Water Efficiency Grant Program 75% Progress Report

Project Name: School District Water Efficiency Project

PO #: PO PDAA 20150000000000000231

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Success of meeting previously identified goals and objectives

Task 1: Perform Indoor Water Assessments – *Completed on time by April 15, 2015*

Beginning in February of 2015 the Center for ReSource Conservation (CRC) began performing indoor water assessments at 20 pre-selected schools within the St. Vrain Valley School District (SVVSD). These assessments were used to evaluate and identify water conservation opportunities within restrooms, kitchens and classrooms in the district. At each school the main objective was to test all water-using fixtures and record specifications of the water-using appliances. Data collected during each assessment was entered into an Excel-based commercial auditing tool (created by the Brendle Group) along with utility rate information. The output from the tool for each school was included as an attachment with the 50% progress report. The aggregation of the indoor assessment data is included was also included as an attachment with the 50% progress report. These two attachments were the two pieces of information provided to the district by April 2015.

While the primary goal of the indoor assessments was to gather data for the analysis of potential and recommended water savings, a secondary goal was to identify processes within each school that could be changed to use less water. As noted in the 50% progress report, identifying process improvements within each school as an obstacle that we encountered. As explained in the "Preliminary Findings and Accomplishments" section below, CRC took steps to address this deficiency through the creation of a water use survey for all staff within the district.

Another part of the indoor assessments was involving the students so as to pass on information about the theories and methods of water conservation. Longmont Estates Elementary School encouraged an after-school group of students to participate in the water assessment. It was a great success, as discussed in the 50% progress report and further below in the "Task 3" section. No other schools were able to gather a group of students for an assessment.

Task 2: Perform Outdoor Water Assessments – *Completed on time by September 30, 2015*

The SVVSD staff identified the top 10 highest water using schools for the outdoor irrigation assessments. They decided to limit the focus to schools that receive water from a municipality, rather than from an irrigation ditch, in order to ensure that any savings gained would directly reduce their water bills. The 10 schools chosen were also a subset of the schools

that received an indoor assessment, therefore providing whole-school audits for half of the schools included in this project.

Complete irrigation system evaluations were performed at all 10 schools during the summer of 2015. Two CRC technicians were assigned to the project and performed all of the assessments so as to maintain continuity throughout the project with the assessments. The summary of the data that they collected was included as an attachment in the 50% progress report.

In addition to the 10 irrigation assessments SVVSD staff requested help assessing the viability and utility of a weather-based irrigation control system. The district was already considering purchasing and installing one of these systems, however they wanted more information on what kind of potential savings one of these systems could offer them. CRC was able to provide an analysis of historical water usage along with the historical ET demand, allowing the district to have some information on how well their previous watering had matched the ET demand. Findings from this assessment were presented to the district in a short report, and were included as an attachment in the 50% progress report.

Task 3: Provide educational lessons and opportunities for students and staff – *Completed on time by 1/21/16*

There are three subtasks associated with this task. Details of each task are explained below the corresponding titles.

Sub-task 1: To develop a database of lesson plans for educators

The first subtask was to develop a database of lesson plans for educators around water and water conservation. This task has been completed. Lessons for K-12 class levels, both for sciences and non-sciences, were gathered, summarized and organized in a way that allows for teachers to easily locate relevant learning activities for whichever subject and age that they are teaching. In addition, CRC researched the SVVSD and State curriculum requirements to include with each lesson, making it easier for the educators to figure out how these lessons apply to the requirements that they must cover.

After compiling the list of lessons for educators in a spreadsheet, we met with Michael O'Toole, lead K-12 Science coordinator for the district, to discuss the format that would be best to have the database presented as. Mr. O'Toole maintains an educational blog for the district and he suggested that we create a blog post that contained all of the lessons in an organized format. Then, he offered to send out the blog post to all educators in the district. With significant work and support from Michael O'Toole, the blog post became an entire blog site of it's own, devoted to a broad array of topics pertaining to Colorado water. The blog is now live at http://blogs.svvsd.org/water/. The database of lesson plans is found at https://blogs.svvsd.org/water/k-12-lessons/. An image of this blog is included in the "Preliminary Findings and Accomplishments" section below.

Another section/page of the blog that is still under construction is a summary of the findings from the indoor and outdoor assessments performed by CRC (https://blogs.svvsd.org/water/st-vrain-schools-report/). This page will allow students,

educators, staff and other SVVSD community members to also learn a little more about water use and efficiency opportunities within their own schools. This page will be created prior to the completion of Task 4.

Sub-task 2: Deliver lessons to students through classroom and/or environmental clubs

The third subtask was to deliver lessons to students through classroom and/or environmental clubs. This subtask has been accomplished through two means, however more work will continue to address the deliverables of this subtask, which include submissions from educators on lesson plans used. First, the Water Blog, that was discussed in the previous subtask, was shared via email with 682 educators from SVVSD as well as through another email list with the Colorado Science Educators Network that carries contacts from across the entire state. Since these two emails went out in early January, there have been 742 unique views of the blog and the SVVSD email list had a 68.3% open rate (as of 1/19/16). Moving forward, CRC will connect with educators who have used the blog site and lessons from the site, in order to get direct feedback on the lesson plans and other resources available within the blog. Michael O'Toole, the district's K-12 Science Coordinator, and Dara Ward, the district lead on sustainability projects, will connect CRC with educators who have taken interest with the blog and who have used it in their classrooms in order to assess the success and challenges of the lessons, to receive feedback on the curriculum and to learn what it needs to better serve the needs of the teachers and district.

The second means of delivering lessons to students has been through the student-led assessment at Longmont Estates Elementary School. The students were part of an after-school program that functioned similar to a club and was lead by a teacher. The grades of the students ranged from 3rd-5th grade. Before walking around the school to measure flow rates and assess fixtures and appliances, a CRC staff member gave a lesson on water conservation, including a discussion with the students about why it is important and why it mattered at their school. More about the assessment is discussed below under Sub-task 3.

Sub-task 3: Student-led assessment of before and after water conservation upgrade

The next subtask was to coordinate student-led assessments of the school water use, before and after implementation of the upgrades. This sub-task has been partially completed. As described above, in the spring of 2015 CRC's staff met with a teacher and a group of 10-12 students in an after-school program from Longmont Estates Elementary and as a group, the water conservation assessment was performed. It was a great, hands-on experience for the students who were able to see the difference in flow rates at faucets all over their school, among other observations. The students were provided with their own "home made" flow rate bags for testing faucet aerator flow rates. They acted as guides around the school, taking the group to every fixture throughout the entire building. At the end of the tour, the students were allowed to keep their flow rate bags and were encouraged to take them home and work with their families to measure how much water was used by the faucets in their own homes. Photos from this

assessment are presented in the "Preliminary Findings and Accomplishments" section below.

In order to fully complete this subtask more work will need to be done to engage students in measuring and assessing water use within some of the schools. The goal of these exercises is to educate the students on the concepts and methods of water conservation. As described in Task 4 below, the school has not yet received any of the indoor fixtures that will be used for a portion of the district's upgrade, therefore, there has not yet been the chance for students to measure "after" water flow rates. This will be able to occur, however, once the new fixtures arrive. This work is being coordinated with the Energy and Sustainability Manager as well as the district's Lead Plumber.

Task 4: Implementation for Water Savings – *In Progress, due 2/26/16 extension request to 3/26/16*

This task is composed of the analysis of the indoor and outdoor assessment, the recommendation process to SVVSD staff, the decision-making process with CRC and SVVSD staff as to what action will be taken and then the implementation of those actions. The first of the two subtasks has been completed and the second sub-task is underway.

Sub-task 1: Evaluate findings from indoor and outdoor assessments

A complete report with the findings from the indoor and outdoor assessments was provided to SVVSD staff (in person) on November 12, 2015. This report can be found as **Attachment 1**. One major part of this report, a detailed, organized, and customized list of water efficiency improvement opportunities, is presented in the "Preliminary Findings and Accomplishments" section below.

After presenting this report to the district staff (including to the Energy and Sustainability Manager, Manager of Building and Outdoor Services, Irrigation Lead, Grounds Lead, and Plumber Lead) the group discussed which upgrades would be best for the district, and set a plan for beginning the process for completing the upgrades. The next sub-task presents the progress made along the process of implementing the upgrades.

Sub-task 2: Order parts and implement water conservation efforts

From the list of recommended water efficiency improvements, as well as from some other suggestions and ideas provided by the district staff themselves, the district has begun to implement some upgrades. CRC staff have collaborated closely with SVVSD to ensure that each chosen upgrade is appropriate and will likely produce water savings at the schools where the assessments took place.

The irrigation-focused staff proposed the idea of using some of the grant funds to purchase and pilot a controller and master valve to help improve irrigation efficiency. The school where they will install it is Mountain View Elementary School where, according to CRC's analysis (see Attachment 1), was one of the schools where consistent over-watering has occurred for at least the past two irrigation seasons. When asking the Irrigation Lead, Dale Bjorhus, for his reasoning of why this controller would be helpful for the district he explained:

The controller is a specialized unit that has the capability to learn what each zone in the system needs to run properly in terms of GPM. Once the controller learns what each zone needs it will monitor each zone during its run cycle an if it notices a change in flow rate due to a broken head or lateral it will shut that zone down, send a alarm to our central control and continue on with the program starting with the next zone. The controller will also monitor the mainline and if it detects flow when a program is not running it will recognize this as a mainline leak and it will shut down water flow to the system and send out an alarm. We should be able to eliminate the loss of water due to broken heads, laterals and mainlines that could go un-noticed for a considerable amount of time.

Dale and the other irrigation staff felt that this instrument could greatly contribute to improving the school's outdoor water use efficiency. CRC agreed and approved of the suggestion to pilot this technology at one of the schools where the irrigation water use has been consistently higher than what was measured as necessary over a multi-year time period. If our extension requests are granted, the final report for this grant will include an analysis of this school's outdoor water use compared to ET, as well as a table detailing this and all upgrades that occur with grant funds.

The other water efficiency upgrade that is relatively certain at this time is the replacement of aerators at some of the schools that received an indoor assessment. CRC and SVVSD staff are working together to plan the installation of the devices and possibly engage students in part of the process as well.

Task 5: Data Analysis and Reporting – *Due 4/1/2016 extension request to 7/1/16*

This task is included to provide for an opportunity to measure any changes in water use from the implementation of the upgrades. It also provides an opportunity for CRC to report to the school the final outcome of the project. It will only provide preliminary analysis of any savings as the time frame between the implementation and the analysis will be less than three months. If the extension is granted, this three month period will now coincide with the outdoor watering season and therefore will provide direct information on approximate water savings gained from upgrades to the irrigation system.

Obstacles Encountered

The primary obstacle encountered has been the direct access to students within the district. In general, students have very regimented schedules during their daytime classes, with very little opportunity for additional or new activities and material to be added to their curriculum. This was evident from the beginning of the project, however CRC had hoped to discover at least a few opportunities to directly interact with students, or with educators who would then directly interact with students. While this level of interaction with students and teachers has not yet occurred; there are plans to coordinate this interaction. This work is planned to be completed by the end date for Task 4.

Another challenge has been the length of time that it can take for the district to figure out which upgrades that they would like to pursue, and then find the time and staff to implement

these changes. It has taken longer than expected to get through this process. The positive aspect of this challenge is that the district is truly taking the time needed to consider each upgrade opportunity, and will therefore likely make the final outcomes of the project more successful.

Preliminary Findings and Accomplishments

Task 3 has been primarily focused on accomplishments, and while we were not able to accomplish all of the originally planned activities, other opportunities arose that have allowed us to feel that we have successfully met the goals of the task. Ongoing efforts to fully complete each sub-task under Task 3 will be accomplished by the completion date for Task 4. Furthermore, much time has been spent on Task 4 and therefore some accomplishments below reflect this work as well.

In order to further promote and spread word about the great educational that Michael O'Toole of SVVSD and CRC partnered to create, the St. Vrain Valley Schools Water Blog, a survey intended for all staff within the district has been completed. The goal of the survey is both to understand water use habits at the schools and to inquire about water efficiency knowledge and awareness amongst the staff. It also contains a question about whether or not the staff have seen and used the Water Blog, therefore gaging it's visibility across the district. All of the questions that will be asked are as follows:

SVVSD Staff Survey on Water Use at Work

*Required Question(s)

Dear SVVSD Staff,

Please take 5 minutes to complete the below survey. The SVVSD Energy & Sustainability Department is working with the Center for Resource Conservation to better understand how our schools interact with water. We are gathering information on water usage and perceptions so we can improve conservation efforts, education, and gaps in addressing problematic areas. Please be honest in your response!

*1. What school or building do you work in?

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* 2. Select the activities below during which you think about water conservation at your school. Select all that apply.

- [ ] Drinking water
- [ ] Washing my hands
- [ ] Flushing the toilet
- [ ] Showering
- [ ] Cleaning items in the sink
- [ ] Using water to prepare food for myself
- [ ] Using water to prepare food for others
- [ ] Watering indoor plants or providing water to animals
- [ ] Watering plants outside
- [ ] Other

* 3. What is your primary source of drinking water at work?

- ○ Bottled water
- ○ Water fountain
- ○ Bottle filling station
- ○ Bathroom faucet or kitchen sink
- ○ Other

4. If you REFILL a reusable water bottle at work, select the answers below that most

closely describe the reasons that you refill your water bottle. Select all that apply.

- [ ] I do it because it is convenient.
- [ ] I don't want to pay for bottled water.
- [ ] I do it out of habit.
- [ ] I want to reduce my contribution to the waste stream.
- [ ] I worry about the quality of bottled water.
- [ ] Other

5. If you do NOT refill a reusable water bottle at work, please select the answers below that most clearly describe the reasons why you do not. Select all that apply.

- [ ] The water fountains and/or faucets look dirty.
- [ ] The design of the water fountains makes it difficult to refill.
- [ ] It is more convenient to buy bottled water than to carry a reusable water bottle.
- [ ] I dislike the taste of tap water.
- [ ] I worry about the water quality of the water fountains and faucet water at work.
- [ ] Other

6. If you are an educator within the district, do you currently teach any lessons about or related to water (e.g. water cycle, water quality, history of water/environment, etc.)? If you do, please describe the lesson topic/focus in the space provided below.

- ○ Yes
- ○ No

Comment:

500 characters left.

* 7. Are you aware of any signs at your school that promote water use awareness? If so, please detail what they say and where they are in the space provided below.

- Yes
- No

Comment:

500 characters left.

* 8. If you were to find a water leak at your school, do you know how to report it so that it can be fixed?

- Yes
- No
- Other

* 9. If you were to find a leak outdoors, including a broken sprinkler head on district property, do you know what to do to report it?

- Yes
- No
- Other

* 10. Do students know what to do if they discover a water leak at school?

- Yes, they do.
- Some do, some do not.
- No, they do not.
- I don't know.
- Other

* 11. Have you ever noticed water leaking from a faucet, water fountain, sprinkler system or other fixture at school?

- ○ Yes
- ○ No
- ○ Other

12. If you have noticed water leaking from a fixture, what kind of fixture was it (choose all that apply) and please describe what you did about the leak in space provided below.

- ☐ Bathroom faucet
- ☐ Toilet
- ☐ Kitchen faucet
- ☐ Classroom faucet
- ☐ Urinal
- ☐ Showerhead
- ☐ Sprinkler system part
- ☐ Other

Comment:

500 characters left.

13. If you have reported a water issue, was the response adequate? If so, please provide an explanation in the box below.

- ○ Yes
- ○ No
- ○ I don't know

Comment:

500 characters left.

* 14. Have you seen the District's new water blog? https://blogs.svvsd.org/water/

- Yes
- No
- Other

15. Do you have any other ideas, comments or questions for SVVSD Energy & Sustainability Department or the Center for ReSource Conservation about water use in the schools?

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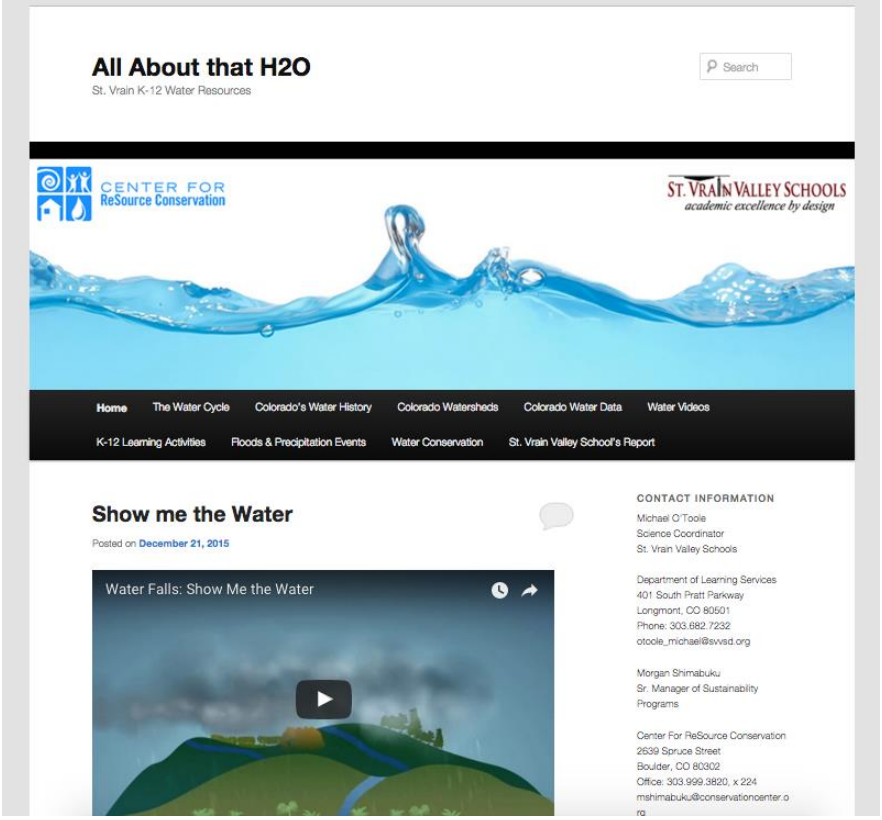
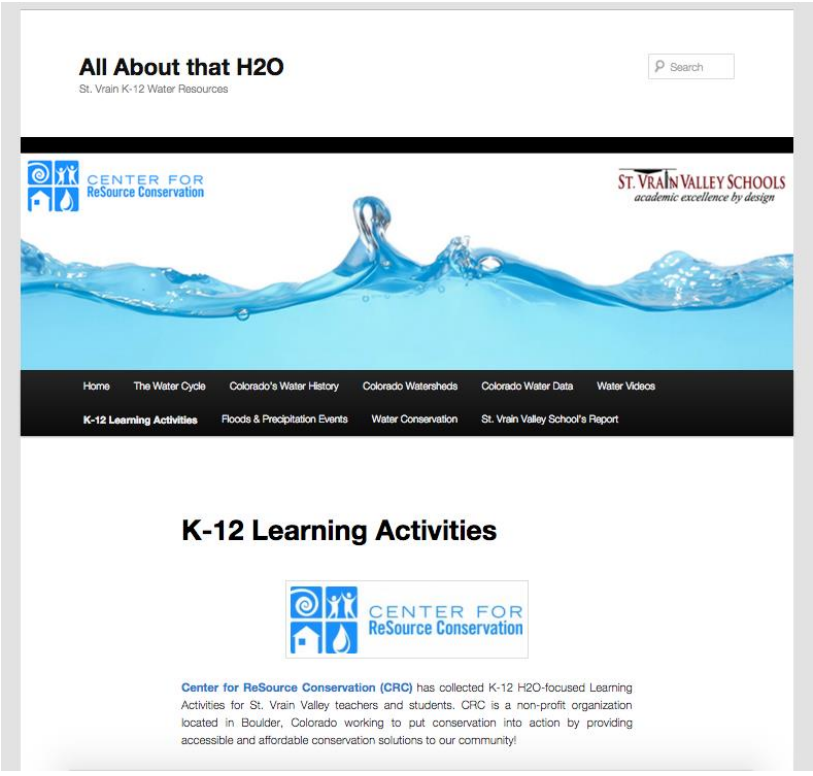
The Water Blog that was created is multi-faceted, with a diverse array of topics. It has over 30 unique sources of information, and in that way, is a compilation of the internet resources available to educators and students in Colorado about all-things water. For this reason, Mike O'Toole thought it worthwhile to share the blog with educators across the state, through the Colorado Science Educators Network. The blog was released in early January and so far has had (as of 1/19/16) 742 unique views. It has been shared with over 600 educators in SVVSD and the email that shared it had a 68.3% open rate. An image of the top of the main page of this blog is below.



An image of the Learning Activities page (created from the lesson database made by CRC) is below.



The student-led assessment at Longmont Estates Elementary School was a huge success. The students were very engaged and picked up the point of the exercise quickly. For example, whenever a hand-wash faucet had a higher flow rate than 0.5 gpm, they would (loudly) note the finding and make sure that it was recorded. Here are photographs from the assessment.

For Task 4 CRC wrote a report (**Attachment 1**) for the district including results from indoor and outdoor audits as well as recommendations on ways to improve water efficiency across the district. The table below was provided to the district along with that report as the summary of the major recommendations for the district.

Indoor Efficiency Improvements Opportunities		
Kitchen Fixtures	**Recommendation &/Or Observation**	**Further Information (If Applicable)**
PRSV	PRSVs were generally T&S or Fisher brand. The brush attachment was an important feature for the kitchen staff at most schools.	Fisher PRSV Model 2949 – 1.15 gpm, $40-$50 each, brush attachment available (Fisher 2949-9001, ~$20) http://www.webstaurantstore.com/fisher-2949-ultra-pre-rinse-spray-valve-for-pre-rinse-units/3402949.html
Sink Faucets	Faucet aerators can be used to reduce flow rates in sinks at a very small cost.	Many sinks were missing aerators, especially in kitchen-type faucets found in classrooms and/or the school kitchens. - Tamper-proof aerators are available, with male and female threads, with a variety of flow rates from AM Conservation Group. http://www.amconservationgroup.com/?post_type=product&s=aerators - Other tamper-proof aerators are available by T&S Brass. http://www.webstaurantstore.com/42251/faucet-aerators-flow-regulators.html

Restroom Fixtures	**Recommendation &/Or Observation**	**Further Information (If Applicable)**

Sink Faucets	Test metered sinks throughout the year to ensure they are running and turning off appropriately.	Metered sinks were common throughout many of the schools, approximately 15% of all metered sinks did not turn off on their own.
Urinals	WaterSense Urinal Flow Rate Spec is 0.5 gpf, however lower flush volumes are available and are already in use at SVVSD.	Many of the schools had urinals that specified usage of 0.125 gpf, the brand was Zurin. This flush volume is better than the WaterSense standard and we recommend using this same model when replacing old urinals, if the performance of this model is adequate in current schools.
Toilets	Run a pilot test of dual-flush toilet handle retrofits and 1-3 schools. Dual-flush handles can be retrofitted onto existing flushometer toilets to provide the option of a reduced flush for liquid waste.	Several companies make dual-flush handles for both 1.6 and 3.5 gpf toilets. - AMTC has models for urinals and for toilets. Reduced flush direction, for liquid waste, is down. http://www.amtcorporation.com/manualflushvalve.htm - Sloan also has a model, but the reduced flush direction, for liquid waste, is up. http://www.sloanvalve.com/Our_Products/UPPERCUT.aspx
	Replace flushometer diaphragms regularly.	To ensure that toilets continue to flush at the specification set by the manufacturer diaphragms/cartridges need to be replaced annually to biannually.
	Check flush cycle lengths - a properly functioning flush valve should not have a flush cycle longer than 4 seconds.	BMP cited by AWE. http://www.allianceforwaterefficiency.org/commercial_restroom_audit.aspx
	When replacing flushometer toilets, consider purchasing 1.28 gpf toilets.	Two SVVSD school, Red Hawk Elementary and Lyons HS/MS, contain several 1.28 gpf toilets and therefore can be a test location for this flow rate in the school setting. In addition, Drainlin transport of solid waste studies have found no significant difference in commercial or residential settings from the 1.6 gpf to the 1.28 gpf toilets. Please see the two studies here: http://www.plumbingefficiencyresearchcoalition.org/

General	Recommendation &/Or Observation	Further Information (If Applicable)

With regards to which schools to focus attention on	When considering which schools to focus on for upgrades and improvements, one aspect to take into consideration is number of restroom users and number of days that the facility is used.	Some schools have year-round student and staff presence due to summer schooling and may be better candidates for upgrades. High schools and middle schools have the highest number of students and staff and should also be considered for upgrades.
With regards to fixture brands	Nearly all top-brands have options for WaterSense fixtures, and through this third-party certified program you can ensure that your new fixture purchases are not only efficient, but that the product works as well or better than their non-efficient counter-parts. Flushometer toilets do not currently have a WaterSense specification, but are likely to have one in the next year.	EPA WaterSense Provides an online Product Search Tool that allows users to search by fixture type and brand. http://www3.epa.gov/watersense/product_search.html
With regards to reducing toilet clogs and backups	Reduce clogging and sewer-backups with educational campaigns around only using toilets from human waste. Consider educating students in a classroom/through announcements and with additional signage in the restrooms and/or restroom stalls. Adding trash cans could help as well.	Several janitors and other maintenance staff mentioned that the biggest problem encountered with regards to plumbing is toilet clogs, most often from student mis-use of toilets for trash and other materials.
With regards to water waste reporting processes	Currently, there is little to no processes in place for water-waste reporting by students and/or non-maintenance staff in the schools. Creating a process that allows the users to report water waste could lead to significant improvement in repair of leaking fixtures, appliances,	The process for reporting leaks could be different in every school, however some ways to promote the reporting of leaks could include: - Signage near/in restrooms and drinking fountains about what to do if leaks are spotted. - Classroom announcements that ask teachers and students to report leaks, unusual puddles, etc. - Online reporting system

and irrigation systems.

Outdoor Recommendations

Irrigation System Improvements	Recommendation &/Or Observation	Further Information (If Applicable)
Weather Based Irrigation Control System	Weather-based irrigation control (WBIC) systems have the capability to control the irrigation schedule based on ET demand. Different WBIC systems incorporate ET demand in different ways, and therefore, when compared, do not always provide equal performance.	The conventional wisdom around WBICs is that even at their best, WBICs cannot make up for poorly designed, installed, or functioning irrigation systems. The first step to becoming more water efficient is to ensure that these three aspects are operational to their full potential. After this, a WBIC controller can help to significantly improve the water application when weather conditions are significantly different than the anticipated/programmed conditions.
Sprinkler head replacements	While we do not recommend sprinkler head replacements as a broad measure for improving water use efficiency, in certain situations it can be used to improve the distribution uniformity of a sprinkler zone.	Based on several studies of rotary nozzles in real-world situations, the efficiency gains claimed by manufacturers have not been found. These findings contrast with tests done by the companies that sell the nozzles who found that they produced measurable water savings. Due to the contrast in the findings from the different groups, we do not recommend upgrading your nozzles with rotary nozzles for the purpose of improving efficiency.

Landscape Change Opportunities	Recommendation &/Or Observation	Further Information (If Applicable)

Turf replacement	If turf area is replaced, consider options beyond grass or fescue such as native and climate-adapted plants. Especially for places that do not receive foot traffic, the option to install native and climate-adapted plants can help to reduce the water requirement of the landscape by over 50%.	For in-depth information on native and climate-adapted plants that do well in the Colorado Front Range, two sources provide reliable information: Northern Colorado Water Conservancy District (www.northerncolorado.org) and the CSU Extension Service, Plantalk Colorado (http://www.planttalk.org/). Maintenance of these recommended landscapes will be different than maintenance of turf, however many reports have shown that maintenance time and cost is reduced when turf is replaced with climate appropriate plants because these plants do not need mowing and require very little if any supplemental nutrients (i.e. fertilizers).
Low-Water Demonstration Garden	Xeric Demonstration Garden Installation - for Education of students and staff	Some school districts have incorporated outdoor classrooms through the installation of water efficient landscapes. For example, see an article on the effects on a project in Texas (http://www.waterworld.com/articles/2015/10/toro-toyota-texas-land-care-wyland-foundation-help-west-dallas-school-create-water-smart-landscape.html). The funds from the grant could be used to support the planning, design and purchasing of materials for this landscape.

Potential Need for Revisions to the Scope of Work and Timelines

Due to the challenge of purchasing decisions within the district, it would be best if the project were allowed more time for Task 4: Implementation for Water Savings and Task 5: Data Analysis and Reporting. For Task 4, the addition of a single month would greatly benefit the project's goals and allow more time for the supplies to come in once ordered. It would also allow for the greater possibility of student involvement in the testing of the fixtures before and after installation. *For this task (Task 4), we request to move the completion date from 2/26/16 to 3/31/16.*

For the final task (Task 5) of reporting and evaluation, *we request to move the due date to July 1, 2016, from the current due date of 4/1/16*. This would allow impact to be measured of the irrigation controller that is being installed this spring, at least through the month of June.

Thank you for considering these revisions to our project timeline.

CRC Water Efficiency Grant Timeline and Progress

Task	Deliverables	Current Deadline	Billable Amt.	Completion Date
Task 1: Indoor Water Assessments	20 indoor water assessments completed Preliminary analysis of water conservation recommendations delivered to district staff	No change	$10,712	4/15/15
Task 2: Outdoor Water Assessments	10 irrigation assessments completed 50% Progress Report	9/30/2015	$15,712	9/30/15
Task 3: Water Conservation Education	Comprehensive, well organized database of water-related lesson plans for K-12 students Submissions from educators on lesson plans used Results from student-led water assessments and aerator replacements 75% Progress Report	1/21/2016 (database will be complete by 8/15/2015)	$6,274	1/21/16
Task 4: Implementation	Report compiling findings of indoor and outdoor assessments with recommendations from CRC Report from School District detailing plan for implementation including details of purchases with grant funds and matching funds and process changes Any water fixture purchases will be complete and delivered to all schools receiving the upgrades Water upgrades and/or process changes implemented and installed	2/26/2016 (Report from CRC and District will be completed by 10/30/2015)	$13,984	In Progress, Request for extension to 3/31/16
Task 5: Data Analysis and Reporting	Analysis of water savings and project accomplishments for school district Final Report to CWCB	4/1/2016	$2,200	Request for extension to 7/1/15

2015

ST. VRAIN VALLEY SCHOOL DISTRICT WATER EFFICIENCY REPORT

Morgan Shimabuku

Center for ReSource Conservation

11/12/2015

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Project Overview

Starting in the spring of 2015 St. Vrain Valley School District (SVVSD) and Center for ReSource Conservation (CRC) partnered to bring water conservation efforts to the district. The CRC provided the district with experience around commercial water conservation assessments and irrigation system consultations. In the spring CRC visited 20 schools, selected by the district, to perform indoor water conservation assessments. During the summer CRC revisited 10 of these schools (one which did not receive an indoor assessment) to perform outdoor irrigation consultations. CRC also engaged students in the conservation assessment process and provided the district with water conservation and water-focused lesson plan database that will be offered through the district's website for teachers to use at all grade levels.

Funding for the project is supplied by the Colorado Water Conservation Board, through CRC. The grant for this project includes $12,500, to be matched in an equal amount by SVVSD, for implementing water conservation measures. The main goals of the project include:

- To provide the school district staff with information about cost effective water efficiency upgrades that can be made and/or process changes that it can implement indoors and outdoors, to cause significant reduction in water use and cost of water bills.
- To implement major water efficiency upgrades and/or operational changes within the district. Major is defined by demonstratable and significant water savings associated with the upgrades and/or changes.
- To provide educational lessons and opportunities to students in each school in the district on water conservation concepts and methods.

This report contains information on the methods, results and recommendations from both the indoor and outdoor assessments. This report is intended to provide a starting point for choosing several opportunities for direct and relatively quick changes that can be made within the school district that will create measureable water savings. CRC and SVVSD have agreed to work together to make the decision as to what will be implemented to achieve the measurable savings. SVVSD is under no obligation to follow the recommendations provided in this report, however CRC must agree to the final decisions made by SVVSD as to what the plan is for creating water savings.

Indoor Assessments

Methods

The indoor water conservation assessments involved flow rate testing of all faucets in restrooms, kitchens and some classrooms (classrooms with classes in session were not visited) and pre-rinse spray valves in the school kitchens. A very small number of gym

showerheads were tested due to frequent reports by school staff that showers were almost never used by students nor staff. For other water-using fixtures including toilets and urinals CRC either recorded the stated gallons per flush (gpf) as labeled on each fixture, or, if none were found, made a best assumption based on fixture age and/or reported age[1] by school district staff. Appliances that use water were recorded and designated as either Energy STAR[2] or Non-Energy STAR, as Energy STAR labels currently mark appliances with the highest level of efficiency from both an energetic as well as a water-use perspective.

The recommendations presented in this report are most directly based off of the standards set by EPA's WaterSense program, which uses 3rd party certification to ensure that the products are at least 20% more water efficient without sacrificing performance. Current WaterSense specifications include:

- 0.5 gpm for hand wash faucets/faucet aerators
- 1.5 gpm for kitchen faucets/faucet aerators
- 2.0 gpm for showerheads
- 1.28 gpf for tank-type toilets (flushometer toilet specification in development)
- 0.5 gpf for urinals
- 1.28 gpm for pre-rinse spray valves
- Energy STAR certified for all appliances

gpm = gallons per minute
gpf = gallons per flush

To calculate the potential water, electricity and natural gas savings CRC uses an Excel-based tool developed by the Brendle Group, a sustainability-focused engineering firm in Fort Collins. The tool includes several different factors in it's calculation to estimate current water, energy and/or natural gas consumption and then it compares that to what would be used if all fixtures and appliances were upgraded to WaterSense and Energy STAR labeled products. To calculate estimated water, electricity and natural gas usage the tool requires flow rate or flush volume of fixtures, number of daily users and number of days of operation. The number of daily users and the number of days of operation were provided to CRC by SVVSD for all schools[3]. The tool also calculates the cost savings and return-on-investment (ROI), in years, of implementing the upgrades to the fixtures and appliances. It is able to

[1] Fixture age can be used to make a reasonable approximation of water use by fixture due to known plumbing code changes over time (i.e. National Energy Policy Act 1992, 2009 Baseline Plumbing Code, 2012 'Green Code' Requirement).
[2] Energy STAR is a program of the U.S. EPA that uses third-party testing to label energy efficient appliances, homes, and other buildings, ensuring that these products are not only efficient, but that they also perform as well or better than non-Energy STAR appliances and buildings in the same class.
[3] SVVSD provided CRC with 2014 enrollment data. Staff numbers were estimated using the assumption of 1 staff:30 students. Teacher work days and summer school were counted as ½ days to account for the smaller number of users during those time periods..

calculate the ROI from the input of the utility rates for the water, electricity and natural gas into the data sheet. Labor and fixture costs are included in the ROI estimates.

Results

During the indoor assessments the CRC technician met with at least one school district staff (e.g. school janitor, maintenance staff, etc.) at each school and visited every restroom and kitchen in each building. At most schools only a representative sample of classrooms were visited in order to not disturb classes in session. All indoor assessments were performed in March and April of 2015.

In general, the indoor assessments revealed that there are significant opportunities for water savings at nearly every school visited. The table below shows both the total (sum) as well as the mean (average) for the categories of water, electricity, and natural gas savings per unit, and cost savings. These are only the savings potentially available through indoor upgrades to fixtures and appliances within the 20 schools included in the assessments.

	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings	Electric Cost Savings	Natural Gas Cost Savings	Total Cost Savings
Total	9,050	109,432	11,194	$62,223	$9,738	$885	$72,307
Mean	453	5,472	560	$3,111	$487	$44	$3,615

The next table presented below shows the number of non-WaterSense fixtures by type (hand wash faucet aerators, kitchen-type faucet aerators, toilets, urinals and PRSVs) by school. The Grand Total (Sum) of all included in the assessments is at the bottom of the table. Zeros and blanks indicate that either all fixture types in that class were meeting WaterSense standards, or that type of fixture was not present or tested.

School	Hand Wash Faucet Aerators	Kitchen-type Faucet Aerators	Toilets	Urinals	Pre-Rinse Spray Valves
Black Rock Elementary	21		26	6	0
Centennial Elementary	14	1	21	6	0
Central Elementary	30	0	40	0	1
Coal Ridge MS	41	11	34	15	0
Columbine Elementary	10	0	29	7	1
Erie Elementary	0	0	23	13	
Erie High School	10		42	11	0
Erie Middle School	0	0	23	0	0
Fall River Elementary	0	0	18	8	2
Legacy Elementary	5	1	26	7	2
Longmont Estates Elementary	6	25	18	8	1
Lyons MS/HS	31	13	17	11	1
Niwot Elementary	31	15	48	9	1
Prairie Ridge	19	5	19	8	2
Red Hawk Elementary	0	0	13	0	0
Spark Elementary	15	2	24	11	0
Thunder Valley K-8	2	0	47	9	1
Timberline K-8	23	5	29	9	2
Trail Ridge MS	33	39	41	18	1
Westview MS	31	15	48	9	1
Grand Total	**322**	**132**	**586**	**165**	**16**

The second table shows the number of appliances that do not meet water efficiency and energy efficiency standards as set by Energy STAR by type (clothes washers, residential dishwashers, ice machines, steam cookers and commercial dishwashers) by school. The Grand Total (Sum) of all included appliances from all assessments is at the bottom of the table. Zeros and blanks indicate that either all fixture types in that class were meeting water efficiency standards, or that type of fixture was not present.

School	Clothes Washers	Residential Dishwashers	Steam Cookers	Ice Machines	Commercial Dishwashers
Black Rock Elementary	1	1	1		1
Centennial Elementary	1	1	1		1
Central Elementary	1	1	1		1
Coal Ridge MS	1	1	1	1	1
Columbine Elementary	1	1	1		1
Erie Elementary	1		1		1
Erie High School	1		1	1	1
Erie Middle School	1		1	1	1
Fall River Elementary	1		1		1
Legacy Elementary	1		1		1
Longmont Estates Elementary	1	1	1		1
Lyons MS/HS	1	1	1	1	1
Niwot Elementary	1		1		1
Prairie Ridge	1		1	1	1
Red Hawk Elementary	1	1	1	1	1
Spark Elementary					
Thunder Valley K-8	1		1		1
Timberline K-8	1		1	1	1
Trail Ridge MS	1		1	1	1
Westview MS	1		1		1
Grand Total	**19**	**8**	**19**	**8**	**19**

Based on these two tables, the most needed fixture and appliance upgrades in the district include:

- Flushometer toilets (only 5% met WaterSense)
- Clothes washers (only 11% met Energy STAR)
- Steam Cookers (only 15% met Energy STAR)
- Dishwasher (only 17% met Energy STAR)

CRC recommends that as these fixtures and appliances come to the end of their useful life, to replace them with WaterSense and Energy STAR labeled devices.

Presented below are the potential water, electricity and natural gas savings from implementing upgrades to all non-WaterSense and non-Energy STAR fixtures and appliances at each school.

School	Water Savings (kgal)	Water Cost Savings ($)	Electricity Savings (kWh)	Electric Cost Savings ($)	Natural Gas Savings (therm)	Natural Gas Cost Savings ($)	Total Cost Savings ($)
Black Rock Elementary	543	$ 7,564	236	$ 24	679	$ 54	$ 7,643
Centennial Elementary	449	$ 1,333	4976	$ 448	413	$ 33	$ 1,814
Central Elementary	255	$ 1,903	5667	$ 448	428	$ 33	$ 2,384
Coal Ridge MS	532	$ 1,579	6003	$ 540	641	$ 51	$ 2,171
Columbine Elementary	280	$ 2,087	5385	$ 425	376	$ 29	$ 2,542
Erie Elementary	220	$ 3,059	5190	$ 537	239	$ 19	$ 3,615
Erie High School	769	$ 10,707	2423	$ 251	1569	$ 126	$ 11,083
Erie Middle School	235	$ 3,269	5190	$ 537	239	$ 19	$ 3,825
Fall River Elementary	397	$ 2,964	11437	$ 904	279	$ 22	$ 3,889
Legacy Elementary	746	$ 1,007	6161	$ 701	1147	$ 92	$ 1,800
Longmont Estates Elementary	249	$ 1,855	664	$ 52	459	$ 36	$ 1,943
Lyons MS/HS	261	$ 1,670	1334	$ 120	417	$ 33	$ 1,824
Niwot Elementary	364	$ 2,714	6530	$ 516	427	$ 33	$ 3,263
Prairie Ridge	416	$ 1,235	20086	$ 1,808	81	$ 7	$ 3,049
Red Hawk Elementary	79	$ 1,095	0	$ -	0	$ -	$ 1,095
Spark Elementary	502	$ 678	0	$ -	436	$ 35	$ 173
Thunder Valley K-8	496	$ 670	5841	$ 665	578	$ 46	$ 1,381
Timberline K-8	975	$ 7,274	11028	$ 871	1130	$ 88	$ 8,234
Trail Ridge MS	604	$ 4,504	5916	$ 467	814	$ 63	$ 5,034
Westview MS	678	$ 5,056	5365	$ 424	842	$ 66	$ 5,545
Grand Total	**9050**	**$ 62,223**	**109432**	**$ 9,738**	**11194**	**$ 885**	**$ 72,307**

The savings may vary in real life if usage rate assumptions do not match actual usage, however this data show that nearly every school has significant potential for improving water efficiency, and saving money.

For detailed information on each school's potential savings, by fixture and appliance, see **Attachment 1**.

Other issues with water use were identified during visits that are not captured by the fixture and appliance lists. These issues are listed below, by school. These notes are not meant to provide a comprehensive picture of water usage at each school, but rather, they reflect the variety of observations made by CRC technicians while performing the assessments. 6 of the 20 schools did not have additional observations.

School	Issue/Comments
Trail Ridge Middle School	Have summer school Cooling towers present, high water use Scotsman brand ice machine, not Energy STAR
Lyons Middle and High School	Metered sinks > 10 sec flow Barb fitted faucets in science classrooms were reported to leak often No summer school Kohler, autoflush toilets in several locations Very old toilets in locker rooms
Longmont Estates Elementary	All faucets were tested by student "helpers" Miniature toilets present
Columbine Elementary	One faucet dripping in the sink in the boys bathroom near 2nd grade classrooms Miniature toilets present Fisher brand PRSV
Westview Middle School	No aerator on 2 7th grade classroom sings in E-wing No aerator on 7th grade science classroom sinks Reported to CRC that "no one drinks the water" due to odd color and bad taste/odor Brush attachment on PRSV
Timberline K-8	Has summer school Girls restroom sinks near room 404 have sinks that run for more than 30 sec before shutting off Mop sink in cafeteria had a leak American Standard flushometer toilets Toilet clogs found
Fall River Elementary	Has summer school No brush on PRSV
Central Elementary	Has summer school Health room staff report that the hot water does not work in their room T&S Brass PRSV
Coal Ridge Middle School	7th grade boys restroom aerators running longer than 10 sec Art classroom has several sink faucets with leaks Crane brand toilets
Prairie Ridge	Kitchen did not have any aerators on the 3 compartment sinks Metered faucets in general ran for more than 10 sec Brush attachment on PRSVs
Centennial Elementary	Sink in room 306 was missing an aerator

Legacy Elementary	Metered sink in boys and girls restrooms did not turn off Kohler brand toilets Fisher brand PRSVs
Spark Preschool	Have summer school Kitchen is not used No aerator on sink in the staff/office space Miniature toilets in some locations here
Thunder Valley K-8	No aerator on 5 sinks in the science room Kenmore brand dishwasher, not Energy STAR Cleveland brand steamer American Standard and Kohler brand toilets Zurin brand urinal

Recommendations

The recommendation list for all changes and upgrades is at the end of the report. This list was created for staff of SVVSD to use when considering upgrades for the water-using fixtures and appliances in schools, primarily related to the grant from the Colorado Water Conservation Board for $12,500 plus the matching funds provided by the District, to total $25,000. However this list could be used for future purchases as well as it offers advice on a wide variety of fixture and appliance upgrade opportunities and best management practices for water and energy efficiency.

Outdoor Assessments

Irrigation system consultations were provided by the Center for ReSource Conservation to 10 SVVSD schools in the summer of 2015. Trained technicians spent anywhere from half a day to two days working at each of the schools doing a thorough analysis of the efficiency of the irrigation system. Methods and results from these audits are presented below.
In addition to the on-site irrigation assessments, CRC did an analysis of historical water use at the same 10 schools to compare outdoor water use to water demand of those landscapes based off of historical weather data. This analysis was used to augment the irrigation system audits and provide the school with information as to whether or not they should consider purchasing a weather based irrigation control system.

Methods

Every irrigation system audit was performed by two technicians. The steps of each audit included:

- A visual inspection of each sprinkler zone while running to pinpoint any issues in the system
- Pressure tests on a representative sample of sprinkler heads
- Tests to measure precipitation rates and distribution uniformity within several representative zones

- Soil samples to determine root depth and soil type within tested zones

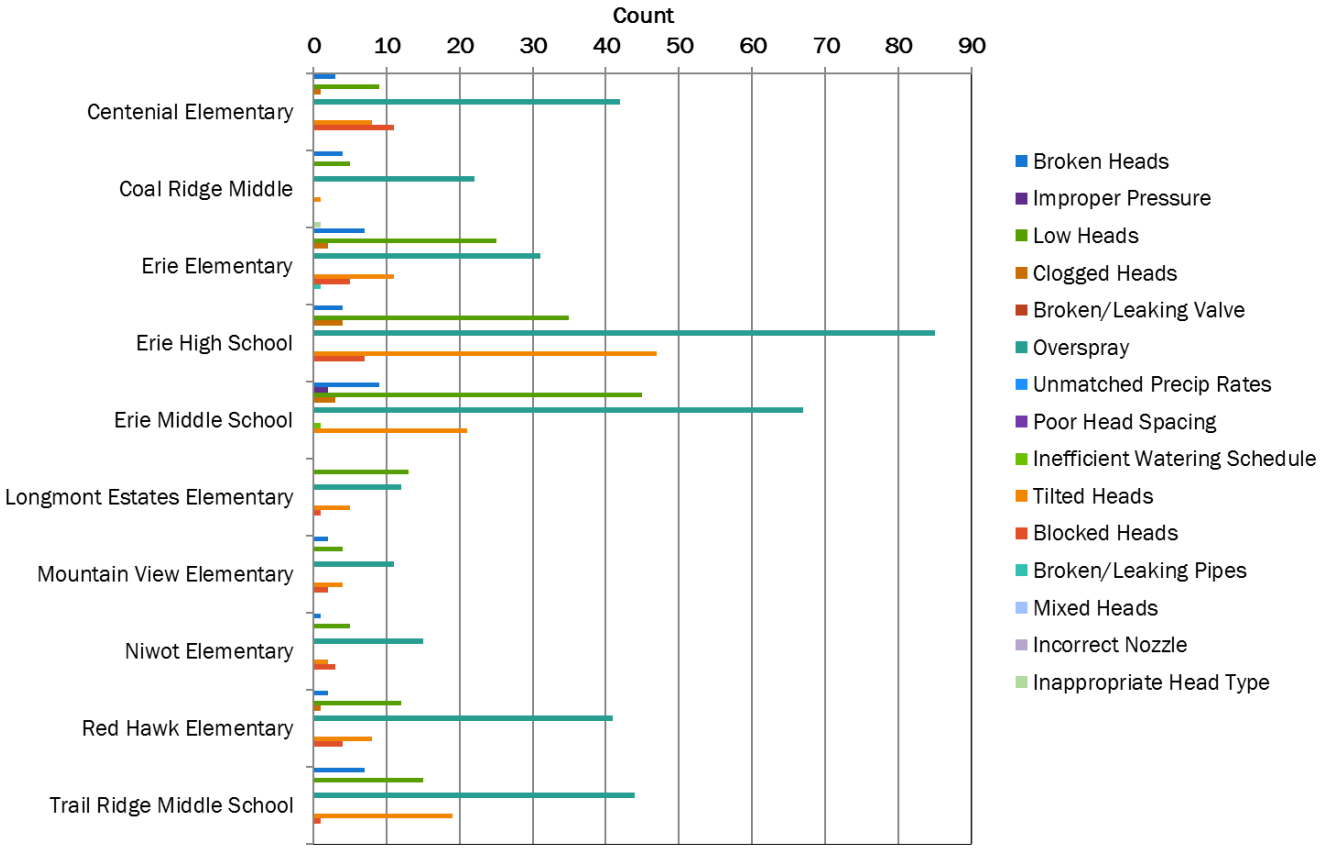
This data set is intended support the maintenance staff to asses which issues are most frequent across all sites.

The methods used for the analysis of historical water use was presented to SVVSD in a short report titled "Irrigation Comparison Analysis Report for SVVSD by CRC." By using landscape area, provided to CRC by the district, weather data from Northern Colorado Water Conservation District's weather station network (northernwater.org), and the data collected in the field, we were able to calculate how much irrigation water was needed for each school, for the 2012 and 2013 growing season (March-Nov). We compared this number to the total irrigation water used during these same years (calculated following the minimum month method). Finally, the application ratio, a value that represents the efficiency of water use, or the ratio of what was used compared to what was needed on the landscape. If the exact amount of water needed is applied, then the application ratio is 100%. If more water is applied than is needed then the application ratio is greater than 100% and if less water is applied than is needed, then the application is less than 100%.

Results

A team of two CRC technicians met with District staff at each school between June 25th and July 16th, 2015. Overall, the irrigation systems at the 10 schools visited were found to be in good working order. The designs of the systems were often good and no major recommendations will be made with regard to this aspect. The SVVSD staff working with the CRC technicians did not permit the staff to evaluate the watering times or schedules for the different zones and therefore this aspect will not be reported on either.

Visual inspections of the running irrigation systems at each school reveled some basic problems are common across schools. The top three issues identified were **overspray**, **clogged heads**, and **low heads**. The graph below shows the count of each issue at each of the 10 schools visited.



The majority of these issues are relatively simple and inexpensive to fix. Clearing out clogged heads and raising low heads will reduce overspray significantly, leading to improved spray coverage and improved distribution uniformity.

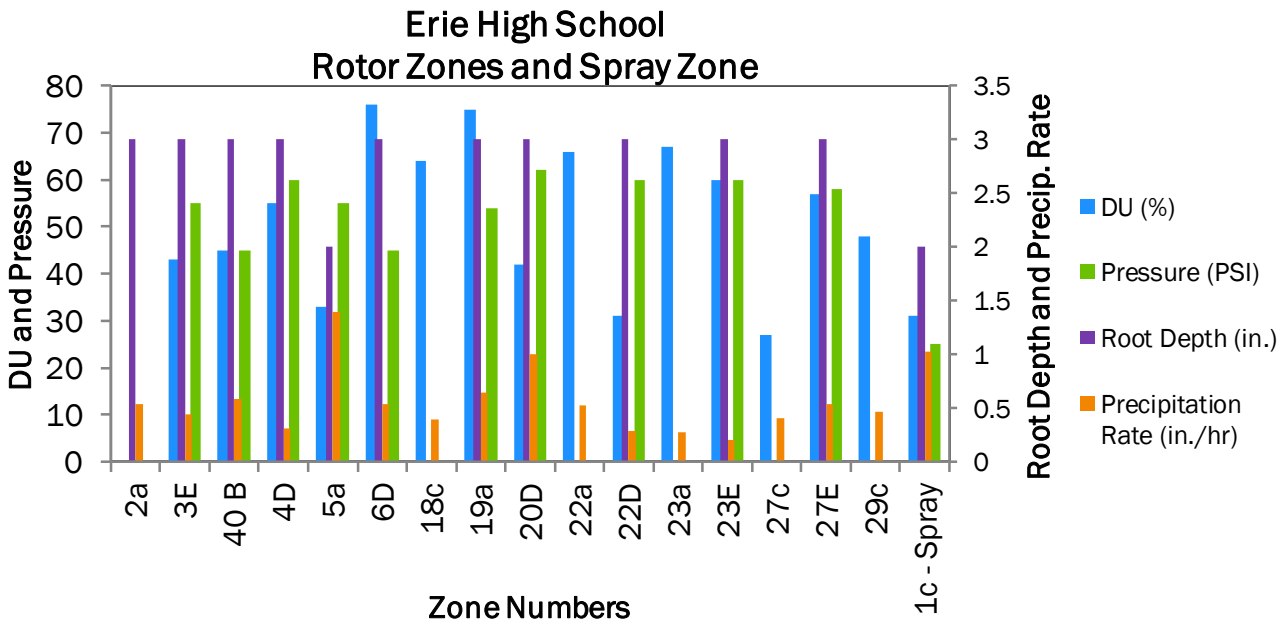
Tests were performed on several spray and rotor zones at each school to measure the distribution uniformity, precipitation rate, pressure and root depth. Overall, 58 rotor zones and 14 spray zones were tested. The table below details the average value for each of these categories between spray and rotor zones, as well as the ranges of the values.

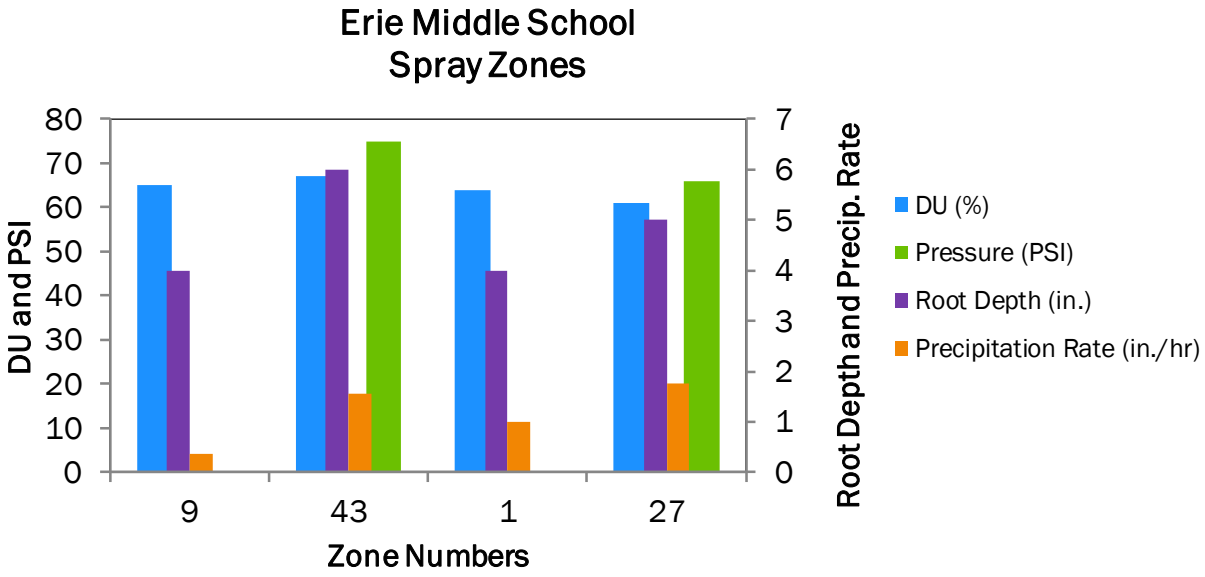
	Distribution Uniformity (%)	Precipitation Rate (in./hr)	Pressure (PSI)	Root Depth (in.)
		Spray Zones		
Average	52	1	32	3
Range	31 to 69	0.4 to 8	25 to 75	2 to 6
		Rotor Zones		
Average	64	1	53	4
Range	27 to 80	0.2 to 1.4	25 to 66	2 to 6

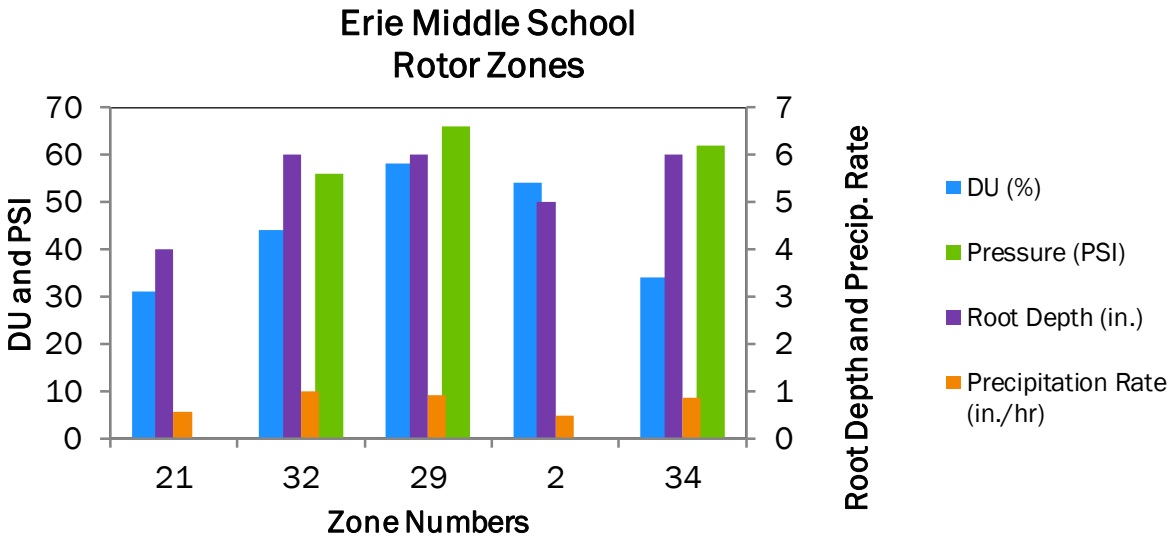
From this data, several opportunities for efficiency improvements are evident.

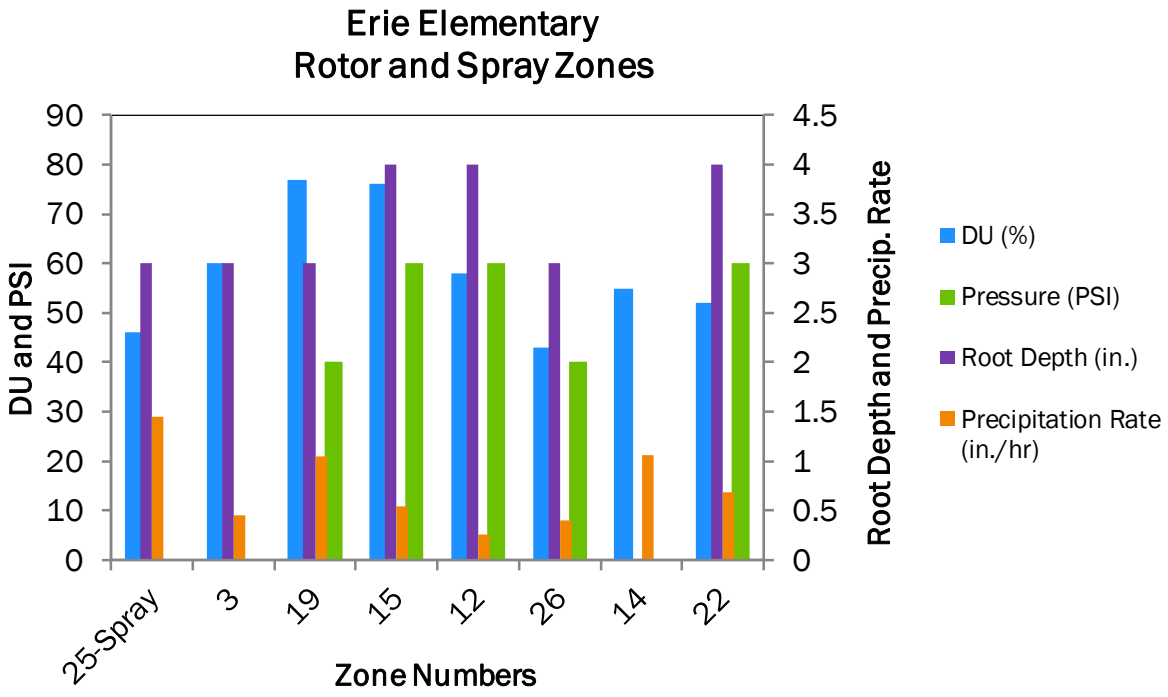
- Distribution uniformity should be at a minimum of 70% for all zones, and therefore this is an area that could be improved across the majority of zones in the district.
- The design pressure for spray heads ranges from 20 to 30 PSI and from 25 to 80 PSI for rotor heads. Work should be done to reduce the pressure in spray zones across the district.

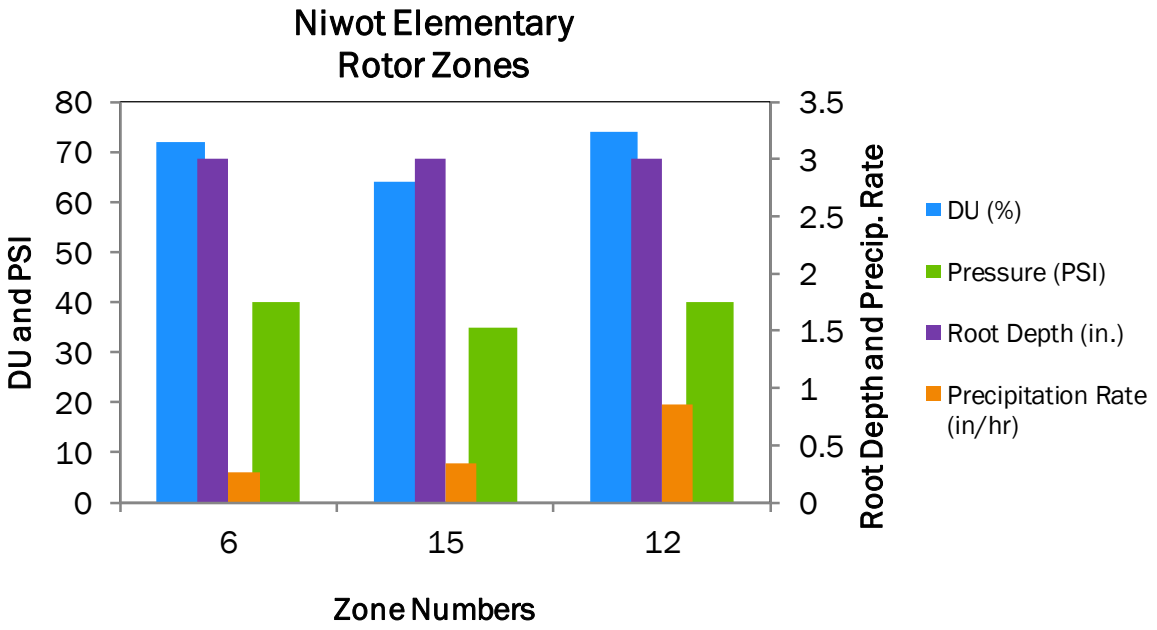
School specific results are shown in the graphs below. These graphs display the measured distribution uniformity (DU) (%), pressure (PSI), root depth (inches) and precipitation rate (inches/hour) for all tested rotor and spray zones. DU and pressure bars correspond with the left-hand y-axis and the root depth and precipitation rate bars correspond with the right-hand y-axis. This display of the data is intended to allow the reader to compare these four categories across each zone tested. Test results for Mountain View Elementary were lost and are therefore not included.

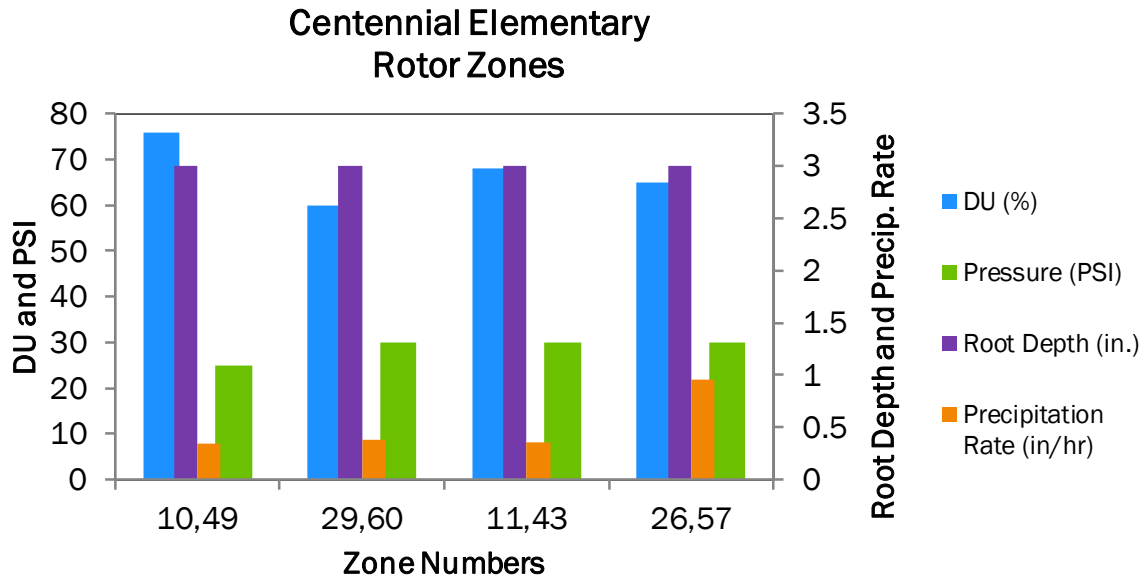


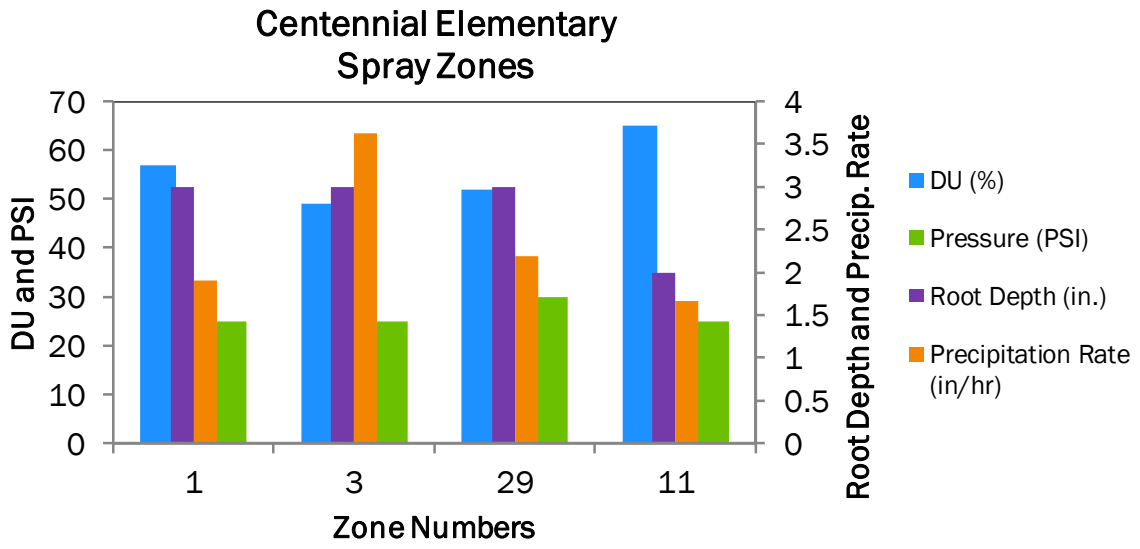

Erie Middle School
Spray Zones
DU and PSI
Root Depth and Precip. Rate
Zone Numbers
9
43
1
27
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in./hr)

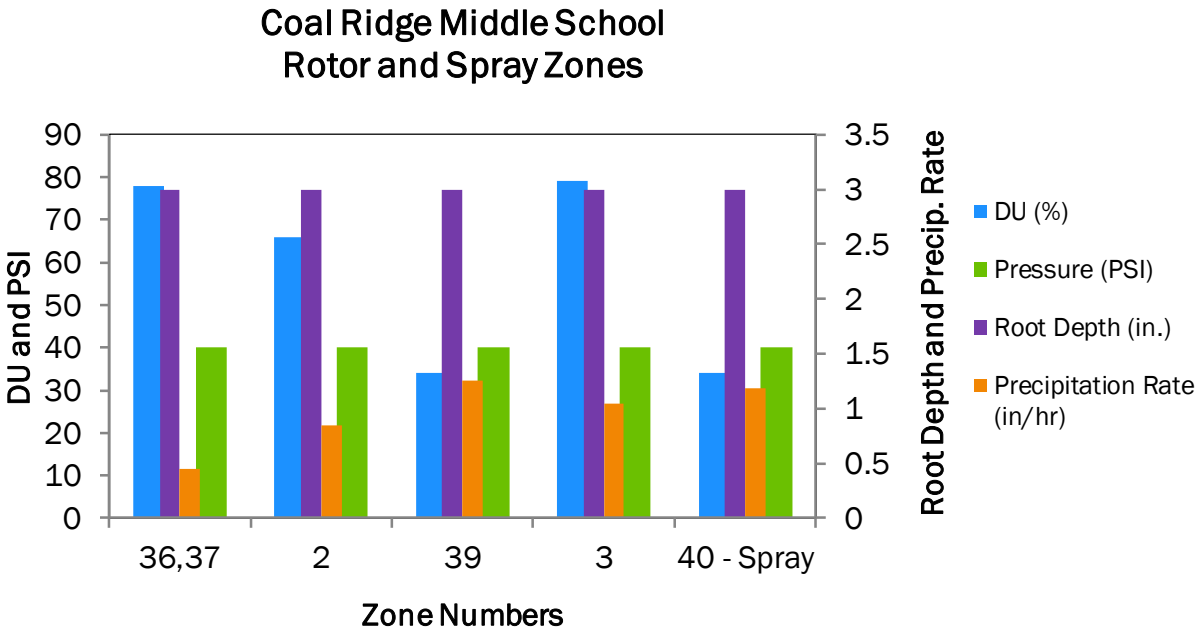

Erie Middle School
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
Zone Numbers
21
32
29
2
34
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in./hr)

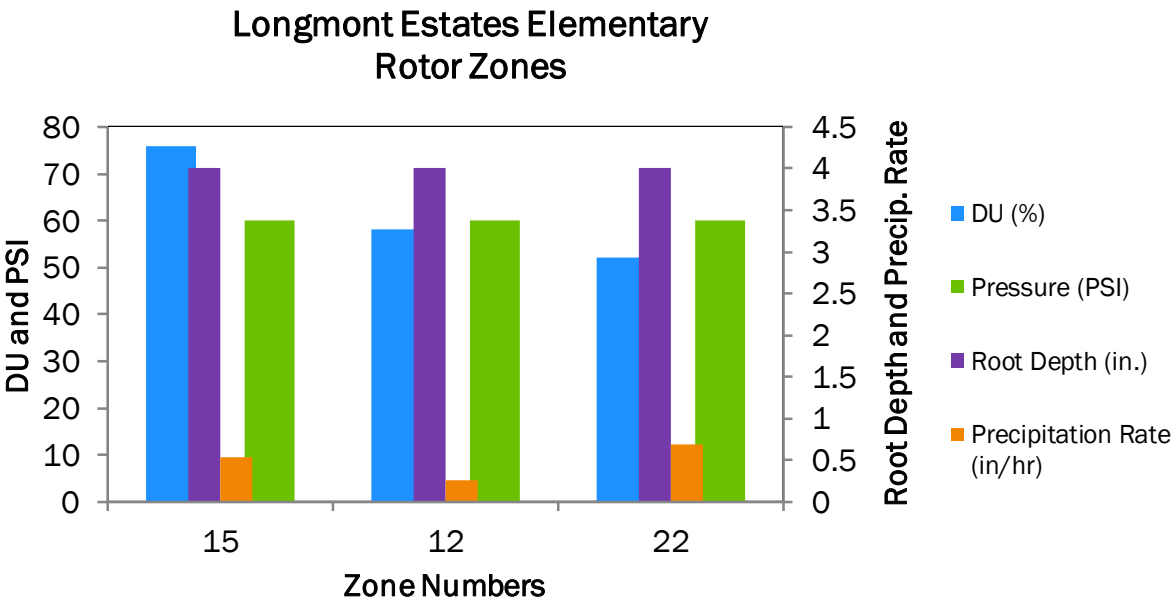

Erie Elementary
Rotor and Spray Zones
DU and PSI
Root Depth and Precip. Rate
90
80
70
60
50
40
30
20
10
0
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
25-Spray
3
19
15
12
26
14
22
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in./hr)

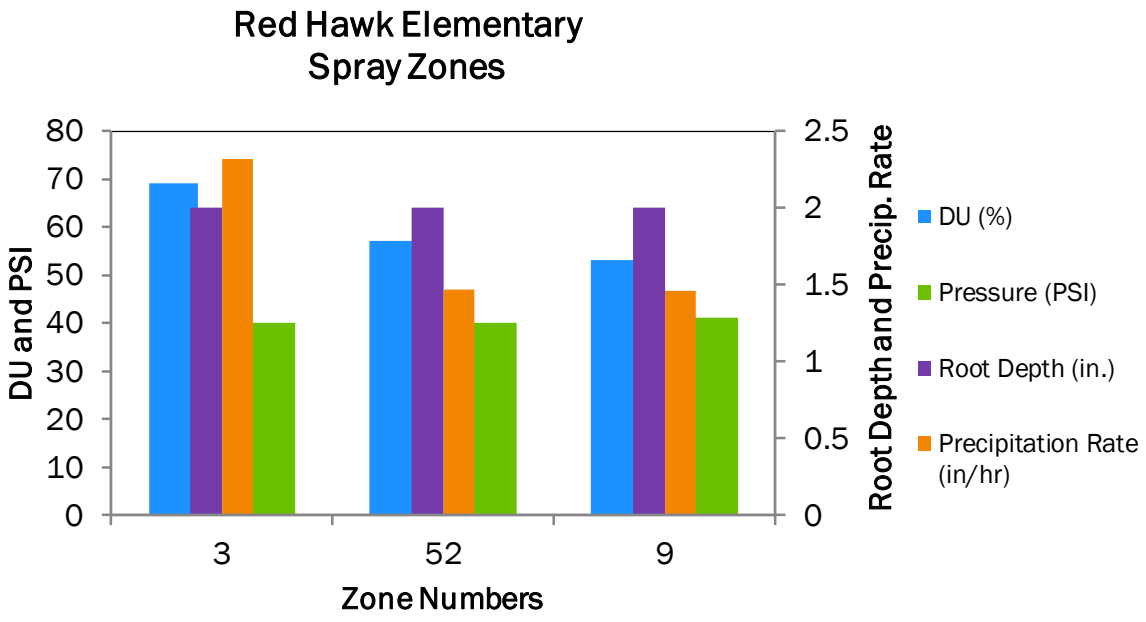

Niwot Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
3.5
3
2.5
2
1.5
1
0.5
0
6
15
12
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)

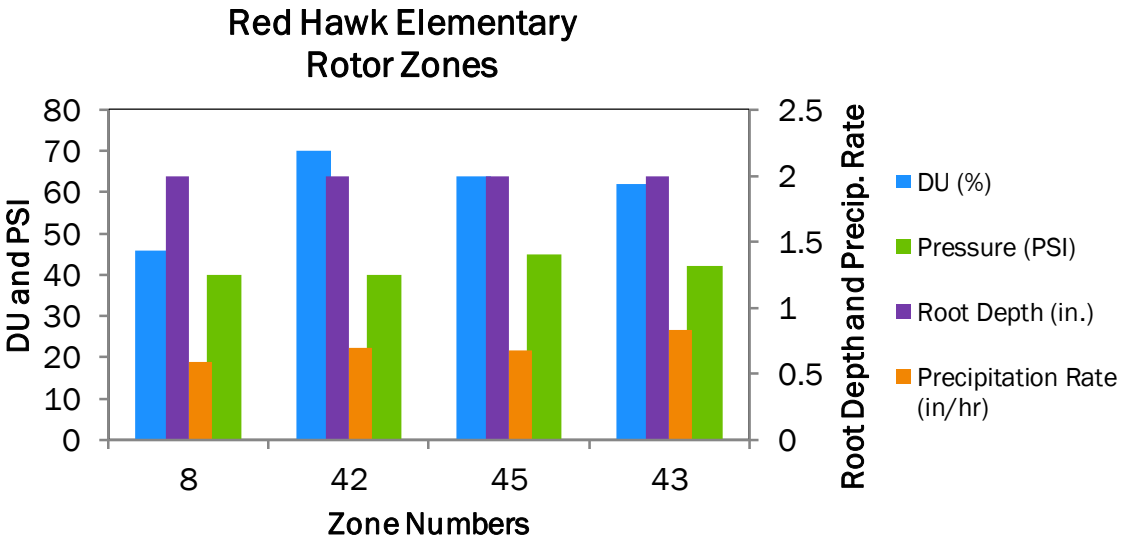

Centennial Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
3.5
3
2.5
2
1.5
1
0.5
0
10,49
29,60
11,43
26,57
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)

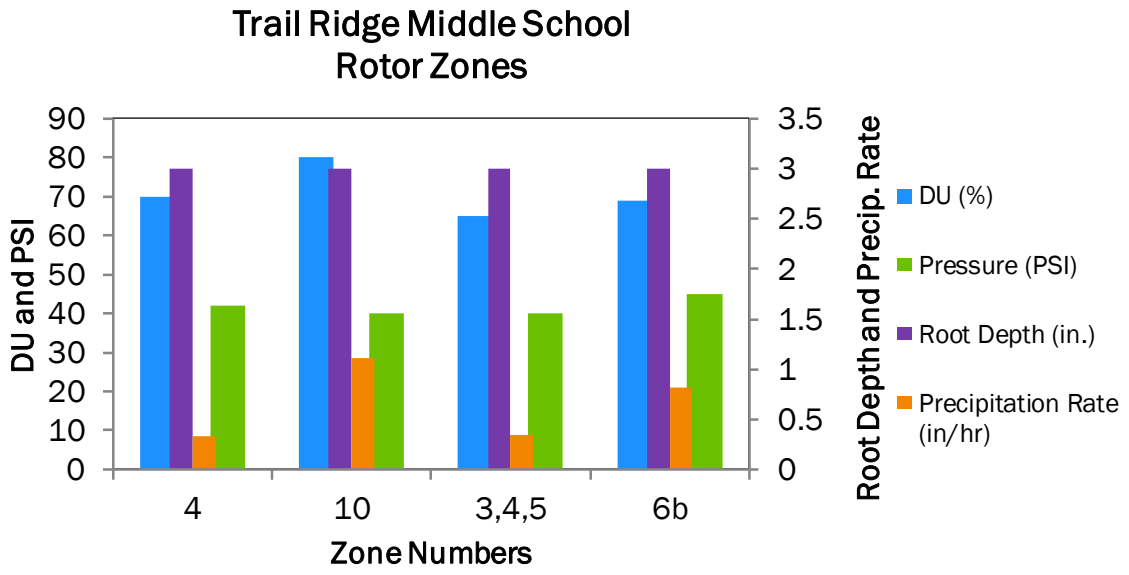

Centennial Elementary
Spray Zones
DU and PSI
Root Depth and Precip. Rate
70
60
50
40
30
20
10
0
4
3.5
3
2.5
2
1.5
1
0.5
0
1
3
29
11
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Coal Ridge Middle School
Rotor and Spray Zones
DU and PSI
Root Depth and Precip. Rate
90
80
70
60
50
40
30
20
10
0
3.5
3
2.5
2
1.5
1
0.5
0
36,37
2
39
3
40 - Spray
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Longmont Estates Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
15
12
22
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Red Hawk Elementary
Spray Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
2.5
2
1.5
1
0.5
0
3
52
9
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Red Hawk Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
2.5
2
1.5
1
0.5
0
8
42
45
43
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)



Outdoor Water Use Analysis - Update

By using landscape area, provided to CRC by the district, weather data from Northern Colorado Water Conservation District's weather station network (northernwater.org), and the data collected in the field, we were able to calculate how much irrigation water was needed for each school, for the 2012 and 2013 growing season (March-Nov). We compared this number to the total irrigation water used during these same years (calculated following the minimum month method). Finally, the application ratio, a value that represents the efficiency of water use, or the ratio of what was used compared to what was needed on the landscape. If the exact amount of water needed is applied, then the application ratio is 100%. If more water is applied than is needed then the application ratio is greater than 100% and if less water is applied than is needed, then the application is less than 100%.

All of the schools with the exception of Mountain View Elementary and Trail Ridge Middle School were watering efficiently, and in some cases were actually watering less than the estimated amount that was needed. Mountain View Elementary had an application ratio of 143% in 2012 and 123% in 2013. Trail Ridge Middle School overwatered in 2012 by approximately 38% and in 2013 75%. Erie High School was the school with the lowest application ratio of the schools audited with an AR of 49% in 2012 and 45% in 2013. On average, the schools audited had an application ratio of 96% of the water needed in 2012 and 95% in 2013.

The results of this analysis have changed since the report was issued earlier in 2015. Information supplied by SVVSD staff indicated that not all landscape area was accounted for

at Erie High School and Erie Middle School in the original data supplied the CRC and therefore these records have been removed from the analysis. The major impact of this update was to increase the average application ratio to 108% and 103% from 96% and 95%.

School	Actual Water Usage 2012	Needed Water Usage 2012	Application Ratio	Actual Water Usage 2013	Needed Water Usage 2013	Application Ratio
Centennial ES	4,532	4,392	103%	2,829	3,310	85%
Erie ES	5,991	5,965	100%	4,317	4,170	104%
Niwot ES	3,043	3,167	96%	2,552	2,387	107%
Longmont Estates ES	5,082	4,759	107%	3,247	5,641	58%
MountainView ES	3,671	2,566	143%	2,387	1,934	123%
Coal Ridge MS	9,305	13,639	68%	7,323	10,703	68%
Trail Ridge MS	7,499	5,425	138%	7,162	4,089	175%
Average	5,589	5,702	108%	4,259	4,605	103%
Sum	39,123	39,914		29,816	32,234	

*All water volumes in thousands of gallons (kgal)

Recommendations

The recommendations for SVVSD to improve outdoor watering efficiency are also included on at the end of this report with the recommended changes to indoor appliances and fixtures.