

HGSD Water Conservation Evaluation Report

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Table of Contents

1 Executive Summary iv

1.1 Study Objectives iv

1.2 Methodology v

1.3 H_2O Labs! Findings and Recommendations vii

Process Evaluation vii

Water Savings vii

Recommendations viii

1.4 WaterMyYard Findings and Recommendations ix

Process Evaluation ix

Savings Analysis ix

Recommendations x

1.5 SmarterAboutWater Findings and Recommendations xi

Process Evaluation xi

Savings Analysis xi

Recommendations xii

1.6 Grants Program Findings and Recommendations xiii

Process Findings xiii

Savings Analysis xiii

Recommendations xiv

1.7 Program Savings Totals xvi

2 H2O Labs! 17

2.1 Evaluation Overview 17

Program Overview 17

Evaluation Objectives 17

2.2 Evaluation Methodology 18

Process Evaluation 18

Savings Assessment 18

2.3 Program Process Findings 19
Teacher Activities 19
Student Survey 23
Parent Survey (New) 25
Other Activities 26
2.4 Water Measure Savings Analysis 27
Toilet Flapper and Leak Detector Tablets 27
Toilet Tank Water Displacement Bag 29
Toilet Fill Cycle Diverter 31
Bathroom Faucet Aerators 34
Shower Timer 36
Outdoor Sprinkler Gauge 39
2.5 Summary of Installed Per-Unit Savings 42
2.6 2025-2026 School Year Savings 42
2.7 Possible Measures and Behaviors for Additional Savings 44
2.8 Recommendations Summary 47
3 WaterMyYard 48
3.1 Program Overview 48
3.2 Evaluation Objectives 48
3.3 Data Collection Methodology 48
3.4 Key Findings 49
3.5 Savings Analysis 51
3.5.1 Savings Correlation to Participation 55
3.6 Recommendations 56
4 SmarterAboutWater 58
4.1 Program Overview 58
4.2 Evaluation Objectives 58
4.3 Website Review and Data Collection 58
4.4 Insights and Considerations 59

4.5 Measure and Behavior Savings Analysis 60
4.5.1 Residential Measure/Behavior Savings Estimates 61
4.6 Recommendations 62
5 Grant Program 63
5.1 Program Overview 63
5.2 Evaluation Objectives 63
5.3 Data Collection 63
5.4 Smart Irrigation Findings and Results 63
5.4.1 Savings Methodology 63
5.4.2 Teranova West MUD 65
5.4.3 City of West University Place 69
5.4.4 KISD Centralized Irrigation Control 72
5.4.5 CCISD Centralized Irrigation Control 75
5.5 Leak Detection Findings and Results 78
5.5.1 Utilis Satellite Water Loss Location for League City 78
5.5.2 Harris County Fresh Water Supply District 79
5.6 AMI Findings and Results 81
5.6.1 City of Friendswood 81
5.6.2 City of Galveston 83
5.6.3 City of Webster 86
5.7 Showerhead Water Savings Results 88
5.7.1 Harris County MUD 88
5.8 Grant Program Savings Overview 88
5.9 Recommendations 90
5.10 Citation 91

1 Executive Summary

1.1 Study Objectives

The Harris-Galveston Subsidence District (HGSD) Water Conservation Program includes the following initiatives:

1. **A school education program entitled "H_2O Lab! School Program."** Includes water conservation education to primary-grade level students through customized lesson plans and a water conservation take-home demonstration kit.
2. **An outdoor irrigation efficiency campaign entitled "Water My Yard."** Offers free lawn watering recommendations for any user who subscribes for notifications through either email or mobile application.
3. **An online resources channel entitled "SmarterAboutWater".** Provides a "one-stop-shop" for online resources related to water efficiency. The website provides resources and guidance for local water managers, businesses, and the general public on effective water efficiency measures and tools.
4. **A Water Conservation Grant Program.** Supports projects that implement water conservation measures or promote water efficiency by providing up to 50% reimbursement on total project costs. Grant applications are accepted year-round.

Resource Innovations evaluated each initiative to determine the potential impact of the program on the total water savings within HGSD.

The objectives of this evaluation were to:

1. Inform and assess opportunities for improving the design and delivery of each of the programs individually.
2. Investigate opportunities to determine the contribution to savings from each of the programs individually.
3. Determine the potential impact of each program on the total water savings within HGSD.

The evaluation of all programs was completed in 2026. The evaluation for H_2O labs was completed in June 2026 to provide findings to benefit the upcoming school year. The WaterMyYard survey was sent out to subscribers on July 2nd, 2026, and closed on July 15th, 2026. The SmarterAboutWater survey was published to the program website on May 28th, 2026, and was removed on July 15th, 2026. Grant recipients were interviewed primarily in June and July.

1.2 Methodology

The evaluation began with staff interviews with those knowledgeable about the HGSD program offerings to help solidify the evaluation methodologies for each program. Each had different participant groups reached by different methods and the manner of participation also differed greatly. The evaluation rested on a series of program staff interviews, participant surveys, in-depth interviews, benchmarking analysis, data review, engineering analysis, and regression analysis. Table 1-1 summarizes the evaluation objectives, the data source, sampling, and approach.

Table 1-1: HGSD Program Evaluation Methodologies

Evaluation Activity/ Objective	Data Source	Data Collection Type	Sample/ Coverage	Analysis Approach
		H_2O Labs		
Obtain background context on the program	Implementer interview	Primary	Program implementers	Qualitative analysis of interview transcripts
Review program documentation and existing survey instruments	Existing program materials and survey instruments	Secondary	2024-2025 report, student survey instrument, student survey responses, teacher evaluation survey	Qualitative review of materials to identify strengths and possible improvements
Update measure level savings calculations	Publicly available or modified algorithms	Secondary	2025-2026 Student response data; publicly available data	Engineering review
		WaterMyYard		
Interview with Texas A&M program administrator	Interview	Primary	Program team	Qualitative review
Assess how the WaterMyYard app changed subscribers' watering behavior and program satisfaction	Online survey	Primary	Sent to all program subscribers in the greater Houston area; evaluated 488 of 618 responses received	Descriptive statistics, qualitative analysis

Evaluation Activity/ Objective	Data Source	Data Collection Type	Sample/ Coverage	Analysis Approach
Ascertain average weekly minutes reduction in watering behavior to determine annual savings by sprinkler type and overall	Online survey	Primary	Sent to all program subscribers in the greater Houston area; evaluated 488 of 618 responses received	Savings analysis on pre-post weekly watering
		SmarterAboutWater		
Review resource metrics	Key metrics from the online resource pages	Secondary	n/a	n/a – insufficient website traffic
Assess behavior-change actions explored in the online resources	Online anonymous survey	Primary	7 responses	Savings analysis, descriptive statistics, qualitative analysis
Determine average savings by measure type	Engineering review	Secondary	n/a	Engineering analysis and create of calculator
		Grant Program		
Obtain baseline understanding of each project scope and savings	Document reviews	Primary	Census	Document and data review
Process and impact interviews with Grant recipients	In-depth Interview	Primary	4 complete	Qualitative analysis
Quantify annual savings for each project	Data from HGSD or Grantee	Primary	Census	Engineering and regression analysis

1.3 H_2O Labs! Findings and Recommendations

Process Evaluation

We sought to evaluate the methods and instruments used by Tinker in their program evaluation. Specifically, we evaluated the existing teacher survey, teacher advisory group activity, and the student survey and suggested other activities that could supplement the current evaluation process.

The teacher advisory group and survey activities and the student survey were strong in that the surveys were relatively quick to complete, and they had good coverage of different themes and topic areas. The teacher advisory group activity allows teachers the opportunity to elaborate on their thoughts and influence program direction. The student survey is also useful as it reminds students of actions they can take to conserve water.

Capturing perspectives from a more diverse sample of teachers would be beneficial. This would ensure that all recommendations derived from the evaluation are applicable to all schools in the district. The teacher and the student survey instruments would benefit from additional questions that aim to capture more perspectives and context about their experience with the program. We also recommend the addition of a parent survey to the evaluation process. This would be useful for corroborating student findings and would allow for a condensed version of the student survey as some topics that are currently in the student survey (e.g., installation) would be better suited to parent respondents.

Additional evaluation activities were suggested and described in the program chapter. Overall, the suggested activities are in line with increasing educational opportunities, determining the most effective way to teach students about water conservation, enhance program participation, and ensuring a representative sample of the school districts in future evaluations.

Water Savings

Water savings calculation methodologies for each kit measure included in the 2024-2025 Tinker report were reviewed and updated using primary survey data where possible and publicly available data. A savings analysis calculator was provided to update inputs in future program years. The 2025-2026 school year boasted 31,291 participating students which resulted in an evaluated savings of over 309 million gallons of water saved annually. The per-unit measure savings with and without in-service rate (ISR, which means the percentage of measures that were installed or in use), as well as the annual water savings for the program are shown in Table 1-2 below.

Table 1-2: Per-Unit Water Savings Values for the 2025-2026 School Year

Measure	Per Unit Savings (Not Including ISR) (gal/yr)	Per Unit Savings (Including ISR) (gal/yr)	Annual Savings (gal/yr)
Toilet Tank Water Displacement Bag	1,438	1,002	31,354,357
Toilet Leak Detector Tablets + Toilet Flapper	10,512	3,113	97,402,308
Bathroom Faucet Aerator #1	789	383	11,977,995
Bathroom Faucet Aerator #2	789	332	10,374,862
Shower Timer	6,353	4,251	133,003,462
Outdoor Sprinkler Gauge	1,635	824	25,790,761
Total	**N/A**	**N/A**	**309,903,745**

Recommendations

The following recommendations were derived from evaluation activities:

Recommendation 1: Updates are recommended to student and teacher surveys to be able to evaluate the program in greater depth and obtain actionable insights.

Recommendation 2: We recommend the addition of a parent survey in the evaluation activities to corroborate student survey findings.

Recommendation 3: Incorporate updated savings algorithms and apply primary survey data for installation rates and any other variables possible (e.g. number of people per home).

Recommendation 4: We recommend consideration of the inclusion of additional measures, particularly the multi-pattern spray nozzle, and behavior tracking, particularly faucet shutoff while brushing teeth and washing dishes, to capture more water savings program-wide.

Recommendation 5: Other proposed activities may be considered as optional additions to the implementation of the program to evaluate program impacts and effectiveness in greater depth. The suggested activities are in line with increasing educational opportunities, determining the most effective way to teach students about water conservation, enhance program participation, and ensuring a representative sample of the school districts in future evaluations.

1.4 WaterMyYard Findings and Recommendations

Process Evaluation

Respondents are largely satisfied with the WaterMyYard program. WaterMyYard users are diverse, with differing yard sizes and sprinkler systems. Most respondents are using WaterMyYard for assistance with watering their yards that consist mostly of grass, and some garden beds. 85% of respondents reported that the program changed the way they irrigate their yard, with 66% of respondents interacting with the program once a week. Of note, most respondents are interacting with the program through email notifications, as opposed to using the program app.

Savings Analysis

To determine the impact of the program information on subscribers' watering behavior, survey respondents were asked on average, how many times per week did they water and for how long in duration each watering, before using the program and after using the program. After analyzing the data individually to determine if the participant's response provided a comprehensive overview of usage, 488 responses evaluated to determine program-wide water use data. Overall, the pre- and post-program usage behavior averaged to the results shown in Table 1-3, and resulted in an overall average reduction in weekly watering of 40-minutes.

Table 1-3 Average Pre- and Post-Watering Behavior

Variable	Average Pre-Program	Average Post-Program
Watering Sessions per Week (Days)	3	2
Watering Length per Session (Minutes)	34	33
Total Minutes per Week	114	74

To illustrate the approximate water savings achieved by the WaterMyYard program it is necessary to assign a flow rate to each sprinkler type, then extrapolate to the number of weeks irrigation occurs, and the total population of program subscribers. For this analysis, 26 weeks was assumed as the irrigation season for the spring and summer months, and the population is the 6,100 subscribers supported by HGSD's sponsored weather stations. The proportion of each sprinkler head type from the survey was applied to the population of 6,100. Drip irrigation, hose-ended sprinklers, and other were assumed to have a flow rate of 4 gal/min, whereas spray, rotor, and multi-stream were assumed to use 13 gal/min. Table 1-4 shows the average minutes saved by sprinkler type, along with gallons per minute, population estimate for each sprinkler type, and the corresponding total gallons saved.

Given these estimated extrapolations, the WaterMyYard program saves nearly 66 million gallons of water each year.

Table 1-4: Savings Extrapolation Estimate

Sprinkler Type	Average Watering Time Reduction (Min/Home/Wk)	Assumed Flow Rate (Gal/Min)	Survey Proportion	Population Estimate	Annual Savings (Gal)
Drip	49.4	4	1%	63	321,100
Spray	30.6	13	47%	2,888	29,858,075
Rotor	47.4	13	20%	1,238	19,819,475
Multi-stream	40.9	13	13%	763	10,530,813
Hose-ended sprinklers	42.1	4	15%	925	4,053,725
Other	47.5	4	4%	225	1,112,150
	Total		**100%**	**6,100**	**65,695,338**

Recommendations

Recommendation 1: On average overall, the program appears to induce a reduction of weekly watering time of about 40 minutes, and collectively results in potentially 66 million gallons saved annually. Consider utilizing the information provided about the average and spread of minutes saved per week to entice additional subscribers and increase visibility to the program.

Recommendation 2: It is worth exploring whether the "adjust rainfall" tool can be integrated into the program beyond the app. Most respondents do not interact with the app, and many respondents reported that they thought that the rainfall in their area was not accurately captured.

Recommendation 3: If the intention is for the app to be the main delivery source of the program, additional marketing of the app may be warranted. Primarily, any features that are added to the app should be advertised in email correspondence to build awareness of the value of the app. With that being said, most respondents are using email notifications, and most respondents are either very satisfied or somewhat satisfied with the program in its current form.

Recommendation 4: In the open-text response, it became apparent that program participants would appreciate more tailored recommendations and may be willing to input additional information manually into the app in order to receive more specific

recommendations (e.g., manually adjust rainfall, input projected rainfall for the following week, add more descriptors about their yard). It is worth investigating the possibility of making the app more customizable, or highlighting through education the existing capabilities.

1.5 SmarterAboutWater Findings and Recommendations

Process Evaluation

There was insufficient website traffic volume to be able to evaluate key resource metrics. A longer time horizon to assess these metrics, or additional marketing to increase traffic to the website, may be required for future evaluations.

The survey sample was also limited, but the preliminary findings suggest that word-of-mouth or conference/events are important strategies for people to learn about the program. Most respondents found what they were looking for on the website and note that the resources prompted them to take an action. A larger sample would allow for a more in-depth understanding of who the website users are, what they come to the website for, and what the most useful resources are. This would allow for tailored marketing of the website and would be informative for future resource development.

Savings Analysis

In order to provide an assessment of the potential savings impact of the website information on water savings in the region, an average per home savings were calculated and then a conservative adoption rate applied and extrapolated to the average number of people shown to visit the "Homeowner Resources" page annually (approximately 625 people). Table 1-5 shows the residential measure full savings per home that may undertake the action, the adoption rate, and the resulting savings when extrapolated to the website visitors. The result is potentially over half a million gallons of water saved per year.

Table 1-5: Estimated Average Annual Savings Due to SAW Website Information - Residential

Measure/Behavior	Full Possible Savings per Home (gal)	Adoption Assumption %	Savings Estimate (gal)
Early/Late Outdoor Watering	3,315	1%	20,719
Outdoor Leak Detection + Repair	51,840	0.1%	32,400

Measure/Behavior	Full Possible Savings per Home (gal)	Adoption Assumption %	Savings Estimate (gal)
Indoor Leak Detection + Repair	26,280	0.1%	16,425
Native Plants	1,345	2%	16,813
Pool Cover	3,505	1%	21,906
Avoid Excess Dishwasher Use	317	2%	3,963
Avoid Excess Laundry Use	1,612	2%	20,150
Reduce Shower Time	4,390	2%	54,875
Turn Off Faucets While Brushing Teeth	7,139	2%	89,238
Turn Off Faucets While Washing Dishes	5,475	2%	68,438
Install Low-Flow Showerhead	2,578	2%	32,225
Install Low-Flow Sink Aerator	488	2%	6,100
Install High-Efficient Toilet	11,304	2%	141,300
Total			**545,550**

Recommendations

Recommendation 1: Consider re-running the online survey again for a longer period of time while increasing marketing to bring more traffic to the website. A sufficient response size could help program staff understand which measure suggestions are being adopted most often, and could use that data for updated annual savings analysis.

Recommendation 2: Utilize the savings calculator and update inputs as they become available.

Recommendation 3: Indications suggest that people find the website helpful and engaging, so additional efforts to gain traffic will likely result in additional savings. HGSD staff already do a lot to promote the website via social media and in-person events. Perhaps consider reaching out to other organizations to include additional SAW marketing.

1.6 Grants Program Findings and Recommendations

Process Findings

Process evaluation findings are based on just the four interviews completed, but generally grant recipients found the application process reasonable, and enjoyed working with HGSD on their projects. In some cases, the grant allowed the project to move forward, while in other cases, it helped the project be completed sooner or helped the financial situation of the project overall.

Savings Analysis

The grant projects varied in the amount of savings achieved. Overall, many projects produced savings validated through engineering or regression analysis, or weather and rainfall normalization of consumption data. The nature of many projects occurring within half a decade meant that project documentation was not always complete, and repeated attempts to interview someone affiliated with the project were not always successful. Ultimately, four of ten grant projects completed an interview. Another challenge was the granularity of data, or lack thereof. For large, city-wide or school district-wide systems, without devoted metering for the treated end-use, finding the savings was not always possible. Lastly, the long time horizons often meant changes to either the project itself or the functioning of the jurisdiction, such as adding additional irrigated acreage over the years. Table 1-6 shows the savings summary of the seven non-AMI projects, showing a combined annual savings of 46 million gallons.

Table 1-6. Grant Project Savings Summary (Non-AMI projects)

Project Name	Annual Savings (Gal)
Terranova West MUD (TWMUD)	4,662,036
Harris County MUD 50 (HCMUD 50)	1,089,918
Harris County Fresh Water Supply District 1A	0
City of League City	33,799,000
CCISD Centralized Irrigation Control	944,313
KISD Centralized Irrigation Control*	2,105,323
City of West University Place (COWUP)	3,412,026
Total	**46,012,616**

*Note, not an annual value, and based on just 4 months of available data.

The three AMI projects were unfortunately not able to be interviewed and thus the pre- and post-project consumption data could not be discussed with the Grantees. In all cases, the usage appeared to increase. The evaluation team does not believe that the implementation of AMI technology inherently increases usage, but likely is witnessing a case of greater accuracy of measurement. Table 1-7 shows the increases in annual usage observed.

Table 1-7. AMI Project Annual Usage Observed Change

AMI Projects	Increase in Annual Usage (Gal)
City of Galveston	117,709,704
City of Webster	258,302,550
City of Friendswood	16,096,367

Recommendations

Recommendation 1: Require monthly usage of all included systems. Partial year data does not provide the full picture of project impacts. Anywhere possible, also require end-use specific metering (such as irrigation only, not whole property).

Recommendation 2: Track and save local Evapotranspiration values. These analyses used evapotranspiration values to adjust the smart irrigation system's raw usage to reflect the usage of a year with average weather conditions. To this end, we used the Turc equation to estimate the reference evapotranspiration value. The Turc equation is convenient as it can be calculated using common weather metrics. However, the value calculated from the Penman-Monteith equation would be more robust and offer more accurate results.

Therefore, it would be useful for future analyses to use the Penman-Monteith equation to calculate and save the reference Evapotranspiration for the local area.

Recommendation 3: Require recipients to report irrigated square footage changes. Multiple grant recipients expanded their irrigated area after or shortly before their new system was installed. This complicated the results as it was difficult to sperate how changes in their usage were due to the new system or the expansion of the irrigation area. However, future analysis can account for this by comparing the water usage per square foot pre and post project. Therefore, we recommend asking recipients to report the pre and post irrigated square footage if they expand their irrigation system.

Recommendation 4: Have recipients report system relocations. One of the grant recipients reduced their irrigation area by replacing a field with turf. As a result, they relocated irrigation network controllers to new sites. The full story around this was not known until this evaluation effort interviewed the site manager. It is possible that such relocation will occur again in the future. Therefore, we recommend asking recipients to report any major changes to their system.

Recommendation 5: Evaluate behavior programs at an individual level. Part of the AMI rollout often included customer portals, education programs, and water saving incentive programs. These initiatives may have effectively reduced customer water usage in ways that are not immediately noticeable in the total population usage data because the population is affected by many other factors such as weather. Therefore, we recommend evaluating these programs individually via randomized treatment and control groups.

Recommendation 6: Account for changes in sensor accuracy. A potential confounding factor in AMI based analysis is the sensors and infrastructure used to measure usage changed before and after the project. This may cause a mirage where false savings or losses may appear in the data because of different sensor accuracy instead of actual changes in usage. Future analysis should account for these differences by either trying to directly measure the accuracy of the pre-post system or find studies estimating the accuracy direct of the previous equipment.

Recommendation 7: Begin analysis with raw billing data. The COF water project included data that spiked every other month. This is likely the result of billing cycles beginning and ending in different months. Future analysis can account for bill cycles by calendarizing the data, i.e. using bills to estimate the monthly usage instead. However, this process requires using raw billing data. Therefore, we recommend starting analysis with the raw billing data instead of data that has already been aggregated to monthly level, if available.

Recommendation 8: Evaluate leak effects at individual/localized level. The current analysis evaluates the impact of leak detection and repair at the population level. However,

population usage is affected by factors such as weather. Therefore, future analysis should use best practices to determine water loss for each individual leak or evaluate usage data on a more localized scale.

1.7 Program Savings Totals

The savings produced by the four evaluated programs have varying degrees of certainty, but overall, the programs appear to save over 422 million gallons of water per year.

Table 1-8. Annual Estimated Savings Due to HGSD Programs

Program	Annual Gallons
H2O Labs!	309,903,745
SmarterAboutWater	524,550
WaterMyYard	65,695,338
Grants	46,012,616
Total	**422,136,249**

2 H2O Labs!

2.1 Evaluation Overview

Program Overview

The Harris-Galveston Subsidence District (District) developed a water conservation school program named H_2O Lab! to teach students about subsidence, groundwater, and water conservation through locally tailored curriculum aligned with Texas Essential Knowledge and Skills (TEKS) and Next Generation Science Standards (NGSS). Program components include hands-on STEM activities, digital resources, student contests, teacher mini-grants, and take-home Water Conservation Kits to engage families. Program objectives include the following:

- Leverage classroom teachers from schools within the District jurisdiction (Harris and Galveston counties) to provide their 3rd–6th grade students with quality, age-appropriate instruction regarding subsidence and water conservation.
- Provide effective education about subsidence as an impact of excessive groundwater withdrawal and the importance of saving water.
- Encourage water conservation at home by engaging students and their families in activities that support and reinforce water conservation concepts.
- Provide age-appropriate tools to facilitate student participation and incentives to encourage follow-through for all program participants.
- Support the District's mission as a trusted source of water conservation tools and resources.
- Maintain or enhance the District customer satisfaction.

This program is offered annually and is currently administered to local schools by Tinker, LLC (Tinker) through the support of District sponsorships.

Evaluation Objectives

The school program has been evaluated in the past by the implementer. Upon discussion with Tinker, it was determined that specific assistance is required for recommendations on savings methodologies and updated savings values to capture water savings based on program modifications, such as student survey results. The evaluation seeks to provide suggestions for updating the methodologies as well as provide updated savings analyses for the 2024-2025 program year. The evaluation will also review the data collection instruments, responses, and results outlined in the Tinker report. Tinker agreed to provide

the raw student survey responses for the analysis, which were used to estimate updated savings values per measure.

The objectives of this evaluation are as follows:

- Interview the program implementer to obtain background context and explore areas of greatest need to focus evaluation activities.
- Review program documentation, including the 2024-2025 report, the student survey instrument, and student survey responses. See Section 2.3 Program Process Findings.
- Update measure level savings calculations, utilizing student response data where possible and supplementing with publicly available data elsewhere. See Section 2.4 Measure Savings Analysis.
- Assess best practices and savings benchmarking. See Section 2.3 Program Process Findings.
- Provide conclusions and recommendations for program enhancement. See Section 2.8 Recommendations Summary.

2.2 Evaluation Methodology

Process Evaluation

Based on experience with other school programs and their best practices, recommendations for process evaluation improvements were assessed. The following elements were considered:

1. Best practices for survey question design
2. Best practices for interview question design
3. Other activities that could supplement traditional survey and interview methodology to provide additional insight into program improvements and capture water savings

The resulting recommendations are broken out into activity types: 1) Teacher Activities; 2) Student Survey; 3) Parent Survey; and 4) Other Activities.

Savings Assessment

Water savings calculation methodologies for each kit measure included in the 2024-2025 Tinker report were reviewed and updated. Per-unit water savings values for each kit measure have been calculated, which can be multiplied by future program participation and in-service rates to determine overall per-measure and program-level water savings. The following elements were considered:

1. Water savings algorithm adjustments, if needed;
2. Variable definitions based on the most up-to-date student survey data, reference manuals, product specifications, or online resources
    a. A copy of the Water Savings Calculator has been provided in which program-specific values obtained from more recent survey data can be used to overwrite researched values for more accurate calculation of program impact;
3. Consideration of additional survey questions or survey specificity needed to obtain the required information to ensure calculation accuracy.

Furthermore, recommendations for additional kit measures and water conservation behavior tracking have been provided, along with a summary of per-unit water savings values and recommended survey questions for each new measure or behavior.

2.3 Program Process Findings

The following sections highlight findings from the assessment of the H_2O Lab! process evaluation. Improvements are suggested to collect more data and more information that could strengthen process and program improvement findings. This section will discuss 1) teacher activities, 2) student survey, 3) parent survey, and 4) other activities.

Teacher Activities

The current program assessment includes the following teacher activities: 1) teacher evaluation survey, and 2) Teacher advisory group focus group.

Teacher Evaluation Survey

The teacher evaluation survey includes questions covering the following:

1. Teacher satisfaction with the program
2. Alignment with education standards
3. Ease of use of content and lessons
4. Experience with program staff
5. Student satisfaction with the program
6. Future participation
7. Likelihood of recommending the program to colleagues

Teacher Advisory Group

The Teacher advisory group was a comprehensive teacher focus group that was held in-person at the District office to guide program improvements for the 2024-2025 year. The

meeting provided teachers with the opportunity to help shape both the classroom experience, and the broader program structure. Eleven educators participated in the three-hour focus group session in May 2025.

Strengths

The following are strengths of the teacher evaluation activities:

1. The survey is short in length and quick to answer.
2. Good coverage of satisfaction, instructional materials provided, experience with the program staff, perceptions of student experience with the program, and future opportunities.
3. Teacher advisory group allowed some teachers the opportunity to elaborate on their thoughts on the program and influence the future of the program.

Suggested Improvements

To improve the Teacher advisory group activity, it is important to ensure that the teacher participation ranges across various schools in different geographic areas in the District. Students in different areas, such as low-income neighborhoods vs. higher income neighborhoods, or areas with more Spanish speakers, for example, might need something different from the program to be impactful. For this reason, it is important to ensure that all of these perspectives be represented at the teacher focus group so that the needs of various types of students are represented in program updates.

A more in-depth teacher survey would also help to ensure that all perspectives are considered. Table 2-1 highlights some suggested additions to the survey to make the findings more actionable.

Table 2-1: Suggested Improvements for the Existing Teacher Survey

Existing Survey Question	Improvement Suggested	Purpose
Q: Overall how satisfied were you with the program? A: Rating between 1 and 5 stars	Leave the question as is but include follow-up questions. What did the teacher like about the program? What did they not like?	Understanding what teachers enjoyed and did not enjoy provides useful feedback for updating the program in the future – which aspects should be kept? Which aspects could be changed?

Existing Survey Question	Improvement Suggested	Purpose
Q: Overall how satisfied were your students with the program? A: Rating between 1 and 5 stars	Leave the question as is but include follow-up questions. What did the teacher perceive the students liked about the program? What did they not like?	Understanding what teachers thought students enjoyed and did not enjoy provides useful feedback for updating the program in the future – which aspects should be kept? Which aspects could be changed?
Q: Were the online content and lessons easy to use? A: Yes/No	Ask which online content they used and provide a multiple choice that outlines all the options of material that they could have used. Then, ask them to rate on a scale from not clear at all to very clear, the clarity of the material. For those that they rated as not clear, ask a follow up to assess what was unclear.	Providing options helps with recognition of what they used. "Easy" is a value-loaded word. Having the option of "yes" may lead to teachers selecting yes because they think it should be easy. The rating scale on clarity allows more nuance and allows for the possibility that the material itself could be the issue, not the teacher. Asking a follow-up question about what may not have been as clear allows for actionable improvements.
Q: Was the program staff knowledgeable and courteous? A: Yes/No	Ask if they had interactions with program staff first. Then, ask them to rate the knowledge and courteousness of the staff separately on a scale. For those who rated the program staff as not too knowledgeable or not too courteous, ask a follow-up for more information.	Asking about knowledge and courteousness separately ensures that the evaluator knows exactly which component of the question the respondent is responding to. The rating scale allows more nuance and allows for the possibility that there were smaller issues that would not have come up with only the options of yes or no. Asking a follow-up question to explain the response allows for actionable improvements.

Based on best practices from other school evaluations that we have recently conducted, we also recommend additions to the existing teacher evaluation survey (see Table 2-2).

Table 2-2: Teacher Evaluation Survey Suggested Additions

Types of Questions to Include	Purpose
Assess the success of the outreach component of the program. Who reached out to the teacher to participate? What messages were provided during outreach that encouraged them to participate? Were they satisfied with these communications?	This would help to understand which messaging is useful in outreach and how outreach could be improved to increase participation.
Questions about what program components (e.g., hands-on STEM activities, digital resources, student contests, teacher mini-grants, take-home kit) were the most motivational for teachers to participate.	Understanding what motivated teachers to participate provides useful insight for which aspects should be kept, what should be changed, and what should be emphasized in program marketing.
Questions about what program components (e.g., hands-on STEM activities, digital resources, student contests, take-home kit) kept the students most engaged.	Understanding teacher perceptions of what components of the program kept students engaged provides useful insight for which aspects should be kept, and what should be changed.
Teacher feelings towards the incentives offered to teachers to encourage participation. What do they think of the incentive model? Is the incentive high enough? How could the incentive model be improved?	Understanding teachers' perspectives on the incentive structure of the program provides useful insight into which incentive structure would be most motivational for teachers to keep participating in the program. It will also be important to assess whether these incentives are realistic for the teachers to achieve.
Questions to assess the in-person presentation component of the program. Were student engagement and comprehension enhanced by this option?	The existing evaluation material does not assess satisfaction or engagement with the in-person presentation component of the program.
Questions that assess whether teachers are satisfied with the structure of the program being teacher-led. Do they have time for all the components? How do they fit the program into their existing curriculum?	Our evaluations of other education in schools' programs highlight that teachers are often too busy to incorporate programs as the program staff intended into their curriculums and day-to-day. It would be interesting to survey teachers who may have said no to participating in the program as well to understand if this may have been the component that held them back from participating in the program.

Student Survey

The current student survey covers general questions on program enjoyment, ease of use of online content, kit measure installation, general questions about the home, and water conservation actions undertaken at home. For the most part, the questions require simple yes/no responses. The purpose of the survey is to capture general satisfaction with the program, and to assess installation rates of measures in the home after the program occurred. These inputs are used to determine program improvements and potential water savings from kit measure installations.

Strengths

The following are strengths of the student survey:

1. Relatively short in length
2. Simply worded questions ideal for young children
3. Good coverage of satisfaction, measure-specific, and water conservation questions
4. Serves as a reminder of possible water conservation actions that the student could take

Suggested Improvements

Table 2-3 highlights areas where the student survey could be updated to get actionable insights into program improvement.

Table 2-3: Suggested Improvements for the Student Survey

Existing Survey Question	Improvement Suggested	Purpose
Q: Did you enjoy the program? A: Rating between 1 and 5 stars	Leave the question as is but include follow-up questions for older students. What did the student like about the program? What did they not like?	Understanding what older students enjoyed and did not enjoy provides useful feedback for updating the program in the future – which aspects should be kept? Which aspects could be changed? Younger students may not be able to articulate as well what components they enjoyed.
Q: Was the online content easy to use? A: Yes/No	Ask which online content they used and provide a multiple choice that outlines all the	Providing options helps younger students with recognition of what they used.

Existing Survey Question	Improvement Suggested	Purpose
	options of material that they could have used. Then, ask them to rate on a scale from not clear at all to very clear, the clarity of the material. For older students that rated some content as not clear, ask a follow up to assess what was unclear.	"Easy" is a value-loaded word. Having the option of "yes" may lead to students selecting yes because they think it should be easy. The rating scale on clarity allows more nuance and allows for the possibility that the material itself could be the issue, not the student. Asking a follow-up question about what may not have been as clear allows for actionable improvements.
Q: Were the items in the Water Conservation Kit easy to install or use? A: Yes/No	Ask which measures were installed first, then ask individually if each measure was easy to install. You can then ask separately whether the measures were easy to use and why they selected to install each measure that they installed.	Understanding which measures were installed FIRST and then asking independently which were easy to install, and then easy to use, and why they selected those measures to install, allows for more understanding of which measures might be worth keeping or updating in the kit.
Q: Was your toilet leaking? A: Yes/No	Include a description of what a toilet leak would look like in this context.	This ensures that students remember what signs they would have seen if their toilet really did leak.
Water Conservation Kit installation questions	Include a "Don't know" option or remove the installation questions from the student survey. See new Parent Survey for more information.	It is best practice to include a "Don't know" survey option. It also gives flexibility to students who may not have been part of the installation at home to say that they are not sure as opposed to providing information that could be incorrect. These questions can also be removed in favor of including this battery of questions in the new Parent Survey. Students may not know the answer to these questions.

Parent Survey (New)

In addition to the student survey, we recommend the addition of a parent survey to the program evaluation. Other school kit programs include parent surveys to corroborate the information that students provide in their program feedback, specifically the installation rates. Table 2-4 outlines the types of questions we recommend including in a parent survey, as well as the purpose of including those types of questions.

The parent survey can be accessed with a QR code in the kit that is sent home with the students. To get parents to respond to the survey, we recommend offering a small incentive (about $10-$20) to all respondents, or a small incentive to the first x number[1] of respondents with a chance to win a larger incentive for all the respondents. We also recommend asking teachers to post information about the survey to their classroom pages or to include information about the survey in any emails that get sent to parents.

Table 2-4: Proposed Parent Survey Questions and Purpose

Types of Questions to Include	Purpose
Ask parents about their water conservation behaviors and their children's conservation behaviors prior to and after the program.	By asking about the behavior prior to and after the program, the program can better assess what behavior *changes* occurred because of the program. With that, behavior savings could be attributed to the program.
Assess the following about kit measures: • **Kit measure installation** • **Kit measure use** • **Uninstallation rates** • **Satisfaction with the measures**	This would help corroborate the answers provided by the students or can fully replace the need to ask students about installations. If the students did not know whether something was installed, the parents might be able to fill in those gaps. Install rates, measure use, and uninstallation rates provide helpful inputs to calculate water savings that could be attributed to the program.
Assess the following about the District: • **Perceptions (e.g., trust, awareness)** • **Offerings provided** • **Offerings desired** • **Thoughts on information provided** • **Recommendations for new informational materials** • **General satisfaction**	One of the goals of the District is to understand perceptions of the District and how they can better serve their area to conserve water. This survey provides a great opportunity to ask for feedback about the District.

[1] This number will depend on the sample size and the target for survey completion.

Types of Questions to Include	Purpose
Assess parent usage of online materials. • **What are they using?** • **Are the resources helpful?** • **What resources are missing?** • **What could be improved?**	This type of question battery would help assess areas of improvement for existing materials provided.

Other Activities

Other activities could be conducted to further evaluate the program. Table 2-5 outlines the suggested activity as well as the benefit of conducting that activity.

Table 2-5: Other Activities Suggested and Benefit of Activity

Activity	Benefit of Activity
Compare quiz and test results of students who had the 1) in-person presentation, 2) just the teacher-led option, and 3) students who did not have the program at all on their understanding of the topics covered by the program.	This comparison would allow for an assessment of which aspect of the program, if any, provides the most value in terms of building student knowledge on water conservation. This would help to assess how to best teach students about water conservation, hopefully leading to more water saved across the District.
Offer a video of the in-person presentation offered by the District to teachers who were unable to schedule an in-person presentation.	Since only one staff member at the District provides the in-person presentation, uptake is limited to the availability of that individual. The presentation, and thus, another opportunity to deepen subsidence knowledge, could be made available to more students with a video option. During the pandemic, other school programs had success with including a video component.
Explore options to provide students who had participated in the previous year with a modified version of the program (e.g., instructional material only, a smaller kit, a video, etc.) where students could still learn about changing their behaviors or be reminded for persistence.	Other school programs have been able to attribute more savings to their programs and benefit from changed behaviors by providing a smaller kit to students who were ineligible due to previous participation.
Assess whether the program captures a good representation of the schools in the District overall.	The Tinker report (page 17) highlights school participation across school districts. It would be useful to assess whether the program covers a good representation of schools in the District overall to assess equitable distribution of the program across different factors (e.g., income levels, race, etc.)

Activity	Benefit of Activity
In reporting, Tinker compares the program results with the "national average." These only include programs implemented by Tinker LLC. Expand the benchmark to include other programs outside of Tinker LLC.	This activity would allow for a more in-depth assessment of how the program is performing relative to other implementers. This provides a less biased benchmarking opportunity to more accurately understand the performance of the program. Any weather-related measures should only use the South as a benchmark.

2.4 Water Measure Savings Analysis

The evaluation calculated updated installed per unit values for the following measures:

- Toilet flapper and leak detector tablets
- Toilet tank water displacement bag
- Toilet fill cycle diverter
- Bathroom faucet aerators
- Shower timer
- Outdoor sprinkler gauge

For each measure, the suggested algorithm is presented along with suitable variables with sources listed. When possible, it is always recommended to use primary program derived data. It is important to note that these savings values are calculated for one installed measure, so it is necessary to multiply these per unit savings values by both the number of participants and the installation rate to obtain a program savings value for the measure overall.

Additional measures and behaviors are also included for consideration for future programs.

Toilet Flapper and Leak Detector Tablets

Measure Description

A toilet flapper functions as a valve to stop water flow into the bowl when the toilet is not being flushed. Over time, they can wear out and eventually start leaking water continuously into the toilet bowl. Toilet leak tablets are used by participants to detect water-wasting flapper leaks in their toilets. Ideally, these leaks will be fixed by participants and their families after detection.

Measure Water Savings Algorithm and Parameter Definition

The water-savings algorithm for replacing a toilet flapper is:

$$\Delta\text{Gal} = \#\ \text{Participants} \times \text{Installation Rate} \times \text{Leak Rate} \times 60\frac{\text{Minutes}}{\text{Hour}} \times 24\frac{\text{Hours}}{\text{Day}} \times 365\frac{\text{Days}}{\text{Year}}$$

This algorithm is directly sourced from the District's Water Conservation Kit Recommendations report, by Frontier Associates, authored September 2025. The WaterWise Report in turn sources it's water savings methodologies from the United States Environmental Protection Agency WaterSense website.

A modified version of this algorithm was used to determine per-unit water savings for an individual toilet flapper replacement:

$$\Delta\text{Gal} = \text{Leak Rate} \times 60\frac{\text{Minutes}}{\text{Hour}} \times 24\frac{\text{Hours}}{\text{Day}} \times 365\frac{\text{Days}}{\text{Year}}$$

The modified algorithm removes the total program participation and in-service (or installation) rate multipliers from the equation.

The following inputs were used with the above per-unit water savings algorithm to determine an annual per-unit water savings value for this installed measure of 10,512.0 gallons / unit.

Table 2-6: Toilet Flapper Water Savings Calculation Variable Definitions

Variable	Value	Unit	Description	Source
# Participants	TDB	House-holds	The number of participating households in the program year -or- The number of kits distributed -or- The number of units distributed	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Annual Report
Installation Rate	TBD	%	The percentage of distributed energy efficiency measures actually installed and operational	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Student Survey Data

Variable	Value	Unit	Description	Source
Leak Rate	0.02	Gallons / Minute	The rate of water leakage from a leaking toilet flapper, identified by the toilet leak tablets (value for a small leak used to remain conservative)	EPA WaterSense Water Losses from Leaks in Commercial Buildings[2]
60	60	Minutes / Hour	The number of minutes in an hour	Constant Value
24	24	Hours / Day	The number of hours in a day	Constant Value
365	365	Days / Year	The number of days the toilet is assumed to leak unnoticed / unattended over the course of the year	Constant Value

$$\Delta\text{Gal} = \mathbf{0.02}\,\frac{\textbf{Gallons}}{\textbf{Minute}} \times \mathbf{60}\,\frac{\textbf{Minutes}}{\textbf{Hour}} \times \mathbf{24}\,\frac{\textbf{Hours}}{\textbf{Day}} \times \mathbf{365}\,\frac{\textbf{Days}}{\textbf{Year}} = \mathbf{10,512.0}\,\frac{\textbf{Gallons}}{\textbf{Year}}$$

Toilet Tank Water Displacement Bag

Measure Description

The toilet tank water displacement bag reduces the amount of water consumed per toilet flush by displacing some of the volume of the toilet tank, thereby requiring less water to refill the tank after each flush. It is assumed that savings are only applicable to older toilets (original toilets in homes built before 1992, when low-flow toilets became standardized).

Measure Water Savings Algorithm and Parameter Definition

The water-savings algorithm for a toilet tank water displacement bag is:

$$\Delta\text{Gal} = \#\ \text{Participants} \times \text{Installation Rate} \times \%\text{Homes Pre 1992} \times \text{Household Size} \times \frac{\frac{\#\ \text{Flushes}}{\text{Day} \cdot \text{Person}}}{\frac{\#\ Toilets}{Household}} \times 365\,\frac{\text{Days}}{\text{Year}} \times \frac{\text{Gallons Displaced}}{\text{Flush}}$$

[2] EPA WaterSense Water Losses from Leaks in Commercial Buildings : https://www.epa.gov/watersense/getting-started#:~:text=Potential%20Losses%20From%20Water%20Leaks

This algorithm is directly sourced from the WaterWise Evaluation for Resource Action Programs: WaterWise Report, by Frontier Associates, authored January 2015. The WaterWise Report in turn sources it's water savings methodologies from the United States Environmental Protection Agency WaterSense website.

A modified version of this algorithm was used to determine per-unit water savings for an individual toilet tank water displacement bag:

$$\Delta\text{Gal} = \%\text{Homes Pre 1992} \times \text{Household Size} \times \frac{\frac{\#\ \text{Flushes}}{\text{Day} \cdot \text{Person}}}{\frac{\#\ Toilets}{Household}} \times 365\,\frac{\text{Days}}{\text{Year}} \times \frac{\text{Gallons Displaced}}{\text{Flush}}$$

The modified algorithm removes the total program participation and in-service (or installation) rate multipliers from the equation.

The following inputs were used with the above per-unit water savings algorithm to determine an annual per-unit water savings value for this measure of 986.6 gallons / unit.

Table 2-7: Toilet Tank Water Displacement Bag Water Savings Calculation Variable Definitions

Variable	Value	Unit	Description	Source
# Participants	TBD	Households	The number of participating households in the program year -or- The number of kits distributed -or- The number of units distrubuted	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Annual Report
Installation Rate	TBD	%	The percentage of distributed energy efficiency measures actually installed and operational	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Student Survey Data
% Homes Pre-1992	51.3%	%	The percentage of homes built before the year 1992 that can be assumed to have toilets with higher gallon-per-flush ratings installed	United States Census Bureau: Harris + Galveston Counties, TX, 2024[3]

[3] United States Census Bureau: Harris + Galveston Counties, TX, 2024 : https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48167_160XX00US4835000, https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48201_160XX00US4835000

Variable	Value	Unit	Description	Source
Household Size	3.26	Persons / Household	The number of occupants living in an average household (only households in Harris & Galveston Counties with one or more school-age children considered)	United States Census Bureau: Harris + Galveston Counties, TX, 2024
# Flushes / Person / Day	5	Flushes / Person / Day	The number of times a toilet is flushed by a single person each day	Home Water Works[4]
# Toilets / Home	2.47	Toilets / Household	Average number of bathrooms per household (households in Harris & Galveston Counties considered)	Homes and Rentals: Harris & Galveston Counties, TX Real Estate[5]
365	365	Days / Year	The number of days in a year	Constant Value
Gallons Displaced / Flush	0.8	Gallons / Flush	The amount of water in the toilet refill tank in gallons displaced by the "toilet tummy" water displacement bag, equivalent to the amount of water saved per flush	WaterWise Evaluation for Resource Action Programs: WaterWise Report, Frontier Associates, January 2015
Per-Unit Water Savings Calculation				
$\Delta Gal = 51.3\% \times 3.26 \frac{Persons}{Home} \times \frac{5 \frac{Flushes}{Day \cdot Person}}{2.47 \frac{Toilets}{Household}} \times 365 \frac{Days}{Year} \times 0.8 \frac{Gallons}{Flush} = 986.6 \frac{Gallons}{Year}$				

Toilet Fill Cycle Diverter

Measure Description

A toilet fill cycle diverter saves water by redirecting some of the refill water from the bowl back into the toilet tank during the fill cycle, reducing excess water sent to the bowl. This lowers the amount of water used per flush while still maintaining proper toilet performance.

[4] Home Water Works : https://home-water-works.org/indoor-use/toilets

[5] Homes and Rentals: Harris & Galveston Counties, TX Real Estate : https://www.har.com/galveston-county-tx/realestate/48167, https://www.har.com/harris-county-tx/realestate/48201

Measure Water Savings Algorithm and Parameter Definition

The water-savings algorithm for a toilet fill cycle diverter is:

$$\begin{aligned}\Delta\text{Gal} = \#\ \text{Participants} \times \text{Installation Rate} \\ \times \big(\%\text{Homes Pre 1992} \times (\text{Pre 1992 Baseline Fill Volume} - \text{Pre 1992 Diverted Fill Volume}) \\ + \%\text{Homes Post 1992} \\ \times (\text{Post 1992 Baseline Fill Volume} - \text{Post 1992 Diverted Fill Volume})\big) \times \text{Household Size} \\ \times \frac{\frac{\#\ \text{Flushes}}{\text{Day} \cdot \text{Person}}}{\frac{\#\ Toilets}{Household}} \times 365\,\frac{\text{Days}}{\text{Year}}\end{aligned}$$

This modified algorithm is sourced from the Chadwell Supply Toilet Fill Cycle Diverter Water Savings Calculator which is based on the EPA WaterSense Water Efficiency Management Guide for Bathroom Suite, authored November 2017.

A modified version of this algorithm was used to determine per-unit water savings for an individual toilet fill cycle diverter:

$$\begin{aligned}\Delta\text{Gal} = \big(\%\text{Homes Pre 1992} \times (\text{Pre 1992 Baseline Fill Volume} - \text{Pre 1992 Diverted Fill Volume}) \\ + \%\text{Homes Post 1992} \\ \times (\text{Post 1992 Baseline Fill Volume} - \text{Post 1992 Diverted Fill Volume})\big) \times \text{Household Size} \\ \times \frac{\frac{\#\ \text{Flushes}}{\text{Day} \cdot \text{Person}}}{\frac{\#\ Toilets}{Household}} \times 365\,\frac{\text{Days}}{\text{Year}}\end{aligned}$$

The modified algorithm removes the total program participation and in-service (or installation) rate multipliers from the equation.

The following inputs were used with the above per-unit water savings algorithm to determine an annual per-unit water savings value for this measure of 2,063.4 gallons / unit.

Table 2-8: Toilet Fill Cycle Diverter Water Savings Calculation Variable Definitions

Variable	Value	Unit	Description	Source
# Participants	TBD	Households	The number of participating households in the program year -or- The number of kits distributed -or- The number of units distributed	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Annual Report

Variable	Value	Unit	Description	Source
Installation Rate	TBD	%	The percentage of distributed energy efficiency measures actually installed and operational	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Student Survey Data
% Homes Pre-1992	51.3%	%	The percentage of homes built before the year 1992 that can be assumed to have toilets with higher gallon-per-flush ratings installed	United States Census Bureau: Harris + Galveston Counties, TX, 2024[6]
Pre-1992 Baseline Fill Volume	3.50	Gallons / Flush	The gallons-per-flush rating of an average toilet installed in a house built before the year 1992	EPA WaterSense Water Efficiency Management Guide (Chadwell Supply)[7]
Pre-1992 Diverted Fill Volume	2.33	Gallons / Flush	The adjusted gallons-per-flush rating of an average toilet installed in a house built before the year 1992 with a fill cycle diverter installed, assumed to divert 33% of the fill water	AM Conservation: Fill Cycle Diverter Specification[8]
% Homes Post-1992	48.7%	%	The percentage of homes built after the year 1992 that can be assumed to have toilets with lower gallon-per-flush ratings installed	United States Census Bureau: Harris + Galveston Counties, TX, 2024
Post-1992 Baseline Fill Volume	1.60	Gallons / Flush	The gallons-per-flush rating of an average toilet installed in a house built after the year 1992	EPA WaterSense Water Efficiency Management Guide (Chadwell Supply)
Post-1992 Diverted Fill Volume	1.07	Gallons / Flush	The adjusted gallons-per-flush rating of an average toilet installed in a house built after the year 1992 with a fill cycle diverter installed, assumed to divert 33% of the fill water	AM Conservation: Fill Cycle Diverter Specification

[6] United States Census Bureau: Harris + Galveston Counties, TX, 2024 : https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48167_160XX00US4835000, https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48201_160XX00US4835000

[7] EPA WaterSense Water Efficiency Management Guide (Chadwell Supply) : https://www.chadwellsupply.com/resources/articles/management-insights/water-savings/

[8] AM Conservation: Fill Cycle Diverter Specification: https://amconservation.com/fill-master-fill-cycle-diverter/

Variable	Value	Unit	Description	Source
Household Size	3.26	Persons / Household	The number of occupants living in an average household (only households in Harris & Galveston Counties with one or more school-age children considered)	United States Census Bureau: Harris + Galveston Counties, TX, 2024
# Flushes / Person / Day	5	Flushes / Person / Day	The number of times a toilet is flushed by a single person each day	Home Water Works[9]
# Toilets / Home	2.47	Toilets / Household	Average number of bathrooms per household (households in Harris & Galveston Counties considered)	Homes and Rentals: Harris & Galveston Counties, TX Real Estate[10]
365	365	Days / Year	The number of days in a year	Constant Value
Per-Unit Water Savings Calculation				
$\Delta\text{Gal} = \left(51.3\% \times \left(3.50\,\frac{\text{Gallons}}{\text{Flush}} - 2.33\,\frac{\text{Gallons}}{\text{Flush}}\right) + 48.7\% \times \left(1.60\,\frac{\text{Gallons}}{\text{Flush}} - 1.07\,\frac{\text{Gallons}}{\text{Flush}}\right)\right) \times 3.26\,\frac{\text{Persons}}{\text{Home}} \times \frac{5\ \text{Flushes}}{\frac{\text{Day} \cdot \text{Person}}{2.47\ \text{Toilets}}} \times 365\,\frac{\text{Days}}{\text{Year}} = 2,063.4\,\frac{\text{Gallons}}{\text{Year}}$				

Bathroom Faucet Aerators

Measure Description

Bathroom faucet aerators save water by mixing air into the water stream, which reduces the amount of water flowing through the faucet while maintaining adequate pressure and usability. This lowers hot water use and the energy needed to heat it, helping reduce both water and utility costs.

Measure Water Savings Algorithm and Parameter Definition

The water-savings algorithm for a bathroom faucet aerator is:

[9] Home Water Works : https://home-water-works.org/indoor-use/toilets

[10] Homes and Rentals: Harris & Galveston Counties, TX Real Estate : https://www.har.com/galveston-county-tx/realestate/48167, https://www.har.com/harris-county-tx/realestate/48201

$$\Delta Gal = \#\ Participants \times Installation\ Rate \times \frac{\frac{Use\ Time}{Person} \times Household\ Size \times (Baseline\ Aerator\ Flow\ Rate - Retrofit\ Aerator\ Flow\ Rate)}{\frac{\#\ Bathroom\ Faucets}{Home}} \times 365 \frac{Days}{Year}$$

This algorithm is directly sourced from the WaterWise Evaluation for Resource Action Programs: WaterWise Report, by Frontier Associates, authored January 2015. The WaterWise Report in turn sources it's water savings methodologies from the United States Environmental Protection Agency WaterSense website.

A modified version of this algorithm was used to determine per-unit water savings for an individual bathroom faucet aerator:

$$\Delta Gal = \frac{\frac{Use\ Time}{Person} \times Household\ Size \times (Baseline\ Aerator\ Flow\ Rate - Retrofit\ Aerator\ Flow\ Rate)}{\frac{\#\ Bathroom\ Faucets}{Home}} \times 365 \frac{Days}{Year}$$

The modified algorithm removes the total program participation and in-service (or installation) rate multipliers from the equation.

The following inputs were used with the above per-unit water savings algorithm to determine an annual per-unit water savings value for this measure of 487.7 gallons / unit.

Table 2-9: Bathroom Faucet Aerator Water Savings Calculation Variable Definitions

Variable	Value	Unit	Description	Source
# Participants	TBD	Households	The number of participating households in the program year -or- The number of kits distributed -or- The number of units distributed	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Annual Report
Installation Rate	TBD	%	The percentage of distributed energy efficiency measures actually installed and operational	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Student Survey Data

Variable	Value	Unit	Description	Source
Use Time / Person	2.34	Minutes / Person / Day	The amount of time each person in the home uses the faucet each day	Texas TRM v.13 Vol.2[11]
Household Size	3.26	Persons / Household	The number of occupants living in an average household (only households in Harris & Galveston Counties with one or more school-age children considered)	United States Census Bureau: Harris + Galveston Counties, TX, 2024[12]
Baseline Aerator Flow Rate	2.2	Gallons / Minute	The flow rate of the faucet before the aerator is installed	Texas TRM v.13 Vol.2
Retrofit Aerator Flow Rate	1.5	Gallons / Minute	The flow rate of the faucet after the aerator is installed	Texas TRM v.13 Vol.2
# Faucets / Home	3.99	Faucets / Household	The total average number of faucets (including kitchen, bathroom and laundry) in each home, ensuring the savings are representative of a single faucet	Texas TRM v.13 Vol.2
365	365	Days / Year	The number of days in a year	Constant Value

Per-Unit Water Savings Calculation

$$\Delta \mathbf{Gal} = \frac{\mathbf{2.34}\,\frac{\mathbf{Minutes}}{\mathbf{Person \cdot Day}} \times \mathbf{3.26}\,\frac{\mathbf{Persons}}{\mathbf{Household}} \times \left(\mathbf{2.2}\,\frac{\mathbf{Gallons}}{\mathbf{Minute}} - \mathbf{1.5}\,\frac{\mathbf{Gallons}}{\mathbf{Minute}}\right)}{\mathbf{3.99}\,\frac{\mathbf{Faucets}}{\mathbf{Home}}} \times \mathbf{365}\,\frac{\mathbf{Days}}{\mathbf{Year}}$$

$$= \mathbf{487.7}\,\frac{\mathbf{Gallons}}{\mathbf{Year}}$$

Shower Timer

Measure Description

The 5-minute shower timer increases participant awareness about the length of their showers. Taking 5-minute showers saves water by reducing the total amount of water used during each shower, especially when compared to longer average shower times.

[11] Texas TRM v.13 Vol.2 : https://texasefficiency.com/wp-content/uploads/2025/11/trm13v2.pdf

[12] United States Census Bureau: Harris + Galveston Counties, TX, 2024 : https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48167_160XX00US4835000, https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48201_160XX00US4835000

Measure Water Savings Algorithm and Parameter Definition

The water-savings algorithm for a shower timer is:

$$\Delta\text{Gal} = \#\text{ Participants} \times \text{Installation Rate} \times \text{Household Size} \times \frac{\frac{\#\text{ Showers}}{\text{Person} \cdot \text{Day}}}{\frac{\#\text{ Showers}}{\text{Household}}} \times \left(\text{Average Shower Length} - 5\frac{\text{Minutes}}{\text{Shower}}\right) \times (\%\text{ Homes Built Pre} - 1992 \times \text{Baseline Showerhead Flow Rate} + \%\text{Homes Built Post} - 1992 \times \text{Low} - \text{Flow Showerhead Flow Rate}) \times 365\frac{\text{Days}}{\text{Year}}$$

This algorithm is directly sourced from the WaterWise Evaluation for Resource Action Programs: WaterWise Report, by Frontier Associates, authored January 2015. The WaterWise Report in turn sources it's water savings methodologies from the United States Environmental Protection Agency WaterSense website.

A modified version of this algorithm was used to determine per-unit water savings for an individual shower timer:

$$\Delta\text{Gal} = \text{Household Size} \times \frac{\frac{\#\text{ Showers}}{\text{Person} \cdot \text{Day}}}{\frac{\#\text{ Showers}}{\text{Household}}} \times \left(\text{Average Shower Length} - 5\frac{\text{Minutes}}{\text{Shower}}\right) \times (\%\text{ Homes Built Pre} - 1992 \times \text{Baseline Showerhead Flow Rate} + \%\text{Homes Built Post} - 1992 \times \text{Low} - \text{Flow Showerhead Flow Rate}) \times 365\frac{\text{Days}}{\text{Year}}$$

The modified algorithm removes the total program participation and in-service (or installation) rate multipliers from the equation.

The following inputs were used with the above per-unit water savings algorithm to determine an annual per-unit water savings value for this measure of 4,170.2 gallons / unit.

Table 2-10: Shower Timer Water Savings Calculation Variable Definitions

Variable	Value	Unit	Description	Source
# Participants	TBD	Households	The number of participating households in the program year -or- The number of kits distributed -or- The number of units distributed	Harris-Galveston Subsidence District Water Conservation School Program: School

Variable	Value	Unit	Description	Source
				Year 2024-2025 Annual Report
Installation Rate	TBD	%	The percentage of distributed energy efficiency measures actually installed and operational	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Student Survey Data
Household Size	3.26	Persons / Household	The number of occupants living in an average household (only households in Harris & Galveston Counties with one or more school-age children considered)	United States Census Bureau: Harris + Galveston Counties, TX, 2024[13]
# Showers / Person / Day	1	Showers / Person / Day	The number of times a shower is taken by a single person each day	Texas TRM v.13 Vol.2[14]
# Showers / Home	1.8	Showers / Household	The average number of showers per household	Texas TRM v.13 Vol.2
Average Shower Length	7.8	Minutes / Shower	The average length of time spent in the shower before the use of the shower timer	Texas TRM v.13 Vol.2
Reduced Shower Length	5	Minutes / Shower	The length of time spent in the shower while using the 5-minute shower timer	5-Minute Shower Timer Specification
% Homes Pre-1992	51.3%	%	The percentage of homes built before the year 1992 that can be assumed to have showerheads with higher gallon-per-minute flow ratings installed	United States Census Bureau: Harris + Galveston Counties, TX, 2024
Baseline Showerhead Flow Rate	2.5	Gallons / Minute	The flow rate of the baseline showerhead	Texas TRM v.13 Vol.2
% Homes Post-1992	48.7%	%	The percentage of homes built after the year 1992 that can be assumed to have showerheads with lower gallon-per-minute flow ratings installed	United States Census Bureau: Harris + Galveston Counties, TX, 2024

[13] United States Census Bureau: Harris + Galveston Counties, TX, 2024 : https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48167_160XX00US4835000, https://data.census.gov/table/ACSST1Y2024.S1101?t=Housing&g=050XX00US48201_160XX00US4835000

[14] Texas TRM v.13 Vol.2 : https://texasefficiency.com/wp-content/uploads/2025/11/trm13v2.pdf

Variable	Value	Unit	Description	Source
Low-Flow Showerhead Flow Rate	2.0	Gallons / Minute	The flow rate of the low-flow showerhead	Texas TRM v.13 Vol.2
365	365	Days / Year	The number of days in a year	Constant Value
Per-Unit Water Savings Calculation				

$$\Delta\text{Gal} = 3.26\,\frac{\text{Persons}}{\text{Household}} \times \frac{1\,\frac{\text{Showers}}{\text{Person}\cdot\text{Day}}}{1.8\,\frac{\text{Showers}}{\text{Household}}} \times \left(7.8\,\frac{\text{Minutes}}{\text{Shower}} - 5\,\frac{\text{Minutes}}{\text{Shower}}\right) \times \left(51.3\% \times 2.5\,\frac{\text{Gallons}}{\text{Minute}} + 48.7\% \times 2.0\,\frac{\text{Gallons}}{\text{Minute}}\right) \times 365\,\frac{\text{Days}}{\text{Year}} = 4,170.2\,\frac{\text{Gallons}}{\text{Year}}$$

Outdoor Sprinkler Gauge

Measure Description

An outdoor lawn moisture gauge saves water by helping homeowners measure their current irrigation output in hopes of encouraging them to reduce their irrigation to 1" of water per week. This helps prevent overwatering, reducing unnecessary outdoor water use while supporting healthier lawn and plant growth. Specifically, the projected water savings for this measure will be determined by calculating the difference between the weekly amount of lawn irrigation water used before the installation of the sprinkler gauge and the amount of lawn irrigation water used at the recommended 1" of water per week.

Measure Water Savings Algorithm and Parameter Definition

The water-savings algorithm for an outdoor sprinkler gauge is:

$$\Delta\text{Gal} = \#\text{ Participants} \times \text{Installation Rate} \times \left(\left(\text{Sprinklerhead Flow Rate} \times \frac{\text{Average Minutes of Irrigation}}{\text{Day}} \times \frac{\#\text{ Watering Days}}{\text{Week}} \times \frac{\#\text{ Sprinklerheads}}{\text{Home}}\right) - \left(\frac{1\text{" water}}{\text{week}} \times \frac{\text{sq. ft. of lawn area}}{\text{home}} \times \frac{144\text{ in}^2}{\text{ft}^2} \times \frac{1\text{ gal}}{231\text{ in}^3}\right)\right) \times \frac{\#\text{ Irrigation Weeks}}{\text{Year}}$$

This algorithm is directly sourced from the WaterWise Evaluation for Resource Action Programs: WaterWise Report, by Frontier Associates, authored January 2015. The WaterWise Report in turn sources it's water savings methodologies from the United States Environmental Protection Agency WaterSense website.

A modified version of this algorithm was used to determine per-unit water savings for an individual outdoor sprinkler gauge:

$$\Delta\text{Gal} = \left(\left(\text{Sprinklerhead Flow Rate} \times \frac{\text{Average Minutes of Irrigation}}{\text{Day}} \times \frac{\#\ \text{Watering Days}}{\text{Week}} \times \frac{\#\ \text{Sprinklerheads}}{\text{Home}}\right) - \left(\frac{1\text{" water}}{\text{week}} \times \frac{\text{sq. ft. of lawn area}}{\text{home}} \times \frac{144\ \text{in}^2}{\text{ft}^2} \times \frac{1\ \text{gal}}{231\ \text{in}^3}\right)\right) \times \frac{\#\ \text{Irrigation Weeks}}{\text{Year}}$$

The modified algorithm removes the total program participation and in-service (or installation) rate multipliers from the equation.

The following inputs were used with the above per-unit water savings algorithm to determine an annual per-unit water savings value for this measure of 1,635.4 gallons / unit.

Table 2-11: Outdoor Sprinkler Gauge Water Savings Calculation Variable Definitions

Variable	Value	Unit	Description	Source
# Participants	TBD	Households	The number of participating households in the program year -or- The number of kits distributed -or- The number of units distributed	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Annual Report
Installation Rate	TBD	%	The percentage of distributed energy efficiency measures actually installed and operational	Harris-Galveston Subsidence District Water Conservation School Program: School Year 2024-2025 Student Survey Data
Sprinkler Flow Rate	2.6	Gallons / Minute / Sprinkler	The flow rate of each sprinklerhead	EPA WaterSense Irrigation Best Practices[15]
Avg. Length of Irrigation / Day	15	Minutes / Day	The length of time lawns are irrigated on a given day	EPA WaterSense Irrigation Best Practices

[15] EPA WaterSense Irrigation Best Practices : https://www.epa.gov/system/files/documents/2023-11/ws-commercial-bmp-watersenseatwork_section5.2_irrigation.pdf

Variable	Value	Unit	Description	Source
# Watering Days / Week	2.4	Days / Week	The number of days lawns are irrigated each week during the irrigating season	WaterWise Evaluation for Resource Action Programs: WaterWise Report, Frontier Associates, January 2015
# Sprinklers / Home	6	Sprinklers / Home	The average number of sprinklerheads installed at a single home	WaterWise Evaluation for Resource Action Programs: WaterWise Report, Frontier Associates, January 2015
1" Irrigation Depth / Week	1	Inches	The depth of water used for irrigation after the sprinkler gauge has been installed	Outdoor Sprinkler Gauge Behavioral Specification
Lawn Area / Home	800	Square Feet	The surface area of the average lawn at a single home	WaterWise Evaluation for Resource Action Programs: WaterWise Report, Frontier Associates, January 2015
144	144	Square Inches / Square Foot	The number of square inches in a square foot	Constant Value
1 / 231	1 / 231	Gallons / Cubic Inches	The number of gallons in a cubic inch of water	Constant Value
# Irrigation Weeks / Year	26	Weeks / Year	The number of weeks per year during which lawn irrigation is needed	WaterWise Evaluation for Resource Action Programs: WaterWise Report, Frontier Associates, January 2015

Variable	Value	Unit	Description	Source
$\Delta Gal = \left(\left(2.6\frac{Gallons}{Minute} \times 15\frac{Minutes}{Day} \times 2.4\frac{Days}{Week} \times 6\frac{Sprinklerheads}{Home}\right) - \left(\frac{1" \text{ water}}{week} \times 800\frac{ft^2 \text{ lawn area}}{home} \times \frac{144\ in^2}{ft^2} \times \frac{1 \text{ gallon}}{231\ in^3}\right)\right) \times 26\frac{Irrigation\ Weeks}{Year} = 1,635.4\frac{Gallons}{Year}$				

2.5 Summary of Installed Per-Unit Savings

A summary of the per-unit water savings for each installed measure included in the kit is detailed below in Table 2-12. Again, ***participation and installation rates must be applied for program savings calculation,*** and any available survey data may be substituted for applicable variables.

Table 2-12: Per-Unit Installed Water Savings Values for Kit Measures

Type	Measure	Per-Unit Annual Water Savings (gallons / year)
Measure	Toilet Leak Detector Tablets + Toilet Flapper	10,512
Measure	Toilet Tank Water Displacement Bag	987
Measure	Toilet Fill Cycle Diverter	2,063
Measure	Bathroom Faucet Aerator (each)	488
Measure + Behavior	Shower Timer	4,170
Measure + Behavior	Outdoor Sprinkler Gauge	1,635

2.6 2025-2026 School Year Savings

Tinker performed a survey for participants in the 2025-2026 school year. Table 2-13 shows the survey data and associated values that were used to calculate savings for the 2025-2026 year.

Table 2-13: Input Values From 2025-2026 Surveys

Variable	Value
Participants	31,291
Household Size	4.91
Toilets per Home	2.6
Faucets per Home	3.7
Toilet Leak Detector Tablets + Toilet Flapper Installation Rate	29.6%
Toilet Tank Water Displacement Bag Installation Rate	69.7%
Bathroom Faucet Aerator -1 Installation Rate	48.5%
Bathroom Faucet Aerator -2 Installation Rate	42.0%
Shower Timer Installation Rate	66.9%
Outdoor Sprinkler Gauge Installation Rate	50.4%

These values were inserted into the equations shown in the previous section and produced the following savings for the program year, totaling over 309 million gallons of water.

Table 2-14: Per-Unit Water Savings Values for the 2025-2026 School Year

Measure	Per Unit Savings (Not Including ISR) (gal/yr)	Per Unit Savings (Including ISR) (gal/yr)	Annual Savings (gal/yr)
Toilet Tank Water Displacement Bag	1,438	1,002	31,354,357
Toilet Leak Detector Tablets + Toilet Flapper	10,512	3,113	97,402,308
Bathroom Faucet Aerator #1	789	383	11,977,995
Bathroom Faucet Aerator #2	789	332	10,374,862
Shower Timer	6,353	4,251	133,003,462
Outdoor Sprinkler Gauge	1,635	824	25,790,761
Total	**N/A**	**N/A**	**309,903,745**

2.7 Possible Measures and Behaviors for Additional Savings

Both the WaterWise Evaluation for Resource Action Programs: WaterWise Report by Frontier Associates, authored January 2015, and the District Water Conservation Kit Recommendations Report by Frontier Energy, authored September 2025, contain recommendations for additional measures to include in the kit, as well as suggestions for water-conservation behaviors to track.

Resource Innovations has evaluated the per-unit water savings for several of the suggested measures and behaviors using the water savings calculation methodologies provided in the report as well as various online resources, with a summary of per-unit water savings values detailed below in Table 2-15.

Table 2-15: Per-Unit Water Savings Values for Additional Recommended Measures + Behaviors

Type	Additional Measures & Behaviors	Per-Unit Annual Water Savings (gal/yr)
Measure	Showerhead Push-Button Flow Reducer	1,475
Measure	Multi-Pattern Spray Nozzle	6,895
Measure	Hose Repair Kit	1,042
Measure	Native Seeds	1,353
Measure	Soil Moisture Meter	1,732
Measure	Faucet Leak Drip Gauge	147
Behavior	Turn off faucets while brushing teeth	6,701
Behavior	Turn off faucets while washing dishes	10,950
Behavior	Water outdoors in the morning / evening to reduce evaporation	3,315
Behavior	Sweep cleaning solid surfaces	639
Behavior	Self-service carwash	1,287

Additional detail about how these values were calculated, including the water savings algorithms, variable definitions, and sources, can be found in the attached Water Savings Calculator.

To obtain the needed input data for these potential added measures, additional questions will need to be considered for the student and/or parent survey. Table 2-16 outlines the specific questions we recommend including in the survey(s) to capture the information necessary to accurately calculate program water savings.

Table 2-16: Recommended Survey Questions for Additional Recommended Measures + Behaviors

Type	Additional Measures or Behaviors	Recommended Survey Questions
Measure	Showerhead Push-Button Flow Reducer	• Did you install (and use) the Showerhead Push-Button Flow Reducer? • How long, on average, do your family members spend in the shower? • How many showers does each person take per day? • How many people live in your household? • How many showerheads are installed in your home?
Measure	Multi-Pattern Spray Nozzle	• Did you install (and use) the Multi-Pattern Spray Nozzle? • How long do you spend watering the lawn or garden using a hose? • How many times do you water the lawn or garden using a hose each week? • How many months out of the year do you water your lawn or garden?
Measure	Hose Repair Kit	• Did you detect any leaks in your garden hose? • Did you repair the detected leaks in your garden hose? • How long do you spend watering the lawn or garden using a hose? • How many times do you water the lawn or garden using a hose each week? • How many months out of the year do you water your lawn or garden?
Measure	Native Seeds	• Did you plant a garden using native seeds? Does the entire garden contain plants grown exclusively from native seeds? • How often and to what depth do you water your garden each week? • How big (in square feet) is your garden? • How many months out of the year do you water your garden?
Measure	Soil Moisture Meter	• Did you install (and use) the Soil Moisture Meter?

Type	Additional Measures or Behaviors	Recommended Survey Questions
		• How often and to what depth do you water your lawn each week? • How big (in square feet) is your lawn? • How many months out of the year do you water your lawn?
Measure	Faucet Leak Drip Gauge	• Did you detect any leaks in your household faucets? How many leaks did you detect? • Did you use the Faucet Leak Drip Gauge to measure faucet leaks? How much water was measured using the Faucet Leak Drip Gauge over the course of one day? • Did you repair some/all of the leaks detected in your household faucets?
Behavior	Turn off faucets while brushing teeth	• Do you regularly turn off the faucet while brushing your teeth? • How long, on average, do your family members take to brush their teeth? • How many times does each person brush their teeth per day? • How many people live in your household?
Behavior	Turn off faucets while washing dishes	• Do you regularly turn off the faucet while washing dishes by hand? • How long, on average, do your family members take to wash dishes by hand? • How many times are dishes washed by hand per day?
Behavior	Water outdoors in the morning / evening to reduce evaporation	• Did you change your lawn irrigation sprinkler schedule to water during the early morning or late evening? • How long do the sprinklers run during each watering cycle? • How many times do you water your lawn each week? • How big (in square feet) is your lawn? • How many months out of the year do you water your lawn?

Type	Additional Measures or Behaviors	Recommended Survey Questions
Behavior	Sweep cleaning solid surfaces	• Did you shift from hose-cleaning to sweep- or blower-cleaning the solid surfaces around your home (eg. patio, walkways, garage)? • How often did you hose-clean the solid surfaces around your home? • How long did you spend hose-cleaning the solid surfaces around your home during each cleaning cycle?
Behavior	Self-service carwash	• Did you shift from washing the car at home to using a self-service car wash? • How often do you wash each vehicle over the year? • How many vehicles are regularly parked at your home?

2.8 Recommendations Summary

Recommendation 1: Updates are recommended to student and teacher surveys to be able to evaluate the program in greater depth and obtain actionable insights.

Recommendation 2: We recommend the addition of a parent survey in the evaluation activities to corroborate student survey findings.

Recommendation 3: Incorporate updated savings algorithms and apply primary survey data for installation rates and any other variables possible (e.g. number of people per home).

Recommendation 4: We recommend consideration of the inclusion of additional measures, particularly the multi-pattern spray nozzle, and behavior tracking, particularly faucet shutoff while brushing teeth and washing dishes, to capture more water savings program-wide.

Recommendation 5: Other proposed activities may be considered as optional additions to the implementation of the program to evaluate program impacts and effectiveness in greater depth.

3 WaterMyYard

3.1 Program Overview

WaterMyYard is a lawn watering recommendation program managed by Texas A&M AgriLife Extension. It is offered free of charge to local residents through sponsorships from local Texas water providers and agencies. The program has a website and mobile app that provides personalized watering recommendations for residential yards within sponsored regions across Texas. This program is a water conservation tool to improve efficiency in irrigation and water use for lawns. The program intends to help homeowners and businesses save water and money while maintaining lawn health. Watering recommendations for subscribers are calculated using an algorithm that incorporates sprinkler type, local weather conditions, and evapotranspiration (ET) data. Tailored recommendations are generated for each area on a weekly basis.

This section focuses on reporting the findings from a short survey sent to all WaterMyYard program subscribers.

3.2 Evaluation Objectives

The goals of the WaterMyYard evaluation were:

1. Assess whether how the WaterMyYard app changed subscribers' watering behavior;
2. Assess overall participation satisfaction with the program; and
3. Ascertain average weekly minutes reduction in watering behavior after participating in the program to evaluate program's potential water savings.

3.3 Data Collection Methodology

A short online survey was developed in collaboration with the Harris-Galveston Subsidence District (HGSD) and WaterMyYard program staff. The survey was delivered via email directly to WaterMyYard program subscribers in the greater Houston area. The WaterMyYard staff sent a one-time survey solicitation email to subscribers from the WaterMyYard notification email. The survey notification was sent on July 2nd, 2026 with no follow-up reminders. The survey closed on July 15th, 2026.

A total of 618 full survey responses were received, accounting for approximately 5% of the 12,530 program subscribers within the greater Houston area who received the survey. Additional partial responses were received, and those responses were utilized where possible for the savings analysis.

3.4 Key Findings

Key findings from the evaluation are summarized in Table 3-1 below.

Table 3-1: Key Findings from WaterMyYard Evaluation

Survey Question	Results	Notes/Analysis
In which year did you start using the WaterMyYard program? Your best guess is fine.	85% of participants started using the WaterMyYard program in 2020.	This may be explained by the COVID-19 pandemic, where more people were spending time at home.
In which month did you start using the WaterMyYard program? Your best guess is fine.	June was the most common month that participants started using the WaterMyYard program (24%), followed by April and May (16% each).	This aligns with the spring/summer season when watering typically takes place.
What best describes the irrigated portion of your yard?	83% of participants describe the irrigated portion of their yard as "mostly grass, some garden beds."	This aligns with the program goal of providing guidance for watering and maintaining lawns/grass.
Select the sprinkler system that most resembles the sprinklers that your irrigation system uses.	Most participants report having a spray sprinkler system (47%).	Just under half of participants use a spray sprinkler system, meaning that it may be possible to further tailor recommendations based on this sprinkler system. Few participants responded to the open-ended question stating that more information on how long and how often to use the sprinkler (based on water output) would be a helpful supplement to the recommendation about how much water is needed.
What is the estimated total square feet or acres that is being irrigated?	In square feet, the most common yard size is between 1,000-1,999 square feet (19% of 489 respondents)	The yard sizes of participants vary, potentially indicating that the program is useful no matter the yard size.
What is the estimated total square feet or acres that is being irrigated?	In acres, the most common yard size is between 0.25-0.49 acres (32% of 100 respondents).	The yard sizes of participants vary, potentially indicating that the program is useful no matter the yard size.

Survey Question	Results	Notes/Analysis
Has the WaterMyYard program changed the way you irrigate your yard?	85% of participants reported that the WaterMyYard program changed the way they irrigate their yard, with 66% of participants interacting with the program once a week.	It is likely that more interaction with the program encourages subscribers to change their watering behavior.
Do you use the mobile app for the WaterMyYard program? **If not, how do you receive notifications about the program?**	79% of participants mentioned that they are not using the app, with 90% responding that they interact with the program through email notifications.	Most participants rely on email notifications to receive recommendations. Some participants were not even aware that there was an app for the program. More marketing of the app and benefits of using the app may be required to enhance its use, if desired.
Mobile app users were asked: **Do you use the "Adjust Runtime" feature on the mobile app?** **Do you use the "Adjust Rainfall" tool on the mobile app?**	Of the app user respondents, 30% are using the "adjust runtime" feature, and 34% are using the "adjust rainfall" feature.	It may be worth investigating whether all subscribers are aware of these features and enhancing marketing of the app to ensure all subscribers have access to these features. Responses to the open-text question indicate that these are desired features, but most subscribers are not using the mobile app.
How satisfied are you with the WaterMyYard program overall?	Participants are largely satisfied with the WaterMyYard program. 44% of participants report being "very satisfied" with the program, and 32% report being "somewhat satisfied" with the program.	There is high program satisfaction, and no large improvements are necessarily required to maintain satisfaction.
Do you have any thoughts you'd like to share about how the WaterMyYard program has changed your watering behavior?	When prompted to give an open-text response about their experience with the program, most participants had nothing to add (25% n=173), but the most common responses were: • The program has helped them conserve water (9.5% n=67), and	In the results for this question, n refers to the sample size/number of people that responded to the question. Responses to the data accuracy concerns are located on the FAQ page on the WaterMyYard website. Calling attention to the FAQ page or

Survey Question	Results	Notes/Analysis
	• Data accuracy concerns within the app, specifically participants noted that they do not believe that rainfall is adequately captured in their area, or they cannot enter their exact zip code into the app. As such, they believe that the recommendations are not tailored to the needs of their yard (9.1% n=64).	elaborating on these responses in an email format may be helpful to enhance subscriber understanding of these limitations.

3.5 Savings Analysis

To determine the impact of the program information on subscribers' watering behavior, survey respondents were asked on average, how many times per week did they water and for how long in duration each watering, before using the program and after using the program. After analyzing the data individually to determine if the participant's response provided a comprehensive overview of usage, 488 responses evaluated to determine program-wide water use data. Overall, the pre- and post-program usage behavior averaged to the results shown in Table 3-2, and resulted in an overall average reduction in weekly watering of 40-minutes.

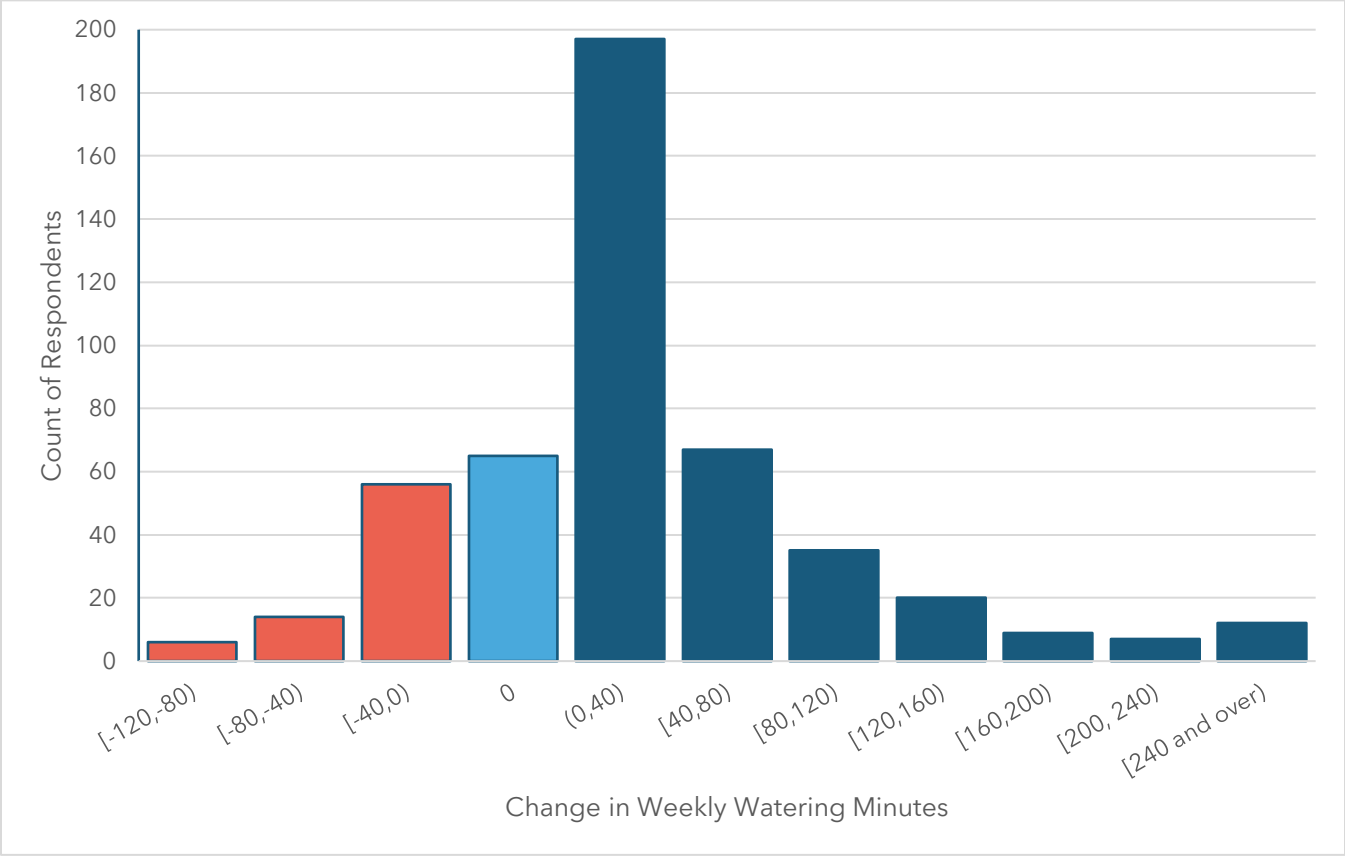
Table 3-2: Average Pre- and Post-Watering Behavior

Variable	Average Pre-Program	Average Post-Program
Watering Sessions per Week (Days)	3	2
Watering Length per Session (Minutes)	34	33
Total Minutes per Week	114	74

It is important to note that not all respondents reported a reduction in watering activity. In some cases, the program instructed them to increase or maintain the overall weekly minutes (though in some cases the frequency or duration changed). Figure 3-1 shows the distribution of the resulting change in watering time in minutes (note positive value bins

(dark blue) indicate water reduction minutes, and negative (orange) indicate an increase in usage).

Figure 3-1: Count of Respondents Showing Reduction in Weekly Watering in Minutes



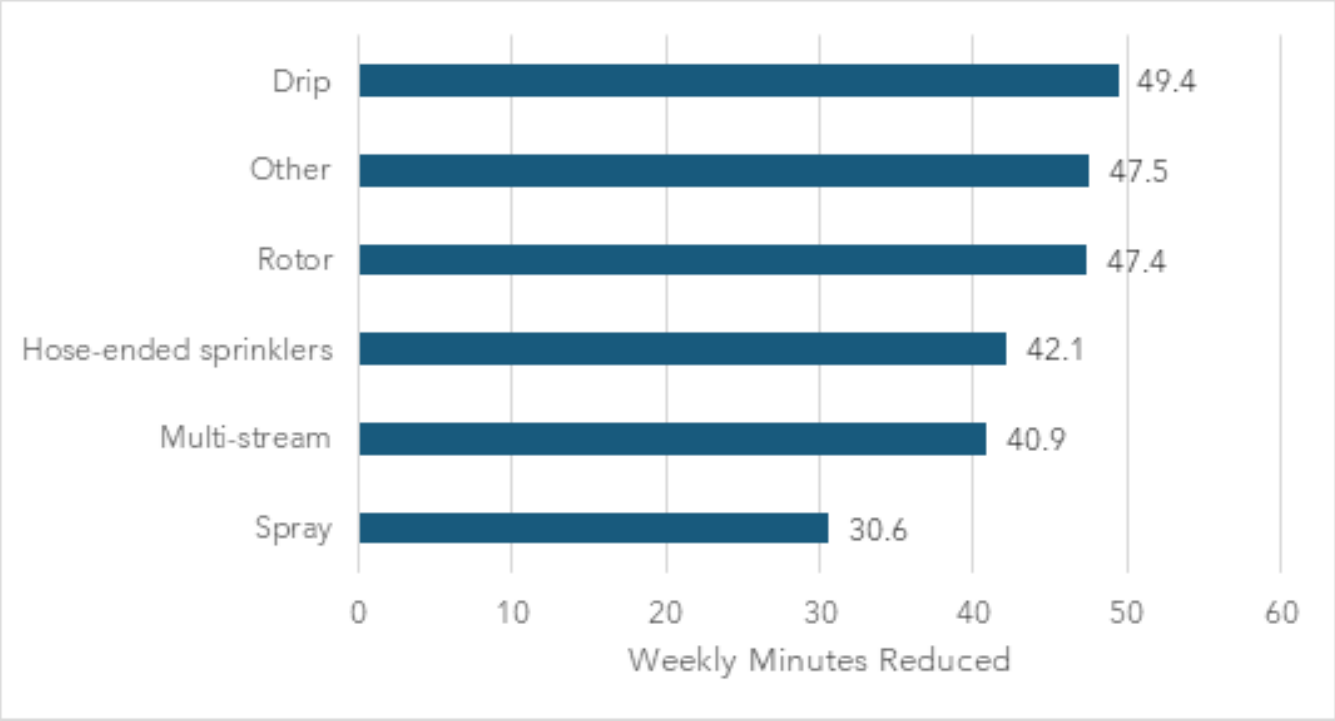
The survey asked participants what type of sprinkler head their irrigation system used. shows the counts and overall percentage of each type of sprinkler used in the savings analysis (n=488).

Table 3-3: Survey Sample Sprinkler Head Types

Sprinkler Head Type	Count	% of Total
Drip	5	1%
Spray	231	47%
Rotor	99	20%
Multi-stream	61	13%
Hose-ended sprinklers	74	15%
Other	18	4%
Total	488	100%

The average weekly minute reduction was also examined by sprinkler head type, as shown in Figure 3-2.

Figure 3-2: Average Weekly Watering Minute Reduction by Sprinkler Type



To illustrate the approximate water savings achieved by the WaterMyYard program it is necessary to assign a flow rate to each sprinkler type, then extrapolate to the number of weeks irrigation occurs, and the total population of program subscribers. For this analysis, 26 weeks was assumed as the irrigation season for the spring and summer months, and the population is the 6,100 subscribers supported by the weather stations sponsored by HGSD. The proportion of each sprinkler head type from the survey was applied to the population of

6,100. Drip irrigation, hose-ended sprinklers, and other were assumed to have a flow rate of 4 gal/min, whereas spray, rotor, and multi-stream were assumed to use 13 gal/min. Table 3-4 shows the average minutes saved by sprinkler type, along with gallons per minute, population estimate for each sprinkler type, and the corresponding total gallons saved. Given these estimated extrapolations, the WaterMyYard program saves nearly 66 million gallons of water each year.

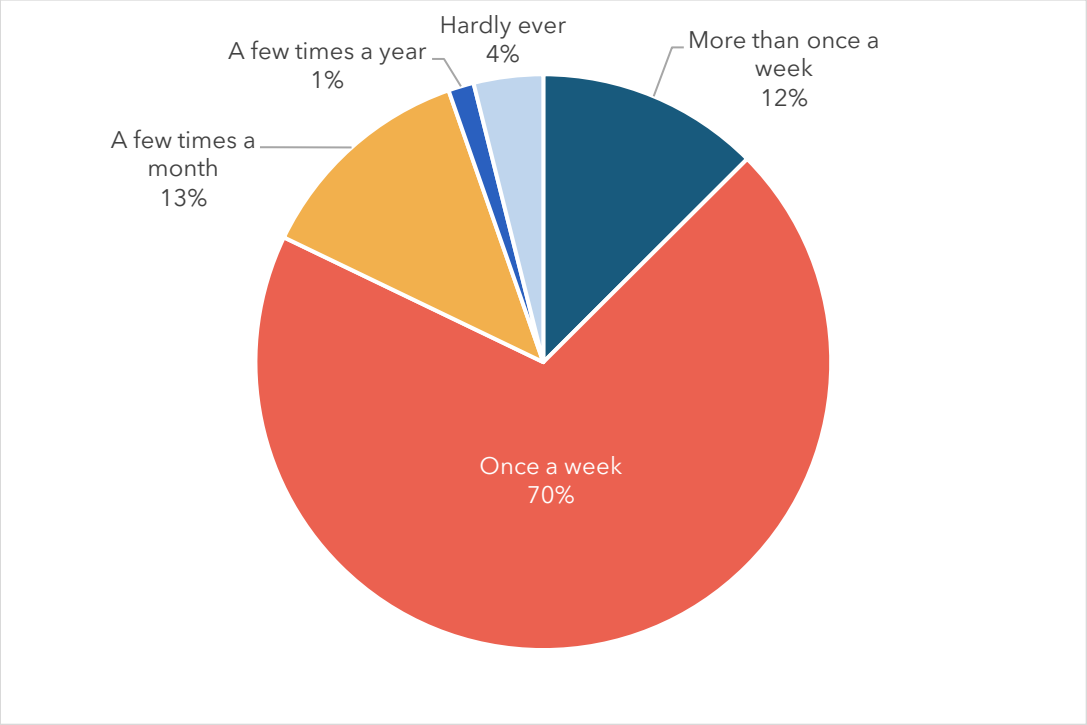
Table 3-4: Savings Extrapolation Estimate

Sprinkler Type	Average Watering Time Reduction (Min/Home/Wk)	Assumed Flow Rate (Gal/Min)	Population Estimate	Annual Savings (Gal)
Drip	49.4	4	63	321,100
Spray	30.6	13	2,888	29,858,075
Rotor	47.4	13	1,238	19,819,475
Multi-stream	40.9	13	763	10,530,813
Hose-ended sprinklers	42.1	4	925	4,053,725
Other	47.5	4	225	1,112,150
	Total		**6,100**	**65,695,338**

3.5.1 Savings Correlation to Participation

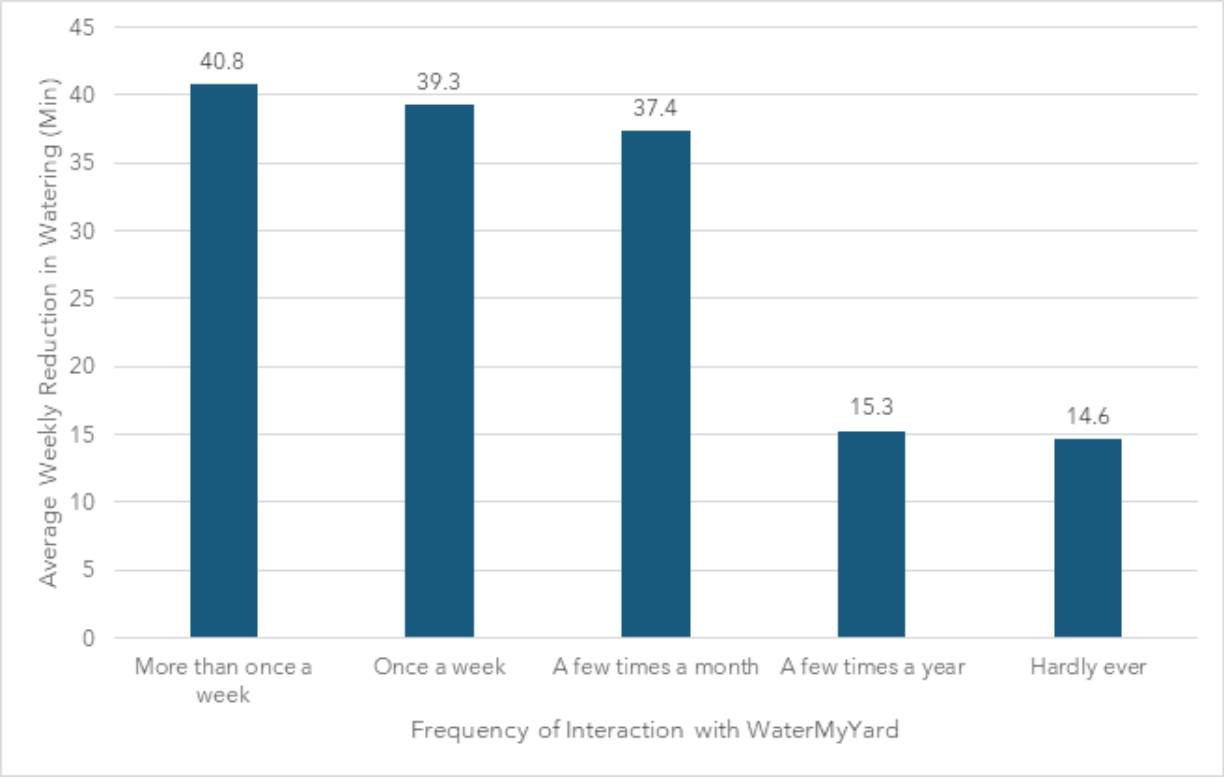
Figure 3-3 shows the frequency that respondents reported interacting with program materials, and unsurprisingly, weekly interactions are the most prevalent.

Figure 3-3: Frequency of Interaction with Program Materials



The following figure shows the average weekly minutes saved per level of self-reported interactions with the program. As can be seen, there appears a direct correlation between more frequently interacting with the program and higher minutes reduction in watering. The results are not each independently statistically significant but can be used to support a program theory that indicates higher program interaction results in more minutes saved.

Figure 3-4: Average Weekly Reduction in Watering Compared to Program Interaction Frequency



3.6 Recommendations

Recommendation 1: On average overall, the program appears to induce a reduction of weekly watering time of about 40 minutes, and collectively results in potentially 66 million gallons saved annually. Consider utilizing the information provided about the average and spread of minutes saved per week to entice additional subscribers and increase visibility to the program.

Recommendation 2: It is worth exploring whether the "adjust rainfall" tool can be integrated into the program beyond the app. Most respondents do not interact with the app, and many respondents reported that they thought that the rainfall in their area was not accurately captured.

Recommendation 3: If the intention is for the app to be the main delivery source of the program, additional marketing of the app may be warranted. Primarily, any features that are added to the app should be advertised in email correspondence to build awareness of the

value of the app. Most respondents are using email notifications, and most respondents are either very satisfied or somewhat satisfied with the program in its current form.

Recommendation 4: In the open-text response, it became apparent that program participants would appreciate more tailored recommendations and may be willing to input additional information manually into the app in order to receive more specific recommendations (e.g., manually adjust rainfall, input projected rainfall for the following week, add more descriptors about their yard). It is worth investigating the possibility of making the app more customizable or highlighting through education the existing capabilities.

4 SmarterAboutWater

4.1 Program Overview

SmarterAboutWater (SAW) is an online resources channel that provides a "one-stop-shop" for water conservation online resources related to water efficiency tailored to the Texas Gulf Coast. The website, https://smarteraboutwater.org/, includes information and guidance for local water providers, businesses, and the general public on effective water efficiency measures, tips, and tools for water users.

This evaluation focused on reporting findings from a review of resource metrics and a short survey on behavior-change actions. Brief considerations and the potential impacts of findings are discussed.

4.2 Evaluation Objectives

The goals of the SmarterAboutWater evaluation were two-fold:

1. Review resource metrics, such as number of site views, when they occur, and what is being viewed to weigh the potential savings accrued.
2. Assess behavior-change actions explored in the online resources to quantify savings for an "average" local resident or business.

4.3 Website Review and Data Collection

SmarterAboutWater staff provided key metrics from the online resource pages. The evaluation team reviewed resource metrics on site views, when they occur, and what is being viewed. We reviewed the landing page for SmarterAboutWater, homeowner resources, educational resources for teachers, parents/caregivers, students, business strategies, and on blog posts.

The evaluation team worked with Harris-Galveston Subsidence District (HGSD) staff to determine a list of priority measures or behavior change actions explored in the online resources. A short survey was developed to assess how users found the website, what users came looking for, and what new users found. Business respondents were asked for their business type to help determine the types that most commonly visit the page, which may help tailor future content. Access to the following pages and related behavior change were assessed through the survey questions:

- The landing page for SmarterAboutWater
- Homeowner resources
- Educational resources for teachers, parents/caregivers, students
- Business strategies

One overarching survey was published on the landing page of the SmarterAboutWater website. HGSD staff further promoted the survey at a local conference, meetings, and through a social media post.

The survey was fielded was published to https://smarteraboutwater.org/ on May 28th, 2026, and was removed from the SmarterAboutWater website on July 15th, 2026. A total of 7 survey responses were received during this time. As such, the ability to draw conclusions is limited.

4.4 Insights and Considerations

There was insufficient website traffic volume to be able to evaluate key resource metrics. Future evaluations can consider a longer time horizon to adequately assess these metrics, or additional marketing may be required to increase website interactions.

As mentioned, the survey sample was also limited. As such, all insights should be treated as preliminary.

- Respondents learned about SmarterAboutWater through word-of-mouth or at a conference/event.
- Most respondents came to the website for Homeowner Resources or Why Conserve/General information about water conservation or local water supply. All respondents noted that they found what they were looking for.
- Most respondents noted that they took a specific action after reviewing the resources they accessed (e.g., washing dishes and laundry in full loads).

Learning what most people come to the website for and who the website users are (e.g., business type), would allow for an assessment of the most useful resources. This would allow for more tailored marketing of the website and resources and would allow for the development of future resources that are tailored to the users and their needs. In turn, this could enhance engagement with the website overall.

To increase website traffic, it may be worthwhile to design an email campaign to advertise the website and available resources. The evaluation for the WaterMyYard program revealed that subscribers typically interact with that program through email notifications, potentially

indicating that this is a preferred communication method for HGSD program users. Cross-program advertising may be feasible given that contact information is already collected and the audiences are engaged and interested in water conservation overall.

4.5 Measure and Behavior Savings Analysis

A larger sample size for the survey would allow for a more accurate attribution of savings to respondent behaviors, and the resources on the website that they learned the behavior from. Because the survey effort did not yield sufficient results, the evaluation team worked with HGSD staff to apply reasonable, but very conservative adoption rates to each of the measures or behaviors identified.

A calculator was created to provide HGSD with a calculation methodology to enable HGSD staff to perform this savings analysis in the future if addition adoption data became available. The following measures or behaviors were examined and included in the calculator for an "average" resident or business, using publicly available and locally source input variable assumptions. These measures were determined by the resources made available on the website.

Residential:

- Early / Late Outdoor Watering
- (Outdoor) Leak Inspection + Repair
- (Indoor) Leak Inspection + Repair
- Native Plants
- Pool Cover
- Avoid Excess Dishwasher Use
- Avoid Excess Laundry Machine Use
- Reduce Shower Time
- Turn off Faucets while Brushing Teeth / Washing Dishes / etc.
- Low-Flow Showerhead
- Low-Flow Sink Aerator
- High-Efficiency Toilet

Business:

- SMART Landscape Irrigation Controls
- Rainwater Catchment Bioswale
- (Outdoor) Leak Inspection + Repair
- (Indoor) Leak Inspection + Repair

Average calculated business savings are not included in the estimates below due to the extremely high rate of variability in business type and property location characteristics.

4.5.1 Residential Measure/Behavior Savings Estimates

In order to provide an assessment of the potential savings impact of the website information on water savings in the region, the per home savings were calculated and then a conservative adoption rate applied and extrapolated to the average number of people shown to visit the "Homeowner Resources" page annually (approximately 625 people). Table 4-1 shows the residential measure full savings per home that may undertake the action, the adoption rate, and the resulting savings when extrapolated to the website visitors. The result is potentially over half a million gallons of water saved per year.

Table 4-1: Estimated Average Annual Savings Due to SAW Website Information - Residential

Measure/Behavior	Full Possible Savings per Home (gal)	Adoption Assumption %	Population	Savings Estimate (gal)
Early/Late Outdoor Watering	3,315	1%	625	20,719
Outdoor Leak Detection + Repair	51,840	0.1%	625	32,400
Indoor Leak Detection + Repair	26,280	0.1%	625	16,425
Native Plants	1,345	2%	625	16,813
Pool Cover	3,505	1%	625	21,906
Avoid Excess Dishwasher Use	317	2%	625	3,963
Avoid Excess Laundry Use	1,612	2%	625	20,150
Reduce Shower Time	4,390	2%	625	54,875
Turn Off Faucets While Brushing Teeth	7,139	2%	625	89,238
Turn Off Faucets While Washing Dishes	5,475	2%	625	68,438
Install Low-Flow Showerhead	2,578	2%	625	32,225
Install Low-Flow Sink Aerator	488	2%	625	6,100
Install High-Efficient Toilet	11,304	2%	625	141,300
	Total			**545,550**

4.6 Recommendations

Recommendation 1: Consider re-running the online survey again for a longer period of time while increasing marketing to bring more traffic to the website. A sufficient response size could help program staff understand which measure suggestions are being adopted most often, and could use that data for updated annual savings analysis.

Recommendation 2: Utilize the savings calculator and update inputs as they become available.

Recommendation 3: Indications suggest that people find the website helpful and engaging, so additional efforts to gain traffic will likely result in additional savings. HGSD staff already do a lot to promote the website via social media and in-person events. Perhaps consider reaching out to other organizations to include additional SAW marketing.

5 Grant Program

5.1 Program Overview

The Grant program offers local municipalities or public entities financial assistance to complete a water conservation project. Applications must be submitted, and upon award and project completion, Grantees provide ongoing project updates and data sharing.

5.2 Evaluation Objectives

The main objectives were two-fold: to determine how the program ran from a process perspective, and how much water savings were attributed to the grant projects. The projects ranged in type from leak detection, to irrigation savings, to installation of AMI systems, and thus necessitated a different project journey.

5.3 Data Collection

There were 10 total grant projects awarded and included in the analysis. An in-depth interview was attempted for each project, and 4 were completed. These proved immensely helpful to provide context for the project details, circumstance, and sometimes changes, that were not apparent in the documentation. Clarifications were also very helpful for savings analysis, specifically to solidify dates of project baselines and post-periods.

Savings and usage data were provided primarily through HGSD's regular data collection procedures, but some supplemental data were provided by Grantees when requested.

5.4 Smart Irrigation Findings and Results

5.4.1 Savings Methodology

The smart irrigation system installed with this project adjusts its waterings schedule in response to local weather conditions. More specifically, smart irrigation systems change the amount of water they deliver according to evapotranspiration (ET) or the amount of water the grass loses due to evaporation and transpiration.

ET is affected by a wide range of weather factors (such as temperature, humidity, and wind speed) and is therefore a complex metric to model. The Penman-Monteith equation is generally preferred because it considers a robust set of factors. However, due to the limited availability of historical data this analysis utilized the Turc equation for irrigation as it is

based on more common metrological data. The Turc equation was found to be effective at estimating ET for humid locations (Trajkovic & Kolakovic, 2009).

The amount of water loss due to transpiration varied from plant to plant. Therefore, it is a numerical convenience to calculate a reference evapotranspiration value that can be scaled to match a given plant. Notationally, this can be represented as

$$ET = K * ET_0$$

where ET is the evapotranspiration of a desired plant, K is the plant factor of the plant, and ET_0 is the reference evapotranspiration. Plant factors for turfgrasses range between 0.6 and 0.8, for the purpose of this study we assume a plant factor of 0.7.

The Turc equation for reference evapotranspiration is as follows:

$$ET_0 = 0.013 \times (23.88 \times (0.25 + 0.5P_s)R_a + 50) \times \frac{T_{mean}}{T_{mean} + 15}$$

where T_{mean} is the mean air temperature, P_s is the percentage of possible sunshine for a given month, and R_a is the extraterrestrial radiation. We used Houston station data from Meteostata.net to find the average air temperature for all relevant months. Furthermore, we used NOAA's 2023 local climatological data annual summary to find the monthly percentage of possible sunshine. Finally, the daily extraterrestrial radiation was calculated from latitude and longitude. Using the Turc equation and aforementioned data sources, we found daily evapotranspiration for each project period.

The ET value represents the water needs of a plant. However, these needs can be fulfilled by natural precipitation as well as an irrigation system. This can muddle the raw usage data as an uncommonly dry year may incorrectly make the system look less efficient. Therefore, we follow the guidelines recommended by the Pacific Northwest National Laboratory and Western Resource Advocates to account for the precipitation (Kurnik et al, 2017). This methodology normalizes the monthly precipitation by finding the ratio between the net ET and the historic net ET. Net ET is the difference between the estimated evapotranspiration and monthly average effective precipitation, $\mathrm{p_e}$. Effective precipitation is the amount of water that makes it to a plant's root system. In this context, historic net evapotranspiration is the net ET derived from the previous year average for evapotranspiration $\overline{\mathrm{ET}}$ and effective precipitin $\overline{\mathrm{p_e}}$.[16]

[16] Historic values retrieved from Texas A&M AgriLife Extension's TexasET network.

$$Net\ ET\ Ratio = \frac{\overline{\mathrm{ET}} - \overline{\mathrm{p_e}}}{\mathrm{ET} - \mathrm{p_e}}$$

The post-installation water data is adjusted by multiplying the raw water usage by the monthly net ET ratio.

5.4.2 Teranova West MUD

5.4.2.1 Project Overview

The Terranova West Municipal Utility District (TWMUD, District) project consisted of implementing irrigation equipment and smart controller system for local parks utilizing reclaimed water. For the purposes of this report, the following are defined as:

- Reclaimed water – water that is diverted from wastewater to be cleaned in a reclaimed water facility that is suitable for irrigation, but not human use
- Treated water – water that is fit for human consumption, e.g. potable water

Prior to being awarded with the Harris-Galveston Subsidence District (HGSD) water conservation grant and without a wastewater treatment plant of their own, TWMUD partnered with a neighboring public utility district's (PUD) to expand the PUD's wastewater treatment plant to include a reclaimed water treatment facility with the purpose of irrigating municipal parks and green spaces. The smart controller system replaced a traditional timer system that did not account for weather conditions such as precipitation and temperature. Furthermore, the reclaimed water irrigation system replaced a system that used treated water.

The HGSD grant began in June 2024, and the new system became active September 2025. From 2019 to 2023 TWMUD used an average of 6.9 million gallons of water per year. The project was expected to reduce water usage by 37% resulting in $23,951 worth of annual water savings.

5.4.2.2 Process Findings

Program Awareness

According to the interviewee, TWMUD's interest in reducing irrigation costs and improving park management led it to explore reclaimed water opportunities. About five to six years prior to the smart irrigation project, TWMUD began working with a neighboring PUD that had a wastewater treatment plant and collaborated with its team to estimate costs and water use before seeking incentives from the North Harris County Regional Water Authority

(NHCRWA). Initially, the project focused on upgrading the neighboring PUD's wastewater treatment plant and connecting it to TWMUD's system. During the process, a NHCWRA representative introduced TWMUD to HGSD's Water Conservation Grant Program.

According to the interviewee, TWMUD inherited a legacy irrigation system that needed upgrades. As the system improvements were considered, TWMUD also looked at replacing older Rain Bird-style irrigation controls. After several Board members attended a water conference and learned about reclaimed water and remote irrigation management, they explored replacing the aging system with weather-based irrigation system. Although this increased the project cost from approximately $1.5 million to $3 million, the Board determined the investment was financially feasible and could be recovered over roughly 20 years. It is worth noting that this is the first grant that the interviewee has ever applied to. They reported that the grant process initially seemed complicated but was an overall good experience.

Project Installation

The District subsequently hired the firm to identify and evaluate landscape contractors, design the irrigation system, and program weather-based irrigation schedules integrated with the national weather system during construction. Before the system became operational, the programming was field-verified, and only minor adjustments (approximately 5%) were needed after startup.

Project Benefits

Although the system had only recently become operational, the District was already reporting measurable water savings of approximately 900,000 gallons per month. Based on these savings, the project is expected to have a payback period of around 20 years. This project is unique in that water savings is indeed a goal, but the interviewee clarified that it is essential the reclaimed water demand remains stable to ensure the reclamation facility can remain operational. This is being achieved, in part, by increasing the area that is served with the irrigated water.

The interviewee emphasized that the primary value of the new system lies in its operational efficiency rather than water savings alone. Unlike the legacy irrigation system, the new smart, remotely managed system integrates weather data, monitors pressure changes, and can quickly detect leaks and equipment issues. Under the previous system, landscapers had to manually inspect each irrigation zone to identify leaks or maintenance needs, making both water management and system maintenance more labor-intensive and costly.

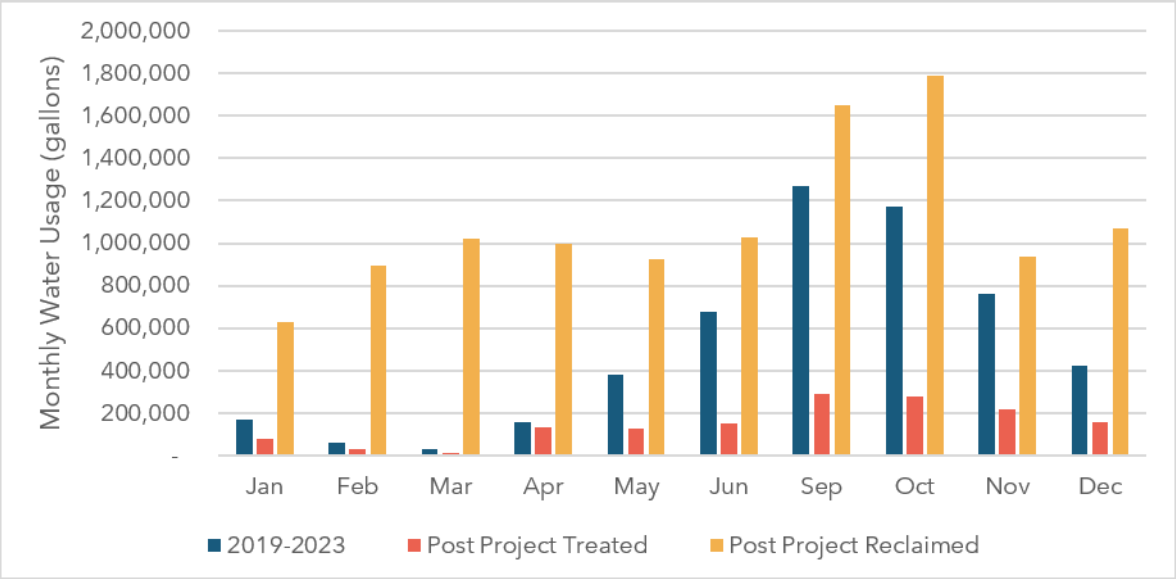
5.4.2.3 Water Savings Analysis

We measured the impact of the new system by looking at changes in TWMUD's sprinkler usage. The new system became active in September 2025, and at the time of this report, post-project data ends in June 2026. Furthermore, we have historical monthly usage data going back to 2019. We did not include 2024 data in this analysis as that is when the new system was being installed.

The pre-project average usage for each month was determined by the MUD's monthly sprinkler usage from 2019 to 2023. Following this we added the average monthly usage for the months with the corresponding post-project data (September through June). This approach is used because we are missing post-project data for July and August and therefore should not include those months in the pre-usage comparison data. Adding the monthly averages for the relevant 10 months results in a combined pre-project usage of 5,101,507 treated gallons.

The total raw usage for the post-project system was 1,669,000 treated gallons (for 10 months). However, this raw usage may be misleading as the new system accounts for weather conditions while the previous timer-based system did not. This is significant as the raw usage may overrepresent savings for wet years or underrepresent savings for dry years. Therefore, we use the methodology described in the previous section to scale the monthly usage to be what we would expect in an average year's weather conditions. This gives us a total normalized usage of 1,486,744 treated gallons (for 10 months). This suggests the new system reduces treated water usage by 70.9%. The new system also used a total of 10,944,534 gallons of reclaimed water during the ten months of post-usage data. The following plot shows the normalized post-project and the average pre-usage for each month. The new system became active in September 2025. Therefore, a full year of post usage data would end August 2026. As of the time of this report, only data up to June 2026 is available as July and August months have not yet been completed. This is a limitation on the current analysis.

Figure 5-1: Pre and Post Monthly Usage



It is important to note that over time, the amount of irrigated land has increased, and thus the amount of irrigation. For the 10 representative months, the average pre-project total usage was 5.1 million gallons, and the post usage was 12.4 million gallons, thus the irrigation is around 2.4 times now than the previous 5-year average. This increase in area is the result of the reclaimed water system drastically reducing the cost of irrigation. More specifically, the new system was able to water a larger area at a much cheaper cost than the previous treated water-based system.

As shown in the following table, the HGSD smart irrigation equipment project saved 70.9% of the treated water that was previously being used (3.6 million gallons), in addition to nearly 11 million gallons of reclaimed water that is being utilized instead of additional treated water. With additional data for July and August, the amount of water saved would likely be much more.

Table 5-1: September through June Usage

Usage Phase	Sept-June Treated (gal)	Sept-June Reclaimed (gal)
Pre-Project Average (2019-2023)	5,101,507	0
Post-Project (Weather Normalized)	1,486,744	10,944,534
Difference in Treated Usage	**-3,614,762**	**-**

5.4.3 City of West University Place

5.4.3.1 Project Overview

The City of West University Place (COWUP) project consisted of implementing irrigation equipment and smart controller system for local parks. The smart controller system replaced a 10 to 15-year-old traditional timer system that did not account for weather conditions such as precipitation and temperature. The new system uses weather data to optimize watering schedules and detect leaks across 19 city parks.

The HGSD phase of the project began in June 2024, the new system became active October 2024, and necessary repairs were completed February 2025. The project was expected to reduce water usage by 35% resulting in $6,340 worth of annual water savings.

5.4.3.2 Process Findings

Program Awareness

According to the interviewee, COWUP had already been planning to replace its 10 to 15-year-old irrigation system because it was nearing the end of its useful life. As the system improvements were considered, COWUP also looked at replacing older Rain Bird-style irrigation controls. Before pursuing grant funding, COWUP obtained cost estimates from Weathermatic for the replacement, including estimates for larger parks such as Colonial Park. A representative from COWUP learned about the grant opportunity while attending a Water Board Directors conference in 2023.

Grant Approval Process

The COWUP staff recalled beginning the internal approval process in August 2023, obtaining board approval, being selected for funding in April 2024, and receiving final approval and funding to begin installation in June 2024.

During the application process, COWUP staff contacted previous grant recipients to better understand the scope of work and application requirements, what reviewers were looking for, and what made a strong application. They also worked closely with Harris-Galveston Subsidence District (HGSD) staff throughout the application process. Overall, they described the application process as easy, straightforward, and free of unnecessary hurdles.

Project Installation

After receiving the grant award, COWUP solicited competitive bids for the project. Weathermatic submitted the most competitive bid and was selected as the vendor for the installation. According to COWUP staff, COWUP did not make a major public announcement about the project. They stated that it may have been mentioned in a parks and recreation or leisure guide, but because the installation did not disrupt park operations, no broader public outreach was considered necessary.

Project Benefits

According to COWUP staff, COWUP has a capital improvement funding process that could have supported a project of this nature. However, the HGSD grant accelerated project implementation by helping COWUP move forward sooner by awarding 50% of the budgeted project cost.

The staff mentioned that the new smart irrigation system has significantly improved the COWUP's ability to detect leaks, enabling COWUP to identify and repair issues much earlier before they go unnoticed for extended periods. They also noted that water savings have resulted from both faster leak detection and improved irrigation optimization, as the system provides staff with real-time information on weather and soil conditions, helping them determine when irrigation is needed based on rainfall and dry conditions.

According to the interviewee, if COWUP acquires additional park land over the next few years, it intends to install smart irrigation systems in those new parks as well. However, they noted that COWUP is largely landlocked by the City of Houston, which limits opportunities for significant future park expansion.

5.4.3.3 Water Savings Analysis

We measured the impact of the new system by looking at changes in COWUP's sprinkler usage. The new system became active in February 2025, and at the time of this report, the post-project data ends in March 2026 (this is a full year of post-project water usage data). Furthermore, we have historical monthly usage data going back to 2016. However, as a baseline we will find the 5-year average water usage for each month. This baseline will ensure that we compare recent post-project data to recent pre-project data. June 2024 to February 2025 data were removed from the analysis as that is when the new system was being installed and repairs were conducted.

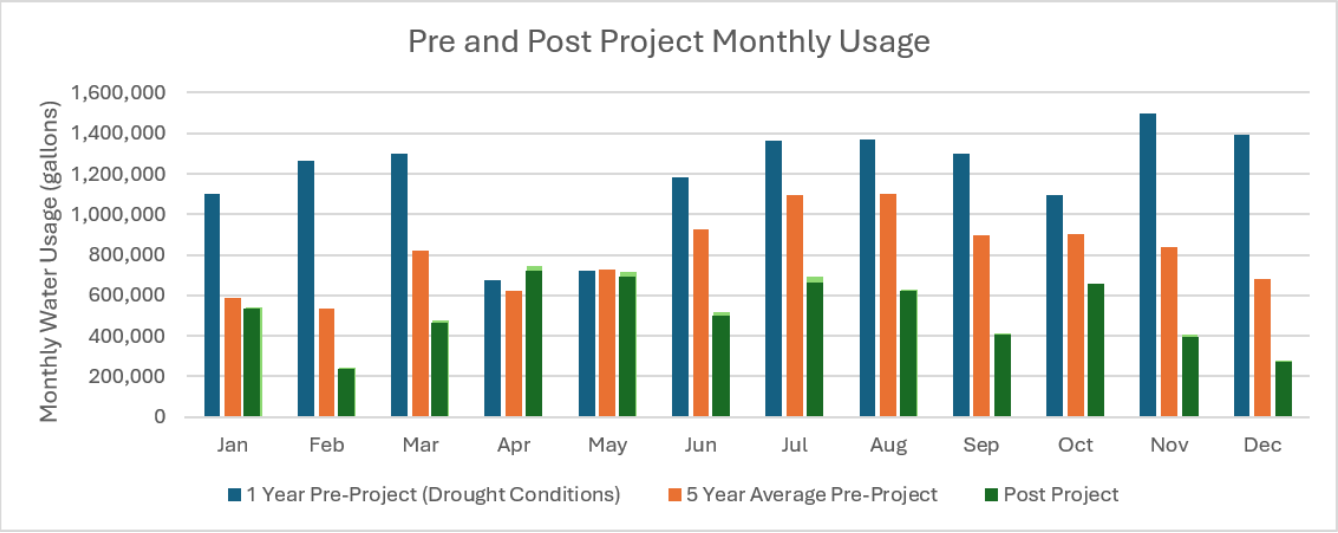
The pre-project average water usage for each month was determined by COWUP's monthly sprinkler usage from June 2019 to May 2024. Summing the monthly pre-project results in an

average annual usage of 9,731,081 gallons. However, we observed that the most recent year of pre-project data was unusually high with an annual usage of 14,262,307 gallons due to a period of drought experienced in 2022 and 2023.

The total raw usage for the post-project system was 7,017,298 gallons. However, this raw usage may be misleading as the new system accounts for weather conditions. Therefore, the raw usage may overrepresent savings for wet years or underrepresent savings for dry years. Therefore, we use the methodology described in the previous section to scale the monthly usage to be what we would expect in an average year's weather conditions. This gives us a total normalized usage of 6,319,055 gallons. This suggests the new system reduces water usage by 35.1%. However, this data includes a previously unirrigated area, Edloe Pathway, and removing this site from the post usage data gives a normalized usage of 6,171,462 gallons which is a 36.6% reduction from the pre-project average.

The following figure shows the normalized post-project and the average pre-project usage for each month. The monthly irrigation of Edloe Pathway is colored separately in a lighter green on top of the dark green. The 1-year pre-project period included stretches of severe drought which caused heavy water usage. As a result, the 1-year pre-project period offers a reference for pre-usage drought years.

Figure 5-2: Pre and Post Monthly Usage



It is important to note that the most recent pre-project year had much higher usage than the pre-usage average. As a result, the year-to-year reduction in water usage is much higher than the average reduction in usage. This translates to a 9.1% reduction from the pre-usage average and a 36.0% reduction from the most recent pre-usage year. The data suggest that

an average year will experience savings of around 3.4 million gallons but a hot, dry year could see up to 8 million gallons of savings (see Table 5-2 below).

Table 5-2: Annual Usage

Usage Phase	Annual Usage (gal)
5 Year Pre-Project Average Usage[17]	9,731,081
Post-Project (Weather Normalized)	6,319,055
Difference in Average Usage	**-3,412,026**
Most Recent Pre-Project Usage Year[18]	14,262,307
Post-Project (Weather Normalized)	6,319,055
Difference in Previous Year (Drought Conditions)	**-7,943,252**

5.4.4 KISD Centralized Irrigation Control

5.4.4.1 Project Overview

The Klein Independent School District (KISD) project consisted of implementing smart irrigation controller systems to school sports fields. However, in the following years many of the irrigated fields were replaced with artificial turf. In these cases, the smart irrigation controllers were relocated to elementary schools that did not have any automated irrigation equipment. Therefore, this project produced a new system that currently irrigates the sport fields for three schools and sections of seven elementary schools.

[17] This period ran from June 2019 to May 2024.
[18] This period ran from June 2023 to May 2024. This period included drought conditions.

5.4.4.2 Process Findings

Program Awareness

The interviewee was told about the grant opportunity by KISD's executive director of operations, and instructed to apply for it. This project was not previously planned and was made wholly possible by the grant.

Project Installation

The main difficulty came from the contracting and product sourcing requirements. More specifically, they had trouble finding a contractor that could satisfy the co-op requirements set forth by the school district. As a result, this was a very hands-on project where KISD staff ordered and stored parts and materials from the co-op vendor and then hired a contractor to install the new system. The interviewee felt it would have been easier if they could have found a turnkey contractor that could have handled the entire process.

Project Benefits

The interviewee mentioned that the new smart irrigation system allows the district to implement rain delays and make quick adjustments to the irrigation schedule. This made sport fields easier to manage. Furthermore, after many of the sport fields were replaced with turf, the controllers were able to be relocated to elementary schools that did not previously have automated systems, and in many cases, the new irrigated area is larger than the original sports fields.

5.4.4.3 Water Savings Analysis

This analysis primarily focused on the three schools that did not replace their sports fields with artificial turf. We would expect the controllers that were moved to elementary schools to produce water savings, however, the elementary schools where the other controllers were relocated do not have separate meters for the irrigation systems. As a result, the available data reflects the water usage for the entire building and any potential irrigation savings are drowned out other factors.

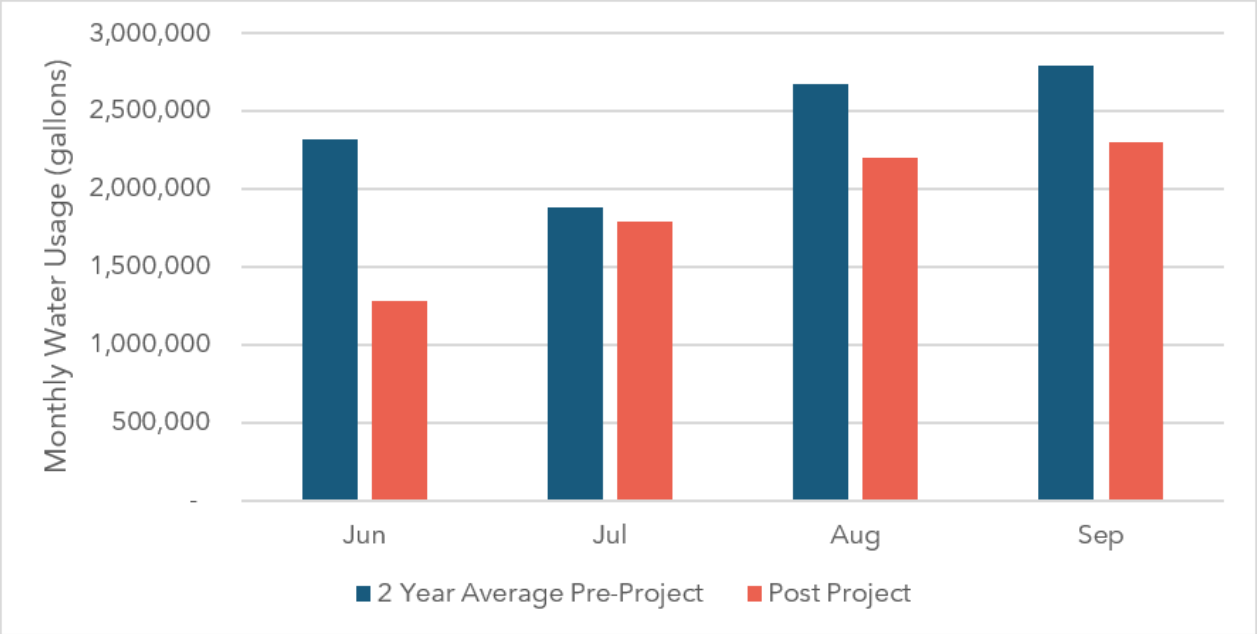
We evaluated the impact of the system by looking at changes in KISD's sprinkler usage for the three campuses that retained their controllers, i.e. Hildebrandt Intermediate, Klein Intermediate, and Klein Forest High School. The new system became active in October 2020, and at the time of this report, the post-project data ends in September 2025. Only the June, July, August, and September months were included in the irrigation dataset therefore

this analysis only includes peak season months. Historical monthly usage data is available back to 2018.

The pre-project average usage for each month was determined by KISD's summer sprinkler usage from June 2018 to September 2019. Summing the monthly pre-project usage across all three campuses results in an average 4-month summer usage of 9,666,793 gallons.

The post-project average usage for each month was determined by KISD's summer sprinkler usage from June 2020 to September 2025. The total raw average summer usage for the post-project system was 7,631,770 gallons. However, this raw usage may be misleading as the new system accounts for weather conditions. Therefore, the raw usage may overrepresent savings for wet years or underrepresent savings for dry years. Thus, we use the methodology described in the previous section to scale the monthly usage to be what we would expect in an average year's weather conditions. This gives a total normalized 4-month summer usage of 7,561,470 gallons. This suggests the new system reduces water usage by 22%.

Figure 5-3: Pre and Post Monthly Usage



The following table shows the average summer savings by campus. Hildebrandt Intermediate had an average reduction of 492,438 gallons a summer which is a 22% reduction. Klein Intermediate had an average of 262,908 gallons a summer which represents a 16% reduction. Finally, Klein Forest High School had an average summer reduction of 1,349,976 gallons which is a 23% reduction. These campus level reductions

combine to yield a project wide reduction of 2,105,323 gallons a summer (22% lower on average).

Table 5-3: Summer Usage

Campus	Usage Phase (June – Sept Months)	Summer Usage (gal)
Hildebrandt Intermediate	2 Year Pre-Project Average Usage[19]	2,188,923
	Post-Project (Weather Normalized)	1,696,484
	Difference in Average Usage	**-492,438**
Klein Intermediate	2 Year Pre-Project Average Usage	1,619,641
	Post-Project (Weather Normalized)	1,356,733
	Difference in Average Usage	**-262,908**
Klein Forest High School	2 Year Pre-Project Average Usage	5,858,230
	Post-Project (Weather Normalized)	4,508,253
	Difference in Average Usage	**-1,349,976**
Total Across Campuses	2 Year Pre-Project Average Usage	9,666,793
	Post-Project (Weather Normalized)	7,561,470
	Difference in Average Usage	**-2,105,323**

5.4.5 CCISD Centralized Irrigation Control

5.4.5.1 Project Overview

In 2020 the Clear Creek Independent School District replaced their timer-based irrigation system with a smart irrigation system that includes Rainbird ESPLXME controllers. The new

[19] This period ran from June 2018 to September 2025.

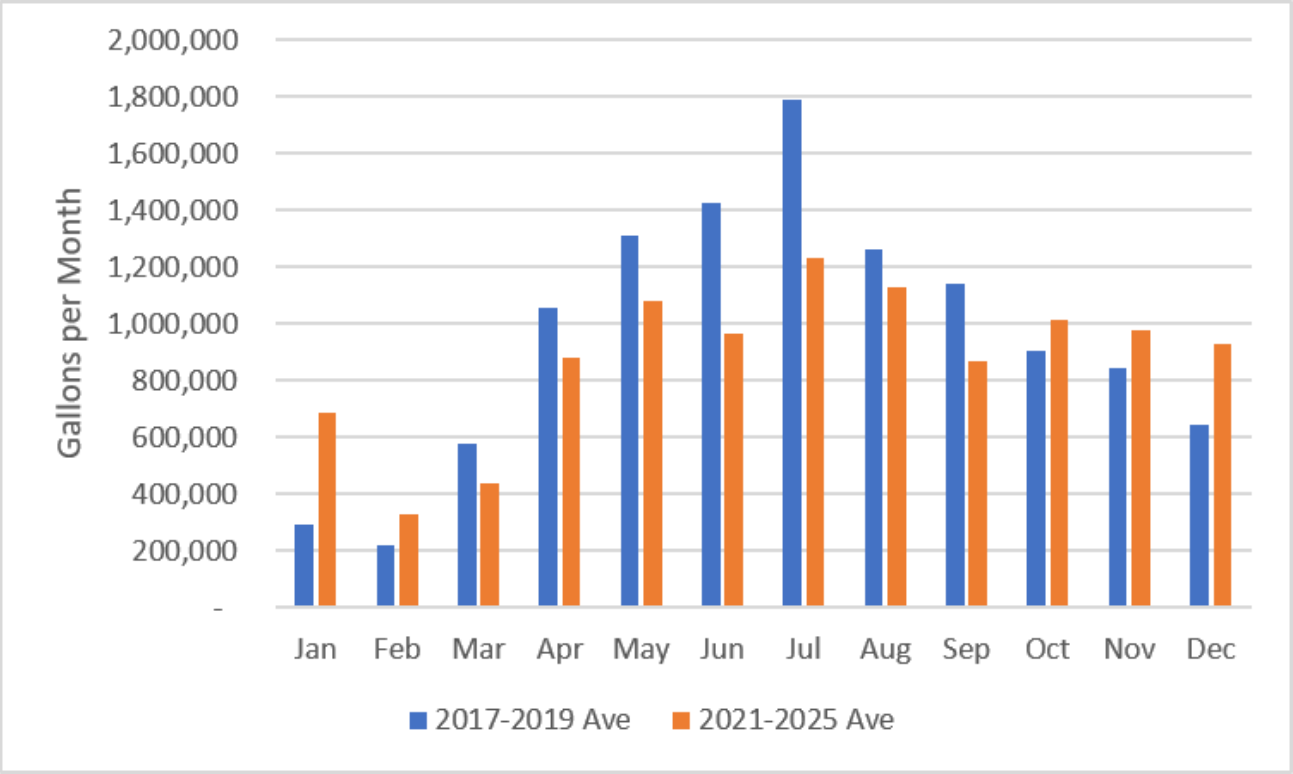
irrigation system was installed at multiple high school and intermediate school campuses with athletic fields. However, consistent data has been provided for two high school campuses, Clear Falls and Clear Creek High Schools. This project is expected to reduce the amount of water used for irrigation at each campus by allowing the site manager to implement rain delays and irrigate based on expected evapotranspiration (ET). Our analysis shows that the new system did reduce the annual irrigation water usage by 8.2% which represents about 944,313 gallons per year.

5.4.5.2 Water Savings Analysis

We evaluated the impact of the new system by looking at changes in CCISD's sprinkler usage. The new system became active in September 2020, and at the time of this report, the post-project data ends in December 2025 (this is 5 years of post-project water usage data). However, it took a few months for the site manager to fully implement the new features we consider the post-installation to start January 2021. We use the average monthly consumption for 2017-2019 as the pre-project baseline. CCISD data is split across two sites, i.e. Clear Falls High School and Clear Creek High School.

Summing the baseline monthly usage results in an average annual usage of 11,464,843 gallons. The total raw usage for the post-project system was 11,036,619 gallons. However, this raw usage may be misleading as the new system accounts for weather conditions while the previous timer-based system did not. Therefore, we use the methodology described in the methodology section to scale the monthly usage to be what we would expect in an average year's weather conditions. This gives us a total normalized usage of 10,520,531 gallons. This suggests the new system reduces water usage by 8%.

Figure 5-4: Pre and Post Monthly Combined Usage



It is important to note that each of the two sites experienced different levels of water savings. The new system reduced the Clear Falls High School annual average usage 1,729,632 gallons, which is a 25% reduction. However, after the new system was installed Clear Creek High School increased their annual usage by 785,319 gallons which is a 17% increase. Unexpectedly, this increase was driven by higher usage in the winter months. We were unable to conduct an interview with the manager for these sites and unaware of what drove the higher winter usage. These results are summarized in the following table (see Table 5-4 below).

Table 5-4: Annual Usage

	Annual Usage (gal)		
Usage Phase	**Clear Falls High School**	**Clear Creek High School**	**Total**
2017 - 2019 Average	6,976,833	4,488,010	11,464,843
2021- 2025 Average	5,247,201	5,273,329	10,520,531
Difference in Pre/Post Usage (gal)	**-1,729,632**	**+785,319**	**-944,313**
Percent Change	**24.8% Reduction**	**17.5% Increase**	**8.2% Reduction**

5.5 Leak Detection Findings and Results

5.5.1 Utilis Satellite Water Loss Location for League City

5.5.1.1 Project Overview

The project consisted of satellite technology to detect underground water leaks to help pinpoint areas for city staff to focus attention. The project occurred in 2020 with three or four "fly overs" that created maps from which to deploy staff. The project had a high success rate of detecting leaks and greatly reduced the hours spent manually walking miles of pipes.

5.5.1.2 Process Findings

League City was very happy with the project and noted the saved hours due to the city being fairly new and having a lot of PVC which is harder to detect leaks via sound than metal pipes. The City found the application process to be reasonable and was "one of the easiest." The interviewee mentioned that they originally learned about the grant because of someone on the board, and suggested they apply.

5.5.1.3 Water Savings Analysis

The leak analysis report provided back in 2020 was found to be comprehensive in its assessment of finding and repairing 92,600 gallons/day of leaks. Because the project happened only the one time, there are no additional leaks fixed because of the project, and

the estimate was deemed reasonable by the evaluation team. The annual savings is confirmed as 33.799 million gallons annually.

5.5.2 Harris County Fresh Water Supply District

5.5.2.1 Project Overview

The Harris County Fresh Water Supply District (HCFWSD) project consisted of inspecting 74,000 feet of waterline for leaks. Through the duration of the project, a total of 45 leaks were repaired, 9 unauthorized connections were identified, and 3 fire hydrants were replaced.

5.5.2.2 Water Savings Analysis

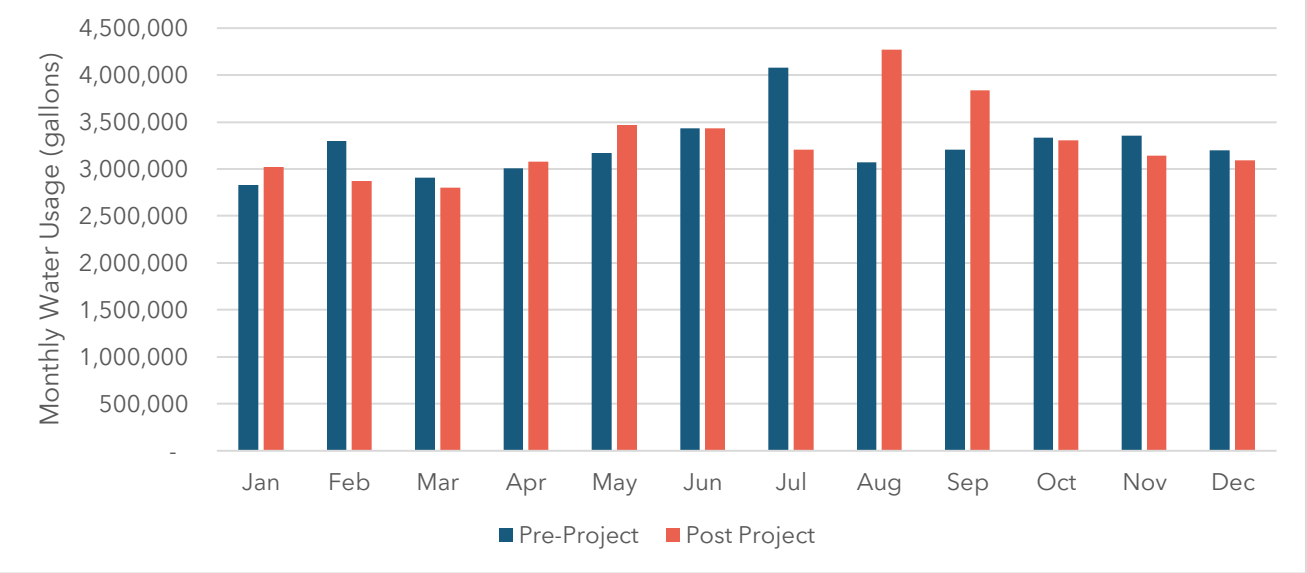
Methodology

This analysis compares the monthly water usage billing data the year before and after the leak detection project. Leak detection began in July 2022 and ended in July 2023. We used the most recent years of pre-project data (July 2021 to June 2022) to establish the pre-usage baseline. Similarly, we used the year following the project (August 2023 to July 2024) as the post project dataset. Savings were then calculated based on the differences in the pre/post project's annual usage.

Results

The pre and post monthly water usage is shown in the following figure. Note, there is not a dramatic decrease in usage after the project.

Figure 5-5: Pre and Post Monthly Usage



The following table shows the difference in the average annual usage before and after the leak detection project was conducted. The most recent pre-project year had an annual usage of 38,876,000 gallons. The year following the project had an annual usage of 39,527,000 gallons. This represents a post project increase of 651,000 gallons a year which is a 2% increase.

Table 5-5: Annual Usage

Usage Phase	Annual Usage (gal)
Pre-Project Usage[20]	38,876,000
Post-Project Usage[21]	39,527,000
Difference in Year-on-Year Usage	**+651,000**

Initial estimates suggested that repairing these leaks saved 6,440,040 gallons in 2024. These estimates assumed that the system included 890 connections that each used 4,500 gallons a month. These assumptions and estimates suggest that repairing the leaks saves about 6.5 million gallons a year. However, these estimates are based on a projected number

[20] This period ran from July 2021 to June 2022.
[21] This period ran from August 2023 to July 2024.

of connections and gallons used a month. Attempting to verify these results, we calculated the change in the monthly usage before and after the leaks were repaired. The pre-post analysis accounted for before and after the leaks were repaired, suggest that the repairs resulted in 13.4% higher water usage.

The discrepancy in the initial estimated savings and the savings based on the billing analysis may be the result of limitations of both methodologies. The billing analysis is based on the population level billing data for HCFWSD. Therefore, the pre and post project usage may be affected by additional factors that overwhelmed any savings produced by the leak detection project. Alternatively, the initial estimate depends on a variety of assumptions and calculated values which may be under or overestimated, and could not be verified during this evaluation. For these reasons, we recommend neither the negative or positive savings value in favor of a null impact.

5.6 AMI Findings and Results

5.6.1 City of Friendswood

5.6.1.1 Project Overview

In 2022 the City of Friendswood (COF) implemented Advanced Meter Infrastructure (AMI) enhancement project to gain better resolution of water meter readings. AMI meters are expected to offer more accurate readings than the previous mechanical water meters. Furthermore, a Customer Engagement Portal was developed to give customers access to real time usage data so they can track and improve water consumption with leak notifications. Additionally, AMI data would allow COF to reduce usage by allowing them to better identify leaks, implement customer usage visualization programs, and observe water usage trends.

This analysis found that water accounted for increased post AMI installation by 23% or 16,096,367 gallons per year. However, the approach is based on monthly usage data which may be affected by additional factors.

5.6.1.2 Limitations

To accommodate the available data, this approach assumed that the new AMI system is the cause of all changes in the amount of water accounted for. However, it is much more likely that total is affected by other factors such as weather, population shifts, etc. Therefore, it would be more beneficial to evaluate the project impact by measuring the combined savings by all programs that have been made possible by AMI data. For example, the true project impact would be the combined savings from AMI drive leak detection initiatives and

engagement/education programs based on customer AMI data. Finally, the observed differences in the pre/post water accounted for may be an artifact of inaccuracies in the previous mechanical system.

5.6.1.3 Water Savings Analysis

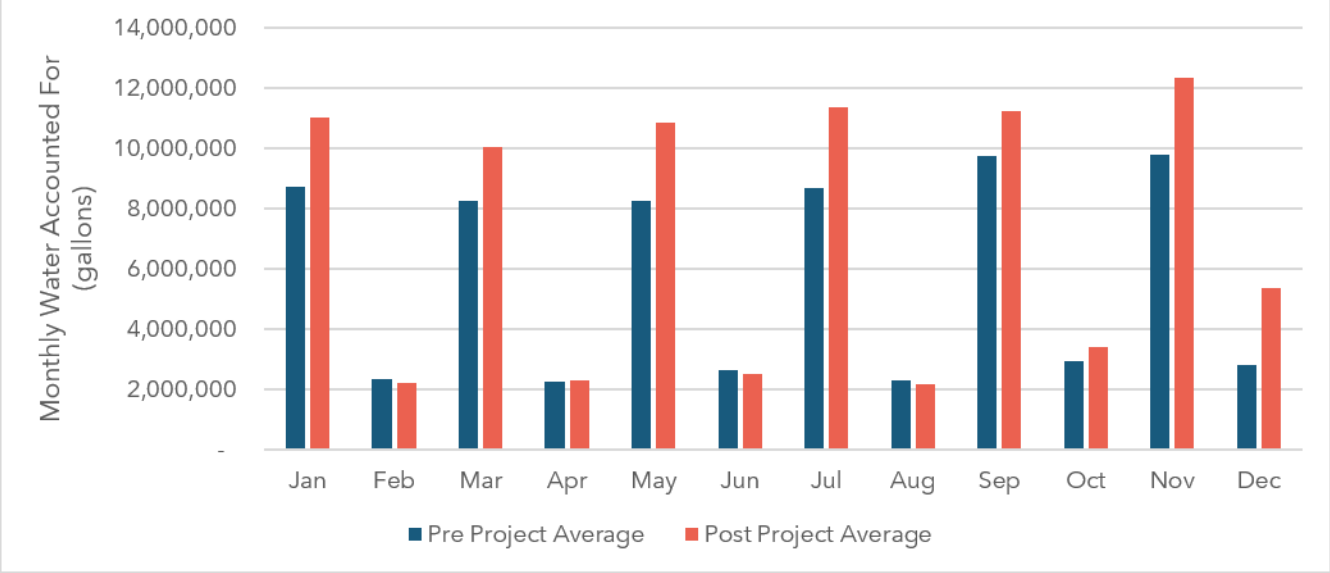
Methodology

This analysis compares the average monthly and annual water accounted for before and after the AMI project was installed. The monthly usage data ranged from 2017 to 2025. AMI meter installation began in January 2022 and ended in June 2023. We used 5 years of pre-installation data (January 2017 to December 2021) to establish the pre-project baseline. We used all available post installation data (July 2023 to December 2025) to determine the post project averages. Savings were then calculated based on the differences in the pre/post averages.

Results

The average pre and post monthly water accounted for is shown in the following figure. Note, for all months the average water accounted for increased after the project. The distinct spike in every other month is likely driven by the billing cycles not being balanced across months and a more accurate account of water accounted for.

Figure 5-6: Pre and Post Monthly Water Accounted For



The following table shows the difference in the average annual water accounted for before and after the new AMI system was installed. The five-year pre-project average annual water accounted for was 68,702,800 gallons while the post-project average annual water accounted for was 84,799,167. The annual water accounted for increased 23% after the project. This represents an annual increase of 16,096,367 gallons a year.

Table 5-6: Annual Water Accounting

Accounting Phase	Annual Water Accounted For (gal)
5 Year Pre-Project Average Water Accounted For[22]	68,702,800
Post-Project Average Water Accounted For[23]	84,799,167
Difference in Average Water Accounted For	**+16,096,367**

5.6.2 City of Galveston

5.6.2.1 Project Overview

In 2022 the City of Galveston (COG) implemented Advanced Meter Infrastructure (AMI) enhancement project to gain better resolution of water meter readings. This was expected to reduce water usage as AMI data can be used to identify leaks, track customer engagement, and promote water conservation through education and/or incentive programs. a Customer Engagement Portal was developed to give customers access to real time usage data so they can track and improve water consumption with leak notifications. COG installed 26,914 meters in sizes that ranged from 5/8 inch to 10 inches.

5.6.2.2 Limitations

To accommodate the available data, this approach assumed that the new AMI system is the cause of all changes in the amount of water accounted for. However, it is much more likely that total water accounted for is affected by other factors such as weather, population shifts, and other factors. Therefore, it would be more beneficial to evaluate the project impact by measuring the combined savings by all programs that have been made possible by AMI data. For example, the true project impact would be the combined savings from AMI drive

[22] This period ran from January 2017 to December 2022.
[23] This period ran from July 2024 to Dec 2025.

leak detection initiatives and engagement/education programs based on customer AMI data. Additionally, the change in recorded water accounted for may be the result of updated the AMI meters may be more accurate than the previous meters.

5.6.2.3 Water Savings Analysis

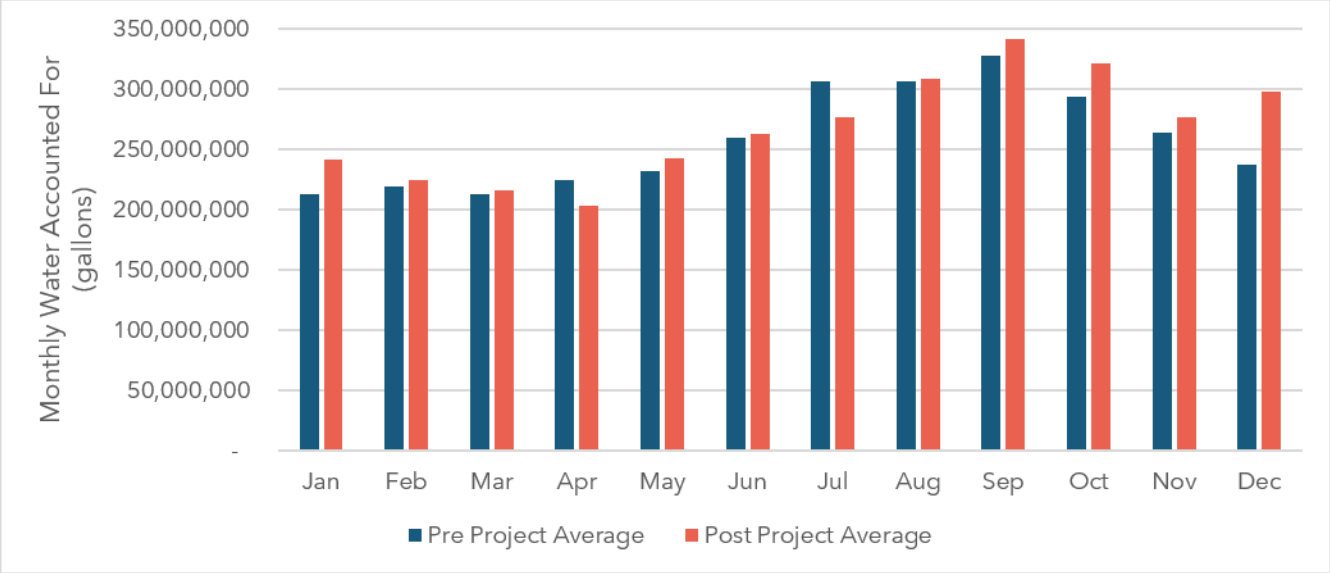
Methodology

This analysis compares the average monthly and annual water accounted for before and after the AMI project was installed. The monthly usage data ranged from 2017 to 2025 and included Domestic and Sprinkler subcategories. AMI meter installation began in February 2022 and ended in December 2023. We used 5 years of pre-installation data (February 2017 to January 2022) to establish the pre-project baseline. We used all available post installation data (January 2024 to December 2025) to determine the post project averages. Savings were then calculated based on the differences in the pre/post averages.

Results

The average pre and post monthly water accounted for is shown in the following figure. Note, the average water accounted for generally increased after the project. The largest increase occurred in December when the post project average was over 25% greater than the pre-project average. The biggest pre/post decrease occurred in April where the post project average was 9% less than the pre project average.

Figure 5-7: Pre and Post Monthly Water Accounted For



The following table shows the difference in the average annual water accounted for before and after the new AMI system was installed. The total pre-project average annual water accounted for was 3,095,411,064 gallons while the post-project average annual water accounted for was 3,213,120,768. The annual water accounted for increased 4% after the project. This represents an annual increase of -117,709,704 gallons a year. This total was driven by changes in the sprinkler water accounted for and the domestic water accounted for. The post project sprinkler water accounted for increased by 8,648,409 gallons a year which is a 2% increase. Furthermore, the post project domestic water accounted for increased by 4% which is an annual increase of 109,061,295 gallons.

Table 5-7: Annual Water Accounting

Accounting Phase	Annual Water Accounted For (gal)
Pre-Project Average Sprinkler Accounted For [24]	356,411,121
Post-Project Average Sprinkler Accounted For [25]	365,059,530
Difference in Accounted Average Sprinkler Accounted For	**+8,648,409**
Pre-Project Average Domestic Accounted For	2,738,999,943
Post-Project Domestic Total Accounted For	2,848,061,238
Difference in Accounted Domestic Accounted For	**+109,061,295**
Pre-Project Average Total Accounted For	3,095,411,064
Post-Project Average Total Accounted For	3,213,120,768
Difference in Accounted Average Accounted For	**+117,709,704**

[24] This period ran from January 2018 to December 2022.
[25] This period ran from July 2024 to Dec 2025.

5.6.3 City of Webster

5.6.3.1 Project Overview

In 2023 the City of Webstar (COW) implemented Advanced Meter Infrastructure (AMI) enhancement project to gain better resolution of water meter readings. This was expected to reduce water usage as AMI data can be used to identify leaks, track customer engagement, and promote water conservation through education and/or incentive programs. COW installed 63 meters in sizes that ranged from 1 inch to 6 inches. Furthermore, a Customer Engagement Portal was developed to give customers access to real time usage data so they can track and improve water consumption with leak notifications. This analysis found that water consumption increased post AMI installation by 48% or 258,302,550 gallons per year. However, the approach is based on monthly water accounted for data which may be affected by additional factors.

5.6.3.2 Limitations

To accommodate the available data, this approach assumed that the new AMI system is the cause of all changes in water accounted for. However, it is much more likely that total water accounted for is affected by other factors such as weather, population shifts, and other factors. Therefore, it would be more beneficial to evaluate the project impact by measuring the combined savings by all programs that have been made possible by AMI data. For example, the true project impact would be the combined savings from AMI drive leak detection initiatives and engagement/education programs based on customer AMI data.

5.6.3.3 Water Savings Analysis

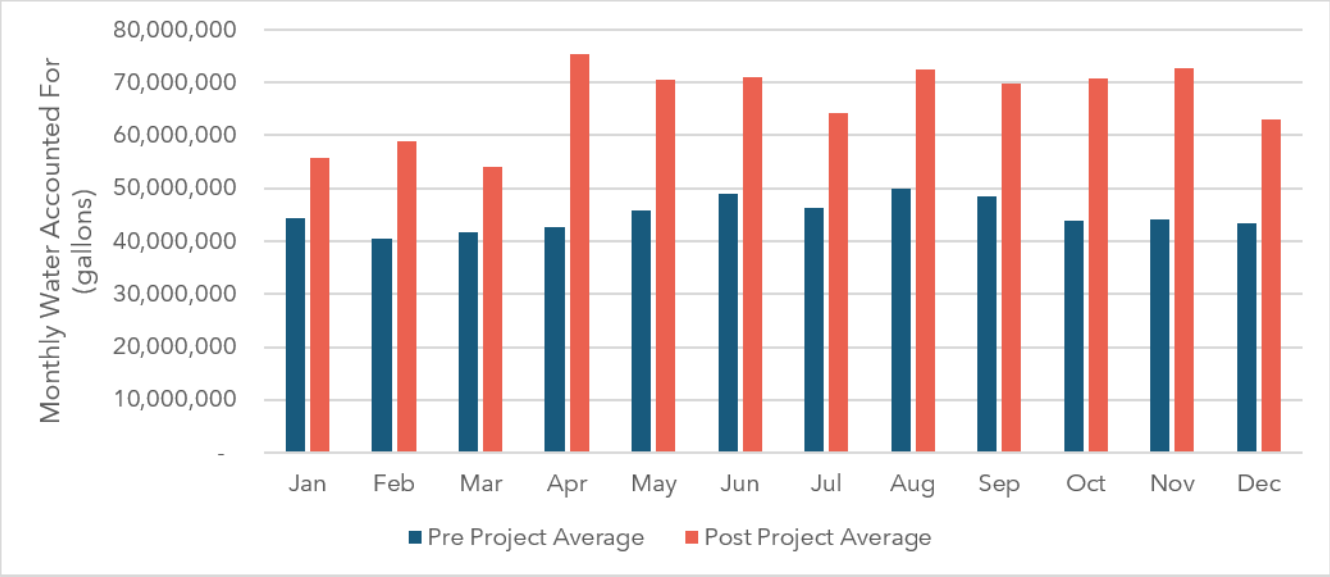
Methodology

This analysis compares the average monthly and annual water accounted for before and after the AMI project was installed. The monthly accounted for data ranged from 2017 to 2025 and included Residential, Muli-Family, Commercial, Commercial – Sprinkler, Industrial, and Fire subcategories. AMI meter installation began in January 2023 and ended in June 2024. We used 5 years of pre-installation data (January 2018 to December 2022) to establish the pre-project baseline. We used all available post installation data (July 2023 to December 2025) to determine the post project averages. Savings were then calculated based on the differences in the pre/post averages.

Results

The average pre and post monthly water accounted for is shown in the following figure. Note, for all months the average accounted for increased after the project. The largest increase occurred in April when the post project average was over 75% greater than the pre-project average. The smallest increase was in March, which only had a 30% increase in post-project average.

Figure 5-8: Pre and Post Monthly Accounted For



The following table shows the difference in the average annual accounted for before and after the new AMI system was installed. The five-year pre-project average annual accounted for was 540,050,200 gallons while the post-project average annual accounted for was 798,352,750. The annual accounted for increased 48% after the project. This represents an annual increase of 258,302,550 gallons a year.

Table 5-8: Annual Water Accounting

Accounting Phase	Annual Water Accounted For (gal)
5 Year Pre-Project Average Water Accounted For[26]	540,050,200
Post-Project Average Water Accounted For [27]	798,352,750
Difference in Water Accounted For	**+258,302,550**

5.7 Showerhead Water Savings Results

5.7.1 Harris County MUD

5.7.1.1 Project Overview

The project provided low-flow showerheads to residents during community events. A total of 302 showerheads were distributed, despite plans to provide more. The community events appeared very successful. Customer data was not provided so no primary data collection with the showerhead recipients was possible.

5.7.1.2 Water Savings Analysis

The showerhead savings calculation relied on the showerhead savings value derived in the SmarterAboutWater savings calculator that claimed 3,609 gallons per year using regional and publicly available data. The simple savings calculation is:

$$302\ units\ \times\ 3{,}609\ \frac{gallons}{unit} = 1{,}089{,}918\ gallons$$

5.8 Grant Program Savings Overview

The grant projects varied in the amount of savings achieved. Overall, many projects produced savings validated through engineering or regression analysis, or weather and rainfall normalization of consumption data. The nature of many projects occurring within half a decade meant that project documentation was not always complete, and repeated attempts to interview someone affiliated with the project were not always successful.

[26] This period ran from January 2018 to December 2022.
[27] This period ran from July 2024 to Dec 2025.

Ultimately, four of ten grant projects completed an interview. Another challenge was the granularity of data, or lack thereof. For large, city-wide or school district-wide systems, without devoted metering for the treated end-use, finding the savings was not always possible. Lastly, the long time horizons often meant changes to either the project itself or the functioning of the jurisdiction, such as adding additional irrigated acreage over the years.

Table 5-9 shows the savings summary of the seven non-AMI projects, showing a combined annual savings of 45 million gallons.

Table 5-9: Grant Project Savings Summary (Non-AMI projects)

Project Name	Annual Savings (Gal)
Terranova West MUD (TWMUD)	4,662,036
Harris County MUD 50 (HCMUD 50)	1,089,918
Harris County Fresh Water Supply District 1A	0
Utilis Satellite Water Loss Location for League City Water System	33,799,000
CCISD Centralized Irrigation Control	944,313
KISD Centralized Irrigation Control*	2,105,323
City of West University Place (COWUP)	3,412,026
Total	**46,012,616**

*Note, not an annual value, and based on just 4 months of available data.

The three AMI projects were unfortunately not able to be interviewed and thus the pre- and post-project consumption data could not be discussed with the Grantees. In all cases, the usage appeared to increase. The evaluation team does not believe that the implementation of AMI technology inherently increases usage, but likely is witnessing a case of greater accuracy of measurement. Table 5-10 shows the increases in annual usage observed.

Table 5-10: AMI Project Annual Usage Observed Change

AMI Projects	Increase in Annual Usage (Gal)
City of Galveston	117,709,704
City of Webster	258,302,550
City of Friendswood	16,096,367

5.9 Recommendations

Recommendation 1: Require monthly usage of all included systems. Partial year data does not provide the full picture of project impacts. Anywhere possible, also require end-use specific metering (such as irrigation only, not whole property).

Recommendation 2: Track and save local Evapotranspiration values.

These analyses used evapotranspiration values to adjust the smart irrigation system's raw usage to reflect the usage of a year with average weather conditions. To this end, we used the Turc equation to estimate the reference evapotranspiration value. The Turc equation is convenient as it can be calculated using common weather metrics. However, the value calculated from the Penman-Monteith equation would be more robust and offer more accurate results. Therefore, it would be useful for future analyses to use the Penman-Monteith equation to calculate and save the reference Evapotranspiration for the local area.

Recommendation 3: Require recipients to report irrigated square footage changes.

Multiple grant recipients expanded their irrigated area after or shortly before their new system was installed. This complicated the results as it was difficult to sperate how changes in their usage were due to the new system or the expansion of the irrigation area. However, future analysis can account for this by comparing the water usage per square foot pre and post project. Therefore, we recommend asking recipients to report the pre and post irrigated square footage if they expand their irrigation system.

Recommendation 4: Have recipients report system relocations.

One of the grant recipients reduced their irrigation area by replacing a field with turf. As a result, they relocated irrigation network controllers to new sites. The full story around this was not known until this evaluation effort interviewed the site manager. It is possible that such relocation will occur again in the future. Therefore, we recommend asking recipients to report any major changes to their system.

Recommendation 5: Evaluate behavior programs at an individual level.

Part of the AMI rollout often included customer portals, education programs, and water saving incentive programs. These initiatives may have effectively reduced customer water usage in ways that are not immediately noticeable in the total population usage data because the population is affected by many other factors such as weather. Therefore, we recommend evaluating these programs individually via randomized treatment and control groups.

Recommendation 6: Account for changes in sensor accuracy.

A potential confounding factor in AMI based analysis is the sensors and infrastructure used to measure usage changed before and after the project. This may cause a mirage where false savings or losses may appear in the data because of different sensor accuracy instead of actual changes in usage. Future analysis should account for these differences by either trying to directly measure the accuracy of the pre-post system or find studies estimating the accuracy direct of the previous equipment.

Recommendation 7: Begin analysis with raw billing data.

The COF water project included data that spiked every other month. This is likely the result of billing cycles beginning and ending in different months. Future analysis can account for bill cycles by calendarizing the data, i.e. using bills to estimate the monthly usage instead. However, this process requires using raw billing data. Therefore, we recommend starting analysis with the raw billing data instead of data that has already been aggregated to monthly level, if available.

Recommendation 8: Evaluate leak effects at individual/localized level.

The current analysis evaluates the impact of leak detection and repair at the population level. However, population usage is affected by factors such as weather. Therefore, future analysis should use best practices to determine water loss for each individual leak or evaluate usage data on a more localized scale.

5.10 Citation

Kurnik, C. W., Stoughton, K. M., & Figueroa, J. (2017). *Outdoor Irrigation Measurement and Verification Protocol* (No. NREL/SR--7A40-70218). National Renewable Energy Lab.(NREL), Golden, CO (United States). Retrieved from https://westernresourceadvocates.org/wp-content/uploads/2019/04/MV_Outdoor-Irrigation.pdf

Trajkovic, S., & Kolakovic, S. (2009). *Evaluation of reference evapotranspiration equations under humid conditions*. *Water Resources Management*, *23*(14), 3057-3067.