Los Angeles
Groundwater Replenishment Project

Sebastien Rossouw

Los Angeles Department of Water & Power

April 11th, 2023

Overview

City Collaboration

LA Green New Deal Goals

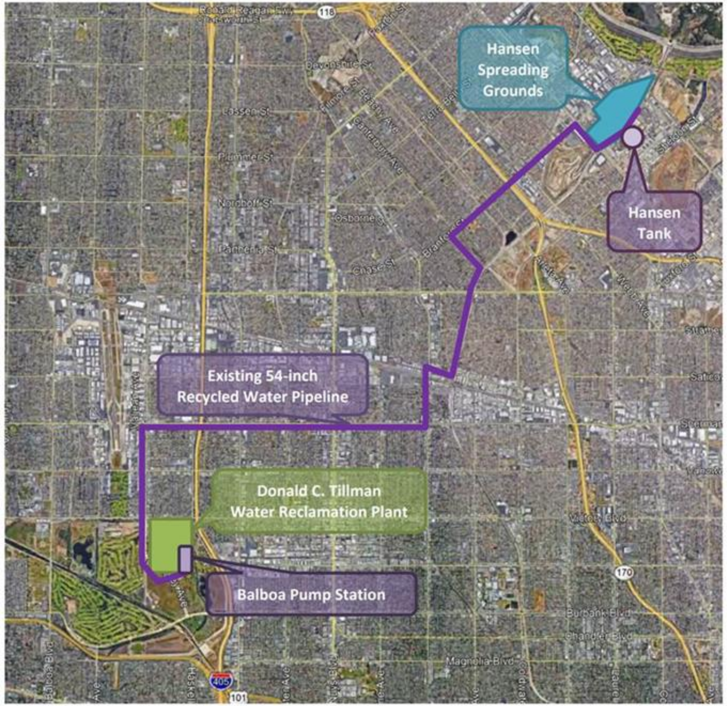
- Recycle 100% of wastewater by 2035
- Source 70% of all water locally by 2035

Project Costs

- $500 M Total Capital Cost
- $224 M WIFIA Federal Support

Project Cornerstones

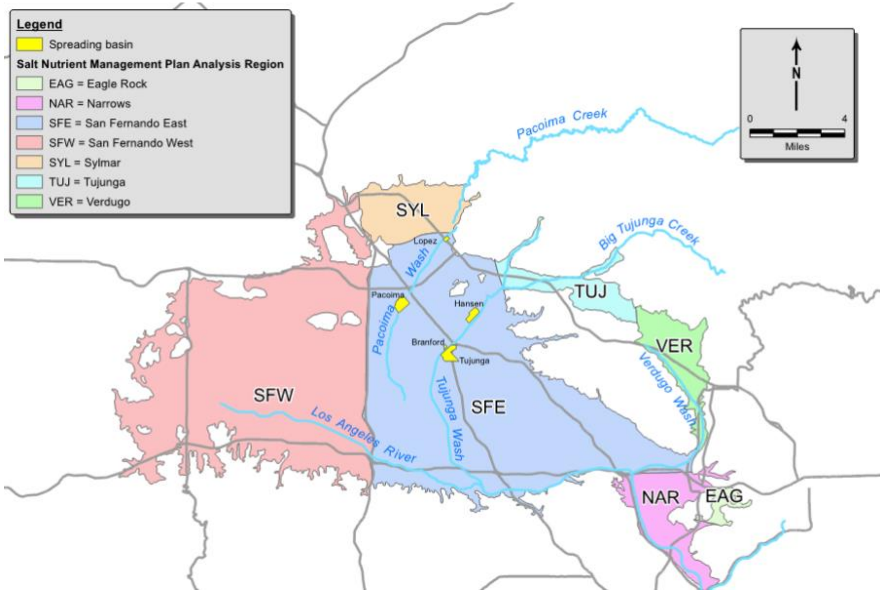
- Treatment of tertiary effluent from DCTWRP
- Conveyance to Hansen Spreading Grounds via Existing Pipeline
- Surface spreading at Hansen Spreading Grounds
  - **17,000 AFY**
  - **Will supply water to 68,000 households**



Replenishing the Aquifer

San Fernando Groundwater Basin

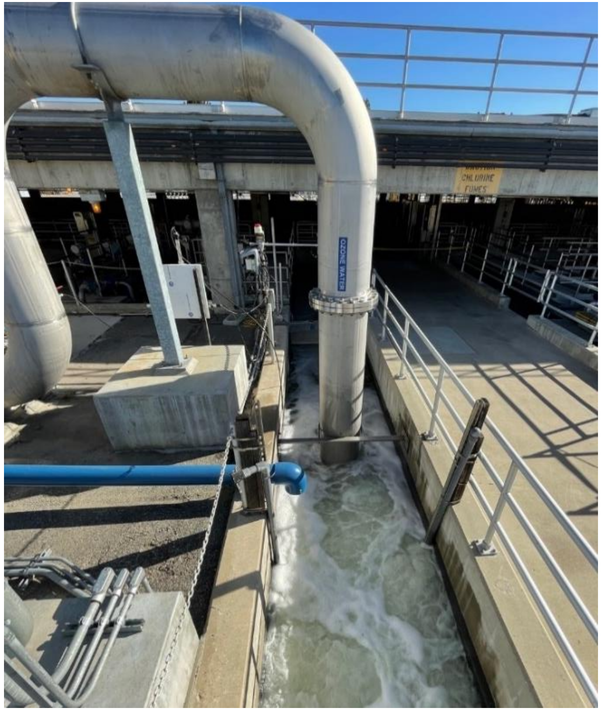
- Principal groundwater resource for the City of Los Angeles
- Up to 23% of total water supply during dry periods



Background

Piloting History Timeline

- 2010: Phase 1 Pilot
  - MF-RO-UV AOP (FAT)
- 2016: Phase 2 Pilot
  - 6 trains comparing FAT to Ozone based treatment
- 2022: Ozone Demo Project
  - Ozone pre-treatment of DCTWRP effluent



Ozone vs FAT: Pros & Cons

Ozone

Pros:

- Relatively inexpensive to construct & operate
- 100% efficient

Cons:

- No protection against some CECs

FAT

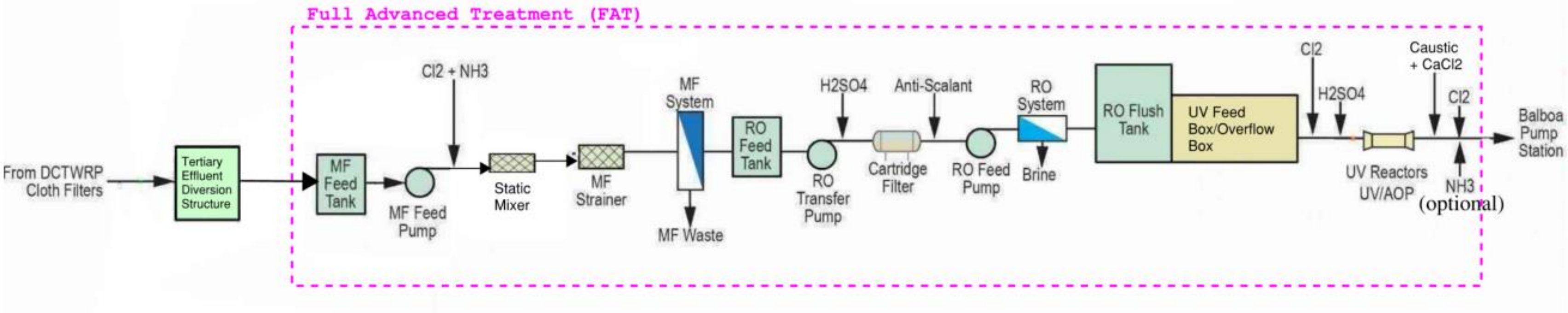
Pros:

- Treats to sub-surface injection standard
- Provides removal of many CECs

Cons:

- Operates at 80-90% efficiency

Advanced Water Purification Facility



Design

Parties Involved

LA DWP Los Angeles Department of Water & Power

LA Sanitation environment CITY OF LOS ANGELES

Hazen

Jacobs

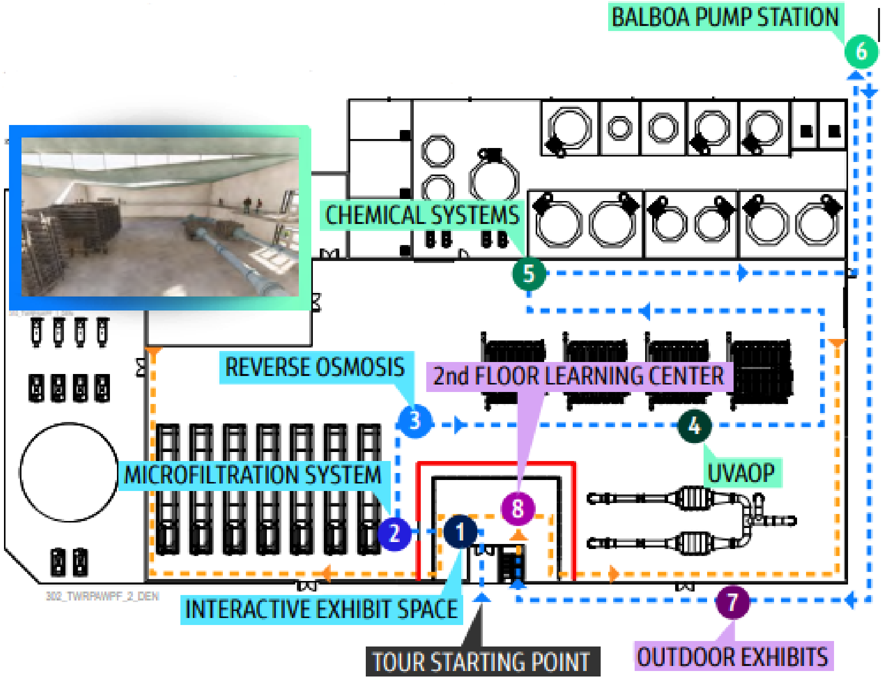
carollo

Woodard & Curran

Trussell Technologies Inc

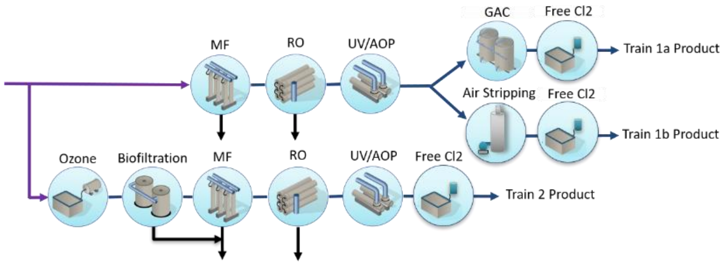
AWPF Building

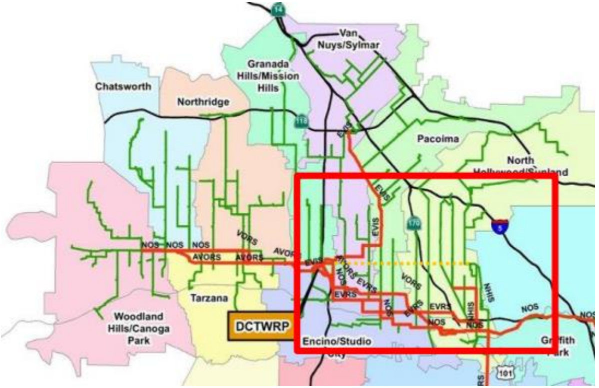
AWPF Building: Learning Center



Additional Project Considerations

- Sub-surface Injection
- Permitting
- Groundwater Management
- Leaching Study
- DPR Pilot
- Flow Increase
- Water Quality



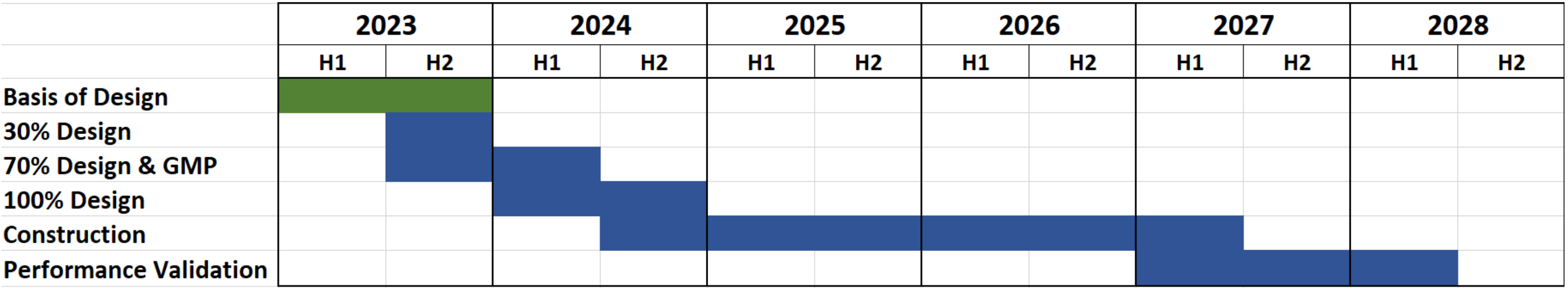


Hansen Spreading Grounds Improvements

- Goals
  - Operational flexibility
  - Increased control & monitoring
- Project Components
  - Automated Valves
  - Mechanical/Electrical Updates
  - 200 ft of New Pipe
  - Flowmeter
- 100% design by Q1 2024

LA DWP

Design Schedule



Thank you!

IN COLLABORATION WITH THE WATER RESEARCH FOUNDATION

WATEREUSE® 2023 SYMPOSIUM

MARCH 5-8, 2023 • MARRIOTT MARQUIS ATLANTA

ATLANTA, GA

REIMAGINING WATER TOGETHER

Advanced Water Treatment

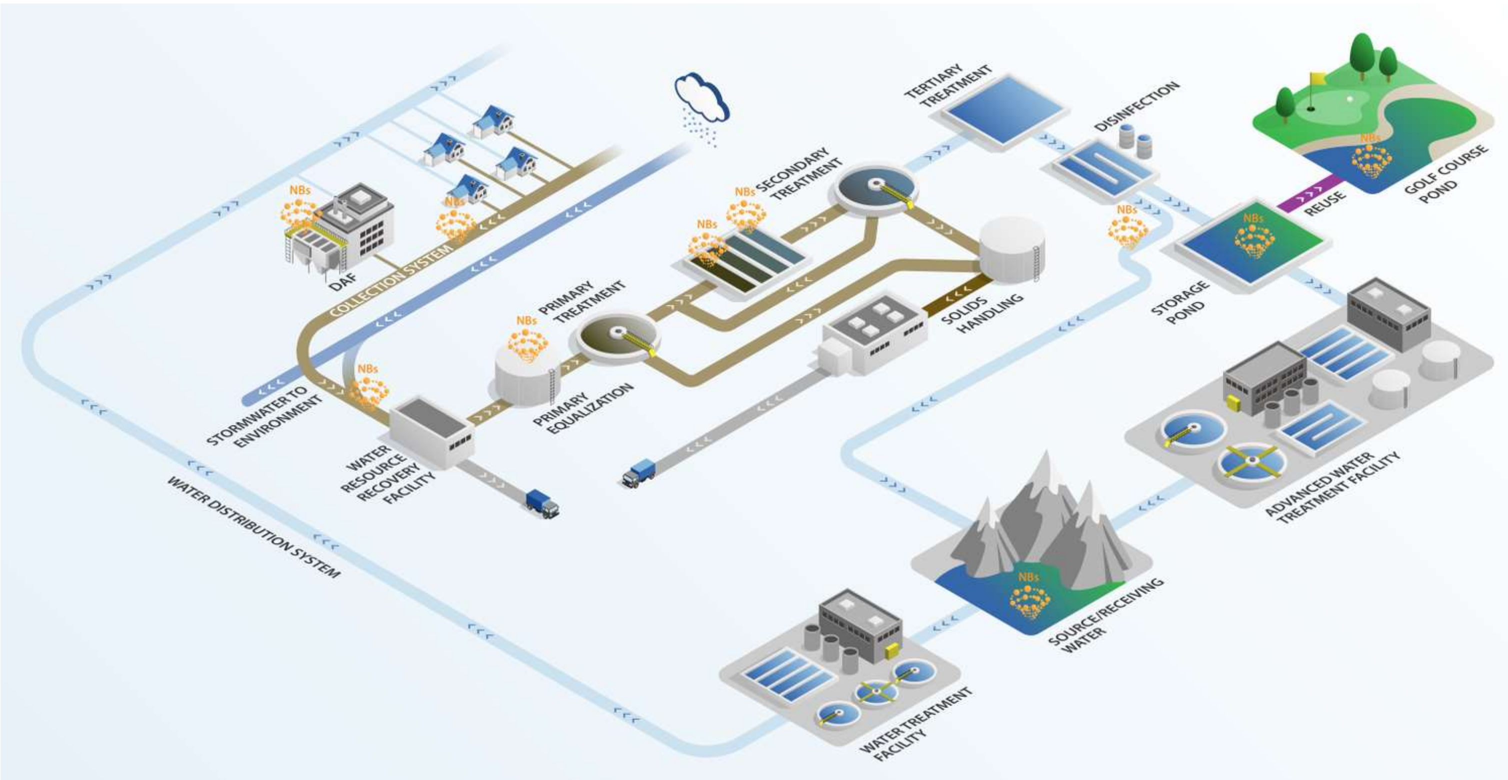
Lowering the Carbon-Footprint of Water Recycling

John Crisman and Andrea White

Moleaer, Inc.

March 8, 2023

Lowering the carbon footprint of water recycling requires that we look at all parts of the water cycle for efficiency



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The Pioneer of Nanobubble Technology at Industrial Scale

The Moleaer Mission: Increasing productivity, sustainably with nanobubble technology

2200
Commercial installations

51
Countries

760M
Gallons of Water per Day

9
Foundational patents & patent applications

86
Employees and growing

Primary markets with proven results: >2200 projects

Samples of game-changing benefits achieved across industries

Agriculture ***Supersaturate irrigation water w/ O_2 NBs***

Increase crop production up to **56%** in **500+**

Aquaculture ***Lower cost of O2***

Reduce **oxygen use by 75%** and reduce its environmental impact

Water Recycling ***Pre-treat to improve treatment performance***

Increase treatment capacity by up to **25%** and reduce energy usage by up to **40%**

Surface Water ***Chemical-free Odor & Algae Control***

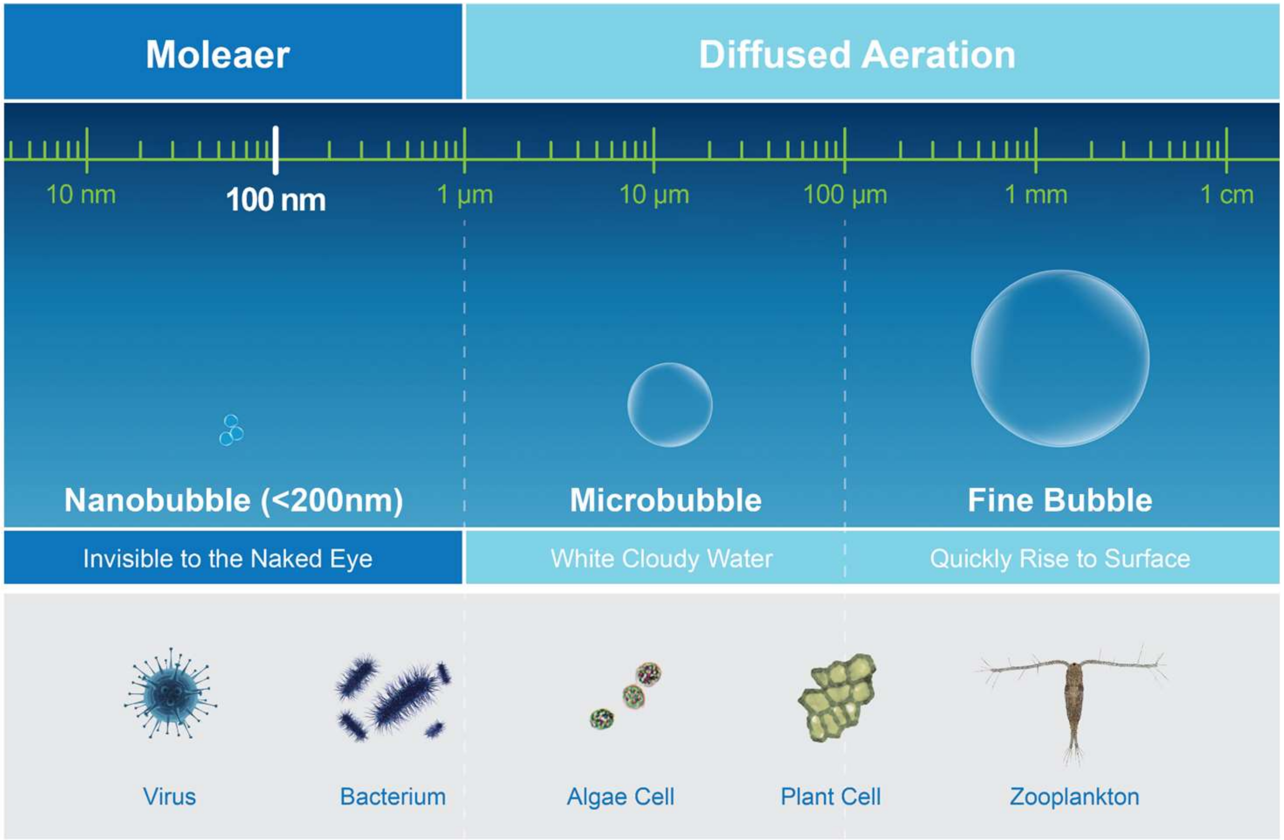
Restore the aquatic ecosystems of **250+** bodies of water without chemicals

Oil & Gas ***Well Stimulation to increase oil production***

Increase oil production >30% thru waterfloods and well stimulation

What are Nanobubbles(NBs)?

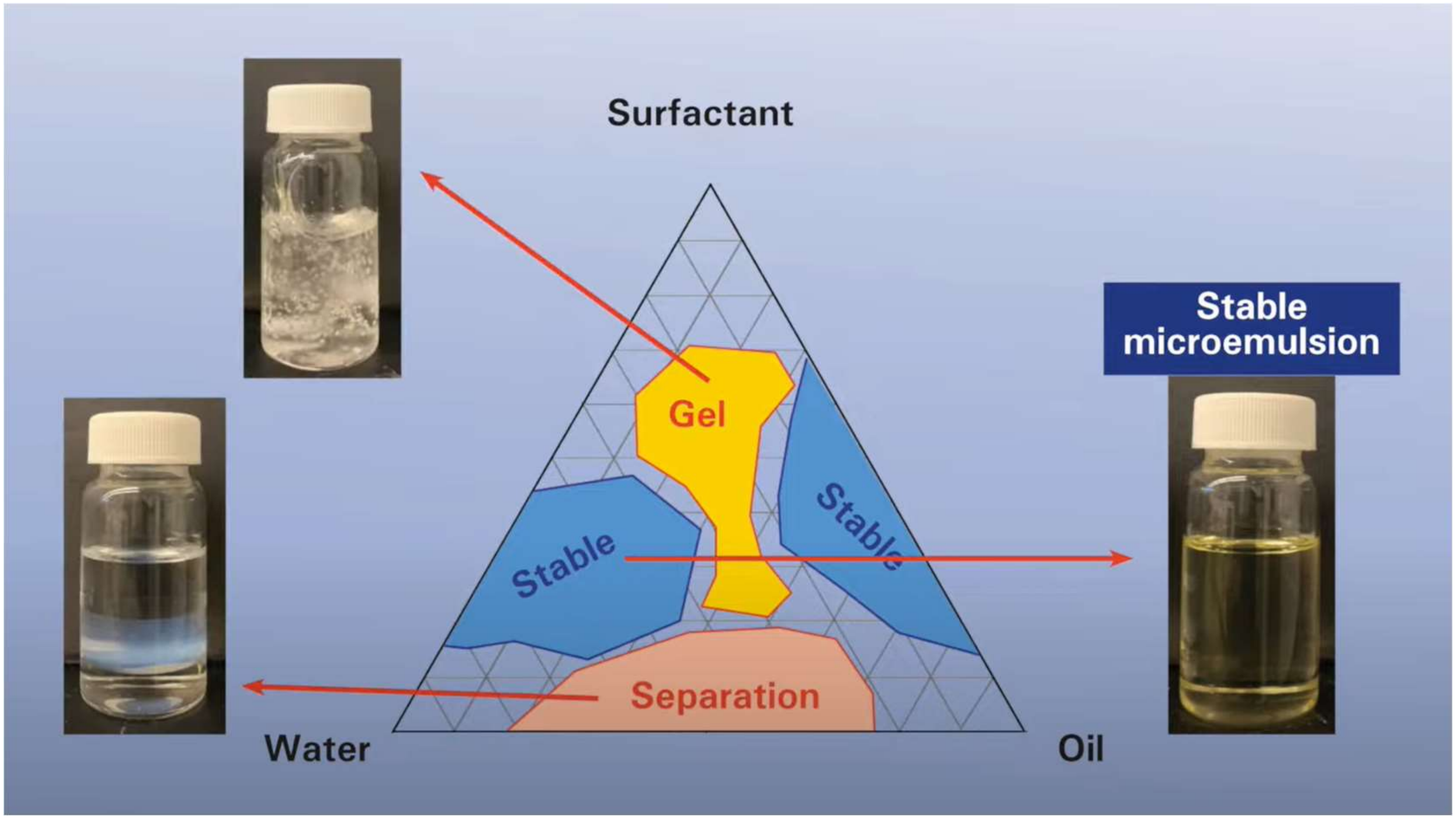
- A form of chemistry that increases productivity and solves climate-driven challenges, promoting sustainably



NB injection improves the treatability of wastewater

- Enables process intensification
- Reduces energy and chemical usage
- Increases treatment capacity
- Improves settleability
- Increases DO / aeration system efficiency
- Increases BOD removal and nitrification
- Improves effluent water quality
- Increases process stability
- Reduces frequency and duration of process upsets
- Reduces odors, corrosion, and foam
- **Removes FOG, surfactants, and scum**

FOG, Surfactants, and Water – Emulsification vs. Separation

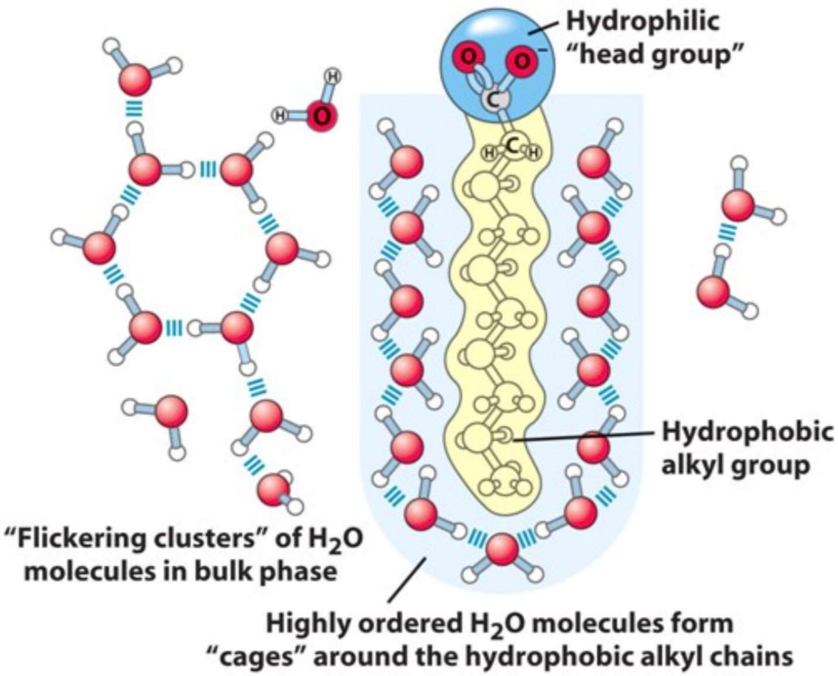


Adapted from: [Using Microemulsions to Benefit Your Formulation - YouTube]

FOG and Surfactants Make Wastewater Treatment Inefficient

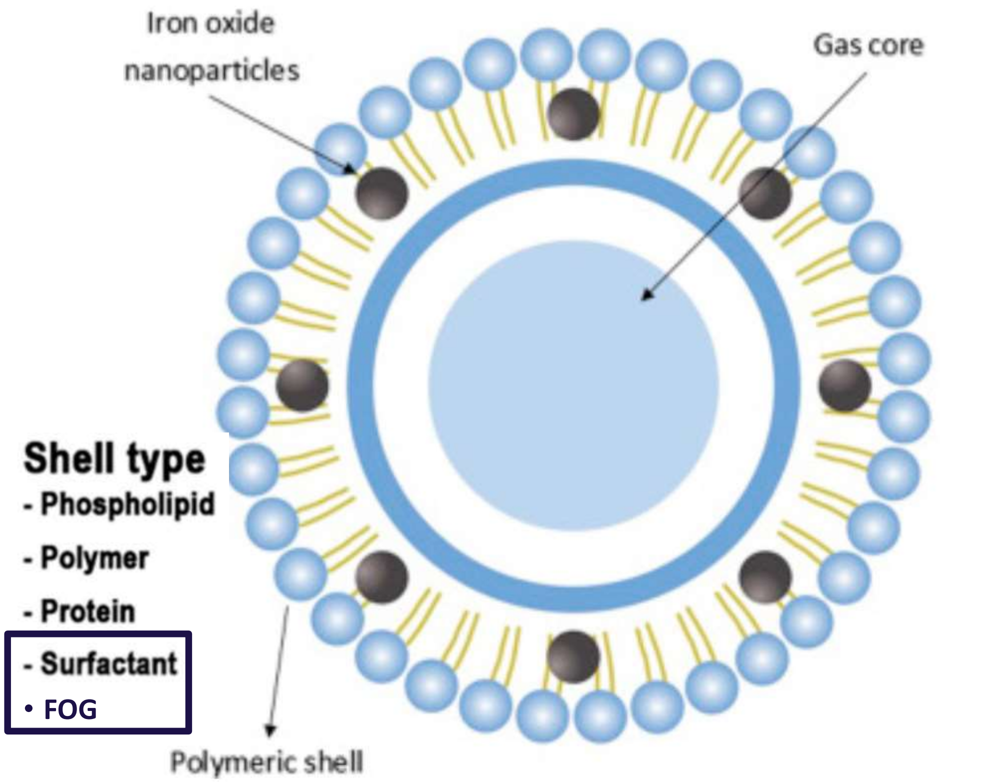
- Because they:
  - Impede the transfer of oxygen at the water surface resulting in septicity, odor, corrosion, and ammonia release
  - Impede solids separation by coating solids and emulsifying wastewater
  - Are slowly biodegradable resulting in inefficient biological uptake (longer SRT, higher effluent sBOD)
  - Impede aeration by coating air bubbles (decrease alpha) resulting in low DO or higher power draw to maintain DO
  - Impede oxygen uptake by coating biomass and limiting oxygen transfer through the floc
  - Have a toxicity effect on bacteria, especially nitrifiers resulting in lower nutrient removal rates
  - Are only partially removed by clarifiers and activated sludge process so the rest is oxidized by disinfectants resulting in higher chemical usage and higher concentrations of disinfection byproducts
  - Cause fouling of MF/UF/RO membranes

Amphiphilic/Amphipathic Molecules in Wastewater



Associations of amphipathic molecules in aqueous solutions.

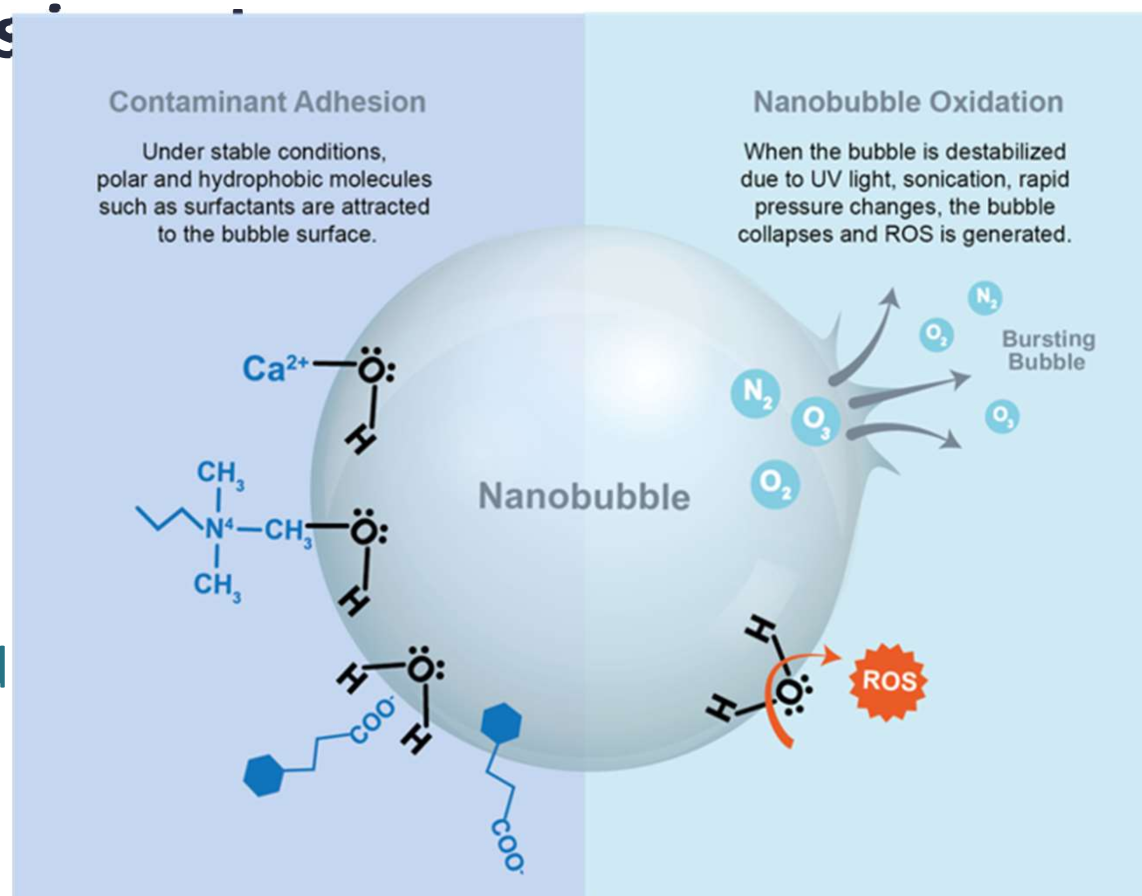
Source: https://slideplayer.com/slide/5698119/



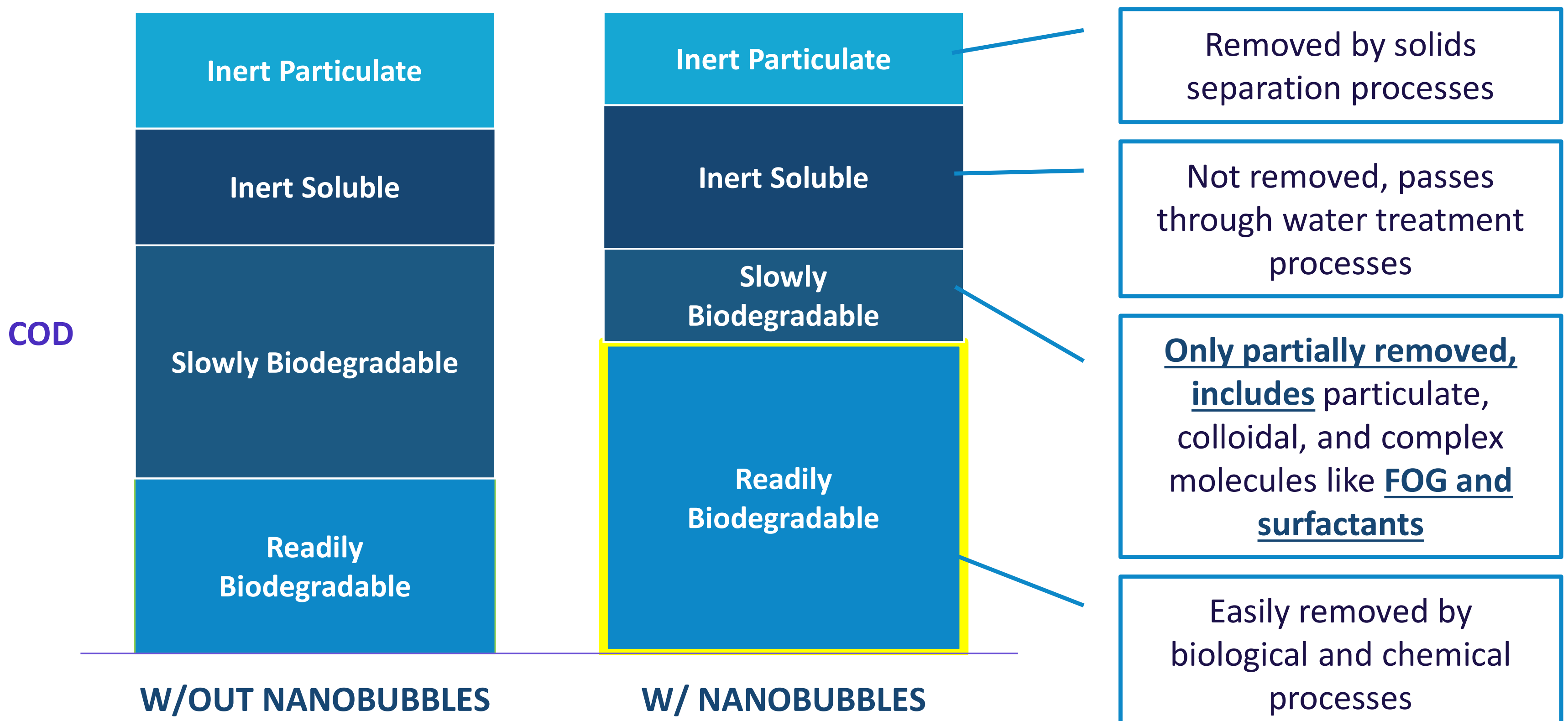
Adapted from: https://www.sciencedirect.com/topics/chemistry/nanobubble

How do Nanobubbles interact with amphiphilic compounds

- Hydrophobic attraction force
- Concentration of compounds to the surface of the Nanobubble
- Bubble destabilization causes collapse and release of Hydroxyl Radical
- Chemicals are partially oxidized changing their characteristics making them more readily biodegradable



Ultimately Nanobubbles convert slowly biodegradable COD to readily biodegradable COD intensifying the wastewater treatment process

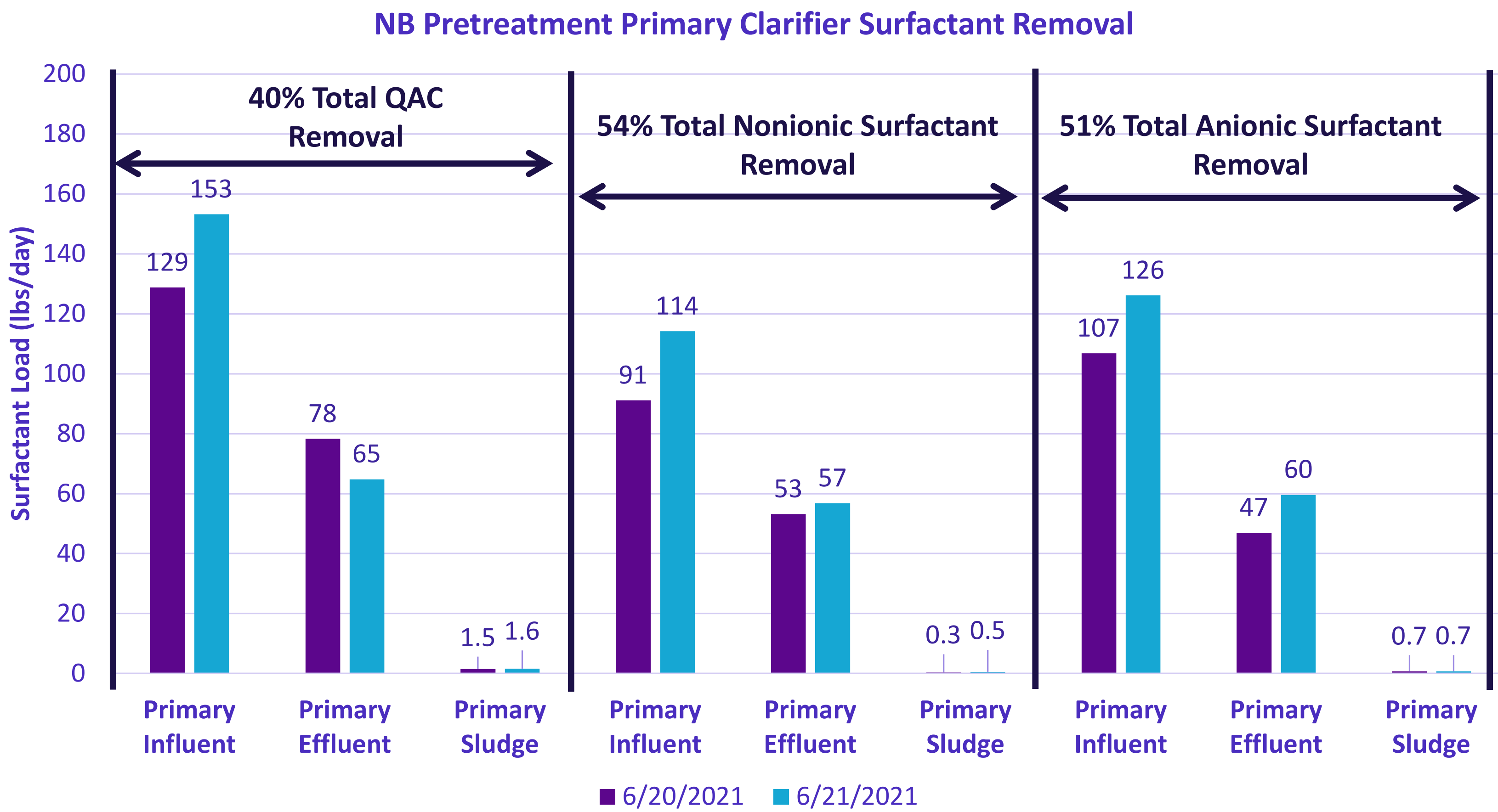


GOLETA SANITARY DISTRICT (GSD) FULL-SCALE INSTALLATION

NB PRETREATMENT OF PRIMARY CLARIFIER INFLUENT AT A MUNICIPAL WRRF

Nanobubble injections treating 4.2 MGD AADWF at WRRF Headworks

Primary Clarifier: Surfactant Removal



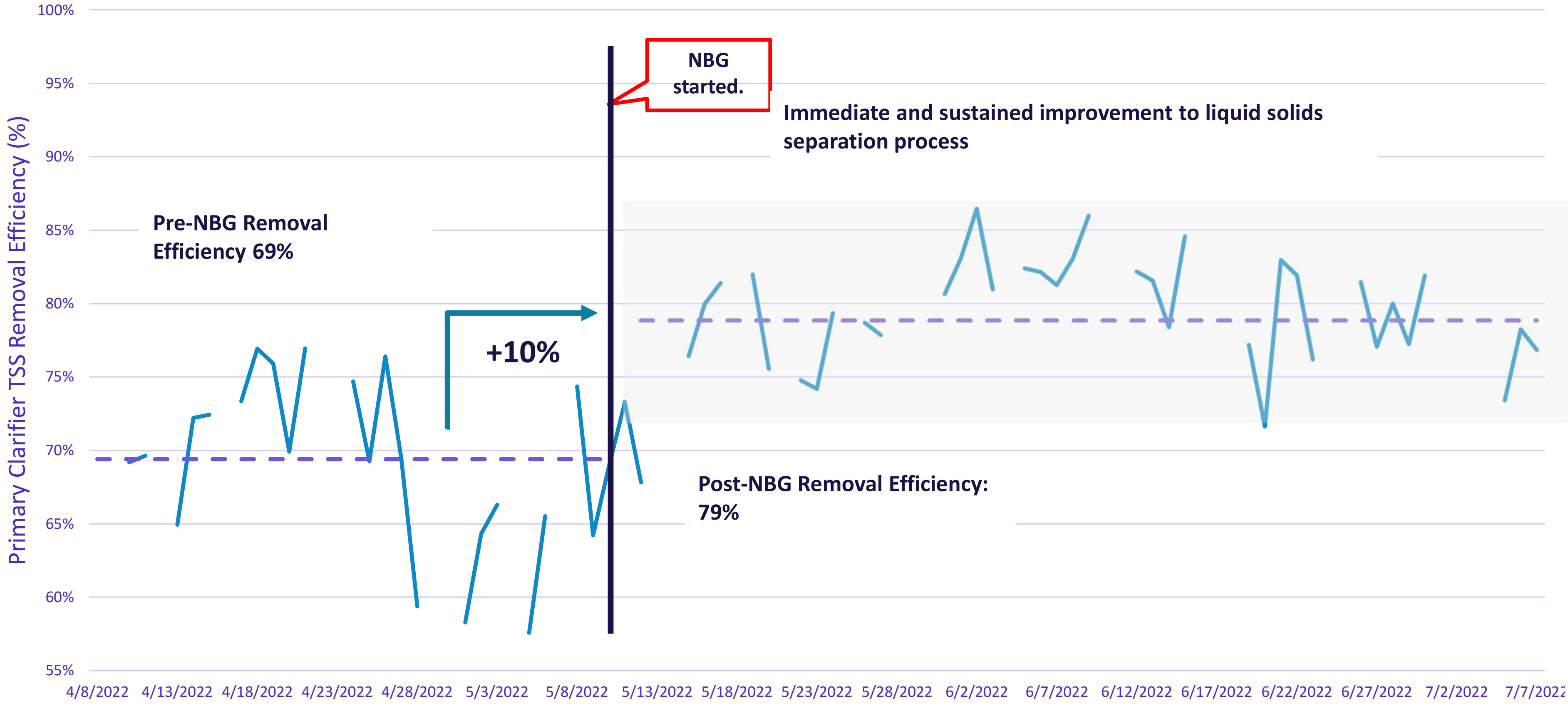
*Analysis Performed by and independent party utilizing HLPC-MS

Hydraulic Equalization Basin: Less foam, odors and costs associated with remediation

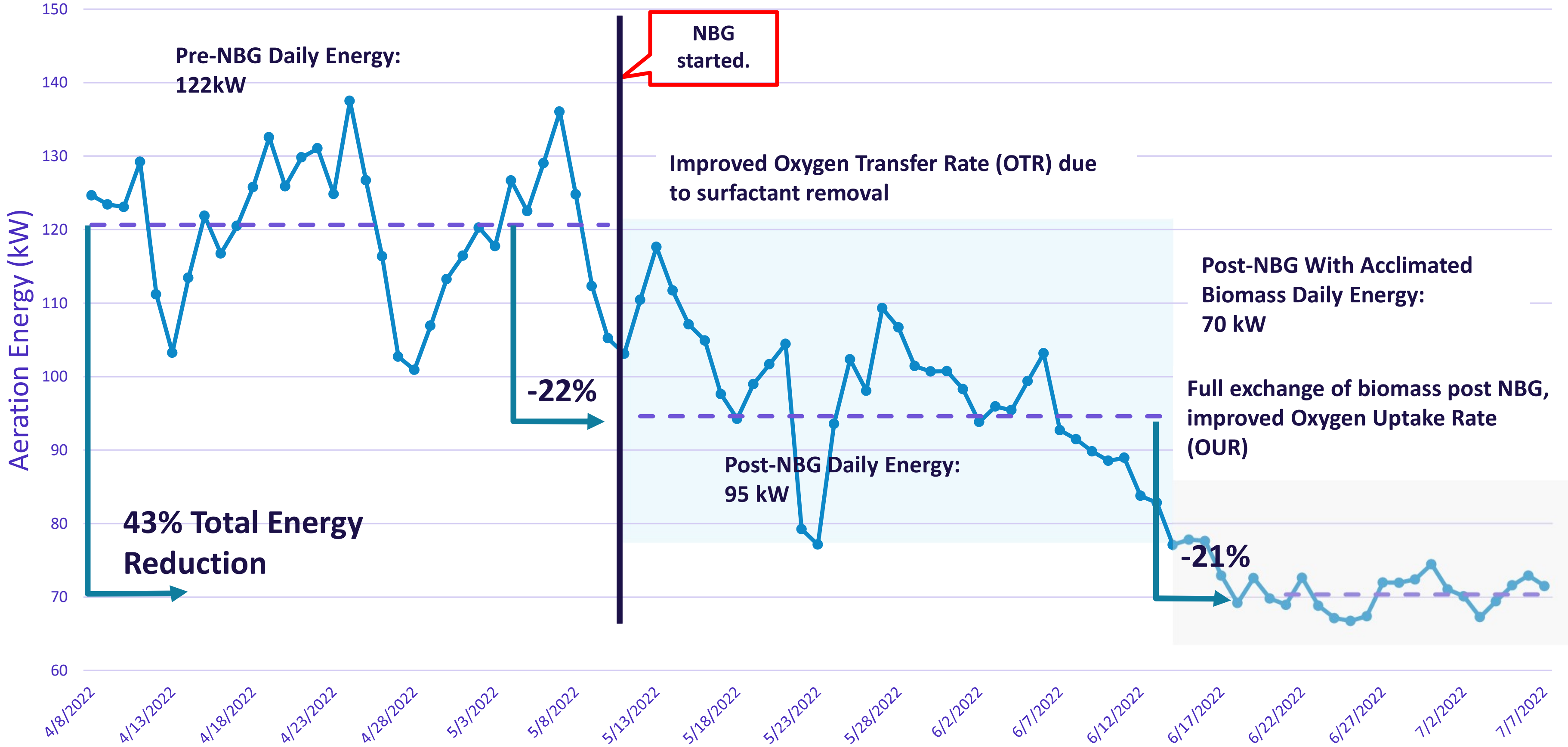
Without Nanobubble Pretreatment

With Nanobubble Pretreatment

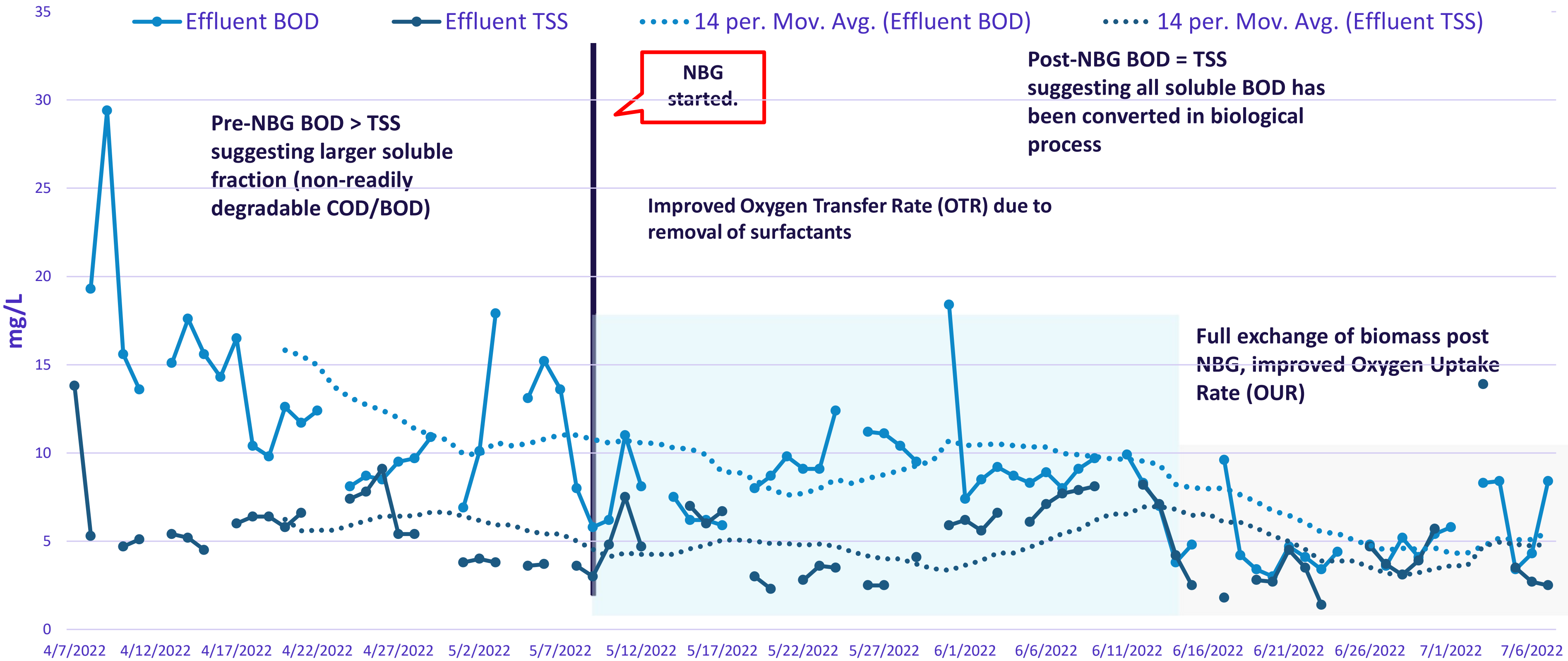
Primary Clarifier: Improved TSS removal improves energy capture with anaerobic digestion and cogeneration



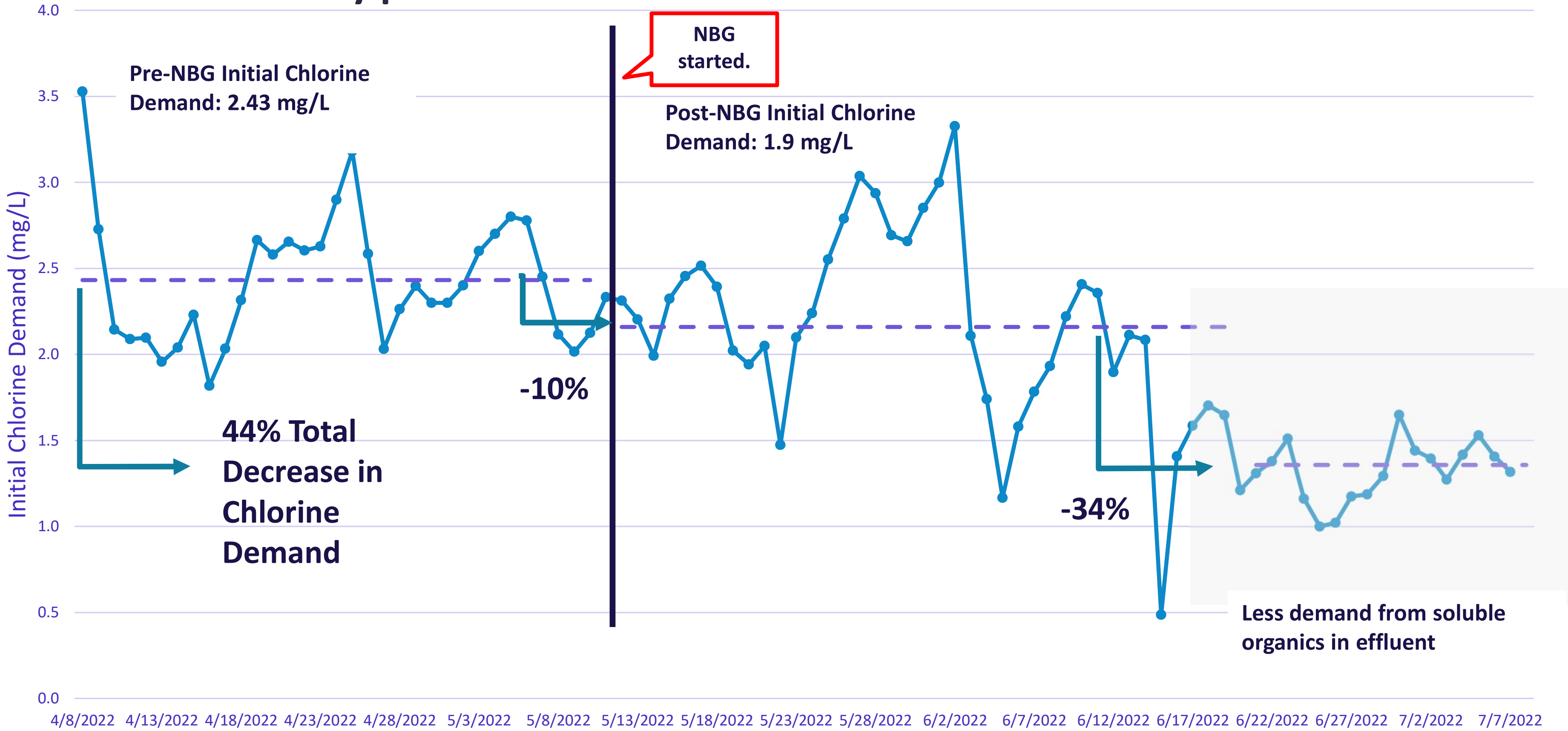
Activated Sludge: Reduced aeration energy is then available for AWT



Secondary Effluent: Improvement in quality results in less fouling of downstream facilities



Disinfection: Reduction in chlorine demand and disinfection byproducts



Cost Savings of Nanobubble Treatment

- Reduction in net energy demand
- = $32,000/year
- Reduction in sodium hypochlorite and sodium bisulfite = $15,000/year
- Elimination of bioaugmentation
- = $44,000/year
- Removal of one treatment trains from service
- = $36,000/year
- Total Avoided Cost = $127,000/year in OPEX
- Plus, up an estimated $50M in CAPEX savings by reducing scope of plant upgrade to meet impending nutrient regs

Energy and chemical savings translate to lowering the carbon footprint of wastewater treatment

- Reduced Energy Use by 625 kWh/day = 118 tons CO2e/year
- Reduce Chemical Use by 0.5 tons/day = 6 tons CO2e/year
- Reduce Biological GHG Emissions due to increase primary clarifier efficiency 556 tons CO2e/year
- Other reductions to GHG emission could also include the footprint of construction of the facilities to meet future regulations
- In total Nanobubble treatment of municipal wastewater has reduce CO2e emissions by over 680 tons per year paving the way to a less carbon intensive water cycle

QUESTIONS

Where to Install NB Pre-Treatment?

- NBG installation location may be recirculating on a channel, tank or basin or inline with an existing pump.
- Nanobubbles must be injected in screened, raw wastewater at a location with at least 15 minutes of contact time before the activated sludge process. The wastewater must be screened to prevent clogging or damage to the pump and/or NBG.

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Mobile Water Quality Lab

Photos of mobile lab deployed at Goleta for COD fractionation study

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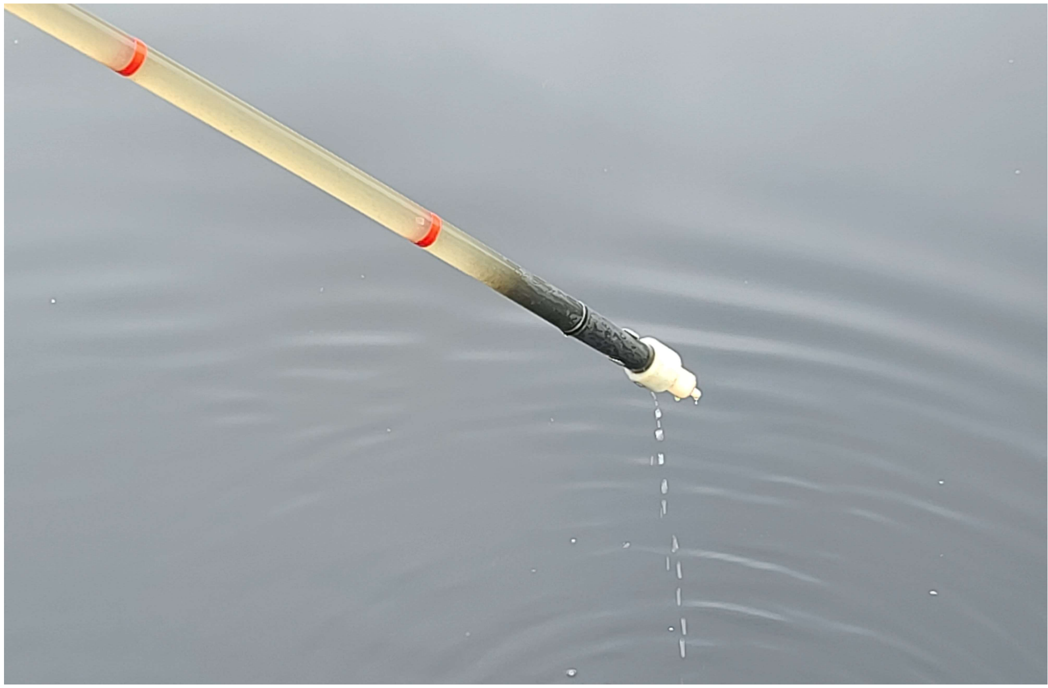
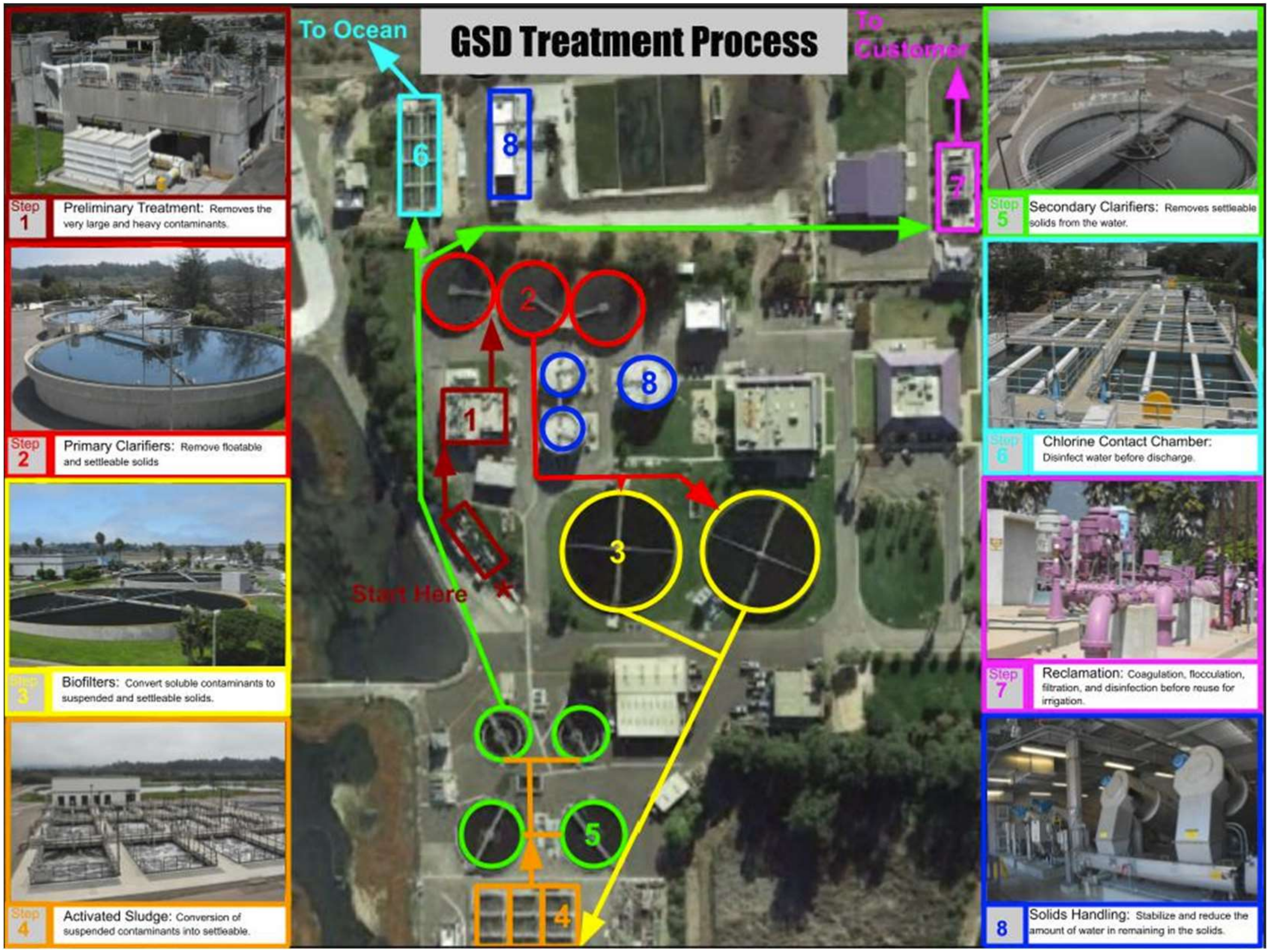
Primary Clarifier: Improved Liquids/Solids Separation

- **Improvements:**
  - Significant odor reduction
  - Clear supernatant down to the sludge blanket
  - Compact sludge
  - No evidence of denitrification or fermentation
  - Can now operate multiple primary clarifiers in service without the risk of septicity due to long hydraulic retention times

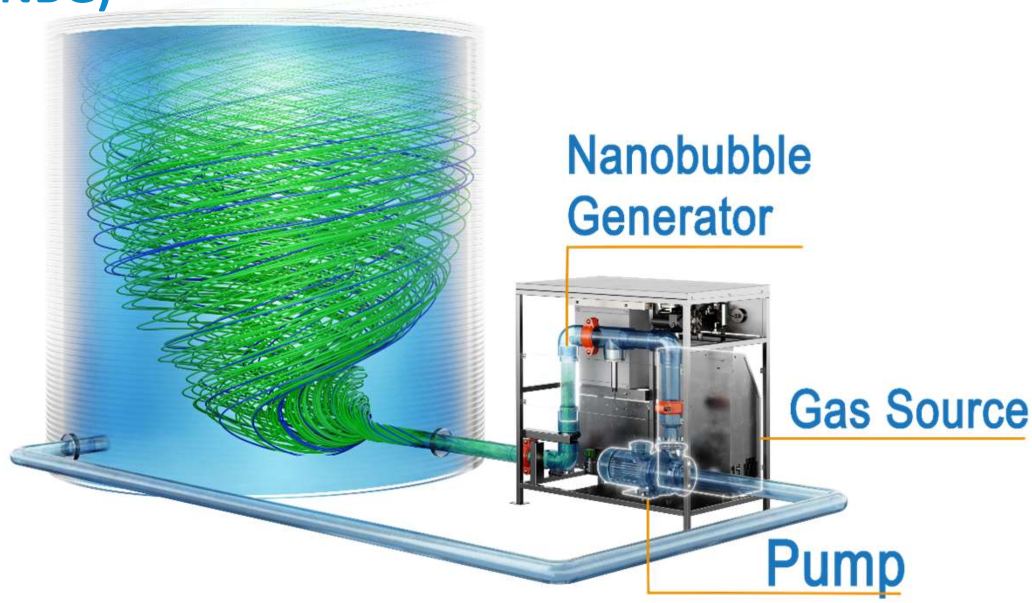



GSD Treatment Process
To Ocean
To Customer
Start Here
Step 1
Preliminary Treatment: Removes the very large and heavy contaminants.
Step 2
Primary Clarifiers: Remove floatable and settleable solids
Step 3
Biofilters: Convert soluble contaminants to suspended and settleable solids.
Step 4
Activated Sludge: Conversion of suspended contaminants into settleable.
Step 5
Secondary Clarifiers: Removes settleable solids from the water.
Step 6
Chlorine Contact Chamber: Disinfect water before discharge.
Step 7
Reclamation: Coagulation, flocculation, filtration, and disinfection before reuse for irrigation.
8
Solids Handling: Stabilize and reduce the amount of water in remaining in the solids.

Moleaer’s Patented Technology

- Scalable to any liquid flow rate < 10 to > 5000 gpm

Produces nanobubbles by pumping water and injecting gas through the Nanobubble Generator (NBG)



Conceptual Permanent Installation

- Submersible non-clog pump installed in primary influent channel
  - Reduced pump horsepower from 60 to 32 BHP
  - Reduced footprint
  - Reduced maintenance

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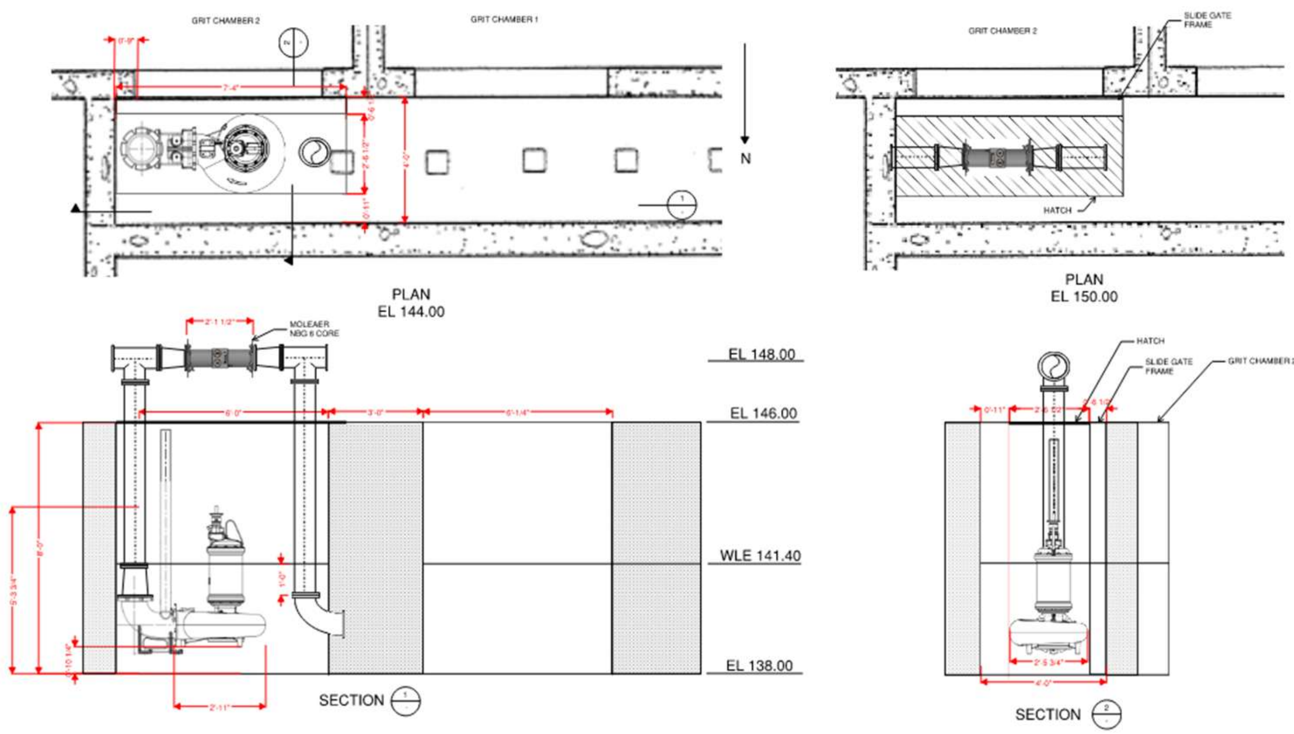
Permanent Installation Concept Design

Pump is installed in existing channel

Nanobubble Generator above grating for easy maintenance

Blind flanges on “T”s for easy inspections



GSD vs Typical Surfactant Levels in Municipal Wastewater

Table 1. GSD Surfactant Concentration of Untreated Wastewater

Surfactant	Concentration (mg/L)
Total QAC	4.6
Total Nonionic	3.3
Total Anionic	3.8
Sum of Surfactants Tested	11.7

Table 2. Typical Range of Surfactant Concentrations after Indicated Level of Treatment

Constituent	Unit	Untreated Wastewater	Conventional Activated Sludge	Activated Sludge with Biological Nutrient Removal	Membrane Bioreactor
Surfactants	mg/L	4–10	0.5–2.0	0.1–1.0	0.1–0.5

Adapted from: McGraw-Hill, Metcalf & Eddy, Inc. an AECOM Company; Takashi Asano; Franklin Burton; Harold Leverenz. Water Reuse: Issues, Technologies, and Applications. Removal of Constituents by Secondary Treatment, Chapter 7 (2007)

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What are Surfactants?

- Sources:
  - Laundry Detergents
  - Dishwasher Detergents
  - Degreasers
  - Personal Care Products: Shampoo, Bodywash
  - Cleaning and Disinfections Products
- Types:
  - Cationic (including Quaternary Ammonium Compounds (QACs or Quats))
  - Anionic
  - Nonionic
  - Zwitterionic

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Factors that Have Increased Surfactants in Water Treatment

- Increased use of surfactant-containing products:
  - Switch from conventional bar soaps to liquid products
  - Pandemic
  - Contamination of public food sources (ie lettuce recalls)
- Less water use per person:
  - Drought
  - Water conservation
  - High-efficiency appliances
- Improvements to collection systems/combined I&I
- Concentrating contaminants/waste streams
- Chemical toilet waste

How are the effects of NB pretreatment measured?

- A reduction in mixed liquor suspended solids (MLSS) in the aeration basin without a change in solids retention time indicating increased removal rates by removing the same amount of ammonia and/or biochemical oxygen demand/chemical oxygen demand (BOD/COD) using less biomass, and
- An increase in aeration system oxygen transfer rate, oxygen uptake rate, and biomass kinetics in combination with less solids under aeration (lower MLSS) resulting in less blower power consumption.
- Increased solids removal across clarifiers. Less load from primary clarifiers to activated sludge process.
- Reduced chemical demand across chemical disinfection process units.
- Wastewater characterization using COD fractionation

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Fundamentals of Nanobubbles

Properties

- Hydrophobic
- Charged Surface
- High Internal Pressure
- Hard ‘Shell-like’ Surface
- High Gas Transfer Efficiency

Behaviors

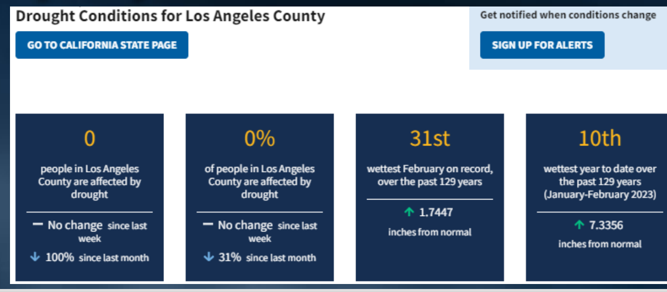
- Neutrally Buoyant
- Stable & Long-Lasting
- Oxidative
- Electrochemically Active
- Reduces Surface Tension

WateReuse California
LA Chapter Meeting

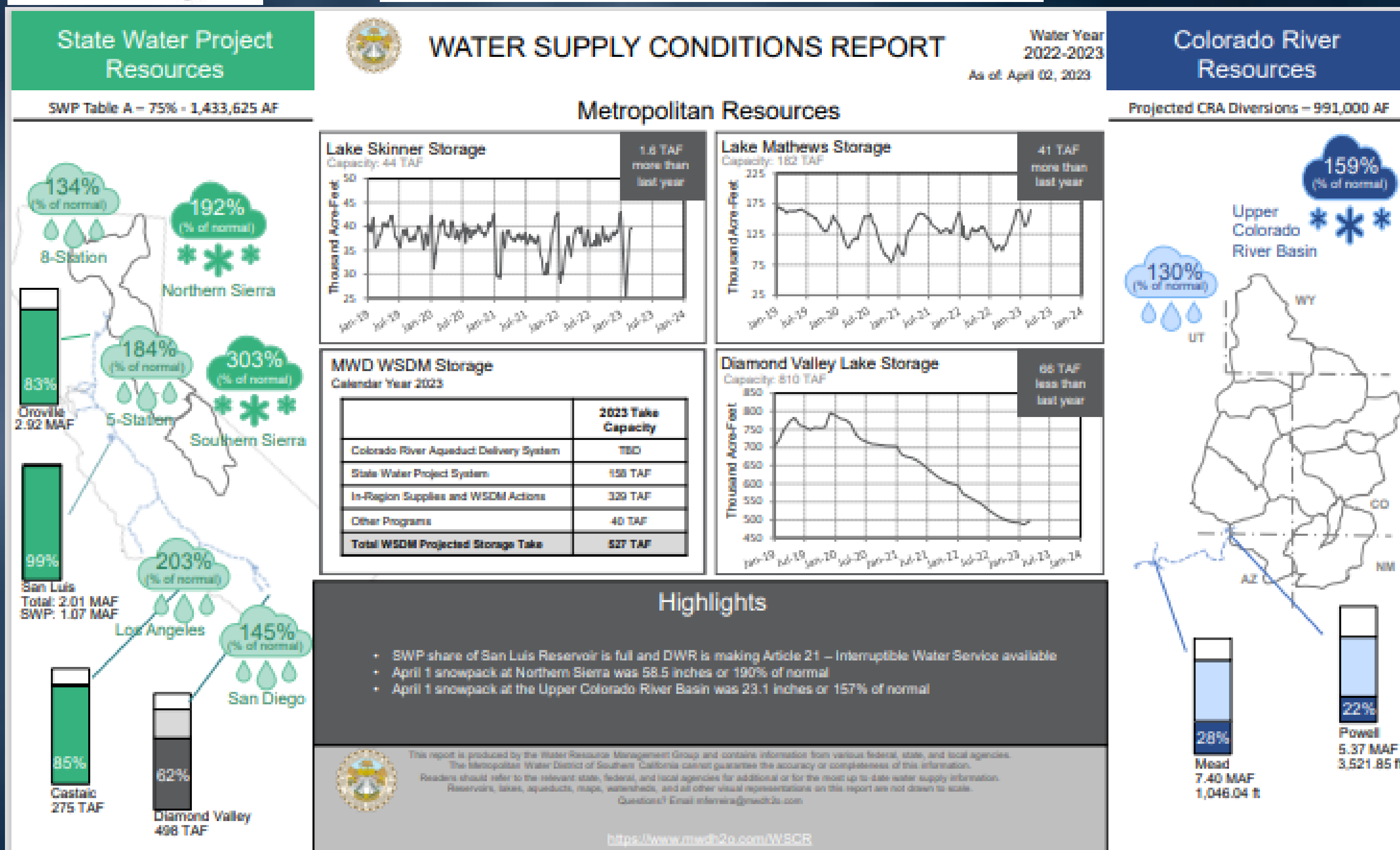
April 11, 2023
Legislation & Regulation Update

Raymond Jay
Metropolitan Water District of Southern California
(213) 217-5777 or rjay@mwdh2o.com

Water Supply Conditions



SWP allocation = 75%



	2023 Take Capacity
Colorado River Aqueduct Delivery System	TBD
State Water Project System	158 TAF
In-Region Supplies and WSDM Actions	329 TAF
Other Programs	40 TAF
Total WSDM Projected Storage Take	527 TAF

https://www.bewaterwise.com/water_supply_conditions/water_supply_conditions.pdf

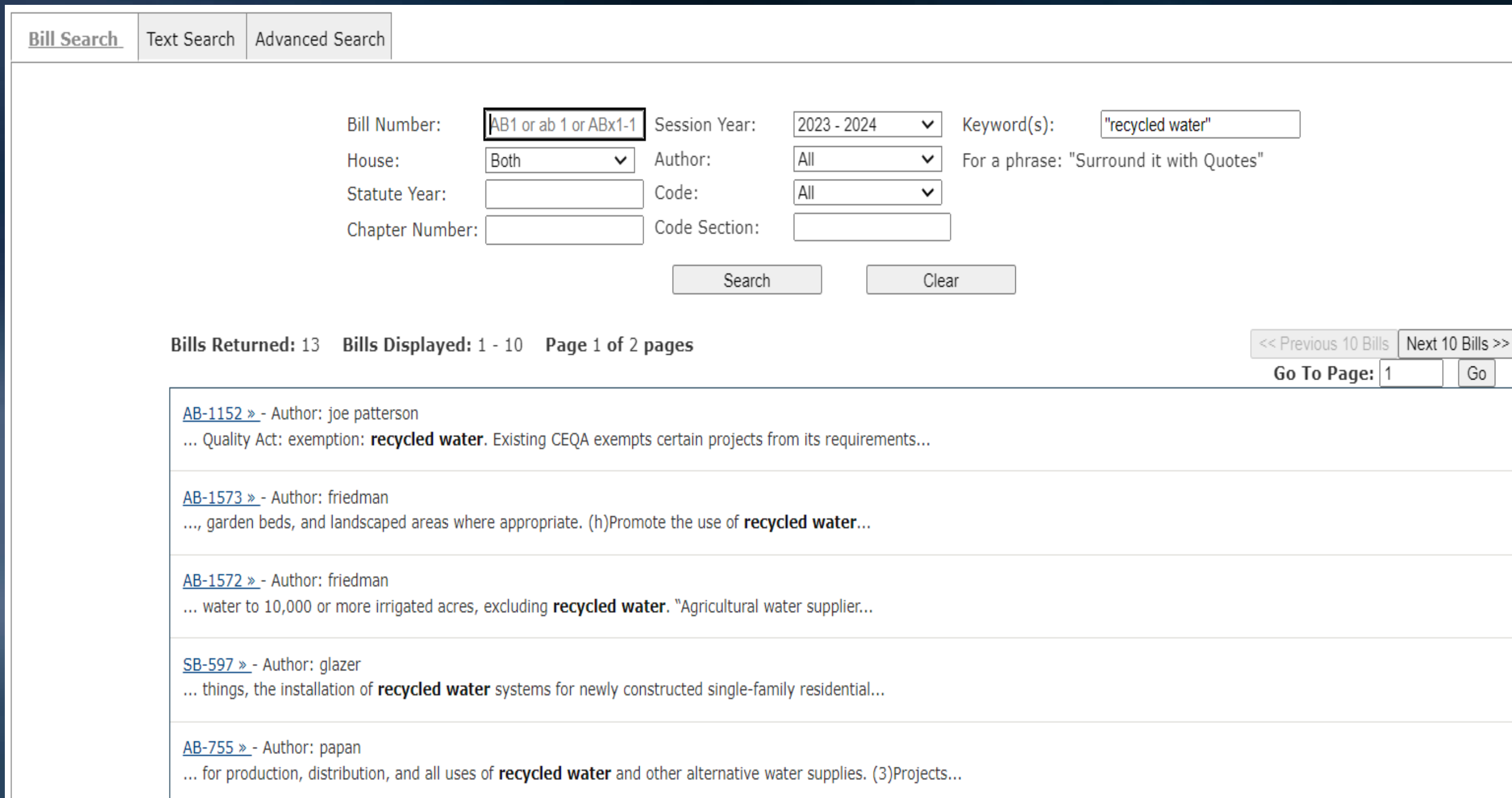
2023 California Legislative Calendar

- Jan. 1 — Statutes take effect
- Jan. 4 — Legislature reconvenes
- Jan. 10 — Governor submits budget to Legislature
- Feb. 17 — Last day for bills to be introduced
- Apr. 28 — Last day policy comm. to report fiscal bills
- May 5 — Last day fiscal comm. to report fiscal bills
- June 2 — Last day for bills to pass house of origin
- June 15 — Last day to pass budget
- Sept. 14 — Last day for any bill to be passed
- Oct. 14 — Last day for Governor to sign or veto bills
- See: http://assembly.ca.gov/legislativedeadlines

2023 Water Legislation Introduced

- SB 366 (Caballero): The California Water Plan: long-term supply targets; WRCA = Support
- SB 745 (Cortese) Drought Resistant Building Standards; WRCA = O/A
- AB 682 (Mathis): SWRCB: online search tool: funding applications
- AB 1573 (Friedman): Water Conservation: Landscape Design: model ordinances; WRCA = Watch
- https://watereuse.org/sections/watereuse-california/legislativeregulatory-committee/

California Legislation: Recycled Water



https://leginfo.legislature.ca.gov/faces/billSearchClient.xhtml?session_year=20232024&keyword=water%20recycling&house=Both&author=All&lawCode=All

California Budget

- Budget due by June 15th
- Expect a Budget deficit for FY 23/24

- $270 million in budget for recycled water
  - $100 million recycled water
  - $170 potable reuse

- WRCA comment letter March 17, 2023

- Budget Trailor Bill with new RW fee

Regulatory Update

- Direct Potable Reuse Regulations
  - SWRCB to adopt regulations by December 31, 2023
  - Expect updated draft and Formal Rule making to begin in May 2023

  https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/dpr-criteria-panel.html
- Water Use Efficiency Regulations
  - Formal Rule making to begin in May 2023
  - Includes potential Potable Reuse Bonus Incentive up to 15%

  https://water.ca.gov/Programs/Water-Use-And-Efficiency/2018-Water-Conservation-Legislation/Urban-Water-Use-Efficiency-Standards-Variances-and-Performance-Measures
- On-Site Treatment & Reuse of Non-Potable Water
  - SWRCB over due to adopt regulations by December 1, 2022
  - SWRCB rulemaking process: Expected to begin in Spring 2023

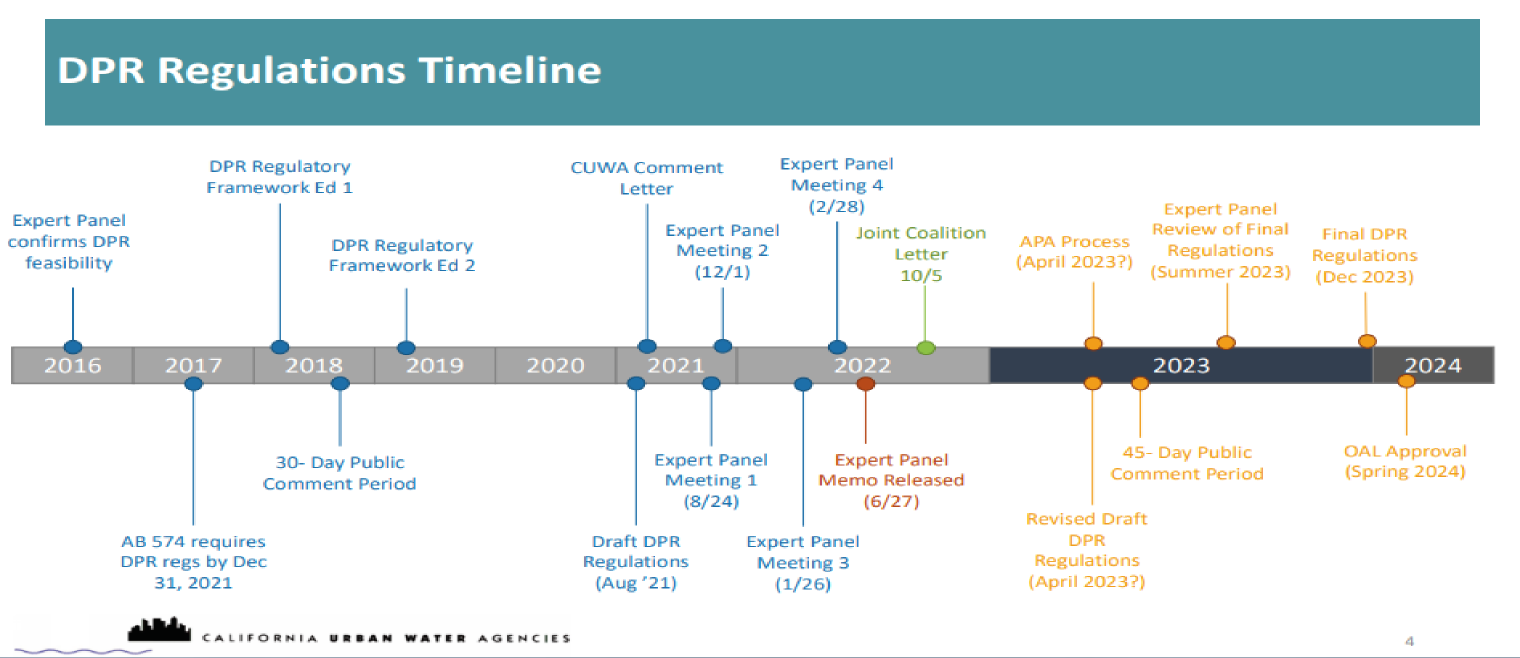
  https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/onsite_nonpotable_reuse_regulations.html
- Cross Connection Control Handbook
  - Allows swivel ell as a change over device; Board Adoption Meeting: TBD

  https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/cccph.html

Regulatory Update

- Direct Potable Reuse Regulations

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/direct_potable_reuse.html



Potential revision to DPR Regulations

- Waivers, BAF flexability, source control, & other changes
- Alternative clause & DiPPRA unlikely to change

Local, State and Federal Funding Opportunities

WATEREUSE CALIFORNIA

Local, State and Federal Funding Opportunities [1] APRIL 2023

PROGRAM TITLE	Description	Eligible Applicants	Federal/Non-Federal Cost Share	Current Status
Title XVI Authorized Projects	Funding for planning, design, and construction of specific congressionally authorized water recycling and reuse projects	Sponsors of water reclamation and reuse projects specifically authorized for funding under Title XVI of P.L. 102-575.	Typically, between $1 million and $6 million per applicant. Non-Federal Cost Share: 75% or greater.	FY22 appropriations were transmitted to Congress on November 30, 2022, and projects were named in FY23 appropriations legislation. **The next Funding Opportunity is expected summer 2023.**
Title XVI WIIN Act Water Reclamation and Reuse Projects	Funding for planning, design, and construction of WIIN Act water recycling and reuse projects	Sponsors of water reclamation and reuse projects with completed feasibility studies that have been submitted to Reclamation for review.	Typically, between $1 million and $6 million per applicant. Non-Federal Cost Share: 75% or greater.	Project selections for FY22 appropriations were transmitted to Congress on November 30, 2022, and projects were named in FY23 appropriations legislation. **The next Funding Opportunity is expected summer 2023.**
USEPA Water and Infrastructure Finance and Innovation Act (WIFIA) Program	Wastewater conveyance and treatment projects Drinking water treatment and distribution projects Enhanced energy efficiency projects at drinking water and wastewater facilities Desalination, aquifer recharge and water recycling projects	Local, state, tribal and federal government entities Partnerships and joint ventures Corporations and trusts CWSRF and DWSRF programs	$20M minimum project size for large communities $5M minimum project size for small communities (<25,000)	Funding available now 49%maximum portion of eligible project costs that WIFIA can fund EPA announces WIFIA funding availability and application process details in the Federal Register and on its website (www.epa.gov/wifia) NEPA, Davis-Bacon, American Iron and Steel and all federal crosscutter provisions apply. Includes acquisition of property if it is integral to the project or will mitigate the environ. impact of a project.

- https://watereuse.org/wp-content/uploads/2023/03/Summary-of-Funding-Opportunities-as-of-04-01-23.pdf

Federal Update

- FY23 Appropriations
- Large Scale Water Recycling program
  - Draft guidance on Feasibility Studies released
  - Funding for Feasibility Studies expected by summer
- Alternative Water Supply program
  - Letter requesting additional funding
- BABAA Waivers
  - Letter requesting additional waivers
- PFAS
  - WRA submitted comment letter
  - EPA Pubic Hearing on Regulations on May 5th

Questions?

If you have any questions, please contact:

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Updates on the Region's Recycled Water Program

April 11, 2023

CALIFORNIA Water Boards

Los Angeles Regional Water Quality Control Board

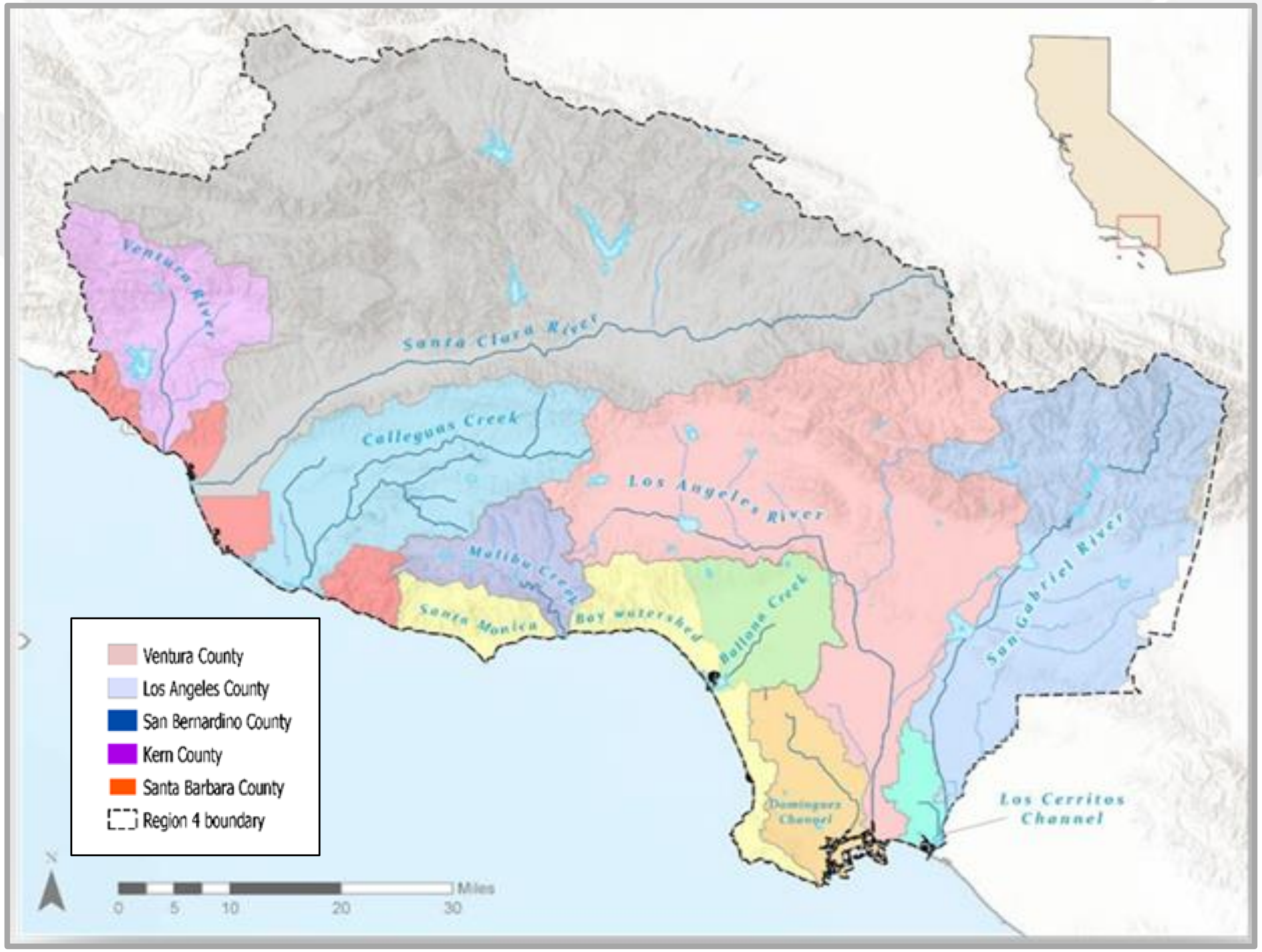
Office of Governor
GAVIN NEWSOM

CalEPA
California Environmental Protection Agency

- CALIFORNIA AIR RESOURCES BOARD
- CalRecycle
- dpr
- Department of Toxic Substances Control
- OEHHA SCIENCE FOR A HEALTHY CALIFORNIA
- CALIFORNIA Water Boards

Waters of Los Angeles and Ventura Region

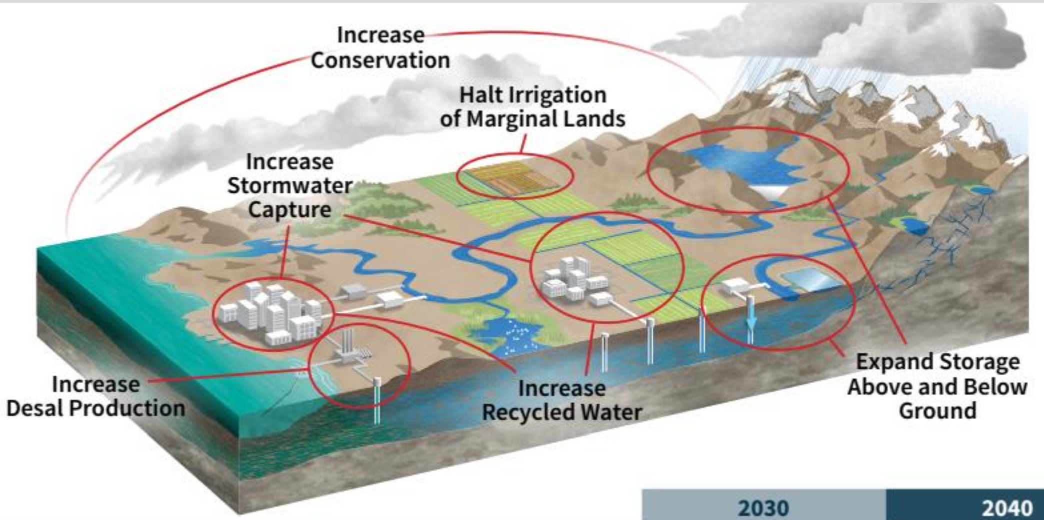
- Area of Region = 4,447 square miles
- Coastline = 120 miles
- Stream = 1,115 miles
- Lakes = 12,107 acres
- Groundwater Basins = 24
- Surface Area = 1,580 square miles
- Storage Capacity = 52 mil. acre feet



Water Supply Strategy: Strike Team

- Identify and resolve permitting and funding obstacles
- Track permitting and funding status of recycled water projects
- Develop public, digital dashboard

Participating Organizations



	2030		2040	
Increase Recycled Water	.8 MAF	About 5 MAF	1.8 MAF	About 7 MAF
Increase Desal Production	28,000 AF		84,000 AF	
Increase Stormwater Capture	.25 MAF		.5 MAF	
Increase Conservation	.5 MAF		.5 MAF	
SUBTOTAL FOR RECYCLED, DESAL, STORMWATER AND CONSERVATION	1.6 MAF		2.9 MAF	
Expand Storage Above and Below Ground*	3.7 MAF		4 MAF	
Total	4.8 MAF		6.9 MAF	

*Additional storage capacity does not equate to a similar volume of new water supply. MAF – million acre-feet.

Pretreatment Program

- The practice of removing pollutants from industrial wastewaters before they are discharged into municipal sewage treatment systems
- Title 40 of the Code of Federal Regulations (CFR) 403 et seq.
- State Water Board provides general program oversight
- Regional Water Boards perform pretreatment compliance audits, inspections, review reports, and enforcement

Pretreatment Program

- National Water Reuse Action Plan
  - Action 2.2.4 – Enhance wastewater source control through local pretreatment programs
  - Develop best practices to mitigate and reduce pollutants into POTWs

Regulatory Updates

- Proposed Maximum Contaminant Levels for PFOS and PFOA
  - Docket ID: EPA-HQ-OW-2022-0114
  - Public Comments due May 30, 2023

Compound	Proposed MCLG	Proposed MCL
PFOA	0	4.0 ng/L
PFOS	0	4.0 ng/L
PFNA	1.O (unitless) hazard index	1.0 (unitless) hazard index
PFHxS		
PFBS		
HFPO-DA (GenX)		

Chapter Trustee Updates
WateReuse LA Chapter – April 11, 2023

Last Board of Trustees Meeting: February 10, 2023

WRCA Summary of Funding Opportunities

- Monthly Local, State and Federal Funding Opportunities List distributed on 4/4/2023

WateReuse California Annual Conference

- Save the Date, registration opening soon!

LA Chapter Update *(Jennifer Jacobus)*

- February 2022 Meeting Summary
- Volunteer Opportunities
  - Meeting Summaries (*thank you Karina Gonzalez*!)
  - 2023 California WateReuse Conference Technical Committee
- Ad Hoc Urban Irrigation Manual Update Committee
  - Co-Chairs:
    - Monica Sanchez/LACSD
    - Erika Bensch/LACSD
    - Jesus Gonzalez/LADWP
- Emerging Professionals Committee
  - Chair: *Seto Cherchian*
    Scherchian@BrwnCald.com
- Communications Lead
  - Chair: *Oliver Slosser*
    oslosser@lvmwd.com
- Awards Champion
  - Chair: *Everett Ferguson*
    eferguson@wrd.org
- Technical Topics Committee
  - Chair: *Alex Franchi*
    alex.franchi@aecom.com

WATEREUSE LOS ANGELES

Membership Roundtable *(Alex Waite)*

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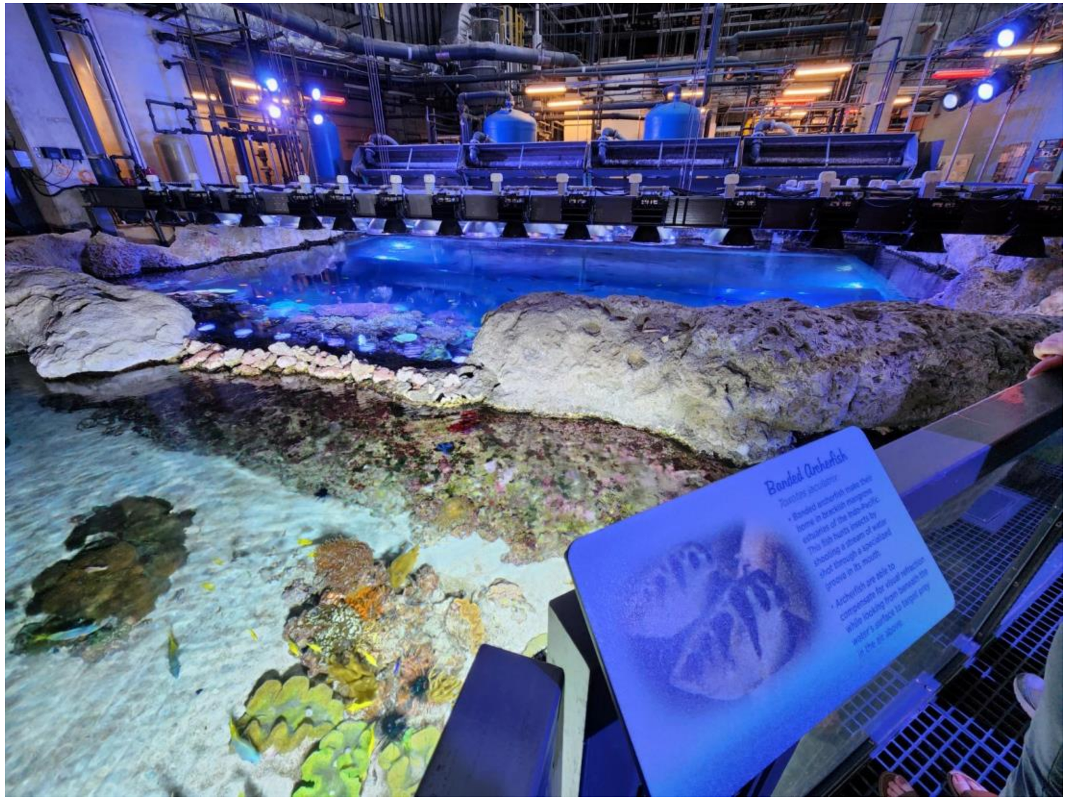
Membership Roundtable *(Alex Waite)*



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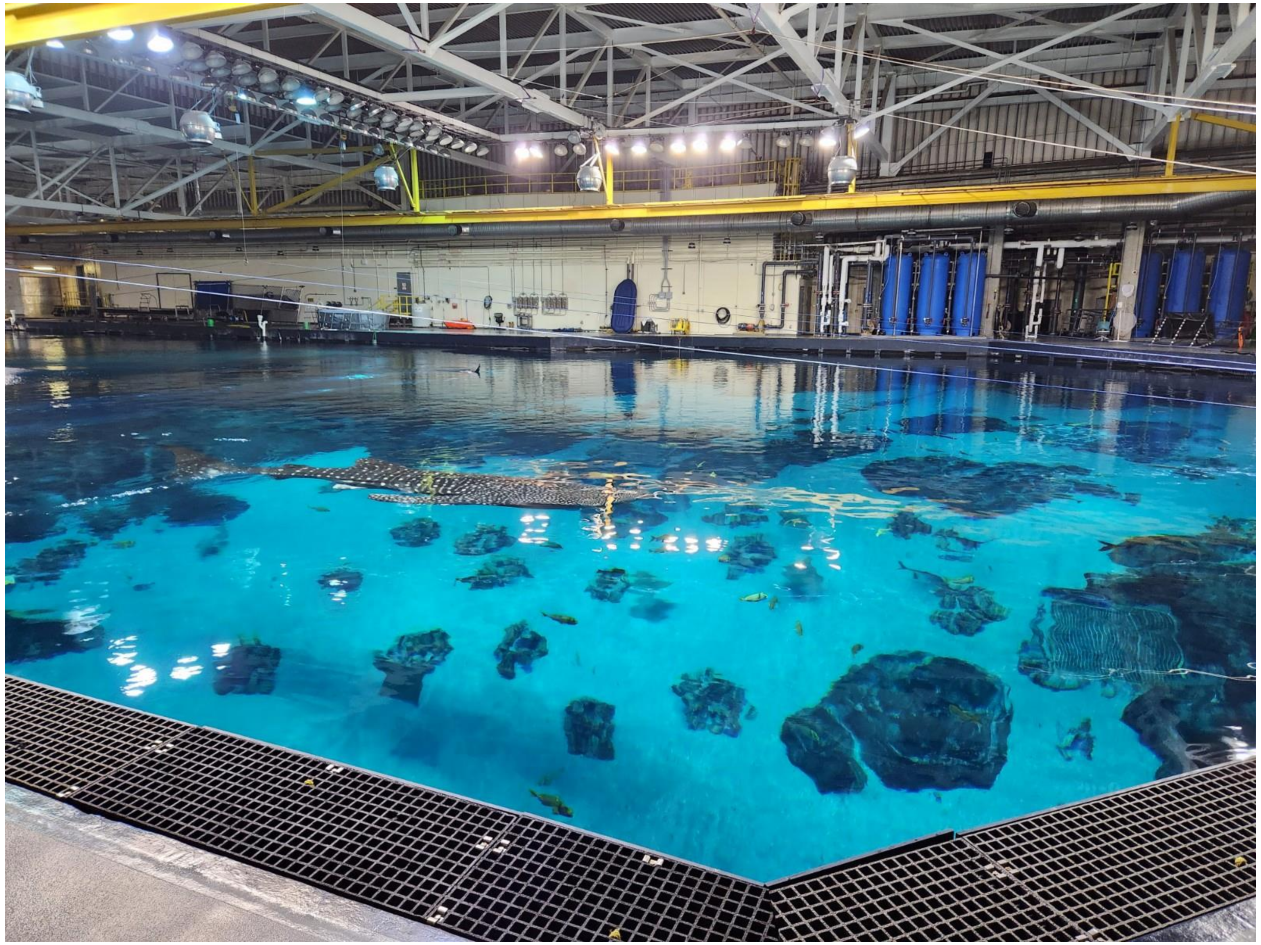
Membership Roundtable *(Alex Waite)*



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Next Meetings

- Tuesday, June 13, 2023:
  - Water Replenishment District of Southern California
  - Sponsorship opportunity

- Tuesday, August 8, 2023:
  - Host opportunity
  - Sponsorship opportunity