Information Technologies to Support Water Conservation

Dr. Joanna Endter-Wada

Department of Environment & Society
Quinney College of Natural Resources

21st Annual Utah Water Summit
October 28, 2014

Overarching Goals

Situate urban water conservation in the current discussion about water planning and management strategies in Utah.

Talk about successes and developments in urban water conservation approaches that make it a viable option for providing significant future water supplies.

Overview

- Water management challenges
- Conservation's "untapped" potential
- The conservation conundrum
- Demand management infrastructure
- Implications for investment strategies

Water Management Challenges

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

A Central Water Challenge

Key Question:

How can we best accommodate a growing population, promote a vibrant economy, and maintain a healthy natural environment in an era of resource constraints?

Resource Constraints:

Two resources that are generally scarce, highly variable, and subject to a variety of risks:

- Western water resources
- Public sector financing

Water utilities are at the crossroads of a changing water resource and financial environment

- Christine Boyle

- Recent economic recession
- Increasing water shortages
- Declining per capita demand
- Aging infrastructure
- Tightened access to capital
- Climate change

"…the strongest financial solutions will be those that increase utilities' capacity to adapt to change"

Source: C.E. Boyle, January 2014, JAWWA

Needed Water Infrastructure Investments

US 12th globally

World Econ. Forum, Global Competitiveness Report 2014-2015

Drinking water infrastructure graded D+

240,000 water main breaks/yr

ASCE (2013)

The Salt Lake Tribune

Cleanup from E. Salt Lake City water main break continues

By Bob Mims The Salt Lake Tribune

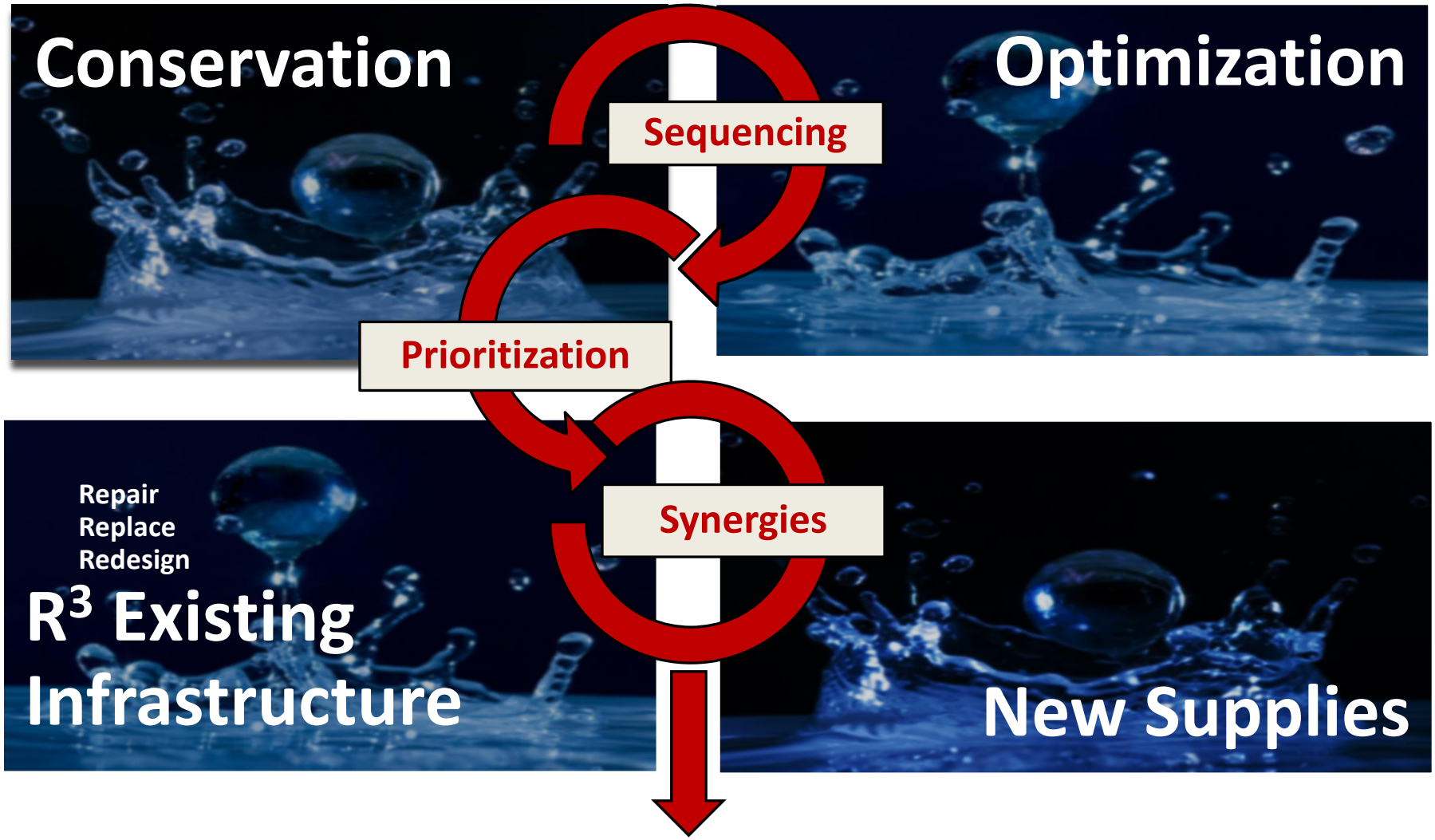
Published October 13, 2014 7:59 am

East Salt Lake City's Foothill Boulevard was open to commuters Monday morning, but a section of 1700 South remained closed as crews continued repair work in the wake of Friday night's water main break and subsequent 2.5 million-gallon flood.

The break in the 48-inch water main — blamed on a failed fitting — sent a river flowing west on 1700 South to near 2500 East, from near its intersection with Foothill Boulevard. Varying amounts of flooding were reported in 34 homes as well as the Montessori Community School at 2416 E. 1700 South.

www.KSL.com

Water Management Strategies



Water and Financial Efficiencies

Water Conservation's "Untapped" Potential

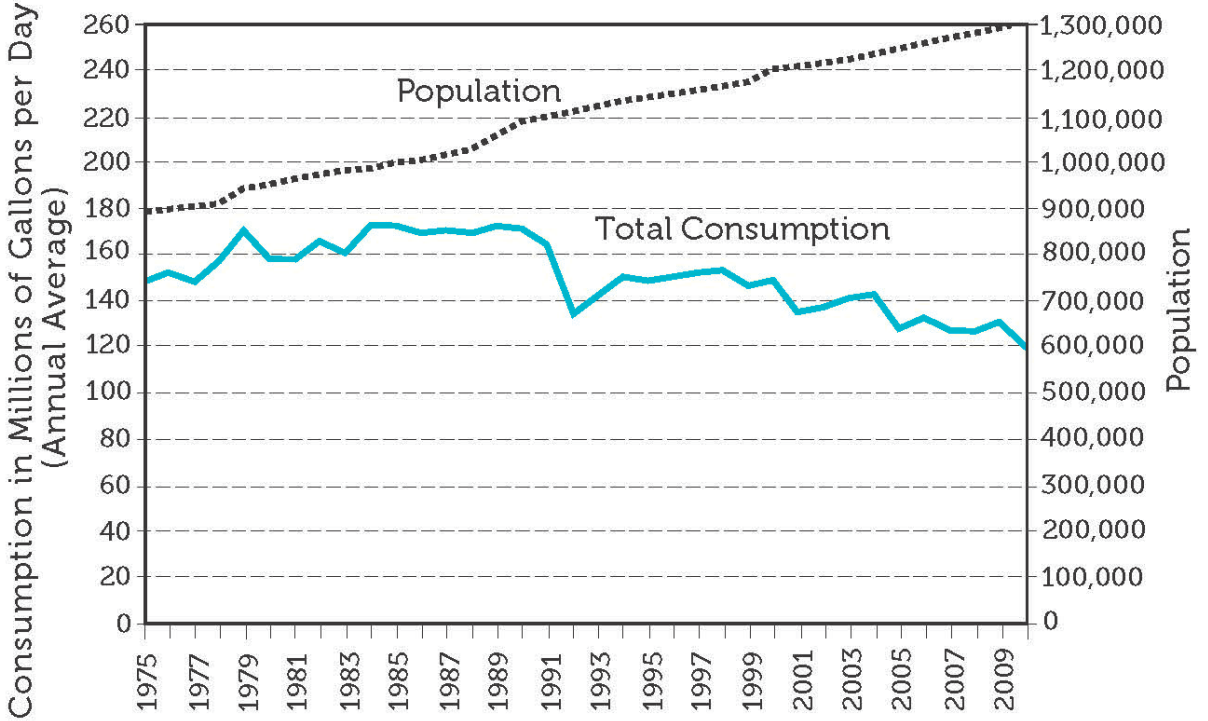
Urban Water Conservation
Why it Matters

- Rapidly growing percentage of Utah's total water use
- Location – requires large physical transfers of water from outlying rural and natural areas
- It is less flexible than agricultural water use in times of shortage (can't "fallow a subdivision")
- Water use expectations and behaviors are being established in the urbanization process
- Physical conversion of moving water from ag. to urban use has long-term implications for future water demand:
  - water delivery and metering infrastructure
  - urban design and initial investments in landscaping
  - situational constraints on efficiency

Urban Water Conservation Example

Seattle, WA

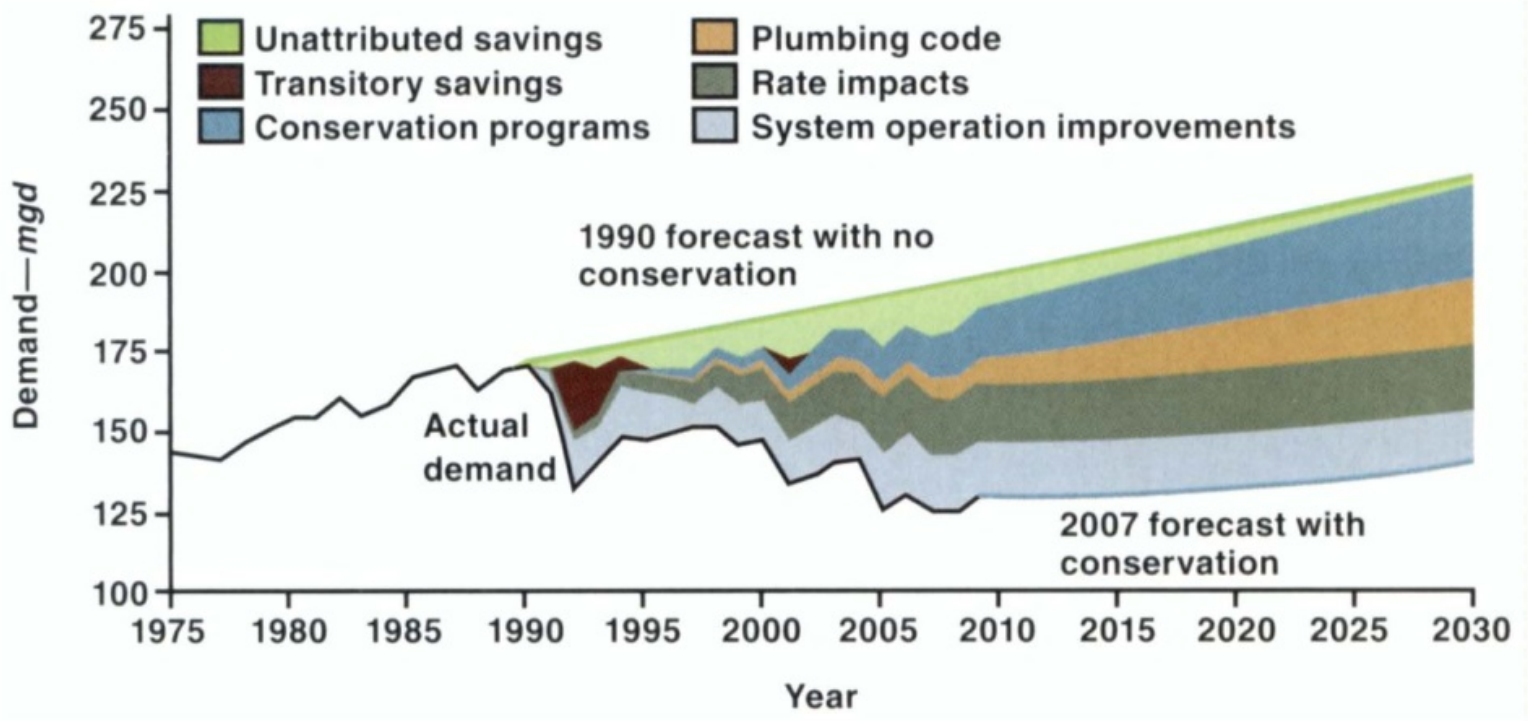
Chart 3: Growth in Population and Water Consumption
Seattle Regional Water System: 1975-2010[1]



Source: http://www.seattle.gov/util/groups/public/@spu/@water/documents/webcontent/02_015230.pdf

Water Conservation Returns – Seattle

FIGURE 2 Demand forecasts with and without conservation



Source: Graphic courtesy of Bruce Flory, Seattle Public Utilities (2009)

Cited in: J.A. Beecher, 2010 (JAWWA), p. 80

Urban Water Conservation Example

Los Angeles

Context:

- Growing population and economy, and yet…
- … they flattened water demand

Success due to:

- A budget-based rate structure
- Portfolio of innovative conservation incentives

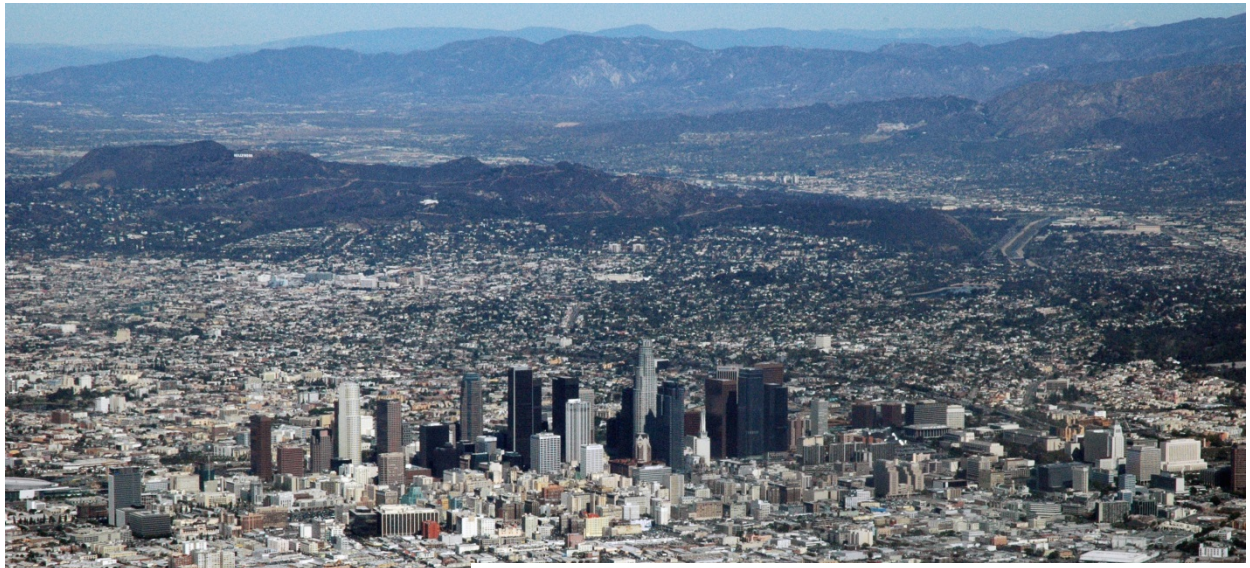
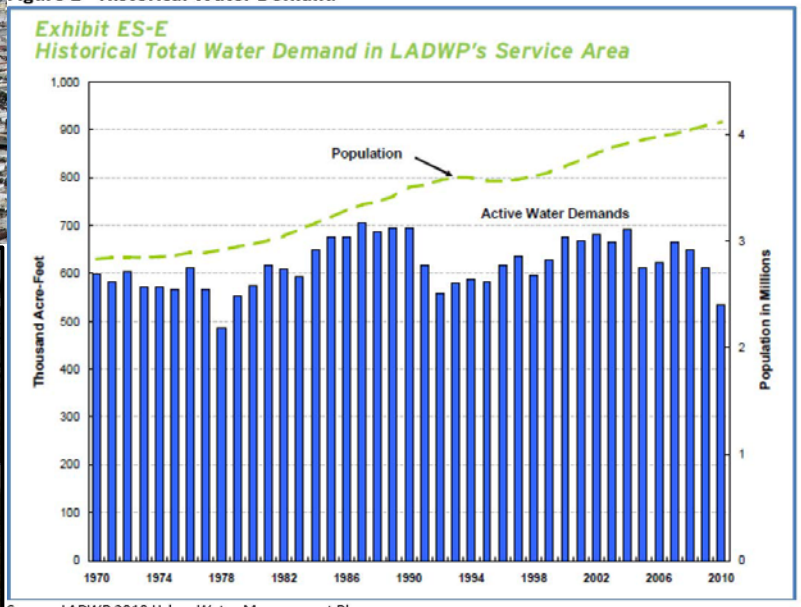


Figure 1 - Historical Water Demand



Source: LADWP 2010 Urban Water Management Plan

Source: http://www.waterrf.org/resources/pages/PublicCaseStudiesList-detail.aspx?ItemID=27

Urban Water Conservation Example

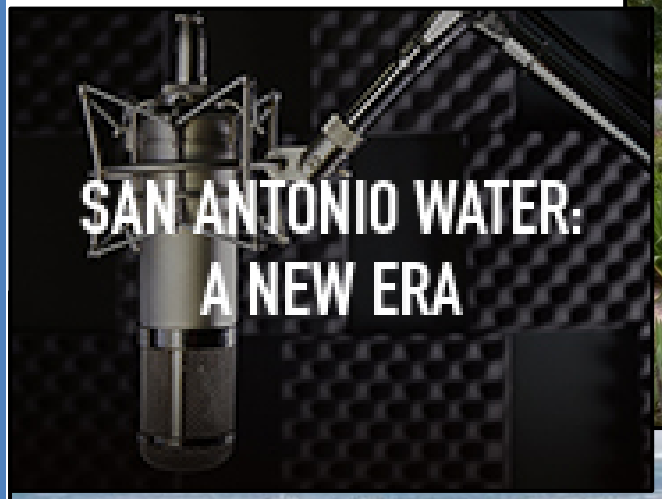
San Antonio

Context:

- Growing population
- Endangered species
- Edwards Aquifer
- Drought
- *Reduced per capita water use 42% since 1994*

Success due to:

- Conservation pricing
- Education/Outreach
- Financial incentives



Story: http://carpediemwest.org/newvisions-smartchoices

Urban Water Conservation Example

Santa Fe

Context:

- 2002:
  demand = supply
  so no wiggle room
- Reduced per capita water use 40% in 10 years

Success due to:

- Aggressive conservation
- Financial incentives
- Recycling programs

Source: http://carpediemwest.org/newvisions-smartchoices

Urban Water Conservation Example

San Diego

Context:

- Had to move from imported to local water sources
- Reduced residential water use 30% over 7-year period

Success due to:

- Low-flow fixtures
- Low-irrigation landscaping
- Behavior change
- Conservation agreements with agriculture

Source: http://carpediemwest.org/newvisions-smartchoices

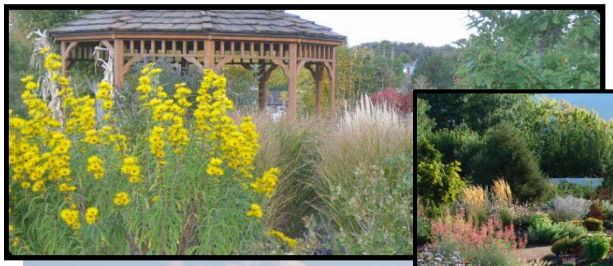
UTAH

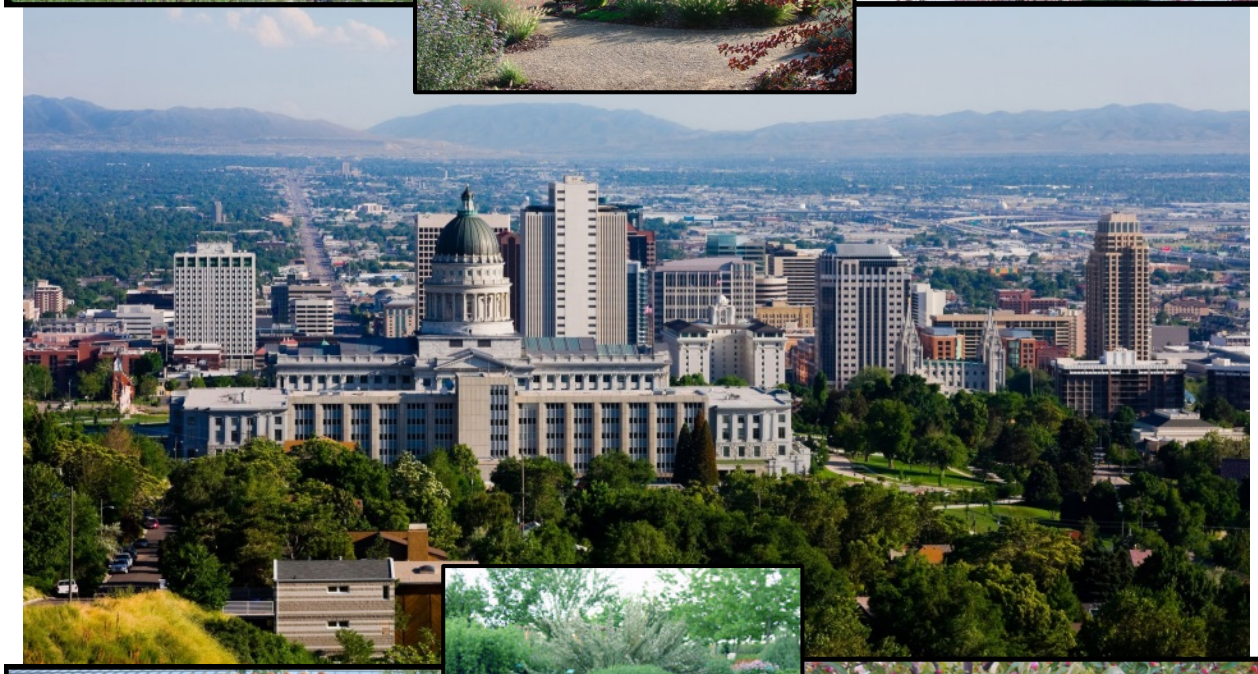
SLOW THE FLOW SAVE H2O

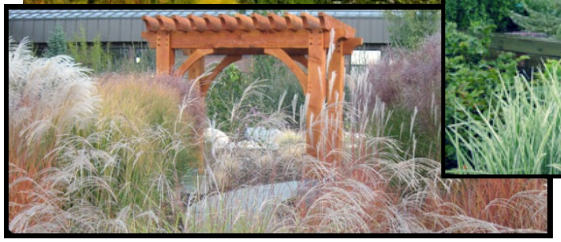
CONSERVATION GARDEN PARK

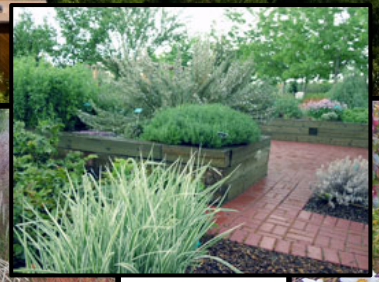
Weber Basin's Water Conservation Learning Garden

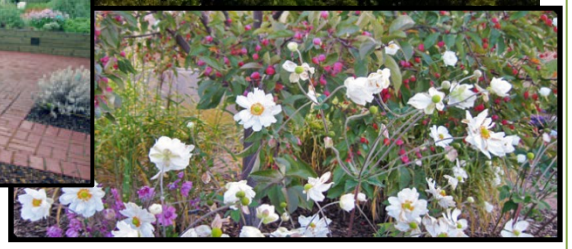
GARDEN WISE SALT LAKE CITY











UTAH DNR WATER RESOURCES

SLOW THE FLOW

Utah Weekly Lawn Watering Guide

CENTRAL UTAH GARDENS
Conserving water through education

CWEL
CENTER FOR WATER-EFFICIENT LANDSCAPING

UtahStateUniversity
BOTANICAL CENTER

Conservation Assessment

Conservation successes

- Water use reductions
- Awareness raised & people responsive to drought
- Voluntary conservation programs implemented
- Uniform building code has had big effect indoors
- “Low-hanging fruit”

“Untapped ” potential

- Outdoor water use efficiency
- More widespread and durable reductions through changes in habits and norms
- Greater use of markets and mandates (e.g. rates, codes)
- Finding outdoor equivalent of the building code
- Needs greater investment

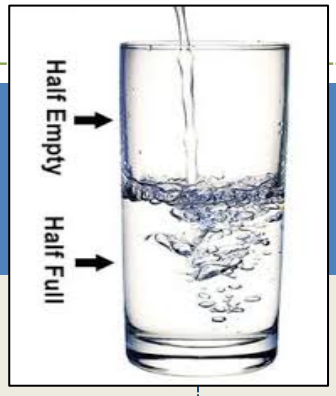
Conservation Conundrum

co·nun·drum

n.

1. A confusing and difficult problem or question.

Conservation Conundrum



Glass Half Full

- Efficiency will yield appreciable environmental and economic gains
- Utilities benefit from improved capacity utilization and life extension
- Customers benefit from avoided capital and operating costs

Glass Half Empty

- Demand erosion presents utilities with a significant but surmountable financial challenge
- Rising infrastructure costs must be recovered from a shrinking sales base
- Water use responds to market forces and mandates

Source: Beecher, 2010; Leurig, 2013; CERES

Conservation Conundrum

Like the proverbial Water Works on the Monopoly board, water utilities were for well over a century low-risk and provided a steady, if unspectacular, return on investment. But every assumption that made water look like a sure bet is now in question: supplies are under stress, demand projections are questionable, and upward price pressures are intense. For investors and suppliers this will require a new way of thinking about water. -Sharlene Leurig

Recent Report:

Measuring and Mitigating Water Revenue Variability: Understanding How Pricing Can Advance Conservation without Undermining Utilities' Revenue Goals, July 2014 (UNC, Ceres)

"Conservation is critical to minimize risk and build financial resilience"

(thinking long term)

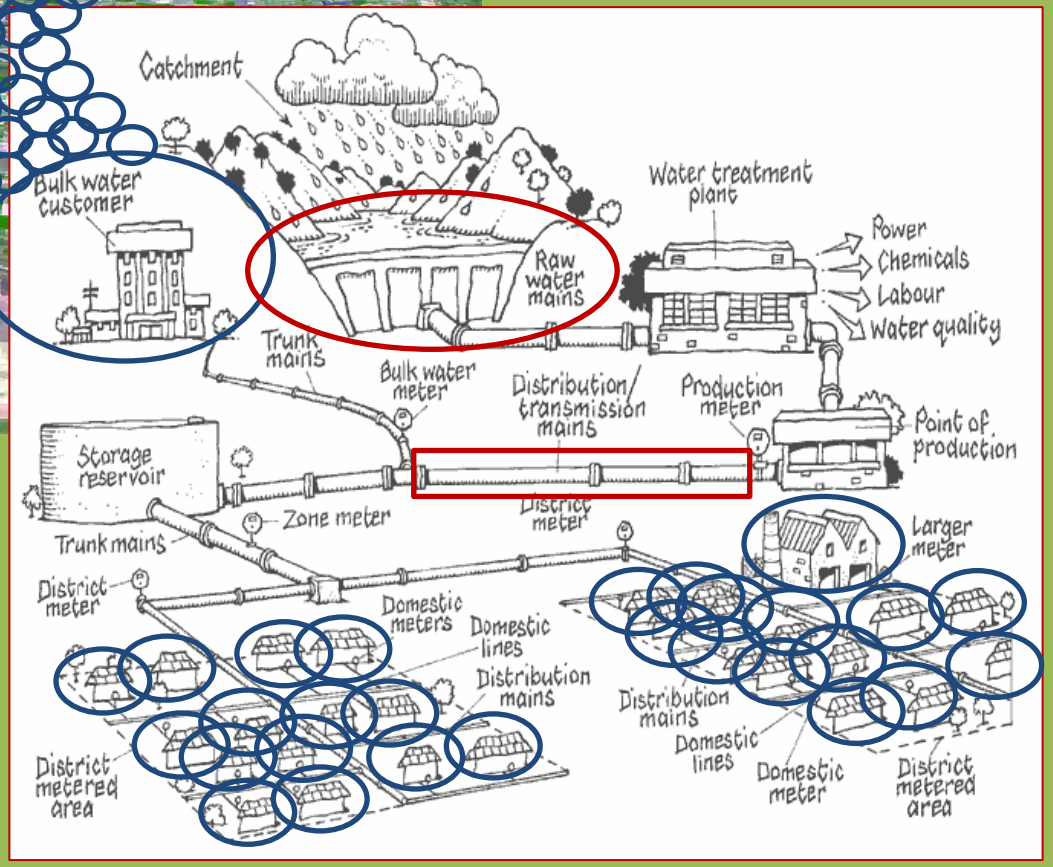
- Allows utilities to cut operation and maintenance costs
- Helps defer expensive supply expansion projects (avoided costs)
- Helps reduce total demand, shave peak use, provide revenue stability

"...credit rating agencies have recognized conservation as a best practice in water utility policy... [and] necessary to deal with long-term risks associated with supply shortages and high costs of capital"

Source: C.E. Boyle, January 2014

Demand Management Infrastructure

Supply-side infrastructure



Demand-side infrastructure

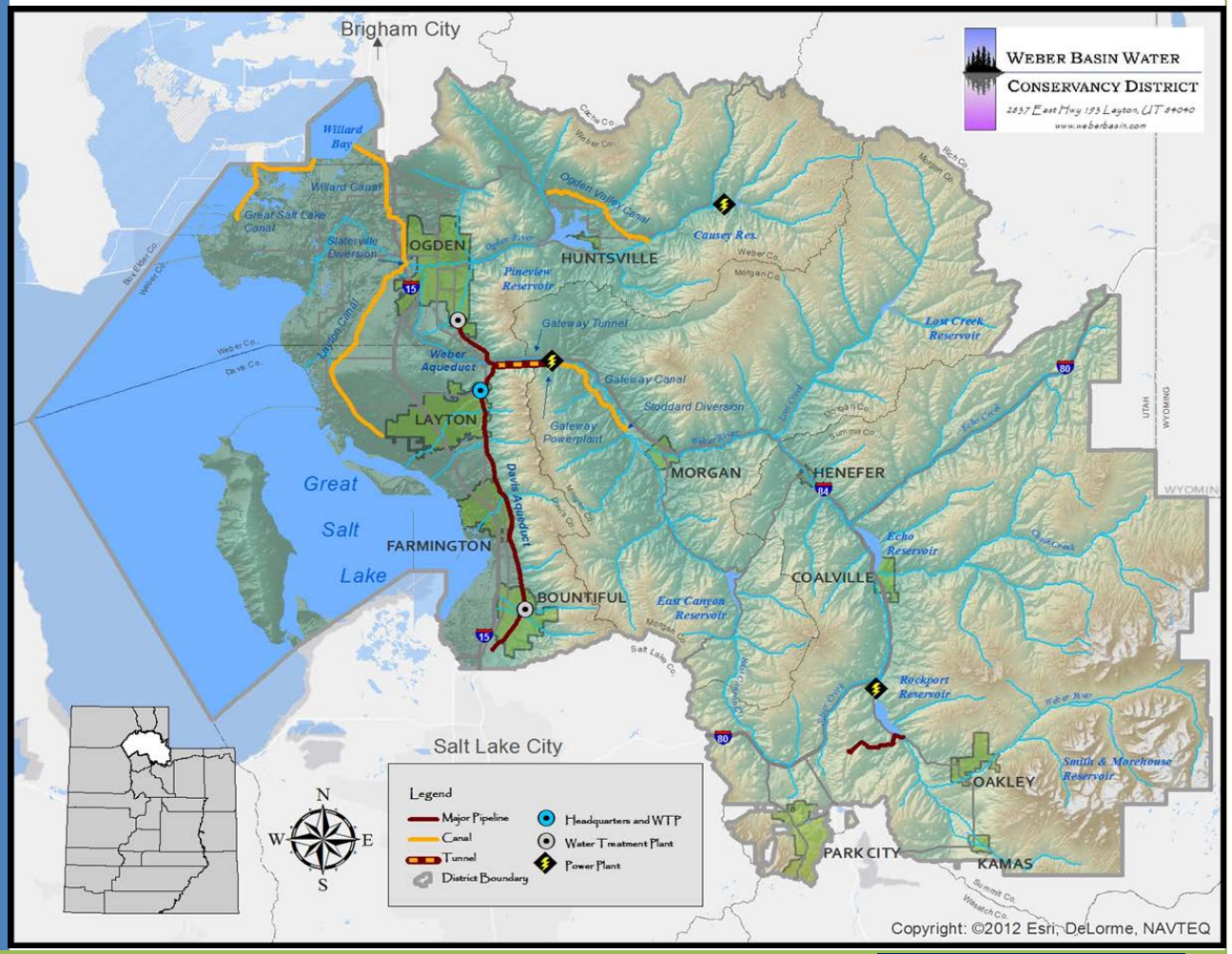
(1) METERING

If you don't meter water, you can't manage it.

Issue in many ag-to-urban transition areas

Example:
Weber Basin Water Conservancy District

WBWCD meter installation project for pressurized secondary irrigation systems



Meters Used

Elster, Smart meter

Evo Q4

Badger, E- Series

Sensus Ipearl

Meter Valve Assembly

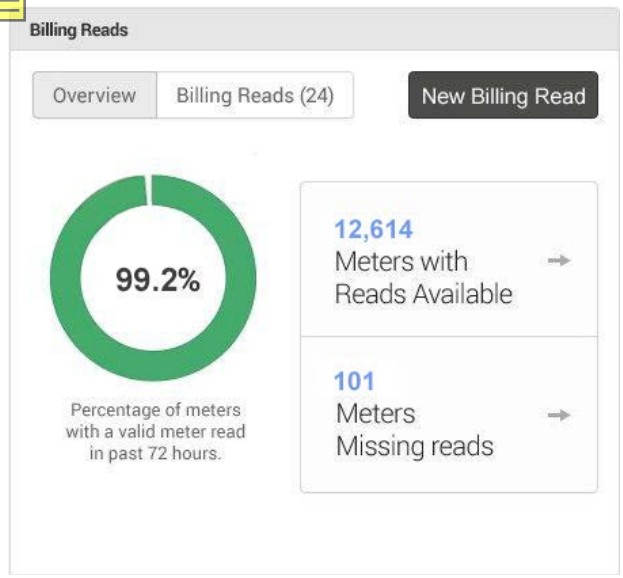
WBWCD METER TRANSITION:

- Approximately 16,500 direct retail connections
- Approximately 50,000-60,000 total secondary connections in the district's service area

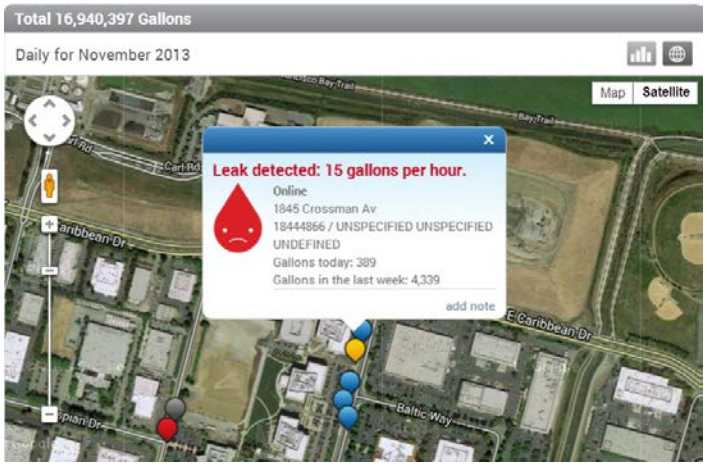
Trend – Advanced Metering Analytics

Evolution of AMR to AMA

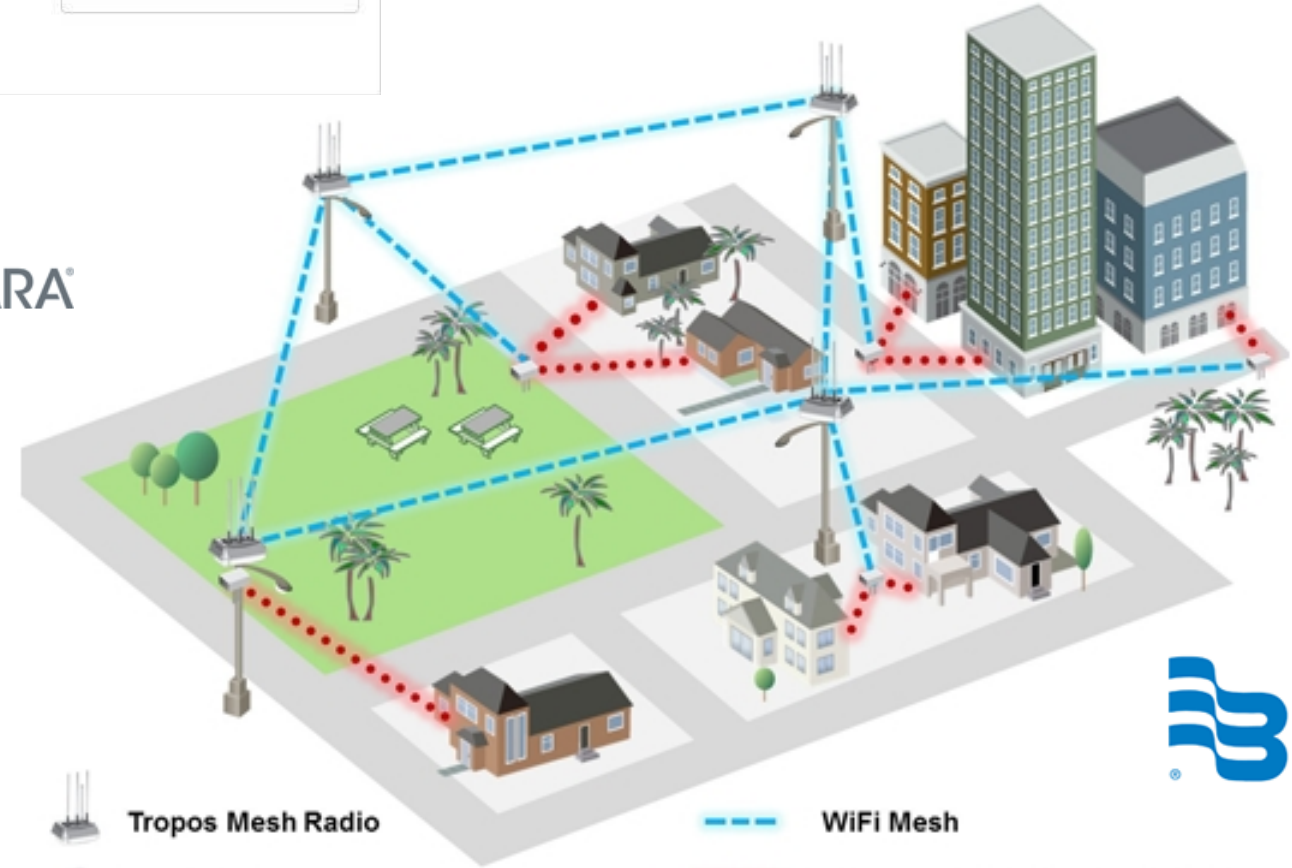
AMR – Automated Meter Reading	AMI – Advanced Metering Infrastructure	AMA – Advanced Metering Analytics
Mobile Meter Reading	Fixed Network Meter Reading	Fixed Network with Powerful Analytics Software
Provides Efficient Reading with Monthly Billing Data	Provides Raw Daily or Hourly Data	Provides Actionable Proactive Intelligence



AQUATIC Informatics



ACLARA



Badger Meter

(2) Analytic Tools

Software applications to analyze and manage urban landscape water use

Example:
USU's WaterMAPS™

Basic Approach: *defining appropriateness of urban landscape irrigation relative to plant water needs*

Basic Approach:
Identifying Capacity to Conserve

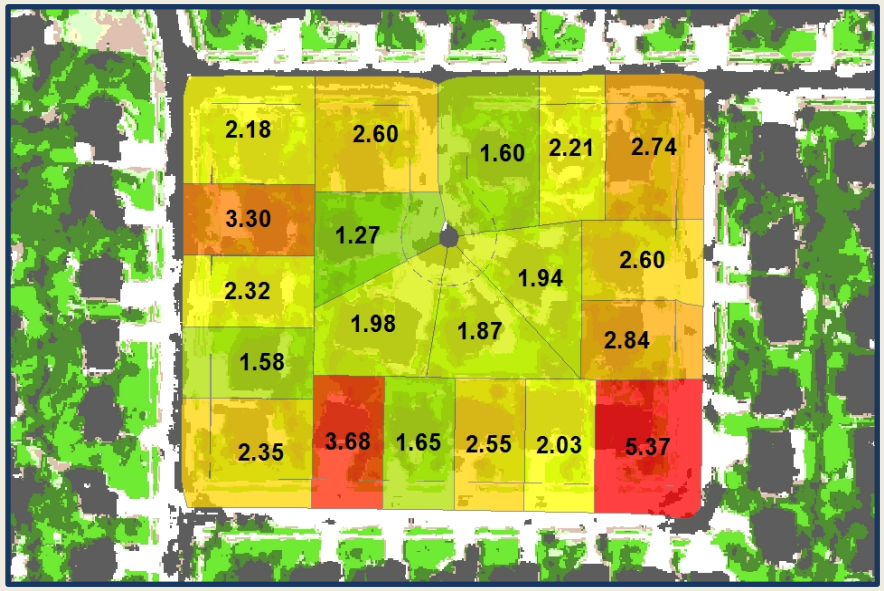
Landscape Irrigation Ratio (LIR)

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

[gallons extracted from municipal or water provider meter/billing data]

[calculated from landscaped area (derived from classification of airborne remotely-sensed multispectral imagery) and local evapotranspiration (ET_o) modified by relevant landscape correction factors for turf vs. trees and shrubs]

(per unit of landscaped area)

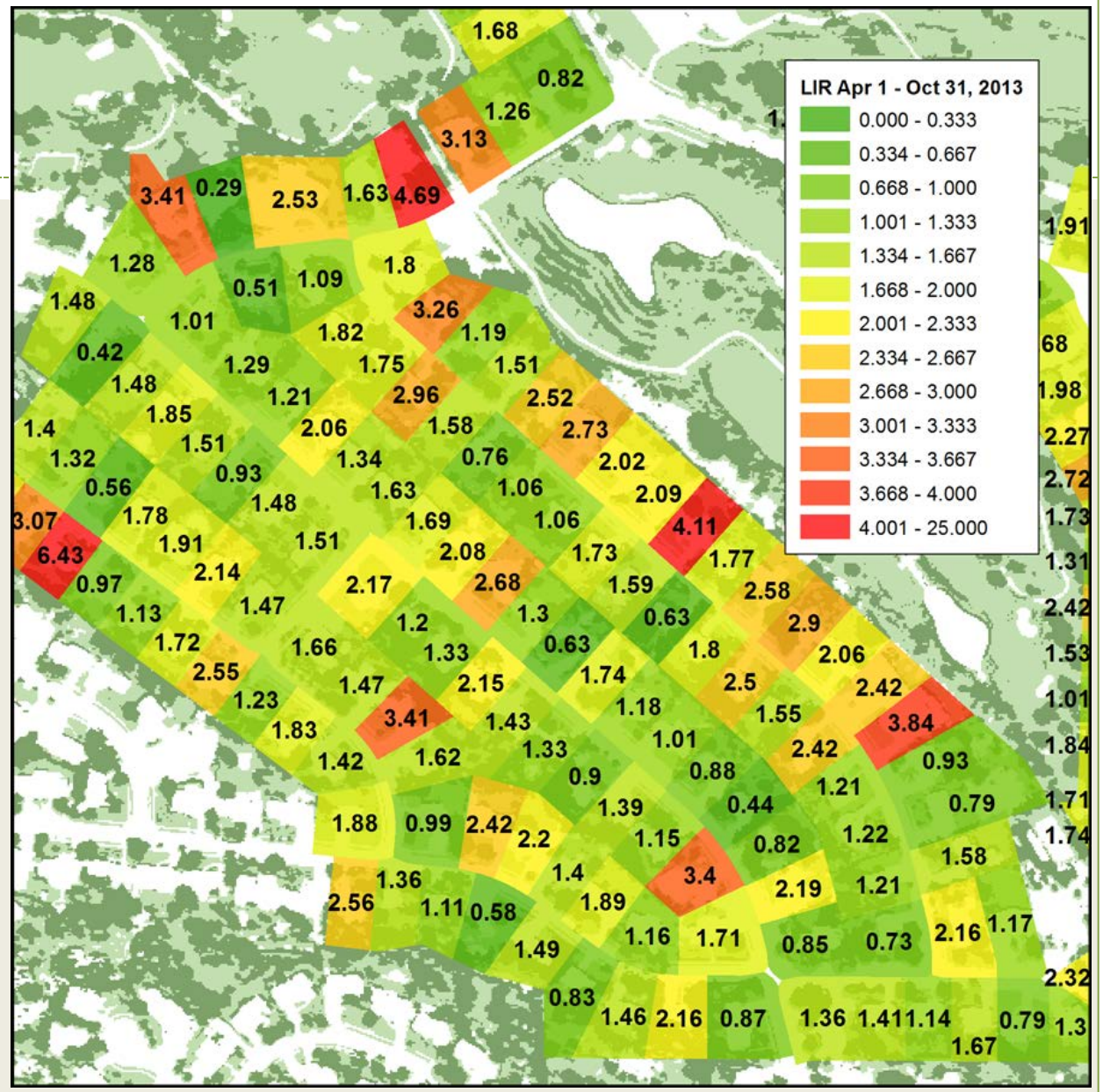


LIR less than 1 = Efficient
Between 1 and 2 = Acceptable
Between 2 and 3 = Inefficient
Greater than 3 = Excessive

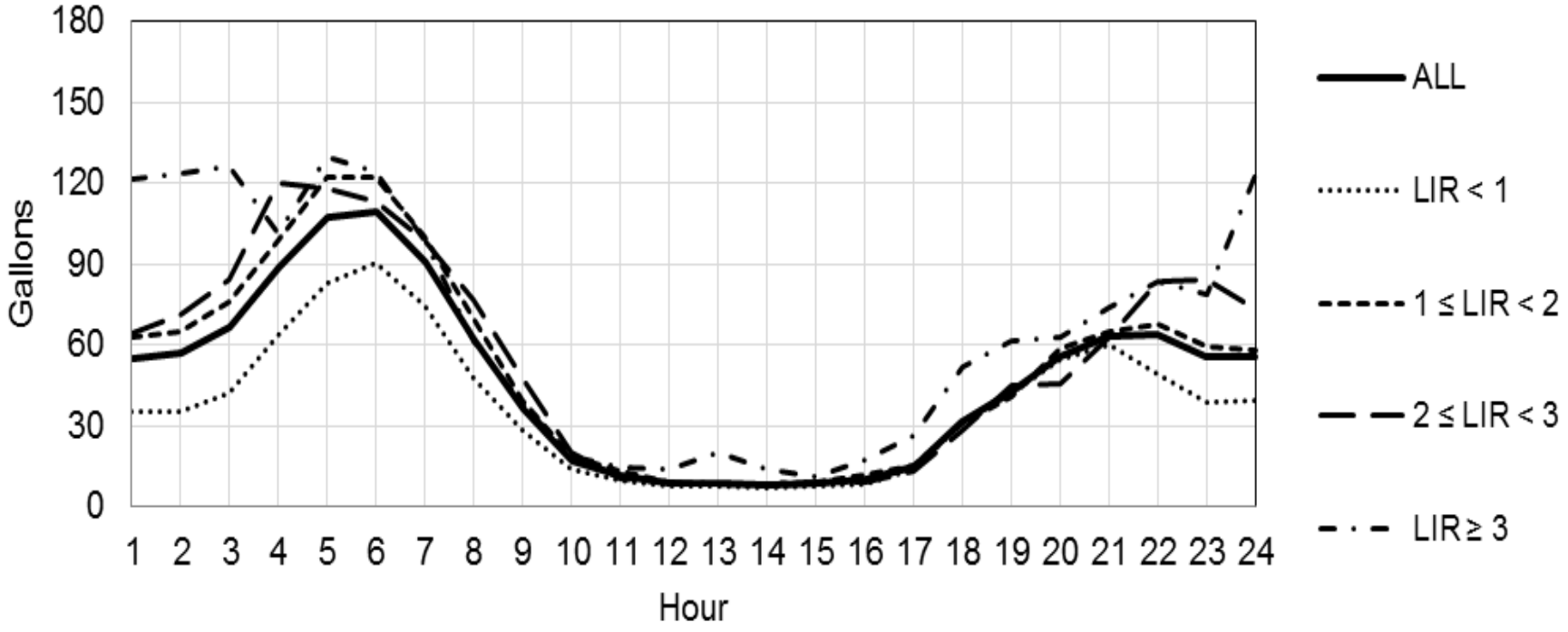
Seasonal LIR Calculations

- **Time Period: 4/1 -10/31, 2013**
- **Locations analyzed: 1369**
- **Mean LIR: 2.01**

Quantifies Conservation Potential

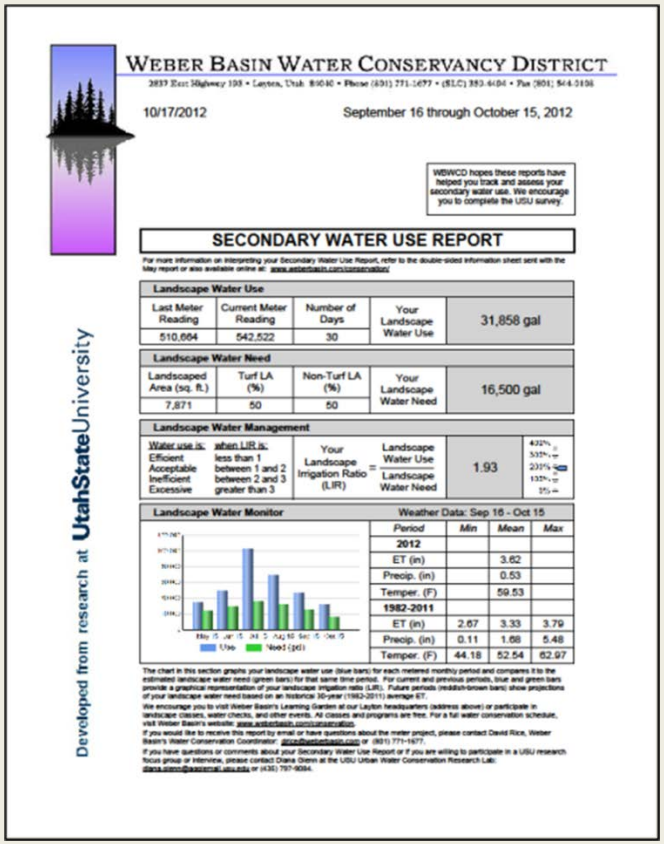


Analysis using hourly data



- People generally do not water during the middle of the day
- People who overwater do so at night
- Caution about only using “visual cues” to enforce waste restrictions

Analysis of seasonal patterns



WEBER BASIN WATER CONSERVANCY DISTRICT

2837 East Highway 193 • Layton, Utah 84040 • Phone (801) 771-1677 • (SLC) 393-4404 • Fax (801) 544-0536

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.

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Developed from research at UtahStateUniversity

Monthly LIR at this location	
May	1.41
June	1.48
July	2.81
Aug	2.13
Sept	1.84
Oct	1.93

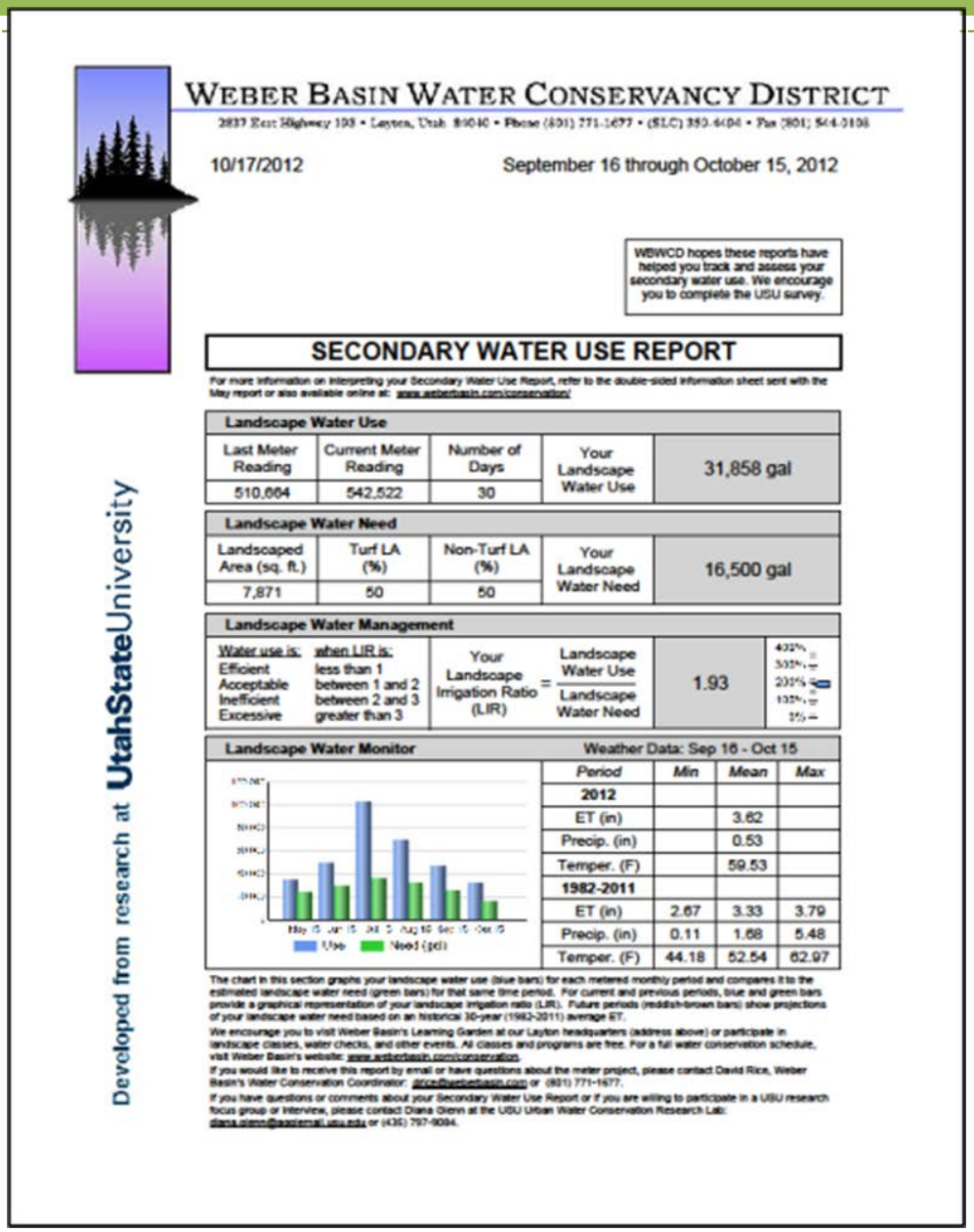
- Can be used to better design water policies and deliver conservation programming

(3) Information Provision

Example:

Individual Water Use Reports:

(WBWCD Meter Transition Project)



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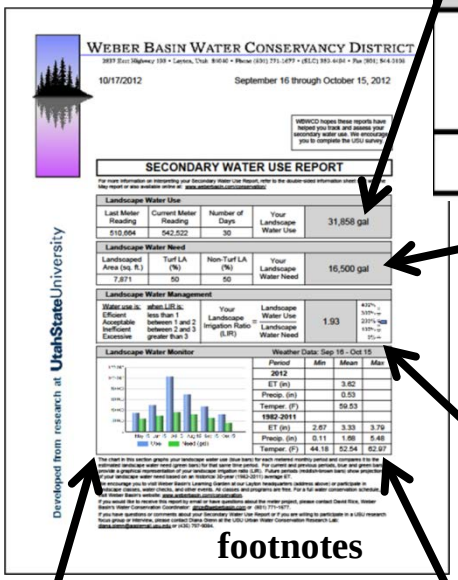
UtahStateUniversity



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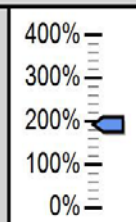

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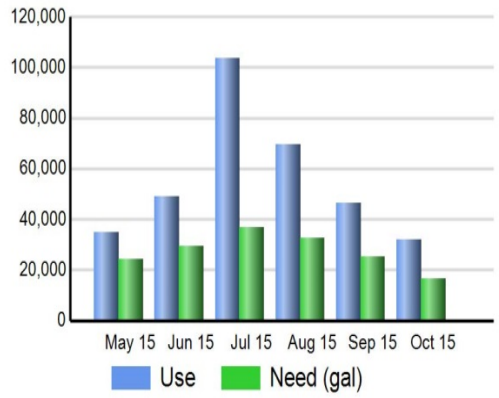

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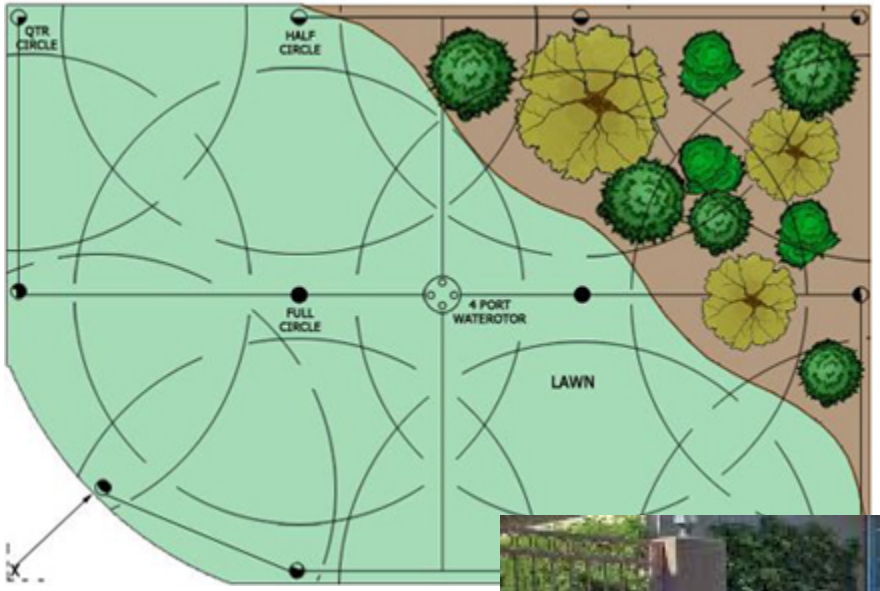
Made possible by investments in new sources of data

(4) Irrigation Systems

Design

Maintenance

Operation




6. Check for Surge
Open valve slowly when restoring water to avoid system damage from a water pressure surge.
2. Check the Controller
Clean; check settings and replace the battery back-up.
5. Check the Valves
Inspect valves closely to ensure they are functioning properly and there is no leakage.
1. Check the Soil
Use a shovel to make sure the soil is thawed to a depth of at least 12".
4. Check for Wear & Tear
Replace broken or worn nozzles, valves, pipes, and other components.
7. Check Water Pressure
Make sure the water pressure is within the the suggested operating range, typically 40-65 PSI.
3. Check for Obstructions
Remove dirt and debris from sprinkler heads.
Springtime Sprinkler Tune-Up Checklist
A checklist to get your automatic sprinkler system up and running again following its winter hibernation.


HH2
Soil Mois
www.delta-

2012 average LIR = 1.26
(average savings = 56,583 gal)

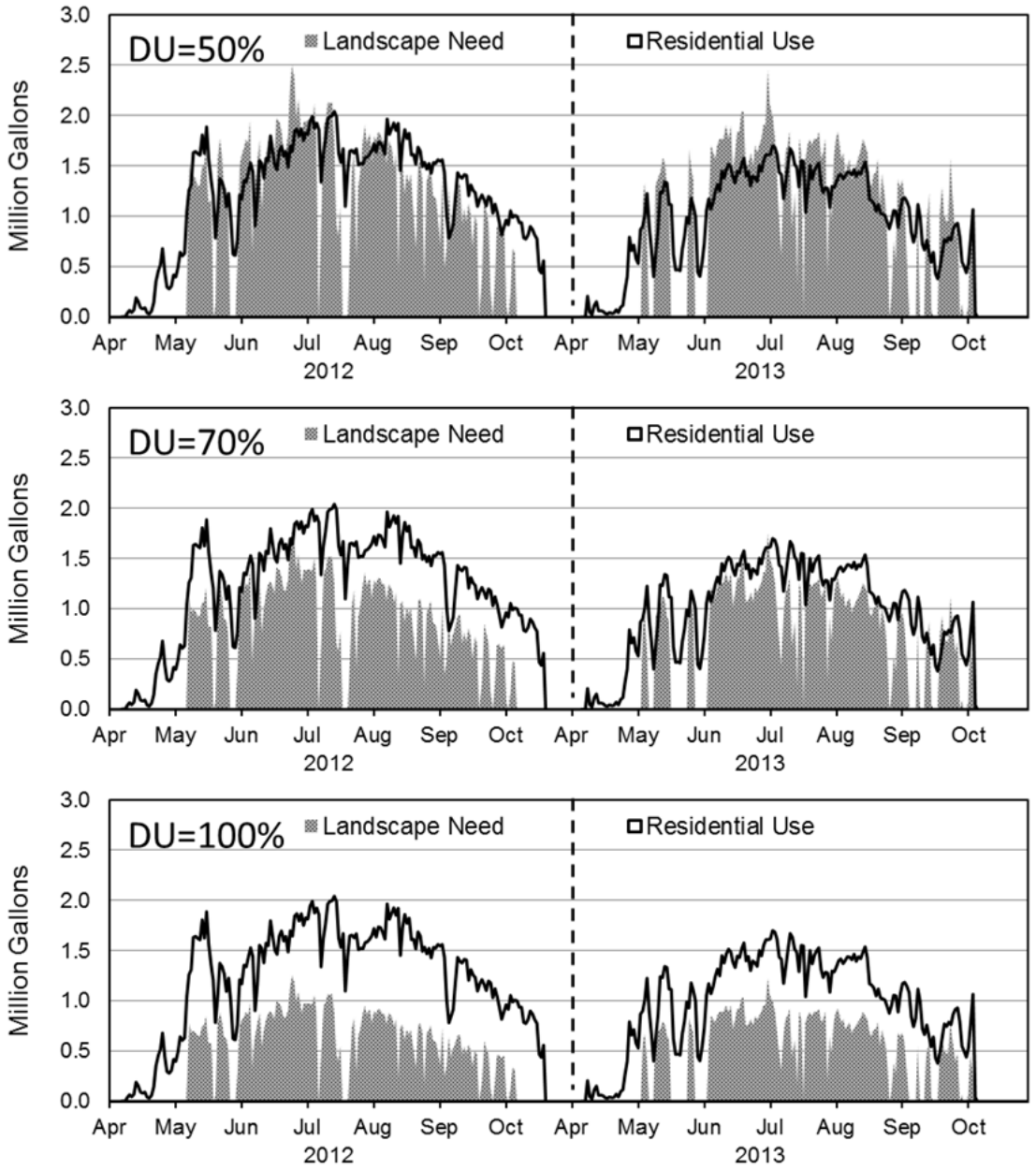
2013 average LIR = 1.06
(average savings = 11,780 gal)

2012 average LIR = 1.89
(average savings = 129,703 gal)

2013 average LIR = 1.59
(average savings = 75,973 gal)

2012 average LIR = 2.52
(average savings = 166,213 gal)

2013 average LIR = 2.12
(average savings = 108,069 gal)



Increasing irrigation system efficiency increases conservation potential

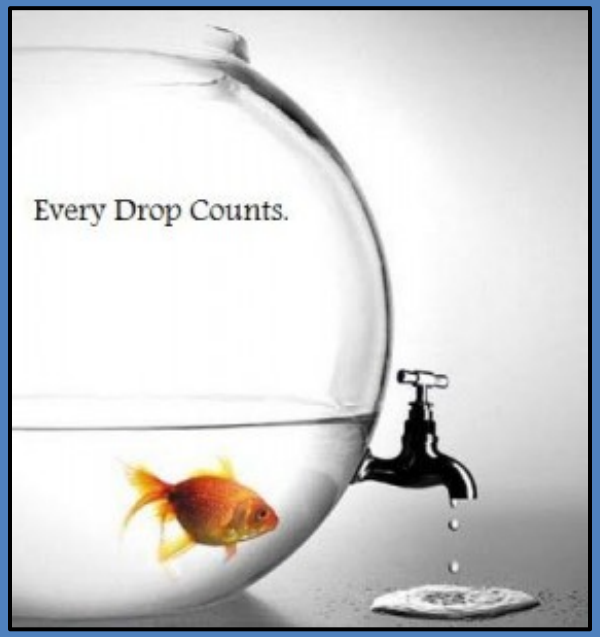
Fixing the "ends of the pipes"

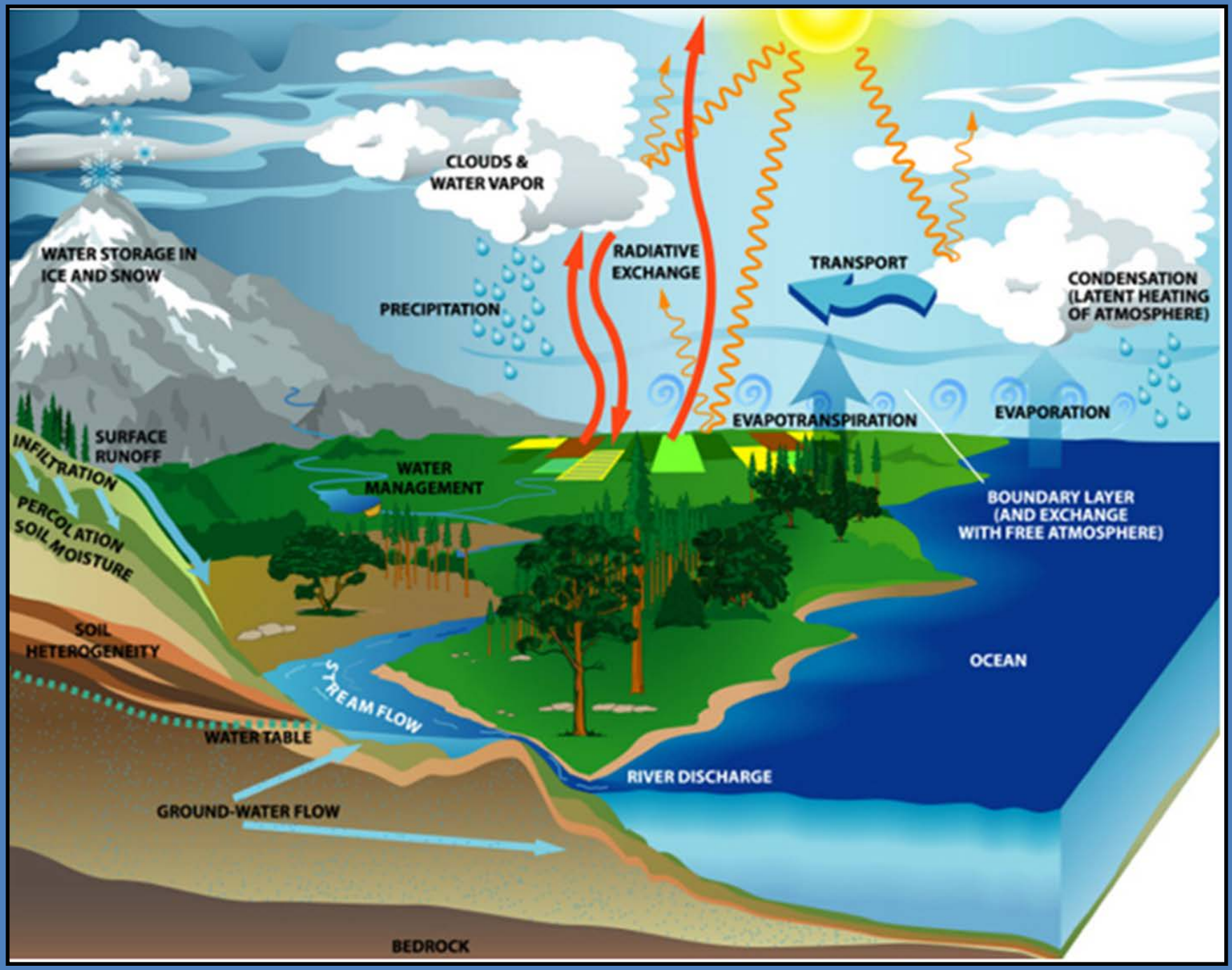
Given current financial and ecological constraints, utilities will have to embrace a new form of infrastructure if they intend to provide reliable, reasonably priced water services. …It includes the many improvements, practices, and devices that conserve water and retain stormwater onsite. …this new infrastructure is often distributed across many properties, some of them privately owned…[and] serves the same purposes as conventional infrastructure…"

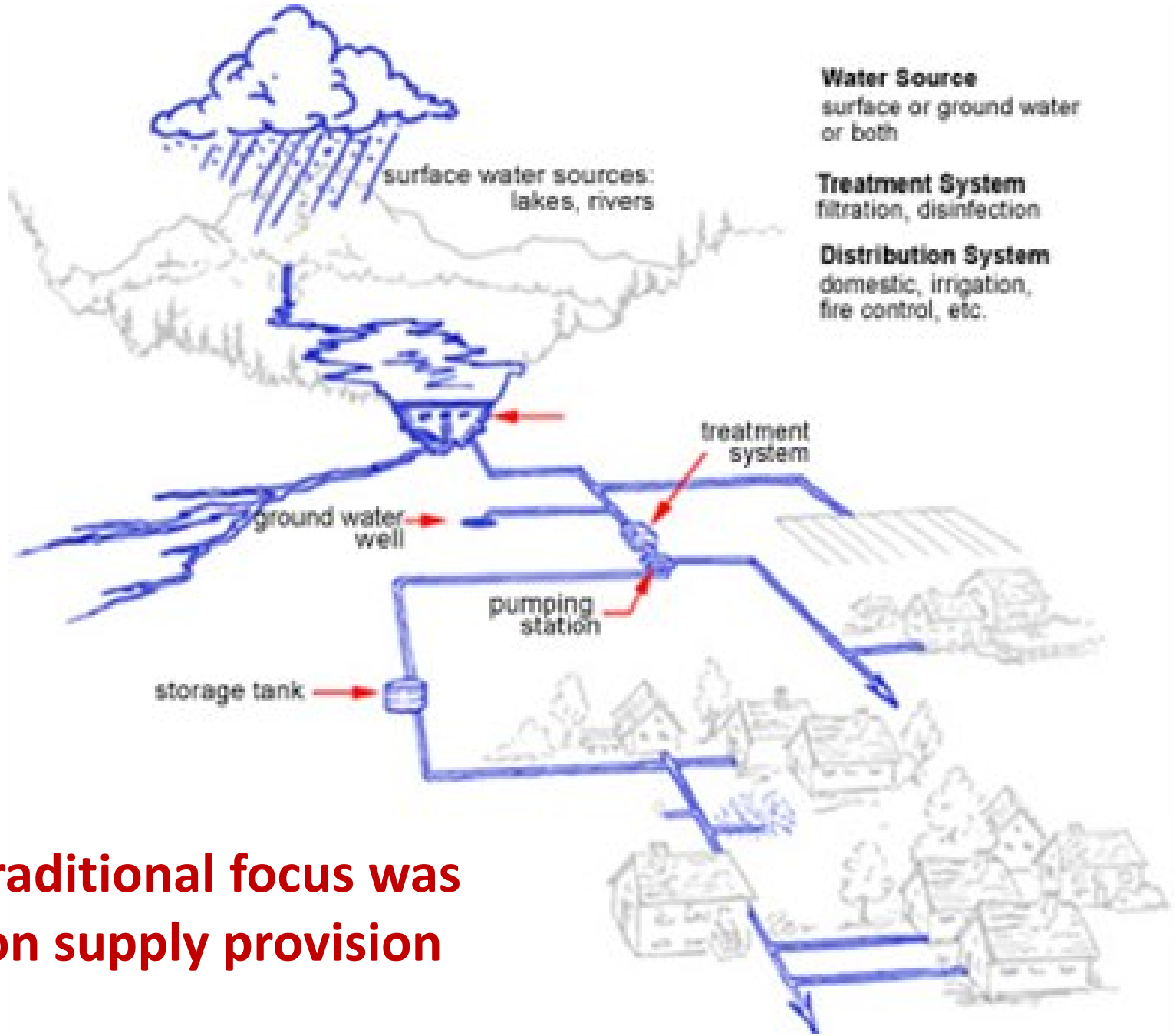
Recent Report:

Bond Financing Distributed Water Systems: How to Make Better Use of Our Most Liquid Market for Financing Water Infrastructure," S. Leurig (Ceres) and J. Brown (Univ. TX School of Law), Sept. 2014

Investment Strategies

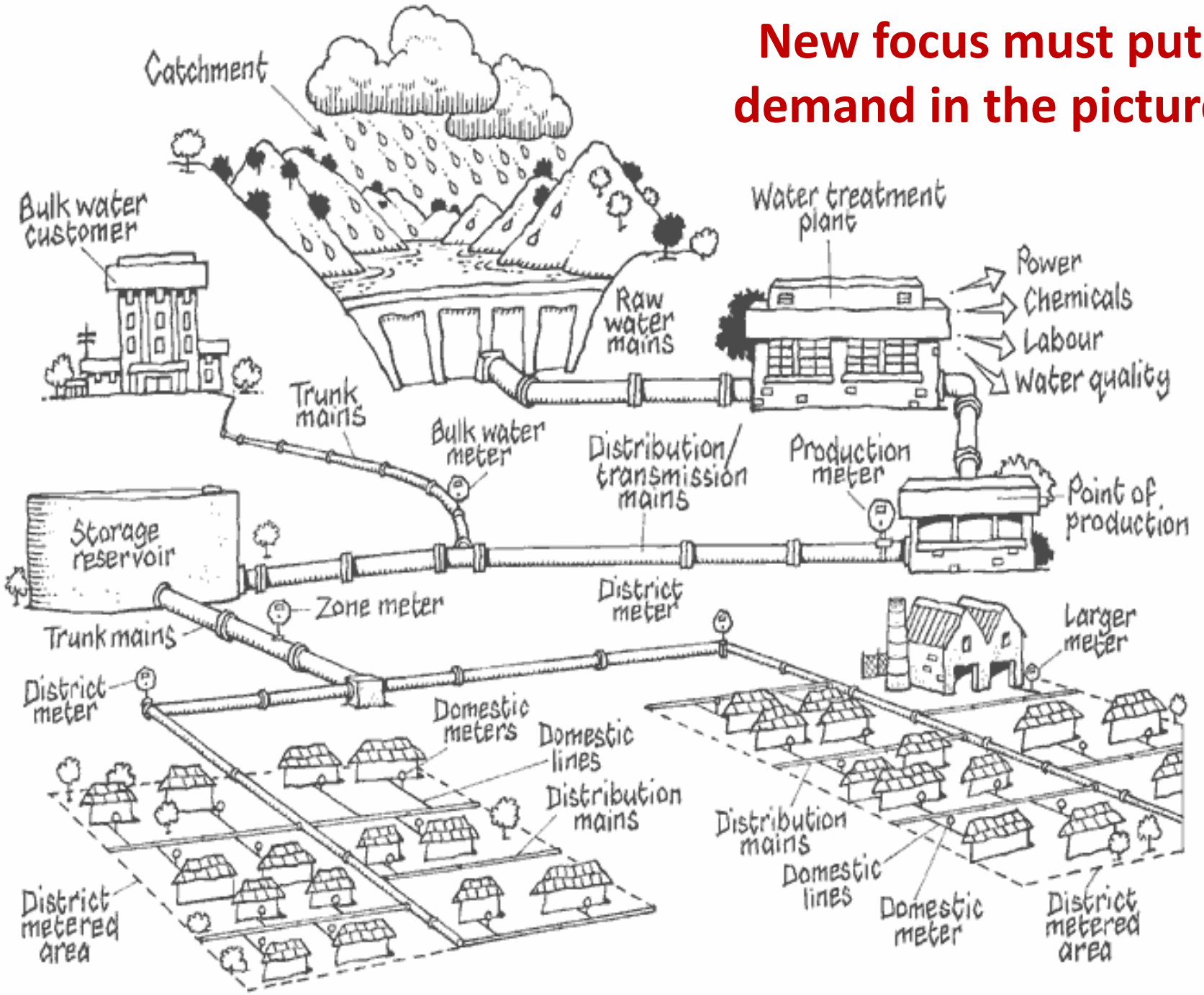



CLOUDS &
WATER VAPOR
WATER STORAGE IN
ICE AND SNOW
PRECIPITATION
RADIATIVE
EXCHANGE
TRANSPORT
CONDENSATION
(LATENT HEATING
OF ATMOSPHERE)
EVAPOTRANSPIRATION
EVAPORATION
SURFACE
RUNOFF
INFILTRATION
WATER
MANAGEMENT
PERCOLATION
SOIL MOISTURE
BOUNDARY LAYER
(AND EXCHANGE
WITH FREE ATMOSPHERE)
SOIL
HETEROGENEITY
OCEAN
STREAM FLOW
WATER TABLE
RIVER DISCHARGE
GROUND-WATER FLOW
BEDROCK



Traditional focus was on supply provision

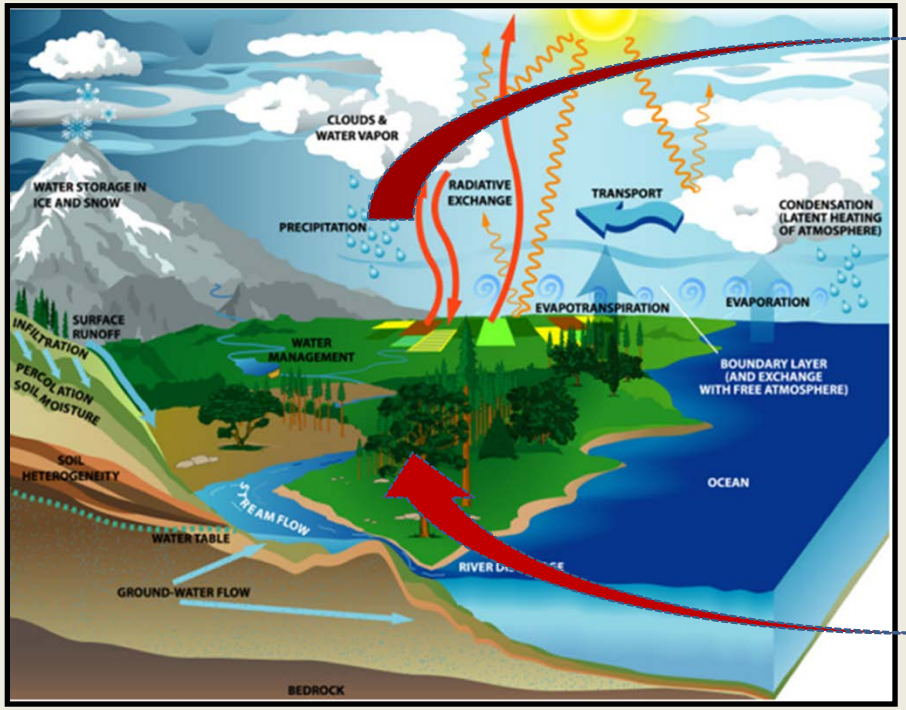
New focus must put demand in the picture

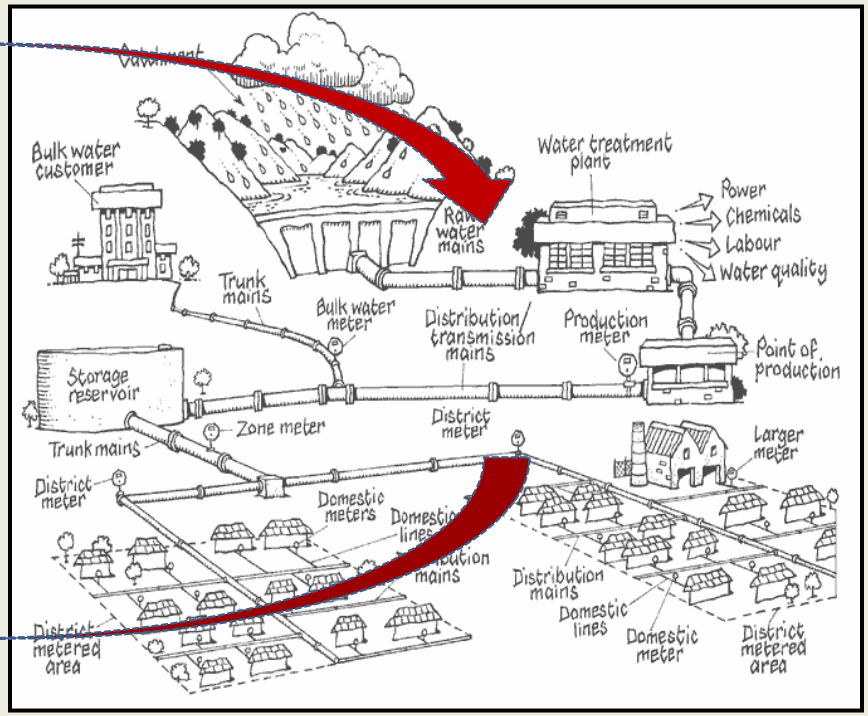


Water Systems Broadly Conceived

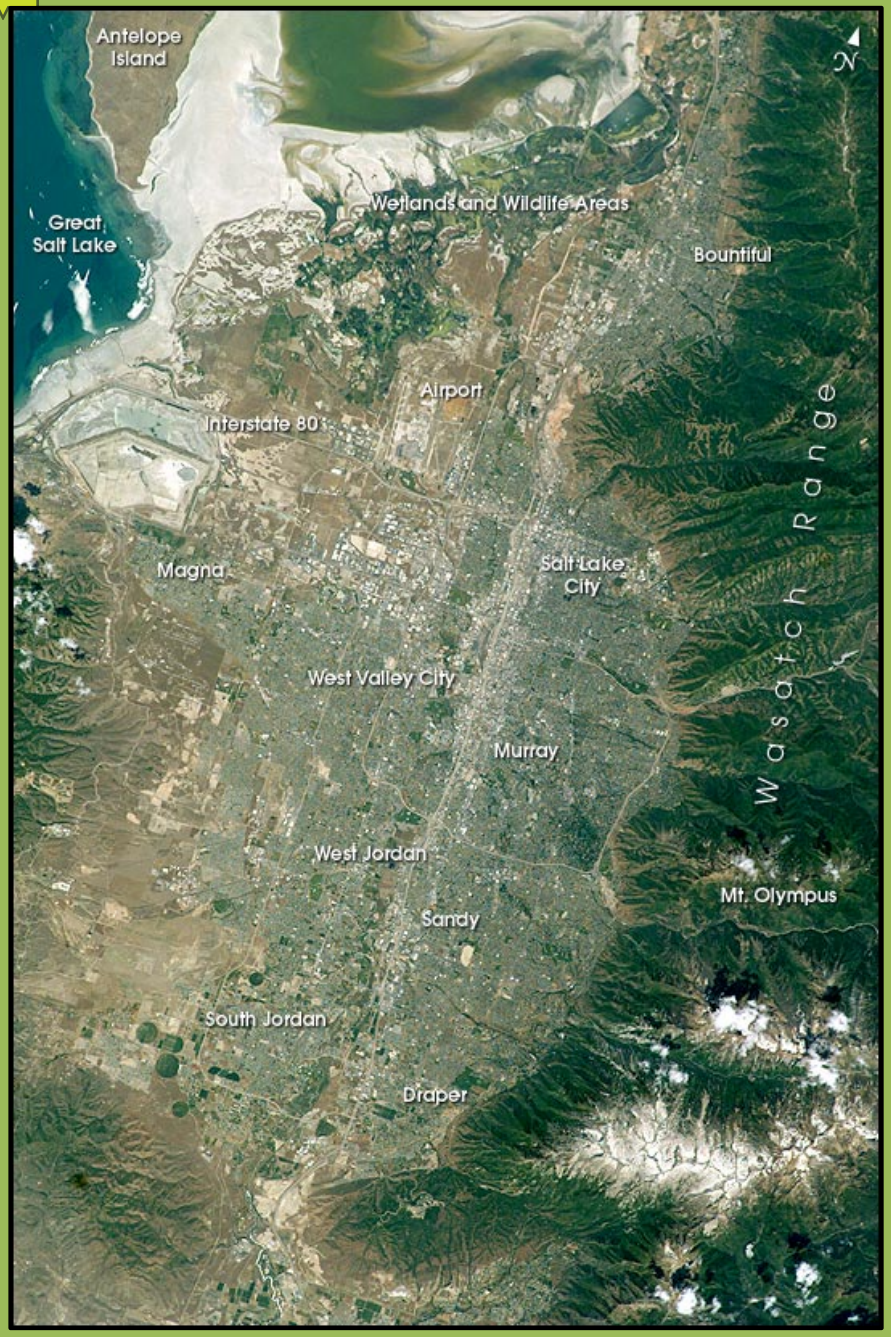
Hydro-ecological components

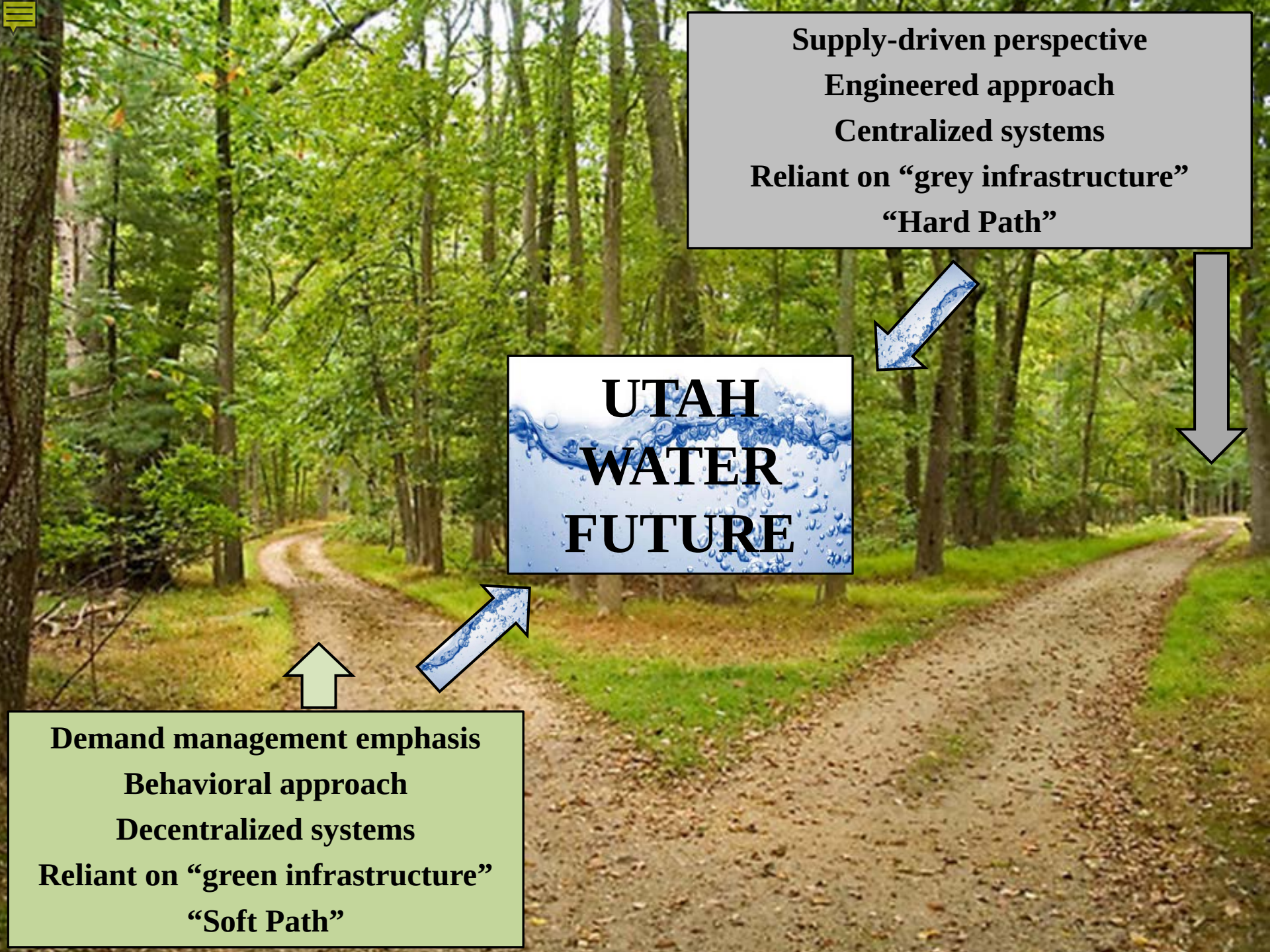
Human components





Highly integrated or “coupled”


Antelope Island
N
Great Salt Lake
Wetlands and Wildlife Areas
Bountiful
Airport
Interstate 80
Wasatch Range
Magna
Salt Lake City
West Valley City
Murray
West Jordan
Mt. Olympus
Sandy
South Jordan
Draper


Supply-driven perspective
Engineered approach
Centralized systems
Reliant on “grey infrastructure”
“Hard Path”
UTAH WATER FUTURE
Demand management emphasis
Behavioral approach
Decentralized systems
Reliant on “green infrastructure”
“Soft Path”

Bottom Line

- Opportunities to shape and sustain our future
- Be serious about water demand management
- Backed by a portfolio of strategic investments in "water conservation infrastructure"
- Propelled by commitment to using water wisely
- Dedicated to making Utah a leader (again) in water management in the West

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Joanna Endter-Wada

(435) 797-2487

joanna.endter-wada@usu.edu