# Conservation Behavior: What's the Potential?

*Presentation for the 2019*
*Central Texas Water Conservation Symposium*

*"Integrated Water:*
*Keeping Water Conservation at the Forefront"*

*January 31, 2019*


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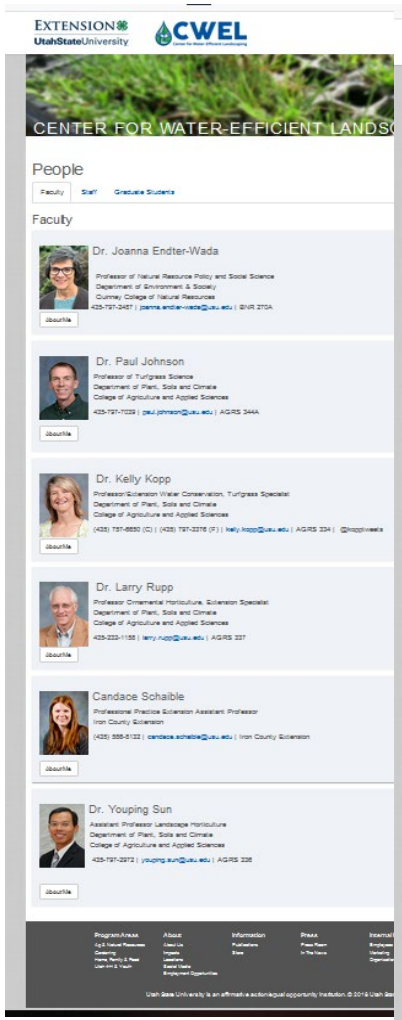
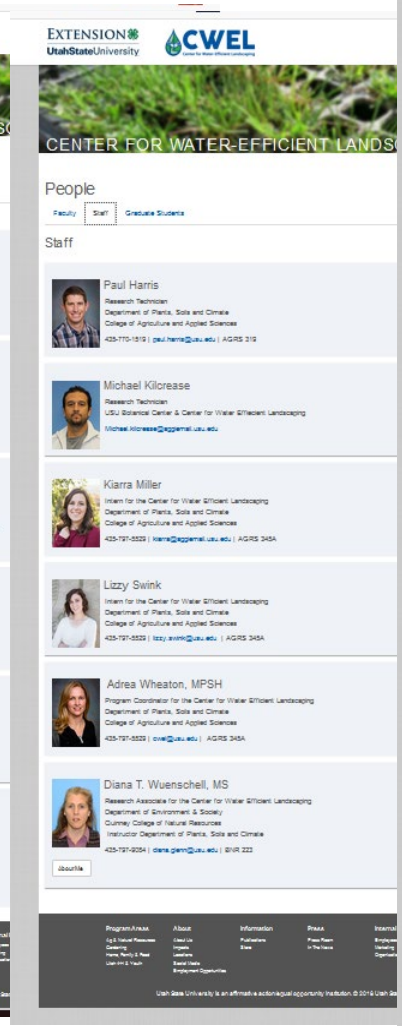
UtahState University

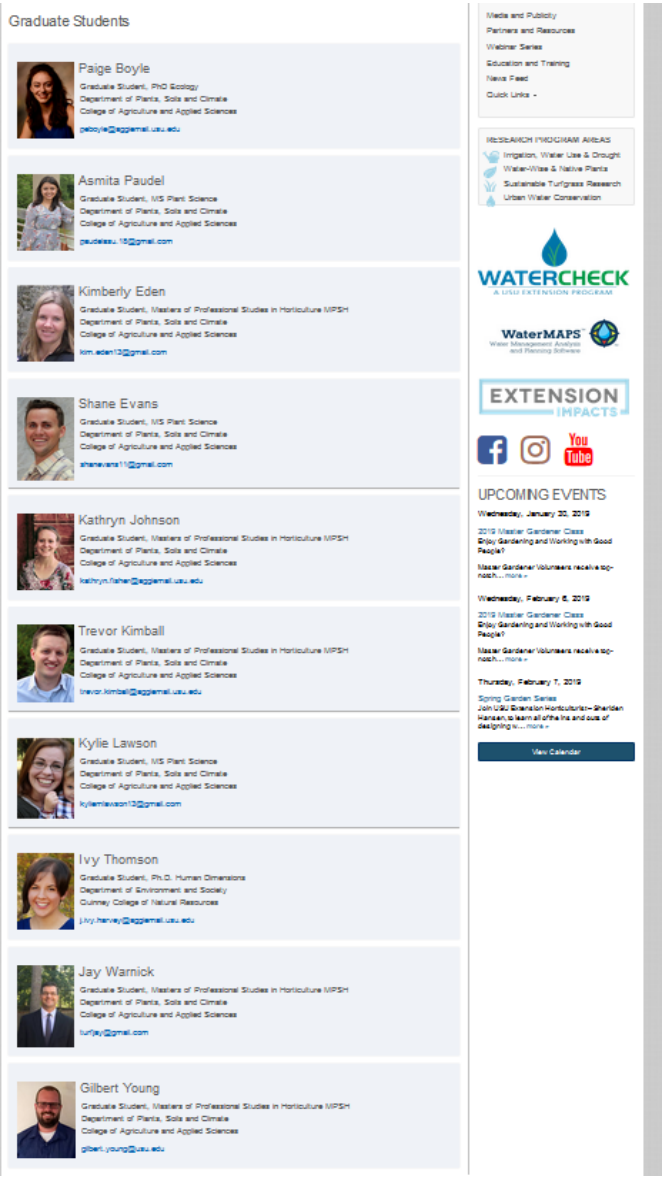
# CWEL

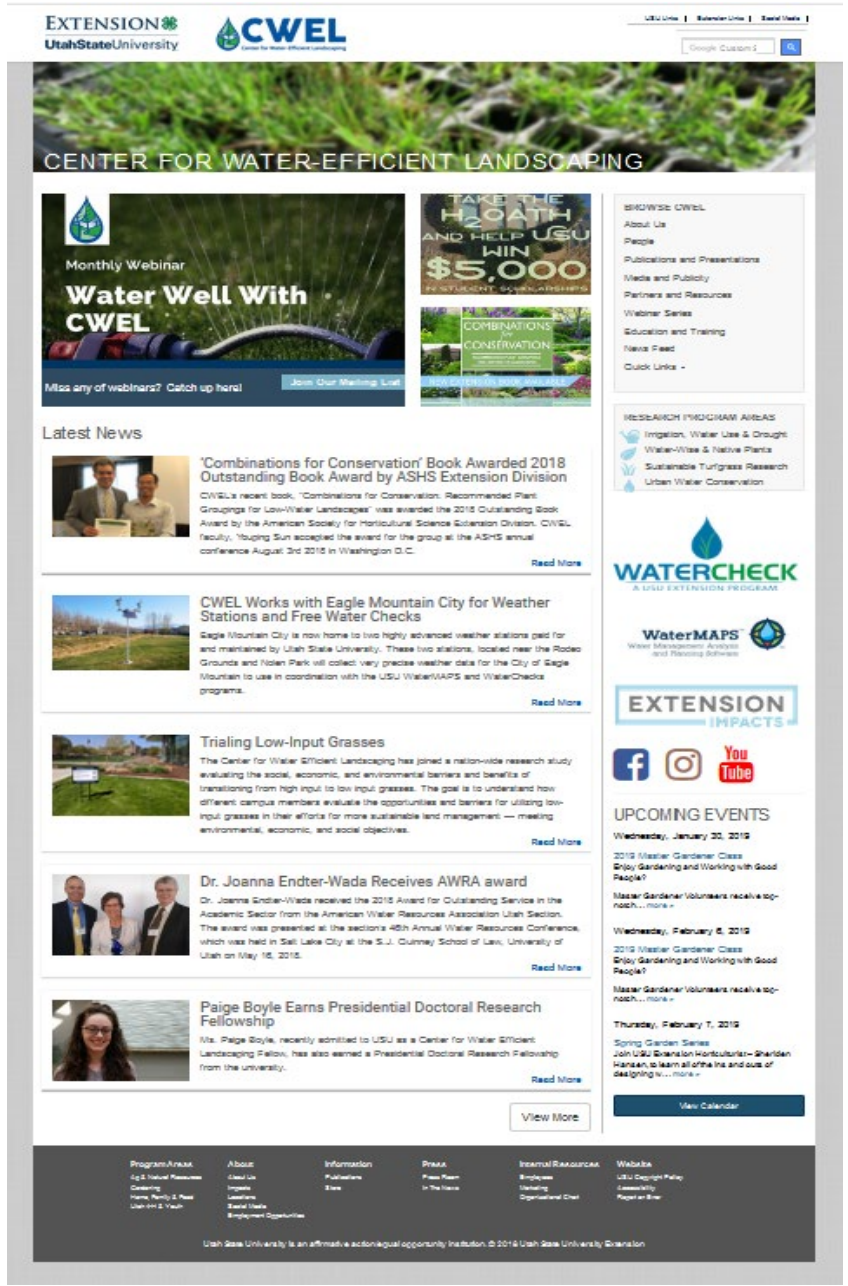
Center for Water-Efficient Landscaping

# Interdisciplinary




https://cwel.usu.edu/

# CWEL

Center for Water-Efficient Landscaping

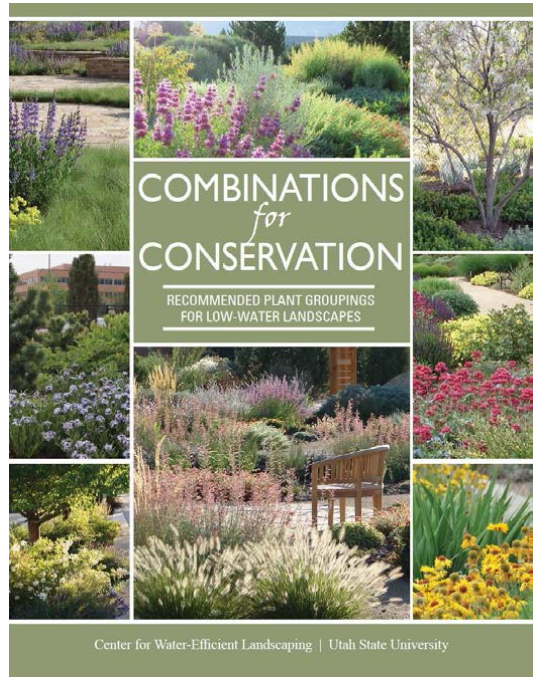
## Research

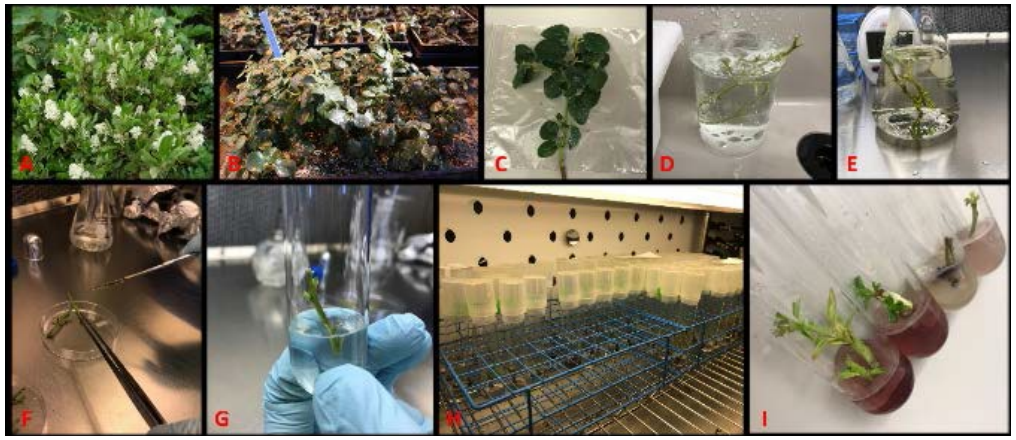
## Education

## Outreach

EXTENSION

UtahStateUniversity

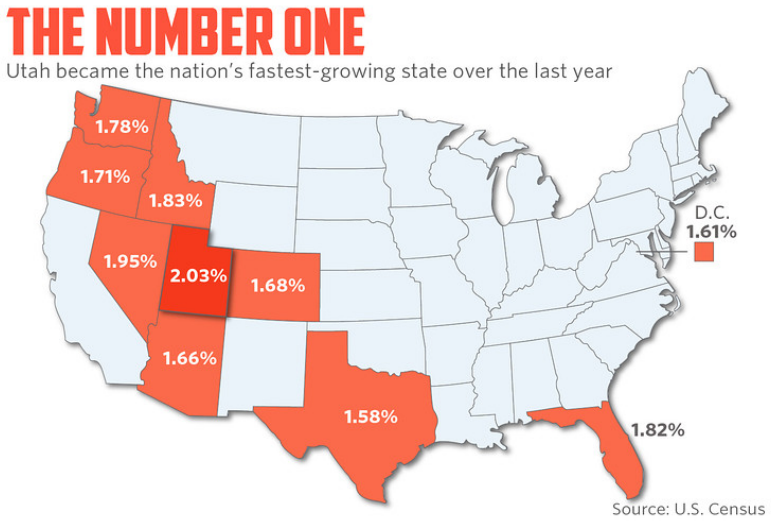


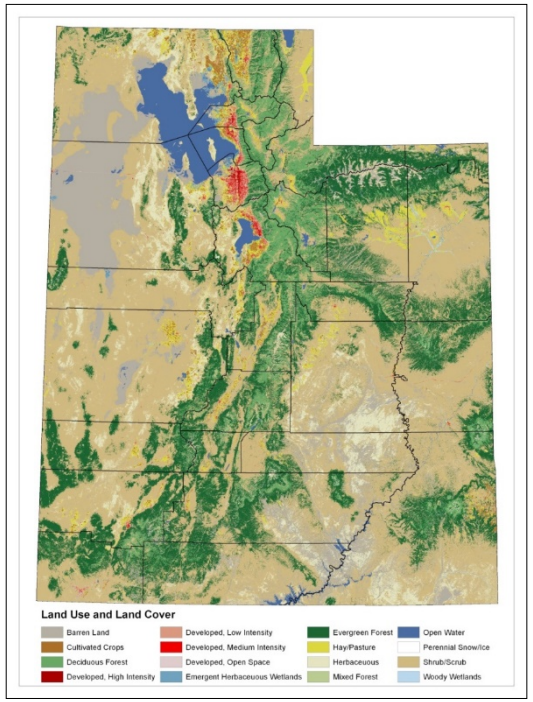

**The mission of the Center for Water Efficient Landscaping (CWEL) is "to sustain the quality of life enjoyed from landscaping while conserving water."**

# Water Policy Context and Challenges


One of USA's most arid states




Rapid population growth




*Map compliments of Shujuan Li*

Concentrated urbanization

http://pics4.city-data.com/cpicc/cfiles7647.jpg

Major land use transitions

# Conservation Opportunities

Greater efficiency on existing landscapes

Transitioning to or installing new low-water landscapes

# Many Decisions & Decision Makers

Public policy and planning decisions

Landscaping decisions

Institutional decisions




Commercial decisions


Consumer decisions


# Research Objectives and Methods

- **Scientific Inquiries** related to understanding the human component of urban ecological systems and urban engineered water systems
- **Observational Studies** seeking to explain urban landscape water use patterns (utilizing interviews, focus groups, surveys, water diaries)
- **Intervention Studies:** experiments in trying to alter landscape water use and assess effectiveness of various conservation approaches (interventions)

# The journey and perspectives gained

- My role on an interdisciplinary team as the social scientist and policy person working with plant scientists, irrigation engineers and climatologists – assumptions about human behavior to overcome
- Opportunities to gain insights through many face-to-face interactions conducting research on urban landscape water use
- What we have learned about water conservation behavior and the need to better understand the context within which it occurs

# Greater efficiency is not as easily engineered in outdoor water use








**Requires understanding the human interface with irrigation technologies and plants in urban landscapes with high site variability**

# Residential and Business Water Use Study

## *Situational Waste*

**Joanna Endter-Wada, Judith Kurtzman, Sean Keenan, Roger Kjelgren and Christopher Neale,** ***2008, Journal of the American Water Resources Association (JAWRA).***

Methods:

1) determine water needs of landscapes
2) categorize water use based on this water budget as "conserving", "acceptable", or "wasteful"
3) explain variations in water use through surveys with households and interviews with businesses

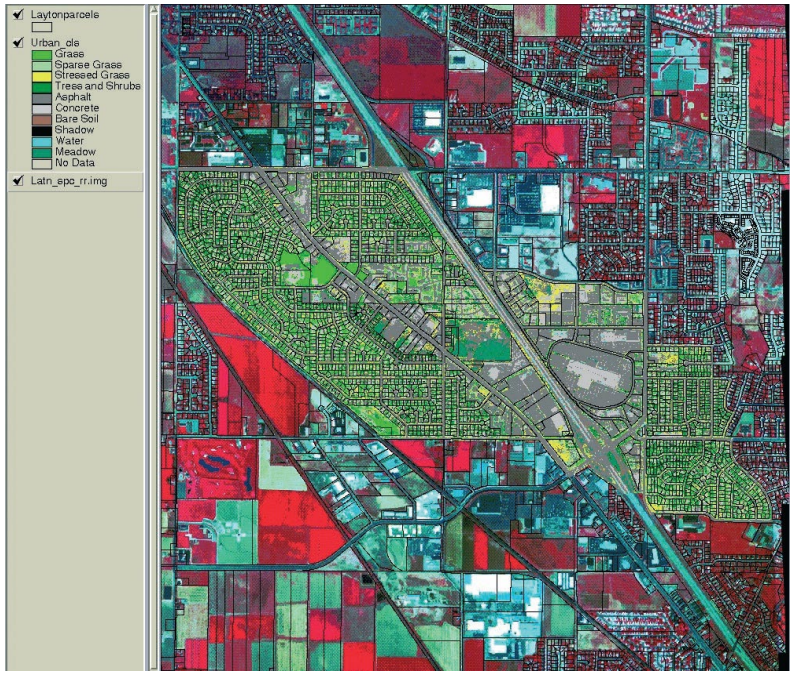



TABLE 1. Water Use Thresholds Used in Categorizing Household and Business Water Use, 1997-2001.

| | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| | Millimeters | | | | |
| Upper Threshold | | | | | |
| ETo, April-October | 843 | 904 | 912 | 1062 | 1080 |
| ETo, May-September | 678 | 719 | 737 | 886 | 904 |
| Rainfall, May-September | 183 | 221 | 140 | 152 | 74 |
| Lower Threshold | | | | | |
| ETo – rain, May-September | 495 | 500 | 594 | 734 | 828 |

# Residential and Business Water Use Study

## *Situational Waste*

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## 1) **"Water waste" is not widespread** but is primarily related to automated irrigation systems.

- time saving devices more than water saving devices
- "convenience" as the common underlying human behavior
  - *convenient to save water with a manual system*
  - *convenient to waste water with an automated one*

**Table 4: Range of Water Use by Automation of Watering System, All Cases**

| Water use range relative to plant need: | Level of automation of watering system [a] (percentages within each category) Low (manual hose watering) | Medium (manual start sprinkler) | High (programmed sprinkler) | All cases |
|---|---|---|---|---|
| Low (conserving use) | 62.7 | 29.4 | 17.5 | 37.0 |
| Medium (acceptable use) | 22.9 | 17.6 | 25.9 | 23.9 |
| High (wasteful use) | 14.4 | 52.9 | 56.6 | 39.1 |
| Column percentage totals | 100.0 | 99.9 | 100.0 | 100.0 |
| Number of total cases | 153 | 34 | 189 | 376 |
| Percentage of total cases | 40.7 | 9.0 | 50.3 | 100.0 |

Descriptive statistics:
Pearson's chi-square = 88.84 ($p < 0.001$)
Gamma correlation coefficient = 0.63

**Residential and Business Water Use Study**

***Situational Waste***

**Joanna Endter-Wada, Judith Kurtzman, Sean Keenan, Roger Kjelgren and Christopher Neale,** ***2008, Journal of the American Water Resources Association (JAWRA).***

2) More conserving water use where business owners were also the property owners

3) Landscapers had incentives to apply more water but also had professional experience, knowledge and pride in their work to both maintain landscapes in good condition and conserve water simultaneously

4) People striving for same green-lawn aesthetic objective varied widely in actual water use – people can have nice landscapes while conserving water

5) Efficient water use is not necessarily result of conscious and intentional actions – hard for people to assess results of their own behavioral motivations

# Homeowner Knowledge Gaps - study with Salt Lake City (*in submission*)

## What specific watering problems are you having?

| Problems Identified (Salt Lake City Study – WSI 2016 presentation) | % Participants Mentioned | % Water Check Evaluation |
|---|---|---|
| **No problems mentioned** | 14% | 0% |
| **Problem Indicators:** | | |
| *Dry/brown spots* | 44% | 36% |
| *Overspray* | 7% | 28% |
| **Irrigation System Design Issues:** | | |
| *Head type, mismatched types on zone* | 6% | 40% |
| *Low head drainage* | 1% | 17% |
| *Valves not separated for plant water requirement* | 4% | 67% |
| *Pressure too high or low* | 8% | 62% |

*Note: responses were volunteered (not answers to forced-choice questions); more than one answer is possible*

# Homeowner Knowledge Gaps - study with Salt Lake City (*in submission*)

## What specific watering problems are you having?

| Problems Identified (Salt Lake City Study – WSI 2016 presentation) | % Participants Mentioned | % Water Check Evaluation |
|---|---|---|
| **Landscape Layout:** | | |
| *Incomplete coverage (head-to-head)* | 24% | 33% |
| **Maintenance Items:** | | |
| *Broken/leaking/clogged valve, pipe, head, nozzle* | 33% | 58% |
| *Misdirected or blocked head* | 17% | 52% |
| *Sunken or tilted heads* | 1% | 59% |
| *Wrong spray patterns* | 3% | 16% |
| **Miscellaneous sprinkler system problems** | 10% | N/A |

*Note: responses were volunteered (not answers to forced-choice questions); more than one answer is possible*

***Salt Lake City is using this applied scientific information to inform the practice of water conservation programming.***

**School district (Institutional) Water Use Study**

***Situational Problem Solving***

**Douglas Kilgren, Joanna Endter-Wada, Roger Kjelgren, Paul G. Johnson, *2010, Journal of the American Water Resources Association (JAWRA)*.**

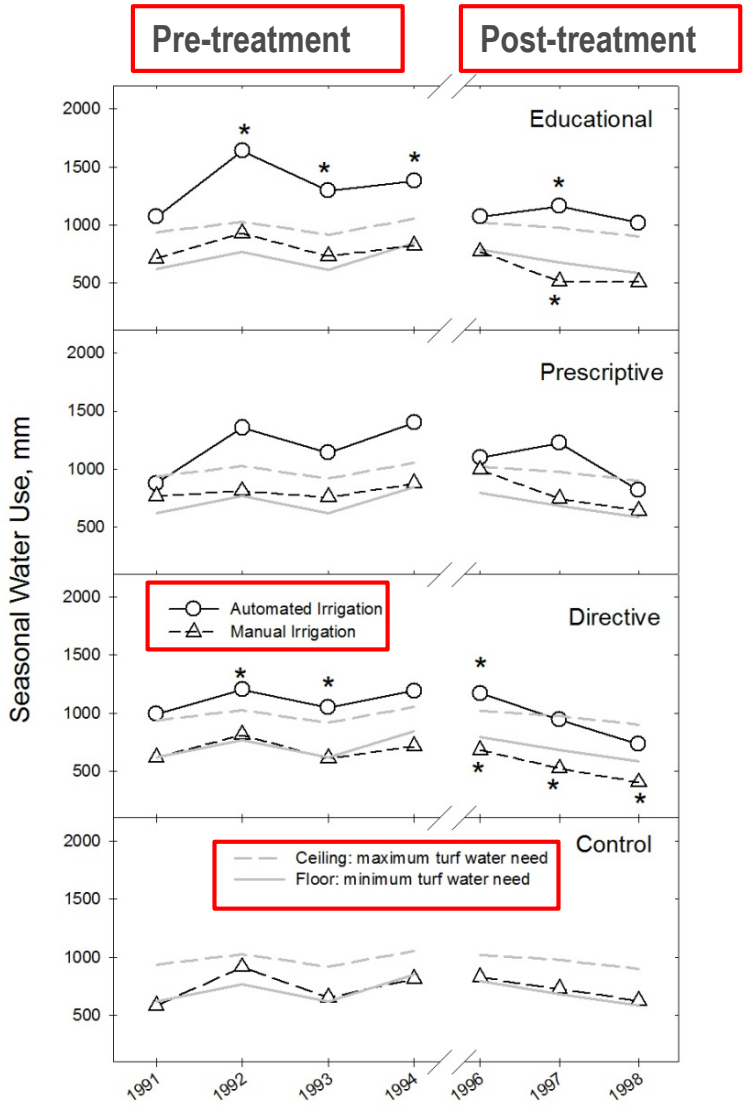
- Experimental intervention study on school grounds
- Controlled for type of irrigation system (manual or automated) and water conservation interventions
- Worked with custodians at elementary schools for 3 summers – used interviews and watering diaries

TABLE 1. Experimental Interventions.

| | Experimental Activities | | | |
|---|---|---|---|---|
| Interventions | Letter About Conserving Water | ETo-Based Watering Schedule | Water Conservation Workshop | Interviews/ Water Diaries |
| [Control Group] | | | | |
| Directive | X | | | X |
| Prescriptive | X | X | | X |
| Educational | X | X | X | X |

Note: Cumulatively combined experimental activities defined the interventions for 35 elementary schools in suburban Salt Lake City, with the effects of the interviews and water diaries (data collection activities) recognized as part of the overall experimental design.

# Influence of irrigation system and site factors




- Differences between automated and manual irrigation systems overshadowed the impact of the interventions on school water use

- Other site factors played a role too

| Less water use: | More water use: |
|---|---|
| manual system | automated system |
| large landscape | small landscape |
| poor water pressure | good water pressure |
| *= convenient to conserve* | *= convenient to overwater* |

*Kilgren, Endter-Wada, Kjelgren, Johnson, 2010, JAWRA*

# Conservation success is related to initial capacity to conserve and is not easily characterized or promoted

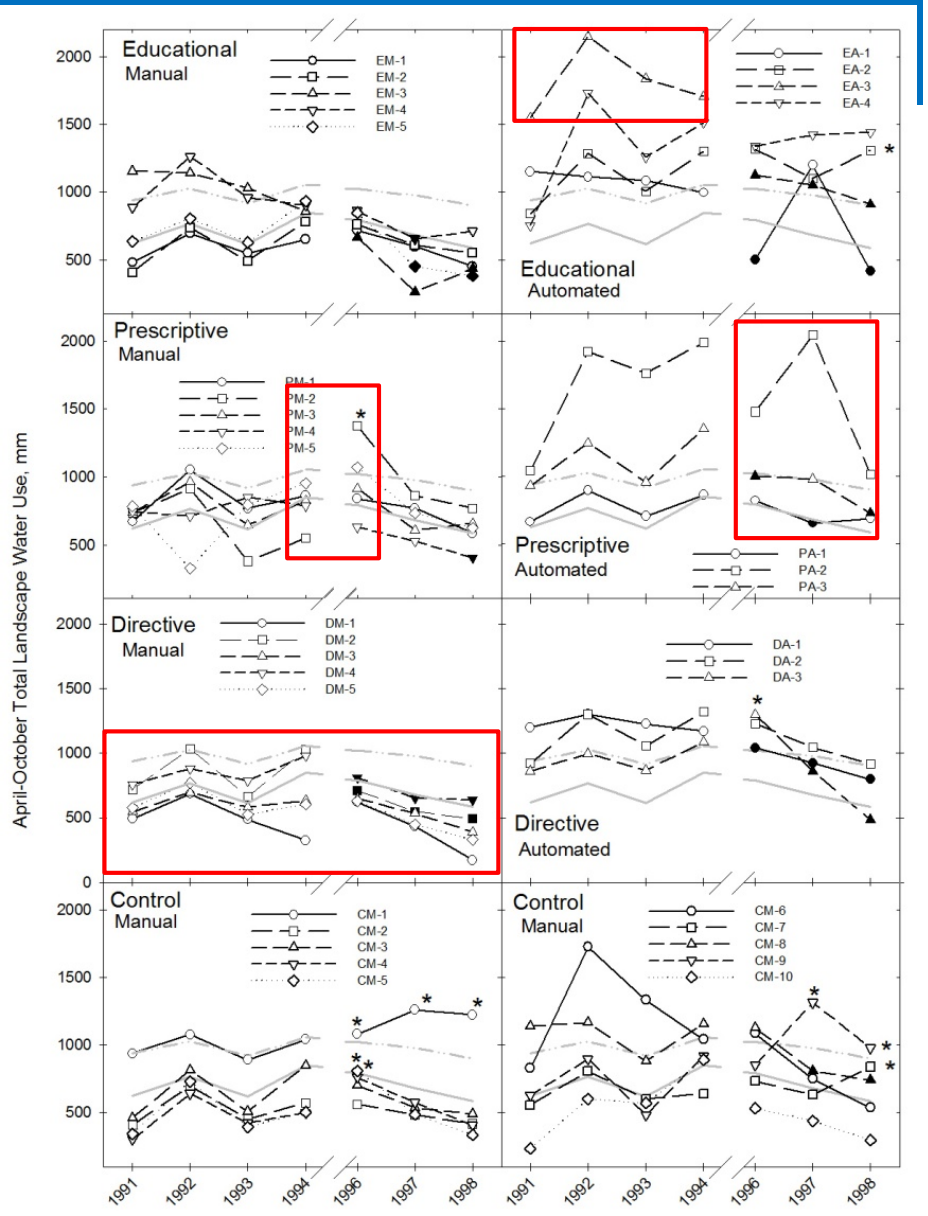
## Nature of success:

- successful at reducing and sustaining effort
  (had pre-intervention capacity to conserve)
- successful at remaining conserving
  (little pre-intervention capacity to conserve)

## Elements of success related to:

- favorable site characteristics
- knowledge, experience, skill of irrigator
- new information

➢ **Situational waste requires situational problem solving**




*Kilgren, Endter-Wada, Kjelgren, Johnson, 2010, JAWRA*

# Study/program participants vary (finding across many studies)

- **Volunteers and "recruits" are different:**
  - Motivations, Needs
  - Responses

- **Participants need different kinds of help based on:**
  - Their own past efforts and experiences with conservation
  - Level of sophistication in the information they are seeking and the detail they expect
  - Whether they can make changes ("do-it-yourselfers") or need help ("hand holders")

# Volunteers are more conserving - so need to recruit high-end users

**Logan Study**

***Categorical Benchmarks based on ranges of Landscape Irrigation Ratio (LIR)***

| Benchmark LIR Category $LIR = \frac{\text{landscape water use}}{\text{landscape water need}}$ | | Mean Water Use[a] *(mm/day)* | Distribution of Cases[c] 2004 Volunteers *(percentage)* | 2005 Recruits *(percentage)* | All Cases *(percentage)* |
|---|---|---|---|---|---|
| *Justifiable Water Use:* | | | | | |
| Efficient: | $LIR \leq 1$ | 2.01 | 30 | 3 | 19 |
| Acceptable: | $1 < LIR \leq 2$ | 4.99 | 35 | 22 | 30 |
| *Unjustifiable Water Use:* | | | | | |
| Inefficient: | $2 < LIR \leq 3$ | 7.72 | 24 | 48 | 34 |
| Unnecessary: | $3 < LIR$ | 12.20[b] | 11 | 27 | 17 |
| | Total % | | 100 | 100 | 100 |
| | N | | (148) | (101) | (249) |

[a] Compared to the 2004 baseline $ET_o$ of 4.56 mm/day and 2005 baseline $ET_o$ of 4.28 mm/day.
[b] 2 outlier cases with greater than 30 mm/day were excluded, 1 case in each year
[c] Pearson's $\chi^2 = 45.479$, $p \leq .000$ (indicative of inherent differences in recruitment methods)

*Glenn et al., 2010*

# Urban Water Conservation Tools
## developed by

CENTER FOR WATER-EFFICIENT LANDSCAPING


**WaterMAPS™**
Water Management Analysis and Planning Software



**WATERCHECK**
A USU EXTENSION PROGRAM

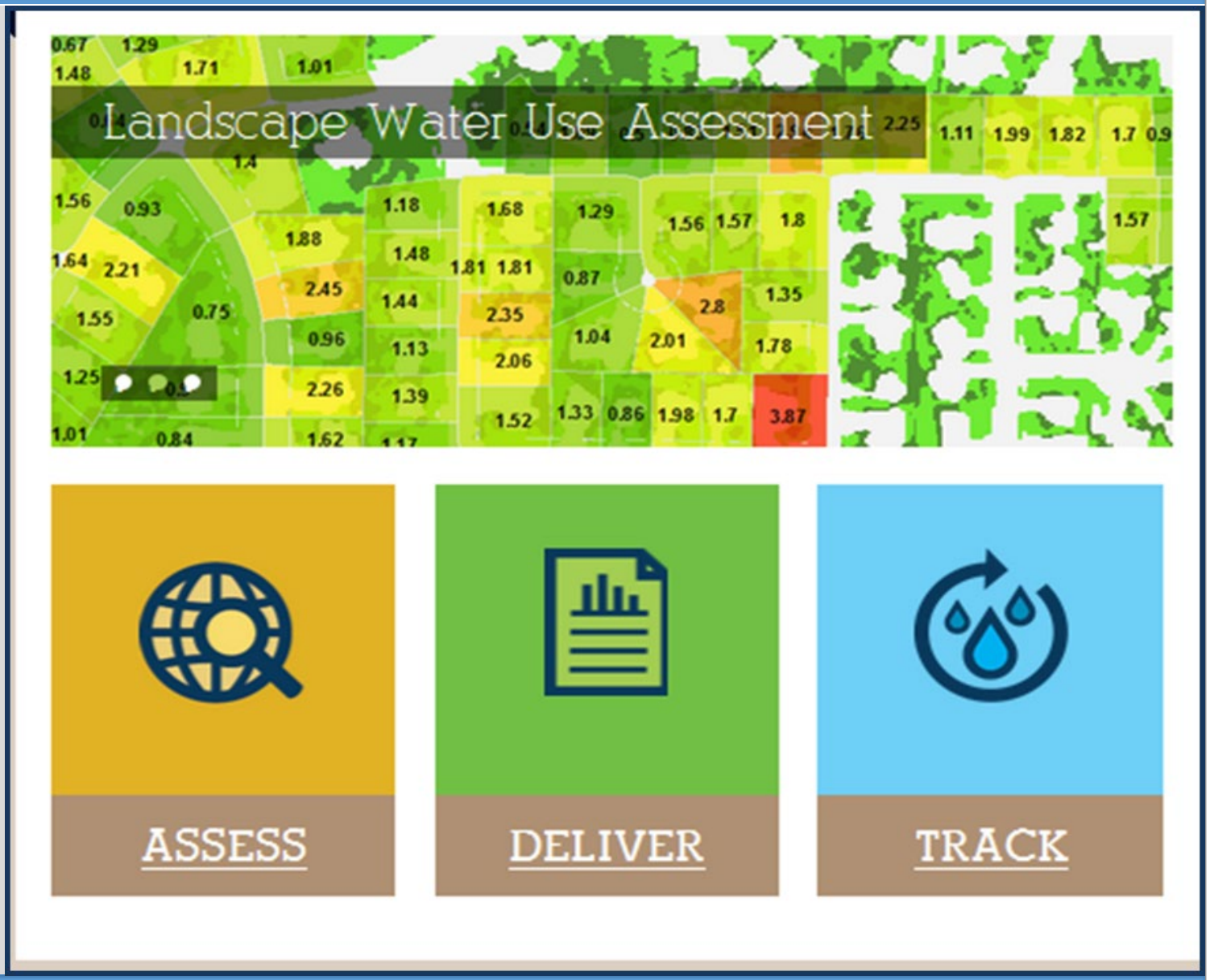
# WaterMAPS™

Software application to analyze and manage urban landscape water use

**ASSESS:** identify locations with capacity to conserve

**DELIVER:** water use reports to help people conserve

**TRACK:** water use change over time; monitor conservation success



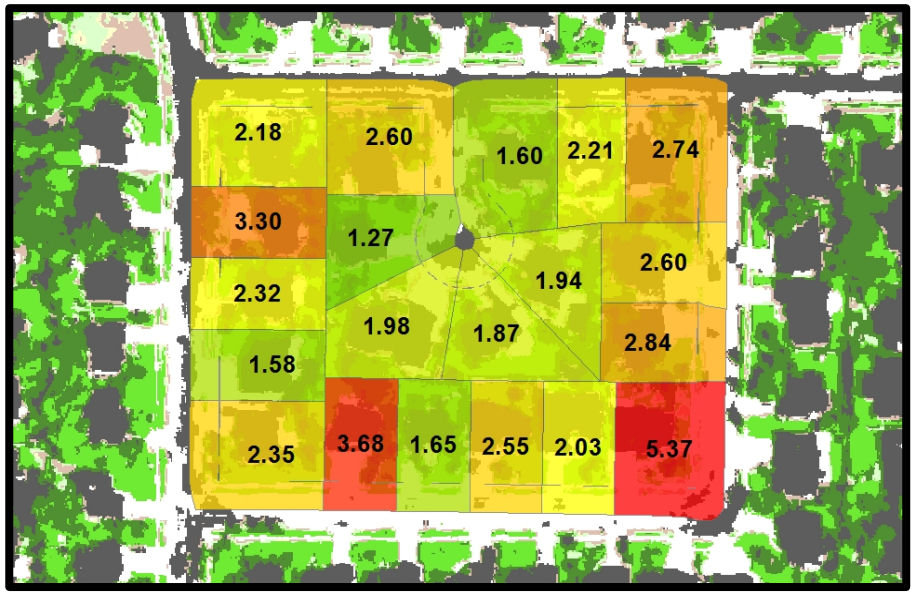
# Identifying Capacity to Conserve Utilizing Landscape Irrigation Ratio (LIR)

$$LIR = \frac{\textbf{Landscape Water Use}\ \textit{estimated}}{\textbf{Landscape Water Need}\ \textit{estimated}}$$

**Landscape Water Use** *estimated*
(derived from analysis of municipal or water provider meter data)

(derived from the classification of remotely-sensed airborne multispectral imagery and localized reference $ET_o$ rates)

**(per unit of landscaped area)**



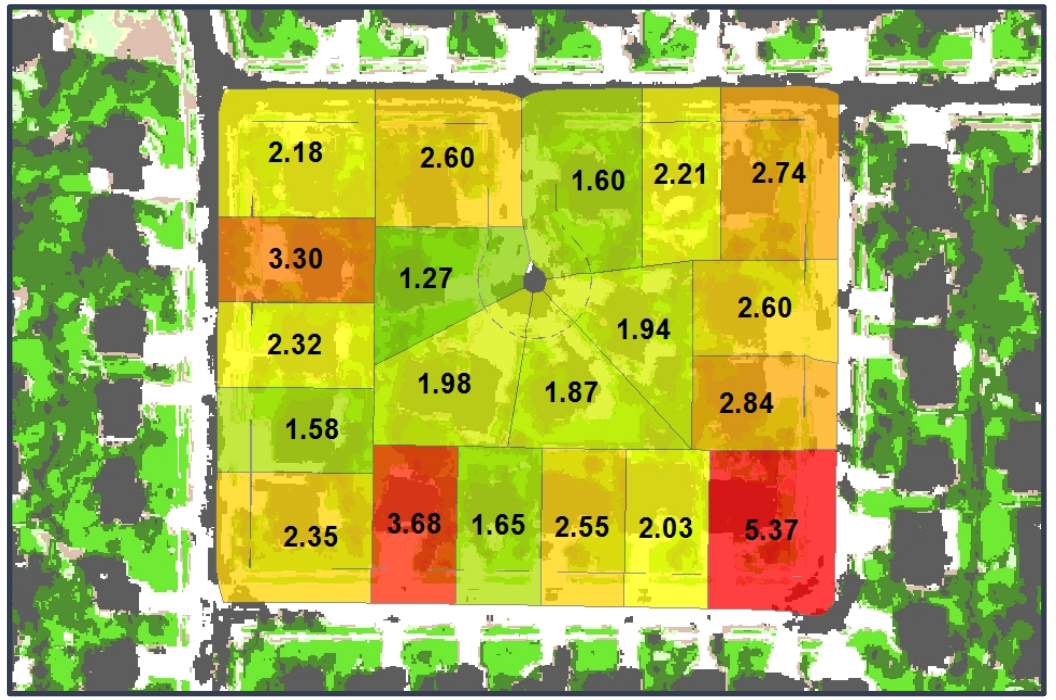

| | | |
|---|---|---|
| **LIR less than 1** | = | **Efficient** |
| **Between 1 and 2** | = | **Acceptable** |
| **Between 2 and 3** | = | **Inefficient** |
| **Greater than 3** | = | **Excessive** |

# Designed to help water agencies:

- Develop benchmarks for water consumption comparisons
- Identify locations with capacity to conserve water
- Direct conservation program outreach to those locations
- Design more sophisticated conservation pricing structures
- Interpret and communicate feedback to individual customers about their specific situation

WaterMAPS™
Water Management Analysis and Planning Software

UtahState University



# Project Goals

## WBWCD Management Goals:

- Work to meet state and district water conservation goals
- Promote individual water use accountability
- Determine if secondary water use is within water allocations

## USU Research Goals:

- Investigate human behaviors and perceptions related to meters
- Analyze urban landscape irrigation in relation to plant water need using USU WaterMAPS™ (software)
- Design innovative strategies for interpreting and sharing meter data with users to motivate conservation absent a price signal
- Encourage people to monitor their own water use by reinforcing conservation through information feedback mechanisms

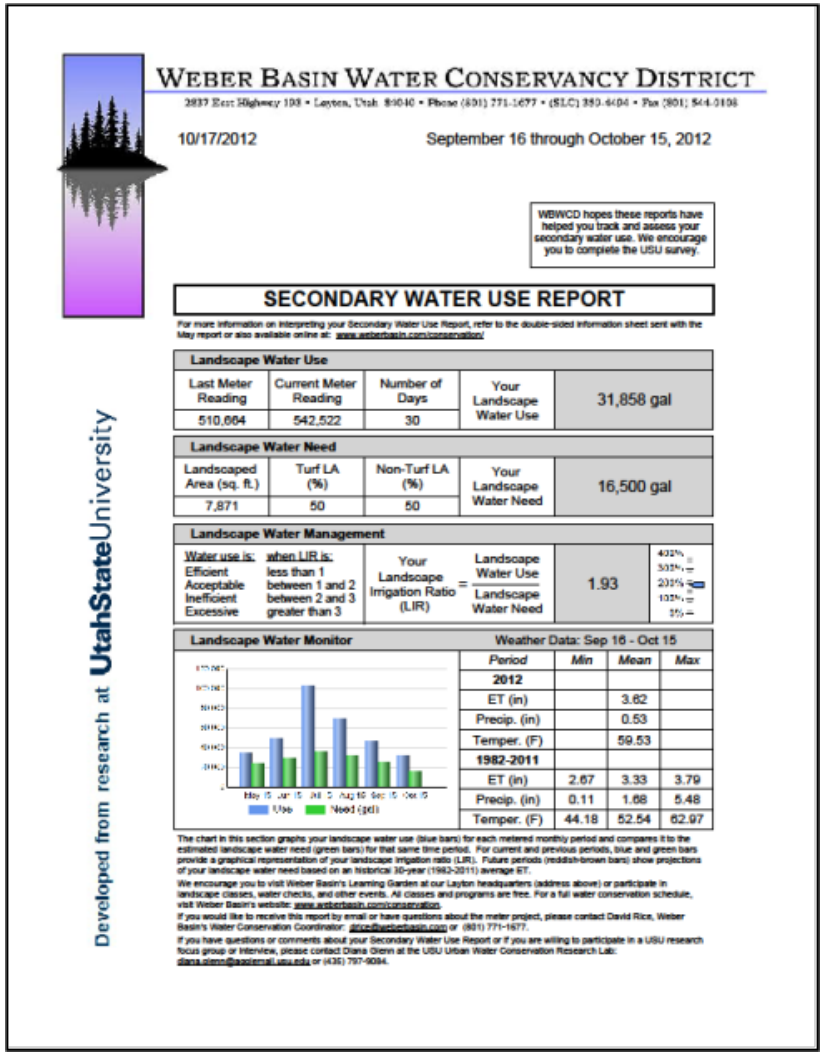
# CONSERVATION STRATEGY

Water meter data interpretation and sharing through Secondary Water Use Reports

*Not a bill.*

People pay for secondary water in connection with property taxes.

## Sample 2012 Secondary Water Use Report



WEBER BASIN WATER CONSERVANCY DISTRICT

2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 359-4494 • Fax (801) 544-0103

10/17/2012 September 16 through October 15, 2012

WBWCD hopes these reports have helped you track and assess your secondary water use. We encourage you to complete the USU survey.

**SECONDARY WATER USE REPORT**

For more information on interpreting your Secondary Water Use Report, refer to the double-sided information sheet sent with the May report or also available online at: www.weberbasin.com/conservation/

**Landscape Water Use**

| Last Meter Reading | Current Meter Reading | Number of Days | Your Landscape Water Use | 31,858 gal |
|---|---|---|---|---|
| 510,664 | 542,522 | 30 | | |

**Landscape Water Need**

| Landscaped Area (sq. ft.) | Turf LA (%) | Non-Turf LA (%) | Your Landscape Water Need | 16,500 gal |
|---|---|---|---|---|
| 7,871 | 50 | 50 | | |

**Landscape Water Management**

| Water use is: | when LIR is: |
|---|---|
| Efficient | less than 1 |
| Acceptable | between 1 and 2 |
| Inefficient | between 2 and 3 |
| Excessive | greater than 3 |

Your Landscape Irrigation Ratio (LIR) = Landscape Water Use / Landscape Water Need = 1.93

**Landscape Water Monitor** Weather Data: Sep 16 - Oct 15

| Period | Min | Mean | Max |
|---|---|---|---|
| 2012 | | | |
| ET (in) | | 3.62 | |
| Precip. (in) | | 0.53 | |
| Temper. (F) | | 59.53 | |
| 1982-2011 | | | |
| ET (in) | 2.67 | 3.33 | 3.79 |
| Precip. (in) | 0.11 | 1.68 | 5.48 |
| Temper. (F) | 44.18 | 52.54 | 62.97 |

The chart in this section graphs your landscape water use (blue bars) for each metered monthly period and compares it to the estimated landscape water need (green bars) for that same time period. For current and previous periods, blue and green bars provide a graphical representation of your landscape irrigation ratio (LIR). Future periods (reddish-brown bars) show projections of your landscape water need based on an historical 30-year (1982-2011) average ET.

We encourage you to visit Weber Basin's Learning Garden at our Layton headquarters (address above) or participate in landscape classes, water checks, and other events. All classes and programs are free. For a full water conservation schedule, visit Weber Basin's website: www.weberbasin.com/conservation

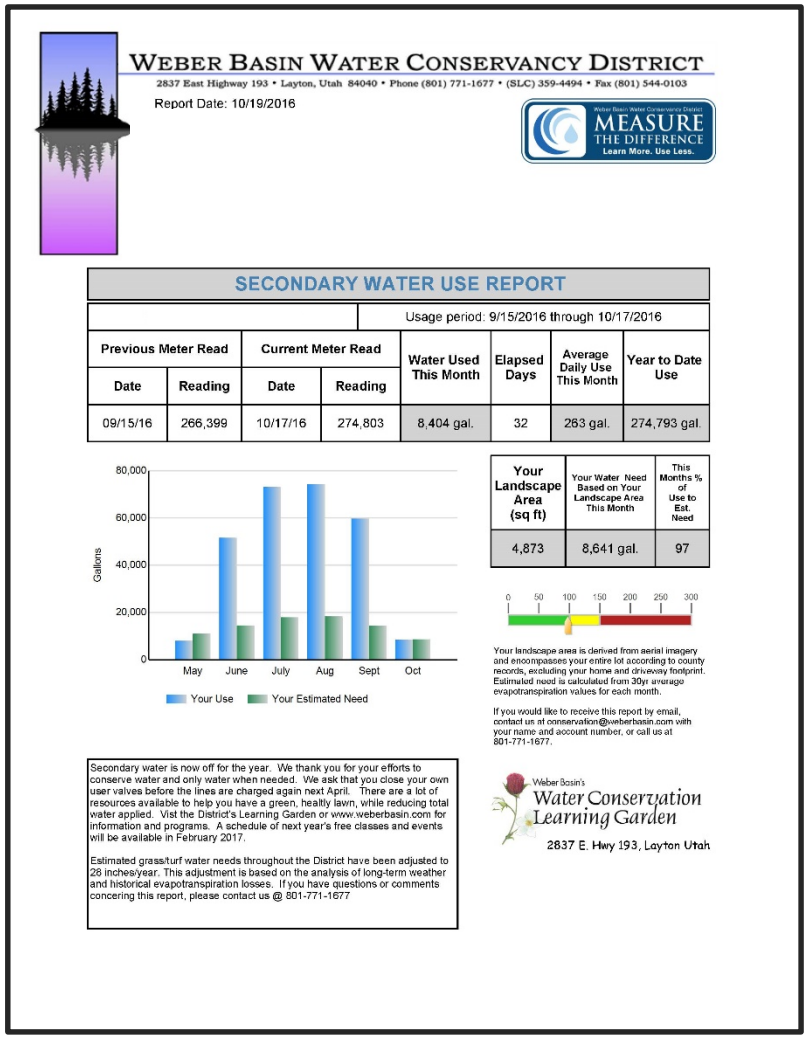
If you would like to receive this report by email or have questions about the meter project, please contact David Rice, Weber Basin's Water Conservation Coordinator: drice@weberbasin.com or (801) 771-1677.

If you have questions or comments about your Secondary Water Use Report or if you are willing to participate in a USU research focus group or interview, please contact Diana Glenn at the USU Urban Water Conservation Research Lab: diana.glenn@aggiemail.usu.edu or (435) 797-9084.

Developed from research at UtahStateUniversity

**Reports are based on defining appropriateness of landscape water use relative to plant water need (landscape water budgeting)**

## Sample 2013-2016 Secondary Water Use Report



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2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 359-4494 • Fax (801) 544-0103

Report Date: 10/19/2016

MEASURE THE DIFFERENCE Learn More. Use Less.

**SECONDARY WATER USE REPORT**

Usage period: 9/15/2016 through 10/17/2016

| Previous Meter Read | | Current Meter Read | | Water Used This Month | Elapsed Days | Average Daily Use This Month | Year to Date Use |
|---|---|---|---|---|---|---|---|
| Date | Reading | Date | Reading | | | | |
| 09/15/16 | 266,399 | 10/17/16 | 274,803 | 8,404 gal. | 32 | 263 gal. | 274,793 gal. |




| Your Landscape Area (sq ft) | Your Water Need Based on Your Landscape Area This Month | This Months % of Use to Est. Need |
|---|---|---|
| 4,873 | 8,641 gal. | 97 |




Your landscape area is derived from aerial imagery and encompasses your entire lot according to county records, excluding your home and driveway footprint. Estimated need is calculated from 30yr average evapotranspiration values for each month.

If you would like to receive this report by email, contact us at conservation@weberbasin.com with your name and account number, or call us at 801-771-1677.

Secondary water is now off for the year. We thank you for your efforts to conserve water and only water when needed. We ask that you close your own user valves before the lines are charged again next April. There are a lot of resources available to help you have a green, healthy lawn, while reducing total water applied. Vist the District's Learning Garden or www.weberbasin.com for information and programs. A schedule of next year's free classes and events will be available in February 2017.

Estimated grass/turf water needs throughout the District have been adjusted to 28 inches/year. This adjustment is based on the analysis of long-term weather and historical evapotranspiration losses. If you have questions or comments concering this report, please contact us @ 801-771-1677

Weber Basin's Water Conservation Learning Garden

2837 E. Hwy 193, Layton Utah

**Customer name, address, account** (not shown)

**Landscape water use:** secondary meter readings and landscape water use in gallons

**Landscape water need:** estimated landscape water need in gallons based on landscaped area and weather data

**Watering appropriateness:** reported as a landscape irrigation ratio (LIR) and/or a %

**Landscape water monitor:** graph of monthly landscape water use compared to need

**Information & messaging:** weather data, conservation programs, contact information

## Weber Basin Water Conservancy District

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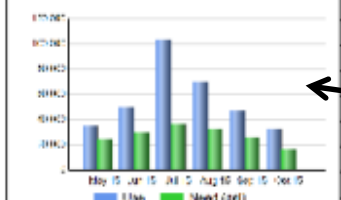
**Landscape Water Monitor** — Weather Data: Sep 16 - Oct 15

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If you would like to receive this report by email or have questions about the meter project, please contact David Rice, Weber Basin's Water Conservation Coordinator: drice@weberbasin.com or (801) 771-1677.

If you have questions or comments about your Secondary Water Use Report or if you are willing to participate in a USU research focus group or interview, please contact Diana Glenn at the USU Urban Water Conservation Research Lab: diana.glenn@aggiemail.usu.edu or (435) 797-9094.

Developed from research at UtahStateUniversity

## Weber Basin Water Conservancy District

2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 359-4494 • Fax (801) 544-0103

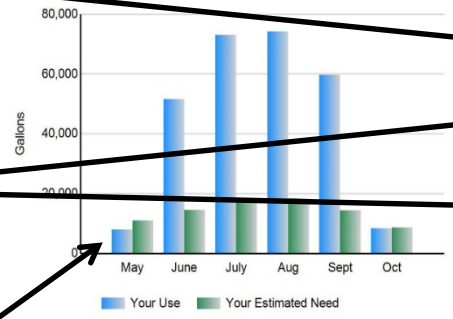
Report Date: 10/19/2016

MEASURE THE DIFFERENCE Learn More. Use Less.

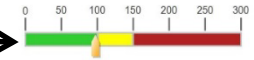
### SECONDARY WATER USE REPORT

Usage period: 9/15/2016 through 10/17/2016

| Previous Meter Read | | Current Meter Read | | Water Used This Month | Elapsed Days | Average Daily Use This Month | Year to Date Use |
|---|---|---|---|---|---|---|---|
| Date | Reading | Date | Reading | | | | |
| 09/15/16 | 266,399 | 10/17/16 | 274,803 | 8,404 gal. | 32 | 263 gal. | 274,793 gal. |




| Your Landscape Area (sq ft) | Your Water Need Based on Your Landscape Area This Month | This Months % of Use to Est. Need |
|---|---|---|
| 4,873 | 8,641 gal. | 97 |




Your landscape area is derived from aerial imagery and encompasses your entire lot according to county records, excluding your home and driveway footprint. Estimated need is calculated from 30yr average evapotranspiration values for each month.

If you would like to receive this report by email, contact us at conservation@weberbasin.com with your name and account number, or call us at 801-771-1677.

Secondary water is now off for the year. We thank you for your efforts to conserve water and only water when needed. We ask that you close your own user valves before the lines are charged again next April. There are a lot of resources available to help you have a green, healthy lawn, while reducing total water applied. Vist the District's Learning Garden or www.weberbasin.com for information and programs. A schedule of next year's free classes and events will be available in February 2017.

Estimated grass/turf water needs throughout the District have been adjusted to 48 inches/year. This adjustment is based on the analysis of long-term weather and historical evapotranspiration losses. If you have questions or comments concering this report, please contact us @ 801-771-1677

Weber Basin's Water Conservation Learning Garden

2837 E. Hwy 193, Layton Utah

# Elements of Secondary Water Use Reports

Weber Basin Water Conservancy District

UtahState University

# RESULTS:
## Water Use Trends 2012-2016

- *Households use, on average, 160% (LIR=1.6) of the water that their landscapes need*
- *Seasons unfold differently, requiring adaptability for maximum efficiency*
- *More overuse tends to occur later in the irrigation season*

**Average LIRs for months and seasons by year**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 5-year average |
|---|---|---|---|---|---|---|
| April 15-May 15 | 1.2 | 1.0 | 0.5 | 0.5 | 0.3 | **0.7** |
| May 16-June 15 | 1.9 | 1.5 | 1.8 | 0.7 | 1.2 | **1.4** |
| June 16-July 15 | 2.2 | 1.9 | 1.6 | 1.6 | 1.9 | **1.8** |
| July 16-Aug. 15 | 2.1 | 1.7 | 1.6 | 1.3 | 2.0 | **1.7** |
| Aug. 16-Sept. 15 | 2.1 | 1.4 | 1.4 | 1.7 | 1.9 | **1.7** |
| Sept. 16-Oct. 15 | 2.4 | | | | 1.3 | **1.9** |
| Sept. 16-Oct. 1 | | 2.0 | 2.0 | 2.0 | | |
| **Seasonal** | **2.0** | **1.6** | **1.5** | **1.3** | **1.4** | **≈ 1.5** |

# Observations About Human Behavior and Water Conservation

- **Good Intentions:** people are generally willing to conserve water and motivated to do so for a variety of reasons
- **Innocent Overwatering:** people don't know how much water landscapes actually need in the context of weather/climate variability
- **"Situational Waste":** role of site specific constraints and opportunities for efficient water use (great variability in residential parcels)
- **Conservation programs:** often attract people who are already efficient and seeking information to increase their conservation skills
- **Conserving water is a *process*:** involving many actions of change, monitoring, adjustment, and reinforcement; it is *iterative* over time

# Implications for Conservation Policy and Planning

- **Broaden influence of conservation programs:** reach the "information receivers" as well as the "information seekers"
- **Identify conservation opportunities:** find locations with inefficient landscape water use and direct conservation efforts to those locations
- **Provide relevant information:** help people understand water needs of *their* landscape and how to maintain it while saving water
- **Promote long-term habit change:** provide consistent and repeated messaging to aid people's decision making and help them monitor their own progress toward conservation goals
- **Prepare for droughts and growing scarcity:** fine-tune people's ability to water appropriately during droughts with less consequence

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# Conservation Behavior: What's the Potential?

## *DISCUSSION*

***Thank you!***


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