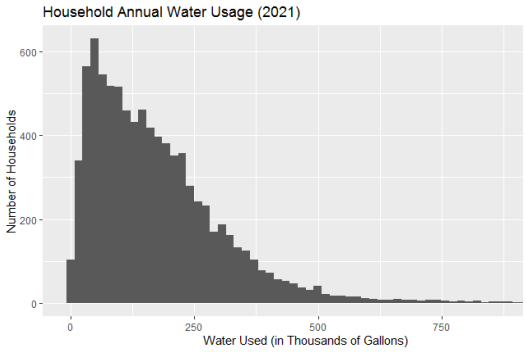
- Technical Drafting
- Proficient in Microsoft Excel
- Word Processing
- Logic Pro X
- AutoCAD trained
- Revit Trained
- ArcGIS Trained
- Allplan Trained
- Member of ASCE
- Member of ACI
- Project Management
- Client Relations

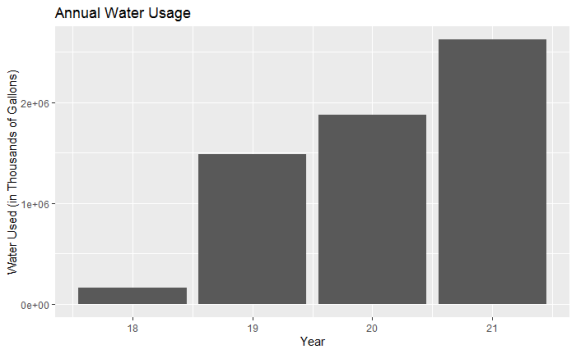
Appendix B

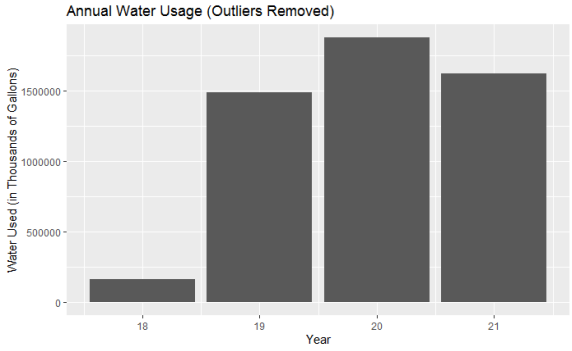

Household Annual Water Usage (2018, incomplete)
Number of Households
Water Used (in Thousands of Gallons)

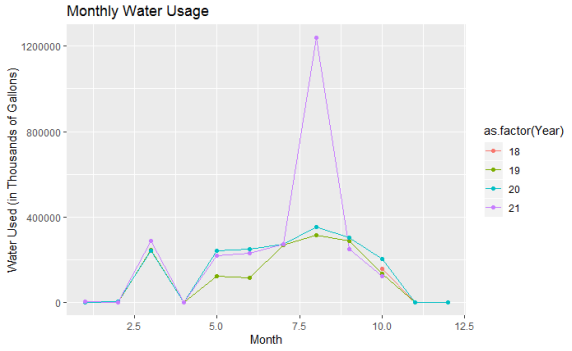

Household Annual Water Usage (2019)
Number of Households
Water Used (in Thousands of Gallons)

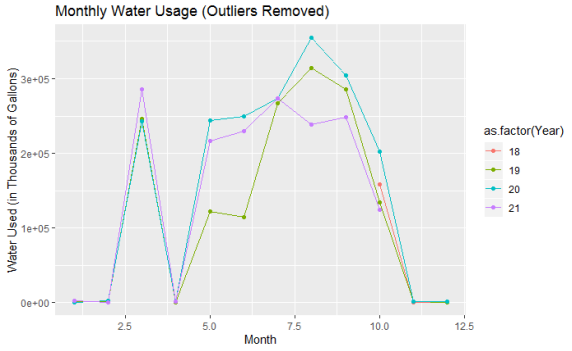

Household Annual Water Usage (2020)
Number of Households
Water Used (in Thousands of Gallons)

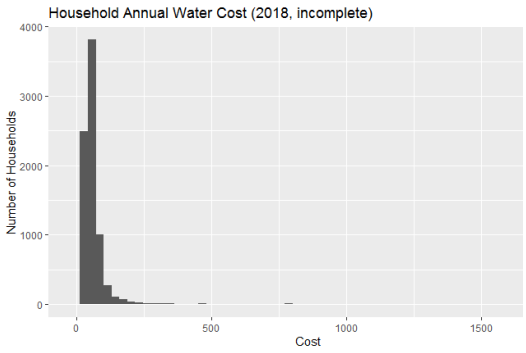

Household Annual Water Usage (2021)
Number of Households
Water Used (in Thousands of Gallons)

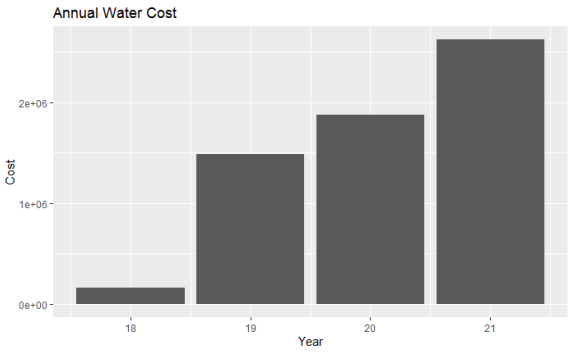

Annual Water Usage
Water Used (in Thousands of Gallons)
Year

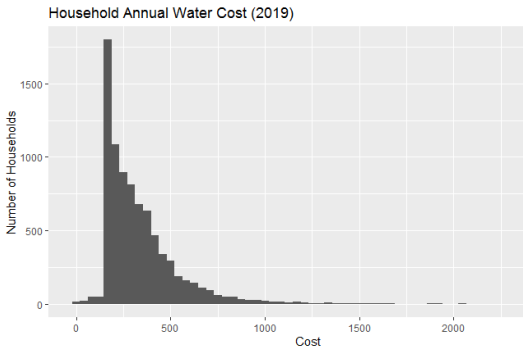

Annual Water Usage (Outliers Removed)
Water Used (in Thousands of Gallons)
Year

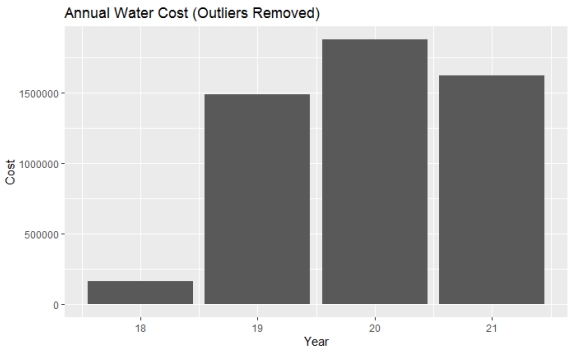

Monthly Water Usage
Water Used (in Thousands of Gallons)
Month
as.factor(Year)
18
19
20
21

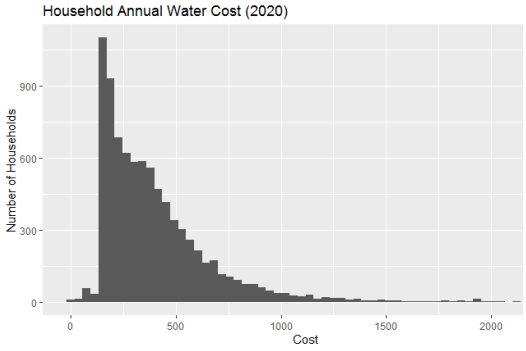

Monthly Water Usage (Outliers Removed)
Water Used (in Thousands of Gallons)
Month
as.factor(Year)
18
19
20
21

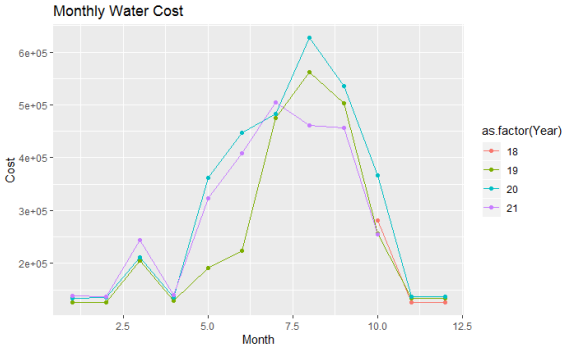

Household Annual Water Cost (2018, incomplete)
Number of Households
Cost

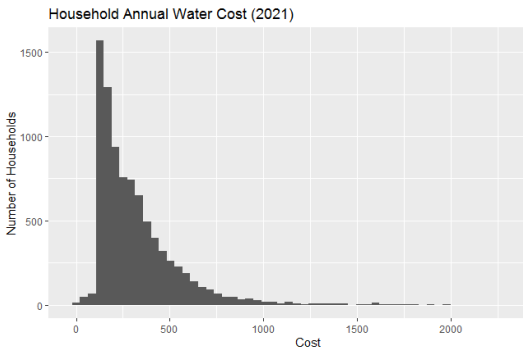

Annual Water Cost
Cost
Year

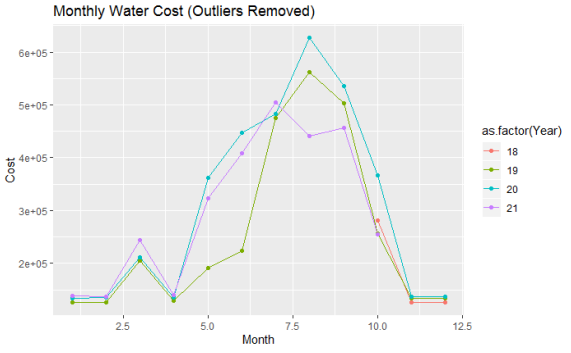

Household Annual Water Cost (2019)
Number of Households
Cost

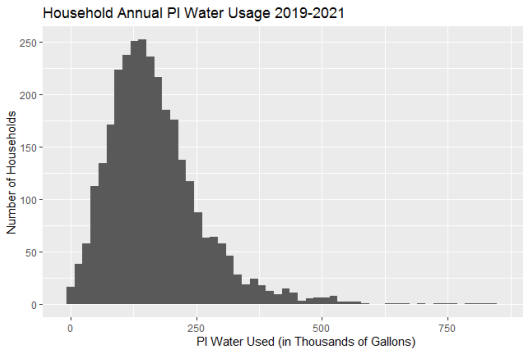

Annual Water Cost (Outliers Removed)
Cost
Year

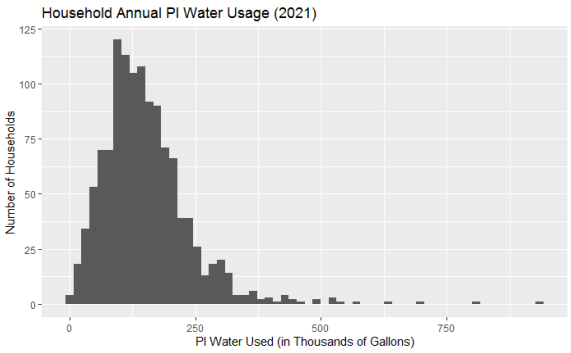

Household Annual Water Cost (2020)
Number of Households
Cost

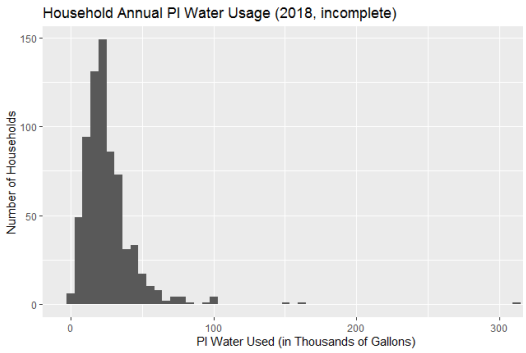

Monthly Water Cost
Cost
Month
as.factor(Year)
18
19
20
21

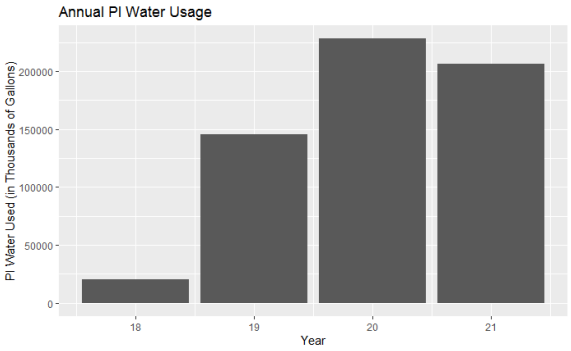

Household Annual Water Cost (2021)
Number of Households
Cost

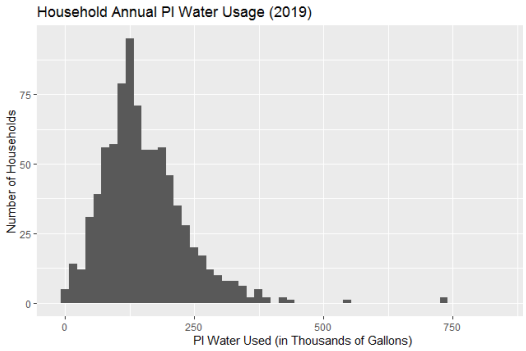

Monthly Water Cost (Outliers Removed)
Cost
Month
as.factor(Year)
18
19
20
21

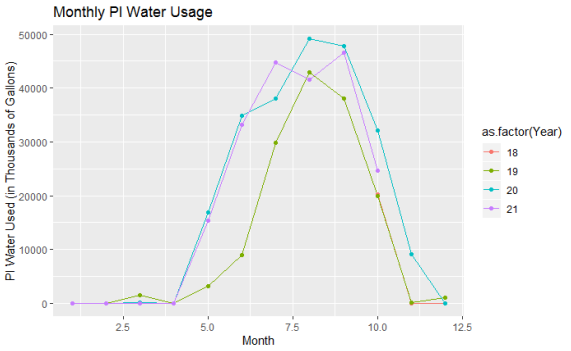

Household Annual PI Water Usage 2019-2021
Number of Households
PI Water Used (in Thousands of Gallons)

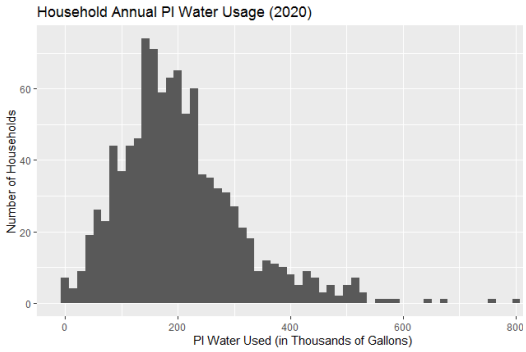

Household Annual PI Water Usage (2021)
Number of Households
PI Water Used (in Thousands of Gallons)

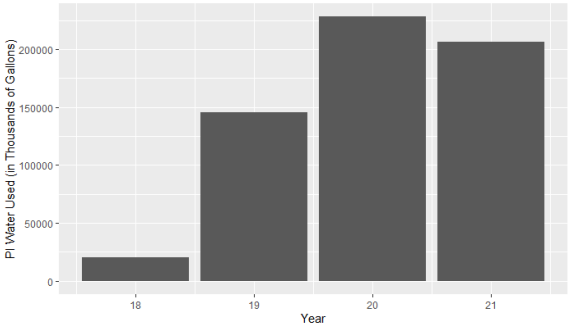

Household Annual PI Water Usage (2018, incomplete)
Number of Households
PI Water Used (in Thousands of Gallons)

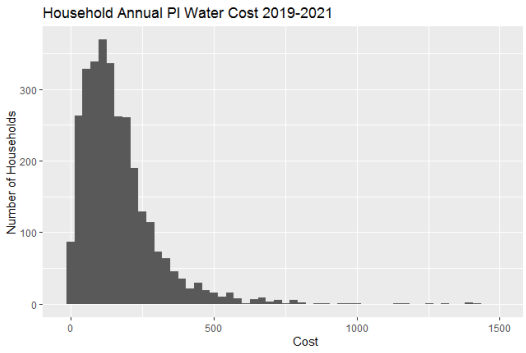

Annual PI Water Usage
PI Water Used (in Thousands of Gallons)
Year

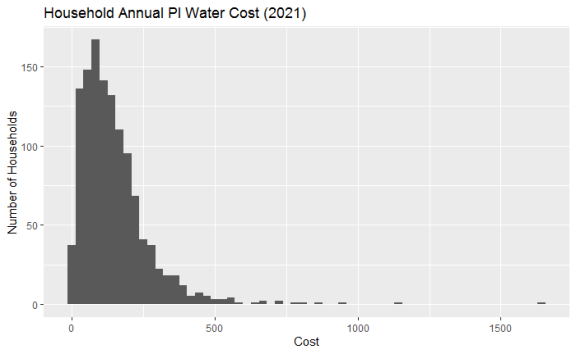

Household Annual PI Water Usage (2019)
Number of Households
PI Water Used (in Thousands of Gallons)

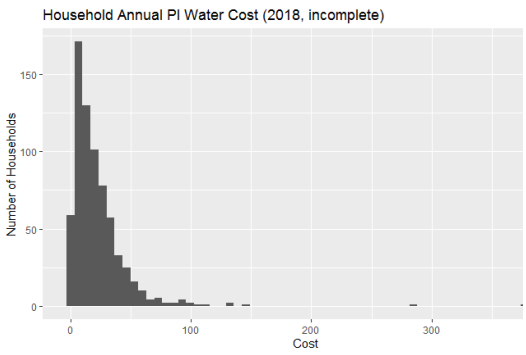

Monthly PI Water Usage
PI Water Used (in Thousands of Gallons)
Month
as.factor(Year)
18
19
20
21

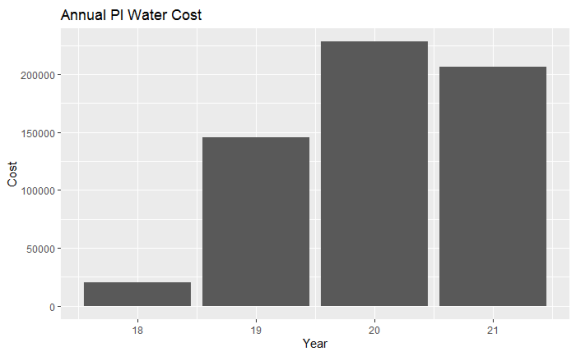

Household Annual PI Water Usage (2020)
Number of Households
PI Water Used (in Thousands of Gallons)

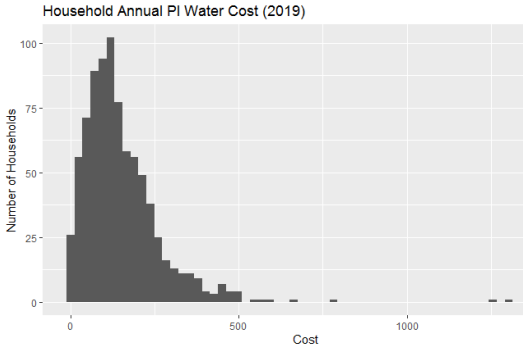

Monthly PI Water Usage
PI Water Used (in Thousands of Gallons)
Year

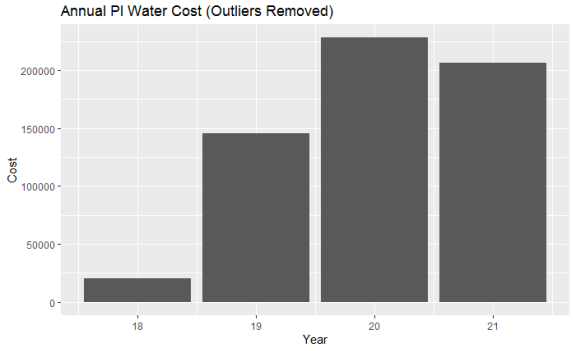

Household Annual PI Water Cost 2019-2021
Number of Households
Cost

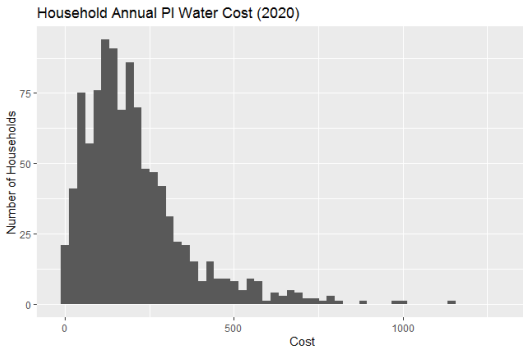

Household Annual PI Water Cost (2021)
Number of Households
Cost

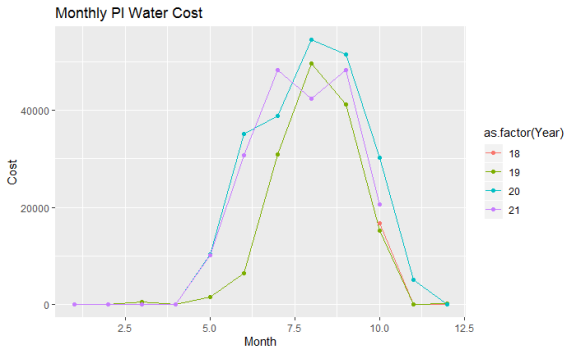

Household Annual PI Water Cost (2018, incomplete)
Number of Households
Cost

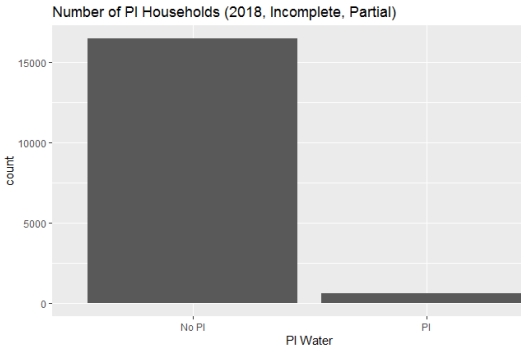

Annual PI Water Cost
Cost
Year

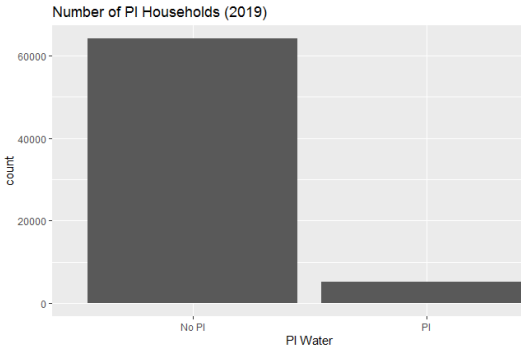

Household Annual PI Water Cost (2019)
Number of Households
Cost

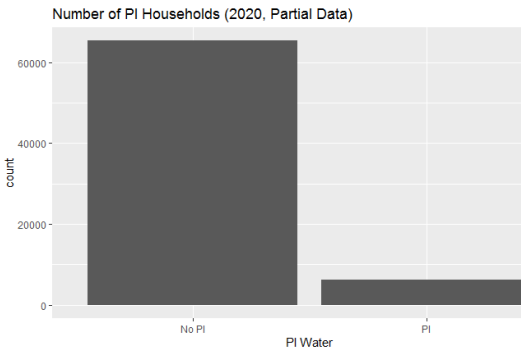

Annual PI Water Cost (Outliers Removed)
Cost
Year

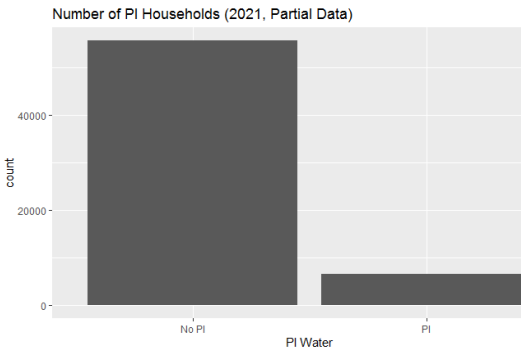

Household Annual PI Water Cost (2020)
Number of Households
Cost

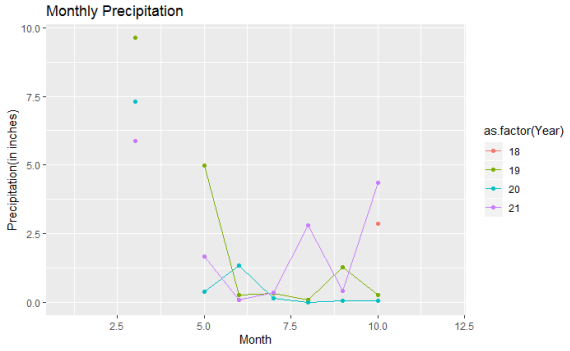

Monthly PI Water Cost
Cost
Month
as.factor(Year)
18
19
20
21

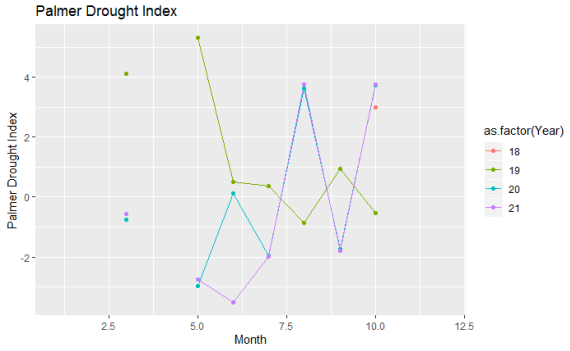

Number of PI Households (2018, Incomplete, Partial)
count
15000
10000
5000
0
No PI
PI
PI Water

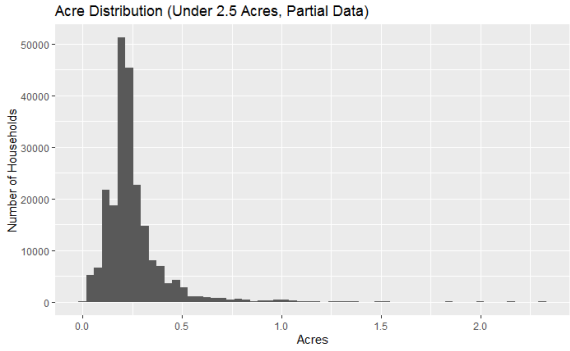

Number of PI Households (2019)
count
60000
40000
20000
0
No PI
PI
PI Water

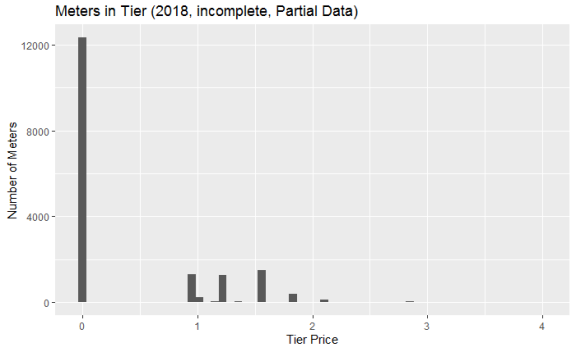

Number of PI Households (2020, Partial Data)
count
60000
40000
20000
0
No PI
PI
PI Water

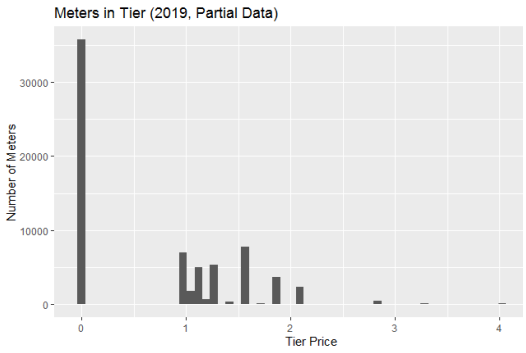

Number of PI Households (2021, Partial Data)
count
40000
20000
0
No PI
PI
PI Water

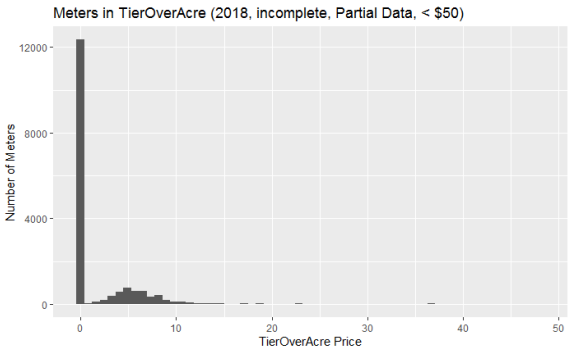

Monthly Precipitation
Precipitation(in inches)
10.0
7.5
5.0
2.5
0.0
2.5
5.0
7.5
10.0
12.5
Month
as.factor(Year)
18
19
20
21

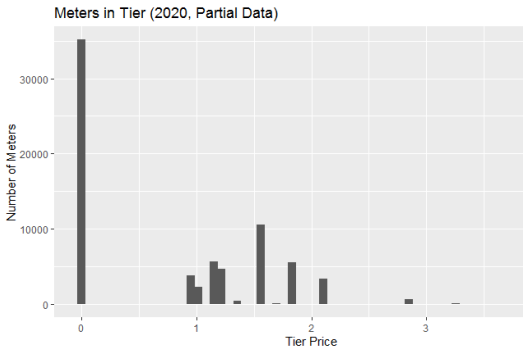

Palmer Drought Index
Palmer Drought Index
4
2
0
-2
2.5
5.0
7.5
10.0
12.5
Month
as.factor(Year)
18
19
20
21

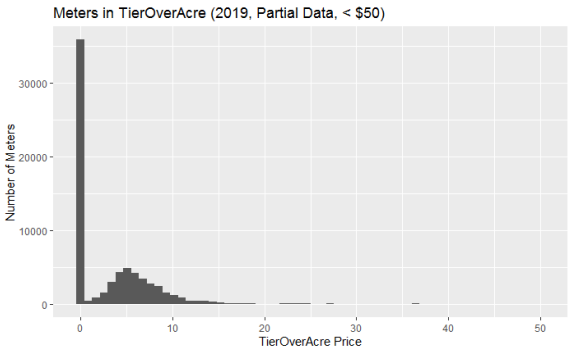

Acre Distribution (Under 2.5 Acres, Partial Data)
Number of Households
50000
40000
30000
20000
10000
0
0.0
0.5
1.0
1.5
2.0
Acres

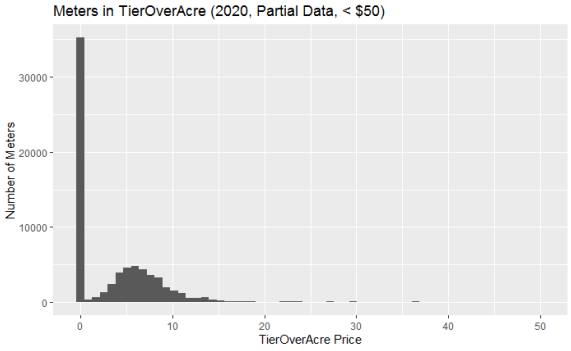

Meters in Tier (2018, incomplete, Partial Data)
Number of Meters
12000
8000
4000
0
0
1
2
3
4
Tier Price

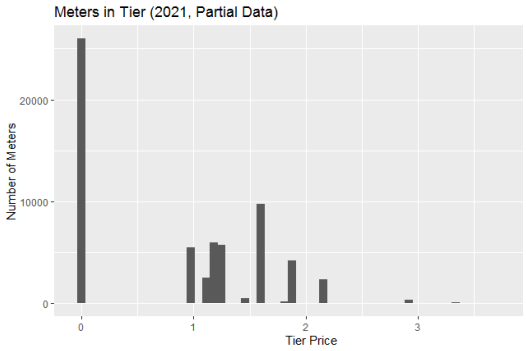

Meters in Tier (2019, Partial Data)
Number of Meters
Tier Price

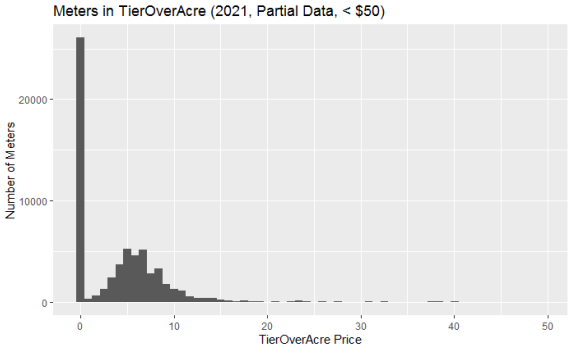

Meters in TierOverAcre (2018, incomplete, Partial Data, < $50)
Number of Meters
TierOverAcre Price

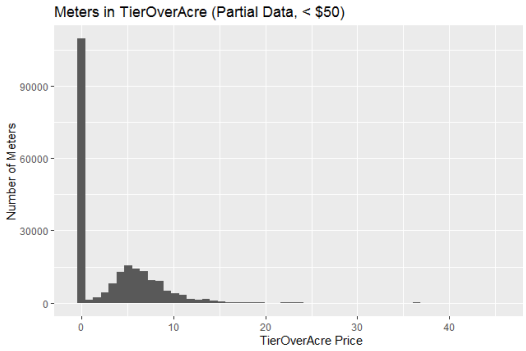

Meters in Tier (2020, Partial Data)
Number of Meters
Tier Price

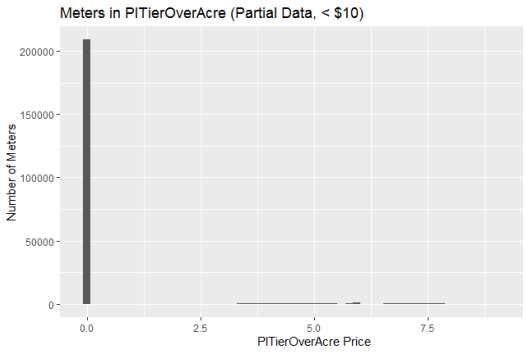

Meters in TierOverAcre (2019, Partial Data, < $50)
Number of Meters
TierOverAcre Price

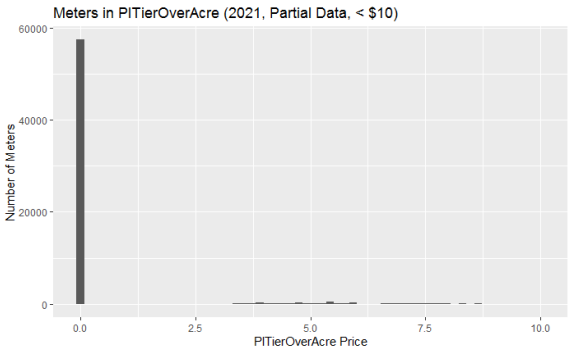

Meters in TierOverAcre (2020, Partial Data, < $50)
Number of Meters
TierOverAcre Price

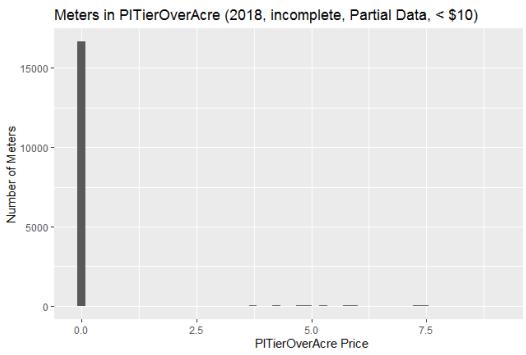

Meters in Tier (2021, Partial Data)
Number of Meters
Tier Price

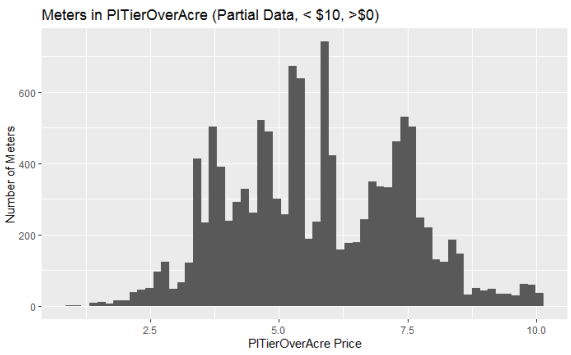

Meters in TierOverAcre (2021, Partial Data, < $50)
Number of Meters
TierOverAcre Price

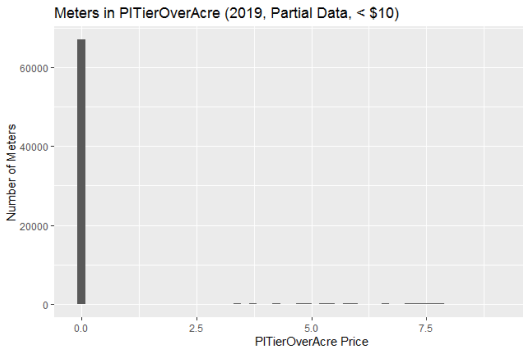

Meters in TierOverAcre (Partial Data, < $50)
Number of Meters
TierOverAcre Price

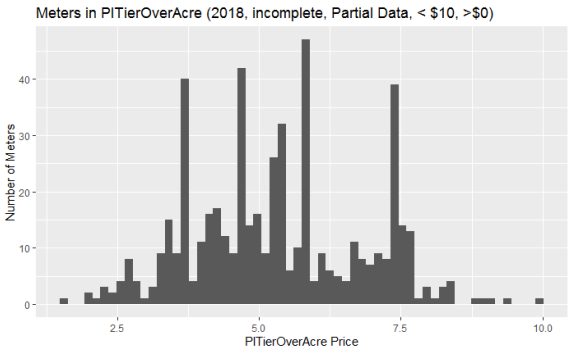

Meters in PITierOverAcre (Partial Data, < $10)
Number of Meters
PITierOverAcre Price

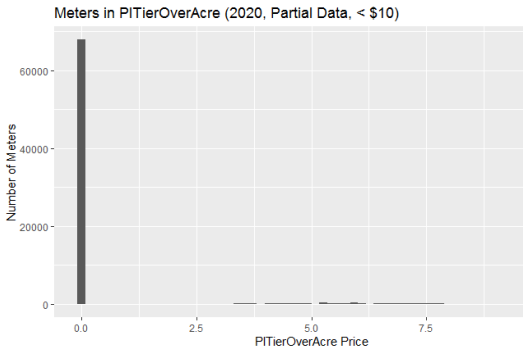

Meters in PITierOverAcre (2021, Partial Data, < $10)
Number of Meters
PITierOverAcre Price

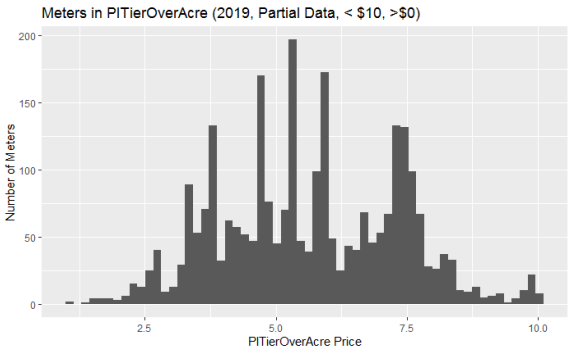

Meters in PITierOverAcre (2018, incomplete, Partial Data, < $10)
Number of Meters
PITierOverAcre Price

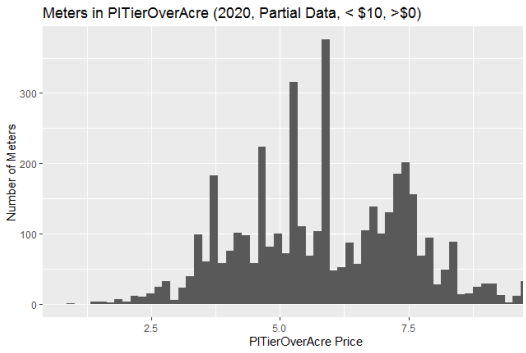

Meters in PITierOverAcre (Partial Data, < $10, >$0)
Number of Meters
PITierOverAcre Price

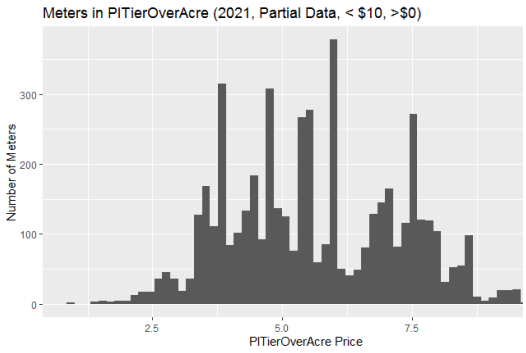

Meters in PITierOverAcre (2019, Partial Data, < $10)
Number of Meters
PITierOverAcre Price

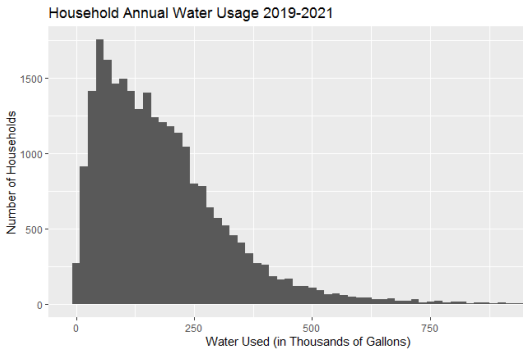

Meters in PITierOverAcre (2018, incomplete, Partial Data, < $10, >$0)
Number of Meters
PITierOverAcre Price


Meters in PITierOverAcre (2020, Partial Data, < $10)
Number of Meters
PITierOverAcre Price


Meters in PITierOverAcre (2019, Partial Data, < $10, >$0)
Number of Meters
PITierOverAcre Price


Meters in PITierOverAcre (2020, Partial Data, < $10, >$0)
Number of Meters
300
200
100
0
2.5
5.0
7.5
PITierOverAcre Price


Meters in PITierOverAcre (2021, Partial Data, < $10, >$0)
Number of Meters
300
200
100
0
2.5
5.0
7.5
PITierOverAcre Price


Household Annual Water Usage 2019-2021
Number of Households
1500
1000
500
0
0
250
500
750
Water Used (in Thousands of Gallons)