Water Efficiency Grant Program Fund Application:

Applicant: Center for ReSource Conservation (CRC)

Project Name: Water Conservation Impact Assessment

Goal: In partnership with CWCB and our partner water utilities, we will refine, test, and codify our research methodology for water conservation program impact assessment. We will conduct an extensive impact analysis of our conservation programs including Slow the Flow and Slow the Flow Indoors, which are among the most widely practiced conservation programs in Colorado. The results of the assessment will provide the CWCB, CRC, and our partner water utilities with detailed information about the water savings of these programs, as well as a framework that can be used to measure a variety of programs.

Funds Requested: $48,800

Matching Funds: $22,100

Contact: Dan Stellar, Water Division Director
Center for ReSource Conservation (CRC)
2639 Spruce St, Boulder, CO 80302
Phone 303.999.3820 x 221; Fax 303.440.0703
dstellar@conservationcenter.org

Project Summary

The Center for Resource Conservation is a leader in Colorado's Front Range for implementation of water conservation programs. Our Slow the Flow (STF) outdoor water conservation program, focusing on irrigation inspection, has been operating, with partner water providers since 2004. Since that time, over 10,000 audits have been conducted in cooperation with 26 water providers, making STF likely to be the most widely adopted outdoor conservation program in Colorado. In light of the program's reach and its importance to water conservation in Colorado, over the past year CRC has initiated an analysis to determine the program's impact on water use.

The proposed project will build on our current methodology that assesses STF's impact and water savings. In addition to studying STF, we will apply our methodology to other programs, including indoor water audits. With access to eight years of actual water usage data from our water partners, we are well-positioned to continue developing methodology to measure our program's true conservation impact. In this process, we have developed an analytic approach that normalizes water usage calculations for weather, expresses change in water usage in volumetric terms rather than as a percentage, and can be applied to a variety of scales – from one homeowner or one property, to an entire water provider's territory, or an entire region. With this data, water providers can more readily compare the cost of new water projects with the cost

of implementing a conservation program.

While the CRC has established itself as a leader in providing indoor and outdoor residential water audit services in the Front Range, at this time there has not been a comprehensive evaluation of the impacts of water conservation programs, including the programs we implement.

In discussions with our municipal partners, other water providers, and the CWCB, it has become evident that an evaluation of the impacts of water conservation efforts is needed to substantiate, document, and guide water conservation programs in their future work in Colorado. Further, the accurate and rigorous measurement of conservation programs will allow conservation to be compared with traditional options for the development of municipal water resources, such as large water supply projects and agricultural transfers. As such, accurate assessment of demand reduction programs is of critical importance to the entire conservation community. This is an identified need that the CRC is well-positioned to address.

The CRC brings its long-term dedication to water conservation to implement this project, along with the interest, cooperation, and water usage data of our 26 partner water utilities in the Front Range (see Appendix A). We are highly invested in expanding the nature and breadth of water conservation practices that can be implemented at local levels, and in supporting our partner water utilities in becoming water conservation leaders.

With this proposal, CRC requests CWCB funding to build off its current work to **1) implement an exhaustive study to thoroughly analyze the impact of Slow the Flow, 2) modify this methodology to apply to a range of conservation programs, including Slow the Flow Indoors and 3) develop customized reports that detail each program's water savings for the CWCB and our water providers.** This project will provide further documentation of the water conservation program results, at the participant, program and state-wide level, and quantify conservation impact. In doing so, the project will further establish Colorado and the CWCB as leaders in the field of accurate measurement of water conservation impact.

Project Background

Who we are: The Center for ReSource Conservation (CRC) is a 501(c)(3) nonprofit organization that empowers our community to conserve natural resources. We have developed extensive expertise implementing practical solutions to conservation challenges, including indoor and outdoor water conservation programs.

Our expertise: CRC has extensive experience working in partnership with local municipal customers to implement water conservation programs (a full list of partners is provided as Appendix A). Through the CRC's flagship conservation program Slow the Flow Colorado, the CRC works with 26 Front Range water providers, offering outdoor water audits to their customers. CRC has conducted over 10,000 of these popular inspections since 2004. CRC offers a range of other water conservation programs, including Garden-In-A-Box (pre-planned xeriscape garden kits), the

WaterWise Landscape Seminar Series, and Slow the Flow Indoor (indoor water audits). Collectively, these programs have served tens of thousands of Colorado residents.

The data: In 2012, we conducted an innovative analysis that evaluated changes in Slow the Flow (STF) participant water usage pre- and post- program delivery. We used high-quality data from the STF program, representing more than 2,400 households in the 8 years since STF's inception. The data set used in our analysis includes meteorlogical data (precipitation and evapotranspiration rates) from four local weather stations along the Front Range, as well as water usage records provided by 8 of our partners. Our pilot-study indicates that the program is reducing homeowner water use by between 5,000 -10,000 gallons per year, on average, relative to the water usage in years prior to our audits. While our pilot study included data from 2,400 households, this represents less than a quarter of the actual data that is available. A more extensive study will look at a much larger data set, as well as identify additional, and more precise, sources of meteorological data.

By evaluating STF based on participant water usage change, the CRC has been able to make changes to the program based on the findings of the analysis. The analysis not only provides our partners with information on water savings, but also allows us to make improvements to the structure of the program and maximize our conservation impact.

The need for the project: The CRC runs three major water conservation programs in Colorado: Slow the Flow, Slow the Flow Indoors and Garden-In-A-Box. In the past 8 years, these programs have been offered in 26 different water districts, and are currently being used by approximately 3,000 customers per year (with increasing reach every year). Two additional programs, a commercial audit program and a residential drought response program, have been added to the CRC's list of offerings in the past year, and will help increase our water conservation impact across Colorado. Our partner water providers use these programs, among other practices and measures, to meet the demands of rapidly growing populations and the implications of reduced water supply due to climate change[1] and drought. These organizations, along with other stakeholders including the CWCB and other groups in the water conservation community, need to understand the extent to which investments in water conservation are bringing about actual savings. With this information, water providers can compare the costs of conservation programs with the costs of developing new water resources, the CWCB can evaluate the effectiveness of their grant money at providing actual water savings, and the CRC can improve the work they do to increase the water savings benefits of the program.

A pilot analysis of the impact of the Slow the Flow program has shown that, on average, participants are saving 7,000 gallons of water during the first two years after they receive an audit. These results are promising and have already begun to help the CRC to improve the program, but there are many aspects that have yet to be addressed, including:

[1] US Department of Interior, Bureau of Reclamation, Colorado River Basin Water Supply and Demand Study, December 2012.

- the need for a comparison analysis using control groups,
- more comprehensive evaluation of water use changes based on parameters such as over/under watering practices pre-audit,
- methodological changes that allow for assessing the other programs offered by the CRC, and
- enhanced data distribution to our partner water providers, the CWCB and to the broader water conservation community.

The CRC recognizes the need for a comprehensive water conservation assessment and has the capability to produce the results in a format that make them available and useful to all stakeholders involved.

Proposed project outcomes. The main outcomes of the proposed project are: 1) a more thorough impact analysis on the data we have collected over the past decade, 2) a report of the findings from the analysis to the CWCB and to each partner water provider, and 3) an education and outreach campaign that serves to distribute information to current partners and to other entities working in Colorado to conserve water. In addition, information gained from this analysis will allow CRC to continually evaluate its water conservation programs in order to make them more effective at conserving water.

For the education and outreach campaign, we will work to publicize our impact analysis work, including both the results and methodology. This outreach will include presentations at least one conference and the submission of one abstract to an academic or trade journal. In all outreach work, we will credit CWCB for their support and leadership in assessing and analyzing water conservation.

Probable long-term success. The CRC has demonstrated success leveraging CWCB funding to establish long-running, self-supporting water conservation programs that have advanced conservation efforts in the state. With generous support from CWCB, CRC launched Slow the Flow (STF) and Slow the Flow Indoor (STFI), in 2005 and 2010, respectively. In both of these cases, CWCB funds helped seed the program, providing funds for program development and supporting initial staffing levels. Also, both of these programs have continued and expanded significantly after the initial grant period ended; since 2005, STF has grown to include 26 partners, while in one year STFI has tripled from 2 to 6 partners.

With the proposed research, CRC will strengthen the conservation programs we are implementing with current providers and provide the CWCB with a comprehensive evaluation of the water savings programs developed with its support. The proposed project includes the development of an advanced impact analysis program, available for a fee to partner utilities and offering more thorough data analysis and reporting. Revenue from this program will give us a base to continue to support the impact analysis over time. In light of CRC's past success at leveraging CWCB grants, and with a nearly 100% partner retention rate, CRC is confident that this proposal can lead to long-term water conservation benefits well after the initial project period.

Project Goals

Specific Goals: In implementing this project, the CRC will integrate key elements – our years of experience, analysis of our own data, support and engagement of our water partners, and the CWCB's leadership in conservation – to make a significant impact on conserving Colorado's water resources. Our goal is to verify and quantify the impact of the major conservation programs in Colorado, and to share this information with all water utilities in the state and in the region. We are requesting support for a ½ year project that incorporates data management, data analysis, and development and implementation of the methodology to study other water conservation programs offered by the CRC including Slow the Flow Indoors and Garden-In-A-Box, to enhance the economic value of conservation program, while rigorously documenting conservation's impact.

We will incorporate the methodology and analytical rigor developed in the course of the work described above to the next phases of the project - the development and implementation of more in-depth analysis, broader scopes of questioning, and a more generalized methodology.

Support of CWCB's Mission: This project strongly supports the CWCB's mission of conserving, protecting and managing Colorado's water resources for present and future generations. A primary goal of research and dissemination of conservation information is to support and inform policy decisions, with quantified data on the impact of water conservation programs, and both environmental (gallons of water) and economic (dollars saved) indicators.

Target Audience: The majority of our current water partners, listed in Appendix A, will engage with the project as providers of data, and will receive a full report of the water saved by the programs offered in their service area. At present, 10 of our partners are engaged with us in the pilot impact analysis, and have both provided us data and attending a meeting that we sponsored in order to get feedback on our methodology. Appendix B also contains several letters of support from partners that are involved with the pilot analysis and plan to continue their involvement, with data and with finances. At our 2012 annual "All-Partners Meeting" we presented information about our impact analysis work, and we explained that in 2013 partners would be able to designate a small portion of their STF funds towards participation in the impact analysis work. To date, multiple partners have indicated their commitment to participating in the impact study, by dedicating funds and providing water records.

To fully realize the potential of this project, disseminate the results produced with our rigorous methodology, and inform the water conservation community about our findings, we will develop presentations, abstracts, and articles to present around the State. We intend to bring this information to water leaders across Colorado, such as the Water Conservation Technical Advisory Group, and Interbasin Compact Committee round-tables, and to present it at important statewide events, such as the Colorado Waterwise annual meeting. We will continue to identify opportunities to present at other technical conferences. Current presentations about our data analysis and methodology include

conferences. Current presentations about our data analysis and methodology include the Upper Colorado River Basin Water Conference (Grand Junction, November, 2012), Rocky Mountain Land-Use Institute Annual Conference (Denver, March, 2013), American Water Works Association Annual Conference (Denver, June, 2013), and WaterSmart Innovations Conference (Las Vegas, October, 2013).

Education and Outreach Promoting the Benefits of Water Conservation: Our in-house research fellow will complete a rigorous analytical and statistical analysis of the data from the CRC's data water conservation programs. Our programs are among the most widely practiced in Colorado, and the results of our analysis to date indicate reductions in water usage of 20%. Through conferences and presentations, we want to bring our data, results, and methodology to the water conservation and water provider communities in Colorado and in the region.

Project Scope of Work

April 2013 – January 2014
The Scope of Work described here encompasses all the steps needed to 1) implement an exhaustive study to thoroughly analyze the impact of Slow the Flow, 2) adapt this methodology to Slow the Flow Indoors, and other water conservation programs run by the CRC, and 3) report the findings to water providers and the CWCB in a way that allows them to easily use this methodology to assess the conservation impact of their programs.

The CRC Research Associate will be conducting the majority of the tasks, with support from the Water Division Director. Volunteers and interns will be utilized when appropriate and/or necessary.

Task 1. Additional Data Collection and Literature Review (April 25, 2013 – July 12, 2013)

For this task we will focus on retrieving data, both to add to the data sets used for our pilot analysis of Slow the Flow, and to obtain data for other programs including Slow the Flow Indoors, and Garden-In-A-Box. The main goals of this task are: 1) to expand our database to allow for a more comprehensive analysis of our programs, and 2) to become more informed on current best practices and recent developments in assessment of water conservation programs. We will also gather and update climate data.

Sub-tasks:

- Extract program identification information (e.g. Water Account Number, Water Provider Name) from CRCs master customer database and prepare for request to water providers.
- Draft and send letters to partner water providers to request water usage data for participants as well as for overall water district water usage data. The letters will specify to our partners the description of our project and goals of the project in order to educate them of the broader impact of their support.

- Receive data from partner water providers and compile the water usage data with the CRC data to create comprehensive spreadsheets that contain all pertinent customer information to water usage.
- Conduct a literature review of past and current assessments of water conservation, using academic publications (e.g. AWWA Journal), online resources, and contact with various local, regional and national water entities (e.g. Northern Water, Alliance for Water Efficiency).
- Obtain additional and more accurate climate data.

Task 2. Expand and Enhance STF Data Analysis (July 14, 2013 – September 27, 2013)

In this task, we will expand upon the pilot work already performed to further measure the impact of Slow the Flow. The main goals of this task will be the completion of two additional analyses of the STF program: 1) inclusion of control groups to further evaluate to what degree factors outside of the STF program may be impacting the data results; and 2) assessment of the longitudinal water savings of the program. We will also update our climate and weather data and use these to further improve the accuracy of the study.

Sub-tasks:

- Review of existing CRC methodology (Appendix C), comparing and contrasting to other methodologies discovered in the literature review (Task 1).
- Make any and all necessary updates to the climate dataset being used in the analysis. Recalculate water savings as necessary.
- Using statistical methodologies, use (a) control group(s) (i.e. water usage data from customers in the same district as STF participants of STF, who did not participate in STF) to calculate and clarify the amount of influence outside factors may be influencing the water savings calculations.
- Longitudinal impact assessment of STF. Evaluate the number of years water savings exist and rate of change in measurable water savings after the program has been administered.
- Run a variety of statistical analyses on the water savings results (e.g. simple linear regression to identify correlations that exist between various data parameters and water savings, Analysis of Variance to evaluate if the calculated water savings are significant).
- Create charts and graphs capturing the results of the analyses in clear and transparent formats.
- 50% Progress Report to the CWCB

Task 3. Methodology Adaption to Other Programs (September 28, 2013 – December 1, 2013)

In this task we will make the necessary adaptions of our methodology (Appendix C) to calculate water savings for Slow the Flow Indoors, Garden-In-A-Box and any other programs that we are able to collect data for. This task will include developing a reporting format and template, so that the results of the analyses can be shared with each participating water provider.

Sub-tasks:

- Develop a methodology for calculating water savings of STF Indoors
- Develop a methodology for calculation water savings of Garden-In-A-Box
- Produce results using these methodologies
- 75% Progress Report to the CWCB

Task 4. Reporting and Dissemination of Results (December 2, 2013 – January 20, 2014)

This task incorporates several efforts directed toward public education and outreach of our project's results. We will seek to demonstrate web application's ability, present conservation and economic case studies, and present conservation impact results, for the water community.

Sub-tasks:

- Create reports and provide partners with clear summary of the impact of STF on their customers
- Develop and present reports at various water conservation organizations including the Water Conservation Technical Advisory Group, Colorado WaterWise, and the Inter-Basin Compact Commission
- Create abstracts for conferences that have opportunities to present on water conservation, such as AWWA[2]
- Make presentations at in-state conferences for the water conservation community (e.g. Upper Colorado River Basin Water Conference (Grand Junction, November, 2012), Rocky Mountain Land-Use Institute Annual Conference (Denver, March, 2013), American Water Works Association Annual Conference (Denver, June, 2013), and WaterSmart Innovations Conference (Las Vegas, October, 2013))[3]
- Final Report to the CWCB

[2] Staff time and travel costs, not conference registration or abstract submission fees will be charged to this project.

[3] See 2

Project Tasks and Deliverables

The scope of work includes four tasks, described below, that will lead the CRC and its partners to the goal of a rigorous analysis of the impact of several major water conservation programs that are currently offered to residential customers across the Front Range of Colorado. The tasks, deliverables, and deadlines are summarized in Table 1 below.[4]

Table 1: Summary of Tasks, Deliverables, and Cost

Task	Deliverables	Timeline	Cost
Task 1: Additional Data Retrieval and Literature Review	Letters to partner water providers requesting more data Updated climate data Literature Review, format of sources, pertinent findings	4/25/2013 – 7/13/2013	$15,600
Task 2. Expand and Enhance STF Data Analysis	Updated results of STF impact analysis using new climate data Results of control group(s) study of STF impact analysis Results of longitudinal study of STF impact analysis 50% Progress Report to CWCB	7/14/2013 – 9/27/2013	$19,000
Task 3. Methodology Adaptation to Other Programs	Development of methodology for assessing additional programs. Preliminary results from assessment of additional programs 75% Progress Report	9/28/2013 – 12/1/2013	$17,000
Task 4. Reporting and Dissemination of Results	Final Reports to All Partner Water Providers Final Report CWCB Presentation at one conference[5] Abstract submission to journal	12/2/2013-1/20/2014	$19,300

[4] This timeline is based on receiving notification of grant acceptance by April, 2014

[5] Staff time and travel costs, not conference registration or abstract submission fees will be charged to this project.

Table 2 details the project's budget. The CRC is requesting $48,800 from the CWCB to fund the development of the program. The CRC anticipates a total of $22,100 of additional support ($3,200 in-kind form partner utilities, $6,000 in direct funds from partner utilities and $12,900 of in-kind support from the CRC).

Under each task the CRC has detailed the time required for the task, the hourly rate for that time, and the cost of items associated, and in-kind support provided by partner utilities for the task. Hourly rates are detailed in the project team and partners section below.

Table 2: Program Budget

	Hours	Rate	Total	CWCB Request	Partner Utility In-Kind	Partner Utility Direct Funds[1]	CRC In-Kind
Task 1: Data and Literature Review							
CRC Water Staff	**50**	$60	$3,000	$0			$3,000
Research Associate	**200**	$40	$8,000	$8,000			
Partner Utility Water Records	$3,200		$3,200	$0	$3,200		
Statistical Software Use	**$1,400**		$1,400	$0			$1,400
Total for Task 1			$15,600	$8,000	$3,200	$0	$4,400
Task 2: Enhanced Data Analysis							
CRC Water Staff	**50**	$60	$3,000	$0			$3,000
Research Associate	**400**	$40	$16,000	$16,000			
Total for Task 2			$19,000	$16,000	$0	$0	$3,000
Task 3: Adapt and Apply Methodology							
CRC Water Staff	**50**	$60	$3,000	$0			$3,000
Research Associate	**350**	$40	$14,000	$14,000			
Total for Task 3			$17,000	$14,000	$0	$0	$3,000
Task 4: Reproting							
CRC Water Staff	**50**	$60	$3,000	$3,000			
Research Associate	**320**	$40	$12,800	$6,800		$6,000	
Report Printing	$1,000		$1,000	$1,000			
Paper Submission Fees	$500		$500	$0			$500
Conference Registration and Travel	$2,000		$2,000	$0			$2,000
Total for Task 4			$19,300	$10,800	$0	$6,000	$2,500

Summary			Total Cost	CWCB	Partner Utility In-Kind	Partner Utlity Direct Funds	CRC In-Kind
Project Cost			$70,900	$48,800	$3,200	$6,000	$12,900

1: Partner utility funds are provided directly to CRC as part of partners' contracts. Partners may elect to pay an increased fee for CRC's services in order to receive the impact analysis. Grant funds in this category will come directly from these payments.

Project Team and Partners

The project team is comprised of CRC staff and future subcontracted employees of a web-developing firm.

Water Division Director
Dan Stellar
$60 per hour billing rate
Dan Stellar joined the CRC as Water Division Director in July of 2011. Dan has a strong background in environmental policy with an emphasis on water issues. For three and a half years Dan served as the Assistant Director of the Columbia Water Center, a program of the Earth Institute, Columbia University. In this capacity he managed water conservation, policy and development projects both domestically and internationally, with a special focus on work in India. In addition to project management, Dan guided the development and operations of the Water Center; he was the founding staff member of the Center, and helped it develop into a thriving program with expertise across a range of disciplines. Dan has written and spoken about water related issues to a range of audiences, including at World Water Week in Stockholm, Sweden, and as a regular contributor to the Asia Society's Global Sustainability Roundtable blog. Dan holds a Master of International Affairs degree, with a focus in environmental policy, from Columbia University's School of International and Public Affairs (SIPA), and his undergraduate degree is from the University of Massachusetts, Boston.

Dan is the primary contact and point person for the execution of this program.

Impact Analysis Research Associate
Morgan Zeliff
$40 per hour billing rate
Morgan Zeliff joined the CRC in 2012 as a research associate in the Water Division. Morgan's primary task is the development and implementation of the CRC's Pilot Impact Analysis of the outdoor water conservation program Slow the Flow (STF). Morgan began working on the Pilot Impact Analysis in January 2012 as a Water Division volunteer. Since this time, she has developed specific methodology for the analysis, with the ability to produce verifiable results documenting STF's impact on the water usage of program participants. Morgan has successfully submitted abstracts to technical conferences including the Upper Colorado River Basin Water Conference (Grand Junction, November, 2012), Rocky Mountain Land-Use Institute Annual Conference (Denver, March, 2013), American Water Works Association Annual Conference (Denver, June, 2013) and WaterSmart Innovations Conference (Las Vegas, October, 2013). Morgan is a Master's candidate at the University of Colorado where she studies the impact of climate change on high-elevation watersheds in the Colorado Rockies. Morgan's goal with earning her Master's degree is to be able to contribute her science-based skill set (e.g. data management, data analysis, technical writing and communication) to help environmental non-profits do their work.

Appendix A: 2012 Water Division Municipal Partners

STF Partners 2005 -2013
Arvada
Aurora
Boulder
Broomfield
Castle Pines Metropolitan District
Castle Pines North
Castle Rock
Centennial
Colorado Springs
Erie
Gillette, WY
Golden
Lafayette
Left Hand Water District
Little Thompson Water District
Longmont
Louisville
Loveland
North Table Mountain
Northglenn
Parker
SACWSD (Commerce City)
Superior
Thornton
Westminster
Willow Water

Appendix B. Letters of Support from our Partners

Appendix C. Slow the Flow Impact Analysis Methodology

Methods

Data Acquisition, Cleaning and Preparation

The methodology presented here was designed to quantify the amount of water saved by the STF program at the participant level, using participant record data collected by the CRC during the audit as well as water usage data from our partner water providers, and weather data from local weather stations.

Participant record data collected by the CRC included water account number, address, and turf and shrub landscape sizes (in ft^2) per household. The CRC requested water usage data (in gal) for at least two years prior and two years following the audit for each participant[6]. Using water account number and address information, the CRC matched the water usage data to the landscape size data. Some participants did not have landscape size data, and in those cases, their records were not included in the analysis.

Following acquisition of the data, it was cleaned and prepared for analysis. Households were required to have water usage data from at least one full year (January-December) pre-audit and one full year post-audit. Annual outdoor water usage (U_o) (gal) was calculated as:

$$U - U_i = U_o \qquad \text{Eq. 1}$$

where U is total annual usage (gal), the sum of water used between January through December for the calendar year, and U_i is total annual indoor usage (gal), calculated following Equation 2:

$$((U_{Jan.} + U_{Feb} + U_{Dec})/3)*12 = U_i \qquad \text{Eq.2}$$

where U_{Jan}, U_{Feb}, and U_{Dec} were the total water usage (gal) for each of the three months, January, February, and December. These three months were assumed, following standard practice in Colorado, to be the "winter quarter average" - the time of year when homeowners in the Front Range do not water outdoors.

Weather data, including daily estimated evapotranspiration (ET) (in.) for bluegrass and measured precipitation (P) (in.) was downloaded from two different weather data providers, Northern Colorado Water Conservancy (NCWC) and Denver Water[7] (DW). Two stations were selected from each weather provider; Longmont South and Boulder Southwest from NCWC and Moffat and Lonetree from DW.

[6] For example, if the audit was performed at a household in 2007, then water usage data for 2005 and 2006 were used for the pre-audit data and water usage data from 2008 and 2009 were used for the post-audit data.

[7] For a full description of the data and methodologies used by these two agencies for estimating ET and measuring P, please visit their respective websites: northernwater.org and denverwater.org.

Growing season measured P (May-September) was summed and then multiplied by 0.5 in order to calculate effective P[8]. Growing season (May-September) ET requirement (ET_o) for bluegrass was calculated as the difference between effective P and estimated ET from each station. The four ET_o values were then averaged to derive a single value used in all analyses for the year in question[9].

Impact Analysis Calculations

The calculations used to quantify the amount of water saved (or not), per STF participant per year, began with calculating how much water each participant needed, for their landscape size, and for the amount of water required by ET (ET_o) demand of the plant, turf and/or shrub. This value was called the Need (*N*), and was in gallons:

$$((ET_o/12)*T*7.48) + ((ET_o/12)*S*7.48*0.7) = N \quad \text{Eq. 3}$$

where 12 is a conversion factor to change ET_o from inches to feet, *T* and *S* are Turf and Shrub landscape size in ft^2, respectively, 7.48 is a conversion factor to convert from ft^3 to gallons, and 0.7 is the shrub ET adjustment factor to convert ET_o for bluegrass to a shrub landscape. Equation 3 was only modified if either measured *T* or *S* did not exist, and in those cases, that half of the equation was removed.

Next, the difference between *N* and the amount of annual outdoor water used (U_o) (both in gallons) was calculated to quantify the amount that the participant over- or under-watered for that year (U_D):

$$U_o - N = U_D \quad \text{Eq. 4}$$

The ratio U_o/N, called the application ratio (*AR*), was calculated to estimate the rate at which the participant was over- or under-watering on an annual basis. An average of each participant's *AR* from the two years prior to the audit and an average *AR* from the two years following the audit were calculated and called the pre-audit *AR* and post-audit *AR*, respectively.

The pre-audit *AR* was used to calculate the projected water use (U_p) of each participant for the two years following the audit:

$$AR_{pre} * N = U_p \quad \text{Eq. 5}$$

A final calculation to quantify the amount of water saved (*WS*) was done by finding the difference between U_p and U_o for the two years following the audit:

$$U_p - U_o = WS \quad \text{Eq. 6}$$

If the participant watered at a rate below their pre-audit *AR*, then *WS* was positive, and water was considered to have been saved. If the participant watered at a rate above their pre-audit *AR*, then *WS* was negative, and water was not considered to have been saved.

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[8] Effective P is defined as the precipitation that is actually available for plant uptake, rather than total or measured P which includes P that evaporates before being available to plant uptake. We will consider modifying this value if research shows that there is a better method for calculating effective precipitation.

[9] 2011 Moffat data was not available, while in 2012 Lonetree data was not available and therefore for these two years, only three values of ET were used to calculate ET_o.

Statistical Methodologies

Statistical tests of the data were used to quantify the probability that the conclusions reached from our analyses were true. In all cases the probability/significance level (α) for acceptance of the null hypothesis was set at < 0.05. Standard statistical tests including descriptive statistics, basic linear regression, and one-way analysis of variance were used. While the sample sizes we use are sufficiently large not to require the use of non-parametric tests, if the data is not normally distributed non-parametric tests equivalent to those listed above will also be run.

TOWN OF ERIE
1874

April 2, 2013

Dear Members of the Colorado Water Conservation Board,

The Town of Erie would like to express its support for the Center for ReSource Conservation's (CRC) proposal to the CWCB for water conservation program assessment.

We appreciate the CWCB's leadership on water conservation throughout the state. Over the years, we have also been impressed with the water conservation programs and customer service provided by the CRC's Water Division.

Beginning in 2011, we encouraged the CRC to do a more in-depth analysis of the impact of Slow the Flow on water usage. We provided data and attended a meeting to review the methodology. The results of the pilot impact analysis were provided to us in the past month and we have found them to be very informative, showing us in terms of gallons the level of effectiveness of the program. In the future, we plan to allocate a portion of our Slow the Flow project funds to support this impact analysis work.

We are proud to have been one of the first groups to get involved with assessing the impact of our conservation programs on actual water savings. We believe it is important to go beyond measuring customer satisfaction when assessing the impact of the program and we are excited to support the more in-depth analysis. We think it is important to see how much these efforts are making in actual water conservation. We applaud CRC for its forward thinking on this topic, and we encourage CWCB to fund this proposal.

We believe that the rate structure laid out here will be workable for our municipal water budget. We are in agreement with this concept and are ready to work with the CRC Water Division staff to enhance the analysis of Slow the Flow and possibly other programs into the future.

If you have any questions please feel free to contact me at (303) 926-2871.

Sincerely,

Gary W. Behlen
Public Works Director
Town of Erie

645 Holbrook • P.O. Box 750 • Erie, Colorado, 80516 • Phone (303) 926-2700 • Fax (303) 926-2705

City of Thornton

Infrastructure Maintenance Center
12450 Washington Street
Thornton, CO 80241-2405

Infrastructure Department
720-977-6600
FAX 720-977-6202
www.cityofthornton.net

March 21, 2013

Dear Members of the Colorado Water Conservation Board,

The City of Thornton would like to express its support for the Center for ReSource Conservation's (CRC) proposal to the CWCB for water conservation program assessment.

We appreciate the CWCB's leadership on water conservation throughout the state. Over the years, we have also been impressed with the water conservation programs and customer service provided by the CRC's Water Division.

When the CRC approached us with the suggestion to provide do a more in-depth analysis of the impact of Slow the Flow on water usage, we were supportive, sending them our data and working with them on the methodology. The results of the pilot impact analysis were provided to us in the past month and we have found them to be very informative, showing us in terms of gallons the level of effectiveness of the program. In the future, we plan to allocate a portion of our Slow the Flow project funds to support this impact analysis work.

We are proud to have been one of the first groups to get involved with assessing the impact of our conservation programs on actual water savings. We believe it is important to go beyond measuring customer satisfaction when assessing the impact of the program and we are excited to support the more in-depth analysis. We applaud CRC for its forward thinking on this topic, and we encourage CWCB to fund this proposal.

We are in agreement with this concept and are ready to work with the CRC Water Division staff to enhance the analysis of Slow the Flow and possibly other programs into the future.

Sincerely,

Laura Wing

Laura Wing
Water Conservation Administrator

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