The WaterHub at Emory University
Moving from Feasibility to Project Execution

Presented by Jonathan Lanciani
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Campus Utility Overview

"The WaterHub is projected to help Emory reclaim some 300,000 gallons of campus wastewater daily, cutting potable water consumption as much as 35 percent and saving the university millions in water utility costs over a 20-year period." Matthew Early, Vice President for Campus Services, Emory University

Emory University Chiller Systems

Startup Year	1960s
Number of Buildings Served	50
Total Square Footage Served	4,390,000 sq ft
Central Plant Capacity	20,300 tons (3 plants)
Number of Chillers	20 chillers
Fuel Types	Electric
Distribution Network Length	2.5 trench miles
Piping Type	Direct-buried insulated steel
Piping Diameter Range	4 to 18 inches
System Pressure	90 psig
System Temperatures	44 F supply/54 F return
System Water Volume	295,000 gal

Growing Campus: Complex Systems with Critical Loads

Campus Utility Overview

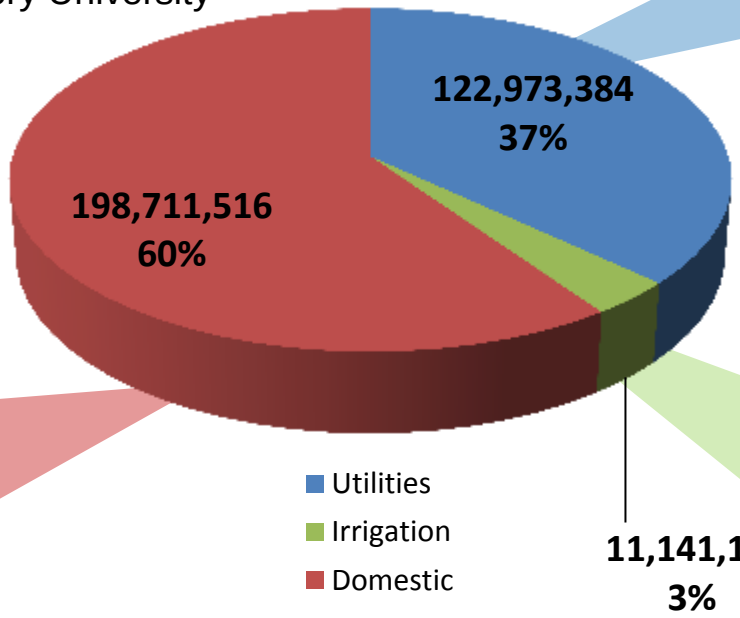
Emory University Steam Systems

Startup Year	1922
Number of Buildings Served	70
Total Square Footage Served	7,500,000 sq ft
Central Plant Capacity	500,000 lb/hr steam
Satellite Plant Capacity	N/A
Number of Boilers	5 boilers
Fuel Types	Natural gas, No. 2 fuel oil
Distribution Network Length	3.5 trench miles
Piping Type	Majority Class A direct-buried & some walk-through tunnels
Piping Diameter Range	1-1/2 to 12 inches
System Pressure	125 psig
System Temperatures	353 F/180 F condensate return
System Water Volume	N/A

Growing Campus: Complex Systems with Critical Loads

Campus Water Footprint, FY13-14

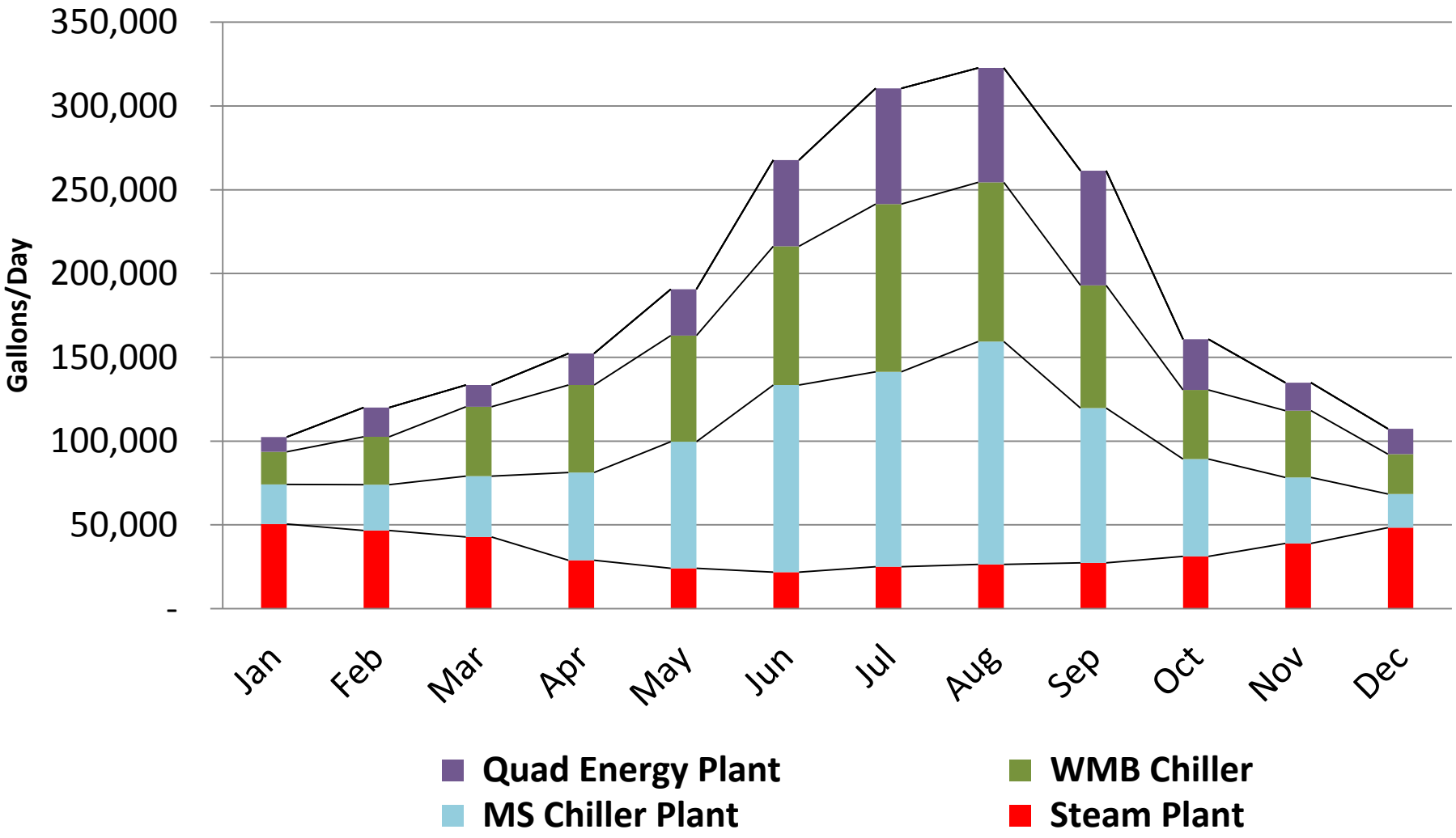
"We looked at where we currently use the most potable water in our facilities — applications where we don't really need drinking-water quality water — and it came down to our toilets, our steam plants and our chiller plants."
Brent Zern, Asst Director of Operational Compliance & Maintenance Programs,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



333 M GPY

40% Considered Non-potable Demand

Reclaimed Water Distribution

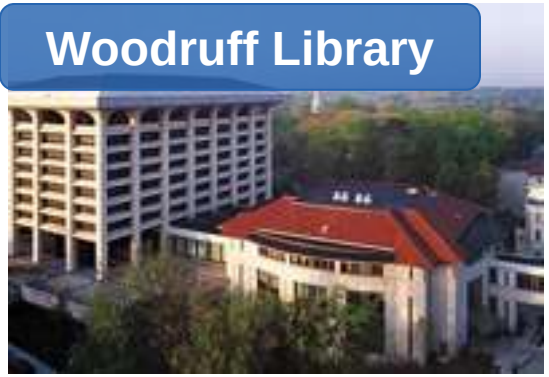


100% Displacement of Utility Water Demand

Future Expansion

EU Hospital

Woodruff Library



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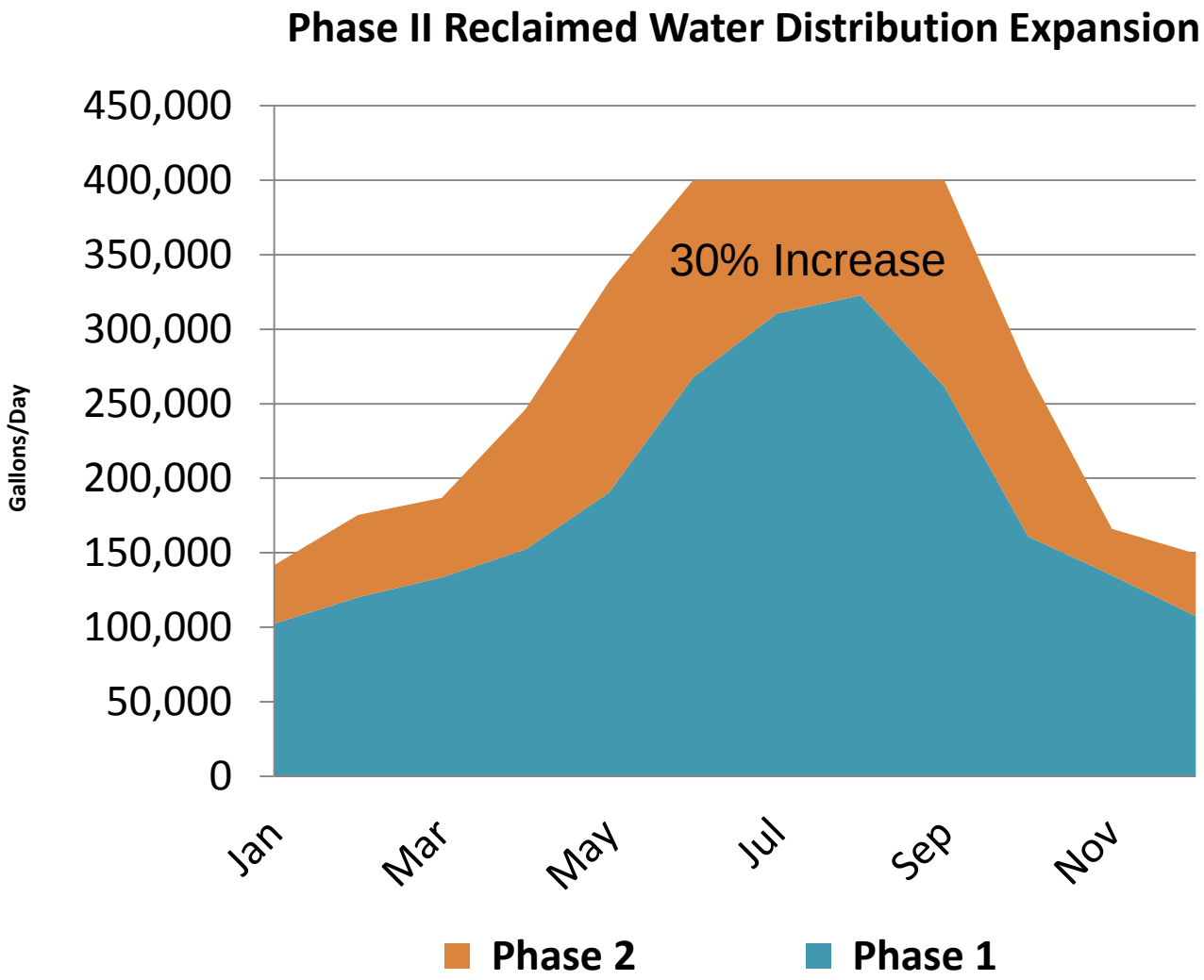


30% Total Reduction in Campus Water Use

Why Water Reuse?

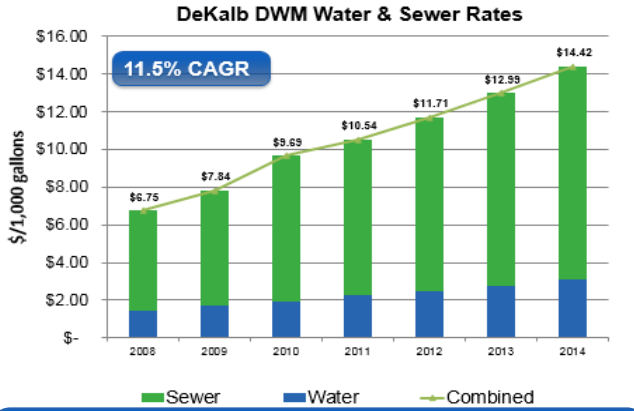
Local Water-Related Stresses

"And because we're not using that drinking water, the county can use it other places, which is important for a region prone to water crises."

Brent Zern, Asst. Director of Operational Compliance and Maintenance Programs

Aging Infrastructure

Rate Pressure



Scarcity

Environmental Constraints

Rate Increases Are Necessary for Infrastructure Improvements

Aging Infrastructure: A Local Concern

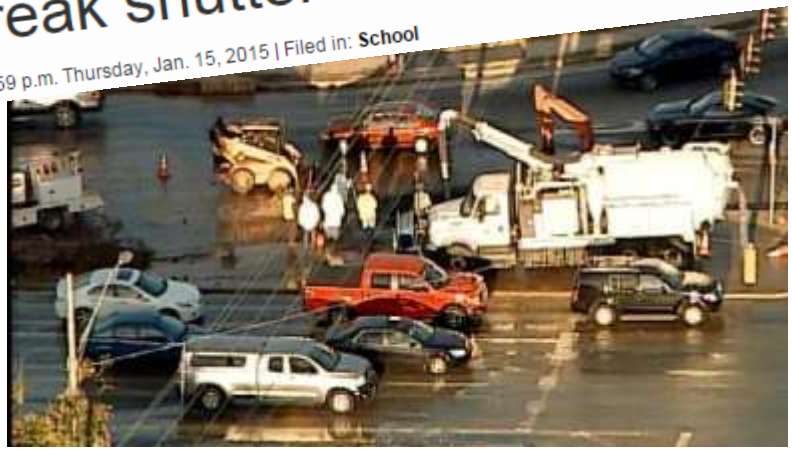
Atlanta's water needs rely on a system designed in 1875, and build piecemeal ever since

Hundreds go without water after water main break in DeKalb County

Posted: Oct 18, 2013 4:26 AM EDT

County restores water after pipe break shutters schools

6:59 p.m. Thursday, Jan. 15, 2015 | Filed in: **School**



DeKalb County crews work to repair water main break

Water Related Impacts Illustrate Need to Promote Water Management

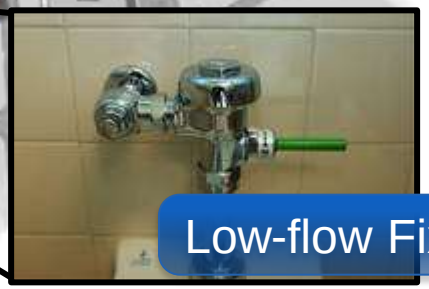
Emory's Water Saving Initiatives

sustainability initiatives

Consumes >340 MGPY

Stormwater Reuse Saves 800 KGPY

Graywater Reuse Saves 750 KGPY

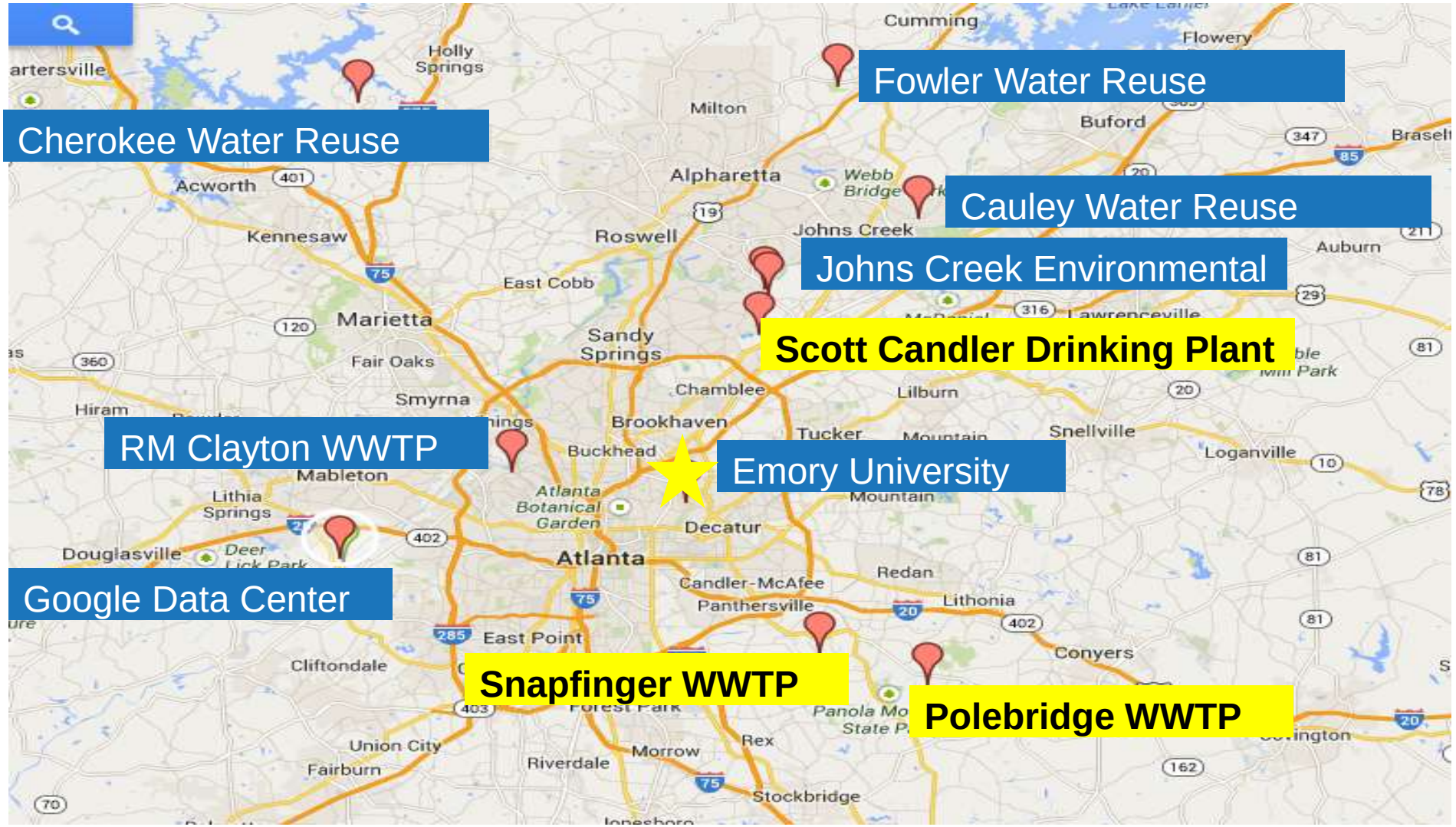


Low-flow Fixtures

Signage & Advertising

Water: Strategic Imperative Drives Project Execution for Small Yields

Decentralized System Approach



Municipal Reclaimed Water Not an Option for Campus

The Evolution of Water Conservation

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Simple Solutions

Building-Based Solutions

Campus-Wide Solutions

Level of Sophistication and Impact

Stickers

Low Flow Fixtures

Rain Barrels

Stormwater Reuse

Reclamation and Reuse

WATER HUB

The Most Impactful Solution That Exists

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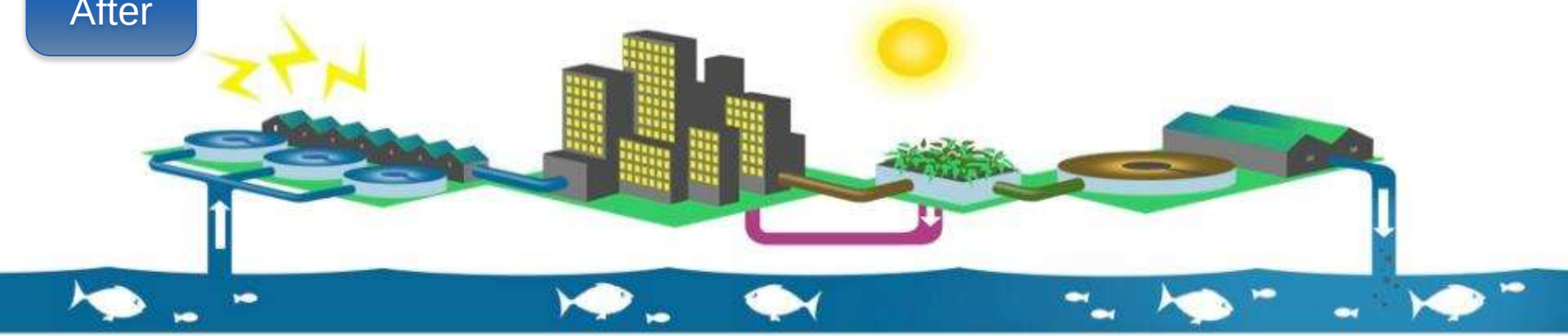
A more sustainable water cycle: Decentralized Reclamation and Reuse

Before

Water Use Reduction: 42%
Wastewater Discharge Reduction: 90%

After



~Risk Management ~Cost Savings ~Environmental Responsibility

Campus Risk Mitigation

Benefits to Emory University:

- Redundant Water Supply
  - Drought
  - Municipal infrastructure failures
- Additional On-Site Storage
- Reduced Environmental Impact
- Flexibility, Independence & Resilience
- Reduced Community Reliance
- Minimum recovery time
- Insulation from rising water costs

N+1: Reliable and Safe Alternatives to Potable Water

Conserving Regional Drinking Water

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EMORY UNIVERSITY

"This (facility) offers an interesting case study for how an institution can move a community toward a bold step in water conservation. It's also exactly the kind of reduction we need to see in order to support a more sustainable future ."

Ciannat Howett, Director of the Office of Sustainability Initiatives at Emory

water conservation

sustainability initiatives

Emory's WaterHub uses natural processes to reclaim wastewater.

The WaterHub is Important Next Step in Long-Term Conservation Strategy

Project Update

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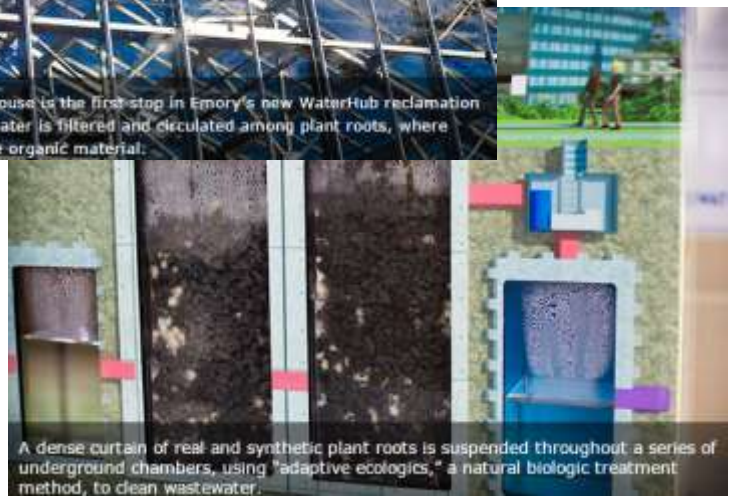
EMORY | news center

A 2,200-square-foot greenhouse is the first stop in Emory's new WaterHub reclamation process, as campus wastewater is filtered and circulated among plant roots, where microbes naturally consume organic material.



A dense curtain of real and synthetic plant roots is suspended throughout a series of underground chambers, using "adaptive ecologics," a natural biologic treatment method, to clean wastewater.

Seen from above, the WaterHub system looks like an attractive botanical garden, with lush beds of native and tropical plants.

"Emory is a leader in sustainability, with this facility, we're taking a major step forward in becoming one of the first in the nation with this technology for cleaning our own wastewater." Matthew Early, Vice President Campus Services, Emory University

Emory University Proud to be at the Leading Edge in Water Reclamation

Community Outreach | Research Opportunity | Living-Learning Laboratory | Educational Tool for Students

The WaterHub at Emory

Extending the lifecycle of our Water

Recycling 140 Million gallons of water per year

Moving Bed Bioreactor (MBBR)

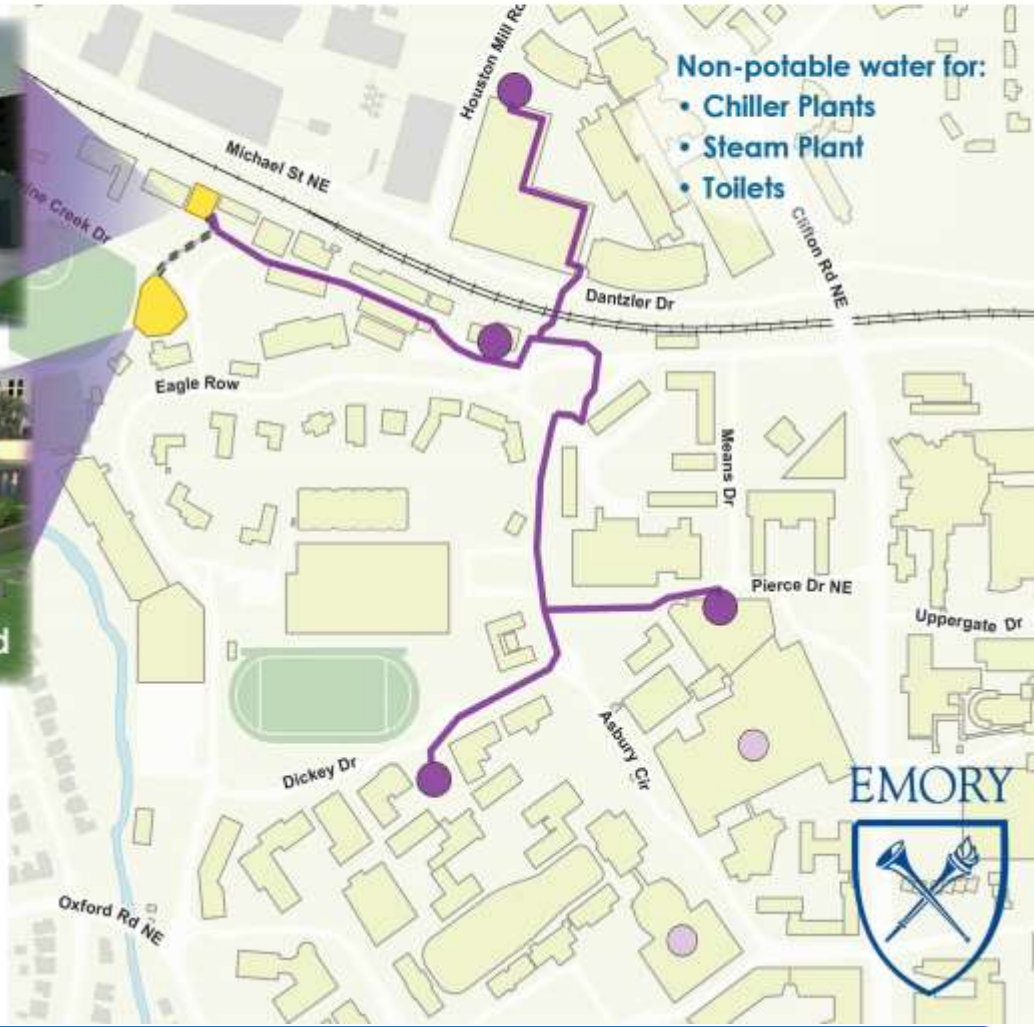
Treatment occurs through specially-engineered BioPortz moving media to mimic natural processes.

Submerged Fixed Film

Natural and synthetic plant roots provide habitat for microbes.

Reciprocating Wetland

Utilizes biomimicry to imitate and improve upon natural tidal processes through multiple fill and drain cycles.



System Benefits:

- Protects water quality
- Decreases campus water footprint by over 1/3
- Saves millions of dollars in utility costs
- Diminishes demand on the community
- Lowers stress on county water infrastructure
- Reduces energy footprint by treating water on-site

First and Only Ecological, Decentralized Reuse System in the US

Update and Progress Since IDEA 2014

Construction Completed Entering Commissioning Phase

Emory - Aerial View: Under Construction

Small Physical Footprint, Sited in the Middle of Campus

Emory - Construction Photos

Construction Time Frame: 6 – 8 Months

The WaterHub at Emory University

The WaterHub at Emory University

Showcase Project for College Campus with Sustainable Vision

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The WaterHub at Emory

Fully Secured Facility Serving as a Sustainable Beacon

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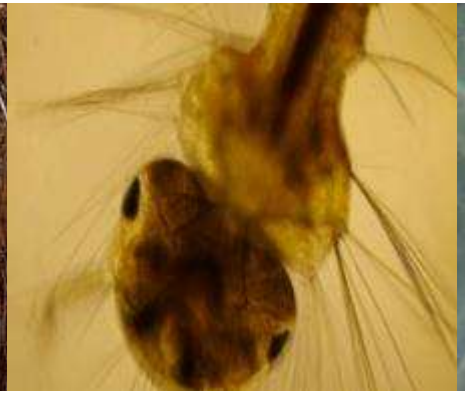
Emory Hydroponic System

A Sustainable Treatment Solution to Treat Extensive Water Demands

Ecological Water Treatment Technologies

	ReCip® Tidal Wetlands	Hydroponic and 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

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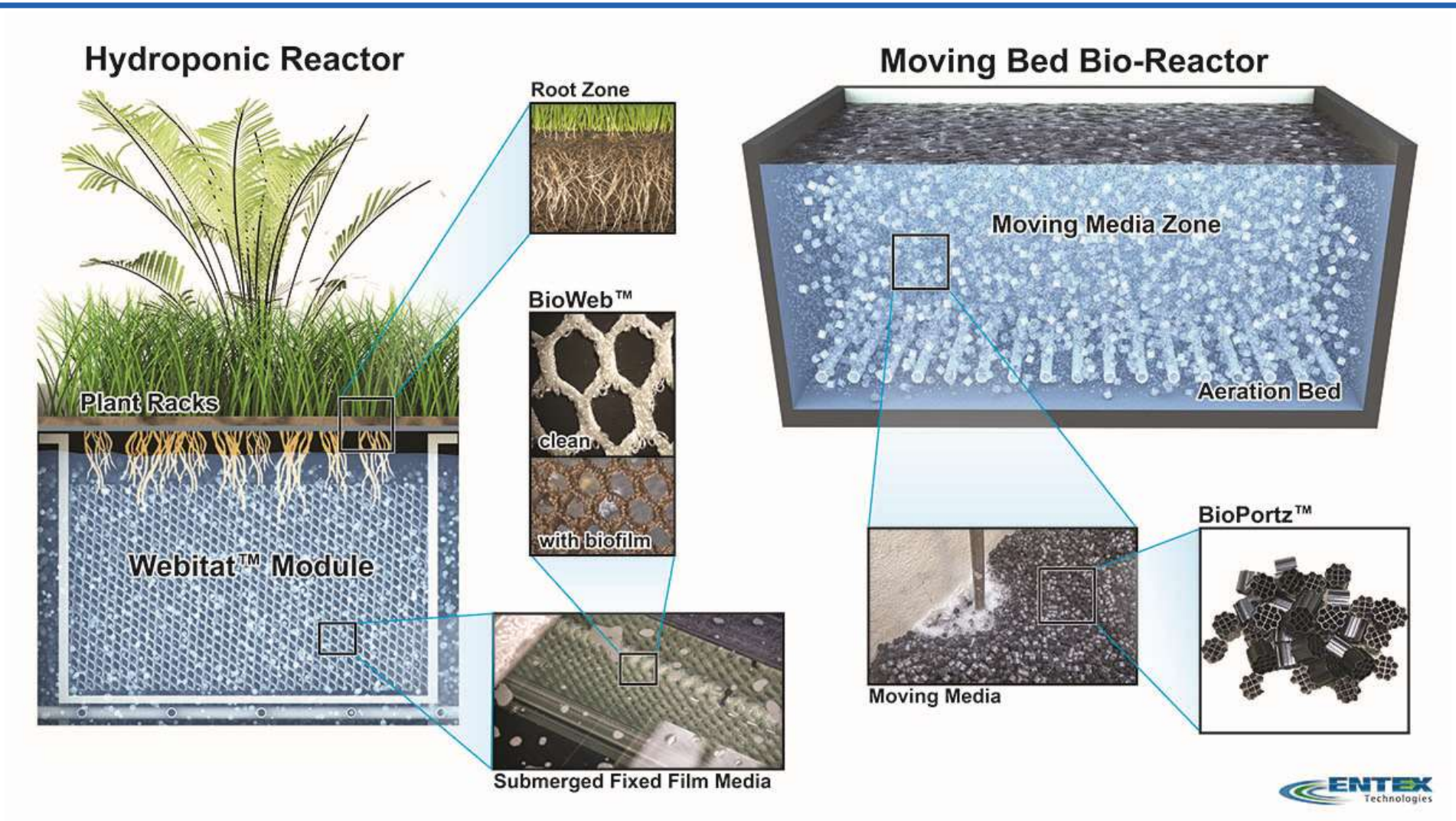
Rostrifera

Collotheca

Philodina

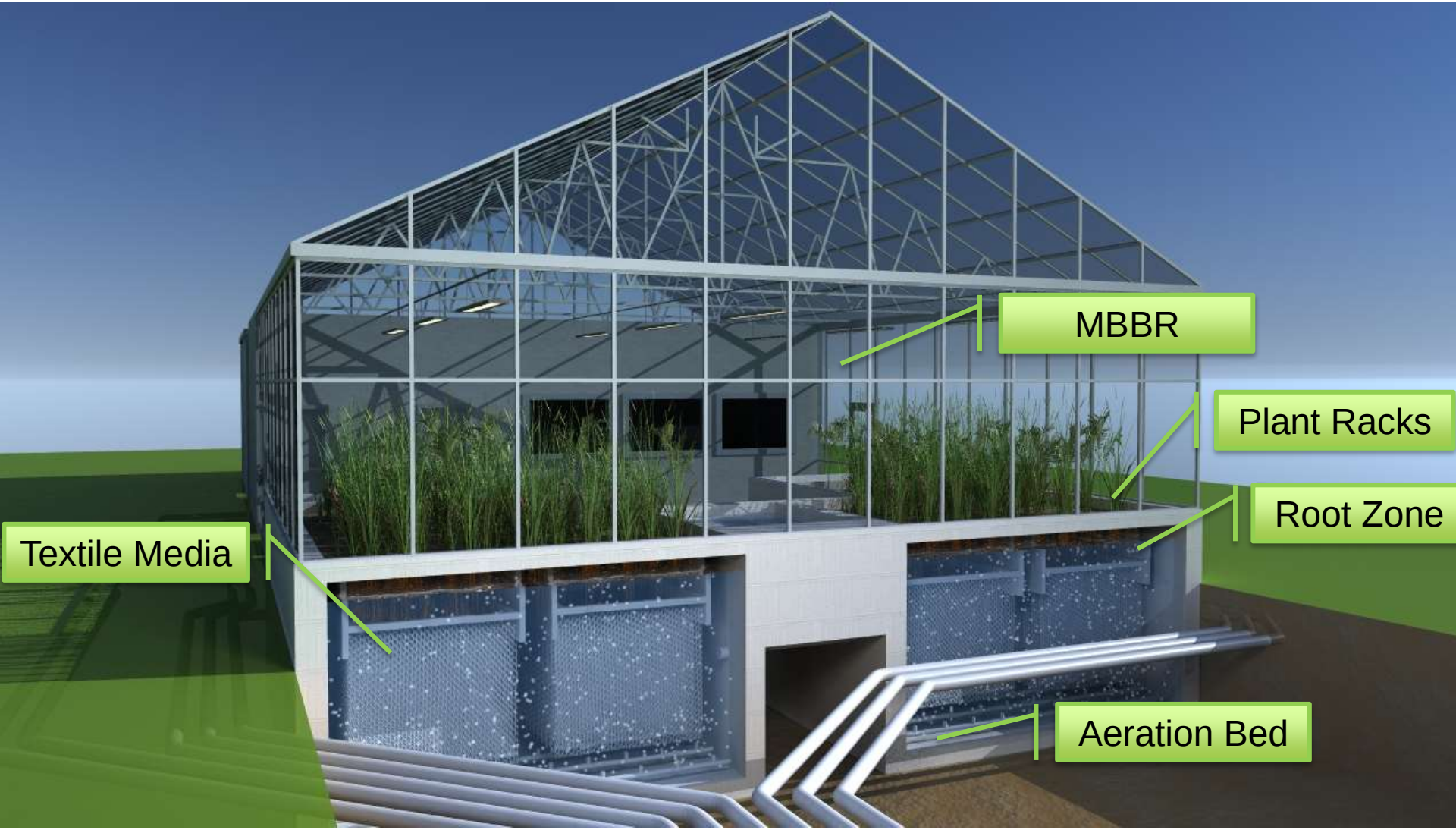
Aquatic Worm

Moving & Fixed Media Solutions



Biomimicry: Maximizing Treatment Capacity / Minimizing Energy and Space

GlassHouse (Upper Site)



GlassHouse Footprint Compact and Efficient at 2,100 SF

How the WaterHub Works

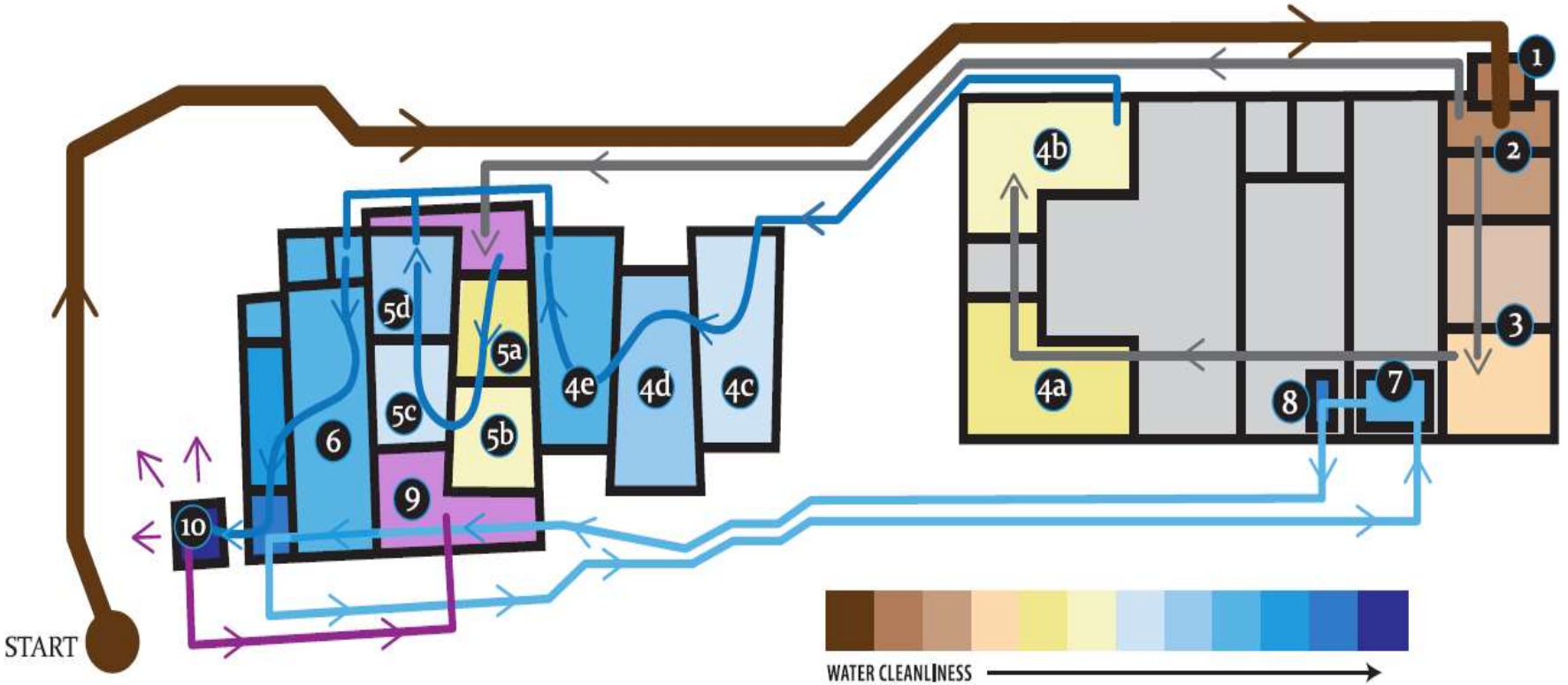
1 Rotary Screen. Wastewater is extracted from the south site and sent to the rotary screen (on roof) which removes non-bio-degradables.

2 Anoxic Moving Bed Bioreactors . In an oxygen depleted environment, carbon containing material is removed by clustering microorganisms that colonize on freely-moving "BioPortz" (honeycombed plastic pellets which maximize habitat). Wastewater circulates between MBBRs to optimize nitrogen removal and minimize creation of odorous gases.

3 Aerobic Moving Bed Bioreactors. Wastewater is aerated with course bubble diffusers. This removes much of the carbonaceous material and further removes odorous gases from the water.

4 Hydroponic Reactors. Within the greenhouse, dense tropical plant root systems and BioPortz provide a healthy habitat for large microbial populations. This results in stable biofilm growth and efficient, stable wastewater treatment. Outdoor Hydroponic Reactors utilize native and naturalized plant species and allow greater volumes of wastewater to be treated. Fine bubble aeration diffusers add oxygen to enhance reduction of carbonaceous material and nitrification. Beneficial organisms graze on microbial biomass and reduce solids/sludge.

5 Demonstration Reciprocating Wetlands (DRW). Created to demonstrate alternate waste treatment systems, the DRW receives screened influent from the MBBR. The fill-and-drain wetland cells use various sizes of gravel which provide microorganism habitat. Fill-and-drain cycling occurs 8 to 18 times a day and provides alternating anoxic and aerobic treatment. Requiring little mechanical energy, yet large land mass, a Reciprocating Wetland is a treatment system appropriate to rural areas and developing countries.



10 Campus Distribution. Water is distributed to the steam and chiller plants for use as process make-up water and to residence halls for toilet flushing.

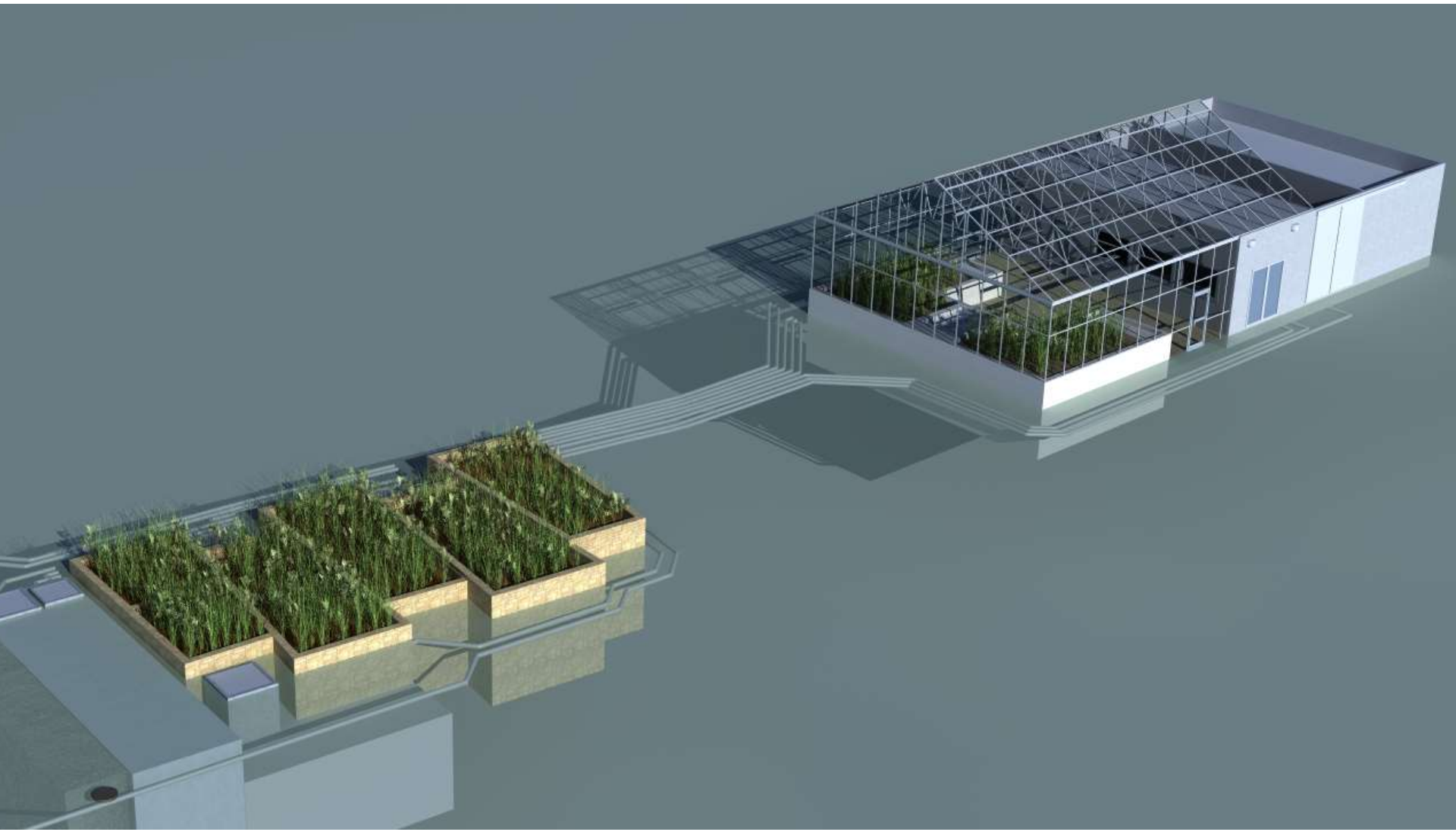
9 50,000 Gallon Storage Tank. Fully treated water is stored underground. This reserve allows the university to operate heating and cooling for an average of 7 hours in the event of disruption in water availability.

8 Ultraviolet Disinfection. Water is subjected to high-quality ultraviolet (UV) light, an energy-efficient, chemical-free method of removing any remaining microorganisms.

7 Disk Filter. Very clean water is sent to the greenhouse and through a disc filter which removes solids using a felt filter membrane. At this point, the water contains very small amounts of microorganisms.

6 Clarifier Tank. Removal of dissolved phosphorus by use of coagulating elements and gravity. A portion of the solids are sent to the greenhouse to provide ample bacterial communities to begin the treatment process.

Ecological Treatment Design



Seamlessly Integrated Into the Built Environment

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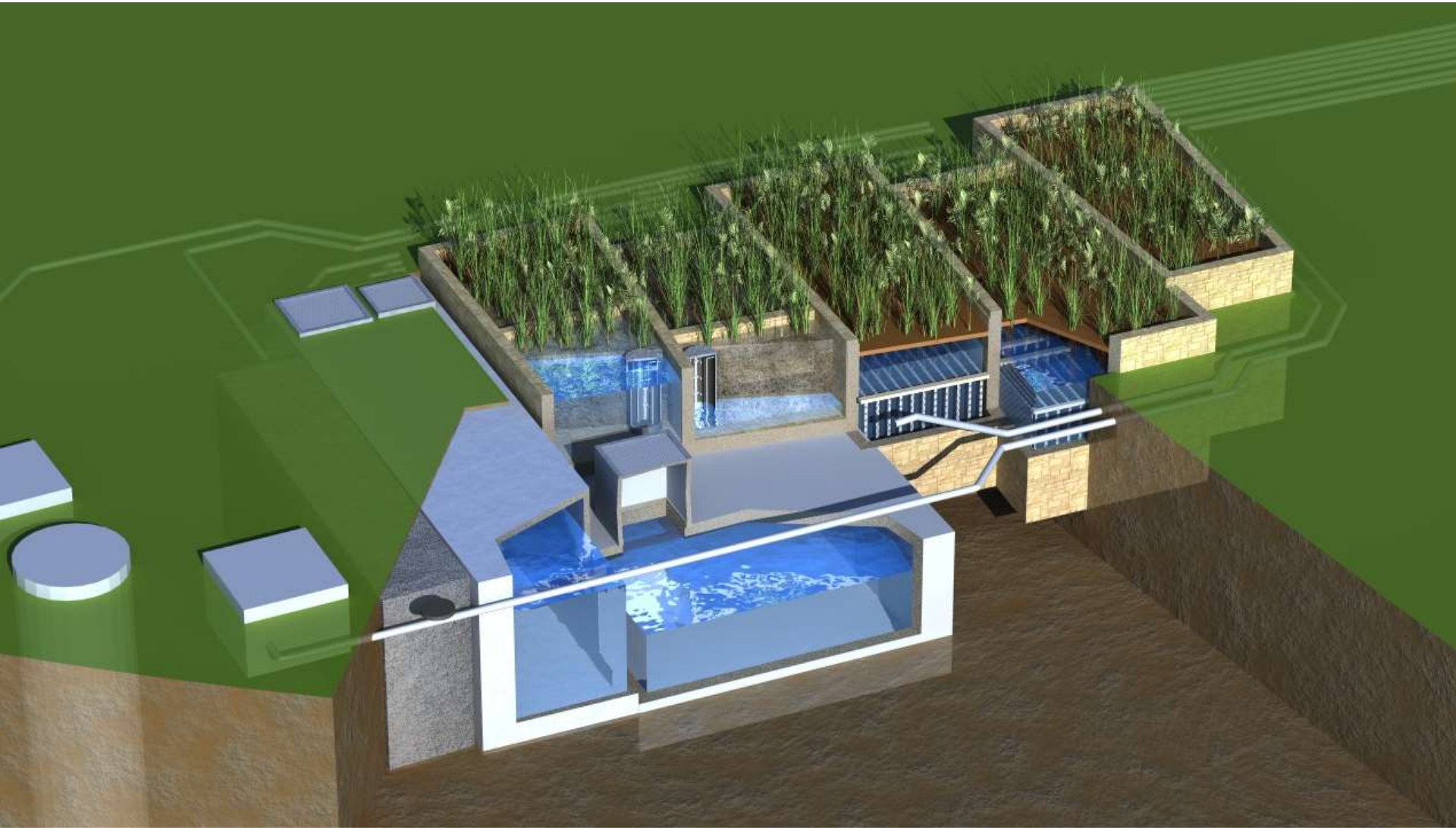
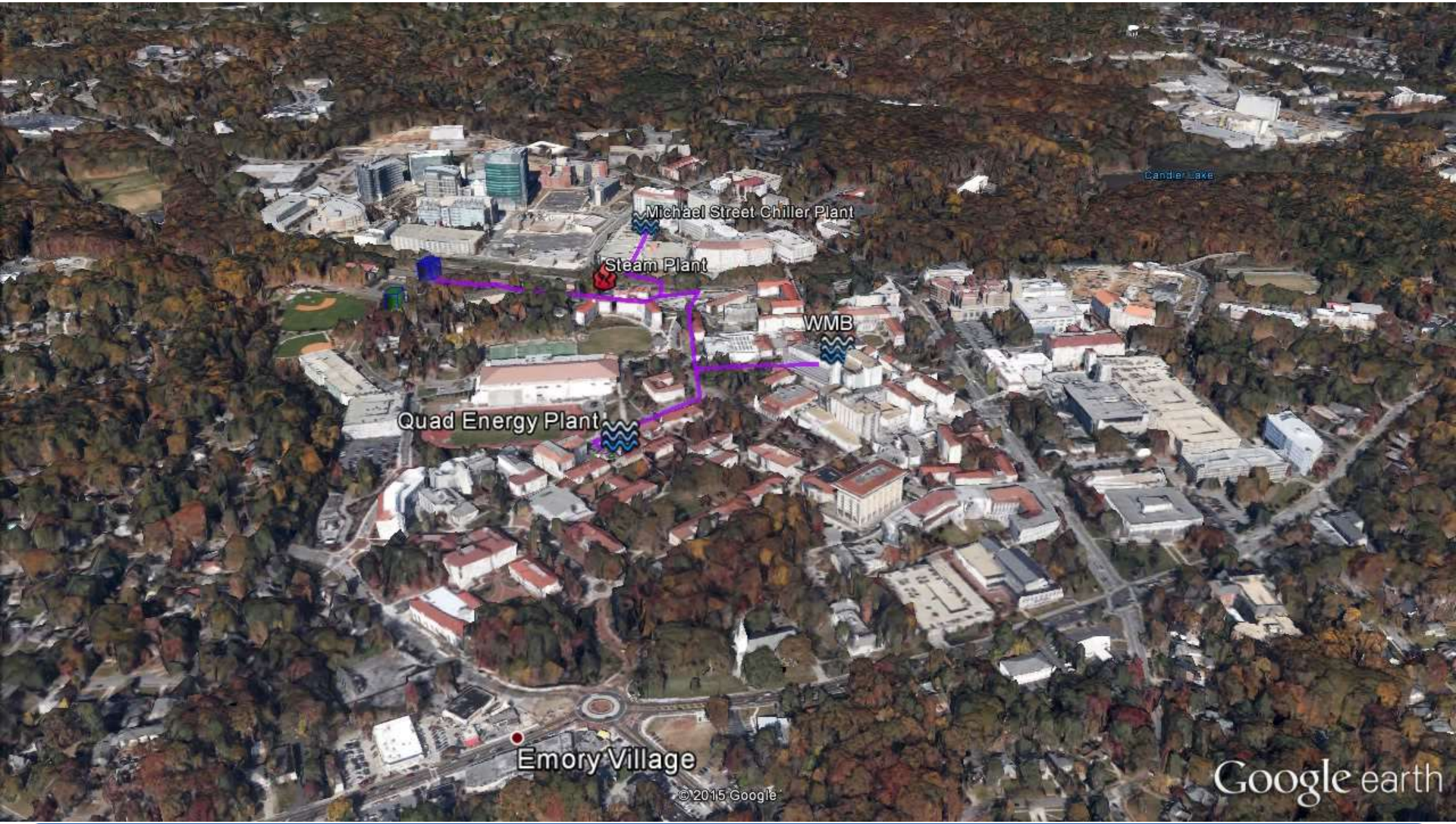
Outdoor System (Lower Site)



Convergence of Multiple Ecological Treatment Technologies

Distribution System Tour



4,425 Linear Feet of Distribution Piping

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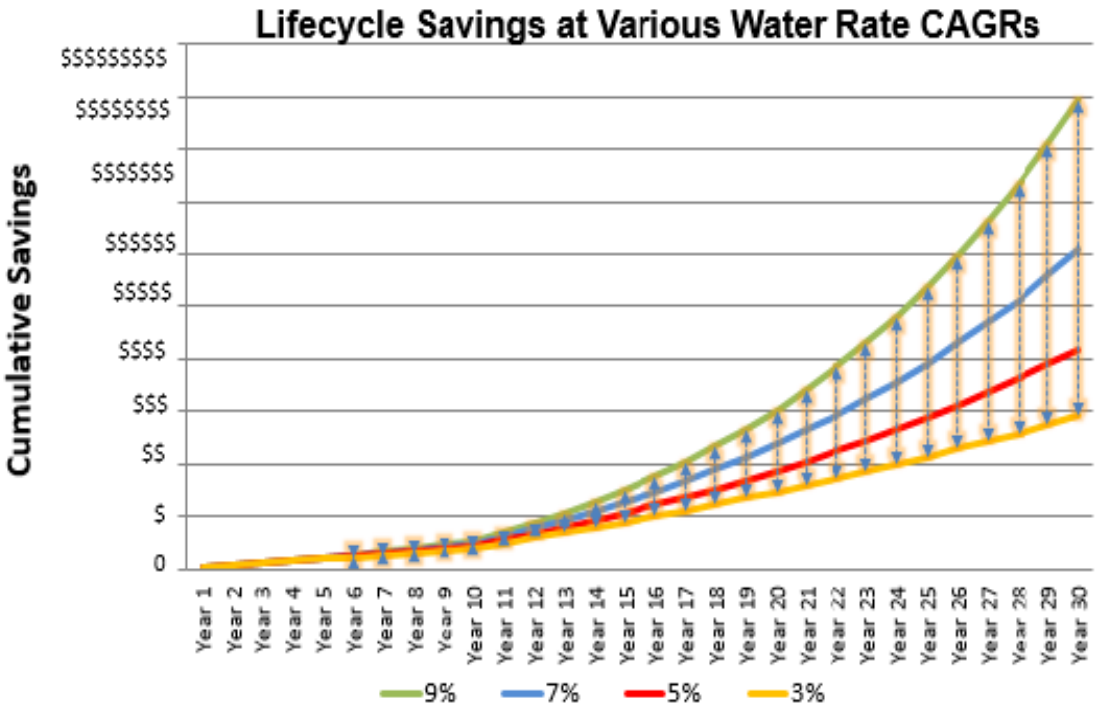
Unique Development Approach

Water Purchase Agreement

~ Shared Savings Agreement ~ Operating Lease ~ DBO Agreement ~ Performance Contract

Benefits

- **No up-front capital**
- Innovative Technologies
- Leverages superior credit rating
- Immediate, Guaranteed Savings
- Long Term Pricing Stability
- **No O&M Responsibilities**
- SW bears majority of risk



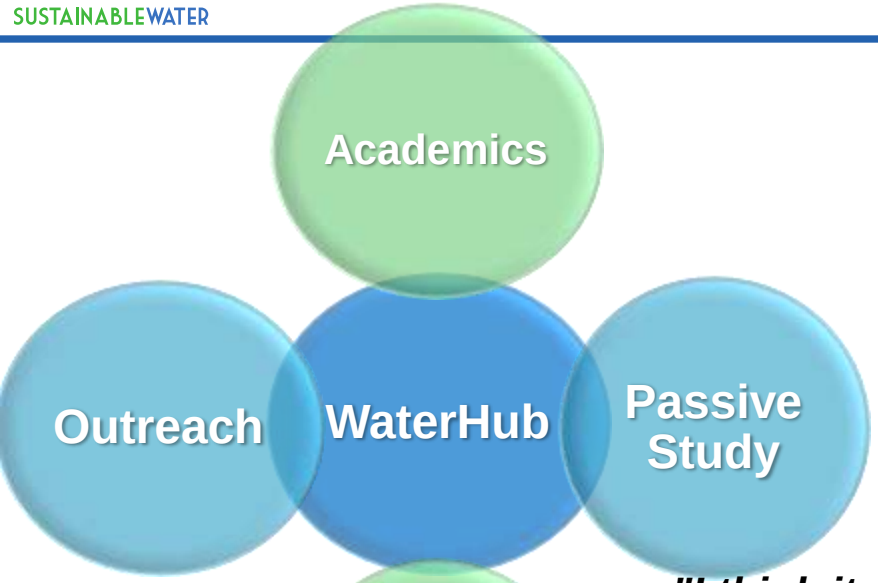
Flexible, Innovative Vehicle that Yields Guaranteed Savings

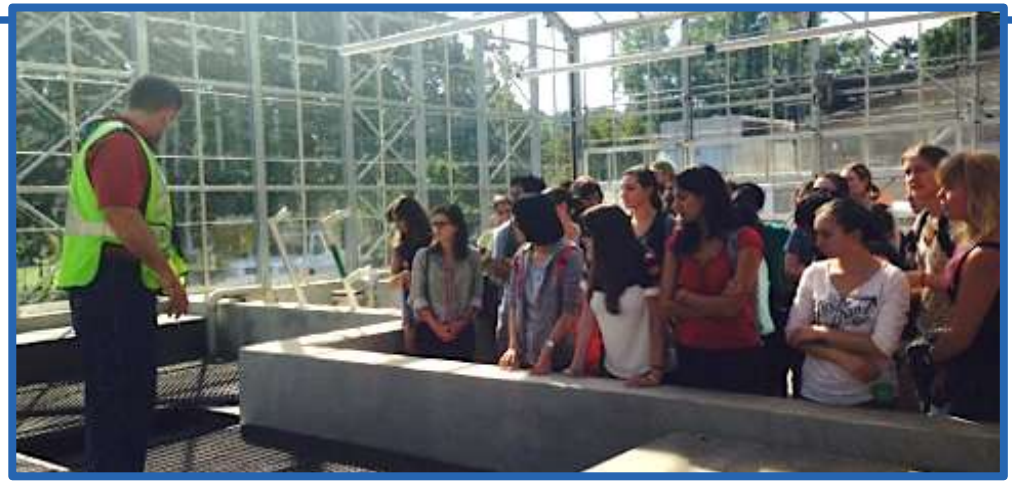
O & M under WPA

- Highly Automated Operations with Remote Monitoring Capabilities
- State Certified Operator On-Site
- Daily Compliance Testing
- Preventative & Predictive Maintenance & Repairs
- Includes All Operating Expenses
  - Labor
  - Energy
  - Permit Fees
  - Compliance Testing
  - Taxes
  - Insurance
  - Chemicals
  - Discharge Fees
  - All Maintenance & Repair

Operations Performed in Accordance to State Standards/Protocols

Living, Learning Laboratory





"I think it also shows an important role the university can play in advancing sustainability and engaging in this idea of the campus as a living laboratory, a place of experimentation and engagement and learning.
This (facility) offers an interesting case study for how an institution can move a community toward a bold step in water conservation. It's also exactly the kind of reduction we need to see in order to support a more sustainable future."

Ciannat Howett, Director of the Office of Sustainability Initiatives at Emory


A 2,200-square-foot greenhouse is the first stop in Emory's new WaterHub reclamation process, as campus wastewater is filtered and circulated among plant roots, where microbes naturally consume organic material.

Multi-Functional Facility Serves as Educational Asset

A Liquid Revolution at Emory

“It provided the experience of collecting real data, interpreting results and writing reports. For some students, it may have been the first hands-on lab experience that they’ve had.”

"One of the things we talk about in class is the growing problem of water scarcity around the world — globally, we’re running out of water. Water scarcity will be one of the defining issues during the lifetime of these students.”

Christine Moe, Eugene J. Gangarosa Professor of Safe Water and Sanitation in the Rollins School of Public Health (RSPH) and Director of the Center for Global Safe Water at Emory

Innovative WaterHub Engages Power of Nature to Clean Wastewater

EPA Administrator Gina McCarthy Tours Emory University's WaterHub

Gina McCarthy @GinaEPA · Feb 5

.@EmoryUniversity cut water use by ~35% w/new WaterHub, saving the school big on utility costs. A model for us all!

Gina McCarthy @GinaEPA · Feb 5

.@EmoryUniversity WaterHub isn't a typical treatment facility. It filters wastewater thru plant roots & microbes clean out organic material.

Federal Validation for an Ecological Solution to Wastewater Management

EXTENDING THE LIFECYCLE OF WATER.

Nature’s Idea. Our Science.

QUESTIONS?

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