February 13, 2020

The WaterHub® - Sustainable Utility Management Through Water Reclamation and Reuse

Bob Salvatelli

CampusEnergy2020
THE POWER TO CHANGE
FEBRUARY 10-14 ▲ SHERATON DENVER DOWNTOWN ▲ DENVER, CO

SUSTAINABLE WATER®
EXTENDING THE LIFE CYCLE OF WATER

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Eco-Engineered Reuse Systems

RISK MITIGATION

FINANCIAL SAVINGS

ENVIRONMENTAL RESPONSIBILITY

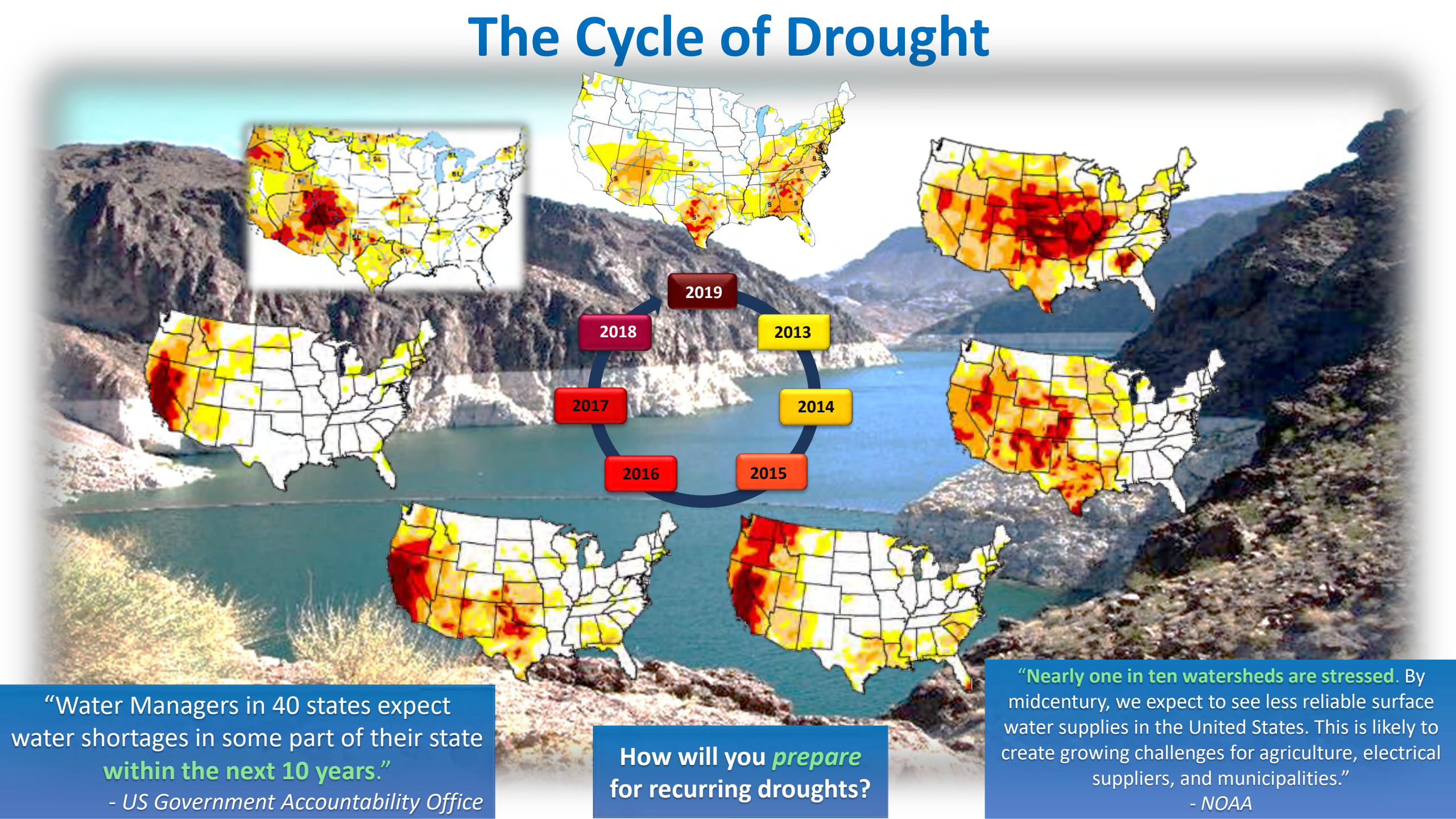
SOCIAL RESPONSIBILITY

Living, Learning Laboratory

Changing the Paradigm of Water Reuse

The Water Apocalypse

The Cycle of Drought



"Water Managers in 40 states expect water shortages in some part of their state **within the next 10 years**."
- US Government Accountability Office

How will you *prepare* for recurring droughts?

"**Nearly one in ten watersheds are stressed**. By midcentury, we expect to see less reliable surface water supplies in the United States. This is likely to create growing challenges for agriculture, electrical suppliers, and municipalities."
- NOAA

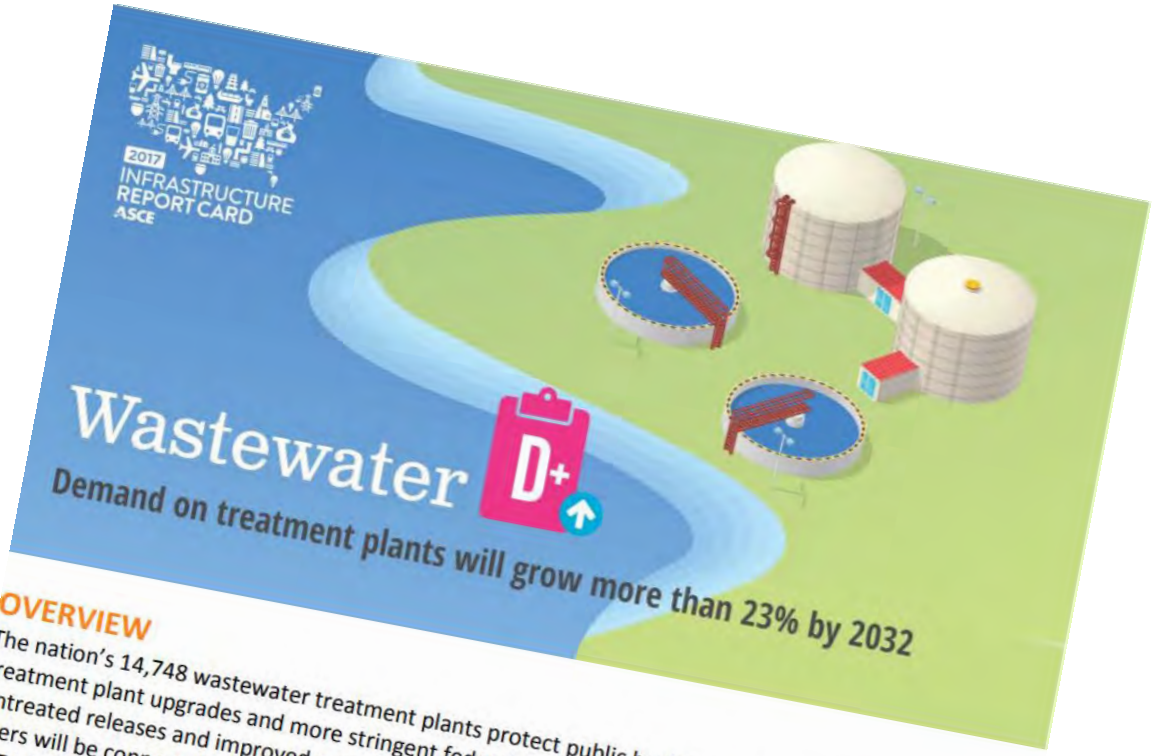
Fixing A Failing System

"Through strategic, sustained investment, bold leadership, thoughtful planning, and careful preparation for the needs of the future, America's infrastructure will be improved and restored."

- American Society of Civil Engineers, *2017 Report Card for America's Infrastructure*

Suggested Solutions…

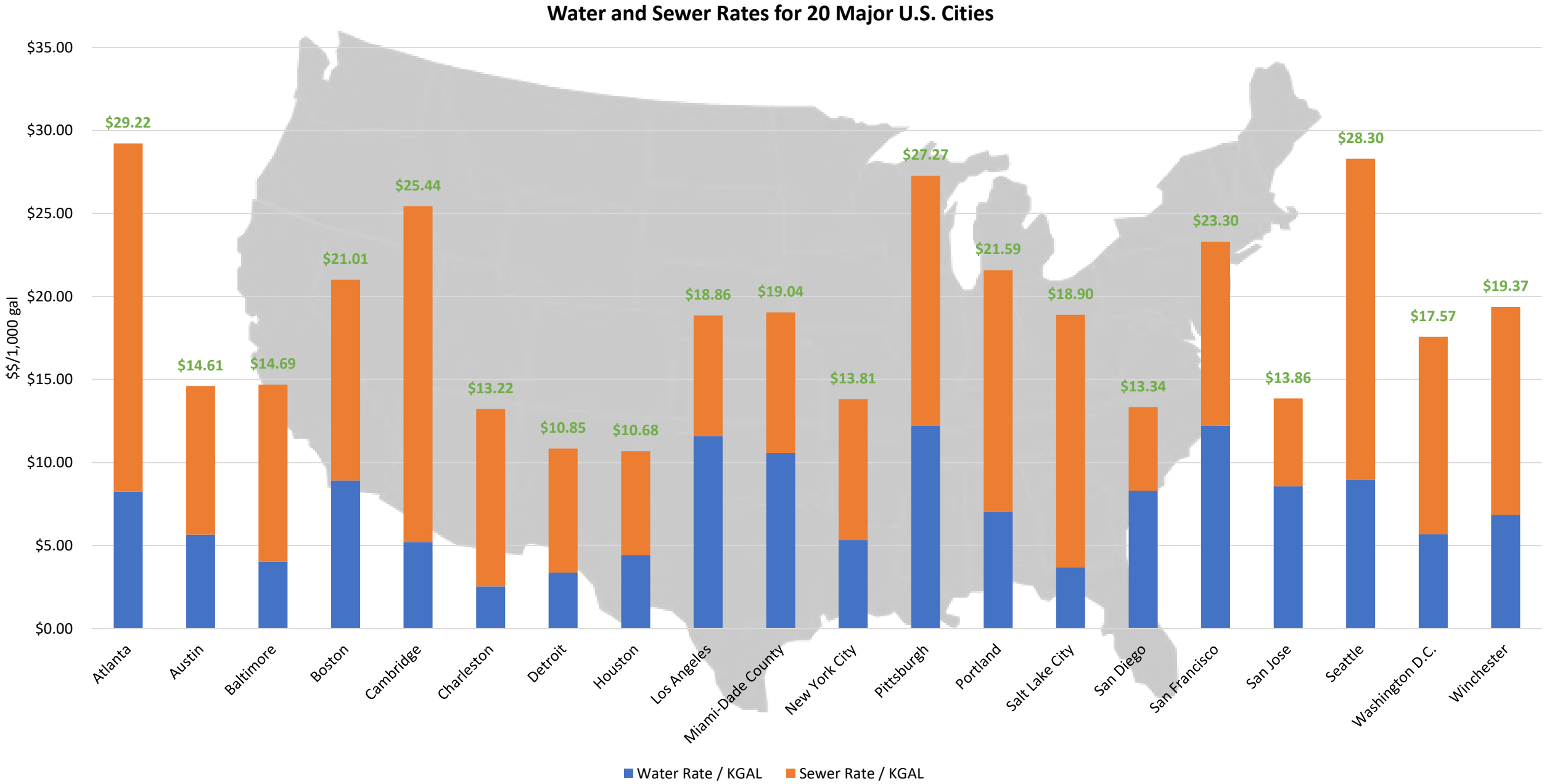
- Raise Awareness for the True Cost of Water
- Increase Costs for Water and Wastewater Services
- Develop and Harness New Technologies
- Increase Private Financing
- Implement Water Reuse & Expand Water Recycling



OVERVIEW

The nation's 14,748 wastewater treatment plants protect public health and the environment. Years of treatment plant upgrades and more stringent federal and state regulations have significantly reduced untreated releases and improved water quality nationwide. It is expected that more than 56 million new users will be connected to centralized treatment systems over the next two decades, and an estimated $271 billion is needed to meet current and future demands. Through new methods and technologies that turn waste into energy, the nation's 1,269 biogas plants help communities better manage waste through reuse.

National Water & Sewer Rates



CAMPUS GROWTH

The WaterHub®: Decentralized Reclamation & Reuse

Before

After

Unique Development Approach

Operating Lease | DBO 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


1. FEASIBILITY & PLANNING


2. ENGINEERING & DESIGN


3. CONSTRUCTION


4. COMMISSIONING & START-UP


5. FACILITY OPERATIONS

Water Processing Agreement

Client Benefits

- Utility Plant Operational Resiliency (N+1 Water Supply)
- Campus Sustainability Initiative
- Guaranteed Savings over Business-as-Usual
- Hands-Off Operations

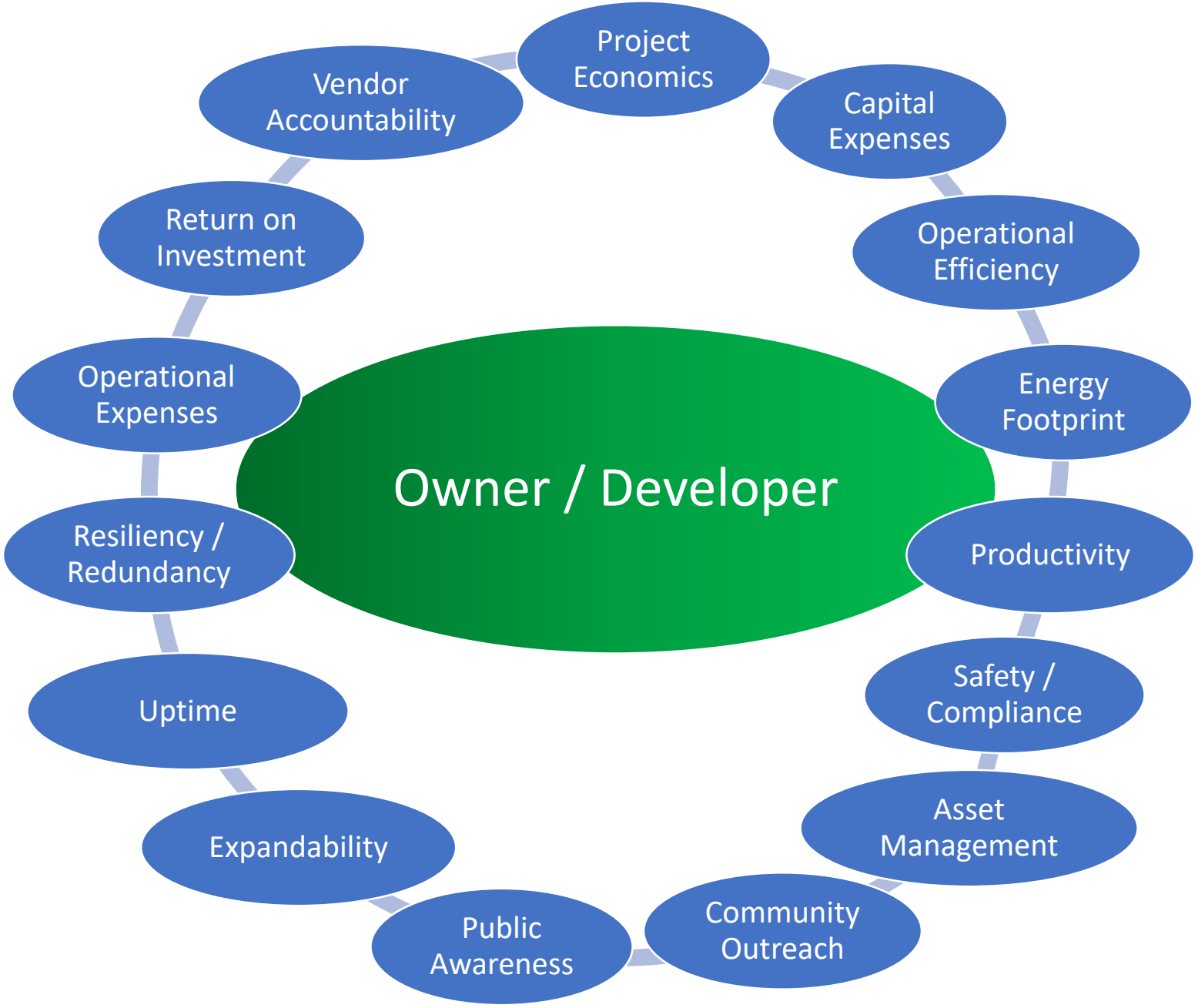
Developer Risk

- Proper System Engineering & Design
- Construction / Development Costs & Bonds
- Facility Operational Cost
- Facility Maintenance Cost
- Production of Compliant Reclaimed Water
- Any Escalation of Long-term water / sewer costs
- Long-term Upkeep of Plant

Client Responsibility

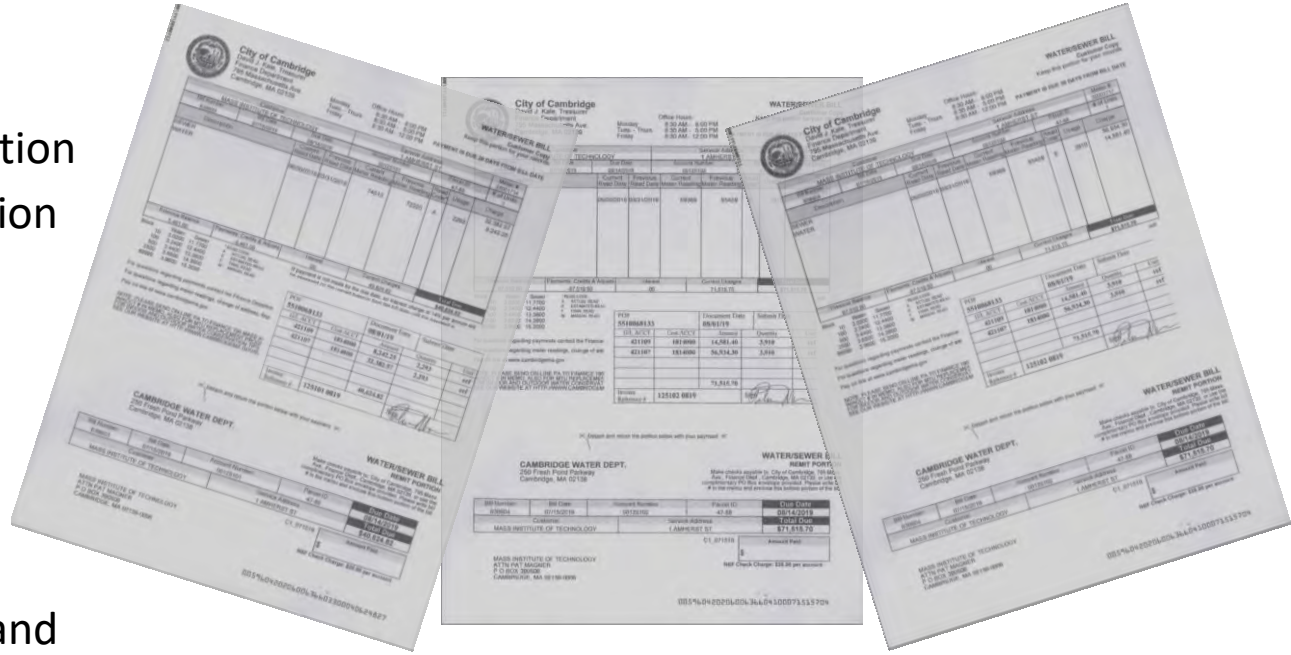
- Minimum Annual Purchase of Compliant Reclaimed Water (Based on historical water use)
- Land Lease and Pipeline Easement
- 30 Year Operating Agreement

Owner / Developer Mindset

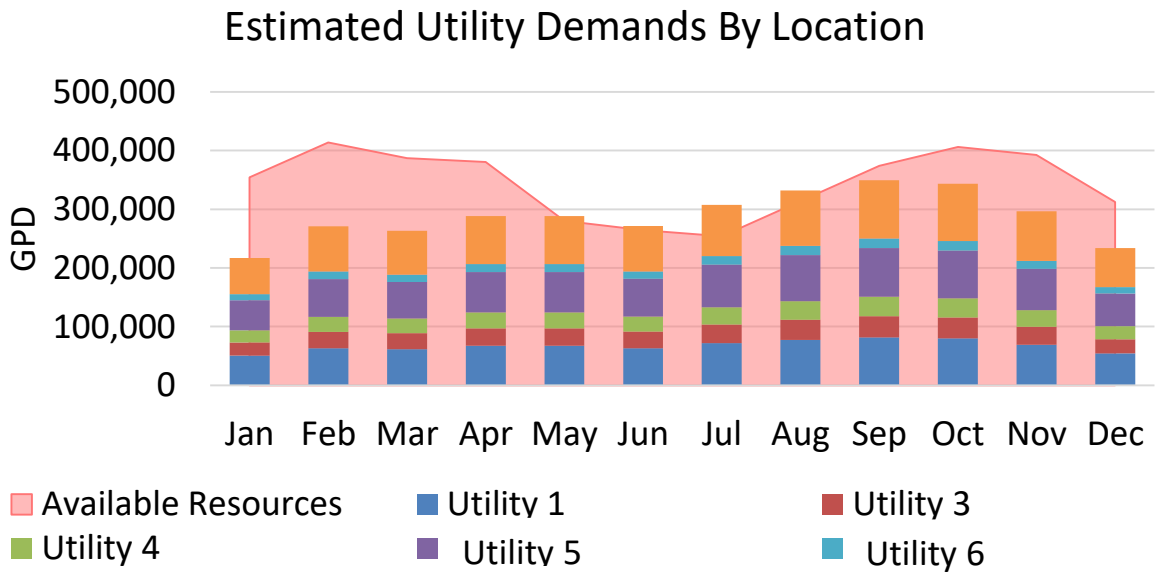


Preliminary Assessment Data Request

- **Water Use (3 years)**
  - Total campus inbound water by Month and Location
  - Chiller Plant/Cooling Tower Make-Up by Month and Location
  - Boiler Make-Up/ Power Block Usage by Month and Location
  - Irrigation by Month and Locations
  - Any Supplemental Sub-Metering Data



- **Economics (3 years)**
  - Recent Water & Sewer Bills
  - Internal OPEX Breakdown for Potable Water Production and Wastewater Pretreatment inclusive of:
    - Energy
    - Manpower
    - Chemical
    - Repair/Replacement



- **Wastewater and Quality Testing**
  - Current Industrial Discharge Permit
  - Historical Groundwater Influent Quality Testing
  - Wastewater Influent and Effluent Quality Testing
    - Industrial and Sanitary

Feasibility Study Scope of Work

- **Existing Conditions Assessment**
  - Water Balance & Demands
  - Site & Infrastructure Review
  - Utility Water Audit / Review
  - Future Demand / Load Forecasts
  - Water Supply Resiliency Review
- **Supplemental Field Investigation**
  - Validate process / Cooling makeup
  - Wastewater Flow Monitoring
  - WW Characterization
- **Establishing the Vision**
  - Opportunities & Constraints
  - Campus Sustainability / Resiliency Goals
  - Developing a Basis of Design for Systems
- **Concept Design**
  - Site Plan
  - Conceptual Layout & Design
  - Water Supply Resiliency Assessment
  - Preliminary Constructability Review & Budget
  - Lifecycle Economics

Supplemental Field Investigation

TASKS:

- Review all 3rd party flow & water quality testing
- Administer supplemental field investigations where needed
  - Wastewater flow monitoring
  - End-use flow validation
  - Wastewater characterization
- Develop field testing reports summarizing results

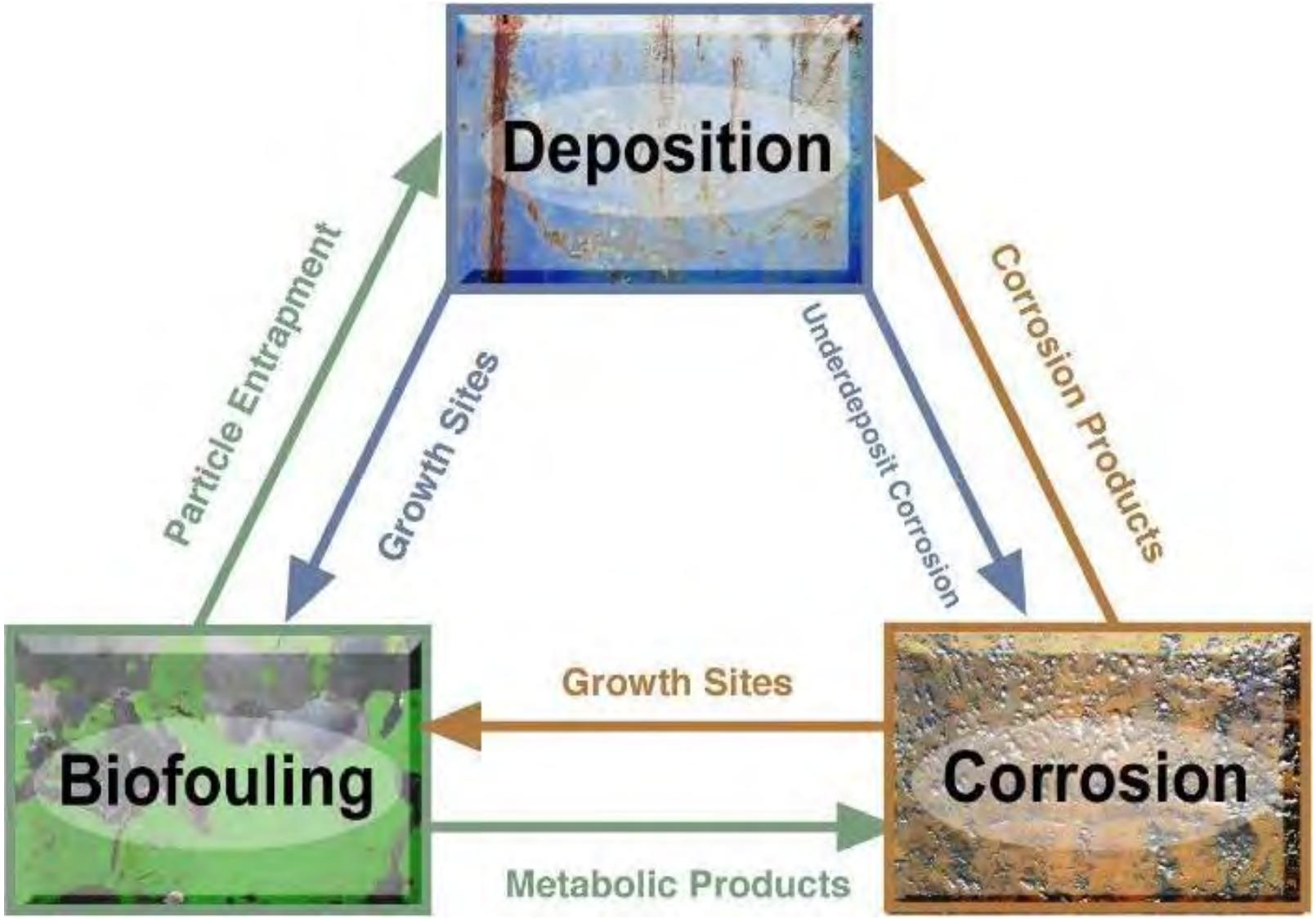
FLOW MONITORING

- Seasonal variations in flow
- Diurnal patterns
- Reuse potential

WASTEWATER CHARACTERIZATION

- Variability
- Treatability
- Contaminants of Concern
- Informs basis of design

Understanding Water Issues



Utility Water Audit

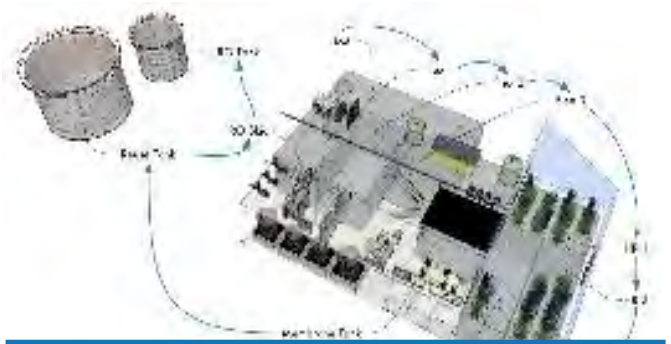
Equipment Inventory

Equipment Conditions

Operational Protocols

Treatment Program Admin

Reclaimed Water Modeling

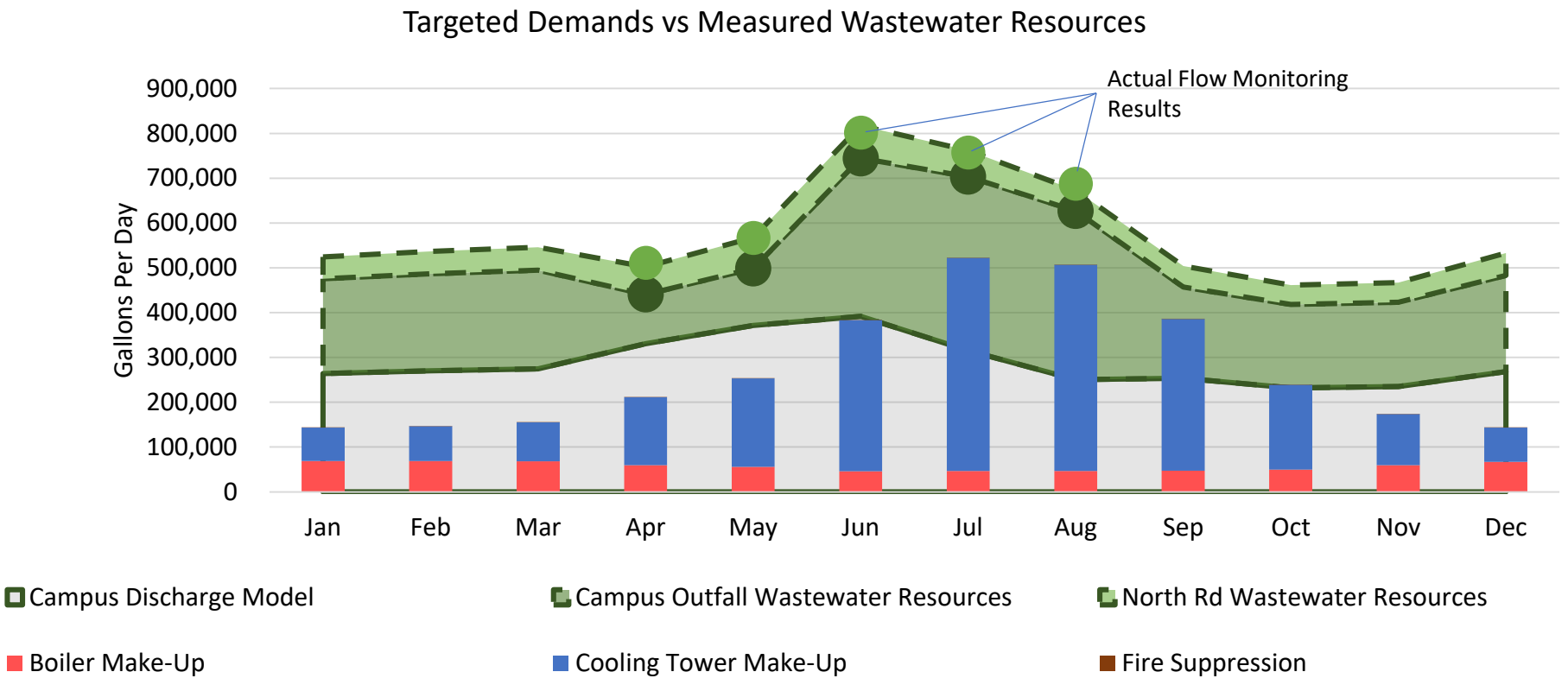


Treatment Process Design

TASKS:

- Catalogue existing utility / process water equipment at targeted reclaimed water end use locations
- Assess process water equipment conditions (w/ Azure Water)
  - Corrosion Rates
  - Non-destructive testing
  - Inspection reports
- Review chemical treatment program administration / maintenance
  - Operator logs
  - Disinfection / Inhibition Program
- Validate operating loads and water demands / diurnal profiles
- Review district energy expansion / modification plans & assess future operating loads
- Establish baseline water quality characteristics

System Design Basis



Parameter	Unit	Influent	Effluent	Standard
BOD	mg/l	183.87	< 10	Class A
TSS	mg/l	151.71	< 5	Class A
pH	S.U.	7.22	6.5 - 8.5	Class A
Turbidity	NTU	72.44	< 2	Class A
Total Nitrogen	mg/l	36.0	< 10	Class A
Fecal Coliform	Col/100ml	--	Non-detect	Class A
Conductivity Tower	uhms	1,000	< 250	End Use
Conductivity Boiler	uhms	730 - 1,100	< 50	End Use

FIELD INVESTIGATION:

- 7 Days of Composite Sampling
- 120 Days of Flow monitoring
- Ongoing to provide highest quality dataset

- Campus Outfall:
  - Avg Flow - 575k GPD
  - Est Annual – 190 MGY
- North Rd Outfall Avg:
  - Avg Flow - 56k GPD
  - Est Annual – 20 MGY

EFFLUENT DESIGN:

- State Class A Standard
- Additional End Use Standards

The WaterHub at Emory University


OUTDOOR WETLANDS


INTERIOR HYDROPONICS


LABORATORY SPACE

CLIENT TYPE
Private University

LOCATION
Atlanta, GA

HYDRAULIC CAPACITY
440,000 GPD

FOOTPRINT
Building: 3,500 ft^2
Lower Site: 3,000 ft^2

COMMERCIAL OPERATION
May 2015

END USES
Boiler Make-Up
Cooling Tower Make-Up
Toilet Flushing

TECHNOLOGIES APPLIED
Hydroponic – MBBR
Reciprocating Wetlands

The WaterHub at Emory University

CAPABILITIES:

- Up to 400K GPD and 146M GPY Capacity
- Displaces Up to 40% of Total Campus Demand
- Reduces Up to 70% of Campus Wastewater
- Displaces 90% of Utility Water Demand
- Living, Learning Laboratory

PERFORMANCE TO DATE

- 95% of City Water Displaced at Cooling Towers
- Averaging 7 Million Gallons per Month Campus Wide
- 280 Million Gallons of Water Delivered since May 2015
- 99% Up-Time Reliability
- Over 5,000 tours conducted

The WaterHub – Living & Learning Lab

EMORY | news center

Fall courses offer fresh perspectives on high-profile issues

By Laura Douglas-Brown and Leslie King | Emory Report | Aug. 24, 2016

Students taking Water and Sanitation in Developing Countries will gain hands-on experience through fieldwork at the Emory WaterHub. Here, professor Christine Moe (second from left) visits the Waterhub to plan water-sampling locations for the class assignment with student Yvonne Kienast, assistant research professor Amy Kirby and student Emeka Anderson. Emory Photo/Video

Emory's fall semester courses bring critical insights to current events and offer new approaches to familiar subjects.

Students will explore high-profile topics like the presidential election, the refugee crisis, Islamophobia and the global struggle for human rights, while also gaining unique perspectives from Emory resources such as the Waterhub and the upcoming display of Shakespeare's First Folio, which Emory was selected to host for the state of Georgia.

Here is a sample of fall classes, from first-year seminars to graduate courses, that are timely, creative or just plain cool.

Appcology: New Commerce Infrastructure

Instructor: Benn Konsynski, George S. Craft Distinguished University Professor of Information Systems & Operations Management

Cool factor: With the assistance and experience of actual app developers, we will explore the design and creations of these "snackable" applications for mobile and desktop environments. The course will consider the opportunities for new patterns of communication between organizations and their mobile stakeholders.

Course description: The course will explore issues associated with the emerging types of services, changing forms of software ecosystems and commerce interactions, development of real apps, gizmos and widgets.

> "THE WATERHUB PROVIDES 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."
>
> - CHRISTINE MOE, DIRECTOR OF THE CENTER FOR GLOBAL SAFE WATER, EMORY UNIVERSITY

EDUCATIONAL FEATURES:

Info / Educational Plaques & Signage
Classroom & Lab Space
Easy Access Water Quality Ports
Public Operations Monitors

NOTEWORTHY RESULTS:

- Over 4,500 tours held since May '15
- Used in graduate thesis studies
- Centerpiece of Student Docent Program
- Integrated into core coursework

RESEARCH & CURRICULUM:

- Used in the following fields:
  - Biology
  - Water, Sanitation & Hygiene (WASH)
  - Journalism
  - Chemistry
  - Law
- New Courses Introduced:
  - Water and Sanitation in Developing Countries
  - Research Methods in WASH

The Virginia WaterHub®

CLIENT TYPE
Industrial Manufacturing

LOCATION
Richmond, VA

HYDRAULIC SIZING
650,000 GPD

FOOTPRINT
Building: 8,200 ft^2
Storage Tank: 1,200 ft^2
(24 ft. hgt. & 39 ft. dia.)

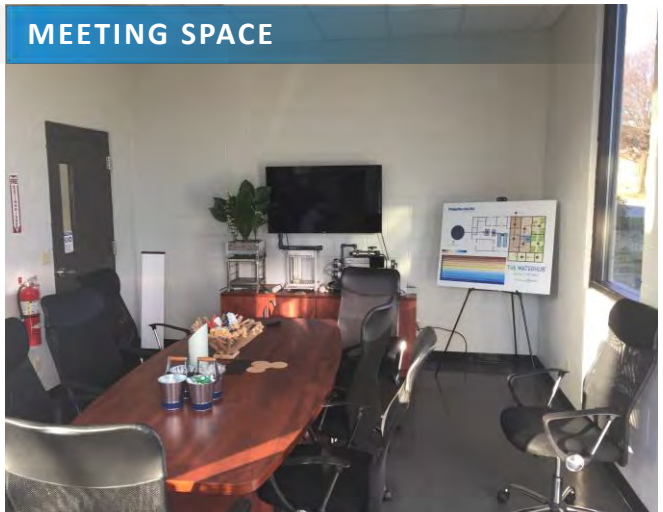
COMMERCIAL OPERATION
July 2019

END USES
Cooling Tower Make-Up
Open-Aired Chiller Make-Up

TECHNOLOGIES APPLIED
- Hydroponic – MBR
- RO Polishing

RECLAIMED STORAGE TANK

MEETING SPACE



HYDROPONIC PLANTINGS

The Virginia WaterHub®

CAPABILITIES:

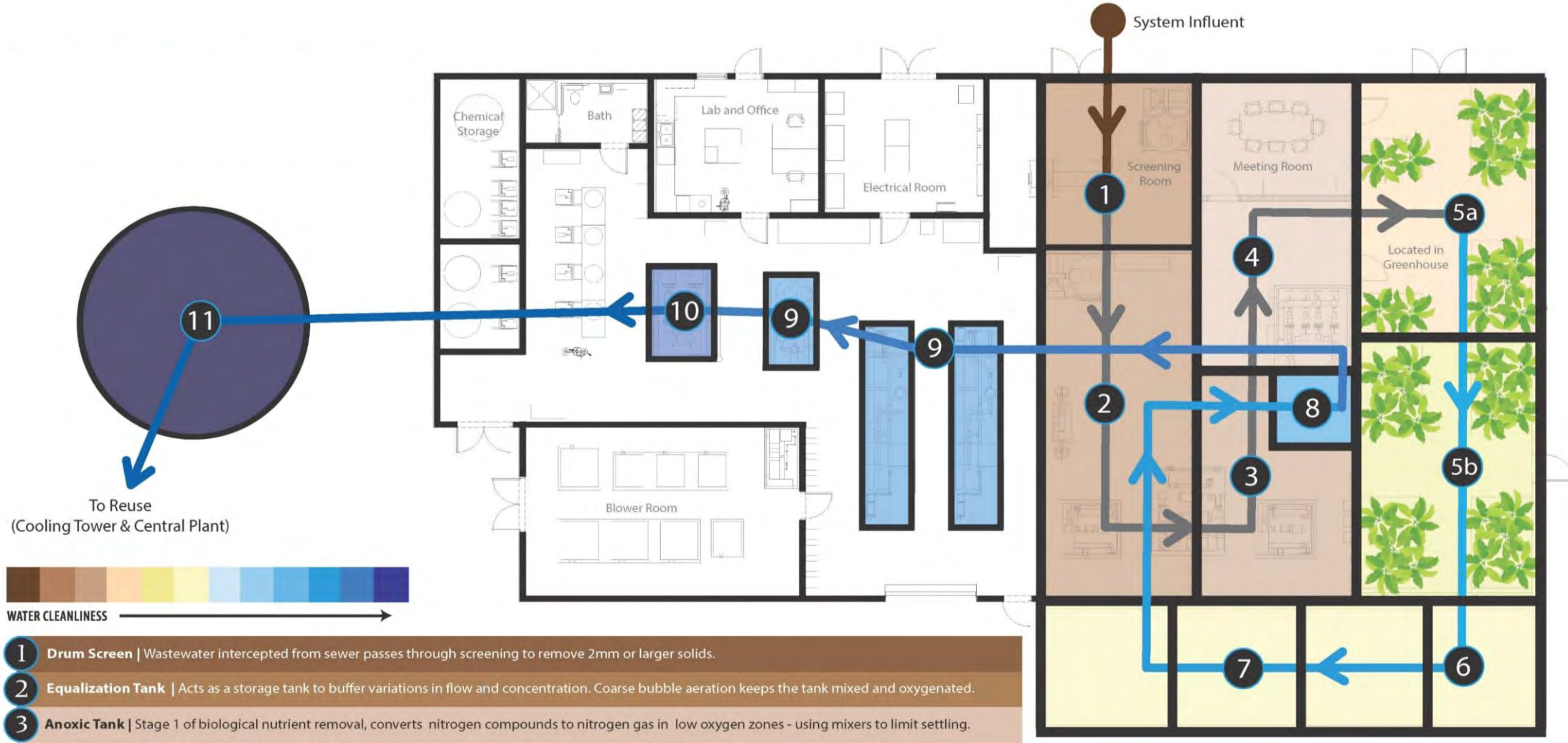
- Up to 650K GPD and 237M GPY capacity
- 40% reduction of consumed water
- 55% reduction of wastewater discharge
- Exceed corporate KPI (25%) in water reduction
- Sustainability featured in campus tour

PROJECT GOALS:

- Conserve community water resources
- Provide leadership in water sustainability
- Relieve strain on local municipal infrastructure
- Insulate operational viability & supply chain

Virginia WaterHub® Goals

- Conserve community water resources
- Provide leadership in water sustainability
- 40% reduction in consumed water
- 55% wastewater discharge reduction
- Relieve strain on local municipal infrastructure
- Insulate operational viability & supply chain



1 **Drum Screen** | Wastewater intercepted from sewer passes through screening to remove 2mm or larger solids.

2 **Equalization Tank** | Acts as a storage tank to buffer variations in flow and concentration. Coarse bubble aeration keeps the tank mixed and oxygenated.

3 **Anoxic Tank** | Stage 1 of biological nutrient removal, converts nitrogen compounds to nitrogen gas in low oxygen zones - using mixers to limit settling.

4 **Aerobic Tank** | Blowers and fine bubble diffusers provide mixing and oxygenation that support bacterials respiration to consume organic materials.

5 **Hydroponic Reactor** | Specific plant species, suspended over aerobic tanks, grow roots into the reactor to provide additional surface area for fixed-film microorganisms..

6 **Post Anoxic Flex Reactor** | The final biological treatment step is a flexible tank operated in either aerobic or anaerobic conditions to remove residual organics or nitrogen.

7 **Submerged Membranes** | Water passes through a 0.5 micron membrane to remove biosolids. The rejected biosolids recycle to anoxic tank for continued microbial growth.

8 **Permeate Tank** | Effluent from submerged membranes is stored here after passing through an ultraviolet disinfection (UV) system that inactivate pathogens.

9 **Reverse Osmosis (RO)** | An RO system treats a side-stream of flow to remove residual minerals and blended into the effluent stream to achieve target conductivity levels.

10 **Reclaimed Water Distribution Pumps** | Pumps designed to supply reclaimed water flow and pressure to industrial users.

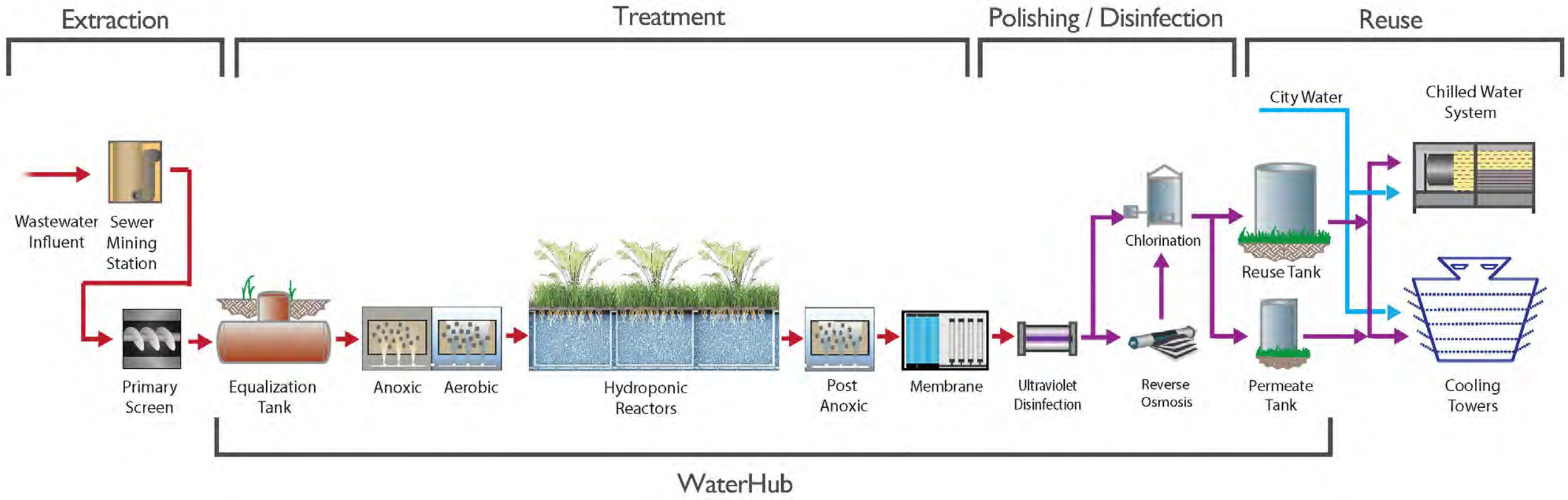
11 **Reuse Tank** | Tank to provide clean water storage and chlorine pathogen disinfection.

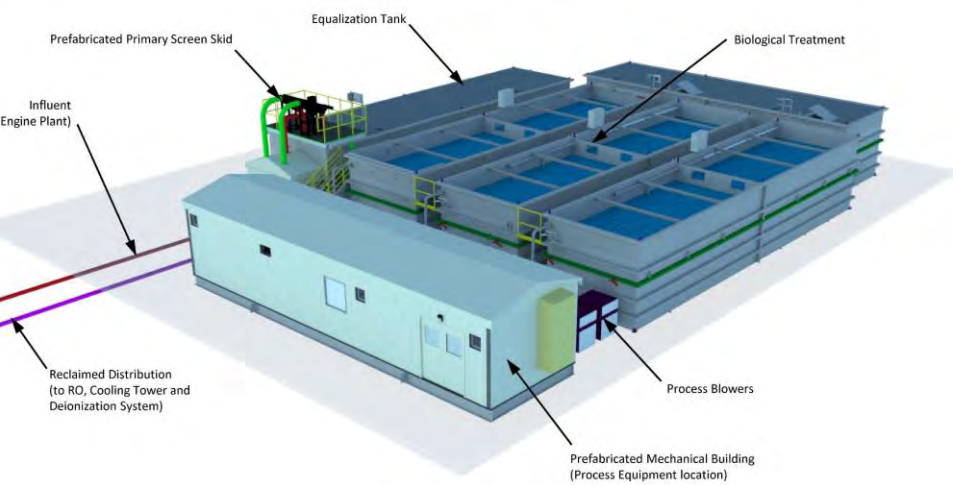
THE WATERHUB®

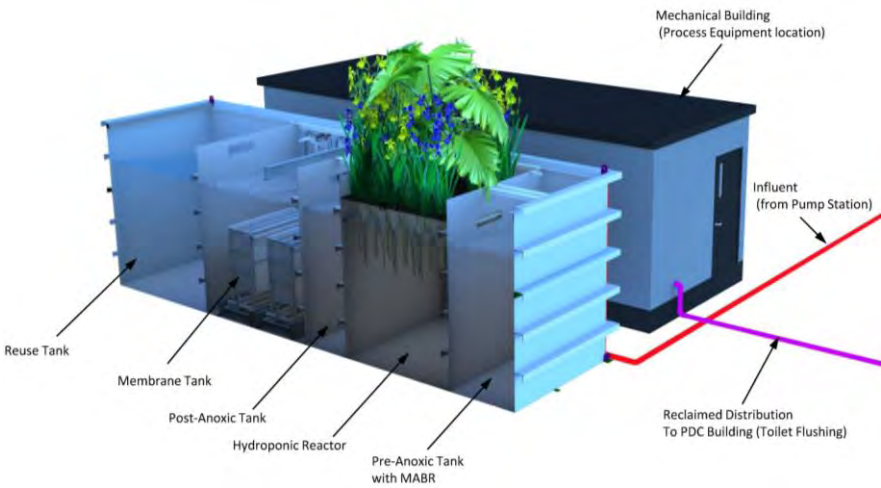
HOW IT WORKS

SUSTAINABLE WATER®

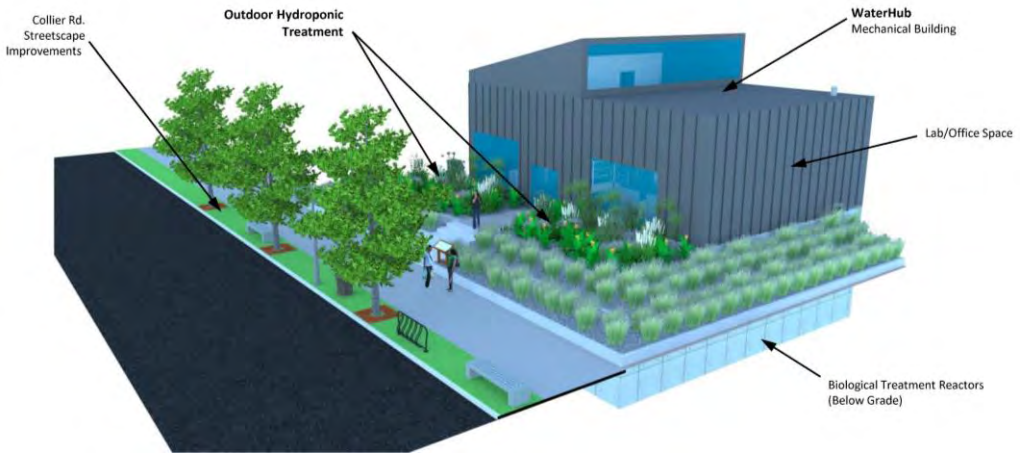
The Virginia WaterHub®
Process Design

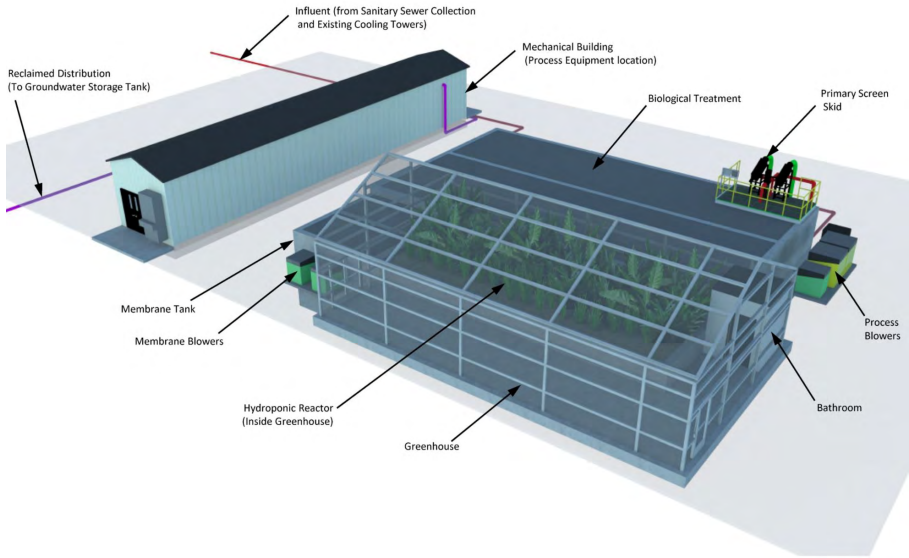




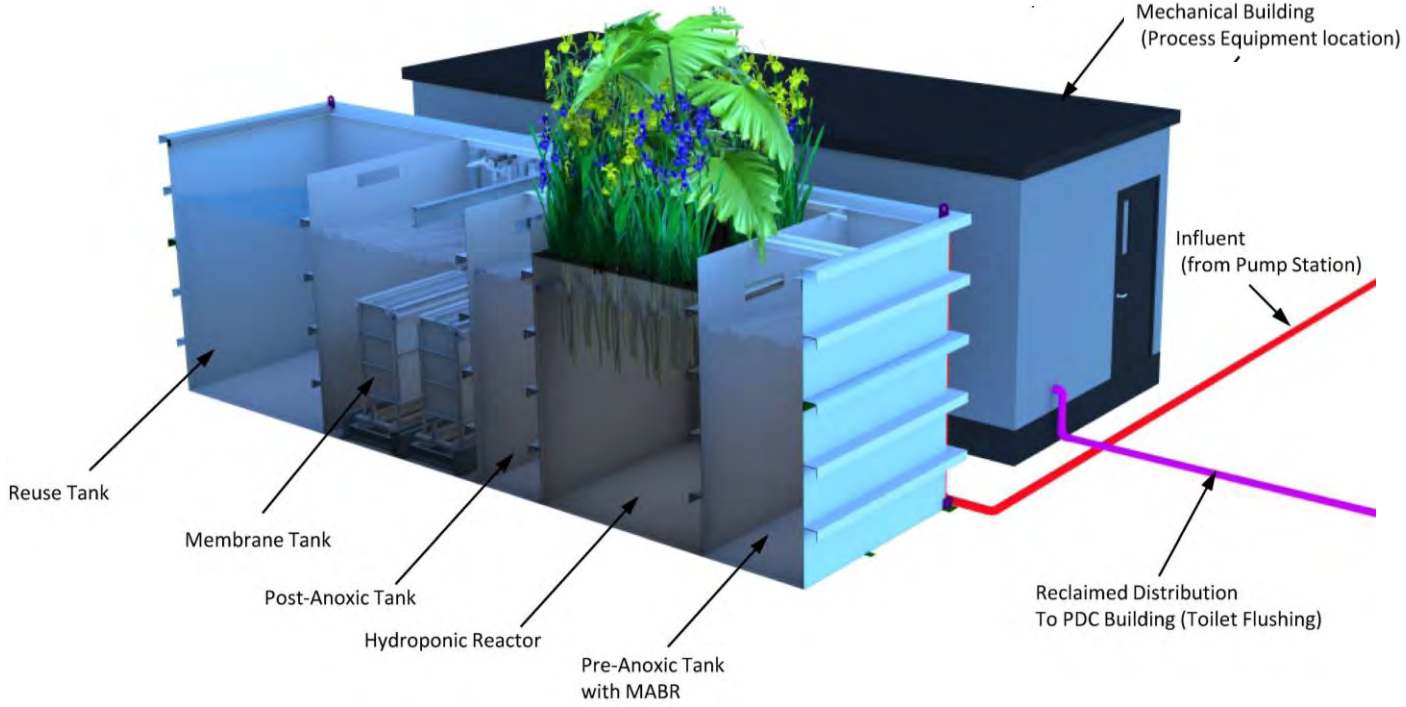


UPCOMING PROJECTS





City of Austin PDC WaterHub®



LOCATION
Austin, TX

CLIENT
City of Austin

PROJECT TYPE
Building-Scale Wastewater Reclamation & Reuse

HYDRAULIC CAPACITY
5,000 GPD

FOOTPRINT
800 ft^2

COMMERCIAL OPERATION
Summer 2021

END USES
Building Toilet Flushing

TECHNOLOGIES APPLIED
Tertiary: Membrane Bioreactor (MBR)
Disinfection: Dual-Stage UV & Chlorine

City of Austin PDC WaterHub®

The WaterHub® at The University of Texas at Austin

CLIENT TYPE
Public University

LOCATION
Austin, TX

PROJECT DESCRIPTION
District-Scale Wastewater Reclamation and Reuse

HYDRAULIC CAPACITY
1,000,000 GPD

FOOTPRINT
15,000 ft^2

COMMERCIAL OPERATION
Spring 2021

END USES
Cooling Tower Make-Up
Boiler Make-Up

TECHNOLOGIES APPLIED
Hydroponics
Membrane Bioreactor (MBR)
Reverse Osmosis

Procurement Process at UT-Austin

Texas Comptroller of Public Accounts
Glenn Hegar

DBOO - District-Scale Water Reclamation and Reuse Facility

Status: Closed **Solicitation ID:** 18UTL006

Response Due Date: 4/13/2018

Response Due Time: 2:00 PM

Agency Number: 721

Days Solicited: 21+ Days for Solicitation Notice

Solicitation Posting Date: 3/5/2018

Last Modified: 4/13/2018 2:00 pm

Solicitation Description: The University is seeking qualified teams indicating their interest and qualifications for the design, build, own and operation of a district-scale water reclamation and reuse system. This document provides preliminary project details to solicit information related to proposed technology, system design and cost from qualified respondents. The full project details and specifications will be presented in a Request for Proposal (RFP), which will be issued to prequalified Respondents only. A pre-submittal conference will be held at the time and location described below. March 19, 2018 at 2:00 PM local time The University of Texas at Austin Utilities and Energy Management Department 215 East 24th St, PPE Rm. 3.304 Austin, Texas 78712

Class/Item Code: 90922-Building Construction, Non-Residential (Office Bldg., Etc.)

Attachments

#	Name	Description
1	ESBD_File_125545_DB RFQ.pdf	DBOO - RFQ
2	ESBD_File_125545_Addendum#1.pdf	Addendum#1
3	ESBD_File_125545_Exhbit H-Bldg Construction Revised 09182017.docx	HUBH
4	ESBD_File_125545_Exhbit h-Professional Services 08042017 #2.docx	HUBh

REQUEST FOR QUALIFICATIONS FOR
DESIGN/BUILD/OWN/OPERATE

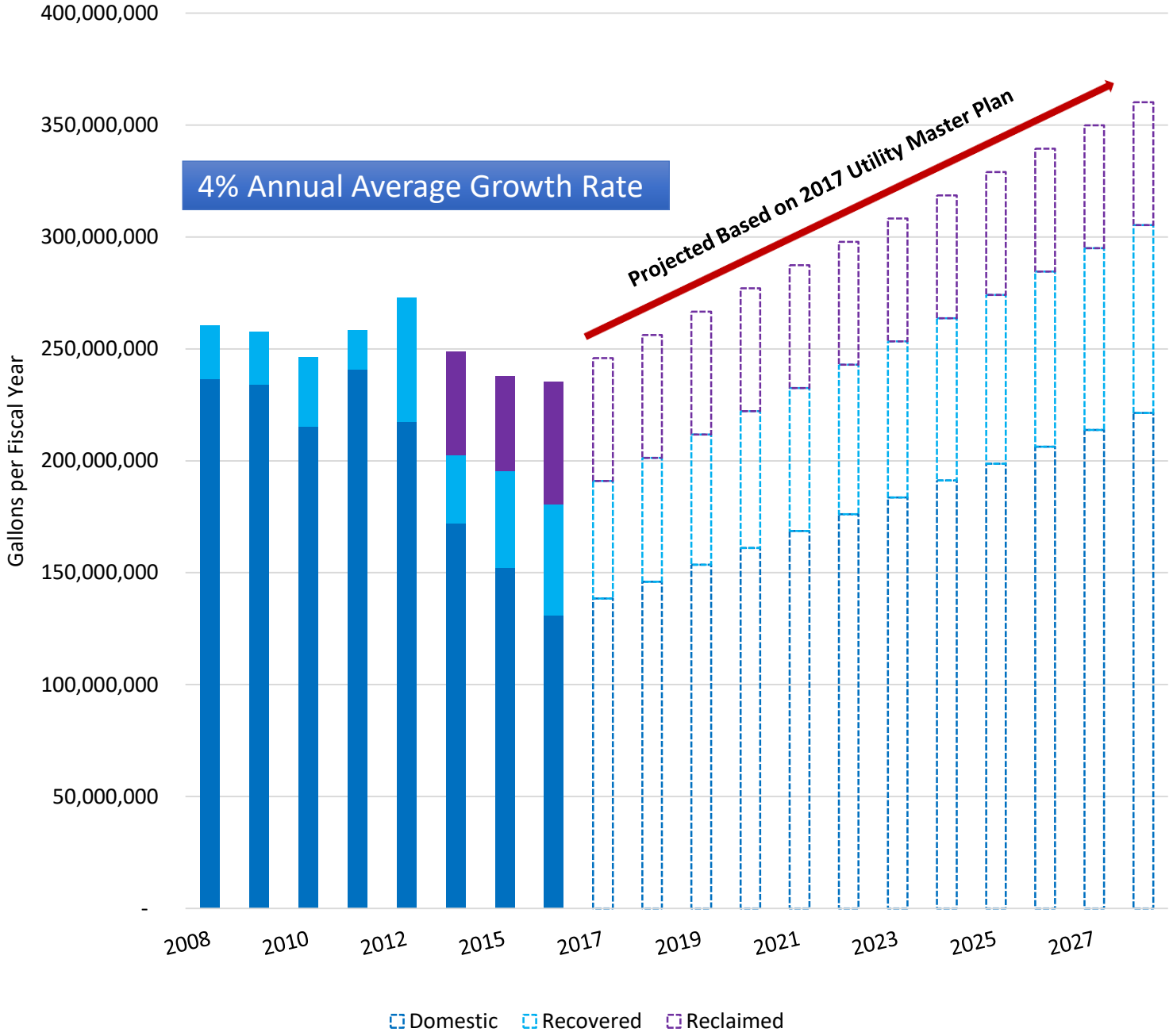
The University of Texas at Austin
District-Scale Water Reclamation and Reuse Facility
RFQ No.: ***18UTL006***

RFQ SUBMITTAL DUE DATE: ***Apr. 13, 2018***

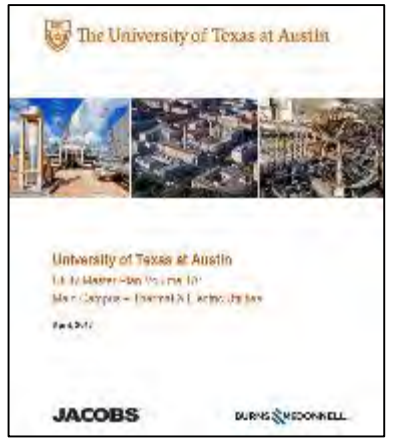
RFQ ISSUE DATE: ***March 5, 2018***

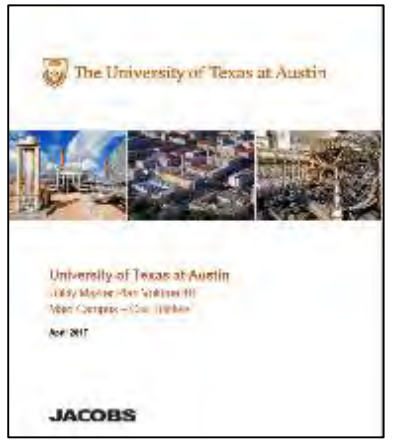
Prepared By:
Ken Bonin, Contract Administrator
The University of Texas at Austin
BFS - UEM
215 East 24th Street
Austin, Texas 78712
512-232-6296
ken.bonin@austin.utexas.edu

Projected Chilling Station M/U By Source



TEXAS
The University of Texas at Austin

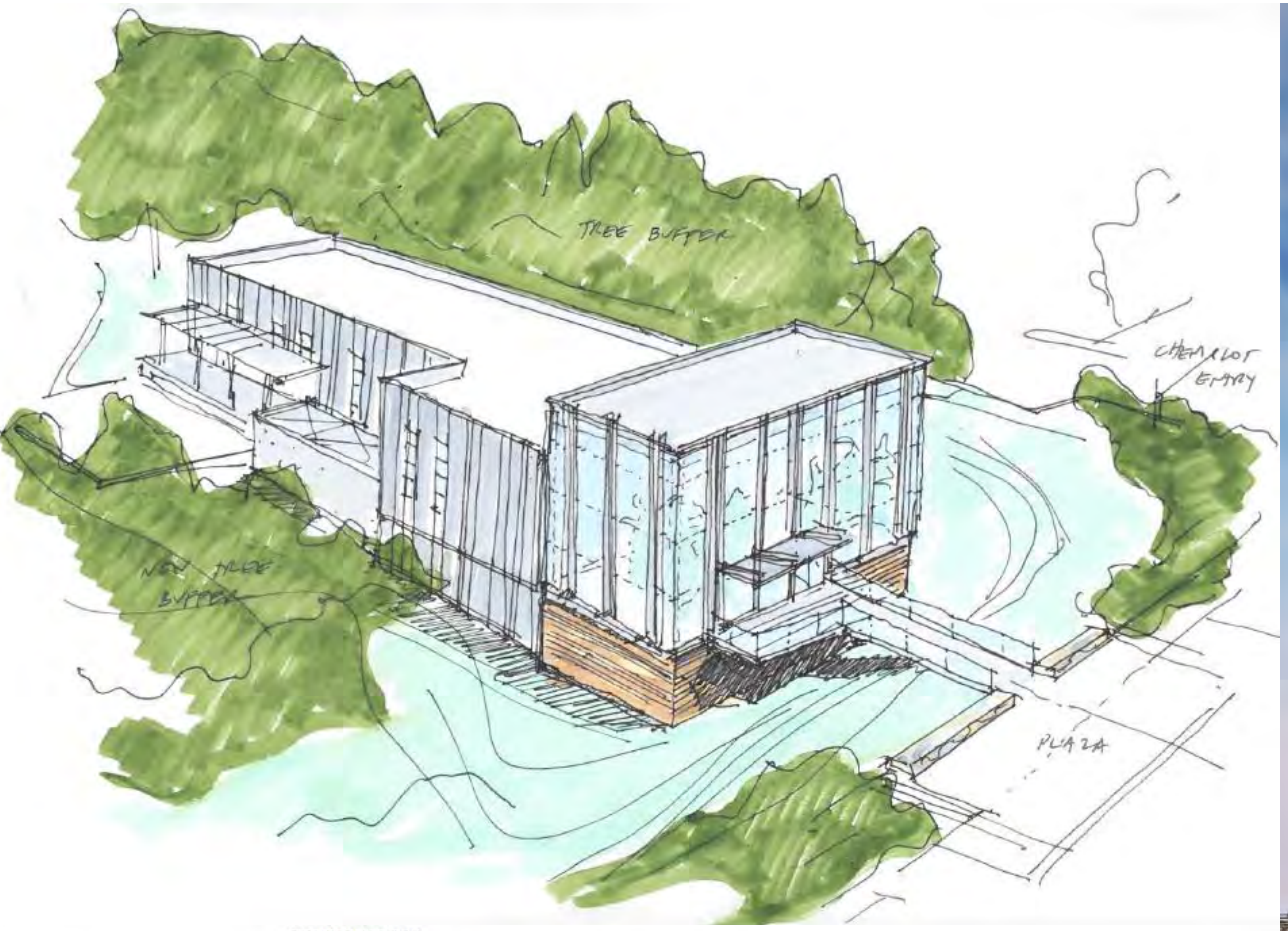


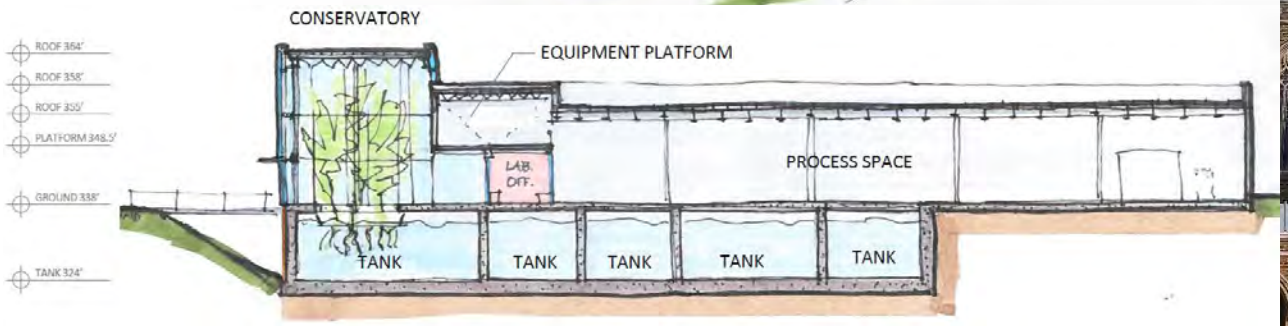


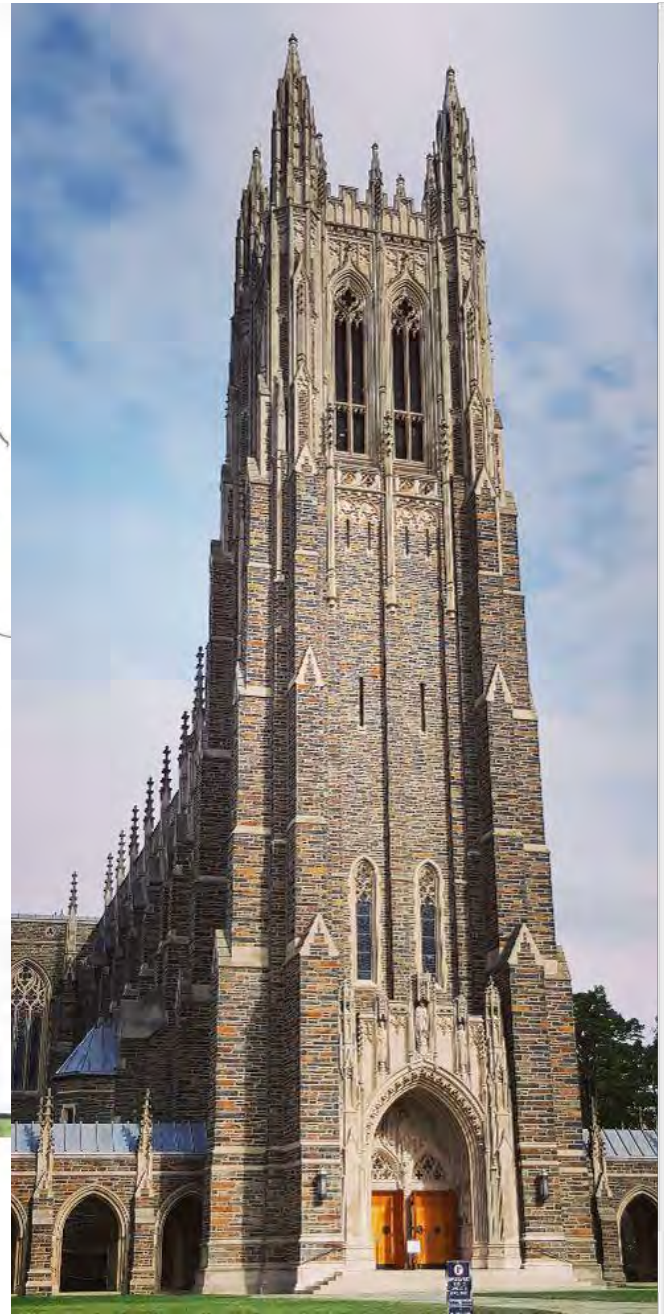
Projected Chilling Station Demands

- **Based on 2017 Utility Plan**
  (does not include Weaver PP)
- **2016 Demand**
  - 31,328 Peak Tons
  - 235 MGY cooling m/u
    - Domestic: 131 MGY
    - Recovered: 49 MGY
    - Reclaimed: 55 MGY
- **2028 Cooling Projections**
  - 53% Increase
  - 47, 675 peak tons
  - 360 MGY cooling m/u
    - Domestic: 221 MGY
    - Recovered: 84 MGY
    - Reclaimed: 55 MGY

The WaterHub® at Duke University







CLIENT TYPE
Private University

LOCATION
Durham, NC

PROJECT DESCRIPTION
- District-Scale Wastewater Reclamation & Reuse
- Develop Sustainable Water Management District

HYDRAULIC CAPACITY
600,000 GPD

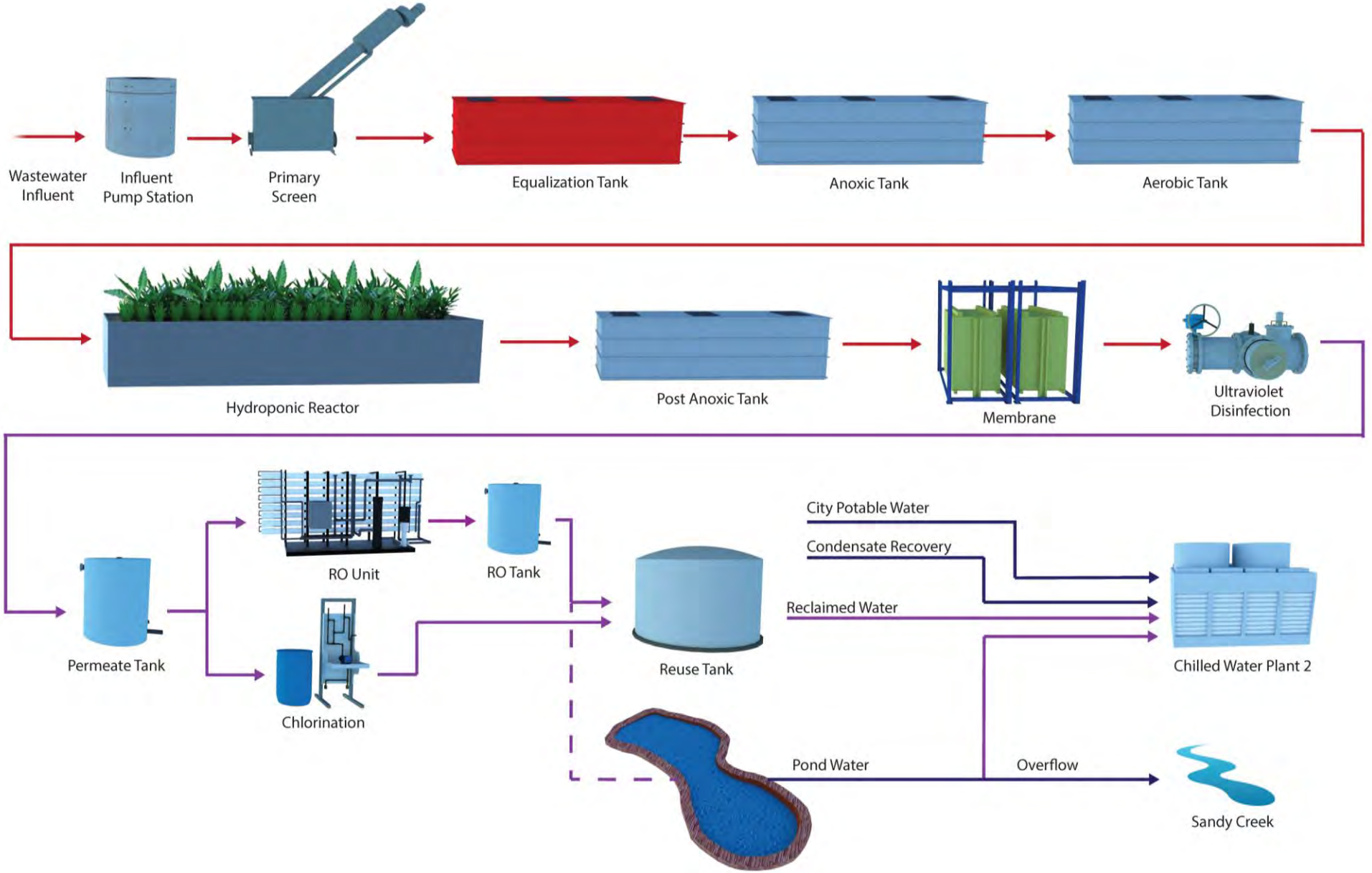
FOOTPRINT
9,400 ft^2

COMMERCIAL OPERATION
Spring 2021

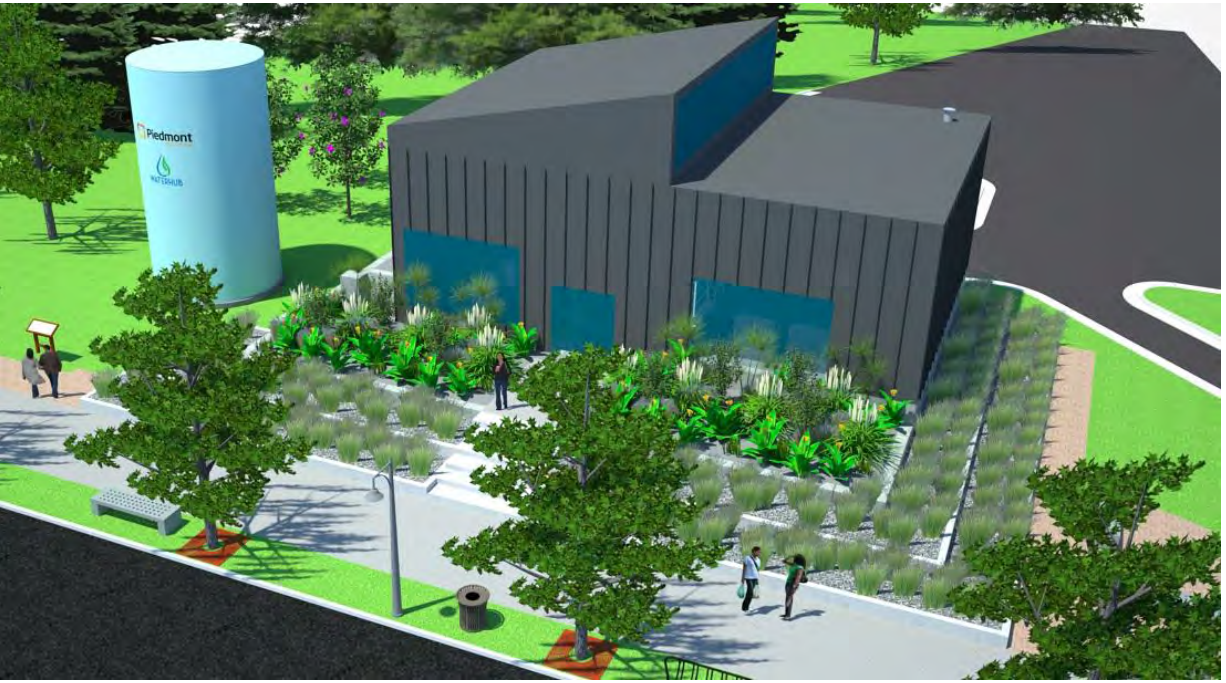
GOALS / OUTCOMES
- Utility / Operational Resiliency
- Reuse 120 MGY
- 45% decrease in discharge

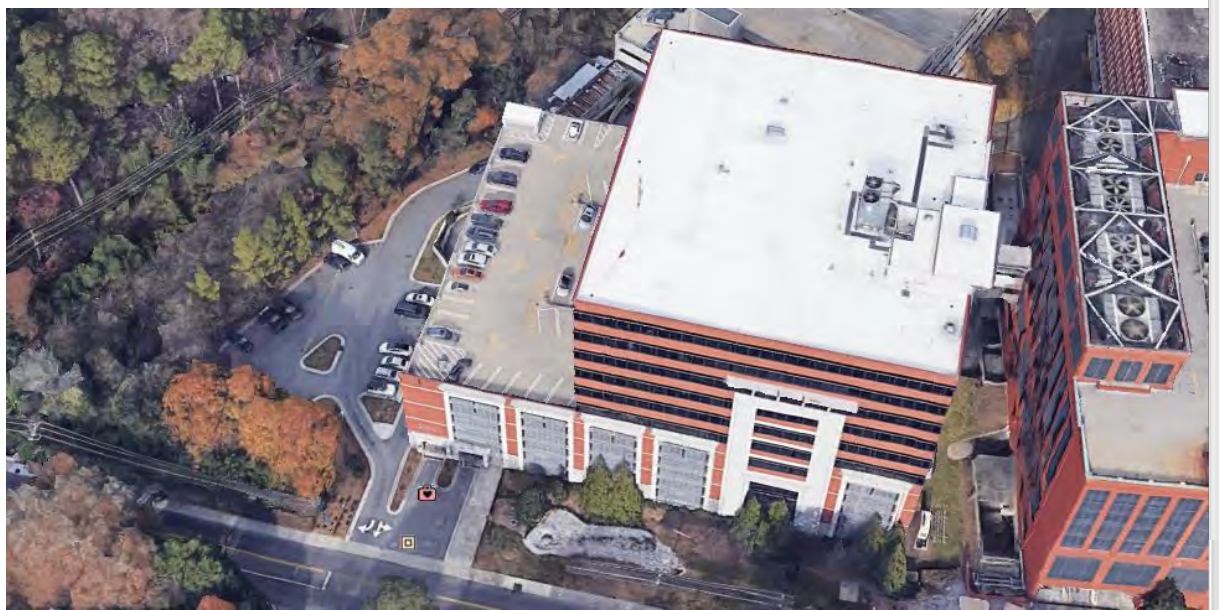
The WaterHub® at Duke University

The WaterHub® at Duke
Process Design



The WaterHub® at Piedmont Atlanta Hospital





LOCATION
Atlanta, GA

CLIENT
Piedmont Healthcare

PROJECT TYPE
Campus-Scale Wastewater Reclamation & Reuse

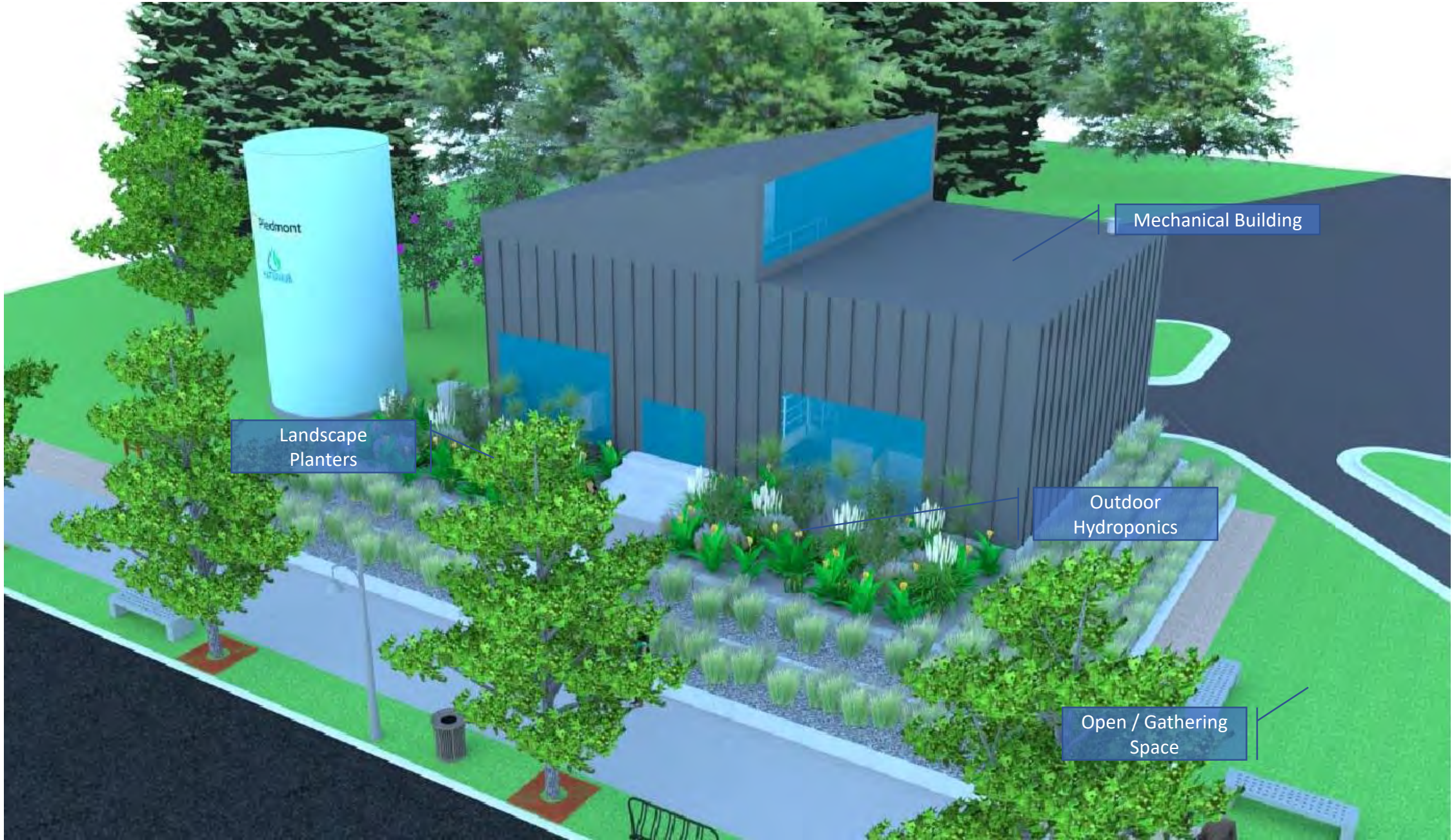
HYDRAULIC CAPACITY
250,000 GPD

FOOTPRINT
4,300 ft^2

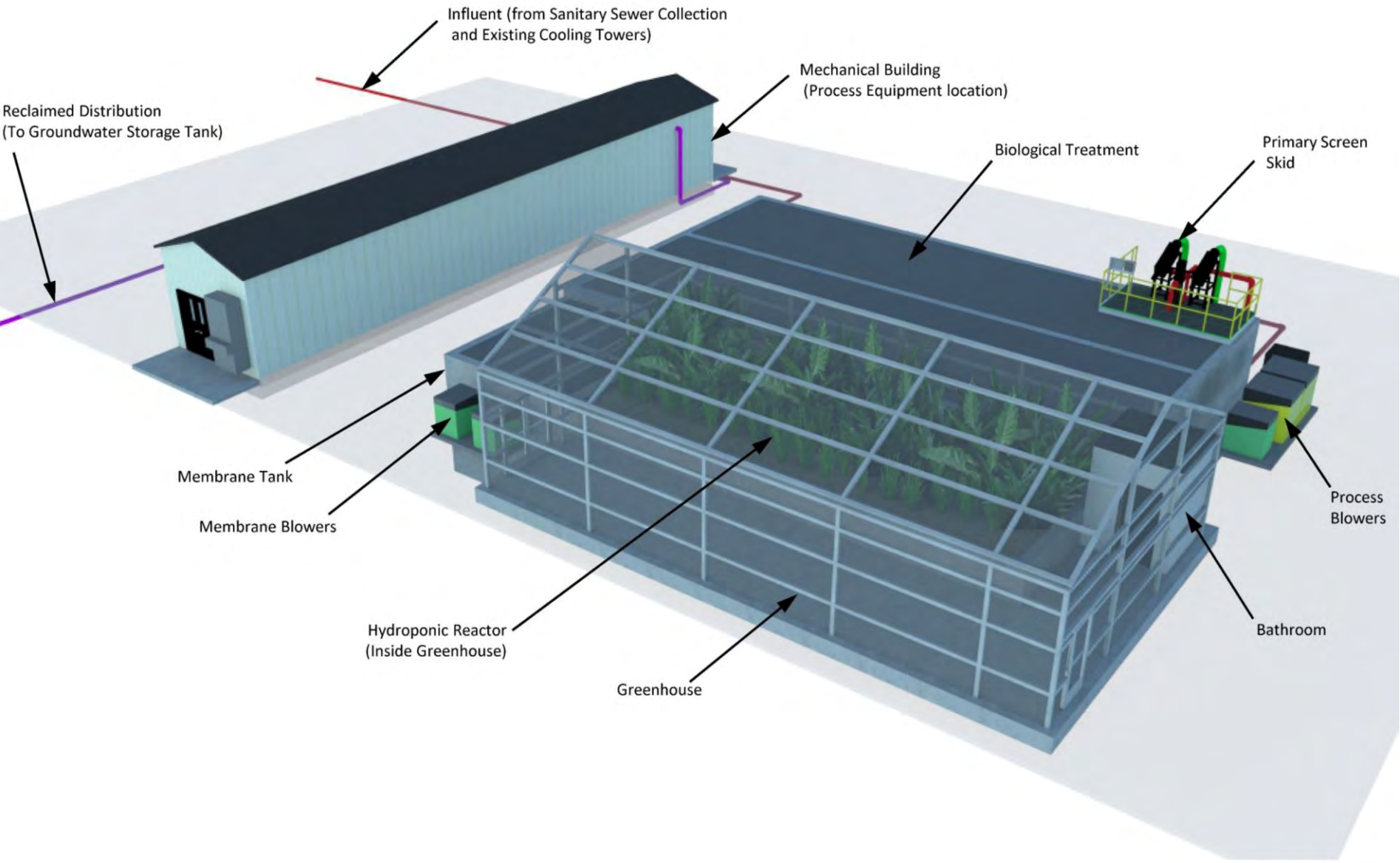
GOALS
- Resilient Utility Operations
- Water Conservation
- 75% Decrease in Discharge
- Enable Future Development

TECHNOLOGIES APPLIED
Outdoor Hydroponics
Tertiary: Membrane Bioreactor (MBR)
Disinfection: Dual-Stage UV & Chlorine

The WaterHub® at Piedmont Atlanta Hospital



The WaterHub® at Rocky Mount



CLIENT TYPE
Automotive Manufacturing

LOCATION
Rocky Mount, NC

HYDRAULIC CAPACITY
75,000 GPD

FOOTPRINT
5,500 ft^2

COMMERCIAL OPERATION
Winter 2019

END USES
Boiler Make-Up
Cooling Tower Make-Up
Toilet Flushing

TECHNOLOGIES APPLIED
Hydroponic – MBR

The WaterHub® at Rocky Mount

CAPABILITIES:

- 100% factory up-time/plant production
- Up to 75K GPD and 27M GPY capacity
- 34% reduction of consumed water
- 90% reduction of wastewater discharge
- 15M gallons of reused water annually

PROJECT GOALS:

- Redundant (N + 1) water supply for utilities
- Drought protection
- Long-term economic savings
- Provide leadership in water sustainability
- Insulate operational viability & supply chain

Lessons Learned: General

Don’t Underestimate Public Interest

- Tours, Program Space, Community Outreach
- 4,500 Tours at Emory University

Facility Design Aesthetics

- Public access areas from Front to Back of House
- Pedestrian circulation through system
- Fully enclosed mechanical areas & better operator access

Data Collection & Field Investigations

- Never “too much” operational, sampling & flow data
- Strong data collection investigations in preliminary engineering, save time and money down the road

Lessons Learned: Process

Pre-Fabrication

- Hydraulic “Sweet-spots” to more or less prefabrication
- Skids, Tanks, Operator Rooms

Process Resiliency

- Equipment Redundancy (Primary screening, Influent Pumps, UV, etc.
- Dual Process Trains
- You can’t optimize what isn’t measured
- WQ Sensors starting in influent wet-well

Maintenance

- Removal & Maintenance of Influent Pumps from Wet Well
- Ability to Pump Backwards from Screen or EQ to flush influent lines
- Membrane / Filter Access, Location of Hoists

Turn-Down

- Contingency planning for turn-down scenarios

SUSTAINABLE WATER®

EXTENDING THE LIFECYCLE OF WATER

Bob Salvatelli | Mobile: (973) 632-8560
Bob.Salvatelli@sustainablewater.com

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