Sustainability through Understanding and Reducing the Water Footprint at Georgia Institute of Technology

Presented by Jonathan Lanciani
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Presentation Content

- Why Water Reuse?
- System Design
- Emory University WaterHub™ Update

Proposed WaterHub Design at GT

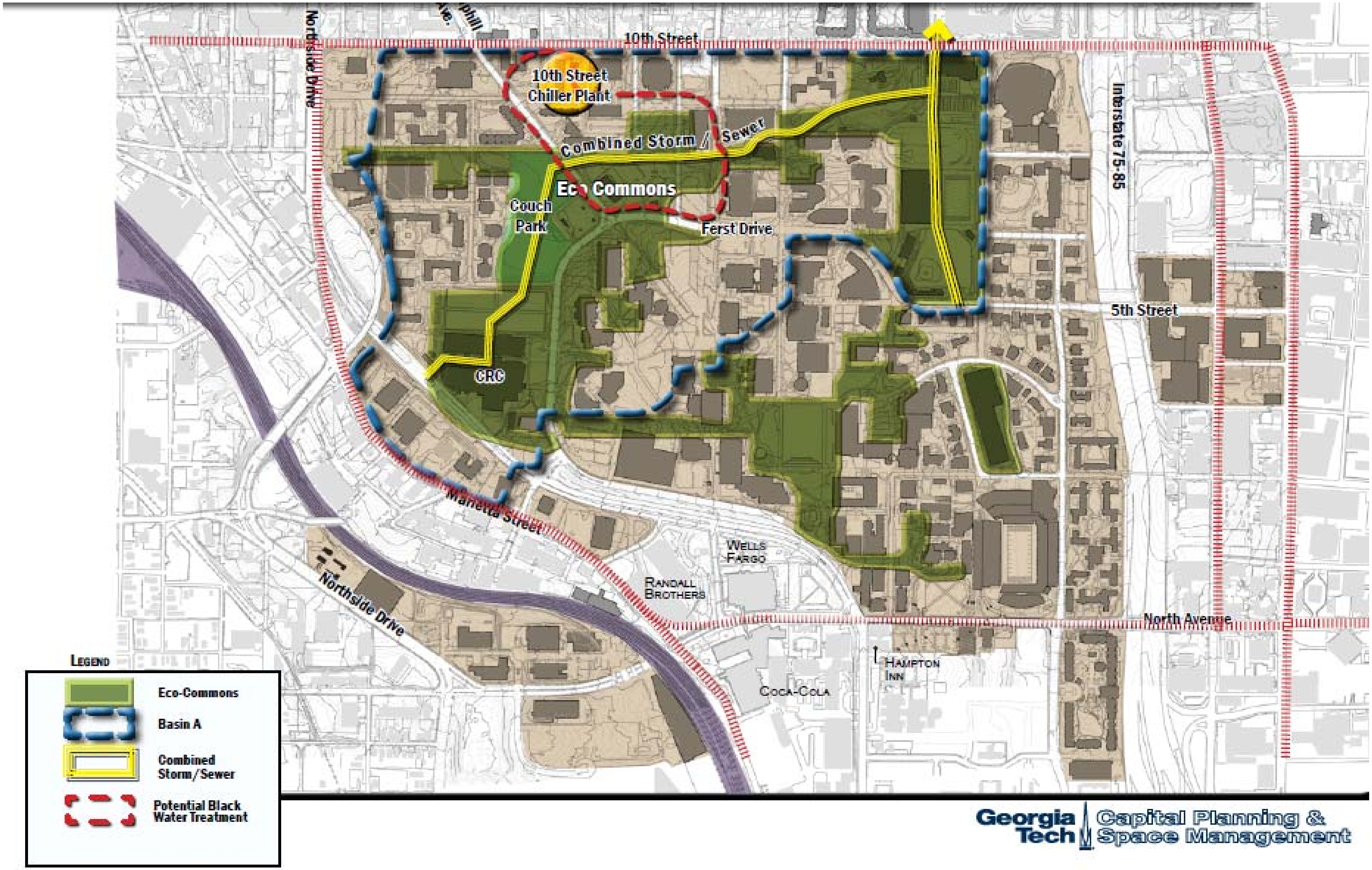
System Overview:

- 400,000 GPD ReCip / Hydroponic System
- Built into new “Eco-Commons” development, and as a component of master water and stormwater management strategy for campus

- ***Phase 1:*** 150,000 GPD ReCip System
  - Feeds 10th Street Chiller Plant
  - 1,200 linear ft. of water distribution piping
  - Recycles 46.5 million gallons annually
  - 30% of total utility demands
- ***Phase 2****:* 250–400,000 GPD Hydroponic expansion
  - Tenant build-out of new parking deck around eco-commons
  - Additional distribution added to Holland Utility Plant
  - 4,200 linear ft. of water distribution piping
  - Recycles 112 million gallons annually
  - 75% of total campus utility demands

Water-Centric Eco-Commons Includes WaterHub Technology

Eco-Commons Master Plan



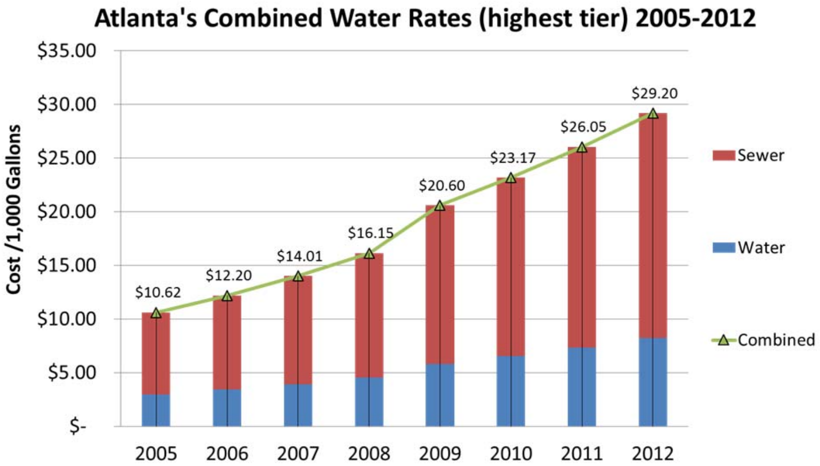
Georgia Tech | Capital Planning & Space Management

Why Water Reuse?

Local Water-Related Stresses

Aging Infrastructure

Rate Pressure 16% CAGR



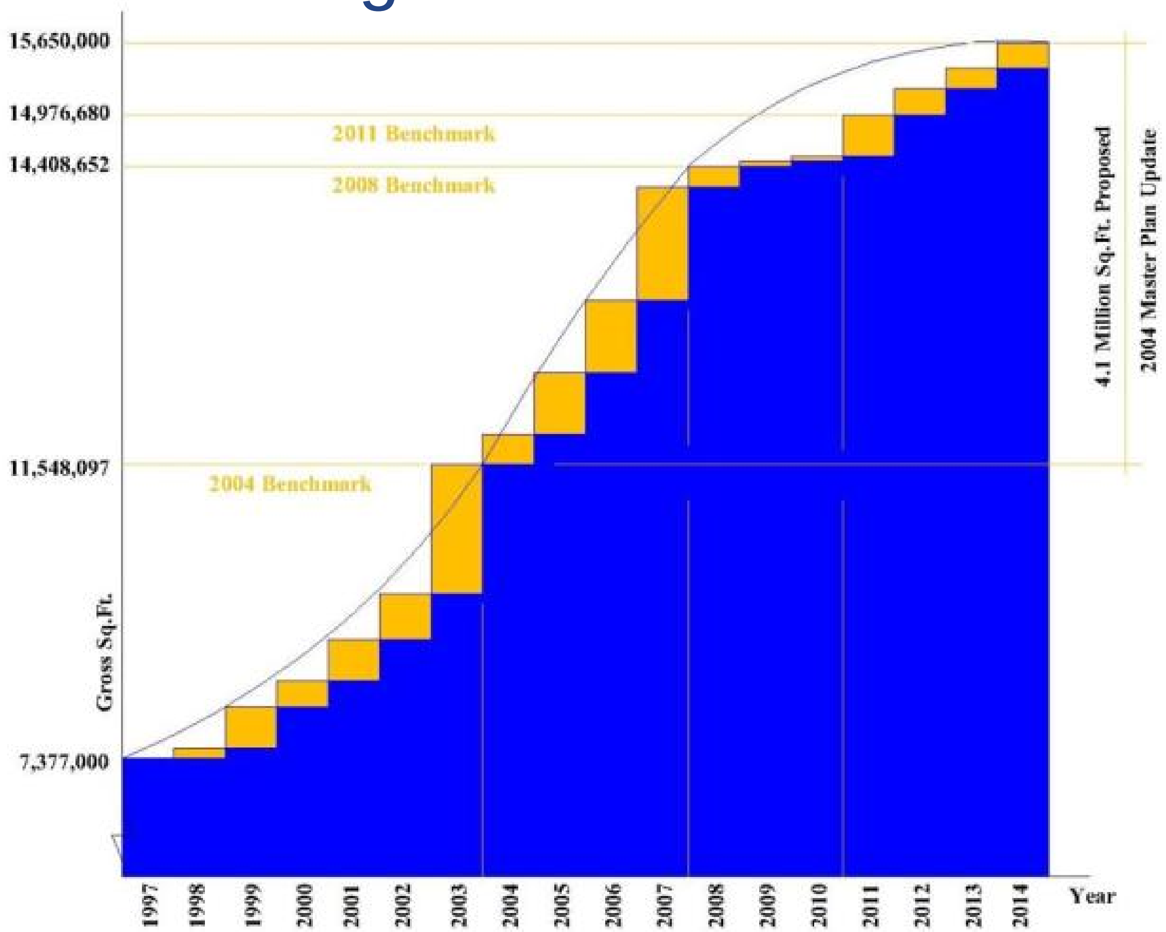
Water Scarcity

Environmental Constraints

Rate Increases Are Necessary for Infrastructure Improvements

Campus Growth

Georgia Tech – 1920



1997 - 2011

- ***540,000 gsf* average growth per year**
- **Faculty/Staff: *161* increase per year**
- **UG Students: *248* increase per year**
- **Grad Students: *297* increase *per year***
- **Total Population Growth: *706* per year**

Doubling Gross Square Footage Increases Water Demands

Aging Infrastructure: A Local Concern

Huge water main break in Chamblee

Collier Drive impassable due to water main break

Massive sinkhole shuts down busy northwest Atlanta road

Water main break causes icy mess on Northside Drive

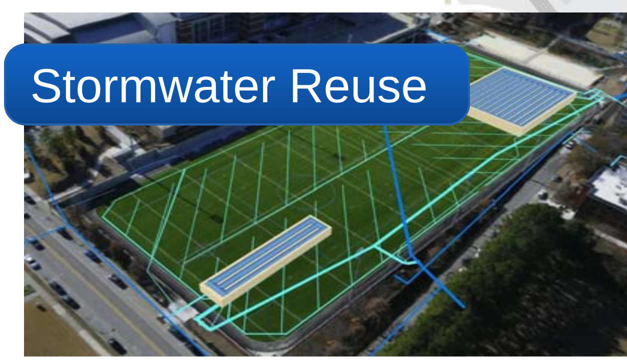
Atlanta's Water Needs Rely on a System Designed in 1875

Georgia Tech's Water Initiatives

Rain Gardens / Infiltration

Master Cistern Plan

Stormwater Reuse



Strategic Imperatives Drives Project Execution for Small Yields: Searching for Impactful Solutions

The Evolution of Water Conservation

Simple Solutions	Building-Based Solutions	Campus-Wide Solutions

Level of Sophistication and Impact

Stickers

Low Flow Fixtures

Rain Barrels

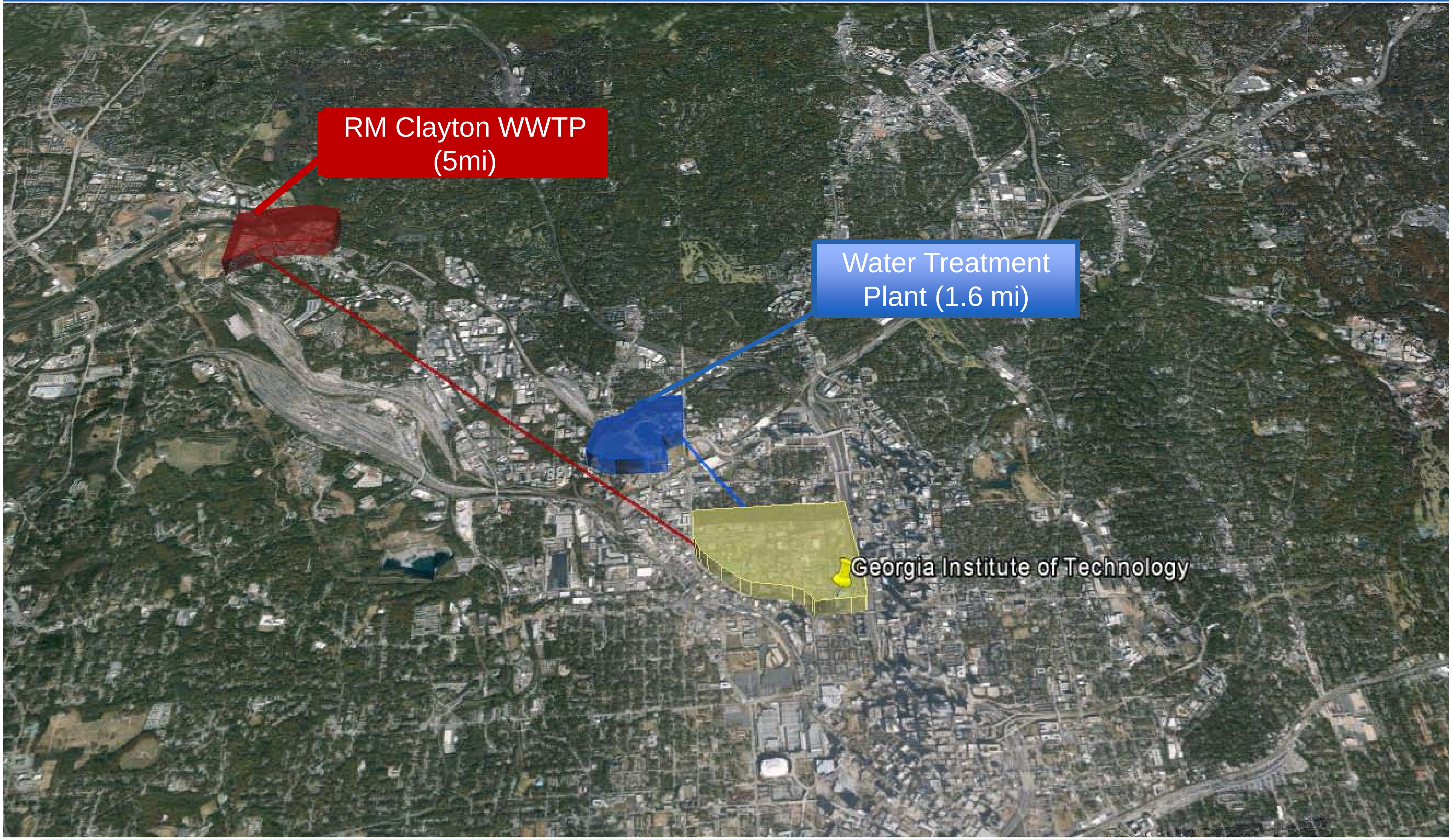
Stormwater Reuse

Reclamation and Reuse

WATER HUB

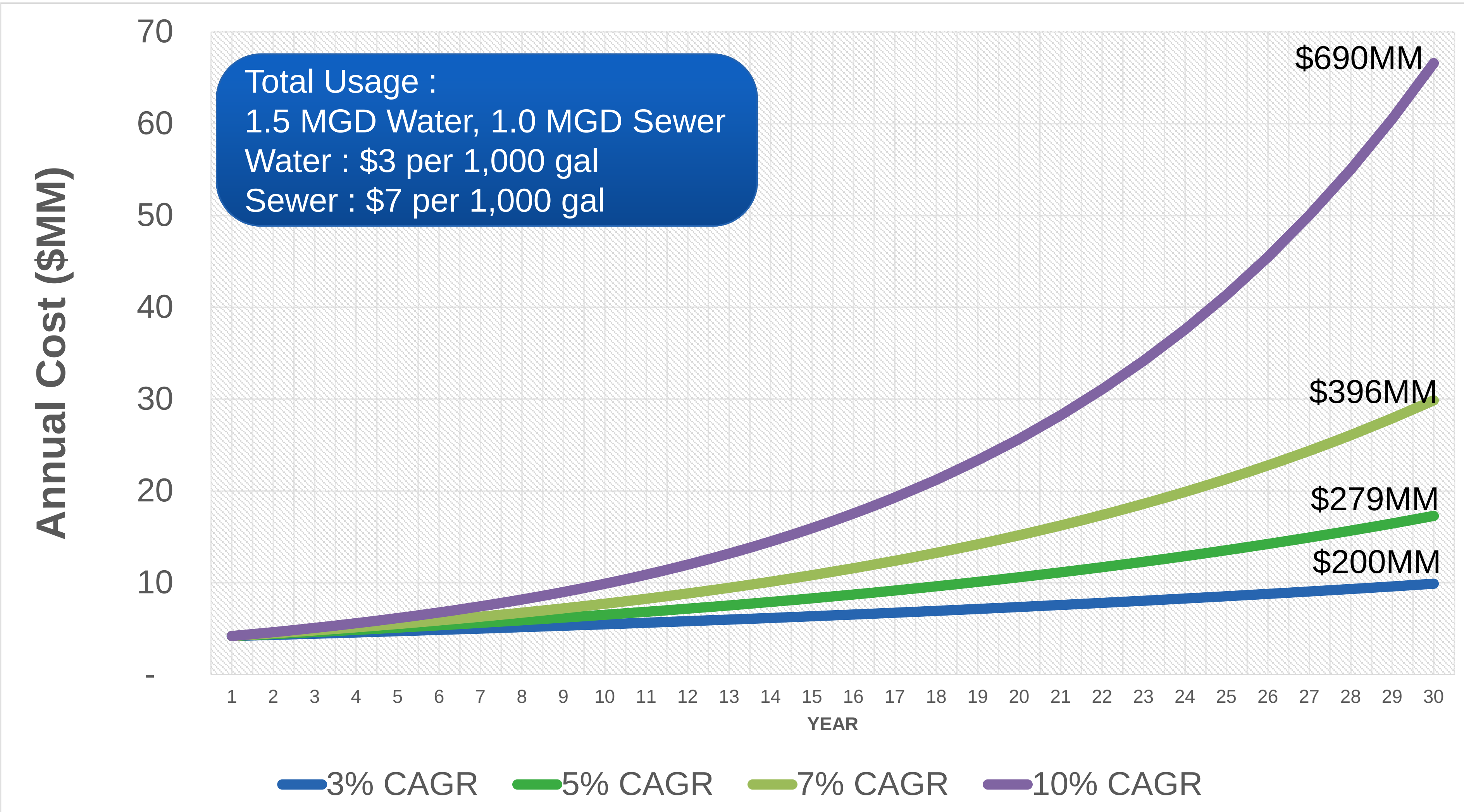
The Most Impactful Solution That Exists

Municipal Water and Wastewater Infrastructure



Lack of Existing Capacity– Supports Decentralized Solution

30 Year Costs of Water at Various Muni CAGR's

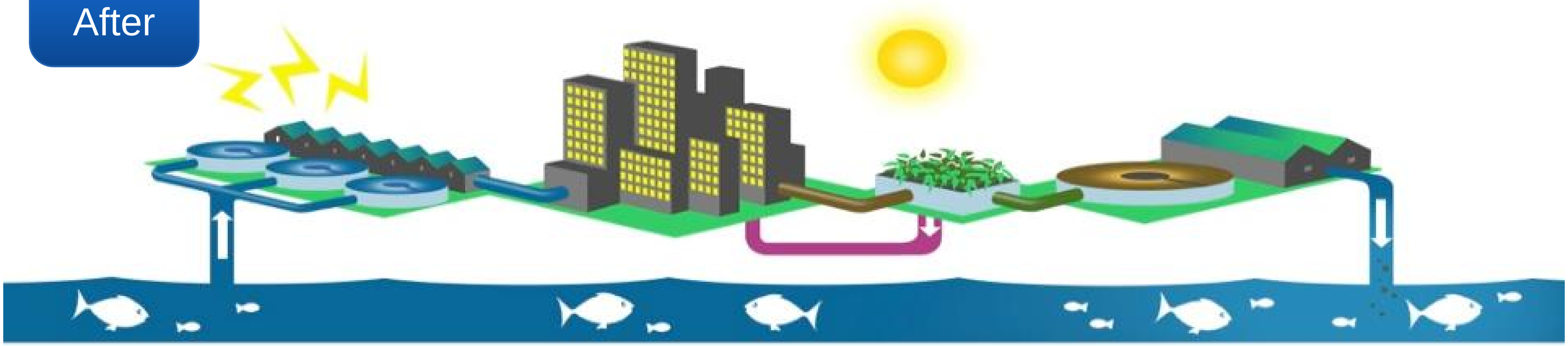


Hundreds of Millions of Dollars Demands Executive Attention

A more sustainable water cycle: Decentralized Reclamation and Reuse

Before

After



~Risk Management ~Cost Savings ~Environmental Responsibility

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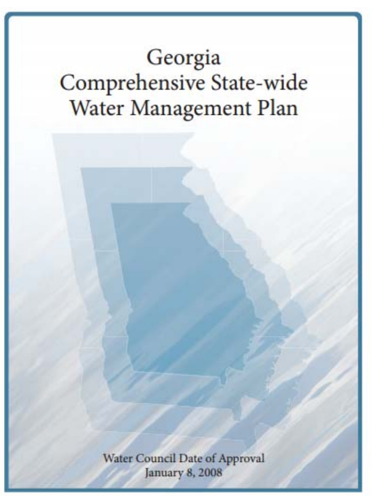
Local Support for Water Reuse

"The Georgia Environmental Protection Division (EPD) encourages the use of reclaimed water as a substitute for potable water for the purposes identified."

- Georgia Department of Natural Resources, *Guidelines for Water Reclamation and Urban Water Reuse*

GEORGIA
DEPARTMENT OF NATURAL RESOURCES


Georgia
Comprehensive State-wide
Water Management Plan

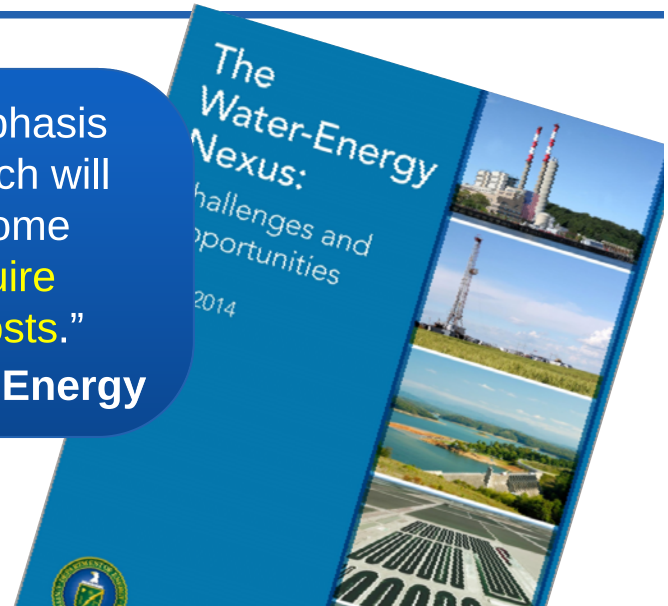
Water Council Date of Approval
January 8, 2008

"Water reuse, or the use of reclaimed water is a viable water management practice that may help sustain Georgia's water resources."

- ***Georgia Comprehensive State-wide Water Management Plan***

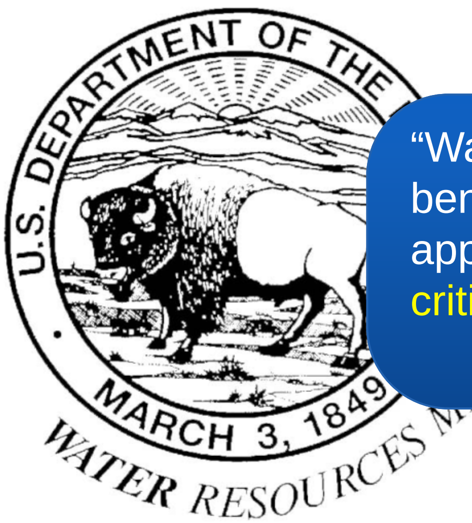
Water Reuse can help Mitigate Atlanta's Major Water Crisis

Federal Support for Water Reuse



"U.S. water and wastewater utilities are putting more of an emphasis on water reuse and improving energy and water efficiency, which will benefit both water and energy conservation. In recent years, some states have started to promote decentralized systems that require much less energy for delivery and much lower infrastructure costs."

- US Department of Energy



"Water reuse is the reclamation of water from wastewater plants for beneficial non-potable and potable uses. As freshwater supplies are approaching or have reached full allocation, water reuse is becoming a critical part of community water supplies."

- US Department of Interior, Bureau of Reclamation

Decentralized Water Treatment and Reuse is becoming Nationally Accepted

Campus Risk Mitigation

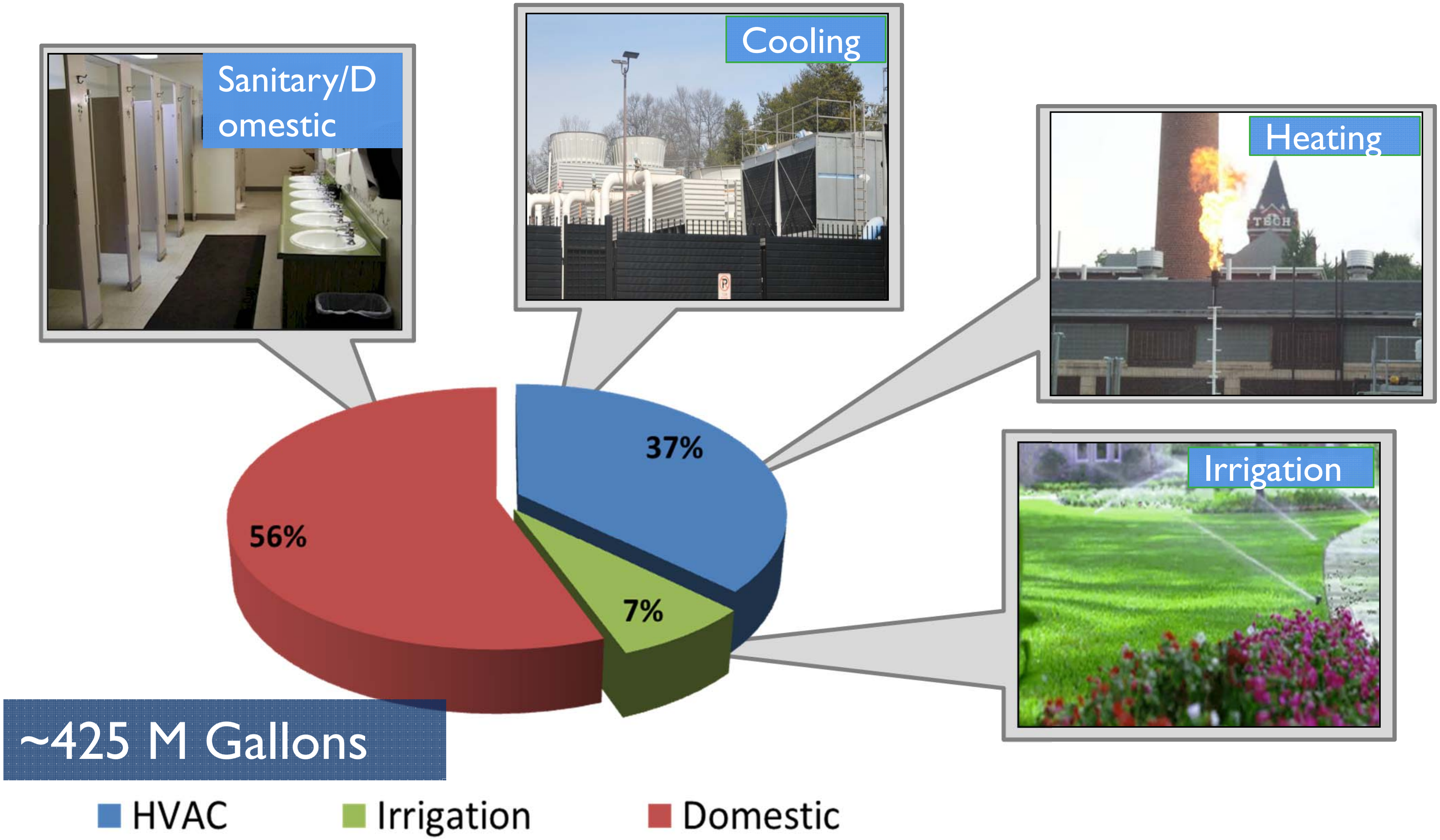
N+1 Redundancy:

- Redundant Water Supply
- Additional On-Site Storage
- Reduced Environmental Impact
- Flexibility & Resilience
  - Drought
  - Municipal infrastructure failures
- Minimum recovery time
- Insulation from rising water costs
- Optimized process water quality and treatment programs

N+1: Reliable and Safe Alternatives to Potable Water

Proposed System Design

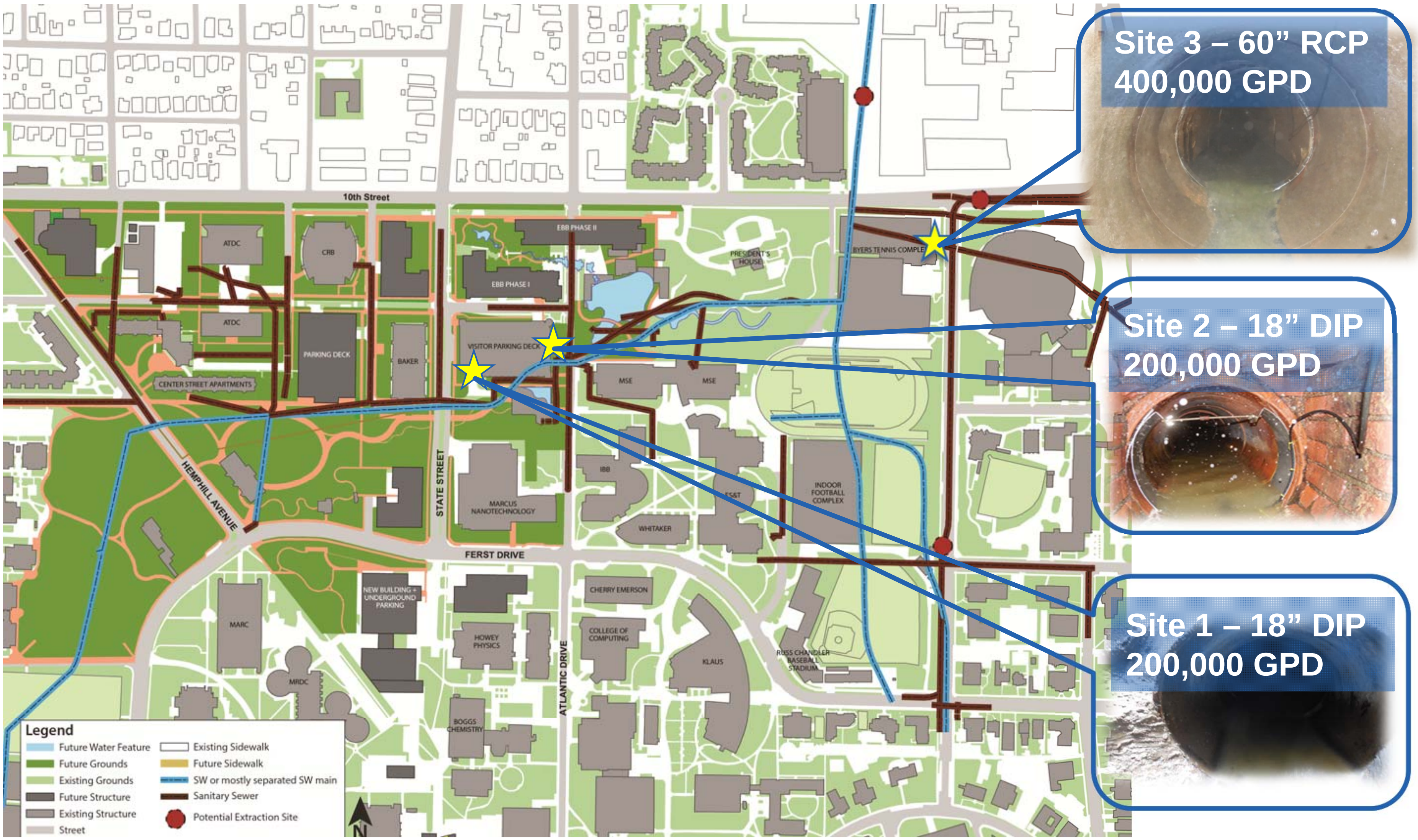
Water Use by Type



42% of Campus Water Use Considered Non-potable Demand

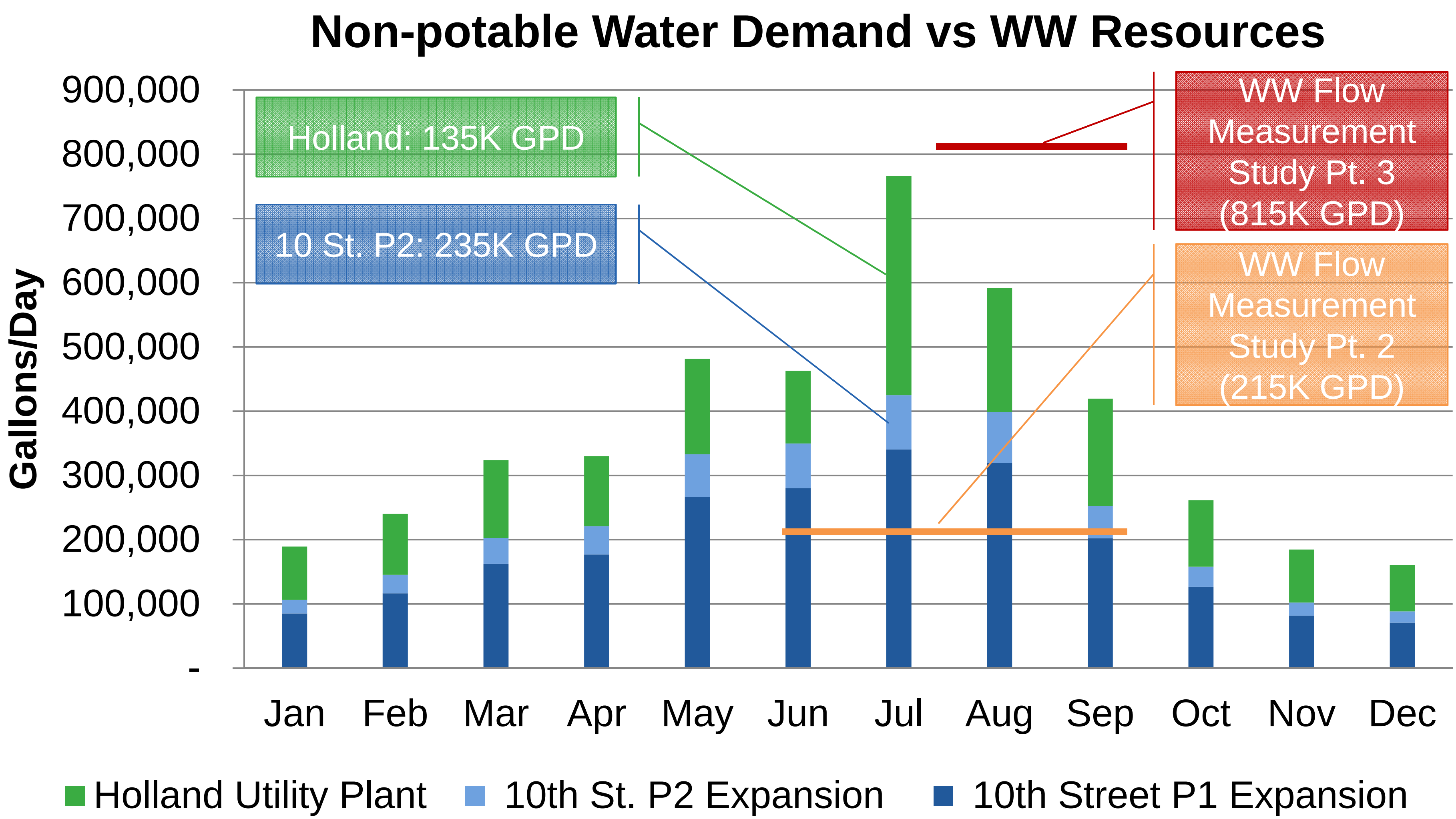
SUSTAINABLEWATER

3- Month Flow Monitoring Study



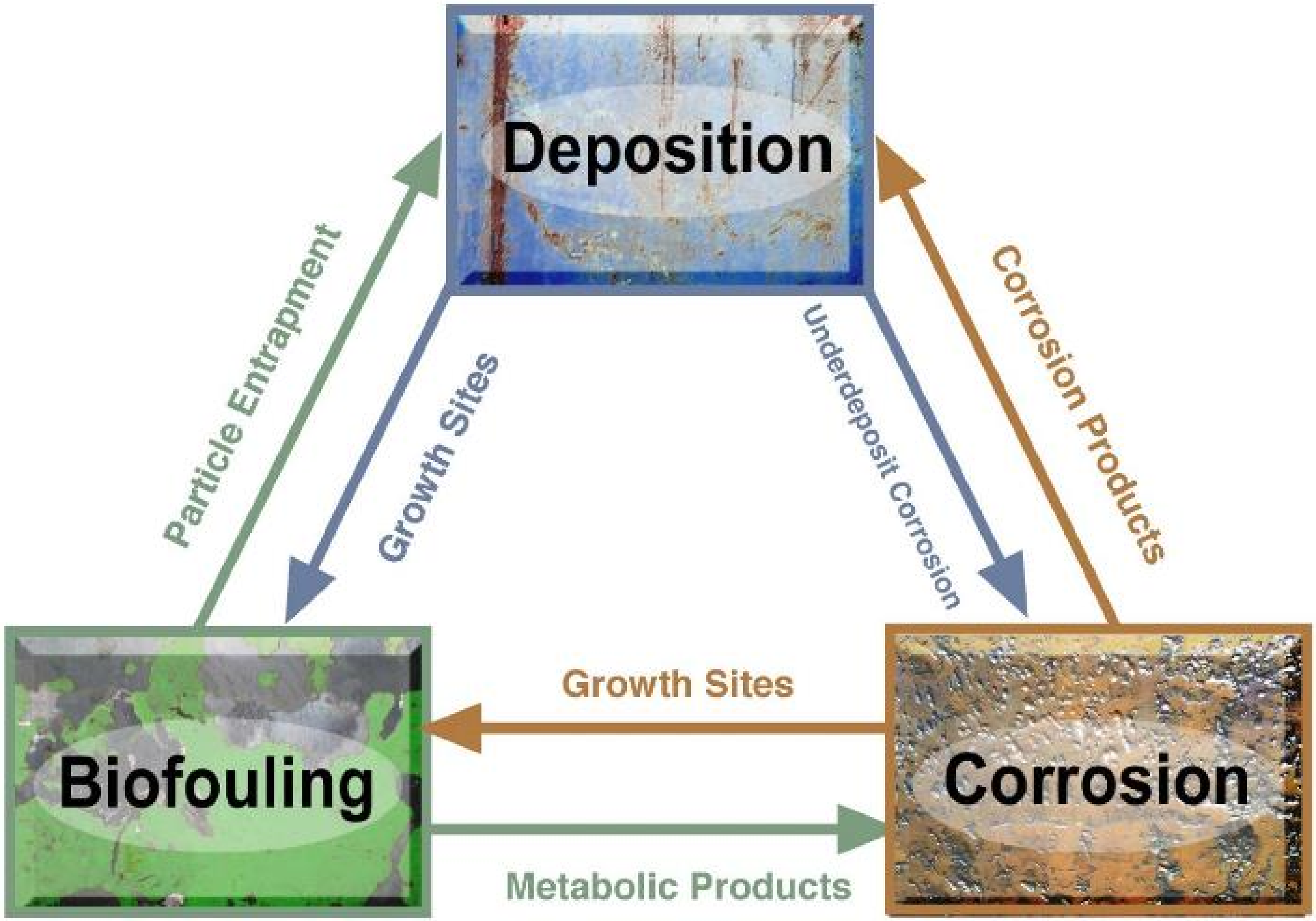
Investigated and Monitored Multiple Extraction Points on Campus

Non-potable Demand Displacement



Significant Resources Available to Displace Utility Water Makeup

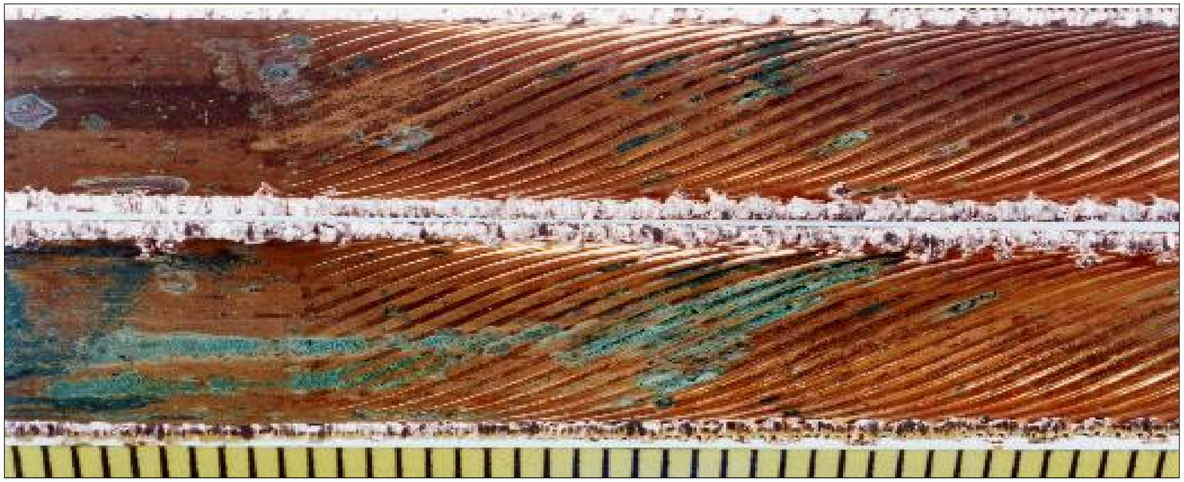
Understanding Water Issues

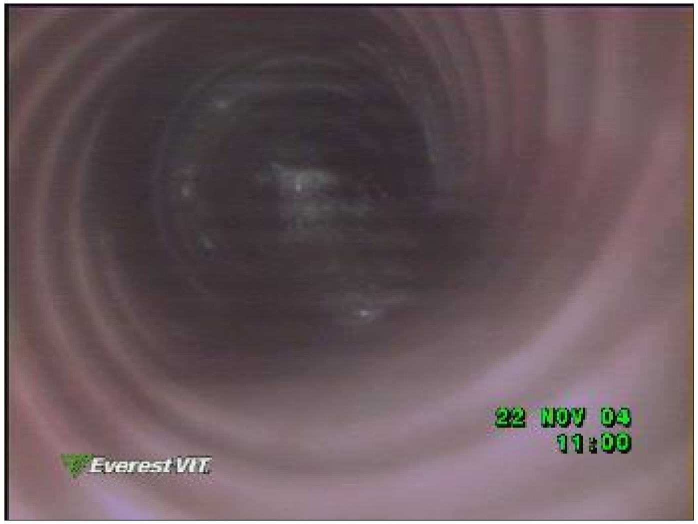


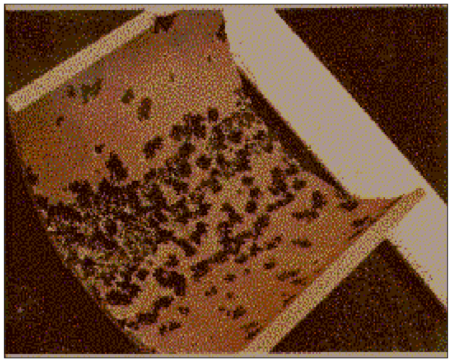
Interdependent Results Require Systemic Solutions

Failure Analysis

- Improper monitoring yields catastrophic results

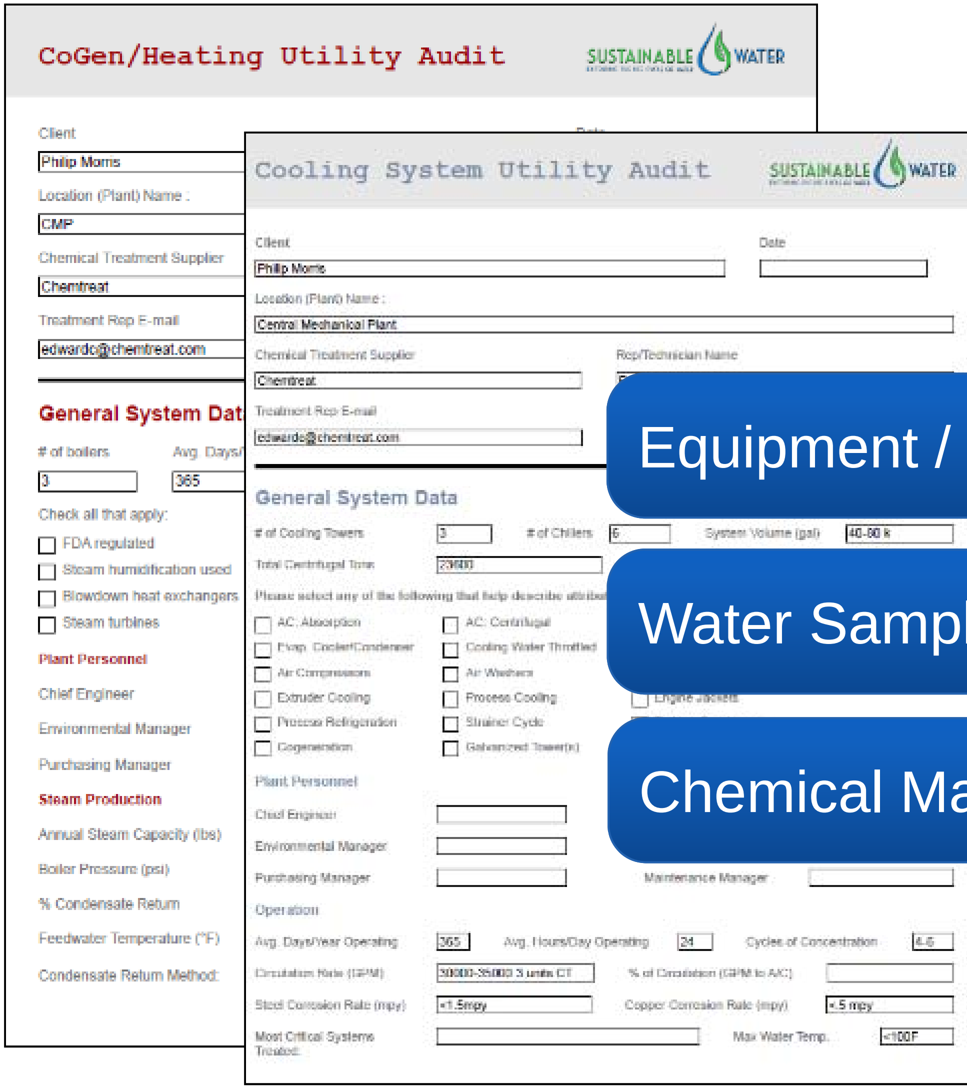






Thoughtful Design Ensures Optimum Water Quality & Results

HVAC Utility Water Audit



CoGen/Heating Utility Audit

Client: Philip Morris

Location (Plant) Name: CMP

Chemical Treatment Supplier: Chemtreat

Treatment Rep E-mail: edwardc@chemtreat.com

General System Dat

\# of boilers: 3

Avg. Days/: 365

Check all that apply:

- [ ] FDA regulated
- [ ] Steam humidification used
- [ ] Blowdown heat exchangers
- [ ] Steam turbines

Plant Personnel

Chief Engineer

Environmental Manager

Purchasing Manager

Steam Production

Annual Steam Capacity (lbs)

Boiler Pressure (psi)

% Condensate Return

Feedwater Temperature (°F)

Condensate Return Method:

Cooling System Utility Audit

Client: Philip Morris

Date:

Location (Plant) Name: Central Mechanical Plant

Chemical Treatment Supplier: Chemtreat

Rep/Technician Name:

Treatment Rep E-mail: edwardc@chemtreat.com

General System Data

\# of Cooling Towers: 3

\# of Chillers: 6

System Volume (gal): 40-80 k

Total Centrifugal Tons: 23000

Please select any of the following that help describe attribu

- [ ] AC: Absorption
- [ ] AC: Centrifugal
- [ ] Evap. Cooler/Condenser
- [ ] Cooling Water Throttled
- [ ] Air Compressors
- [ ] Air Washers
- [ ] Extruder Cooling
- [ ] Process Cooling
- [ ] Engine Jackets
- [ ] Process Refrigeration
- [ ] Strainer Cycle
- [ ] Cogeneration
- [ ] Galvanized Tower(s)

Plant Personnel

Chief Engineer

Environmental Manager

Purchasing Manager

Maintenance Manager

Operation

Avg. Days/Year Operating: 365

Avg. Hours/Day Operating: 24

Cycles of Concentration: 4-6

Circulation Rate (GPM): 30000-35000 3 units CT

% of Circulation (GPM to A/C):

Steel Corrosion Rate (mpy): <1.5mpy

Copper Corrosion Rate (mpy): <.5 mpy

Most Critical Systems Treated:

Max Water Temp.: <100F

Equipment / System Review

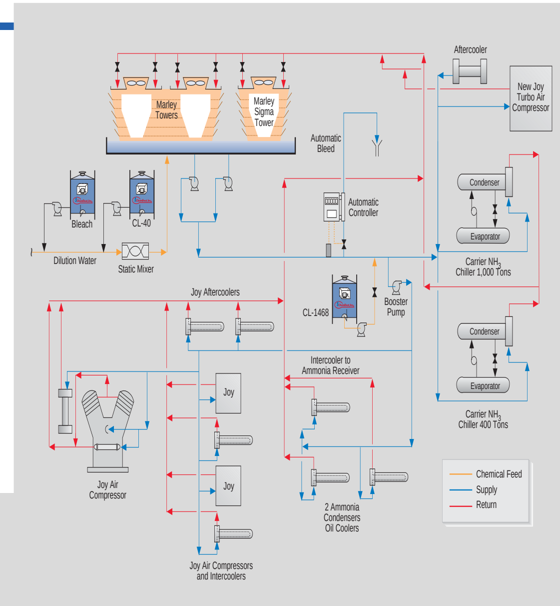
Water Sampling Review

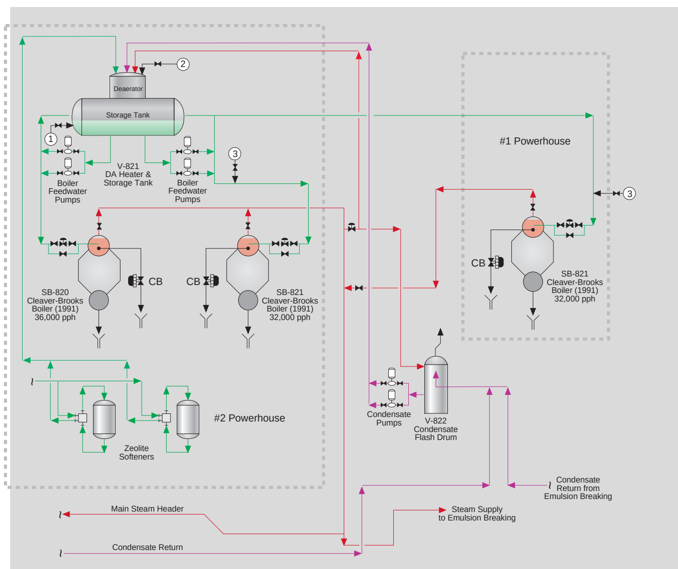
Chemical Mass Balance

Well Controlled Systems With Extensive Oversight

Utility Assessment Overview

- Biological studies
- Corrosion studies
- Automation
- Treatability studies
- Equipment Integrity





Recommendations

- Treatment Specifications
- Conservation
- Training
- Modifications
- Mechanical

Systematic Audit of Existing Conditions to Confirm Reliability

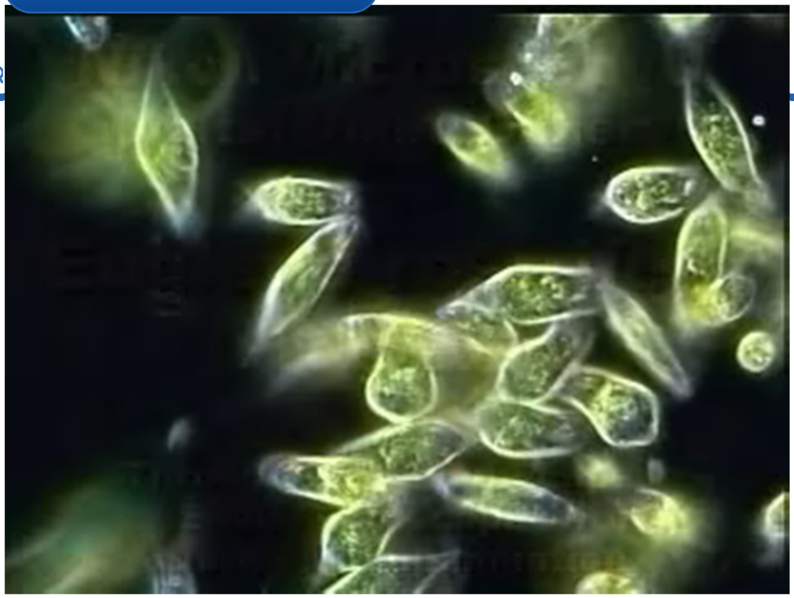
SUSTAINABLEWATER

Ecological Treatment Solutions

	ReCip® Tidal Wetlands	Hydroponic and Fixed Media	Moving Bed Bioreactor (MBBR)	Membrane Bioreactor (MBR)	Conventional Activated Sludge
Capital Expense	Green	Green	Green	Red	Yellow
Operating Expense	Green	Green	Yellow	Red	Yellow
Energy Efficiency	Green	Yellow	Yellow	Red	Yellow
Effluent Quality	Green	Green	Green	Green	Red
Footprint	Yellow	Green	Green	Yellow	Red
Aesthetics	Green	Green	Yellow	Red	Red

Increased Biodiversity, Reduced Energy Requirements

Rostrifera

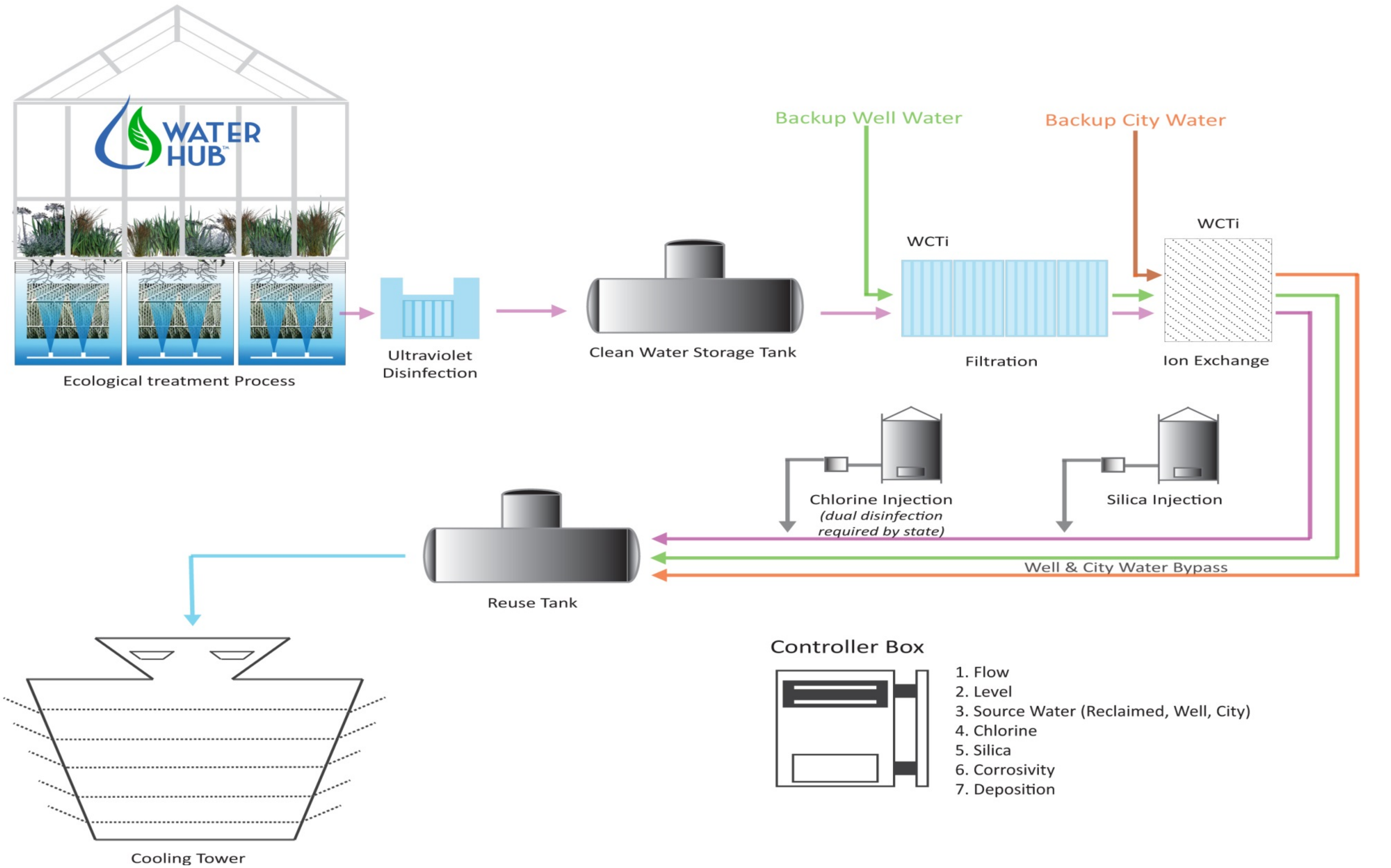


Collotheca

Philodina

Aquatic Worm

GT Water Reuse Process Diagram



WCTI System Integrates Well into Overall Reclamation Strategy

The Future: Decentralized Urban Reuse

Turn-key solution for an increasingly urban environment

Complete Build-Out Concept

Design Helps Anchor the Centerpiece of the Eco-commons

Complete Build-Out Concept

- Risk Management
- Cost Savings
- Environmental Responsibility

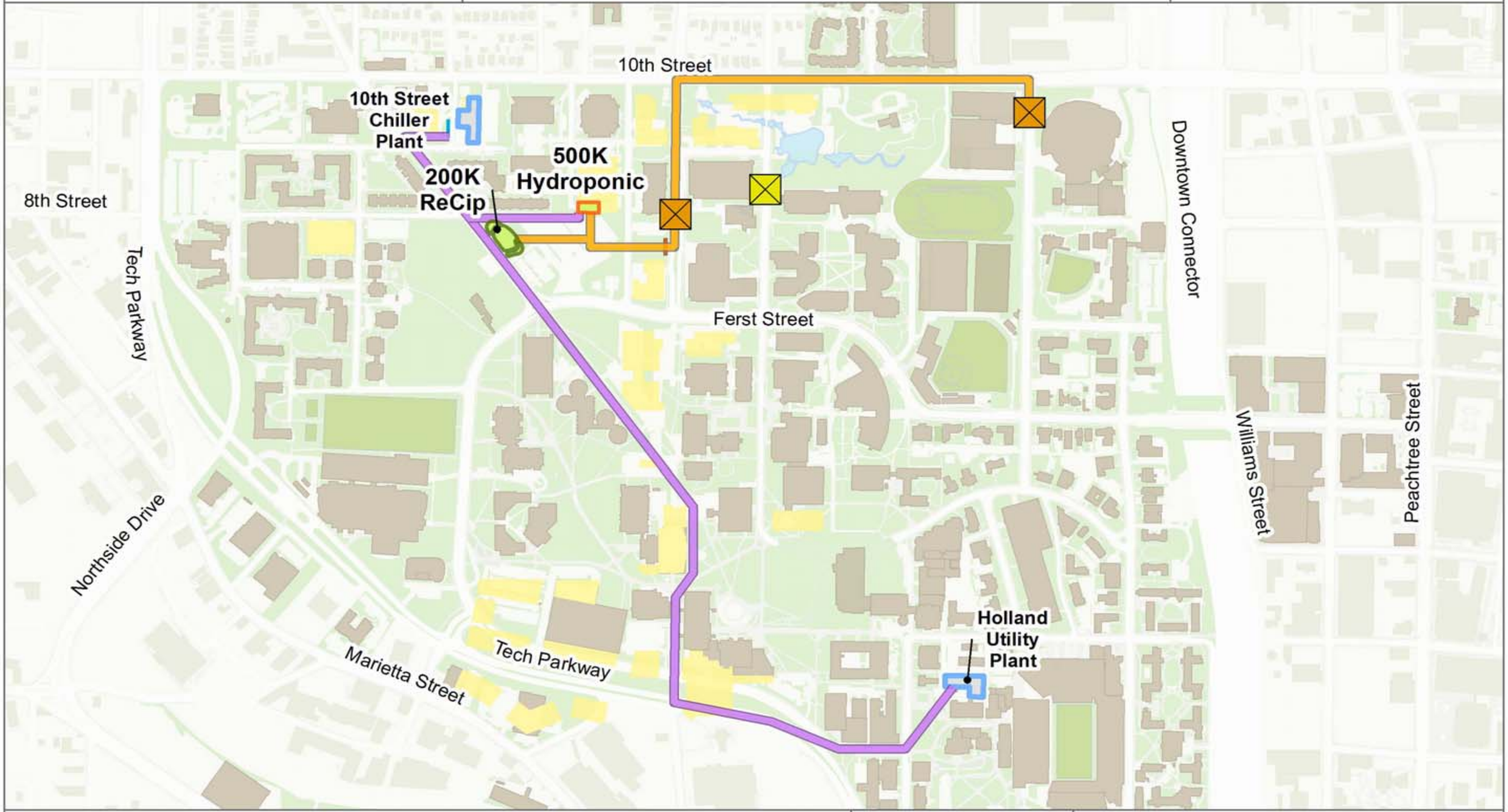
- Results in 26% reduction in total campus water demand

Design Helps Anchor the Centerpiece of the Eco-commons

Georgia Institute of Technology

WaterHub Conceptual Site Plan

Georgia Institute of Technology
Atlanta, Georgia



Extraction Point
Alternative Extraction Point
Reclaimed Water Distribution
WW Extraction
200K ReCip
500K Hydroponic
Utility Plants
Primary Tanks
Reuse Tanks
Future Buildings
Georgia Tech Buildings

Revised 10/14/2014

Utility features portrayed on this map may not be survey verified.

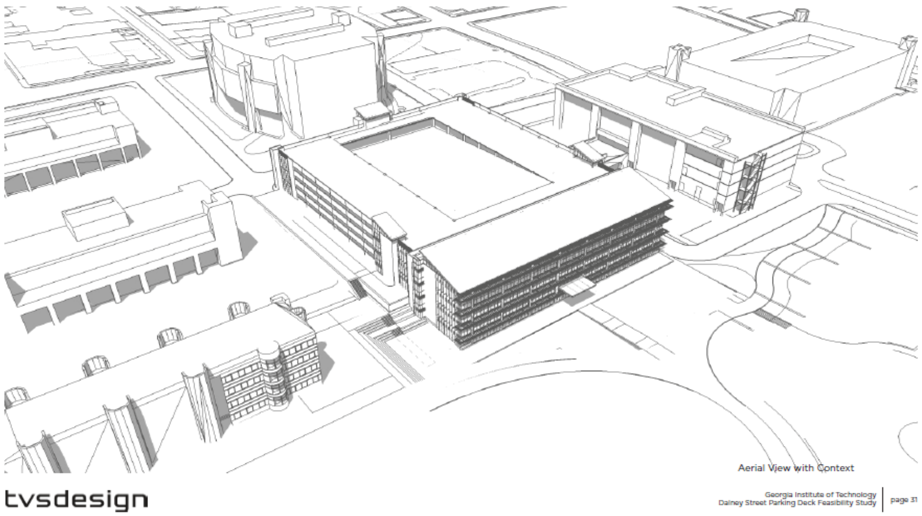
0 600 1,200 Feet

Scale: 1:8,000

Coordinate System: NAD 1983 StatePlane Georgia West FIPS 1002 Feet

SUSTAINABLE WATER
Sustainable Water Consultants LLC
Glen Allen, VA

Dalney Street Parking Deck Concept



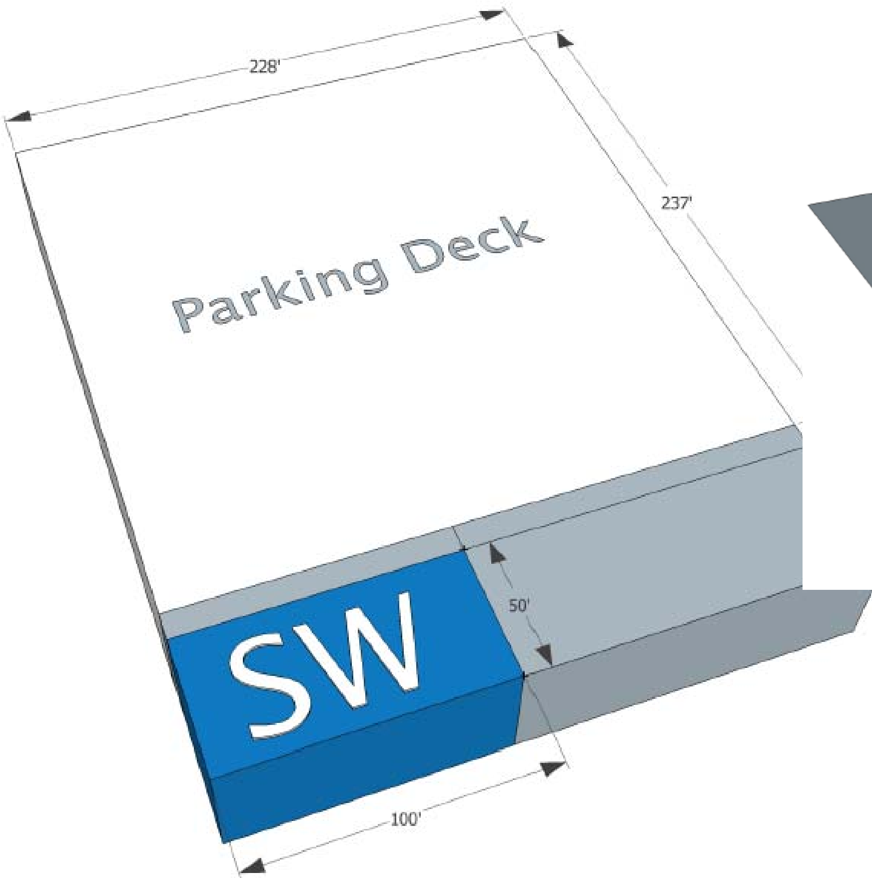
Artist's Impression

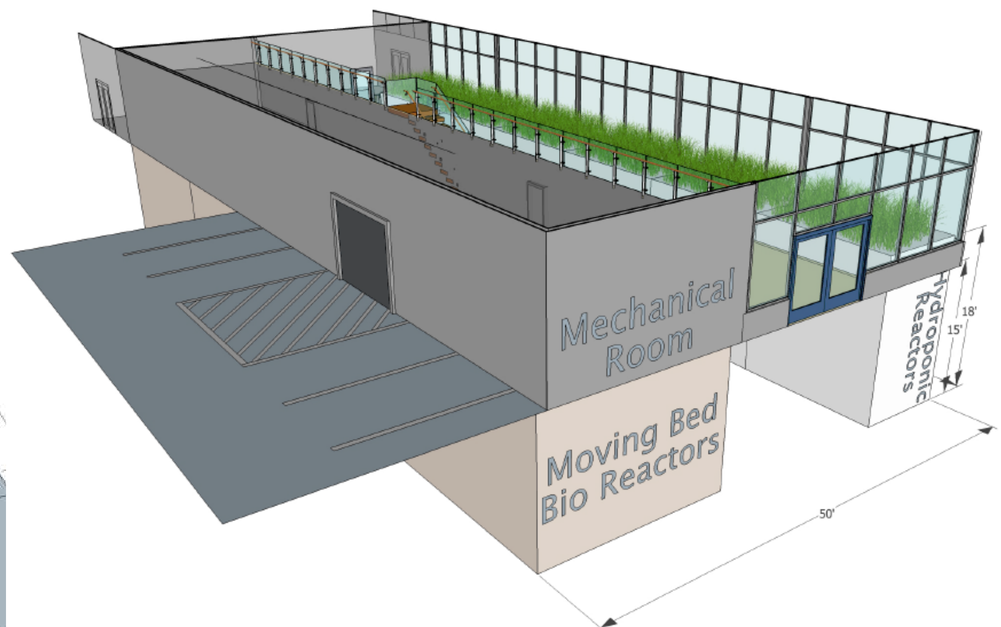
Option E (w/ roof)
4-Bay N/S w/ Office Lamination
Parking Deck: Basement + 6 Levels, 1,025 spaces
Office Lamination: 4 Levels, 54,720 s.f.

- Streamlined facility that allows for the construction of the Eco-commons Lawn
- Functional utility that provides a living, learning, laboratory
- 1,100 parking spaces and 55,000 sq. feet of glass laminated office space

Instructional Facility that Compliments the Eco-commons

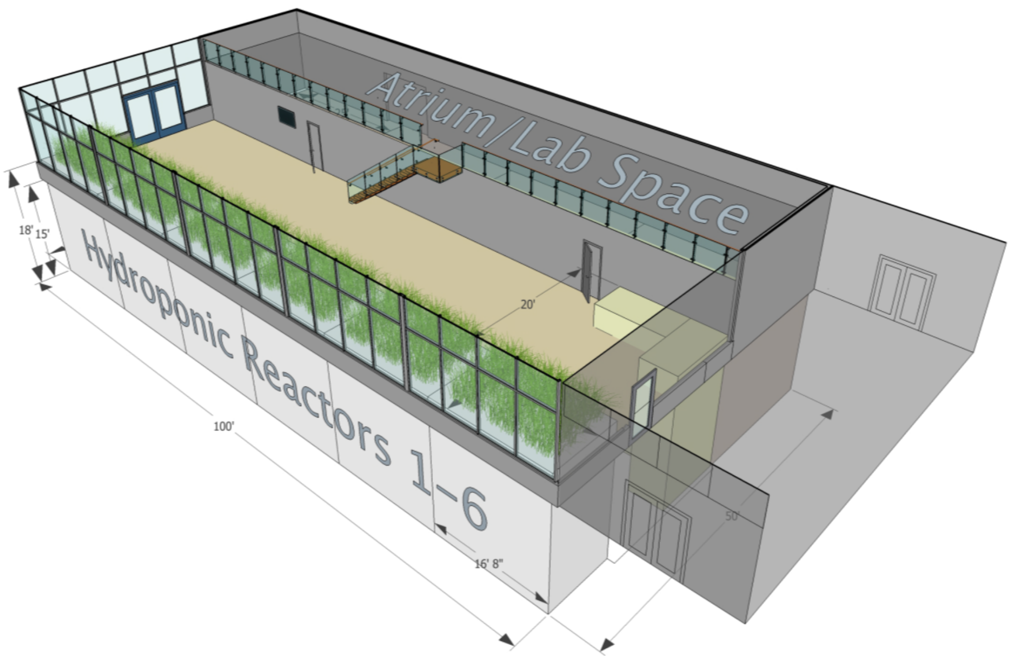
Dalney Street Parking Deck Design

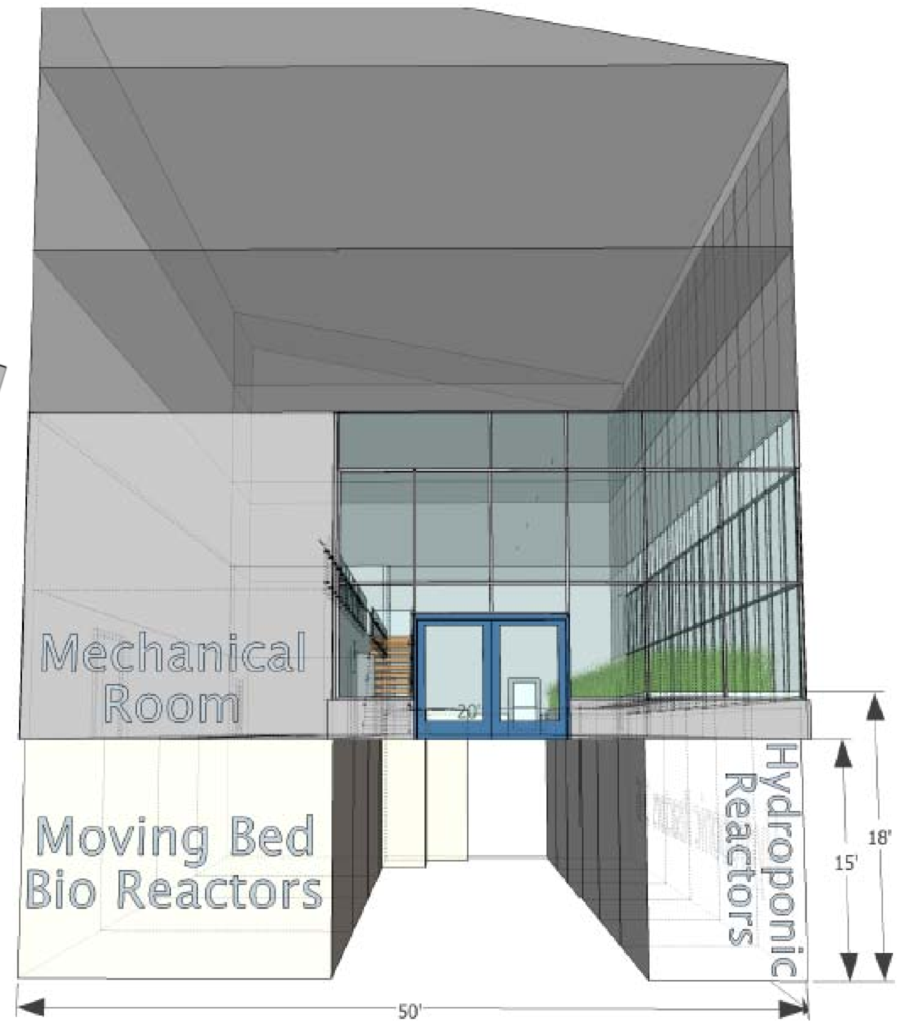




Collaborative Design Between Georgia Tech and Sustainable Water

Dalney Street Parking Deck Design





A Living, Learning, Laboratory

Advantages to Phase 1 System

1. **Significant economic savings immediately**
   - *Parking Deck design Timeline*
   - *Phase II Facility Fully Operational – 3 years best case*

2. **Allows GT to undertake phased approach to water reuse**
   - *Utilize and review how a smaller system is working before complete system is finalized, helps influence the final build-out.*

3. **Design provides built in redundancies**
   - *Dual extraction points*
   - *Redundant water storage capacities (primary equalization and clean water)*

Multiple Advantages to a Phased Build-Out

Comprehensive Approach to Sustainability
"*Georgia Tech as a Living Learning Laboratory*"

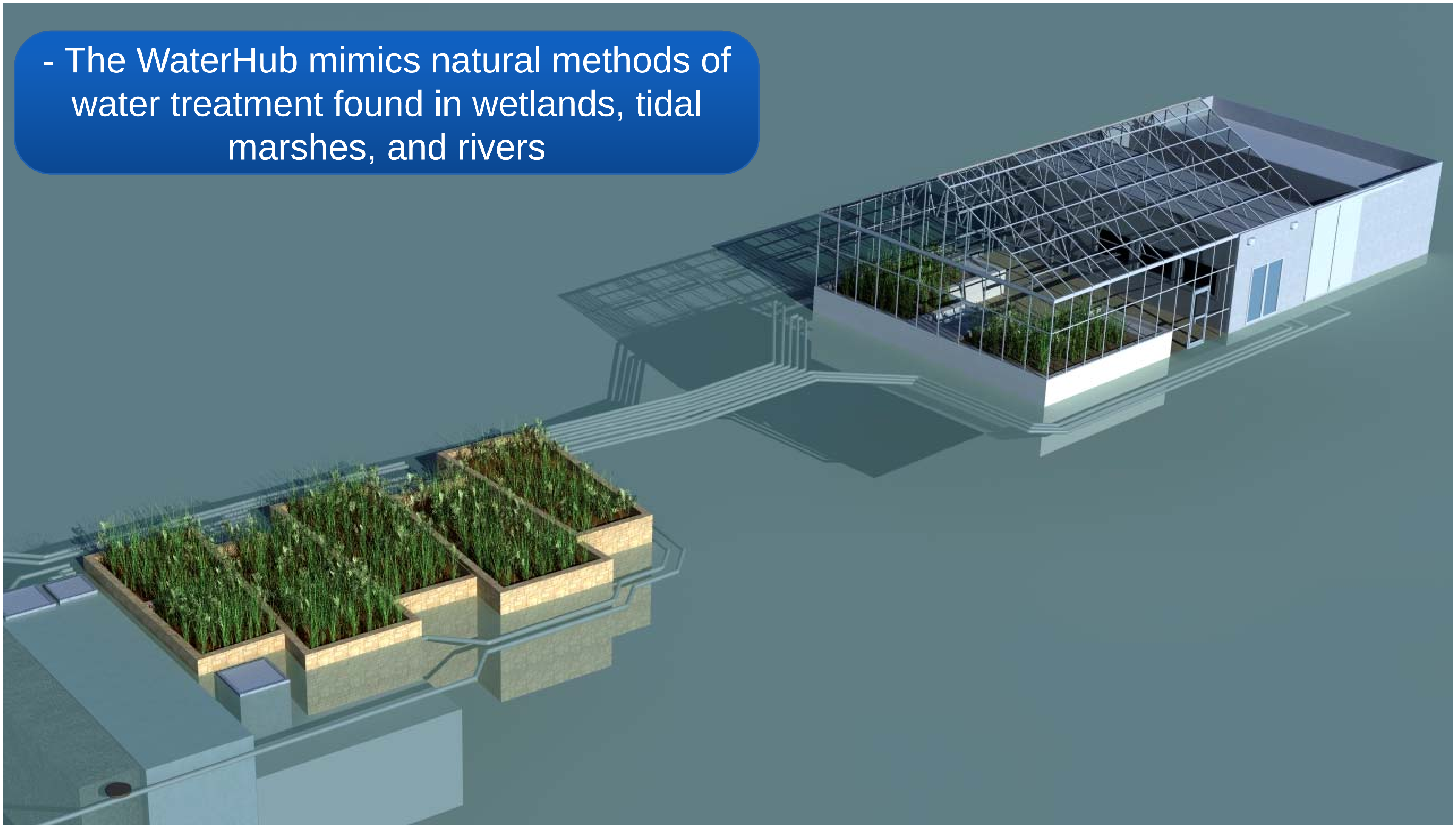
- Education
  - – Learning in the Classroom
- Research
  - – Discovery in the Laboratory
- Campus
  - – Practice in Managing our Campus

Sustainability is an Integral Component of Georgia Tech

Update at Emory University

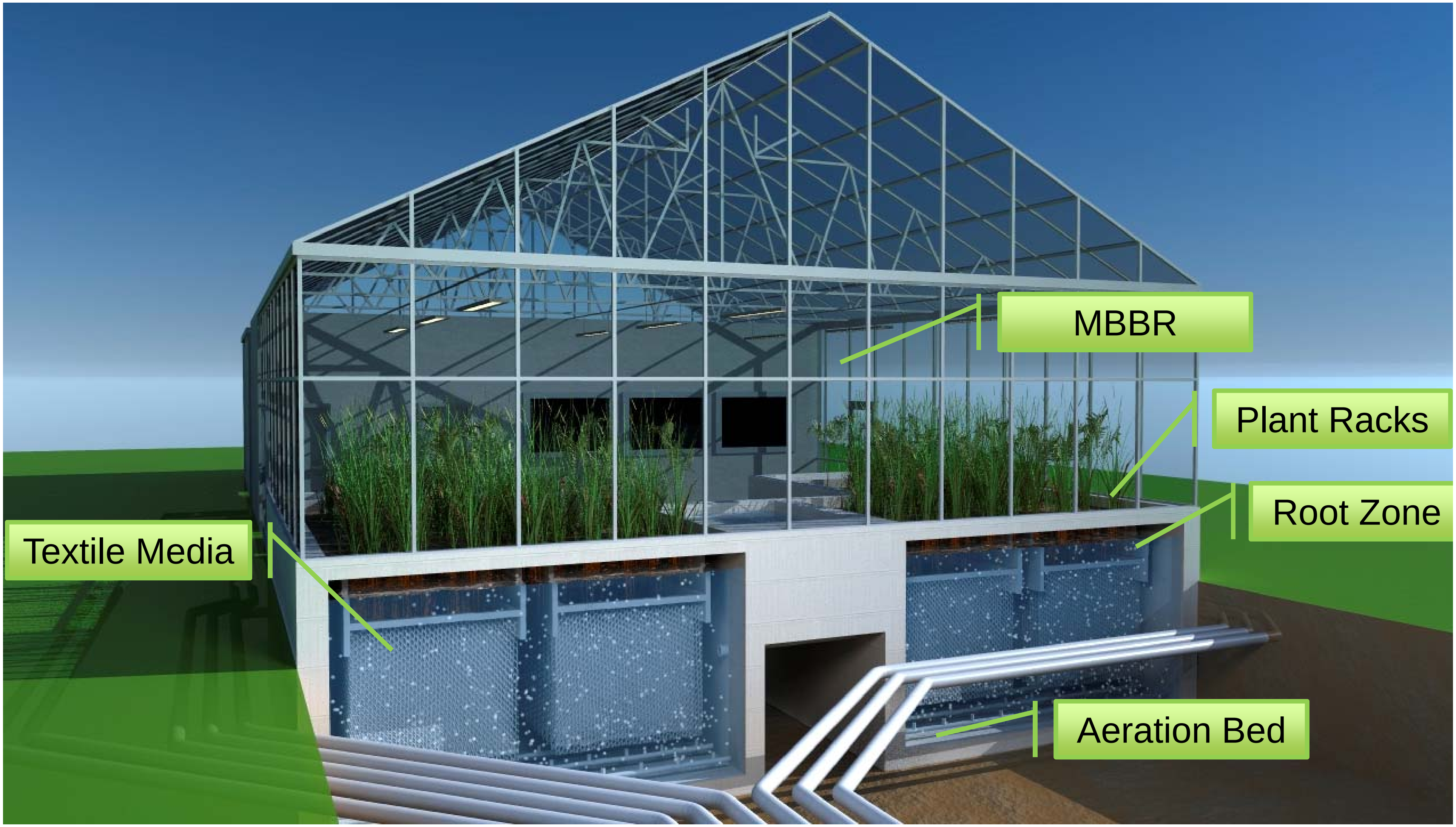
Ecological Treatment Design

- The WaterHub mimics natural methods of water treatment found in wetlands, tidal marshes, and rivers



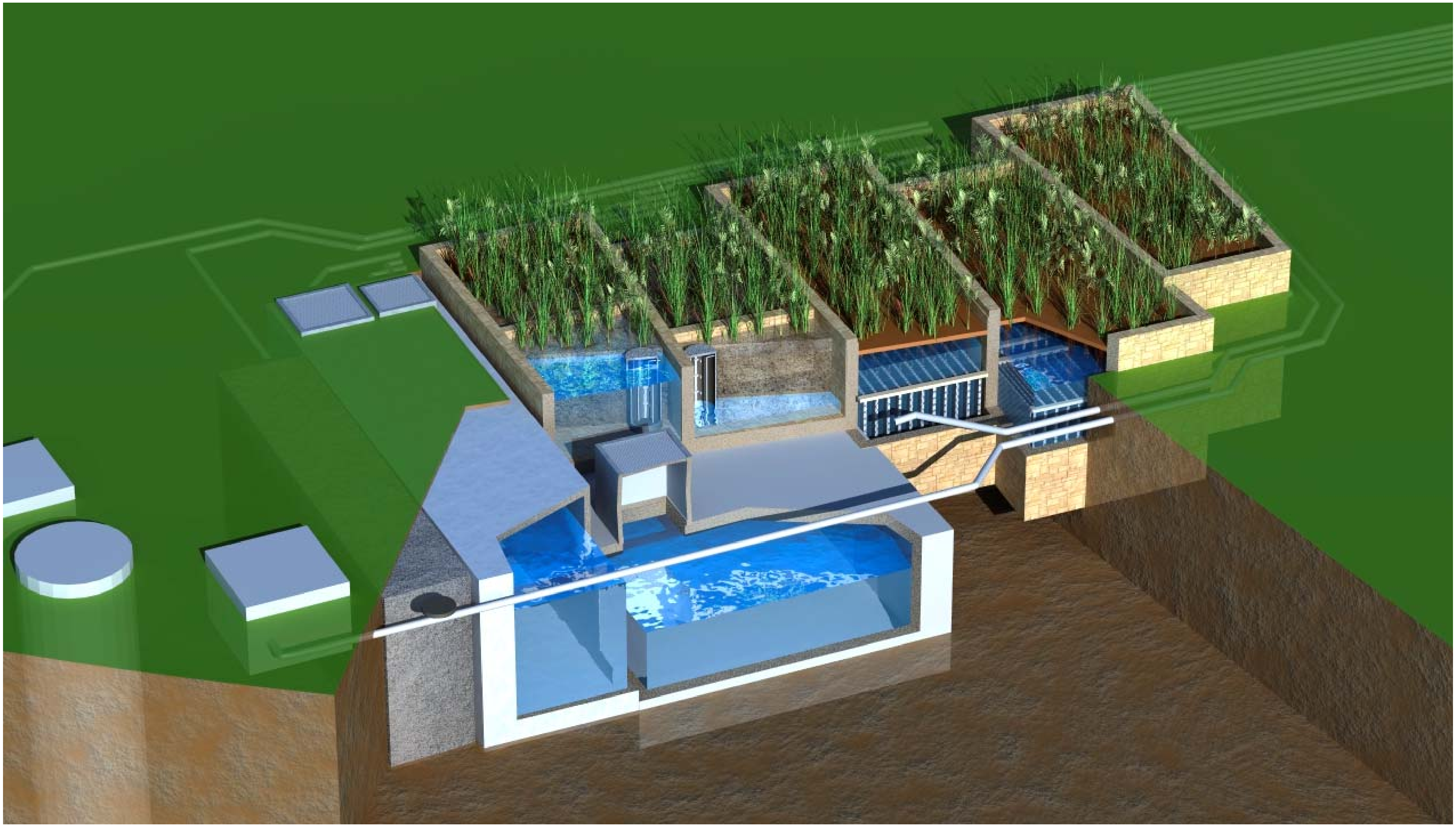
Integrated into the Built Environment

GlassHouse (Upper Site)



GlassHouse Footprint Compact and Efficient at 2,200 ft^2

Outdoor System (Lower Site)



Convergence of Multiple Ecological Treatment Technologies

Emory - Aerial View: Under Construction

Small Physical Footprint, Sited in the Middle of Campus

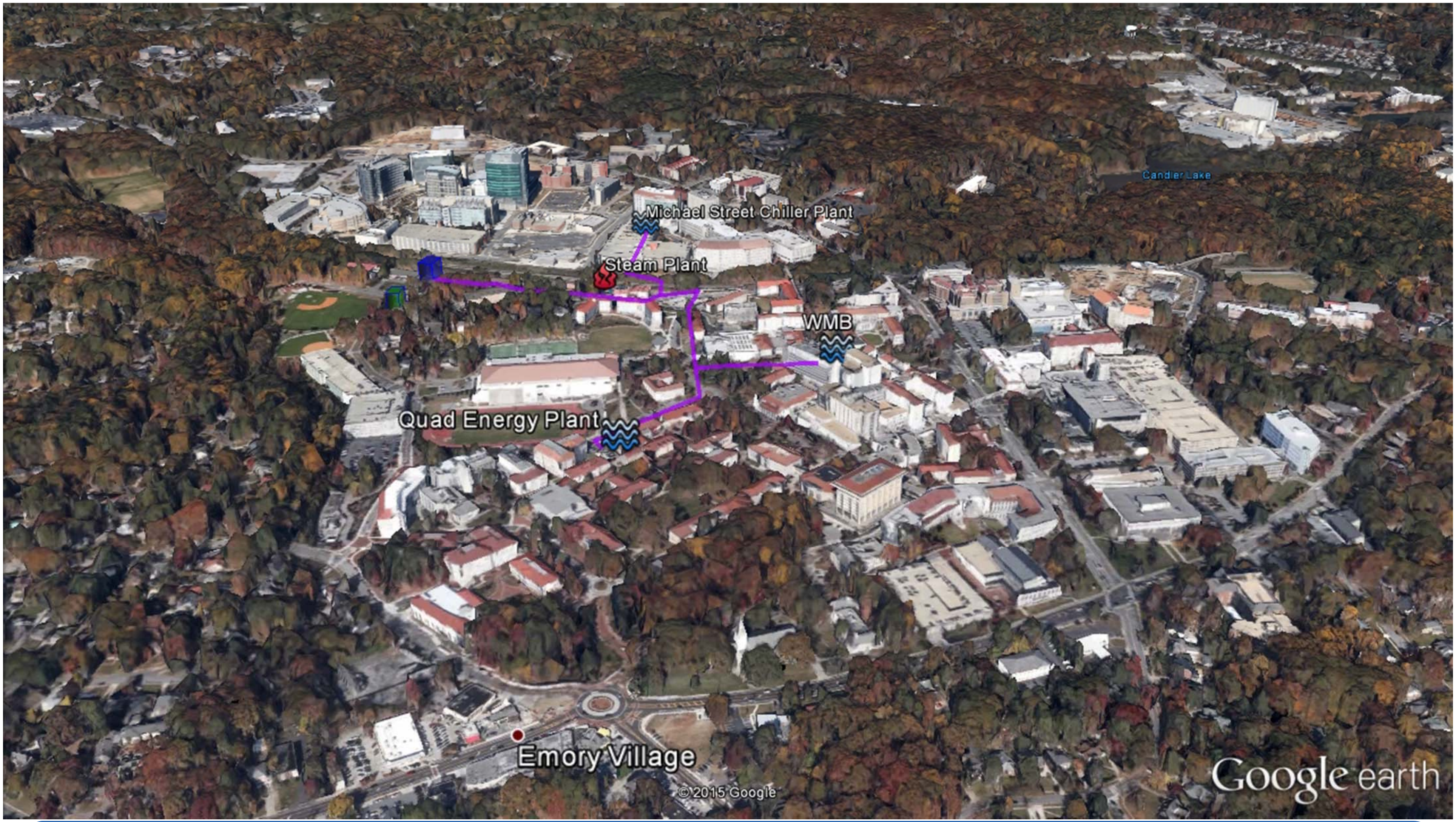
The WaterHub at Emory University

- Capable of recycling up to 400,000 gallons-per-day

First and Only Ecological, Decentralized Reuse System in the U.S.

Time Lapse of Project

Distribution System Tour



4,425 Linear feet of distribution piping

EPA Administrator Gina McCarthy Tours Emory University's WaterHub

SUSTAINABLEWATER

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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