This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

watersmart
INNOVATIONS

Colorado Water Collaboratory :
the campus as living laboratory

Paul W. Lander
University of Colorado-Boulder
WSI 2017

Chad Mortensen
Metro State University-Denver
Las Vegas, NV

Why College Campuses?

1. Water Savings:
Need to optimize available water supplies in many water scarce regions of the US
Reach individual campus goals to reduce water use

2. Implementation Strategies:
Overcome past struggles with efficiency projects on campuses
No single dedicated campus position for water resources

3. Funding:
Lack of dedicated funding source for water conservation projects.
Gain support by showing that conservation is a good & sustainable idea, and “proving it”.
Potential for combined funding / grant / rebate / bulk purchases

4. Flexibility for Behavior and/or Structural Changes

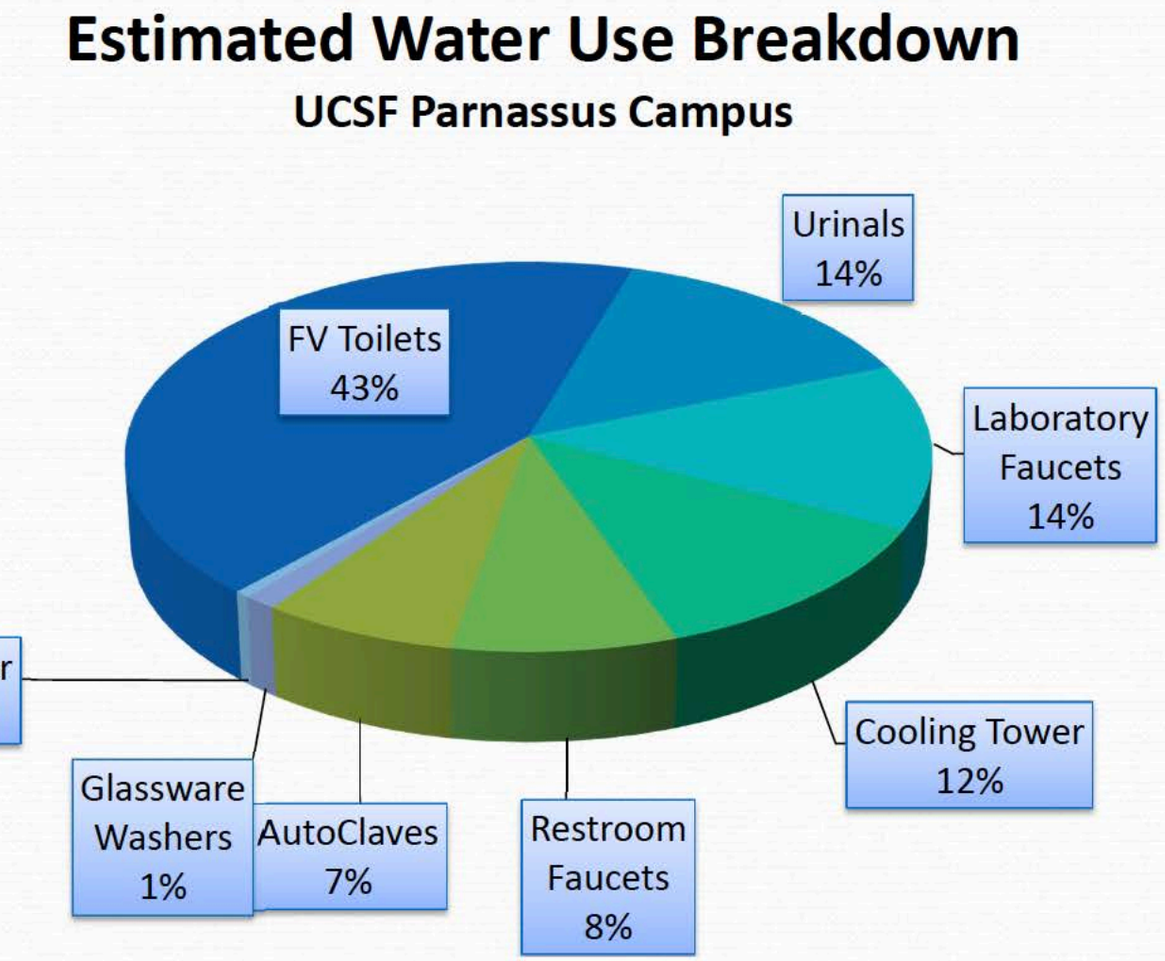
> M. Maddaus, AWE College Water Efficiency Group. 2017

Measuring to Manage

Determining Water Use on Campus through Audit

Parnassus Campus Water Audit

- 15 buildings (2,654,288 gross sf) laboratory, academic and clinical uses.
- In 2011 water consumption averaged 240,682 gpd.



Note – water use for Parnassus only. Total campus survey included in Phase 1 and Phase 2 with 31 buildings and 5,400,000 sq ft

21

> M. Maddaus, AWE College Water Efficiency Group. 2017

Summary for College Water Savings:

- HUGE Water Savings Potential:
  1. Billions of gallons of water used on campuses
     - UC system alone uses 4.9 Billion gallons per year
  2. Universities are often in the top 10 customers of the local water utility
  3. Water rates planned to increase in future making projects more attractive
  4. Millions of inefficient fixtures can be replaced across the state!
  5. Synergy with mutually beneficial “goals” to save water :
     - Campus can be “sustainable” and save water
     - Water utility can help meet rebate targets and water saving goals
     - Colleges are researching and piloting alternative water sources!

> M. Maddaus, AWE College Water Efficiency Group. 2017

the international water association

17 Principles for Water-Wise Cities

4 Levels of Action

1 Regenerative Water Services

- Replenish Waterbodies and their Ecosystems
- Reduce the Amount of Water and Energy Used
- Reuse and Use Diverse Sources of Water
- Apply a Systems Approach for Integration with Other Services
- Increase the Modularity of Systems for Multiple Options

2 Water Sensitive Urban Design

- Enable Regenerative Water Services
- Design Urban Space to Reduce Flood Risk
- Enhance Livability with Visible Water
- Modify and Adapt Urban Materials to Minimise Environmental Impact

3 Basin Connected Cities

- Secure Water Resources and Plan for Drought Mitigation
- Protect the Quality of Water Resources
- Plan for Extreme Events

4 Water Wise Communities

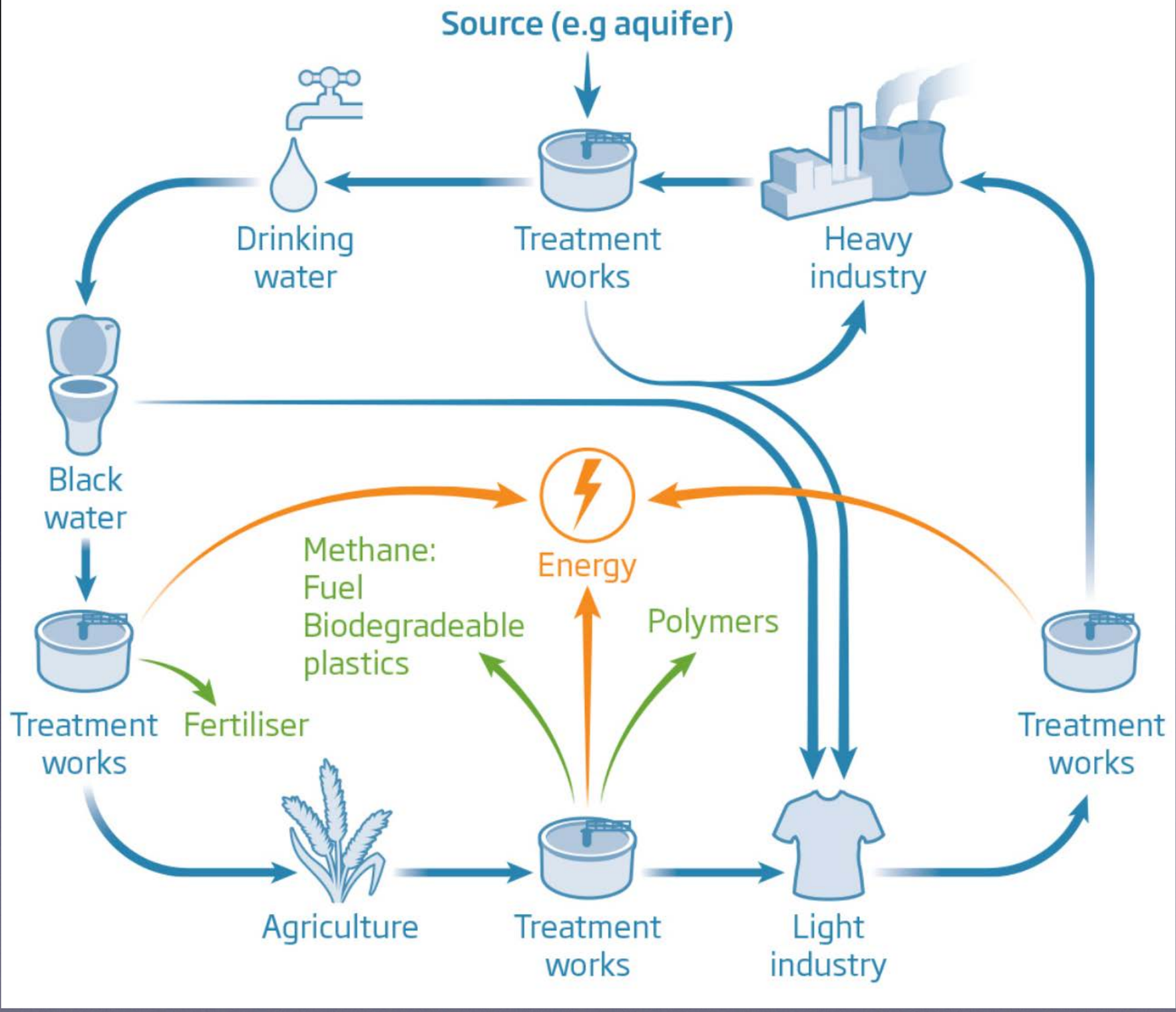
- Empowered Citizens
- Incentivized Professionals
- Transdisciplinary Planning Teams
- Progressive Policy Makers
- Leaders that Engage and Engender Trust

5 Building Blocks

Vision | Governance | Knowledge & Capacity | Planning Tools | Implementation Tools

Closing the loop

A closed loop water system avoids costly centralised treatment – it can even extract value and generate energy while processing waste



Matching Quality to Service

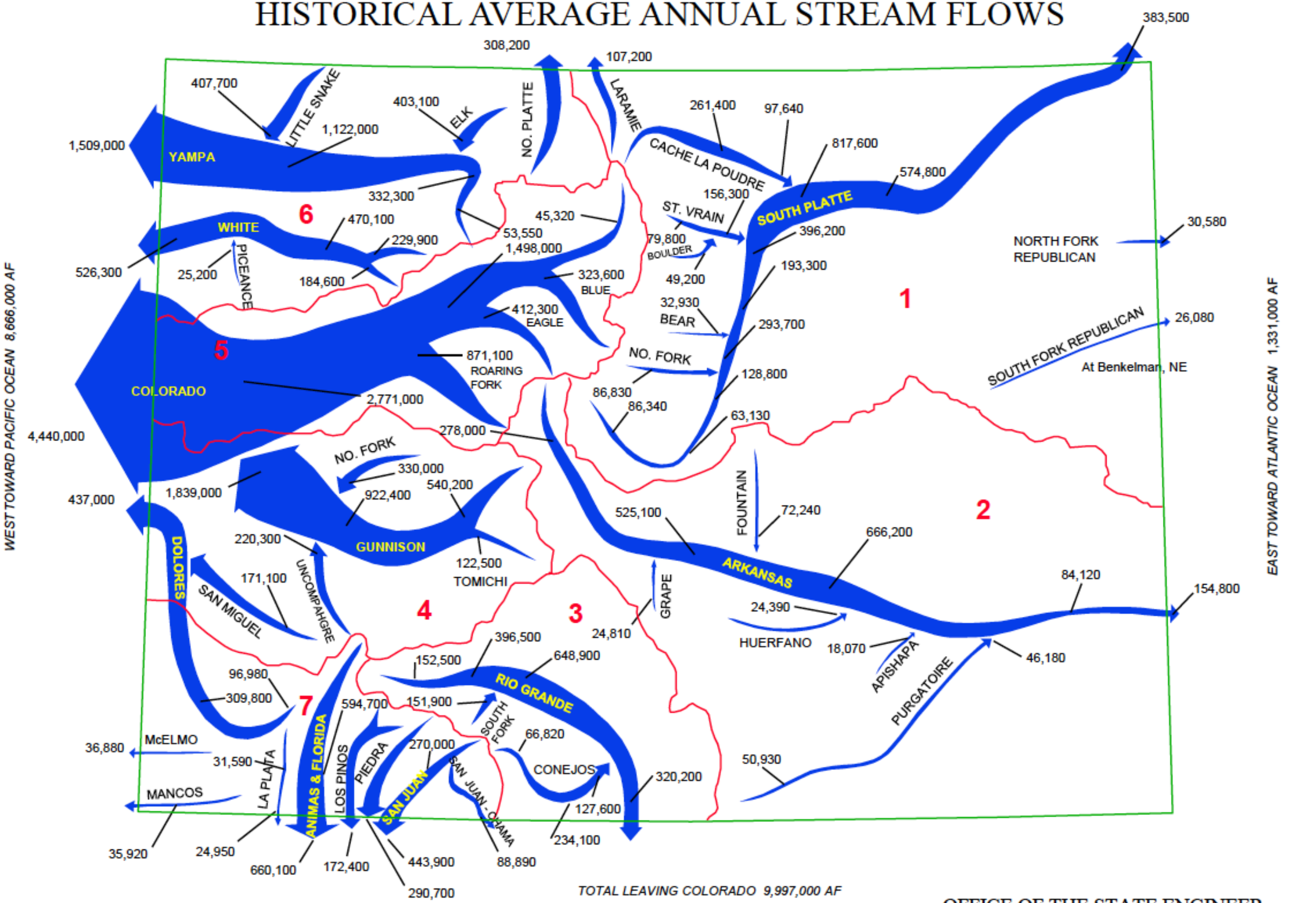
USE	ISSUES	SYSTEM FUNCTION DETERMINANT	SERVICE LEVEL CONFLICT
Potable Water	Consumers want consistently quality water. Consumers willing to pay for additional treatment or bottled water to gain this level of service.	Treatment Processes & Distribution Sytem Operation	**LOW VOLUME VS. HIGH QUALITY** Single treatment & delivery system must meet all demands with the highest quality water.
Fire Protection	Residents expect immediate control & suppression of fires at all times.	Distribution System Storage & Flow Capacity	**HIGH VOLUME VS. LOW QUALITY** Single delivery system must meet infrequent but essential high demand with the highest quality water.
Landscape Irrigation	Lush vegetation and large turf areas (parks, game fields) enhance visual esthetics and quality of life.	Treatment Capacity and Distribution System Operation	**HIGH VOLUME VS. LOW QUALITY** High but constant seasonal demand, variable with weather.
Hydroelectric Power Generation	Helps reduce consumer rates by generating revenues to the utility	Source Selection & Distribution System Operation	**HIGH VOLUME VS. LOW QUALITY** Sources selected based on highest revenue potential instead of treatability, increased detention time in some reservoirs

P =15-20 inches/yr

IMUS GEOGRAPHICS • THE ART OF CARTOGRAPHY
Relief artist: Ellen Kuzdro

State of Colorado

COLORADO
HISTORICAL AVERAGE ANNUAL STREAM FLOWS

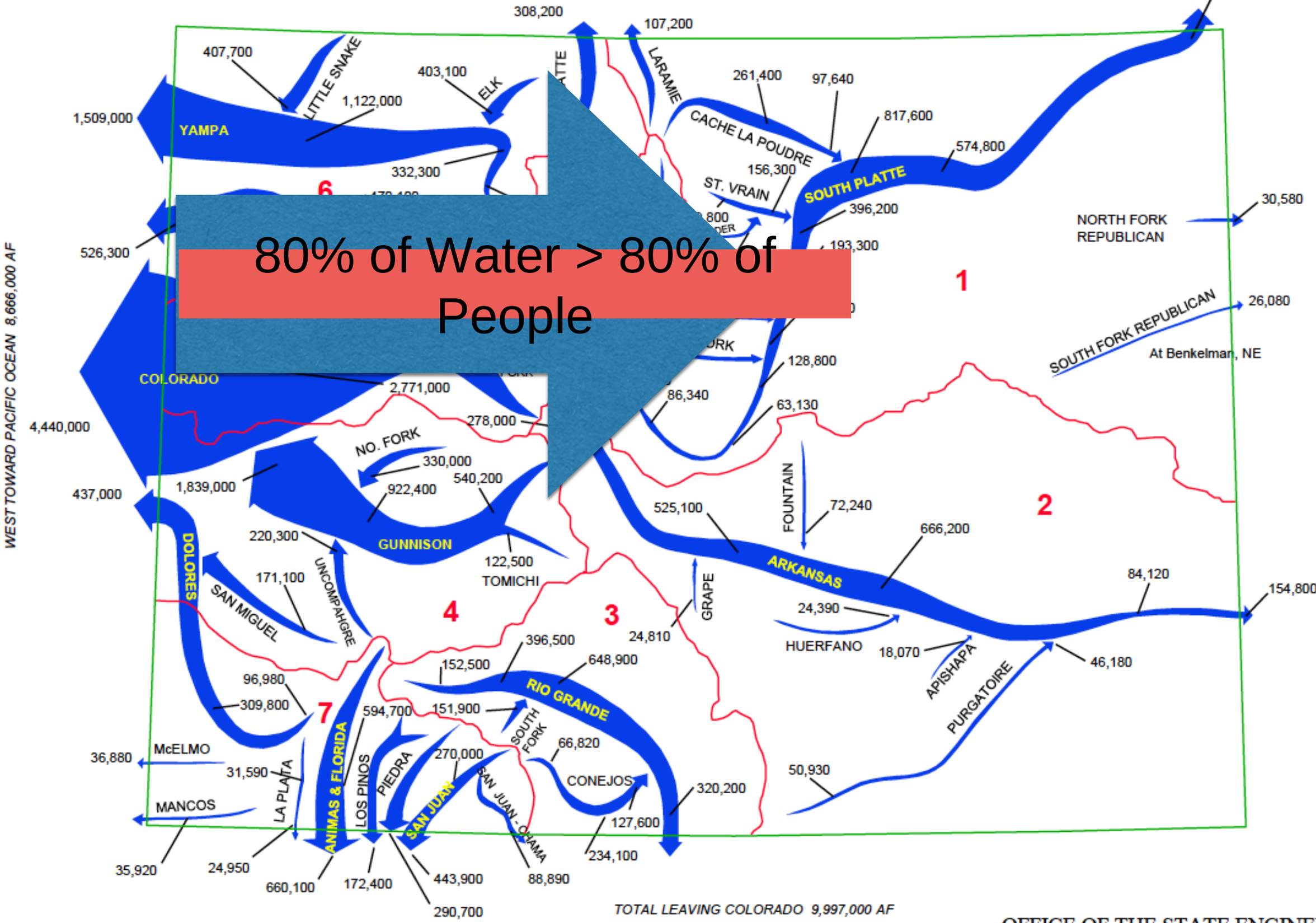


Prepared by the Hydrographic Branch (2011 Revision)
[all values in acre feet (AF)]

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

COLORADO
HISTORICAL AVERAGE ANNUAL STREAM FLOWS

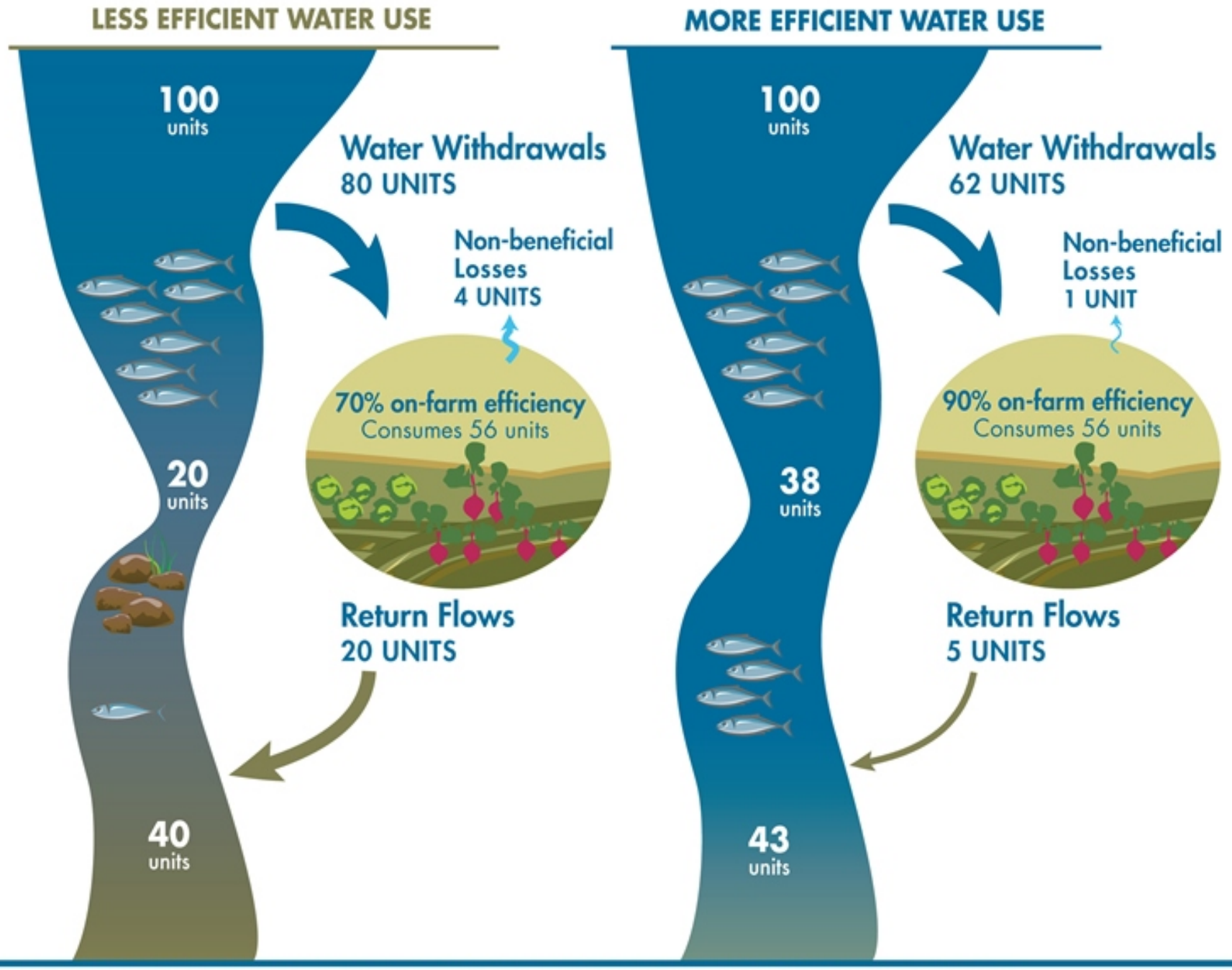
80% of Water > 80% of People



Prepared by the Hydrographic Branch (2011 Revision)
[all values in acre feet (AF)]

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

The Multiple Benefits of Water Efficiency



BENEFITS OF EFFICIENCY INCLUDE:

- Maintain agricultural production
- Reduced non-beneficial consumptive losses, creating new supply
- Less polluted runoff into rivers, streams, and groundwater aquifers
- More water to support in-stream flows
- Less energy for pumping
- Reduce or eliminate need for expensive infrastructure
- Less vulnerability to drought

PACIFIC INSTITUTE

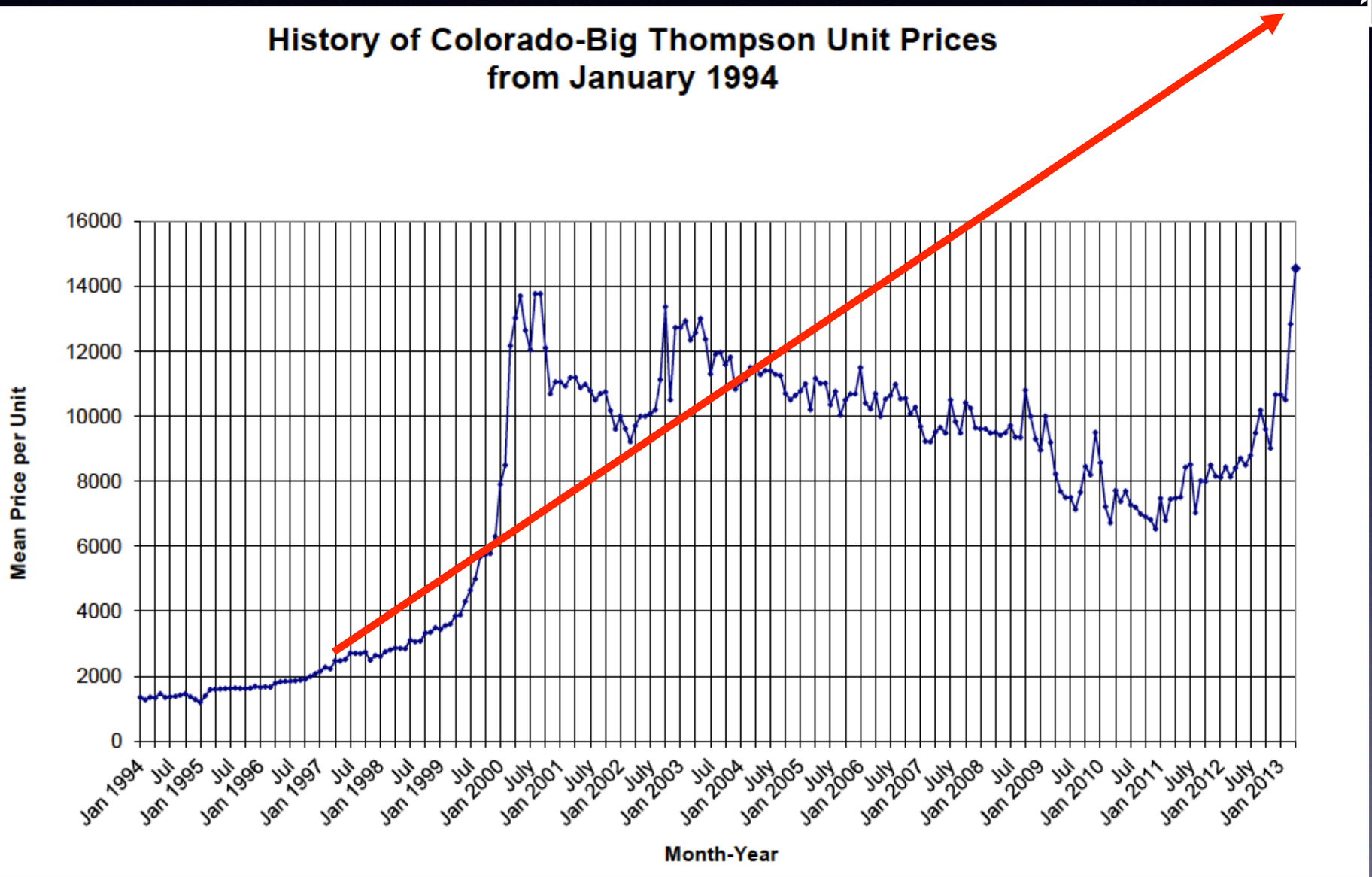
www.pacinst.org

*Numbers in this figure are for illustrative purposes. Actual quantities would depend on site-specific conditions.

Pricey, Pricey, Pricey !

2015
> $35,000/AF
[26,000 £= 21£/m3]

10X in 20 years!



Colorado

University of Colorado at Boulder

University of Colorado--Boulder

public institution that was founded in 1876.

It has an undergraduate enrollment of

27,010,

the campus size is **600 acres**.

Water + 4.31 / 8.00

Credit	Status	Points
Water Use	✔ Complete	2.31 / 5.00
Rainwater Management	✔ Complete	2.00 / 2.00
Wastewater Management	✖ Not Pursuing	0.00 / 1.00

University of Colorado Boulder

OP-26: Water Use

Status	Score	Responsible Party
✔	2.31 / 5.00	**Kristin Epley** Administrator Facilities Management Administration

Reporting Fields | Credit Info

"---" indicates that no data was submitted for this field

Level of water risk for the institution's main campus:

High

Total water use (potable and non-potable combined)::

	Performance Year	Baseline Year
Total water use	378,115 *Gallons*	413,695 *Gallons*

Potable water use::

METROPOLITAN STATE UNIVERSITY[SM] OF DENVER

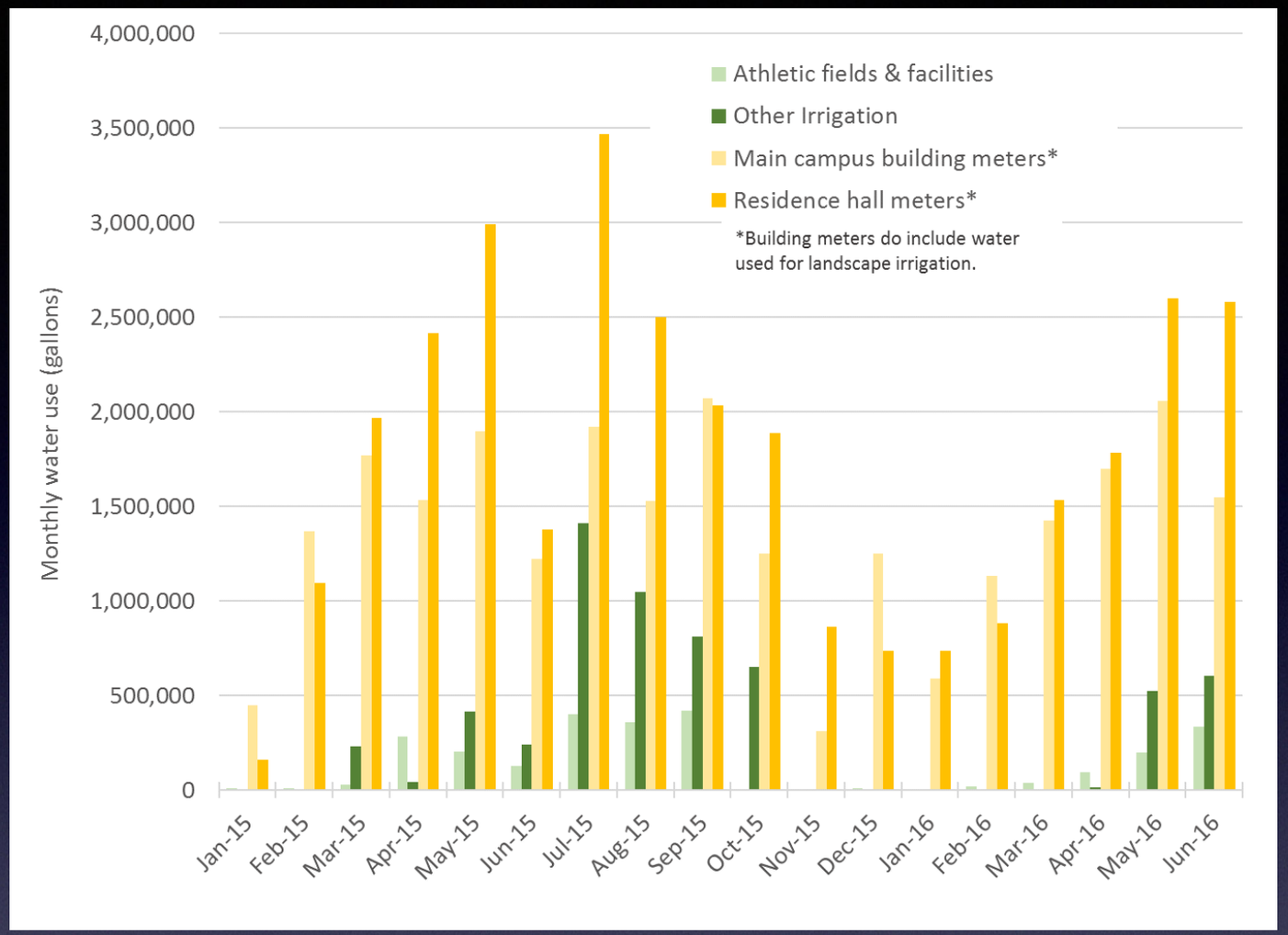
It has a total undergraduate enrollment of **20,186**, its setting is urban, and the campus size is **127 acres**

COLORADO MESA UNIVERSITY

Colorado Mesa University is a public institution that was founded in 1925.

It has a total undergraduate enrollment of **9,299**, its setting is city,

and the campus size is **86 acres**.

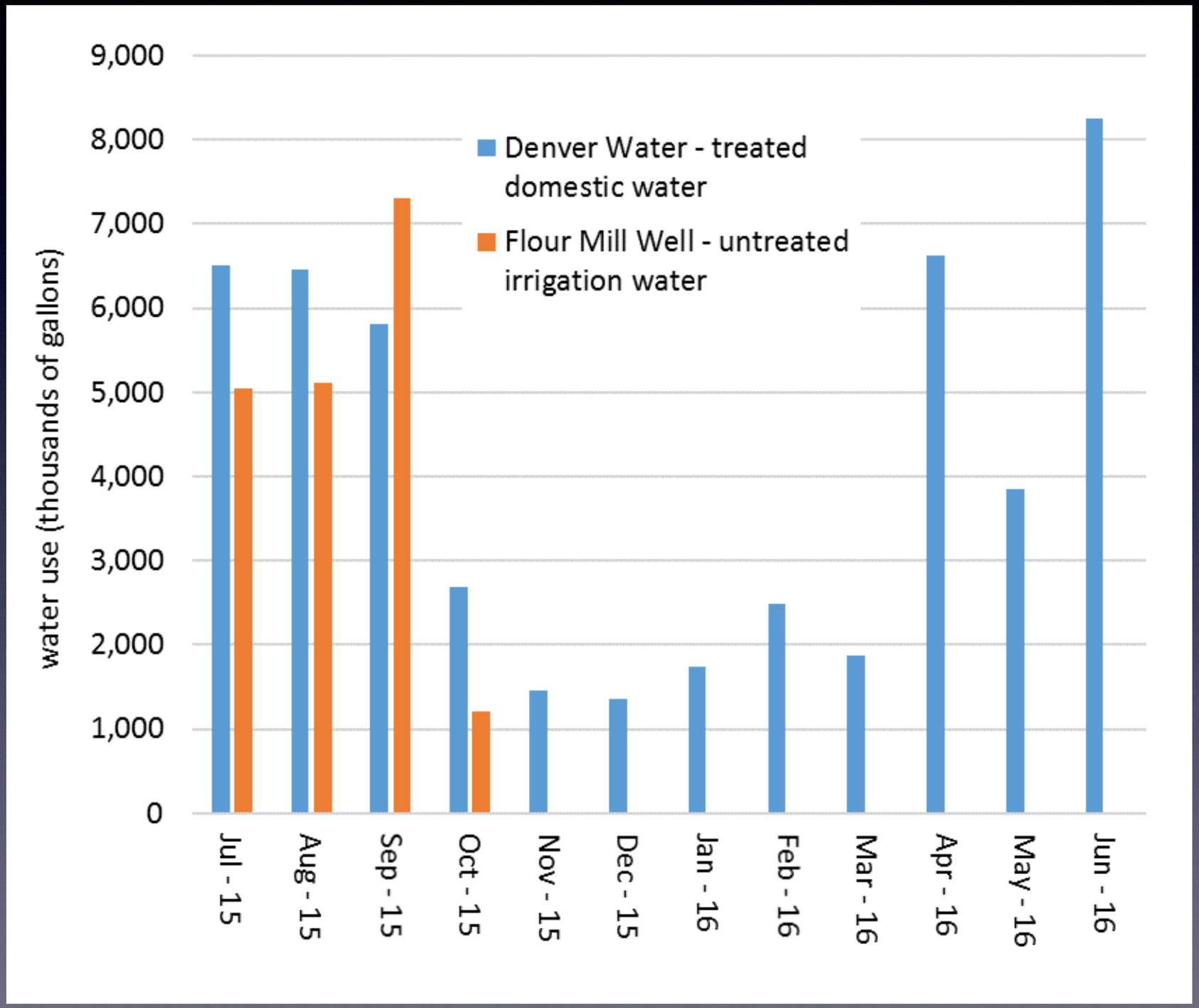


CMU:

outdoor watering: 50% untreated/50% city treated water
31 water meters on buildings (includes some outdoor irrigation)
12 water meters for irrigation and athletic fields (treated)

MSU-Denver : treated domestic water is supplied to campus by Denver Water, and untreated water from alluvial groundwater well.

48 water meters.

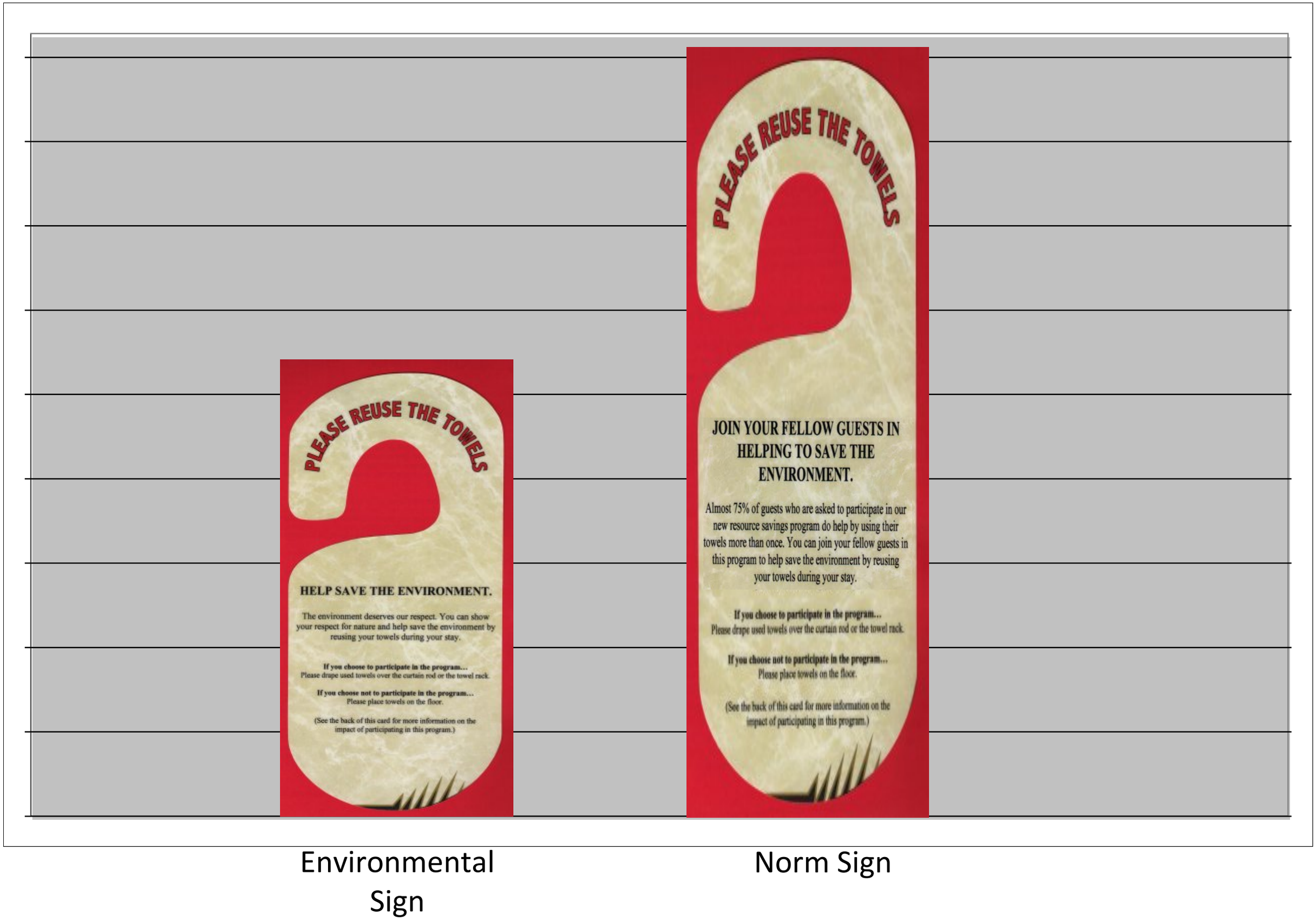


Psychological Influences

- Understanding the psychology underlying water conservation can better hone conservation programs
  - Implement effective, cost-efficient strategies to encourage conservation
    - Subtle wording changes on signs can have large effects
  - Discover innovative strategies
    - Psychologists often looking to advance basic science as well as application, so constantly searching for new tactics
  - Select tactics depending on the target population
    - No strategy is a panacea; psychologists often look to see what is most effective depending on the situation

Percent towel reuse

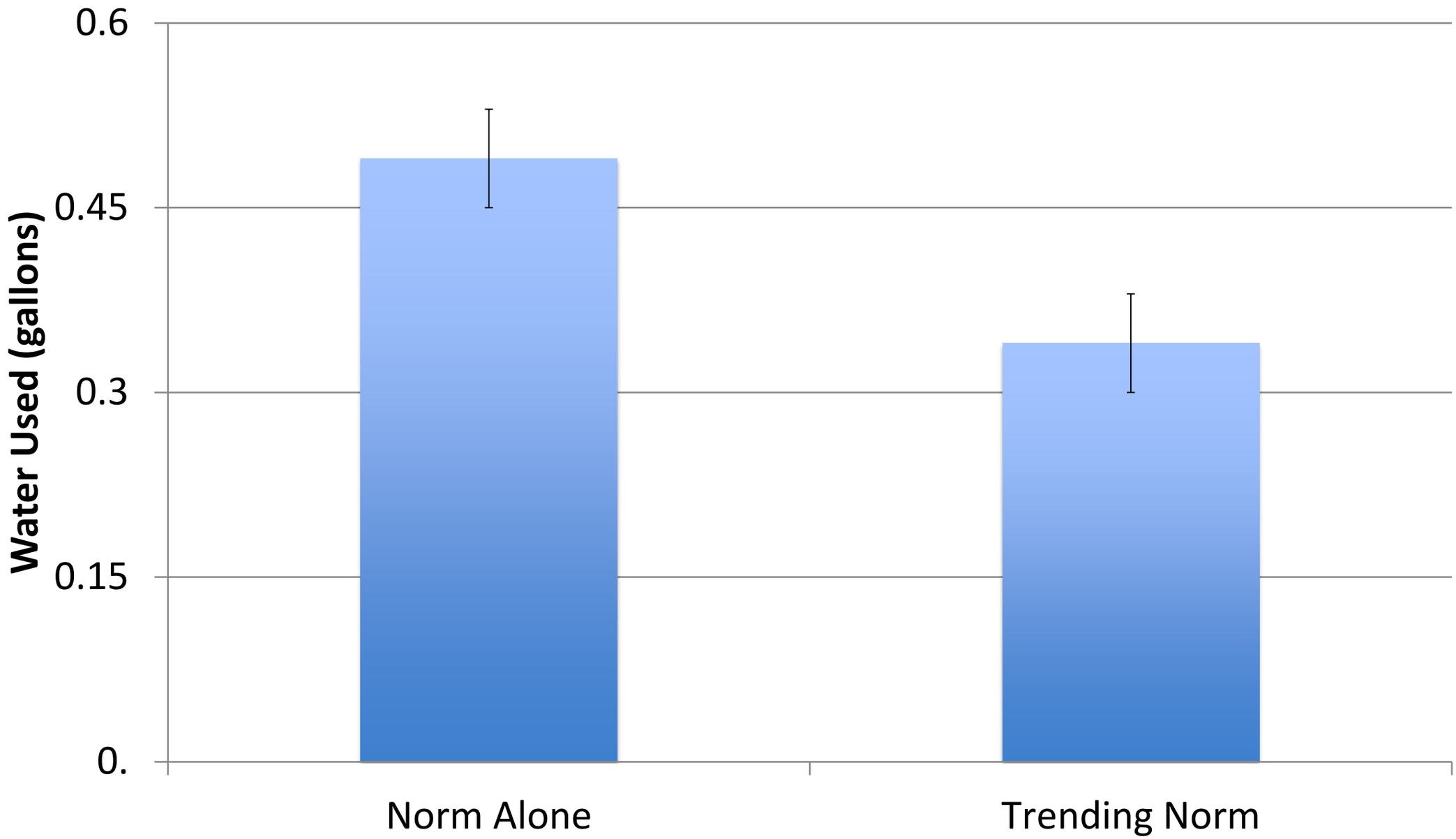
Goldstein, Cialdini, & Griskevicius (2008)



Improving Normative Influence

- Can we improve normative influence? What if only a minority perform the behavior?
  - Communicating an upward trend in popularity has unique effects (Mortensen et al., in press; Sparkman & Walton, in press)
    - Communicated water conservation rate
      - Norm only
      - Norm plus trend
      - Measured water use during a “toothpaste taste test”

Water Use During Tooth Brushing



$F(1, 95) = 5.94$, $p = .02$, $\eta_p^2 = .06$, $CI_{95\%}$ [−0.261, −0.027]

Collaboratory Research

- Gathered data from three CO campuses (faculty, students, staff)
- Measured water conservation intentions
  - Behavior change
  - Installing water-efficient appliances
- Predicted intentions using
  - Norms
  - Perceived Behavioral Control
  - Attitudes

Collaboratory Research

- Intentions to change behavior predicted by
  - Norms ($p < .001$)
  - Perceived Behavioral Control ($p < .001$)
  - Attitudes ($p < .001$)
- Intentions to install appliances predicted by
  - Norms ($p < .001$)
  - Perceived Behavioral Control ($p < .001$)
  - NOT Attitudes ($p = .50$)
- *Attitudes <u>unrelated</u> to use of water-conserving technology*

What Psychology Adds

- Psychologists have studied for decades how to change behavior and how to evaluate effectiveness
- Psychological research supports shows incentive programs can work, but these can be costly
  - People can also be motivated in other ways
- Collaboration with a social psychologist in your region can improve energy conservation programs

Expected outcomes of the multi-phased **Colorado Water Collaboratory** include:

- Greater awareness of the need for water use efficiency
- Identification of potential urban water use efficiency practices (particularly outdoor)
- Improved water use efficiency practices at the three universities
- Technology/information transfer from the three university campuses
  - ♠to individual homes of students, faculty and staff.
- Increased interest in students, faculty and staff >
  - ♠ improved water use efficiency practices on campus and at home.

Paul.W.Lander@colorado.edu

cmorten2@msudenver.edu

socialnorms.org