EMBRACING REGULATORY CHANGES TO MEET WATER-RELATED CHALLENGES

RECLAMATION AND REUSE STRATEGIES

Bob Salvatelli

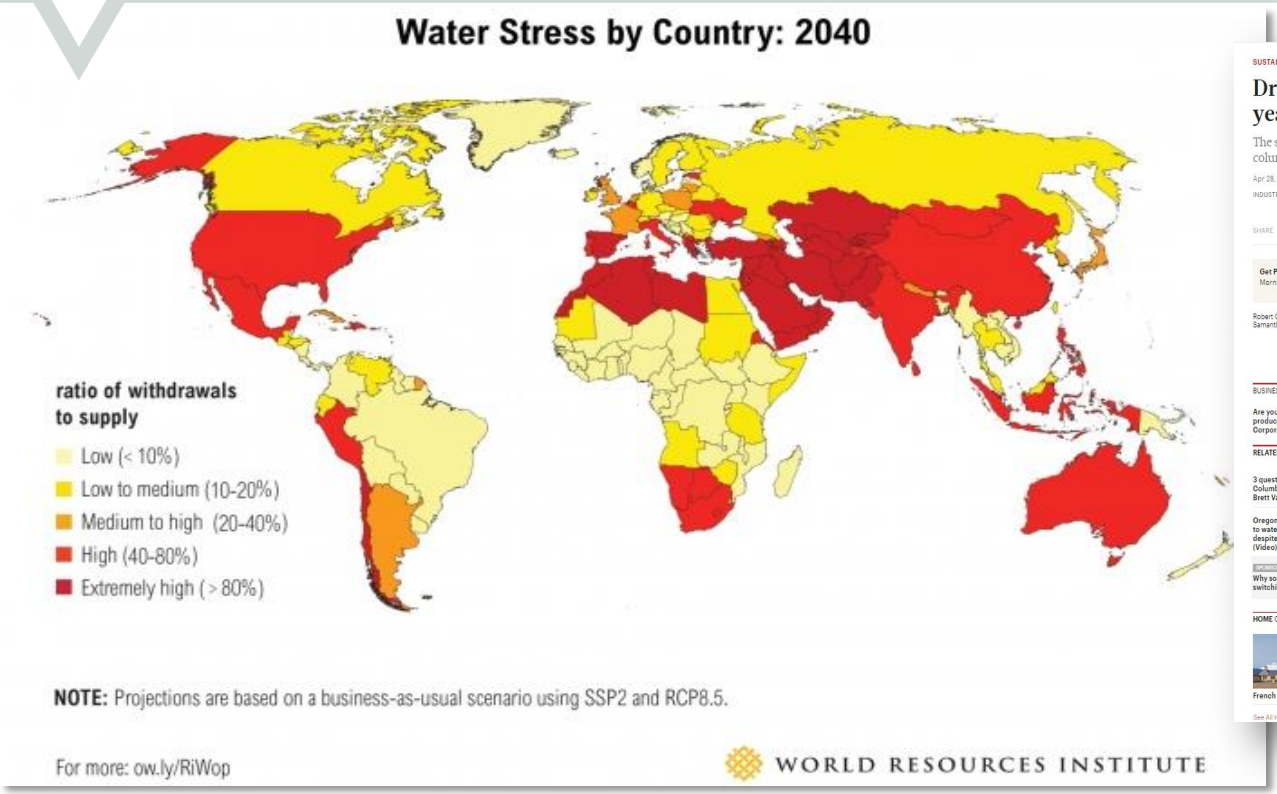
Director of Sales, Sustainable Water

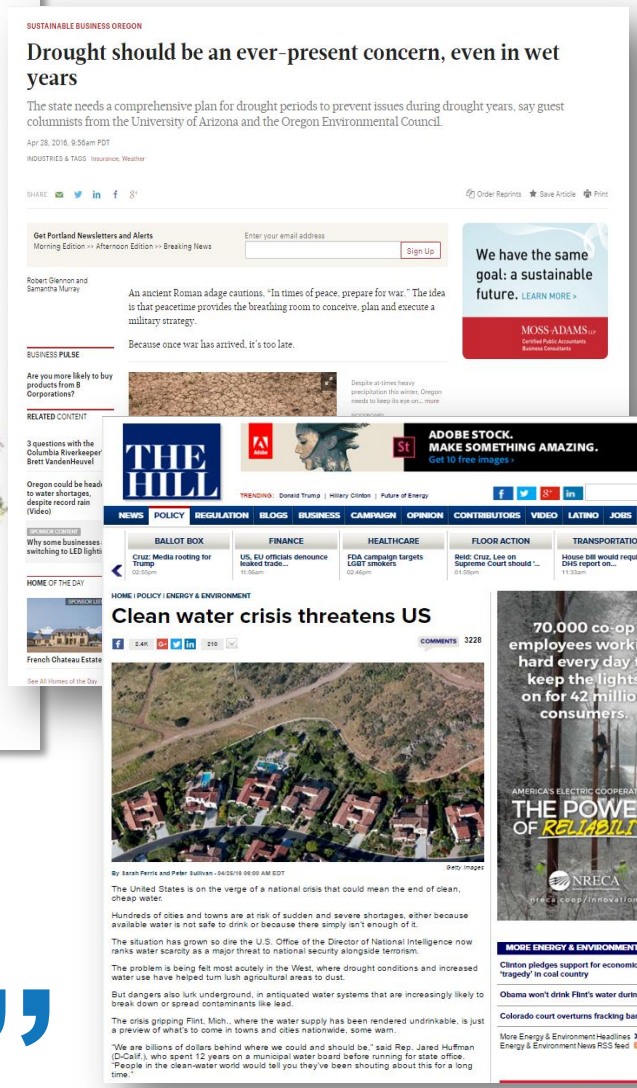
804.965.5590 | INFO@SUSTAINABLEWATER.COM | WWW.SUSTAINABLEWATER.COM

THE WATER APOCALYPSE

Together These Factors Will Completely Change Water Management

WATER SCARCITY THREATENS OUR NATION





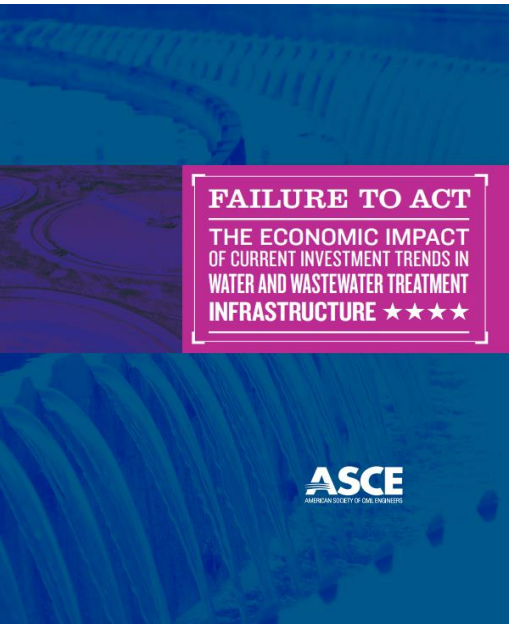
> "The United States is on the verge of a national crisis…the situation has grown so dire the US Office of the Director of National Intelligence now ranks water scarcity as a major threat to national security alongside *terrorism*."
>
> - The Hill, April 2016

Water Scarcity is Not Just a Concern Outside of the U.S.

A FAILED INFRASTRUCTURE SYSTEM

"Households and *businesses that do not self-supply are assumed to absorb the higher costs* that are a consequence of disruptions in water delivery and wastewater treatment *due to worsening infrastructure.*"

- American Society of Civil Engineers, Failure to Act



By 2040, the total costs to businesses due to unreliable infrastructure will be *$1.634 trillion*

"The underlying assumption for this cost is that ***the prices of water and wastewater treatment will increase as services need to be rationed*** to stretch the effectiveness of the infrastructure in overcoming the capital gap."

TABLE 2★ **Estimated Costs for U.S. Households and Businesses due to Unreliable Water and Wastewater Infrastructure** *(billions of 2010 dollars)*

SECTOR	COSTS, 2011–20		COSTS, 2021–40		COSTS, 2011–40	
	CUMULATIVE	ANNUAL	CUMULATIVE	ANNUAL	CUMULATIVE	ANNUAL
Households	$59	$6	$557	$28	$616	$21
Businesses	$147	$15	$1,487	$74	$1,634	$54
TOTALS	**$206**	**$21**	**$2,044**	**$102**	**$2,250**	**$75**

NOTE Numbers may not add due to rounding.

SOURCES EDR Group based on interviews, establishment counts, and sizes by sector from *County Business Patterns*, population forecasts of the U.S. Census, and forecasts of establishments and households provided by the INFORUM Group of the University of Maryland.

Capital Spending Has Not Kept Pace with Needs for Water Infrastructure

TIGHTENING GOVERNMENTAL REGULATIONS

The federal & state regulatory environment is constricting to eliminate ground and surface water pollution as well as provide greater control over critical water resource management. A few regulatory issues driving water reuse:

- **A move toward water withdrawal limitations**
- **Federal mandates to resolve CSO & SSO issues**
- **Stricter nitrogen & phosphorus discharge standards**
- **Stricter drinking water testing parameters**

Water Withdrawal Limits

Combined Sewer Overflows

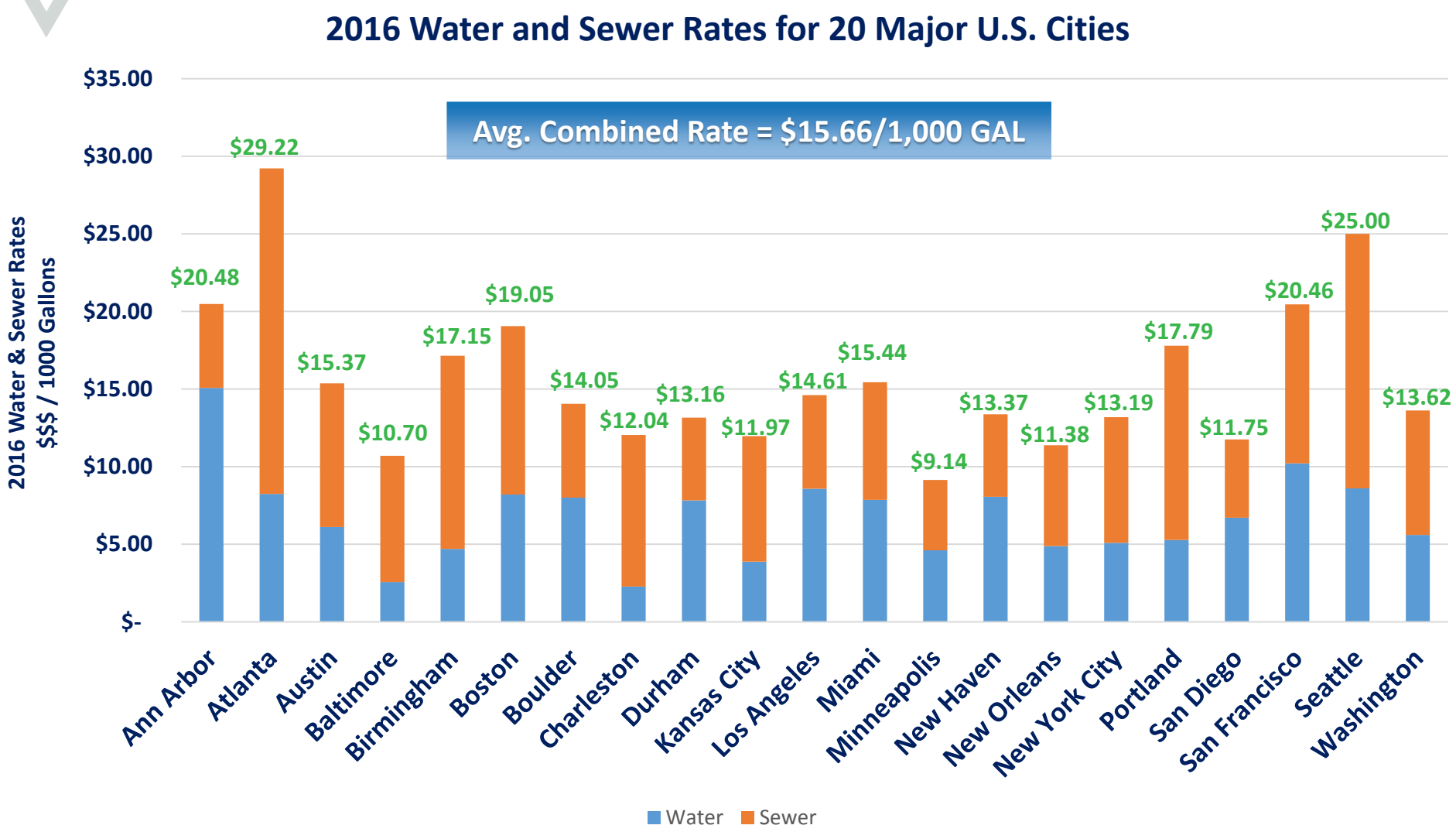
Point Source Pollution Control

U.S. DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

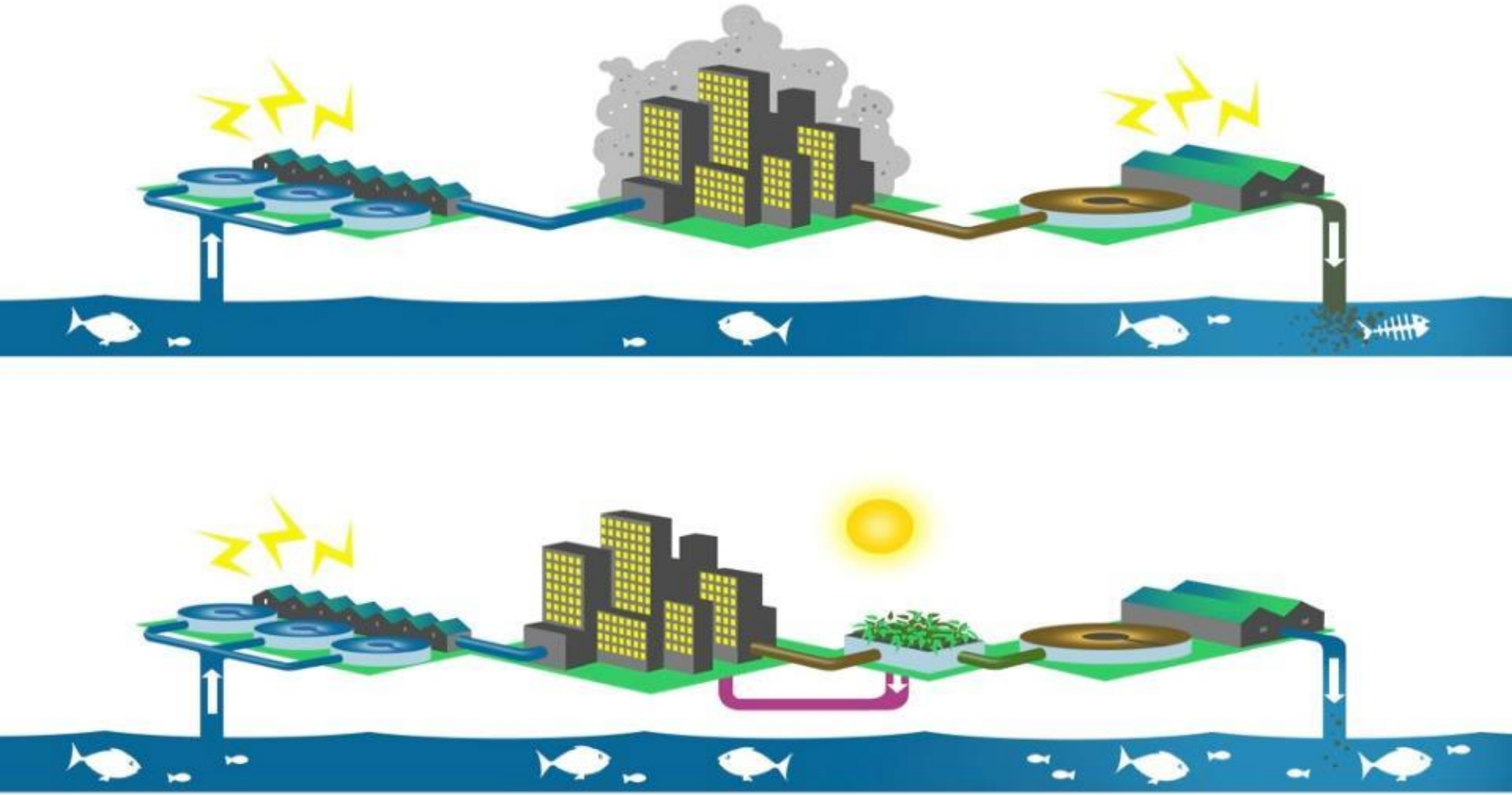
Unfunded Mandates Drive Rate Increases

HOW RATES COMPARE NATIONALLY



Consistent Rate Increases for all Major Cities Driving Operational Costs

A SUSTAINABLE WATER CYCLE…DECENTRALIZED WATER RECLAMATION & REUSE



Risk Management | Cost Savings | Environmental Responsibility

FLEXIBILITY: INDEPENDENCE & RESILIENCE

- Reduces freshwater withdrawal
- Expands Muni. Infrastructure Capacity
- Additional On-Site Storage
- Reliable & local water supply
- Lower Life Cycle Costs
- Zero Discharge: reduced contribution to CSOs and wastewater discharge to environment
- Protects valuable research experiments
- Minimum recovery time

Multiple Benefits Allow for Cross Facility Collaboration

ECOLOGICAL WATER TREATMENT TECHNOLOGIES





	ReCip® Tidal Wetlands	Hydroponic & Fixed Media	Moving Bed Bioreactor (MBBR)	Membrane Bioreactor (MBR)	Conventional Activated Sludge
CAPITAL EXPENSE	🟢	🟢	🟢	🔴	🟡
OPERATING EXPENSE	🟢	🟢	🟡	🔴	🟡
ENERGY EFFICIENCY	🟢	🟡	🟡	🔴	🟡
EFFLUENT QUALITY	🟢	🟢	🟢	🟢	🔴
FOOTPRINT	🟡	🟢	🟢	🟡	🔴
AESTHETICS	🟢	🟢	🟡	🔴	🔴

Innovative Technology Increases Biodiversity & Reduces Energy Requirements

THE EVOLUTION OF WATER CONSERVATION

The Most Impactful Solution That Does Not Require Behavioral Change

A THRIVING MARKET

"Global water reclamation and reuse markets to grow at a CAR of 22.39% in terms of volume of water recycled, and at a CAGR of 19.2% in terms of revenue between 2015 and 2019."

Global Water Recycle and Reuse Market 2015 - 2019

July 10, 2015

Water Recycling Required in San Francisco Large Buildings

RELATED STORIES

Despite Drought San Francisco Uses Drinking Water to Heat Hundreds of Buildings

San Francisco Publishes Energy Consumption Data for 305 City Buildings

LA, DC, San Francisco Top Cities for Energy Star Buildings

Developers in San Francisco must install water recycling systems on large, new buildings in the city per an ordinance unanimously approved by the San Francisco Board of Supervisors.

The vote happens as California enters its fourth year of record drought.

Other cities are trying similar water reuse strategies to conserve water, reports KQED. Palo Alto requires new homes and commercial buildings to have laundry-to-landscape systems and San Jose plans to pass a similar law this year.

Late last month the California Water Resources Board approved revisions to Los Angeles County's stormwater discharge permit, which includes a plan to capture and reuse stormwater runoff that could serve a model for the rest of the state.

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Market Acceptance Presents Opportunity for Risk Mitigation and Revenue Insulation

SUPPORT FOR WATER RECLAMATION & REUSE

> "Decentralized wastewater systems help communities reach the *triple bottom line of sustainability*: good for the environment, good for the economy, and good for the people."
>
> - US EPA, Decentralized Wastewater Treatment: A Sensible Solution

Water Resiliency has become a National Priority Requiring

FEDERAL FUNDING FOR WATER REUSE

Clean Water Act
40th Anniversary

THE WHITE HOUSE
WASHINGTON

"*The Federal government also has a unique role supporting private and public sector investments* in the early stages of these innovations, developing them through new and existing Federal partnerships and programs…"

- The White House, Moonshot for Water

Promoting Innovative Solutions for Effective Water Management Planning

SUSTAINABLE WATER'S COMMITMENT

COMMITMENT TO THE WHITE HOUSE WATER SUMMIT INITIATIVE

Sustainable Water is committing to deploy $500 million in capital to develop 50 eco-engineered decentralized water reclamation and reuse systems across governmental, institutional, and commercial market sectors. This commitment is anticipated to save 7.5 billion gallons of potable water annually in the next 10 years.

- RISK MITIGATION
- FINANCIAL SAVINGS
- ENVIRONMENTAL RESPONSIBILITY
- SOCIAL RESPONSIBILITY

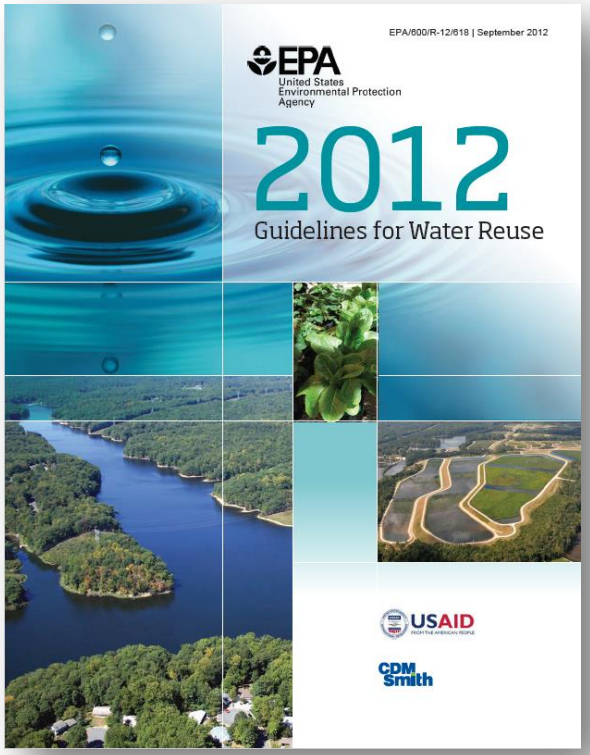
$500 MILLION
TO DEVELOP
50 ECO-ENGINEERED
WATER RECLAMATION SYSTEMS

Sustainable Water's Innovative Approach to Increasing Water Security

WATER REUSE SUCCESS STORIES

NATIONAL IMPLICATIONS FOR REUSE

Category of reuse		Description	Number of States or Territories with Rules, Regulations, or Guidelines Addressing Reuse Category
Urban Reuse	Unrestricted	The use of reclaimed water for nonpotable applications in municipal settings where public access is not restricted	32
	Restricted	The use of reclaimed water for nonpotable applications in municipal settings where public access is controlled or restricted by physical or institutional barriers, such as fencing, advisory signage, or temporal access restriction	40
Agricultural Reuse	Food Crops	The use of reclaimed water to irrigate food crops that are intended for human consumption	27
	Processed Food Crops and Non-food Crops	The use of reclaimed water to irrigate crops that are either processed before human consumption or not consumed by humans	43
Impoundments	Unrestricted	The use of reclaimed water in an impoundment in which no limitations are imposed on body-contact water recreation activities (some states categorize snowmaking in this category)	13
	Restricted	The use of reclaimed water in an impoundment where body contact is restricted (some states include fishing and boating in this category)	17
Environmental Reuse		The use of reclaimed water to create, enhance, sustain, or augment water bodies, including wetlands, aquatic habitats, or stream flow	17
Industrial Reuse		The use of reclaimed water in industrial applications and facilities, power production, and extraction of fossil fuels	31
Groundwater Recharge – Nonpotable Reuse		The use of reclaimed water to recharge aquifers that are not used as a potable water source	16
Potable Reuse	Indirect Potable Reuse (IPR)	Augmentation of a drinking water source (surface or groundwater) with reclaimed water followed by an environmental buffer that precedes normal drinking water treatment	9
	Direct Potable Reuse (DPR)	The introduction of reclaimed water (with or without retention in an engineered storage buffer) directly into a water treatment plant, either collocated or remote from the advanced wastewater treatment system	0



As of August 2012, ***22 States have adopted regulations and 11 states have guidelines or design standards*** with water reuse as the primary intent.

- 2012 Guidelines for Water Reuse, EPA

Validated Technology to Minimize Risk for District-Scale Management

CALIFORNIA SUPPORTS WATER INVESTMENT

74%

Of voters supported a tax on water investment

Voters in the area have twice supported taxes for water investment. The funds support projects from a massive seismic retrofit of the water district's largest reservoir to the installation of hydration stations in schools.

YES ON PROPS 1&2

In November 2014, California voters approved Proposition 1, the Water Quality, Supply, and Infrastructure Improvement Act, a $7.5 billion water bond for investments in the state's water management systems.

Center on Budget and Policy Priorities

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POLICY FUTURES

It's Time for States to Invest in Infrastructure

FEBRUARY 23, 2016 | BY ELIZABETH MCNICHOL

SHARE

PDF of this report (20 pp.)

MORE ON THIS TOPIC

REPORT

Reversing the decline in state investment in transportation, public buildings, water treatment systems, and other forms of vital infrastructure is key to creating good jobs and promoting full economic recovery — and this is an especially good time for states to do it.

The condition of roads, bridges, schools, water treatment plants, and other physical assets greatly influences the economy's ability to function and grow. Commerce requires well-maintained roads, railroads, airports, and ports so that manufacturers

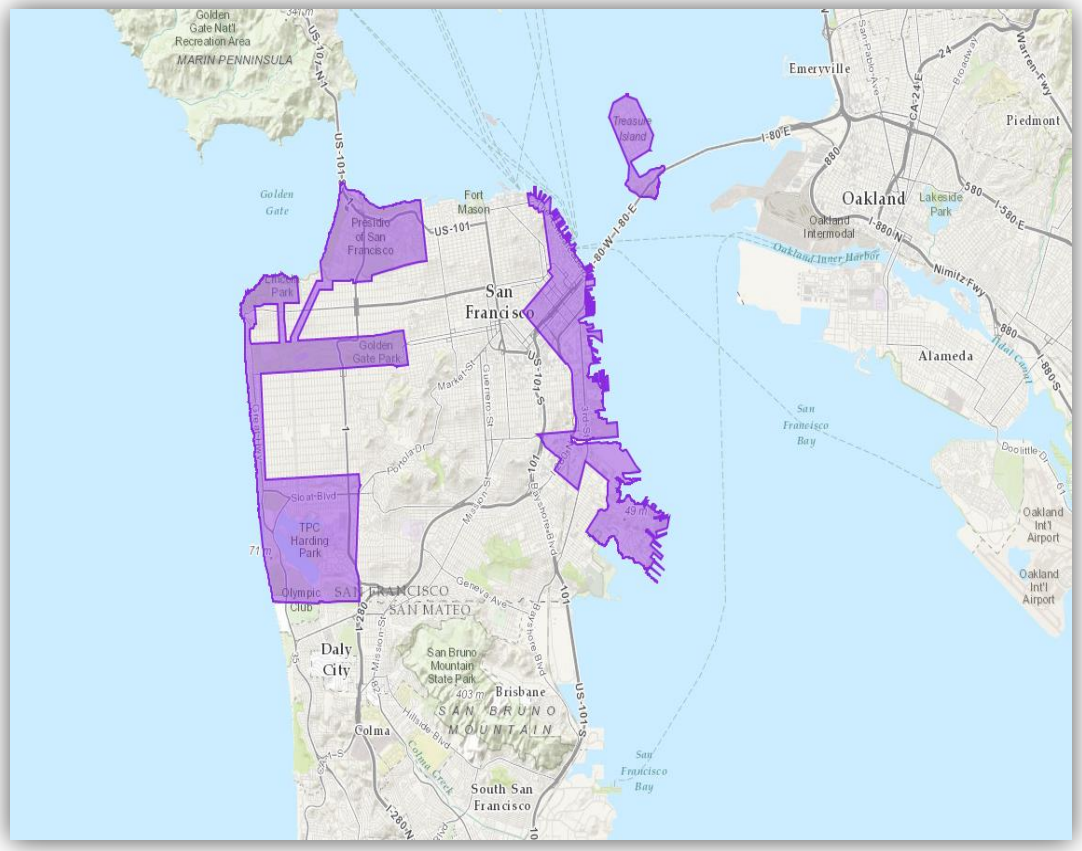
EVERY STATE NEEDS INFRASTRUCTURE IMPROVEMENTS THAT

Statewide Approval for Resilient Water Planning and Effective Treatment Solutions

SAN FRANCISCO PUBLIC UTILITIES

In the early 1900's, ***the Golden Gate Park area was transformed from "great sand and waste" to a garden spot through the use of partially treated wastewater and groundwater.*** In the 1930s, the McQueen Treatment Plant was constructed in the Park to provide secondary-treated recycled water to irrigate Golden Gate Park.

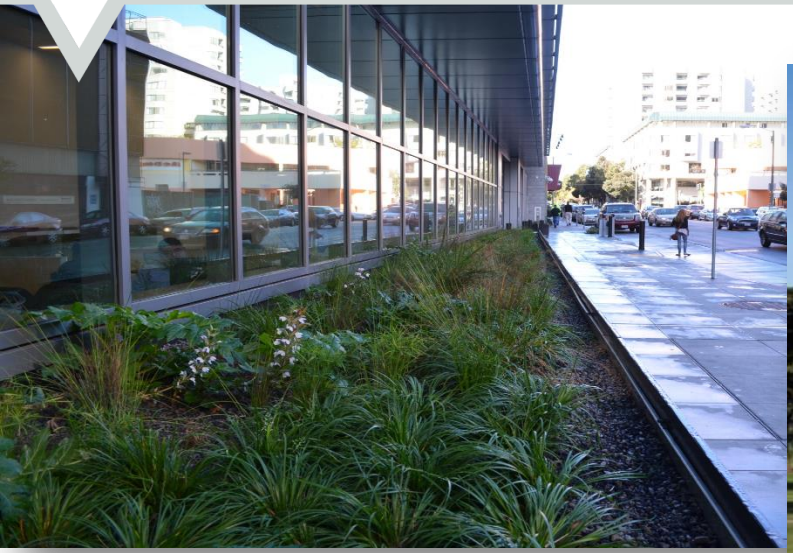
- San Francisco Water Power Sewer



The City and County of San Francisco's Recycled Water Ordinance Requirements (highlighted purple area):

- New construction or major alterations to a building totaling 40,000 square feet or more
- All subdivisions
- New and existing irrigated areas of 10,000 square feet or more

SFPUC HEADQUARTERS BUILDING



Building Features

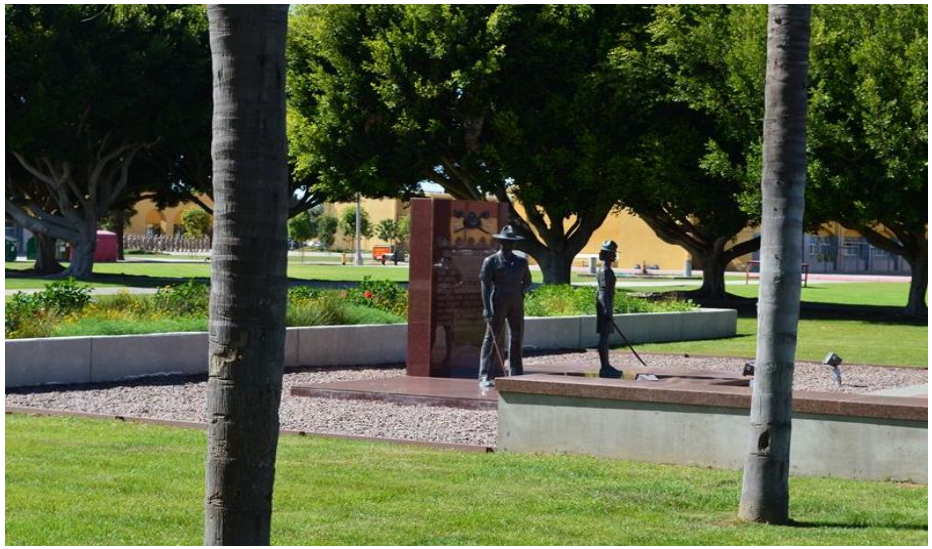
- One of the first buildings in the nation with on-site treatment of gray and black water
- Treats 5,000 gallons of wastewater daily – Satisfying 100% of the water demand for the low-flow toilets and urinals
- 25,000 gallon rainwater harvesting system provides water for irrigation uses

Impactful Solution that Decreased Potable Water Consumption by 70%

SAN DIEGO MARINE CORP RECRUITING DEPOT

Treatment Features

- 10,000 GPD wastewater treatment facility.
- Satisfies 100% of irrigation demands.
- Efficient solution for high traffic area.



Wastewater Management Tool Serves as the Centerpiece of the Depot

MANKATO, MINNESOTA


RWL Water About Solutions Industries Library Case Studies Blog

Minnesota Town Bolsters Local Water Reuse

August 21, 2014 | By Linda Dailey Paulson

MPRnews Sections Members More

Minnesota starts to think about re-using wastewater

Elizabeth Dunbar · Mankato, Minn. · Aug 4, 2014 Environment

Al Gerard, Lead Control Room Operator at the Calpine energy plant in Mankato, Minn., said that when the plant is in operation, it will use 700 to 1,200 gallons of reclaimed water per minute and will supply on average 3,200 Megawatts per day to the Northern States Power energy grid. Jackson Forderer / For MPR News

LISTEN Story audio
Aug 5, 2014
7min 16sec

First Large-Scale Project in MN to Use Recycled Water for Cooling

- Natural gas-fired, combined-cycle facility
- Meets power needs in MN and Upper Midwest
- Cooling water for the plant is supplied by municipal WWTF
  - Provides up to 6.2 mgd of reclaimed water
  - Power plant returns cooling water discharge to the WWTF

Currently, MN has 40 water reuse projects across the state for:

- Toilet Flushing
- Energy Plant Cooling Water
- Golf Course Irrigation
- Agricultural Irrigation
- Wetland Enhancement

Water Scarcity Driving Minnesota's Largest Reuse Project

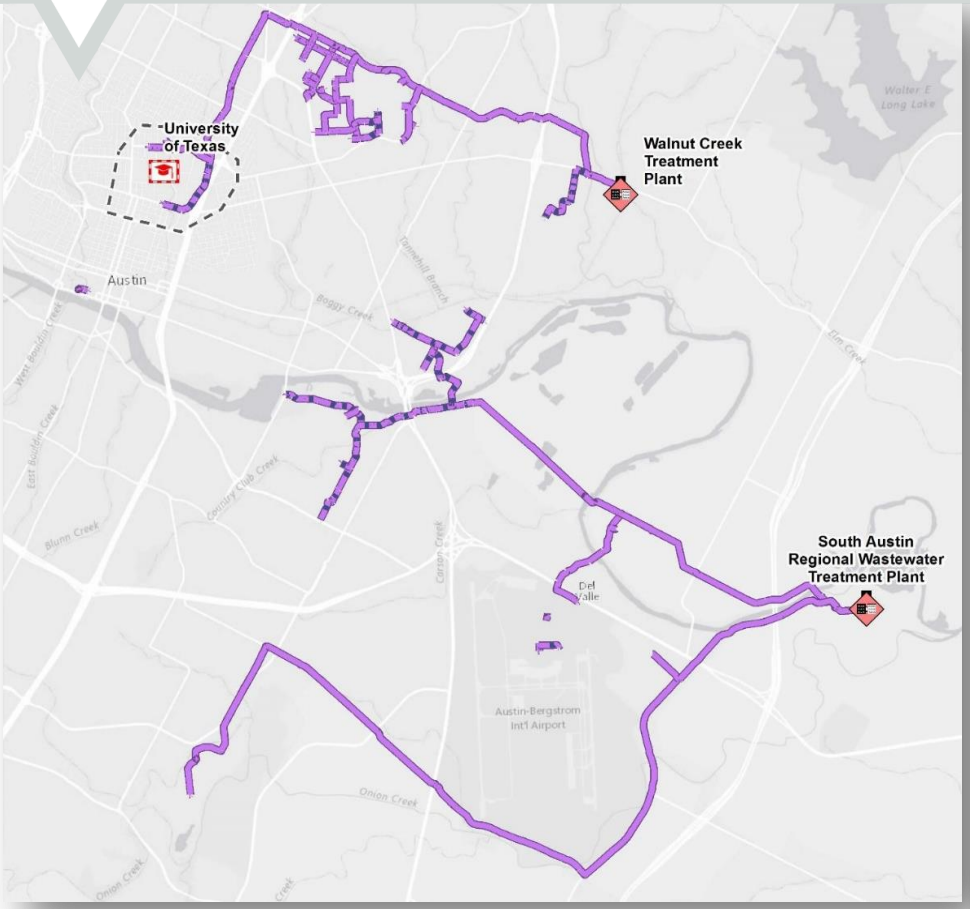
CITY OF AUSTIN RECLAIMED WATER

"As of May 2015 , ***City Code requires new commercial developments or redevelopments within 250 feet of a reclaimed water main to connect*** for irrigation, cooling, and other significant non-potable water uses."

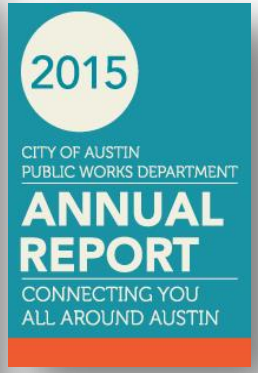
- City of Austin

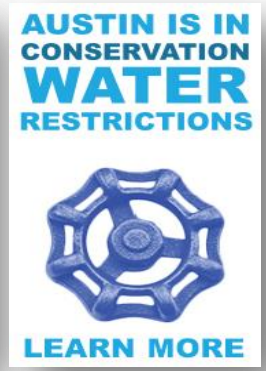
New Construction and Redevelopments Require Reclaimed Water

CITY OF AUSTIN RECLAIMED WATER



74 Total Customers
1.5 Billions Gallons Reclaimed in 2013
Over 50 Miles of Distribution Lines





Why Do Austin Customers Decline Reclaimed Water Connections?

Customer	Vol. (MG/yr)	Reason
3502/3504 Red River	0.2	Cost of abandoning sprinkler system and adding new
ABIA Chiller	10.0	Unfamiliar with water chemistry, cost of treatment change
ABIA Garage Irrigation	10.0	Cost of sleeving piping in highly landscaped area
ACC Riverside		Cost of adding purple pipe
AE's Dell Chiller	30.0	Microbial drift from cooling tower
CTECC	0.3	Inability to shut down to perform annual test
Data Foundry	15.7	System capacity / low pressure
Hancock Shopping	5.0	Cost of abandoning sprinkler system and adding new
Hornsby Bend	?	Expensive to address preexisting x-connection issues
Long Horn Hotels	0.3	Cost of abandoning sprinkler system and adding new

Centralized Reuse has Challenges in Dense Urban Environments

THE WATERHUB®

EMORY UNIVERSITY

THE WATERHUB® AT EMORY UNIVERSITY

400K GPD and up to 140M GPY Displaced

Up to 40% of Total Campus Demand

90% of Utility Water Demand

3 Chiller Plants/1 Power Plant (phase 1)

Performance to Date

- 95% of City Water Displaced at Cooling Towers
- Averaging 7 Million Gallons/Month Campus Wide
- Over 50 Million Gallons of Water Delivered since May
- 99% Up-time Reliability

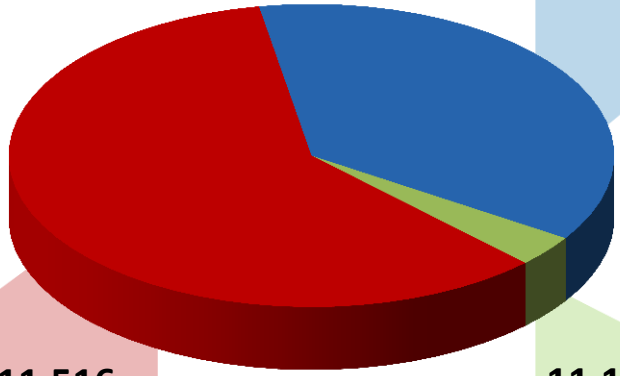
Permitted for Use in Utilities, Irrigation, and Toilet Flushing

CAMPUS WATER FOOTPRINT, FY13-14

> We looked at where we currently use the most potable water in our facilities — *applications where we don't really need drinking-water quality water* — and it came down to our toilets, our steam plants and our chiller plants.
>
> - Brent Zern, Assistant Director of Operational Compliance and Maintenance Programs, Emory University

122,973,384
37%

333 Million Gallons Per Year



198,711,516
60%

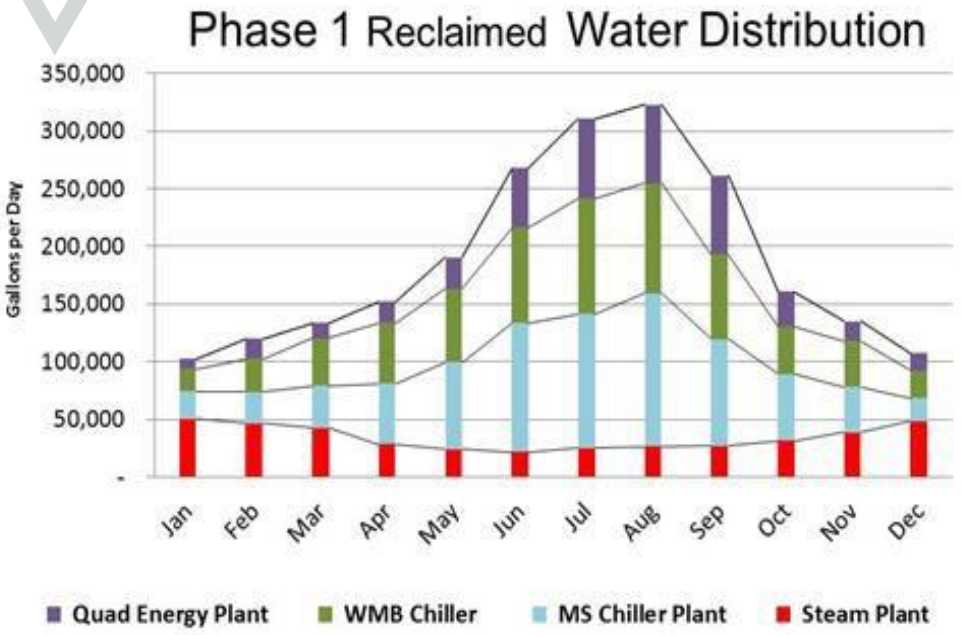
- Utilities
- Irrigation
- Domestic

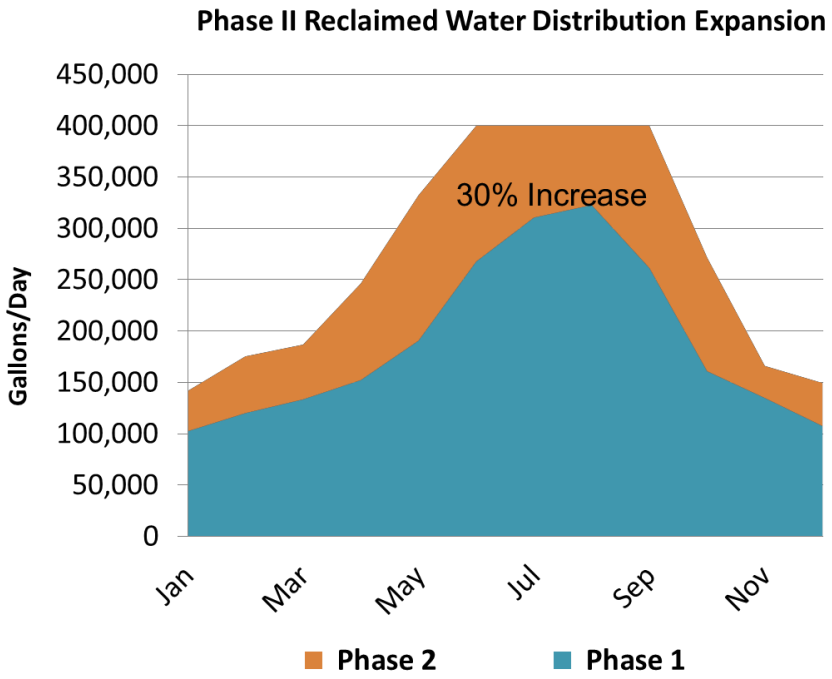
11,141,100
3%

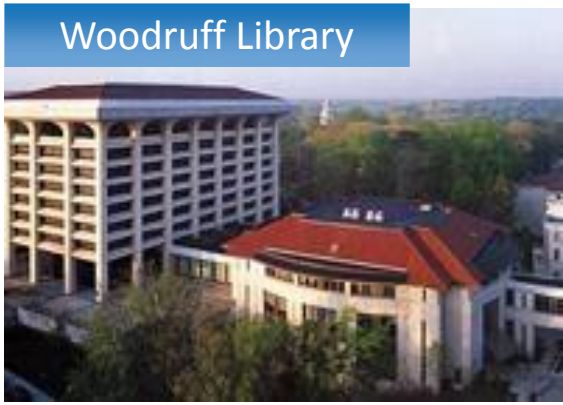
EMORY

40% Non Potable Demand Identified and Strategy Formulated

RECLAIMED WATER DISTRIBUTION







Additional Reclaimed Water Supply Will Address Future Demands

WATERHUB PROCESS DESIGN

How the WaterHub Works

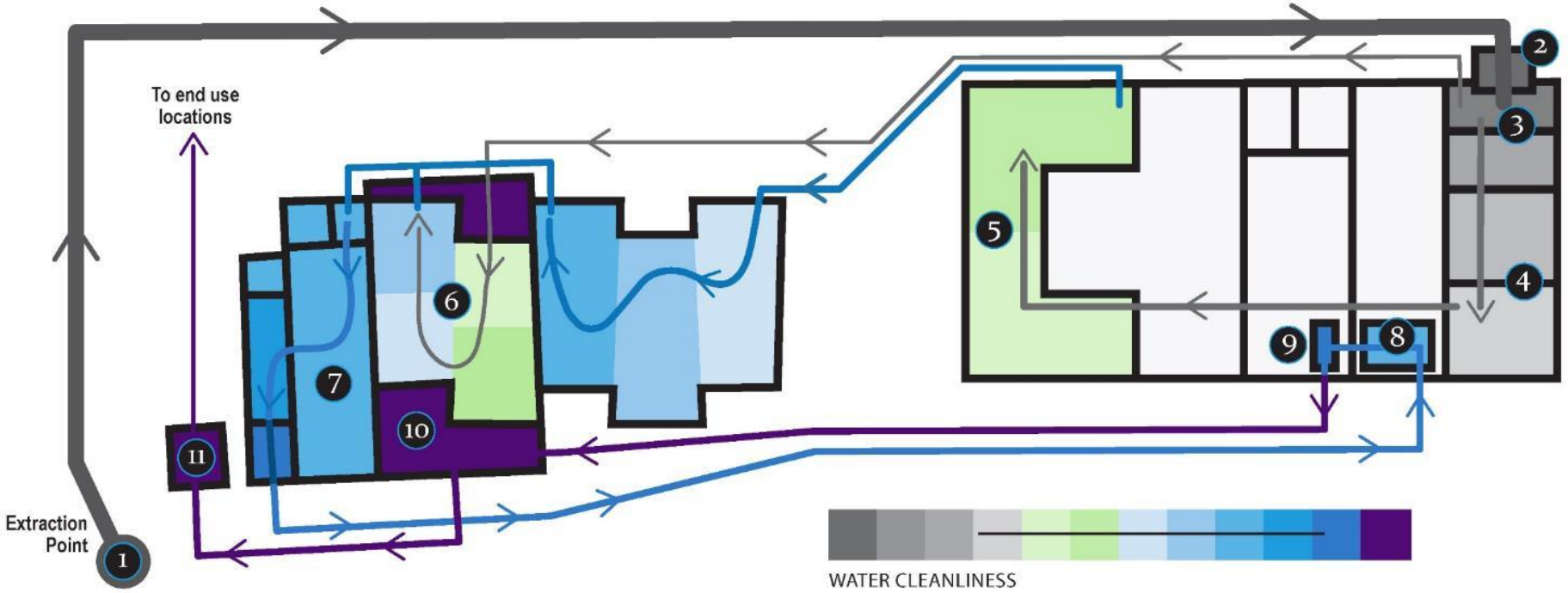
1 2 Extraction Point & Rotary Screen
Wastewater is diverted from the sewer system and sent through a screen to remove debris.

3 Anoxic Moving Bed Bioreactors
Wastewater enters a low-oxygen environment where microorganisms living on honeycombed plastic pellets (mid-density housing for microbes) begin to metabolize carbon and nitrogen.

4 Aerobic Moving Bed Bioreactors
Wastewater enters an oxygen containing environment with a different community of microbes that continue the treatment process. Diffusers add air bubbles to assist treatment. Odorous gasses are removed with charcoal filters.

5 Hydroponic Reactors
Water clarity increases as water is treated in tanks with suspended plant roots. Water is cleaned by microbes living on the plant roots and on the specially engineered bio fabric (high-density housing for microbes) located below the plant roots.

6 Demonstration Reciprocating Wetlands
An alternate treatment system, this area demonstrates a highly energy efficient treatment process applicable for rural areas and developing countries. Screened wastewater is pumped to four 8' deep cells. Cells are alternately filled-and-drained 8 to 18 times a day. The system mimics the behavior of natural tidal wetland areas and uses gravel and plant roots to provide microbial habitat.



7 Clarifier Tank
In a still-water tank, Phosphorus and any remaining solids are removed as the particles hit interior baffles and slide to the bottom.

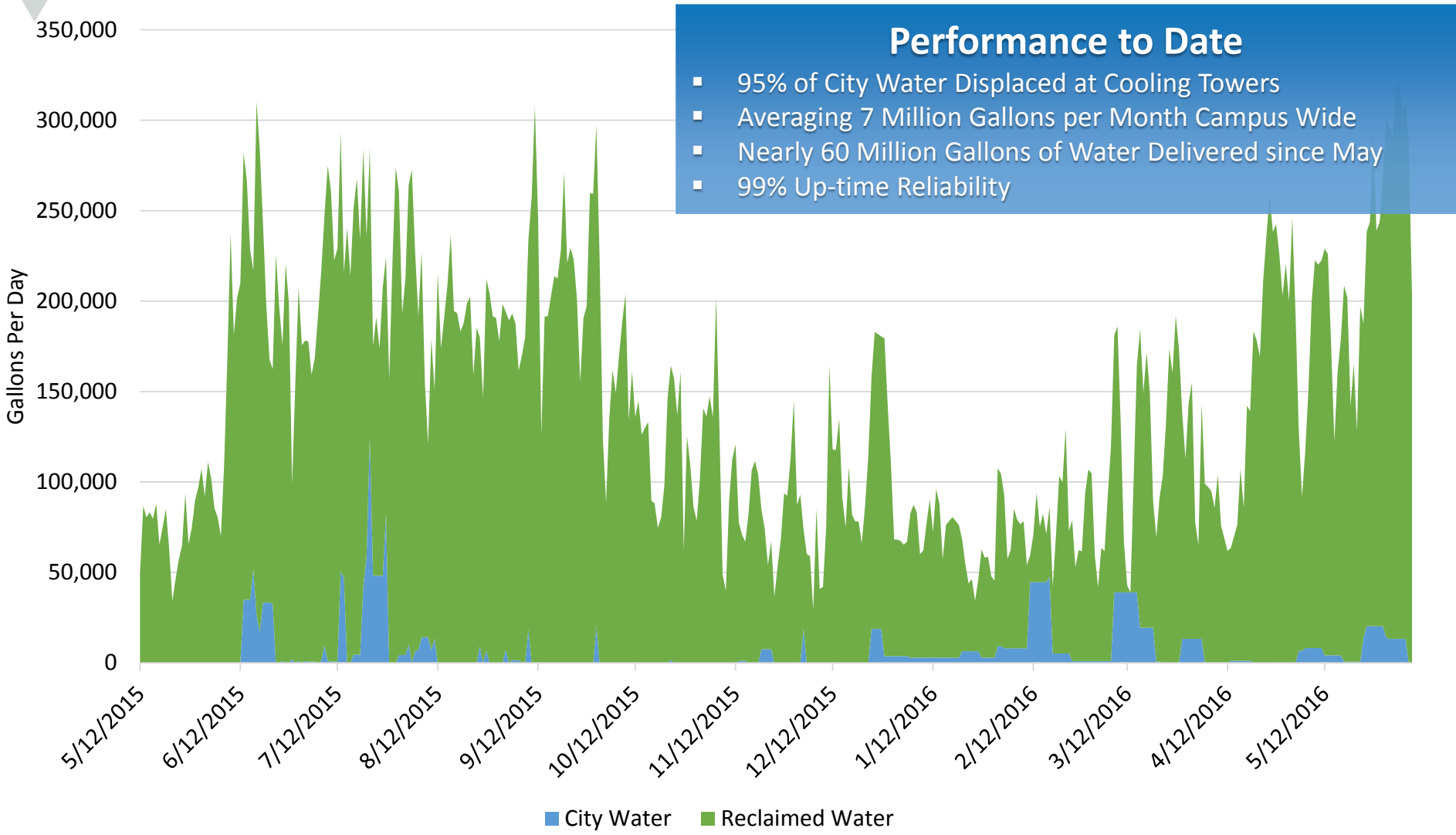
8 Disk Filter
Very clean water is sent through a felt filter to remove any remaining particulate material.

9 Ultraviolet Disinfection
Water is treated with ultraviolet light that provides extensive disinfection, producing water that complies with state and local health requirements.

10 50,000 Gallon Storage Tank
Fully treated water is stored underground as a reserve supply.

11 Campus Distribution
Water is distributed to the steam and chiller plants for use as process make-up water. In the future, water will be sent to residence halls for toilet flushing.

HISTORICAL WATER USE AT END USERS



Reliable Supply of Reclaimed Water with Proven Results

UNIQUE DEVELOPMENT APPROACH

Water Purchase Agreement

Operating Lease | DABOOM Agreement | Performance Contract

ZERO
CAPITAL EXPENSE
—AND—
DEVELOPMENT RISK
TO THE END USER

Benefits

- No up-front capital
- Innovative technologies
- Leverages superior credit rating
- Lifecycle savings
- Long-term pricing stability
- No O&M responsibilities
- SW bears majority of risk

Flexible, Innovative Vehicle that Yields Guaranteed Savings

SUSTAINABLE WATER®

EXTENDING THE LIFECYCLE OF WATER

Bob Salvatelli | Office: (804) 965-5590
Mobile: (973) 632-8560
Bob.Salvatelli@sustainablewater.com