14th Annual Groundwater Quality Workshop

4320 San Gabriel River Parkway
Pico Rivera, CA 90660

December 11, 2019 (9:30AM ~ 2:30PM)

WRD
WATER REPLENISHMENT DISTRICT
OF SOUTHERN CALIFORNIA

Speaker Bio’s

WRD's 14th Annual Groundwater Quality Workshop - Speaker Bios

(In order of presentation)

Brian Partington manages the hydrogeology department at the Water Replenishment District. He is responsible for providing technical analysis, review, and oversight for various projects related to artificial recharge, seawater intrusion, groundwater quality, conjunctive use, computer modeling, recycled water, and groundwater production within the Central Basin and West Coast Basin (CBWCB). He has over 20 years of groundwater experience and received a Bachelor of Science degree in geology from California State University Fullerton. He is also a California Professional Geologist and Certified Hydrogeologist (PG/CHg).

Jeff O'Keefe is a Supervising Sanitary Engineer with the State Water Resources Control Board, Division of Drinking Water – Southern California Section. The section is responsible for regulatory oversight of public water systems in San Luis Obispo, Santa Barbara, Ventura and Los Angeles counties. He has been with the drinking water regulatory program for 22 years. He graduated with a B.S. in Mechanical Engineering from the Catholic University in Washington D.C. and M.S. in Civil Engineering from San Jose State University and is a licensed professional civil engineer and a certified grade 4 water treatment operator. Prior to working in the drinking water field, Jeff worked as a systems engineer in the aerospace industry for 10 years.

Ken Reich is Manager of Quality Assurance Reporting at Suburban Water Systems. He has a BA in Social Ecology and BS in Biological Sciences from UC Irvine and a Master in Public Health from UC Berkeley. At Suburban, Ken is the main interface between the utility and water quality regulators. He interprets monitoring data for operations and regulatory compliance, and creates, reviews and submits a variety of monthly and annual regulatory reports. Earlier in his career, Ken was the co-chair of the Water Research Foundation/American Waterworks Association/ACWA joint arsenic research needs committee, a member of the National Drinking Water Advisory Council Consumer Confidence Report Working Group and is currently a member of the AWWA Inorganics Committee. Recently, he has been working with the California Water Quality Monitoring Council updating its Safe to Drink internet portal. Previous employers have included, in order of appearance: Montgomery Engineers, Central and West Basin Municipal Water Districts, McGuire Environmental Consultants and Stetson Engineers.

Rick Zimmer is a Senior Account Manager at Eurofins Eaton Analytical, LLC, the largest water testing laboratory in the United States. Mr. Zimmer holds both Bachelor's and Master's degrees and has over 25 years of experience working in the water industry as a Project Manager, Account Manager, Customer Service Manager and Regulatory Specialist. Mr. Zimmer presently manages projects for Eurofins' customers in California, Hawaii, American Samoa, Guam, the CNMI and Japan. Mr. Zimmer has also served as Safe Drinking Water Committee Chairman for the California-Nevada Section of the AWWA and is presently a member of the Water Quality Committee Member for the Association of California Water Agencies.

Daniel Pichardo is a project engineer at General Pump Company, the leading water well redevelopment contractor in Southern California. Daniel works with his team at GPC to provide engineering assistance for water well maintenance and rehabilitation. Prior to entering the water industry, Daniel began his career in environmental consulting, where he performed phase I and II environmental site assessments and prepared regulatory reports for LUST fund cleanup sites, delineating contamination plumes and determining suitable remediation methods. Daniel has spoken at numerous utility and professional water organizations including Southern California Edison, Southern California Gas Company, Inland Empire Utilities Agency, and Southern California Water Utility Association. Daniel holds an undergraduate degree in Civil Engineering from Seattle University where he obtained his EIT certification.

WRD's 14th Annual Groundwater Quality Workshop - Speaker Bios

(In order of presentation)

Cathy Swanson is a Groundwater Remediation Specialist and the West Sales Manager for Purolite Corporation. She has worked in the water treatment world of perchlorate, nitrate, uranium, TOC, VOC, and now PFAS removal for the last dozen years at Purolite and previously at Evoqua. She has worked on treatment technologies ranging from GAC to biological to reverse osmosis, but her true focus has been ion exchange resins. Her project portfolio includes both remediation and drinking water sites. She received her BS in Chemical Engineering at Northwestern University in the Chicago area. She is a frequent speaker at PFAS educational events including the American Groundwater Trust, American Water Works Association, and others.

Kelsey Hakes has more than 8 years of experience in the water treatment, environmental, and oil and gas industries. Her extensive knowledge base includes: municipal and industrial water systems, GAC and ion exchange media, process control engineering and application metallurgy. Previous positions included account management, business development, and engineering design at Evoqua Water Technologies and Control Components Inc. Ms. Hakes had direct involvement with specification and solution development, technical trainings, and aftermarket services. As Business Development Engineer, Kelsey will be responsible for all critical aspects of the business including market development, strategic planning and key client management covering Southern California and Arizona. A graduate of the University of California Irvine, Kelsey holds both a BS in Mechanical Engineering and Material Science Engineering. She is a member of the CA-NV AWWA Women's Leadership Committee.

Maria Elena Kennedy works on behalf of disadvantaged communities at the local, state and federal levels. In this capacity, Kennedy seeks not only funding to bring improvements to water resources infrastructure but also to form partnerships among stakeholders to ensure a successful project. Kennedy works throughout the State of California.

Charlene King is the Safe Drinking Water Program Manager, Well Profiling Program Manager and WRD Title 22 Monitoring Program Manager at the Water Replenishment District of Southern California. She works on projects related to groundwater quality, wellhead treatment, water quality regulatory compliance and construction management. Charlene has been with WRD for 21 years with a Bachelor of Science in Civil Engineering, Master of Business Administration, and Certification in Construction Management.

Speaker #1

WRD Overview – December 2019

Brian Partington

Water Replenishment District

bpartington@wrd.org

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

Overview – December 2019

Brian Partington, PG, CHg

December 11, 2019

Program

9:30 – 10:00

WRD Overview

Brian Partington, Water Replenishment District

10:00 – 10:30

DDW Regulatory Updates

Jeff O’Keefe, SWRCB – Division of Drinking Water

10:30 – 11:00

The Impact of Unregulated Contaminant Monitoring on Regulatory Development in California

Ken Reich, Suburban Water Systems

11:00 – 11:30

Ex-Situ Ultraviolet Treatment for 1,4-Dioxane

Terry Keep, Trojan Technologies

11:30 – 12:00

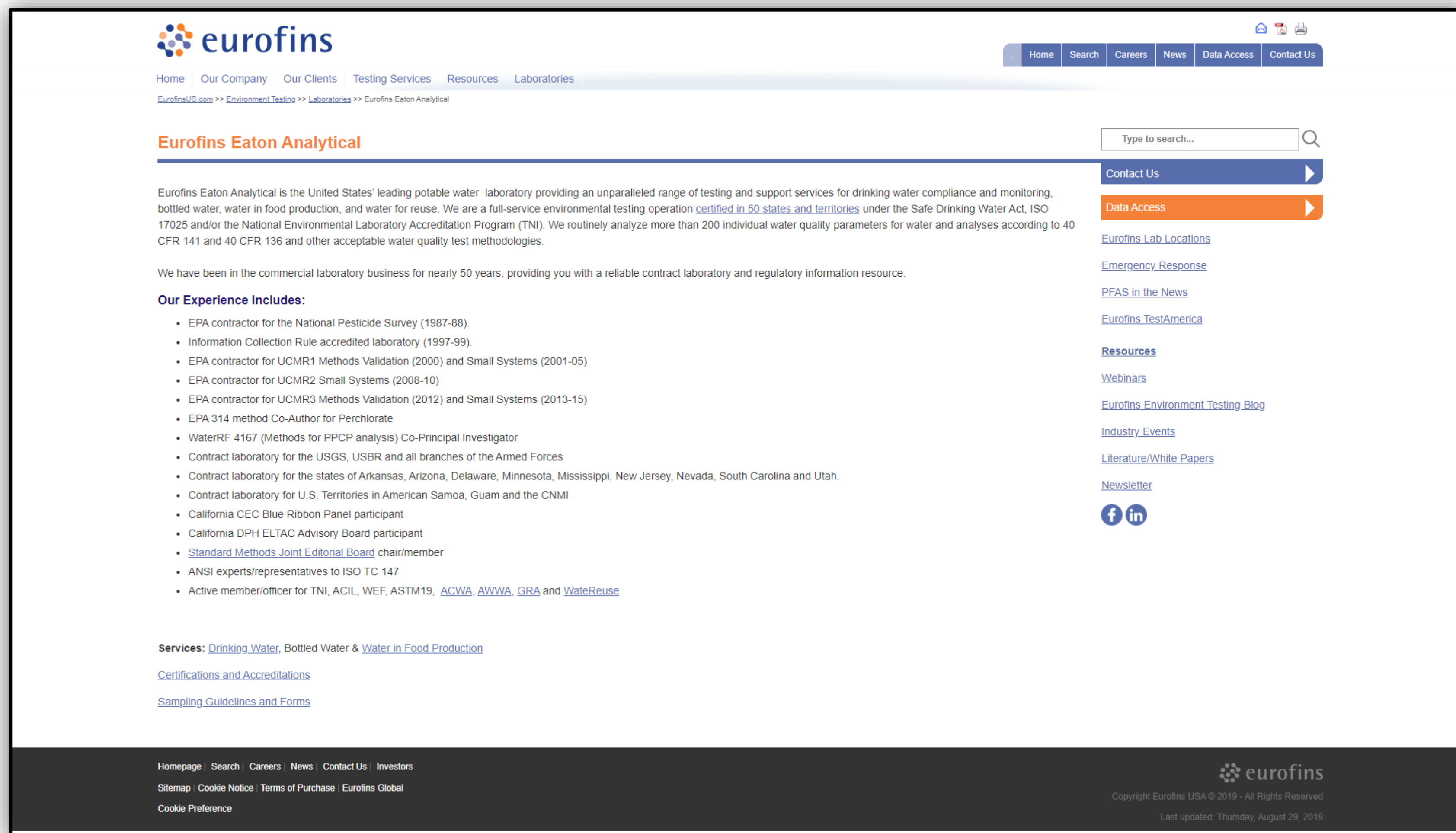
Analytical Methods for PFAS

Rick Zimmer, Eurofins Eaton Analytical

Program

12:00 – 12:45

Lunch provided by Eurofins Eaton Analytical



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EurofinsUS.com >> Environment Testing >> Laboratories >> Eurofins Eaton Analytical

Eurofins Eaton Analytical

Eurofins Eaton Analytical is the United States' leading potable water laboratory providing an unparalleled range of testing and support services for drinking water compliance and monitoring, bottled water, water in food production, and water for reuse. We are a full-service environmental testing operation certified in 50 states and territories under the Safe Drinking Water Act, ISO 17025 and/or the National Environmental Laboratory Accreditation Program (TNI). We routinely analyze more than 200 individual water quality parameters for water and analyses according to 40 CFR 141 and 40 CFR 136 and other acceptable water quality test methodologies.

We have been in the commercial laboratory business for nearly 50 years, providing you with a reliable contract laboratory and regulatory information resource.

Our Experience Includes:

- EPA contractor for the National Pesticide Survey (1987-88).
- Information Collection Rule accredited laboratory (1997-99).
- EPA contractor for UCMR1 Methods Validation (2000) and Small Systems (2001-05)
- EPA contractor for UCMR2 Small Systems (2008-10)
- EPA contractor for UCMR3 Methods Validation (2012) and Small Systems (2013-15)
- EPA 314 method Co-Author for Perchlorate
- WaterRF 4167 (Methods for PPCP analysis) Co-Principal Investigator
- Contract laboratory for the USGS, USBR and all branches of the Armed Forces
- Contract laboratory for the states of Arkansas, Arizona, Delaware, Minnesota, Mississippi, New Jersey, Nevada, South Carolina and Utah.
- Contract laboratory for U.S. Territories in American Samoa, Guam and the CNMI
- California CEC Blue Ribbon Panel participant
- California DPH ELTAC Advisory Board participant
- Standard Methods Joint Editorial Board chair/member
- ANSI experts/representatives to ISO TC 147
- Active member/officer for TNI, ACIL, WEF, ASTM19, ACWA, AWWA, GRA and WateReuse

Services: Drinking Water, Bottled Water & Water in Food Production

Certifications and Accreditations

Sampling Guidelines and Forms

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Last updated: Thursday, August 29, 2019

Program

12:45 – 1:15

Well Pump Design

Daniel Pichardo, General Pump Company

1:15 – 2:00

Treatment Options for PFAS

Kelsey Hakes, AqueousVETS and Cathy Swanson, Purolite

2:00 – 2:15

Safe Drinking Water Program

Charlene King, Water Replenishment District and Maria Kennedy, Kennedy Communications

2:15 – 2:30

Questions and Certificates

The presentations will be emailed to the participants and/or uploaded to http://www.wrd.org

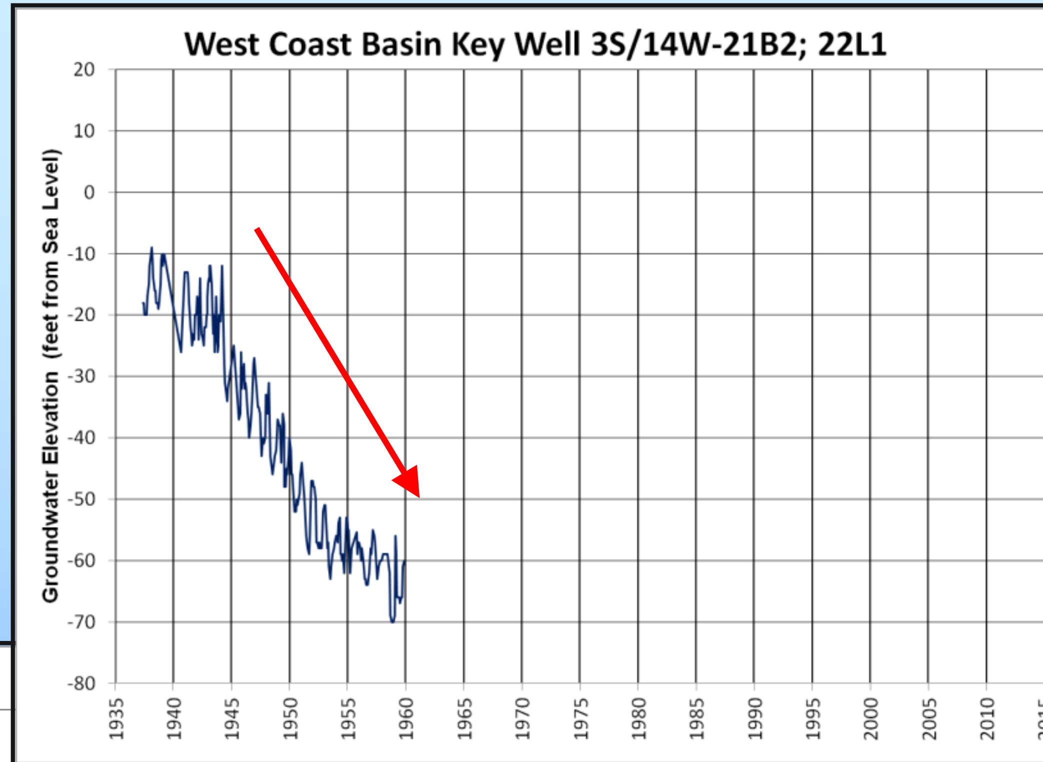
High Level Overview of WRD

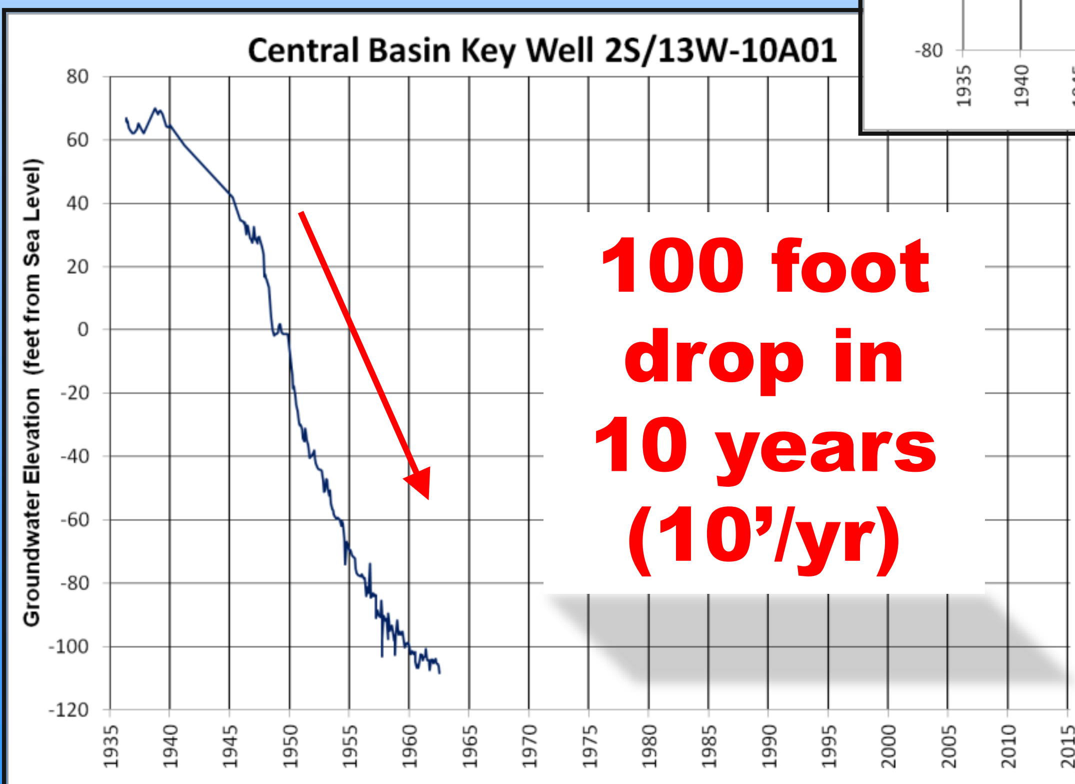
- History and Mission
- Major Programs
- Resources and Online Programs
- Water Independence Now

Past History:

1900s-1950s
Pumping Double Natural Replenishment.

OVERDRAFT





100 foot drop in 10 years (10'/yr)

- **Plunging Water Levels**
- **Loss of Supply**
- **Wells going Dry**
- **Seawater Intrusion**

Solutions

- WRD formed in 1959 to eliminate overdraft via Managed Aquifer Recharge (MAR).
- Pumping adjudicated at 281,835 acre feet/year (AFY).
- Higher than natural recharge within the basin, but the difference is made up WRD.

WRD
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

GROUNDWATER BASINS IN THE WRD SERVICE AREA

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

SERVICE AREA = 420 SQUARE MILES

43 CITIES

POPULATION > 4 MILLION

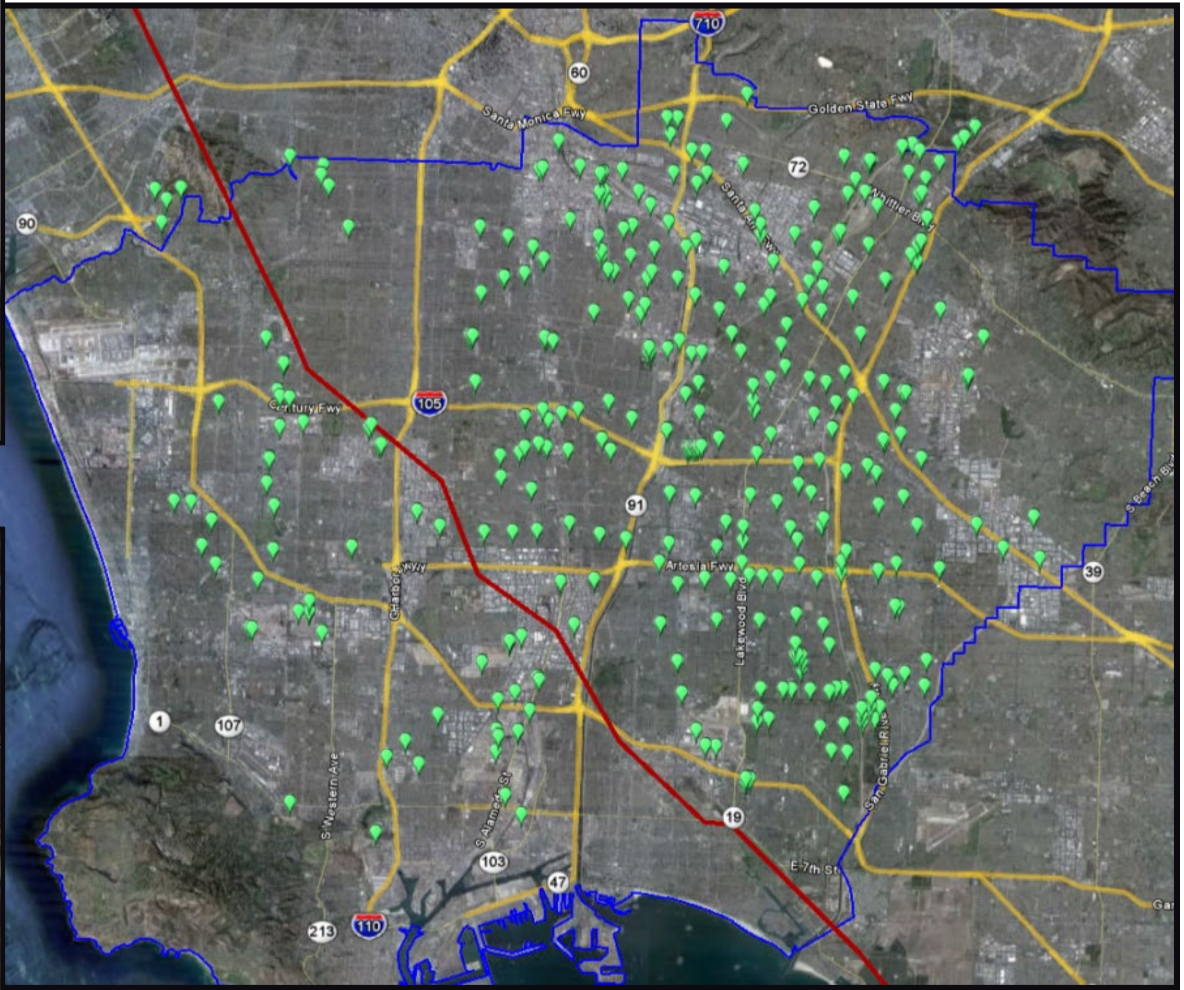
550,000 ACRE FEET USED PER YEAR

50% GROUNDWATER FROM LOCAL WATER WELLS

50% IMPORTED WATER

WRD SUPPLEMENTS NATURAL GROUNDWATER RECHARGE

Over 400 Wells Provide Water Supply



WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

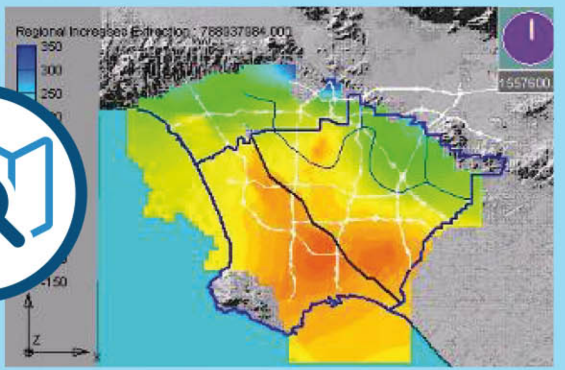
HOW WRD MANAGES THE BASINS

REPLENISHMENT OF GROUNDWATER

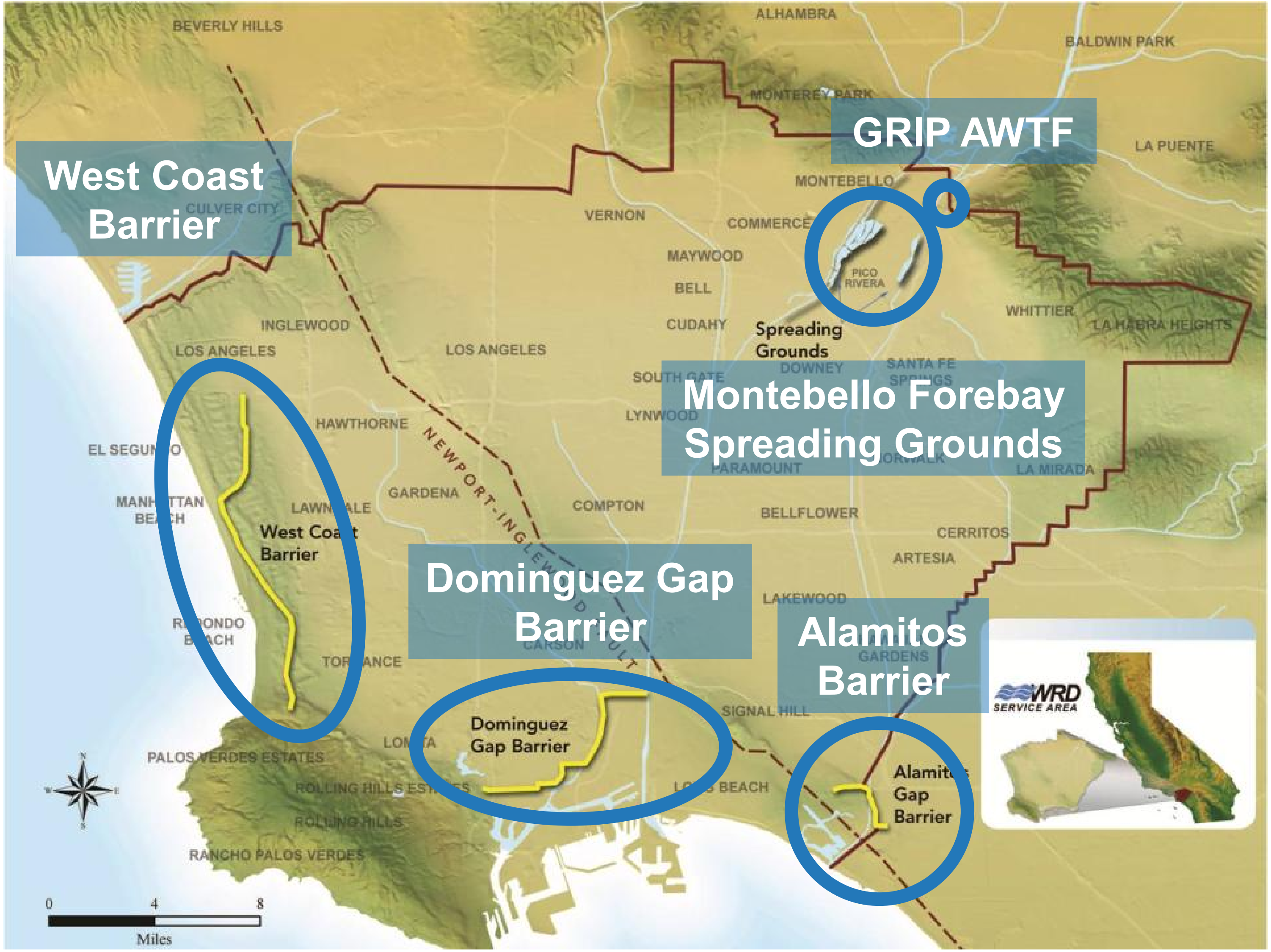
GROUNDWATER CLEAN UP

BASIN MONITORING

BASIN MODELING



Replenishment Facilities



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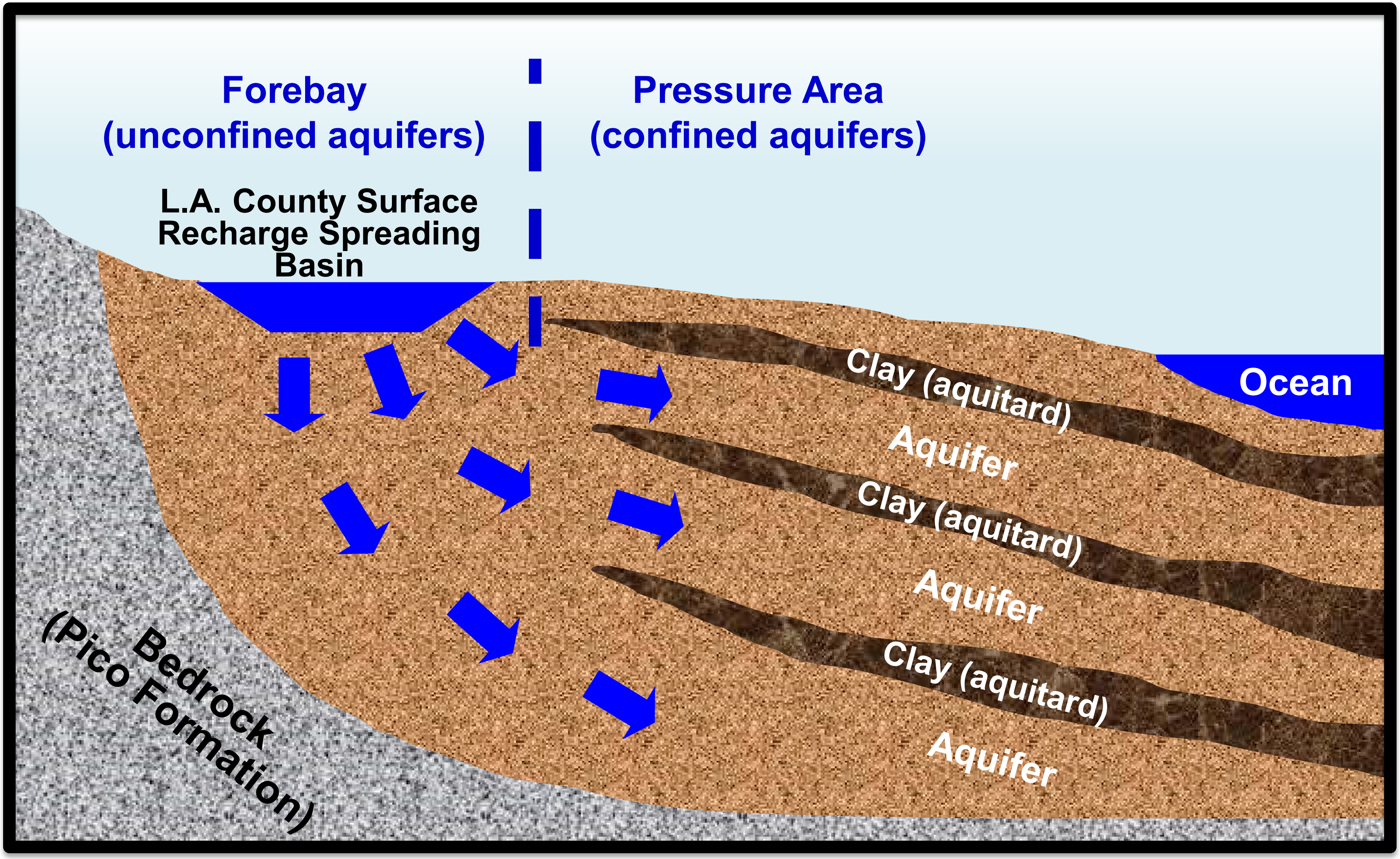
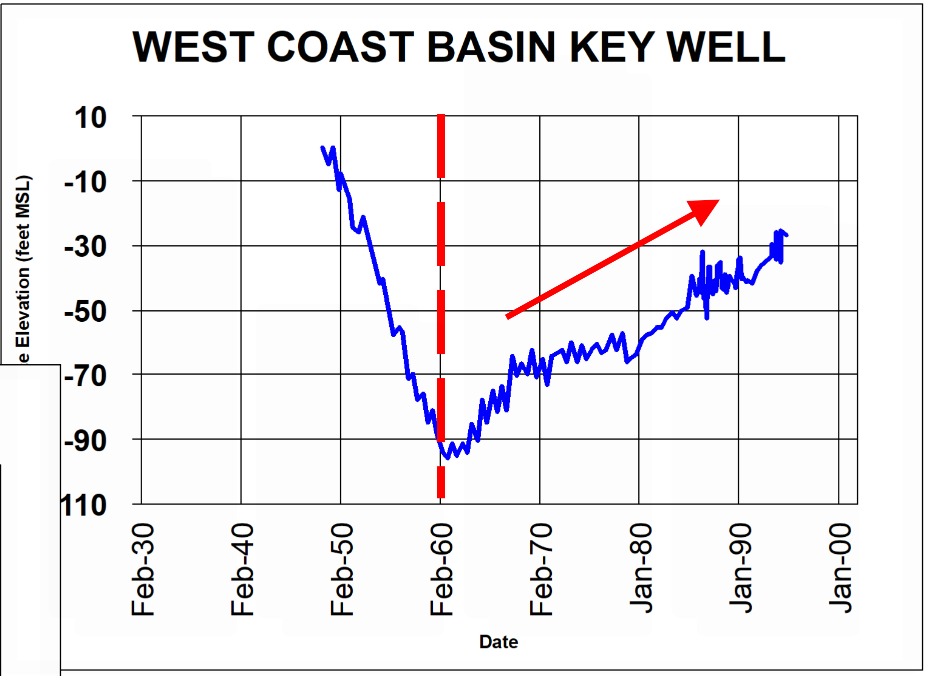
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

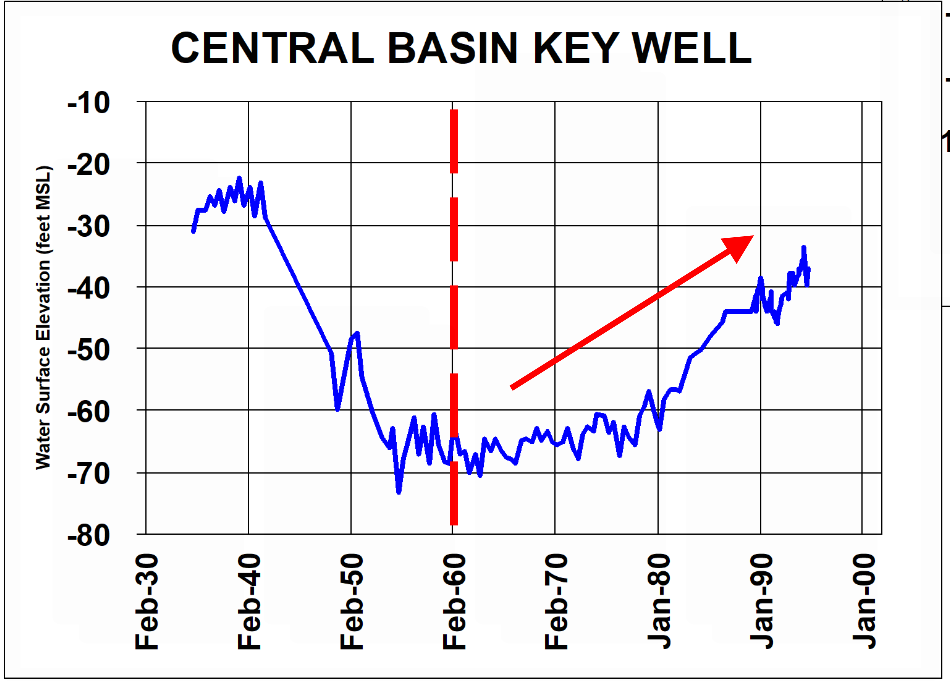
LA County Public Works Recharge Facilities

Replenishing Groundwater Basin



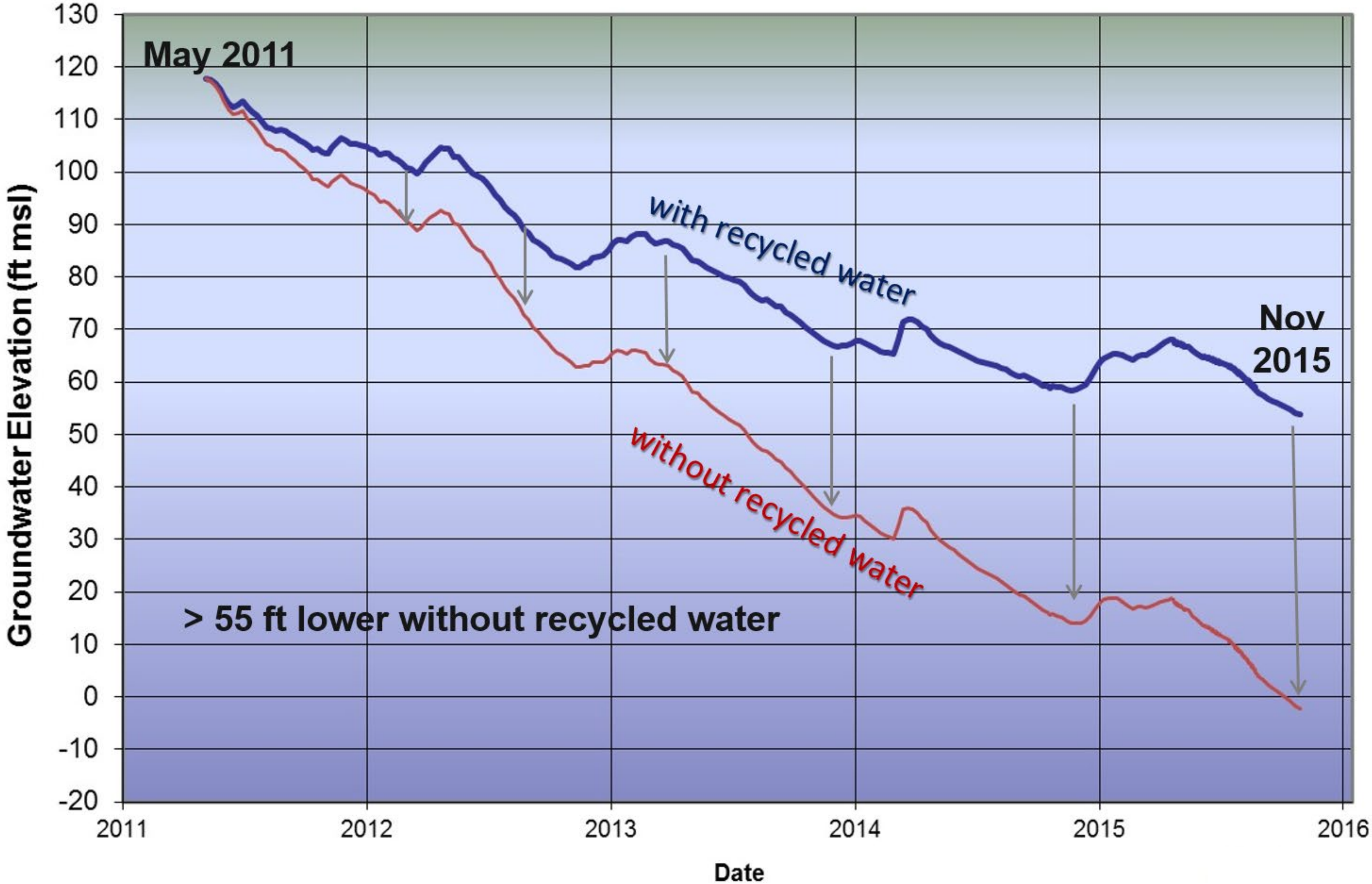
Results of WRD Basin Management





Rising water levels & drought protection

Forecasted water levels during drought without recharge



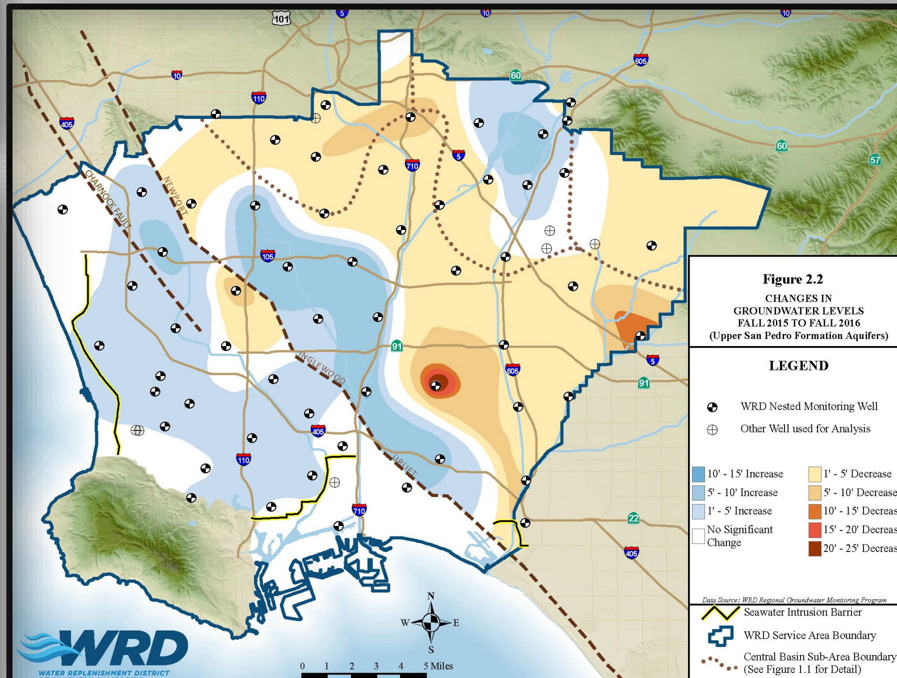
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

Regional Groundwater Monitoring Program

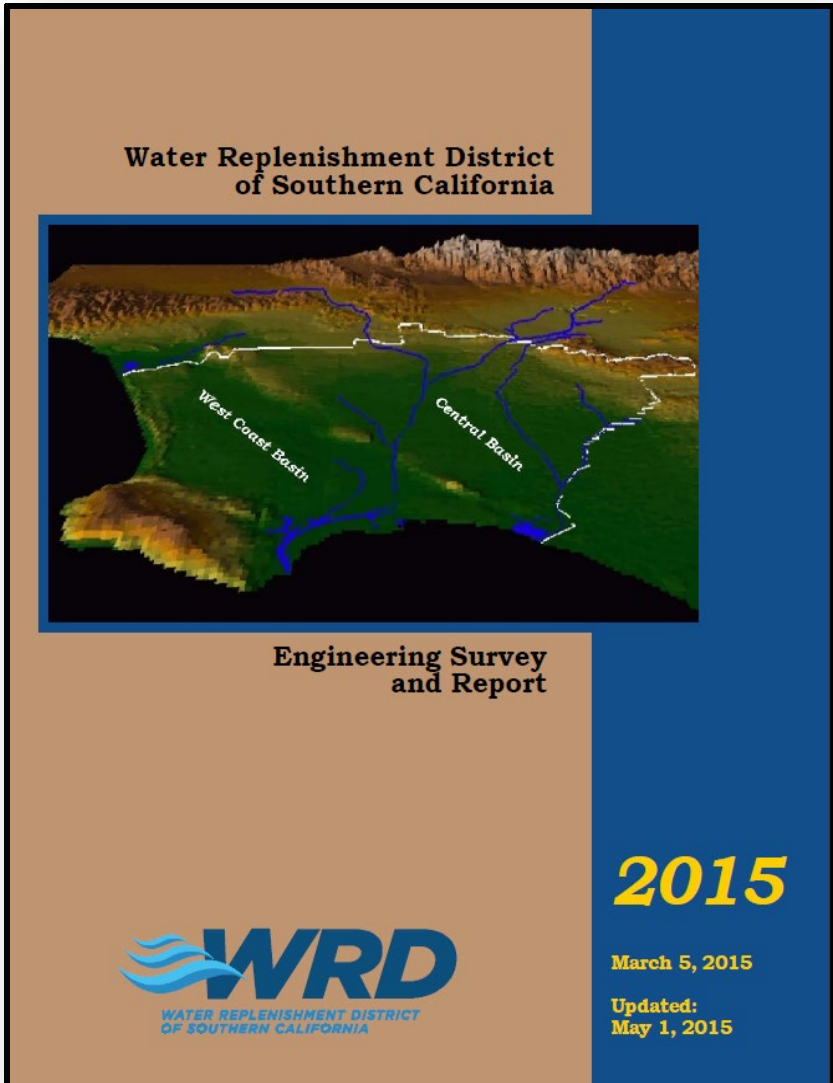
Sampling

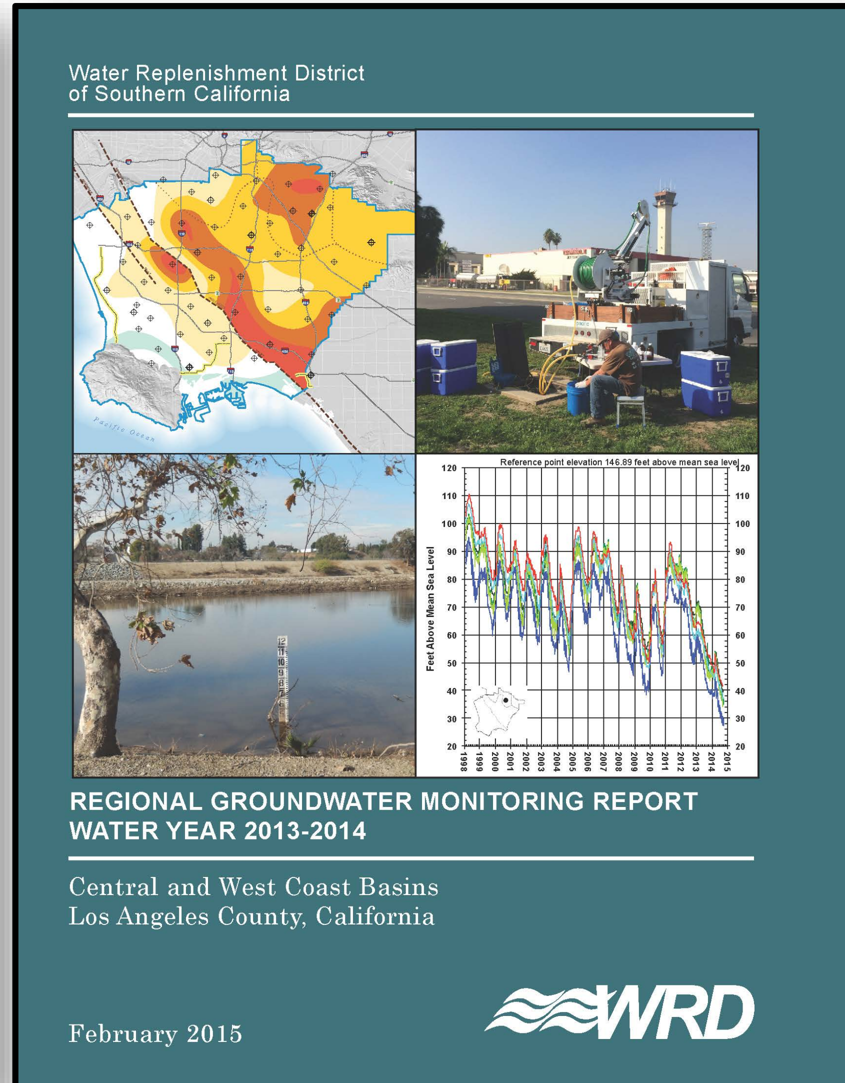
Nested Monitoring Wells

Drilling with USGS



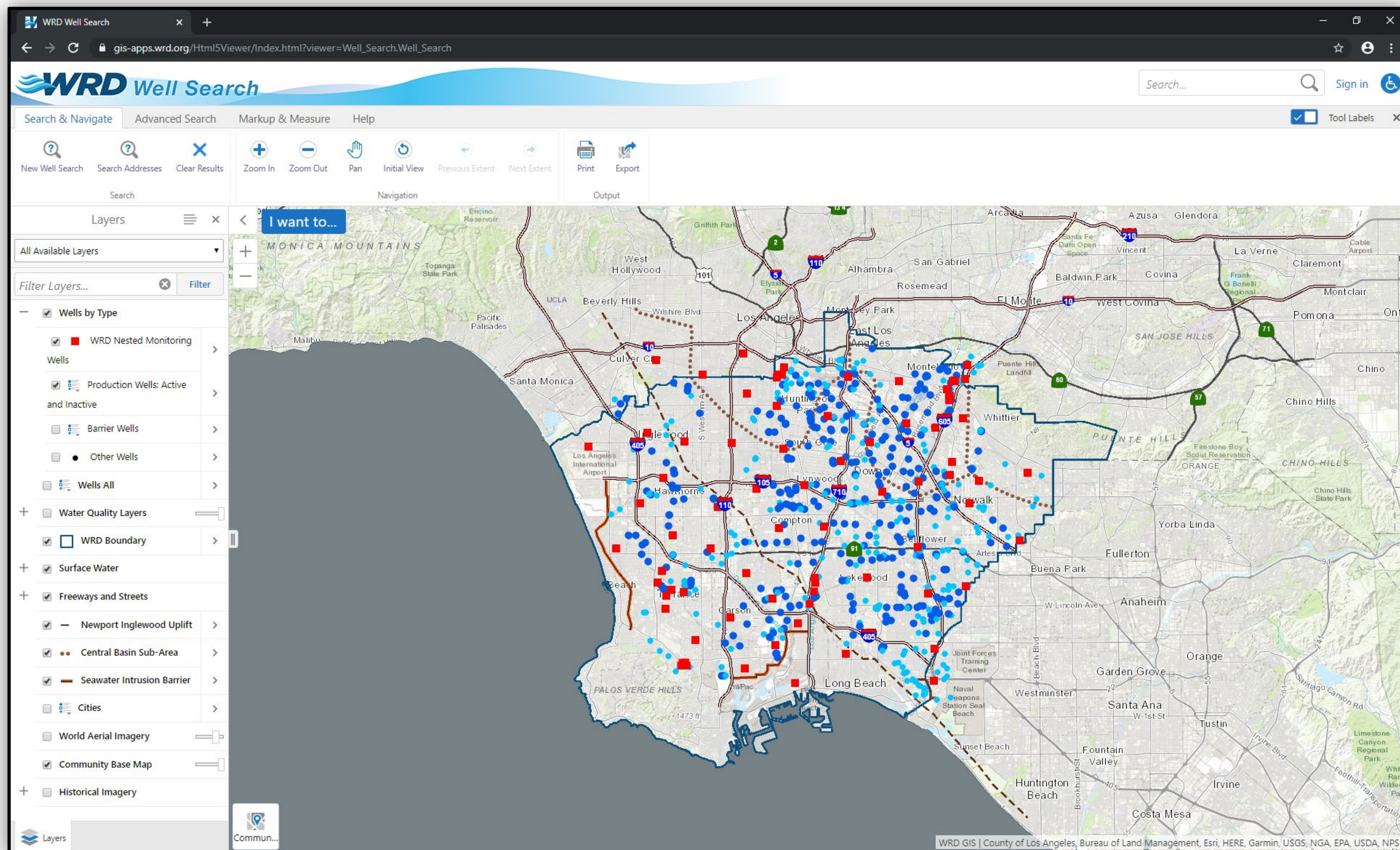
Data Presented in Two Annual Reports





Reports are available at http://www.wrd.org

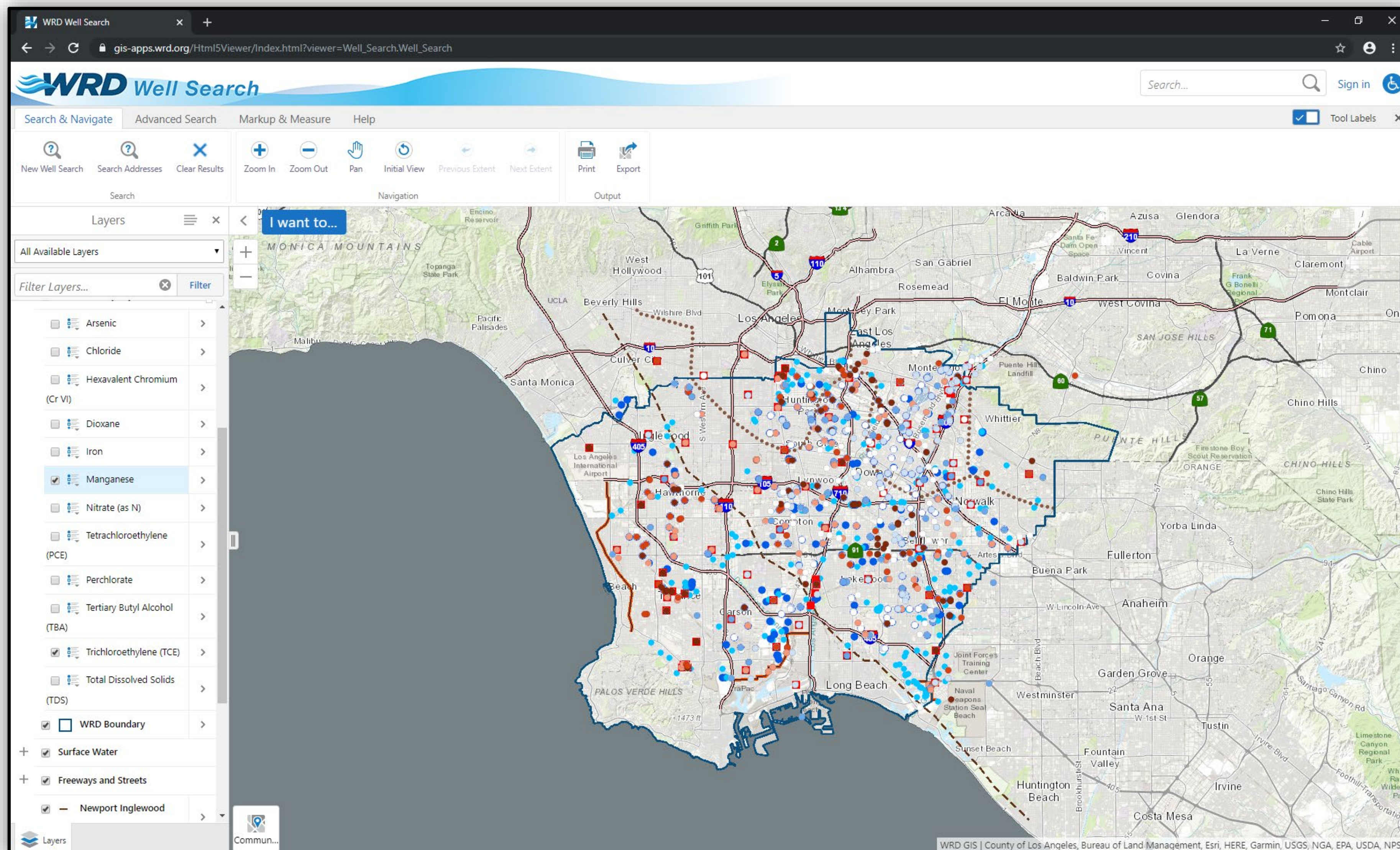
Interactive Well Search (Recently Updated)



https://gis.wrd.org/

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

Interactive Well Search (Recently Updated)



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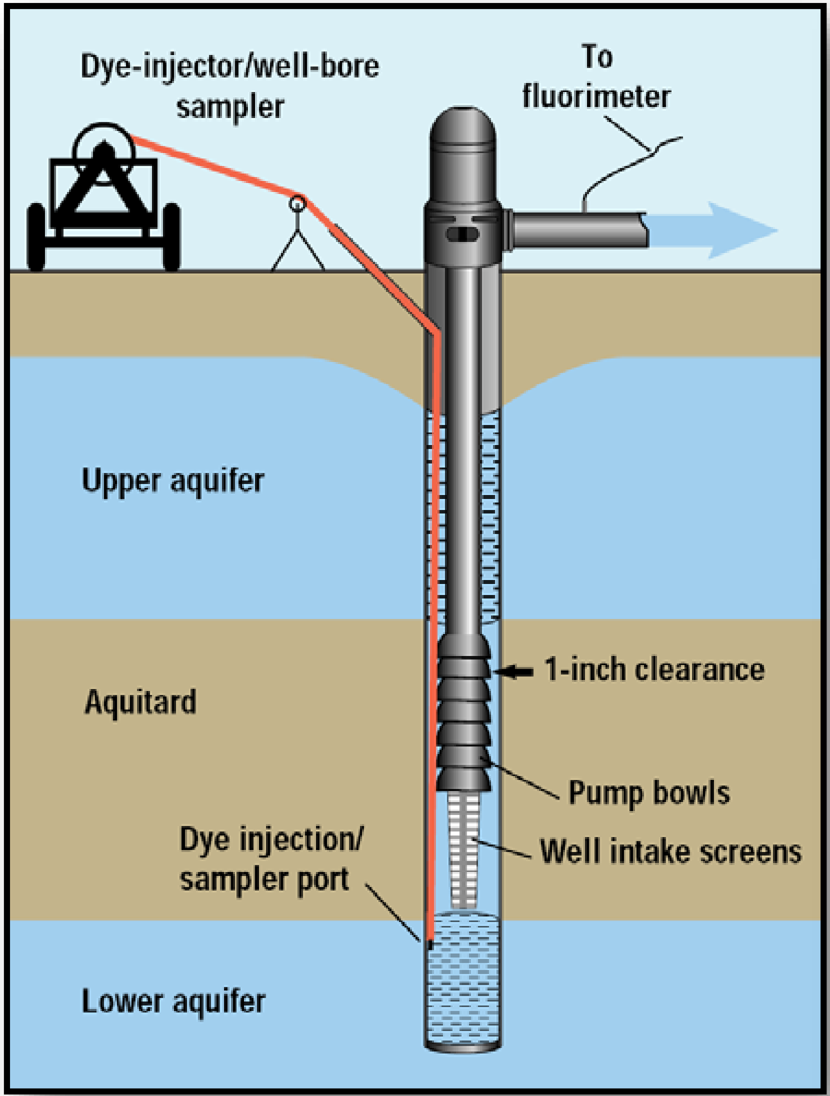
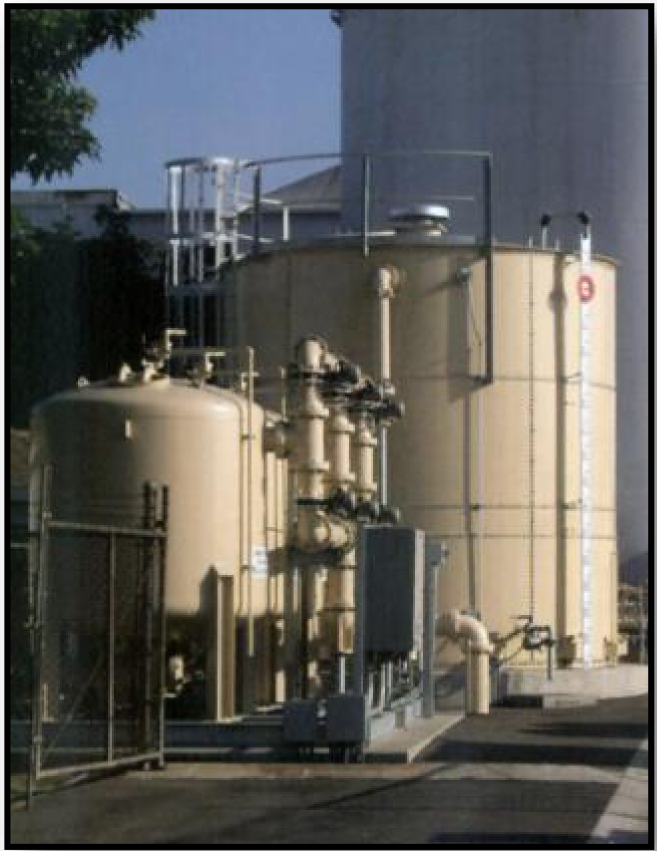
Well Profiling Program

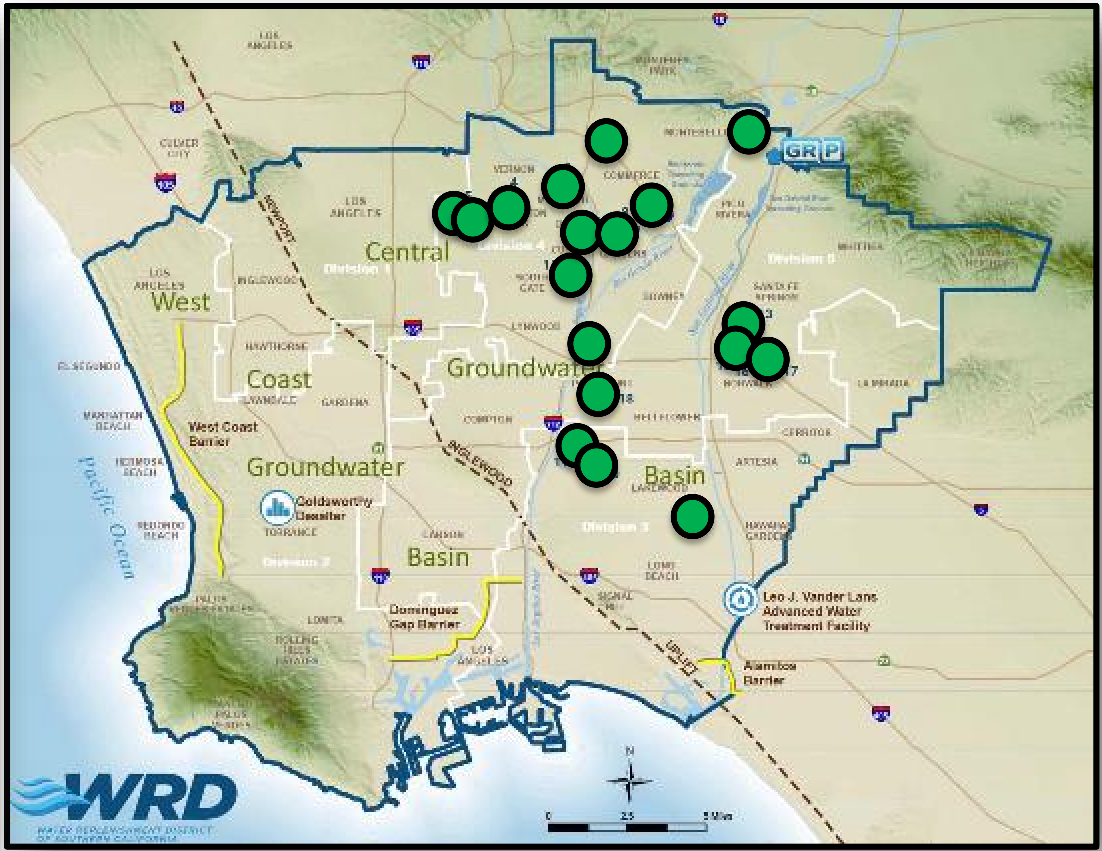


Contact Charlene King at cking@wrd.org (562.275.4252)

Safe Drinking Water Program (since1991)

- **Financial assistance for wellhead treatment.**
- **Outreach program for DACs.**





Contact Charlene King at cking@wrd.org (562.275.4252)

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

Groundwater Contamination Program

- **WRD staff track the progress of high priority environmental investigations located in the West Coast Basin and Central Basin (currently 46).**
- **Conduct high level reviews and when necessary provide feedback to the various regulatory agencies including EPA, DTSC, RWQCB.**

WRD awarded $7.28M in Proposition 1 grant funds to cleanup a Perchlorate and VOC "hot spot" in the City of Vernon (March 30, 2017).

Contact Brian Partington at bpartington@wrd.org (562.275.4249)

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

(WIN) WATER INDEPENDENCE NOW PROGRAM

COLLECTION OF PROJECTS TO ELIMINATE REMAINING DEMAND FOR IMPORTED WATER

WIN
WATER INDEPENDENCE NOW

A key to developing independence from imported water is the development of local recycled water sources.

PROJECTS TO:

- CAPTURE AND CONSERVE ADDITIONAL STORMWATER
- INCREASE USE OF RECYCLED WATER FOR GROUNDWATER REPLENISHMENT

SECURING OUR WATER FUTURE TODAY

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WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

(WIN) WATER INDEPENDENCE NOW PROGRAM

GOAL IS TO REPLACE IMPORTED WATER WITH LOCALLY AVAILABLE WATER (E.G. RECYCLED WATER) FOR AQUIFER REPLENISHMENT.

WIN
WATER INDEPENDENCE NOW

BENEFITS OF RECYCLED WATER OVER IMPORTED WATER:

INCREASED RELIABILITY | COST-EFFECTIVE | LOCALLY CONTROLLED | DROUGHT PROOF

SECURING OUR WATER FUTURE TODAY

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WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

GROUNDWATER RELIABILITY IMPROVEMENT ADVANCED WATER TREATMENT FACILITY

GRIP IS THE CORNERSTONE OF WRD'S WIN PROGRAM

GRIP
GROUNDWATER RELIABILITY IMPROVEMENT PROJECT

GRIP WILL PROVIDE 21,000 ACRE-FEET PER YEAR OF RECYCLED WATER IN PLACE OF EXPENSIVE IMPORTED WATER.

UPON COMPLETION, GROUNDWATER BASINS WILL BE COMPLETELY LOCALLY SUSTAINABLE

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

GROUNDWATER RELIABILITY IMPROVEMENT ADVANCED WATER TREATMENT FACILITY

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WRD

WATER REPLENISHMENT DISTRICT
OF SOUTHERN CALIFORNIA

Thank You!

Brian Partington

bpartington@wrd.org

562.275.4249

GRIP

GROUNDWATER RELIABILITY
IMPROVEMENT PROJECT

WIN

WATER INDEPENDENCE NOW

Speaker #2

DDW Regulatory Update

Jeff O’Keefe

SWRCB - DDW

Jeff.OKeefe@waterboards.ca.gov

DDW Regulations Update

Jeff O’Keefe, P.E.
Southern California Section Chief
Division of Drinking Water
State Water Resources Control Board

2019 Annual Groundwater Quality Workshop

December 11, 2019

California's Division of Drinking Water

- Northern California Field Operations Branch
- Southern California Field Operations Branch
- Program Management Branch
  - Technical Operations Section
  - Quality Assurance Section
  - Environmental Laboratory Accreditation Program (ELAP)

District Offices and LPAs:

- 7500+ Water Systems
- 5 Regions
- 24 State District Offices
- 30 County Local Primacy Agencies

Maximum Contaminant Level (MCL) Review

- Background
  - Health and Safety Code §11635 requires
    - MCLs to be reviewed every five years
    - Public notice by March 1 of MCLs to be reviewed
    - MCLs set as close to Public Health Goal as economically and technologically feasible
  - All MCLs were reviewed in 2018
  - Staff recommends no further review for 2019

DLR Limitations Review

- DLR = Detection Limit for purposes of Reporting
- PHG = Public Health Goal
- >30 contaminants with DLR > PHG
- Working with ELTAC and laboratory community to determine which DLRs can be lowered

Regulations Update

- MCL for 1,2,3-Trichloropropane (1,2,3-TCP)
  - *Adopted July 18, 2017; effective December 14, 2017*
- Surface Water Augmentation (SWA) Regulation
  - *Adopted March 6, 2018; effective October 1, 2018*
- Permanent Point-of-Use (POU) / Point-of-Entry (POE) Regulations
  - *Became effective on March 22, 2019*
- Direct Potable Re-use
  - *Proposed framework presented June 2018*

Hexavalent Chromium

- Background
  - 10 ppb MCL June 2014
  - Court-ordered removal of MCL September 2017
- Current Regulatory Work
  - Economic Feasibility White Paper
    - Post for Public Comment – November 2019
    - Public workshops – December 2019 / January 2020
  - MCL Development is Underway
    - Meeting requirements of Administrative Procedures Act
    - Evaluation of occurrence data & Impacted Sources
    - Development of Treatment Options, Costs

Lead and Copper Rule (LCR)

- Background
  - Plumbing materials are primary contaminant sources
  - Action levels instead of MCLs
  - Compliance assessed at tap
  - 1991 U.S. EPA LCR, revised 2007
  - U.S. EPA considering long-term revisions

Lead and Copper Rule (LCR)

- CA Proposed Regulatory Work
  - Short-Term Revisions
  - Revised Lead DLR being considered
  - Department of Social Services Assistance
  - Lead and Copper Rule Revision
- EPA Proposed Updates in October 2019
  - Identifying areas most impacted
  - Increasing sampling reliability
  - Improving Risk Communication
  - Protecting Children in Schools
  - Replacing Lead Service Lines
  - Strengthening Treatment Requirements

Lead Sampling in Schools

- Assembly Bill 746 and 2017 Permit Amendment Programs
  - Mandatory program requires community water systems to test for lead at public K-12 schools (AB 746)
  - Voluntary program allowing private K-12 schools to request sampling from their water provider (2017 Permit Amendment)
  - Through October 16, 2019:
    - ✓41,636 sample results submitted for 38,815 sample sites
    - ✓Only 289 (of 7,579) schools had an action level exceedance (>15 ppb)
  - 96.2% of all sampled schools in California had zero action level exceedances
  - We are expecting data from about 900 schools through the end of the year

Lead Service Line Inventory

- SB 1398 and SB 427 requires all community water systems to compile an inventory of known lead service lines and identify areas that may have lead service lines by July 1, 2018
- By **July 1, 2020** – Provide timeline for replacement of lead and unknown service lines or determine presence of lead service lines in areas where it is unknown.

Lead Service Line Inventory

- DDW District offices are reviewing inventories submitted
- Recommended to inform customers of inventory completion in Consumer Confidence Report
- Additional information available at:

  http://www.waterboards.ca.gov/drinkingwater

  Program Quick Links: Lead Service Line Inventory

Lead in Day Care Centers (AB 2370)

- Implemented by Department of Social Services
- Day care center must test drinking water for lead between January 1, 2020, and January 1, 2023
- Every five years after the initial testing
- Results submitted electronically to SWRCB
- SWRCB to post all test results
- Day care center must take action if results are elevated.

Revised Total Coliform Rule (RTCR)

- Background
  - U.S. EPA RTCR effective April 1, 2016
  - 6 public workshops held in February and March 2017
  - Draft California RTCR will
    - Adopt all but 9 federal provisions; CA more stringent
    - Increased levels of monitoring to determine contamination levels
- Proposed Regulatory Work
  - California RTCR will adopt all but 9 federal provisions
  - Notice of Proposed Rulemaking – 2nd quarter of 2020
  - Public hearing – Summer, 2020
  - Board adoption – 3rd quarter of 2020
  - Regulations effective – Early 2021

Direct Potable Re-use (DPR)

- Background
  - Mandate to adopt criteria by December 31, 2023
  - Research required by Water Code §13561.2(c) before adopting uniform water recycling criteria
  - Proposed framework was presented to Board in June 2018
- Proposed Rulemaking Work
  - Five research projects in progress
  - Work continues on overall regulatory approach (framework)
  - Research and establishment of an Expert Panel
  - Update to the Board on DPR framework – Fall 2019

Cross-Connection Control

- Background
  - Title 17, §7583(e): "Cross-Connection"
    "an unprotected actual or potential connection between a potable water system used to supply water for drinking purposes and any source or system containing unapproved water or a substance that is not or cannot be approved as safe, wholesome, and potable."
  - AB 1671 (2017)
    - January 1, 2020 deadline to develop regulations
    - May do so through adoption of a policy handbook, with at least two public hearings
- Proposed Regulatory Work
  - Update/replace existing cross-connection regulations
  - Develop specialist and tester certification criteria
  - Informational Webinars in February 2020
  - Draft standards to be available in early 2020

Environmental Laboratory Accreditation Program (ELAP)

- Background
  - Accredits environmental labs used for regulatory compliance
  - Expert Review Panel determined that current regulations are inadequate (2015/2016)
  - ELAP selected national (TNI) standards
  - Draft regulations released for multiple comment periods
  - Workshops held in 2017 and 2019
  - Notice of Proposed Rulemaking – October 11, 2019
- Proposed Regulatory Work
  - Close of 45-Day Public Comment Period - December 20, 2019
  - Date of Scheduled Public Hearings - December 18, 2019
  - SWRCB Meeting to Consider Adoption - March 17, 2020
  - Full compliance ~3 years from adoption

Perchlorate

- Background
  - PHG lowered from 6 ppb to 1 ppb in 2015
  - Current MCL: 6 ppb
  - Current DLR: 4 ppb
  - Board approved DDW proposal to evaluate lowering DLR ahead of MCL
- Proposed Regulatory Work
  - Notice of Proposed Rulemaking – early 2020
  - Board adoption hearing – Summer, 2020

Microplastics

- Background and Proposed Rulemaking Work
  - Emerging contaminant of concern
  - Not regulated at federal level
  - SB 1422 (2018)
    - July 1, 2020 deadline to develop definition
    - July 1, 2021 deadline for
      - Adopting standard analytical method(s)
      - Adopting requirements for four years of testing and public disclosure of results
      - Considering issuance of a notification level or other guidance
      - Accrediting qualified laboratories for analysis
    - May use policy handbook instead of regular rulemaking

On-Site Treatment and Re-use Water Quality Standards

- Background and Proposed Rulemaking Work
  - SB 966 (2018)
    - December 1, 2022 deadline to adopt regulations
    - Anticipate rulemaking to start in late 2021
    - On-site treatment and re-use of non-potable water
    - Multi-family residential, commercial, mixed-use buildings
    - Not for untreated graywater systems used only for subsurface irrigation
    - Not for untreated rainwater systems
    - Regulations must include
      - Risk-based log reduction targets for pathogen removal
      - Water quality monitoring and reporting requirements
      - Notification and public information requirements
      - Cross-connection controls

Electronic Reporting of Drinking Water Quality Data

- Background
  - Data system/format specified in regulations inadequate
  - Current system not CROMERR-compliant [Cross Media Electronic Reporting Regulation]
    - Electronic signatures—data integrity and enforceability
  - U.S. EPA's Compliance Monitoring Data Portal (CMDP)
    - CROMERR-compliant
    - Doesn't meet California-specific data needs
- Proposed Rulemaking Work
  - Update regulations to specify data intake system/format meeting California data needs and U.S. EPA requirements
  - Notice of Proposed Rulemaking – mid-2019
  - Board adoption hearing – late 2019 / early 2020

Per- and Polyfluoroalkyl Substances (PFAS)

SWRCB PFAS Monitoring Orders

- Phased Investigation is underway
- First quarter of data posted as of October 14, 2019
- Revised Notification Level in August 2019
- Response Level to be revised relatively soon
- New interactive maps are available with statewide data

PFAS Source and Public Water System Investigations – Next Phases

- Chrome Plating Facilities (288)
- Waste-Water Treatment Facilities (influent, effluent, biosolids)
- Refineries and Bulk Terminals
- Military Bases
- Additional sampling outwards from impacted wells
- PHG development started with goal of MCLs by end of 2023

Timeline: PFOA & PFOS Response Levels, Public Health Goals, Maximum Contaminant Level

January 2020
- AB 756 statute changes become effective

April/May 2020
- OEHHA releases draft PHGs for public comment

July/August 2020
- OEHHA initiates scientific peer review of draft PHGs

Fall 2020
- OEHHA releases 2nd public review draft of PHGs for public comment

Summer 2021
- OEHHA releases final PHGs and responses to comments

Summer 2022
- Water Board releases draft MCLs regulation package and begins public comment period

Fall 2022
- Board Hearing on MCLs and close of comment period

Spring 2023
- Board adoption hearing on MCLs

Summer 2023
- Water Board submits regulation package to Office of Administrative Law (OAL) for approval

Fall 2023
- OAL approval, MCLs become effective

CALIFORNIA Water Boards

Per- and Polyfluoroalkyl Substances (PFAS)

Assembly Bill 756 – Beginning January 2020 requires community and non-transient non-community systems to:

- Water Board may order testing for groups or all water systems.
- Report any detection to the customers via the Consumer Confidence Report unless:
  - Water source is taken out of use OR
  - New data shows that the detection is no longer exceeded
- If a source exceeds the Response Level, either:
  - Remove the source form service OR
  - Provide public notification

Future Year Regulations—Preview

- Total Trihalomethanes (TTHMs)
  - Draft Public Health Goals released for comment October 2018
  - Revised Public Health Goals for individual THMs expected 2019
- 1,4-Dioxane
  - Public Health Goal requested from OEHHA January 2019
- Nitrosamines
- Cyanotoxins
- *Legionella*
- Detection Limits for Purposes of Reporting (DLRs)
  - Coordination with ELTAC to survey laboratories
  - Needed to evaluate occurrence and treatment capabilities

Staff Recommendation for Prioritization of Drinking Water Regulations in Calendar Year 2019

Summary

1. Hexavalent Chromium MCL
2. Lead and Copper Rule (LCR)
3. Revised Total Coliform Rule (RTCR)
4. Direct Potable Re-use
5. Cross-Connection Control Regulations
6. Environmental Laboratory Accreditation Program (ELAP)
7. Primacy Package Applications
8. Revised Detection Limit for Purposes of Reporting for Perchlorate
9. Microplastics
10. Regulations for On-Site Treatment and Re-use
11. Electronic Reporting of Drinking Water Quality Data
12. Per- and Poly-fluoroalkyl Substances (PFAS) Investigation

Resources

- **DDW Website:**

  http://www.waterboards.ca.gov/drinkingwater

- **Contact Your Local DDW Field Office:**

  http://www.waterboards.ca.gov/drinking_water/programs/documents/ddwem/DDWdistrictofficesmap.pdf

- **Follow Regulation Package Movement**

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

Resources cont'd

- **Drinking Water Watch:**
  https://sdwis.waterboards.ca.gov/PDWW/
- **Subscribe to E-mail Subscription Mailing List:**

  - Go to **http://www.waterboards.ca.gov/resources/email_subscriptions/**
  - Select "State Water Resources Control Board"
  - Fill in contact information with your email address and full name
  - Select category "Drinking Water" and then select the first box "Drinking Water Program Announcements"
  - You may select other categories as well
  - Click "subscribe"

Contact Information

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CALIFORNIA
Water Boards

Gavin Newsom
Governor

Jared Blumenfeld
Secretary for
Environmental Protection

State Water Resources Control Board

Questions?

Speaker #3

The Impact of Unregulated Contaminant Monitoring on Regulatory Development in California

Ken Reich

Suburban Water Systems

Suburban Water Systems
A SouthWest Water Company

The Impact of Unregulated Contaminant Monitoring on Regulatory Development in California

Presented at the Water Replenishment District of So. California

Groundwater Quality Workshop

December 11, 2019

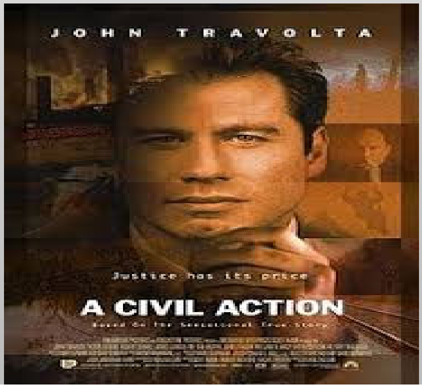
by

Ken Reich, Suburban Water Systems

Where Were You in the Mid-Late 1970's When the Environment Became the Focus of National Attention?
And In 1974, When Trihalomethanes Were Discovered In Drinking Water?

"A Twinkle in Your Parents Eyes, Perhaps?" – The Thin Man, 1934

I Was Working on My BS at UC Irvine and MPH at UC Berkeley: Anaerobic Microbial Methylation of Mercury, Enterovirus Recovery from Recycled Water, Prepping for the 1974 SDWA Impacts



Discovery of Organic Chemicals in California Groundwater and Drinking Water Supplies 1976-1979

Main San Gabriel Groundwater Basin

Southern California Manufacturing

Industrial Solvents – PCE, TCE, DCE

Deep Domestic Supply Wells

Hundreds of Wells Impacted

San Joaquin Valley, Riverside, SB

Central Valley California Agriculture

EDB, DBCP

Shallow Irrigation Supply Wells

Thousands of Wells Impacted

California's Immediate Regulatory Response
Action Levels

In The Absence of MCLs in the Early 1980's, Action Levels (ALs) for Unregulated Organic Chemicals Were Created by CA Department of Health Services (CDHS):

- Informal, Not Legally Enforceable, Health-Based Advisory Levels
- Provide Guidance if a Chemical is Detected Above the Action Level - Blending or Removal from Service
- As Many as 60 Action Levels were set in California During the 1980's, Including 20 Agricultural Chemicals 1982-83 (J. Gaston to Central Valley Regional Water Quality Control Board)

California's Immediate Regulatory Response
Action Levels

- Thirty-Seven (37) of the 60 ALs Now Have MCLs; 21 are Archived; 2 Have Notification Levels (NL)
- ALs Replaced by NLs in 2004 with Stringent Public Governmental Bodies Notification, CCR Notification

Suburban Water Systems
A SouthWest Water Company

California's Immediate Regulatory Response
Action Levels

- In 2004 Action Levels Become Notification/Response Levels with More Stringent Public Notification and Source Removal Requirements
  - Today, NLs Generally, but not Always, Established in Response to Actual Contamination of Drinking Water Supplies

Decade Established	Notification Levels Created	Now with MCLs	Archived	Current
1980s	60	37	21	2
1990s	12	2	3	7
2000s - Present	23	1	0	20
Total	95	40	24	31

  - To Date, of the 95 Chemicals that have had a Designated AL / NL, 40 have MCLs and 31 still have NLs; Latest NLs are PFOS and PFOA

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CA Legislative Response to Groundwater Contamination
Unregulated Contaminant Monitoring Program of PWS Wells

- 1980 AB 2407 (Tanner) Directs CDHS to Develop List of Chemicals and Plan to Test PWS Wells
- In 1983 CDHS Selects Testing for Priority Pollutants Plus Others and Publishes Analytical Methods
- Labs Gear Up for What is Coming with GCMS Instruments and Extraction Space
- Assembly Bill 1803 UCM in Groundwater Passes Legislature and Takes Effect January 1, 1984

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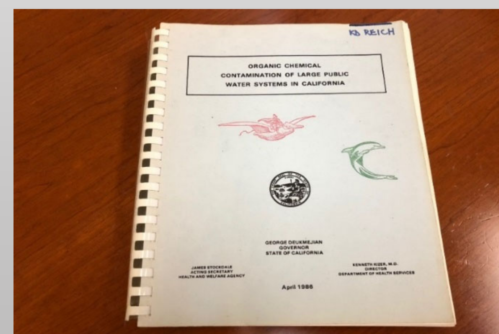
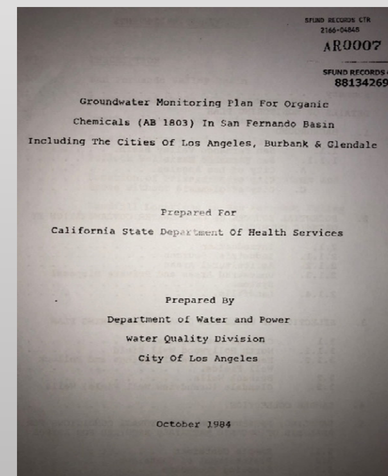
CA Legislative Response to Groundwater Contamination
Unregulated Contaminant Monitoring Program (UCM) of PWS Wells

- Jan 1, 1985 - CDHS Completes List of Potentially Vulnerable Systems >200 Connections
- April 1985 – CDHS Completes Notifying Vulnerable to Prepare Sampling Plans
- May 1985 – CDPH Completes Reviews PWS Plans
- August 1985 – PWS Complete Sampling
- April 1986 – CDHS Submits Final Report to the Legislature





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AB 1803 Monitoring Program Statistics

- 819 PWS Subject to AB 1803 UCM with 5,600 Wells
- 3,000 Most Vulnerable Wells Sampled
- 33 Organic Chemicals Detected
- Quarterly Monitoring of Contaminated Wells Imposed
- 538 Wells Had Detects of One or More Chemicals (18%)
- 165 Wells Exceeded One or More ALs (6%)

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A SouthWest Water Company

AB 1803 Monitoring Program Statistics

- 40% of the Contaminated Wells Were in LA County
- CDHS Position was to Remove Wells from Service is AL Exceeded but 13 Detected Chemicals did not have Als
- Aggressive Program to Set MCLs for Chemicals with and without ALs Through 1983 and 1986 Amendments to CA SDWA – but Rulemaking Process not Spelled Out in Detail
- Between 1991 – 1994, 14 First Time Detections of New Organic Chemicals

AB 1803 Monitoring Program Regulatory Dates

TOP 10 AB 1803 DETECTIONS BY FREQUENCY

COMBINED LARGE AND SMALL PUBLIC WATER SYSTEMS AND NOT INCLUDING DBPs

CHEMICAL	CA ACTION LEVEL 1986 (ppb)	CA MCL 1990 (ppb)	# OF WELLS DETECTED	MAXIMUM DETECTED (ppb)	MCL EFFECTIVE IN CA	MCL EFFECTIVE BY EPA
DCBP	1	0.2	275	7.4	1989	1992
TETRACHLOROETHYLENE	4	5	264	166	1989	1992
TRICHLOROETHYLENE	5	5	217	538	1989	1989
1,1,1-TRICHLOROETHANE	200	200	99	202	1989	1989
1,1-DICHLOROETHYLENE	0.1	5	72	78	1989	1989
CARBON TETRACHLORIDE	5	0.5	45	29	1989	1989
ATRAZINE	Not Established	3	42	2.4	1989	1992
1,2-DICHLOROETHANE	1	0.5	36	24	1989	1989
1,2-DICHLOROETHYLENE	None Established	None	36	100	1994	1992
SIMAZINE	None Established	4	32	28	1989	1994

Whatever Happened to Herbicide Simazine in the Central Basin?

- I Was Laboratory Project Manager for the Central Basin AB 1803 Program While at Montgomery Engineers
- Most of the Simazine AB 1803 Detections Were in Los Angeles County
- 19 Central Basin Wells Had Detectable Levels Ranging 0.5 ppb – 1.9 ppb
- AB 1803 Reporting Limit Was 0.2 ppb
- Initial Compliance Reporting Limit Was 1.0 ppb; MCL 4.0 ppb in 1989

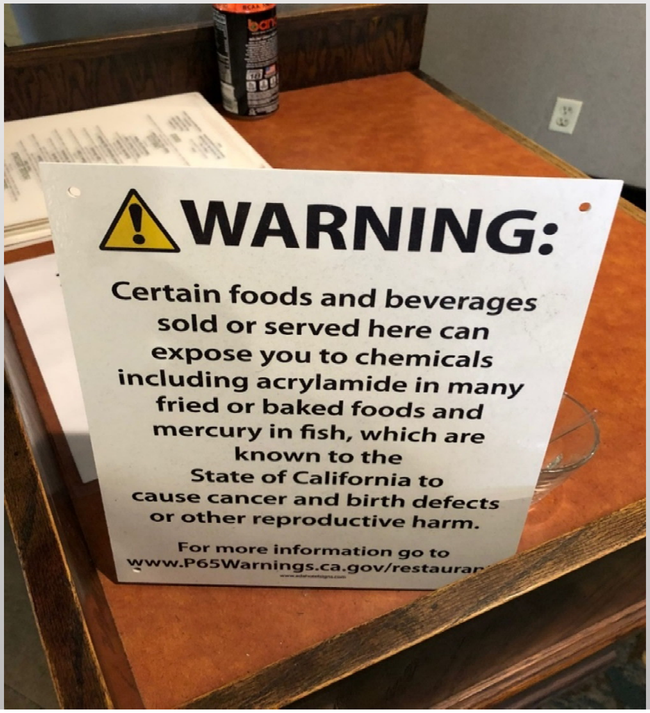
Suburban Water Systems
A SouthWest Water Company

Whatever Happened to Herbicide Simazine in the Central Basin?

- Central Basin MWD Organized Domestic Well Compliance Monitoring at the Time
- Initial Compliance Monitoring in 1989-1990 Produced Very Few Detections in CB Wells; 90th Percentile Concentration Was 1.4 ppb
- While Water Quality Manager at Central Basin MWD in the Early 1990's, I Received a call from CDHS Inquiring Where Did all the Atrazine Detections Go? I Referred CDHS to the Detection Limits and Decrease in Use Around the San Gabriel River Where Most Wells Were Impacted

Public Response to Groundwater Contamination

Proposition 65 Safe Drinking Water and Toxic Enforcement Act of 1986, Sold to Public as a Drinking Water Protection Act, Wins Big in 1986 Election



Subsequent Legislation Redefines California's Role in Setting Drinking Water Standards

- 1983 and 1986 Amendments of the California SDWA allows the CDHS to Adopt Standards that are More Stringent than federal MCLs and not Necessarily Regulated yet by the USEPA
- 1989 AB 21 Sets Forth Requirements for Adopting Primary Drinking Water Standards
- Mechanism for Adoption or Revision of MCLs Becomes Creation of Recommended Public Health Levels Established by the Office of Environmental Health Hazard Assessment for Each Regulated Contaminant Similar to MCLGs; Based Solely on Health Effects and Carcinogens are not Set at Zero

Subsequent Legislation Redefines California's Role in Setting Drinking Water Standards

- Five Year Reviews of MCLs and Periodic Review of RPHLs Introduced
- RPHLs Become the Current Public Health Goals in 1996
- Under the Calderon-Sher Safe Drinking Water Act of 1996 (the Act), Water Utilities are Required to Prepare a Report Every Three Years for Contaminants that Exceed PHGs

Subsequent UCM in California Leads to MCLs

- Perchlorate
  - 1997 AL of 18 ppb; 2002 AL 4 ppb
  - 1997 Unregulated Monitoring Begins With DLR at 5 ppb
  - 2004 PHG 6 ppb
  - 2007 MCL 6 ppb
  - 2015 Revised PHG 1 ppb
- Hexavalent Chromium
  - 2001 SB 351 Required MCL by Jan. 1, 2004
  - 2001 Unregulated Monitoring Begins With 1 ppb DLR
  - 2011 Final PHG 0.02 ppb
  - 2014 MCL 10 ppb
  - 2017 MCL Invalidated by CA Superior Court

Subsequent UCM in California Leads to MCLs

- 1,2,3-Trichloropropane
  - 1999 Notification Level 5 ppt
  - 2001 Unregulated Monitoring Begins with DLR at 5 ppt
  - 2009 PHG 0.7 ppt
  - 2017 MCL 5 ppt

Speaker #4

Advanced UV-Oxidation for Treating Emerging Contaminants

Terry Keep

TrojanUV

tkeep@trojanuv.com

TROJAN UV

Advance UV-Oxidation for Treating Emerging Contaminants

2019 Annual Groundwater Quality Workshop WRD

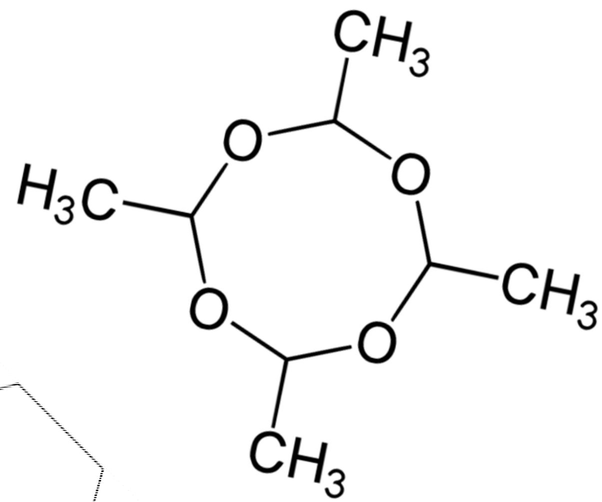
WATER QUALITY – GLOBAL TRENDS

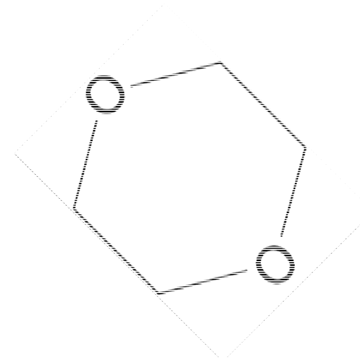
- UV technology is used ubiquitously for drinking water disinfection
- Rising populations result in decreasing availability of “pure” water sources
- Contaminants infiltrate water sources in a variety of ways
  - Agricultural run-off
  - Wastewater discharge
- Many contaminants cannot be treated through conventional approaches

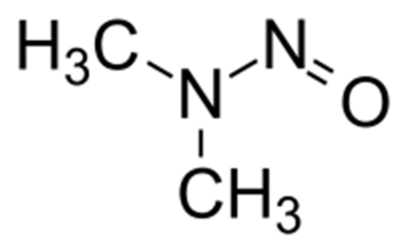
TROJAN UV

COMPLEX CONTAMINANT DESTRUCTION

- Many contaminants are removed through conventional filtration
- Contaminants exist which, due to specific chemical or physical properties, are more recalcitrant
  - Various pesticides
  - 1,4-Dioxane
  - Nitrosamines
- Such contaminants require more advanced treatment approaches





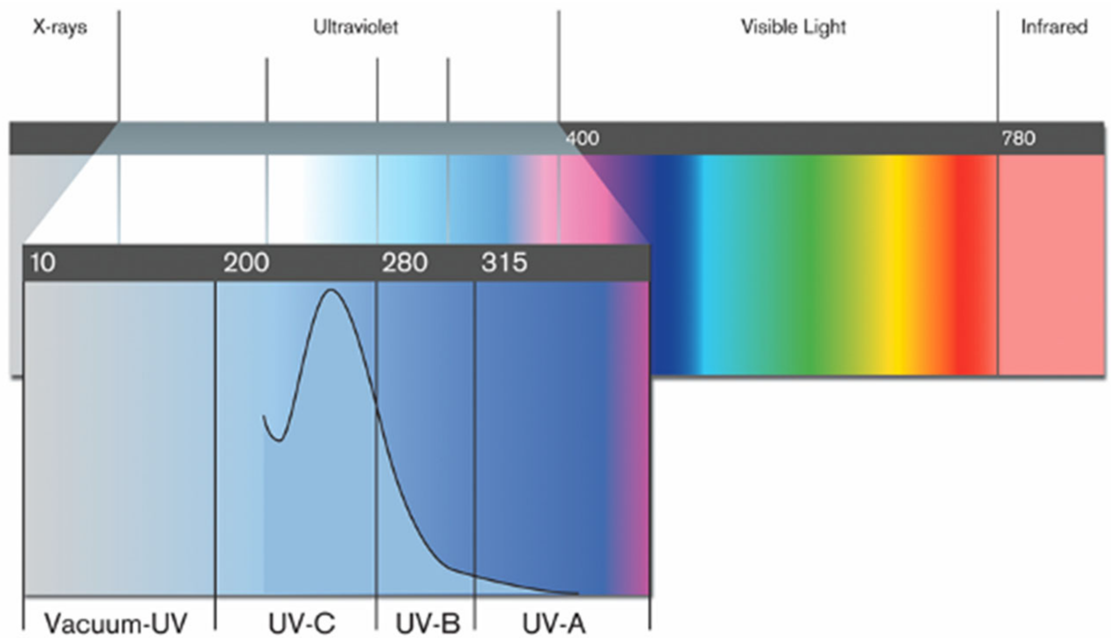


ENVIRONMENTAL CONTAMINANT TREATMENT (ECT)

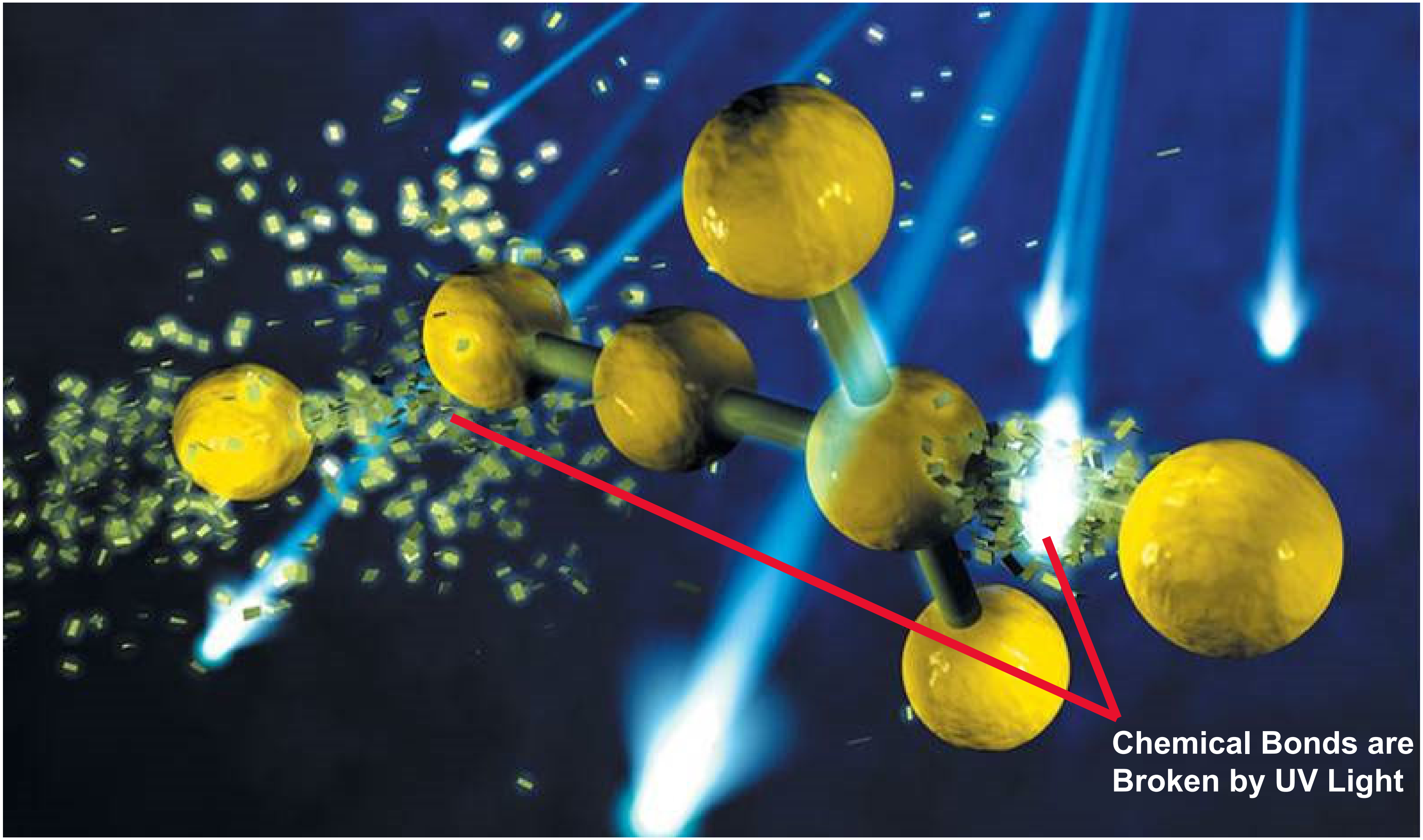
Using UV and hydrogen peroxide to destroy trace organic contaminants in water by:

UV-Photolysis

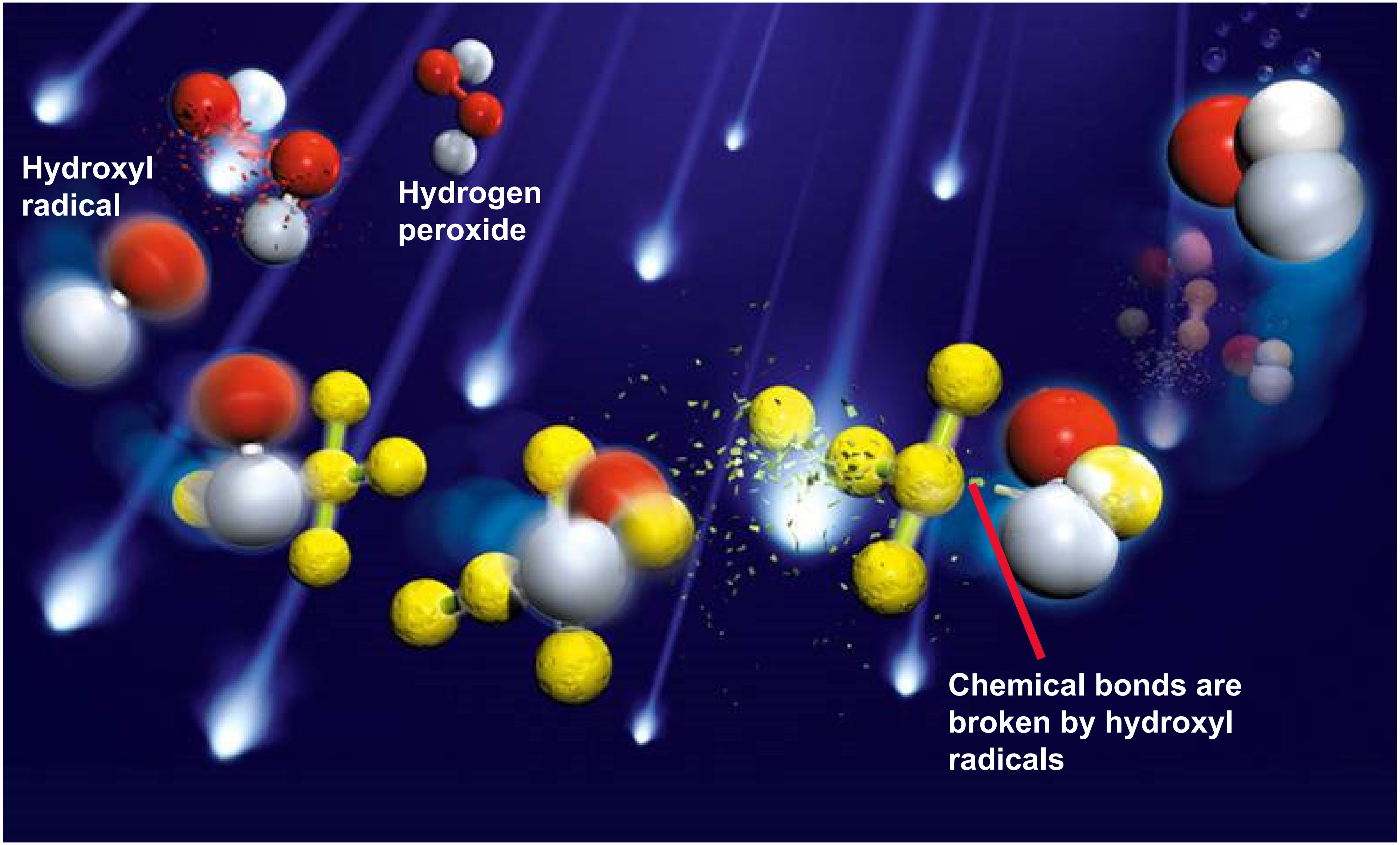
UV-Oxidation



UV-PHOTOLYSIS



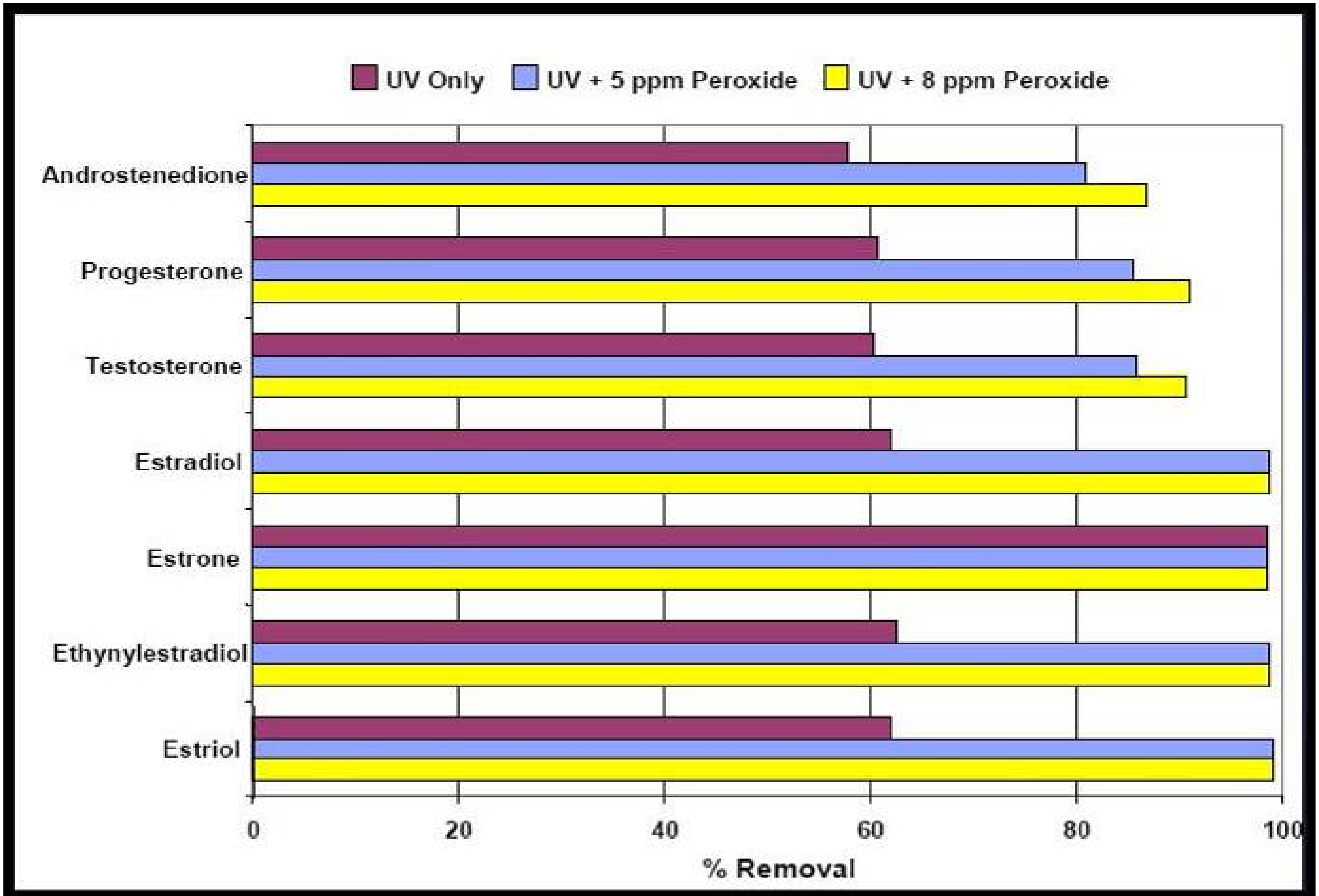
UV-OXIDATION



TROJAN UV™

UV-OXIDATION APPLICATIONS
CASE STUDIES OF CONTAMINANT TREATMENT

TREATABILITY OF STEROIDS



Testing Performed in Partnership with Southern Nevada Water Authority – Special Thanks to Dr. Shane Snyder

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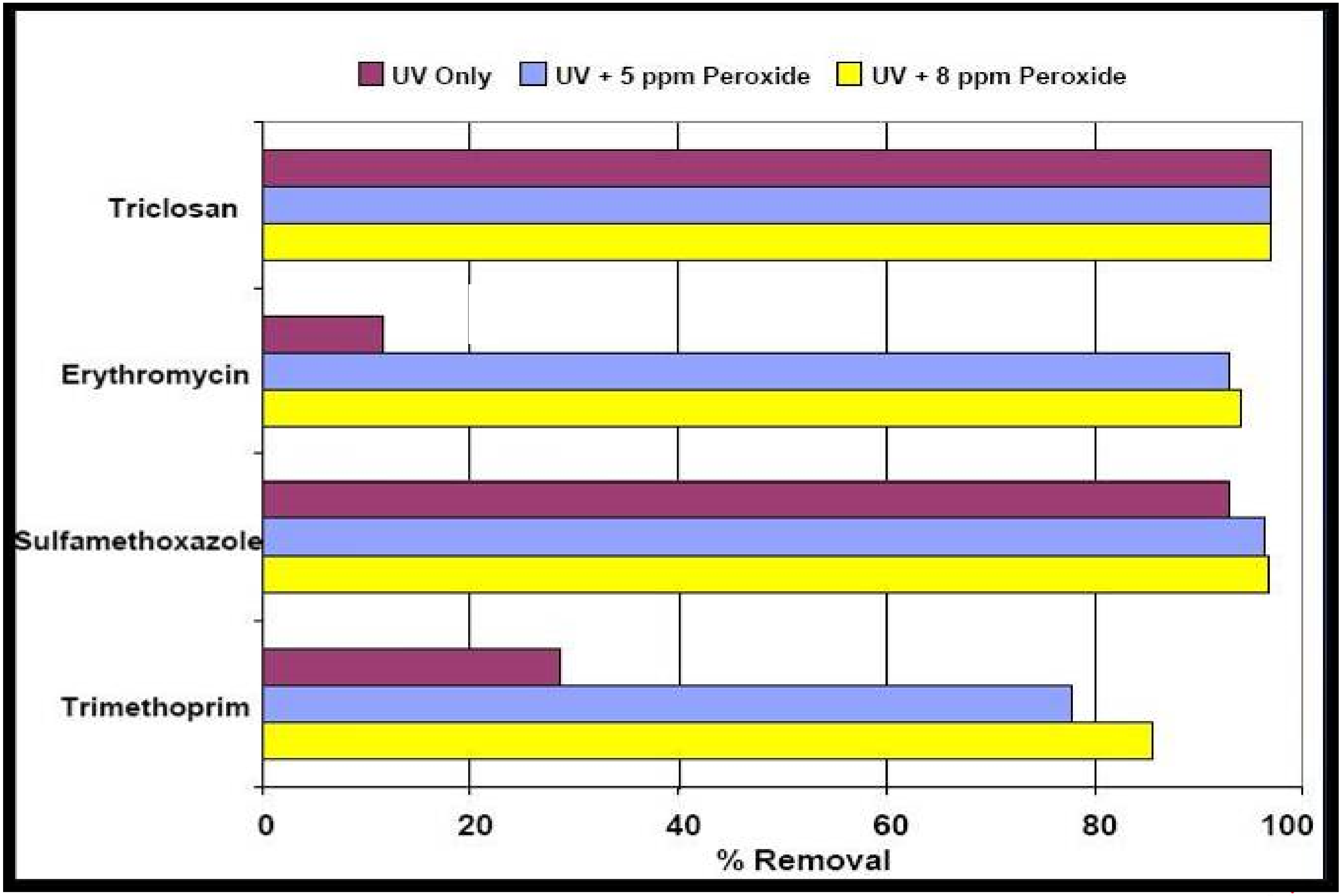
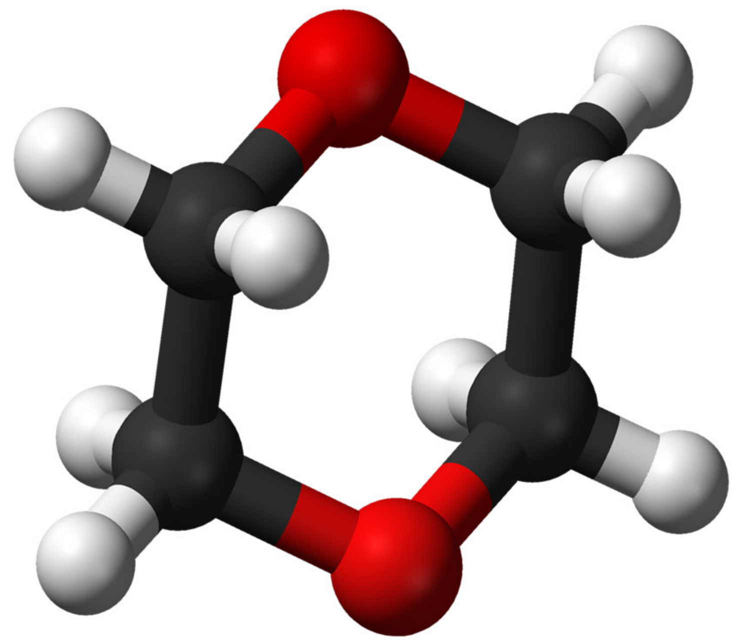
TREATABILITY OF ANTIBIOTICS



Testing Performed in Partnership with Southern Nevada Water Authority – Special Thanks to Dr. Shane Snyder

1,4-DIOXANE

- Found in groundwater plumes containing volatile organic contaminants (VOCs)
- Very stable molecule; not volatile
  - Air stripping not effective
  - Activated Carbon ineffective
  - Passes through reverse osmosis
- Recent cancer risk level set by EPA at 0.35 ppt



TROJAN UV

CASE STUDIES

Suffolk County Water Authority: Scale and Full Scale Pilot

- High Water Quality (99% UVT)
- Scavenging demand lower = lower H_2O_2 dose
- 1100 gpm full scale system. operational spring 2015 treating 1.7 log of 1,4 dioxane, TCE and PCE. Existing GAC to quench residual peroxide/redundant barrier. UV Reactor housed inside existing GAC building, H_2O_2 storage tank and dosing skid reside outdoors

TROJAN UV™

Suffolk County Full Scale Installation

- 1100 gpm
- 1.7 log 1,4 dioxane removal
- Other VOCs, TCE, PCE
- First Full Scale UV AOP System Approved DOH

TROJAN UV™

Bethpage Water District Pilot

- H2M Supervised the pilot
- Regulators on site
- Completed September 22, 2014
- Flows of 15 - 60 gpm, 60-100% BPL
- Demonstrated 4 log TCE and 1,4 dioxane destruction
- GAC for quenching residual H_2O_2
- UV AOP system installation scheduled May 2018. 2 log of 1,4 dioxane, TCE and PCE.

TROJAN UV

BETHPAGE FULLSCALE INSTALLATION

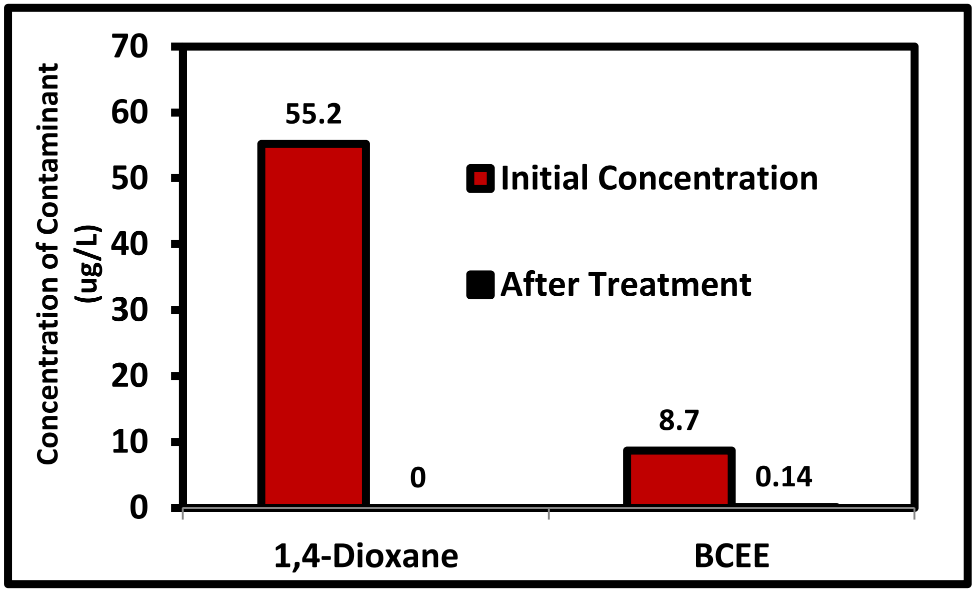
- 2600gpm
- 96%UVT, Low Scavenging demand
- 4 log TCE Removal
- 3.8 log 1,4 dioxane removal
- 2 PHOX D72AL75s
- High Power requirement +

High Power cost = LPHO lamp technology

TROJANUV

ARTESIAN WATER COMPANY NEWARK, DELAWARE

- Bis-2,chloroethyl ether (BCEE), 1,4-dioxane, PCE and TCE in groundwater due to impacts from industry and landfill
- Existing GAC/airstripper ineffective for removal of 1, 4 dioxane



ARTESIAN WATER COMPANY NEWARK, DELAWARE

- GAC for quenching peroxide
- 8.33 MLD, 2-TrojanUVPhox D72AL75s, 8 ppm peroxide, 2-log of 1,4-dioxane and 1.7-log BCEE
- May 2014 installation

2-D72AL75 stacked in production

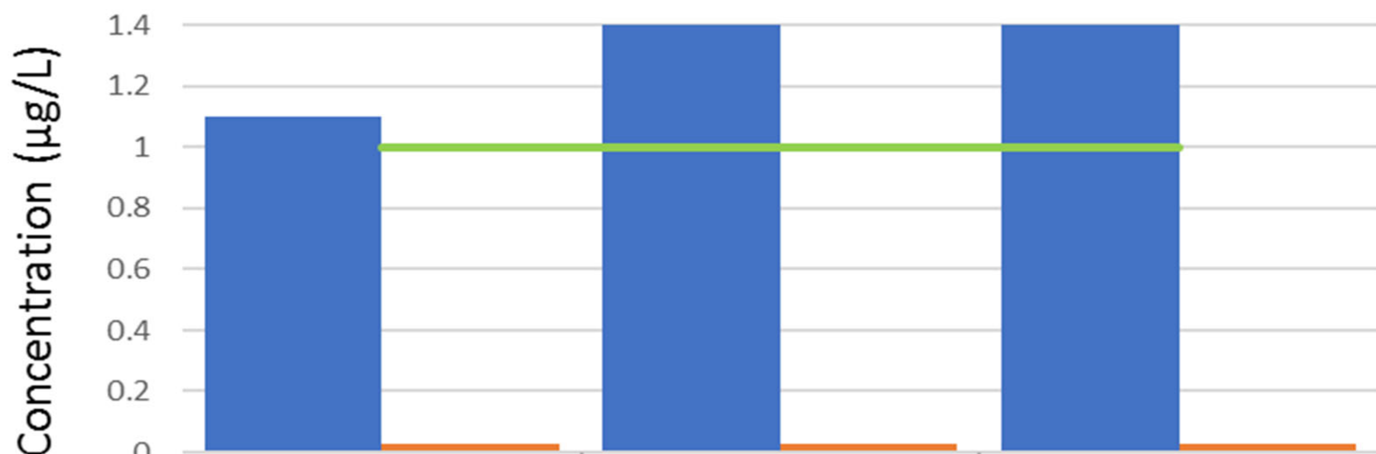
TROJAN UV

- MDH recommends keeping exposures at or below 1 ppb
- Detected 1.6ppb in 2015
- Pilot Study in 2016 confirmed UV AOP applicability
- 1575gpm, 1.5 log of 1,4 dioxane removal

City of St. Anthony Village, MN
Performance Guarantee 1,4-Dioxane Removal Results

July 19/20 Test:

High Flowrate (1575 gpm), 20 ppm peroxide



	Train No. 1	Train No. 2	Train No. 3
Influent [1,4-Dioxane]	1.1	1.4	1.4
Effluent [1,4-Dioxane]	0.028	0.028	0.028
MDH Limit	1	1	1
Log Reduction 1,4-Dioxane	1.59	1.7	1.7

TROJAN UV

CONCLUSIONS

- UV-oxidation used to treat a variety of recalcitrant contaminants
  - Surface water (T&O, algal toxins, pesticides, PPCPs)
  - Groundwater (1,4-Dioxane)
- Applications drive lamp technology that favor either low-pressure OR medium-pressure
  - Medium Pressure = Seasonal Use / Small Footprint
  - Low Pressure = Consistent Year-Round Use / Energy Efficiency

CONCLUSIONS

- **Experience is key**
  - No two contaminants are the same
  - Reactor efficiency is unique and needs to be understood for sizing and performance
  - Translating design from paper to performance has its technical challenges (Inexperienced Contractors, piping, peroxide mixing, disinfection requirements, footprint restrictions)
  - These are not turn-key products
  - Extensive piloting, internal research and full scale experience with the actual reactor is needed to meet Performance Guarantee

TROJAN UV™

Questions?

Terry Keep
ECT Sales Manager – Global Applications
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Speaker #5

PFAS Analytical Methods

Rick Zimmer

Eurofins Eaton Analytical, LLC

RickZimmer@EurofinsUS.com



eurofins | Eaton Analytical

WRD
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

WATER QUALITY WORKSHOP 2019

PFAS ANALYTICAL METHODS

December 11, 2019

Acknowledging all the smart people

DESERT WATER

WATER | ENERGY | LIFE
CITY OF RIVERSIDE
PUBLIC UTILITIES

CORONA
"THE CIRCLE CITY"
Incorporated July 13, 1896
To Cherish Our Past - To Plan Our Future

ORANGE COUNTY WATER DISTRICT
SINCE 1933

eurofins | Environment Testing TestAmerica

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

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WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

PFAS METHODS - LIKE DRIVING TO TAHOE



Name	Type of trips	Going to Tahoe area				Returning home		Round one-day trip price (bus only)	One way price	Can buy discount tickets, rentals, classes?	Price range for bus + lift ticket (actual price depends on resort)	Food?	Wifi on board?	Movie on board?	Restroom on board?
		Departure point	Arrival point	Departure time	Arrival time	Departure time	Arrival time								
Public Charter Bus (updated for 2017/2018 season)															
Bay Area Ski Bus	One-day (almost everyday), weekend, weeklong	Various Bay Area (including SF Potrero Hill - 16th & Carolina)	Ski resort (differs by date & trip)	4-5:30am	9am	4-5pm	8-10pm	$69	Full price going ($69), $45 return	✔	$159-200	Light breakfast & afternoon BBQ	Rarely	✔	✔
Sourced Adventures	One-day (Saturday only)	San Francisco only - Mission (Best Buy) or Marina (Safeway)						$69	N/A	✔	$179-189	✗	Depends on conditions	✔	✔
Santa Rosa Ski & Sports (SRSS)	One-day (Saturday only)	Sonoma County Veterans Building						$65	N/A (trips 2 weeks apart)	✔	$135-175	Light breakfast, dinner stop (pay yourself)	✗	✔	✔
N. American Charter (NAC) Ski	One-day (Saturday or Sunday)	Various Bay Area (including SF Potrero Hill - 17th & Wisconsin)						$51-66	$42 going, $43 return	✔	$130-180	Light breakfast	Depends on conditions	✔	✔
Regular Public Transit															
AMTRAK		Various Bay Area (closest station to San Francisco is Emeryville)	South Lake Tahoe, Truckee, or Reno	Various	5-6 hour journey (depending on itinerary)	Various	5-6 hour journey (depending on itinerary)	$100-120 (SF to various destinations)	$50-60 (SF to various destinations)	✗		✗	Maybe	✗	✔
Greyhound		Various Bay Area (including San Francisco - Folsom & Main)	Truckee, or Reno	Various		Various		~$20 web fare to Reno, ~$70 to Truckee	~$10 web fare to Reno, ~$35 to Truckee	✗		✗	Maybe	✗	✔
Megabus		San Francisco 4th & King Caltrain Station	Reno	9am	1:50pm	3:30pm	7:50pm	$32-34	$15-17	✗		✗	✔	✗	✔

12 METHODS AND COUNTING

EPA 8327

EPA 537

DoD QSM

ASTM D7979

EPA 8328

EPA 537 rev 1.1

EPA 537m

EPA 537.1

EPA 533

"WATER" AND "DRINKING WATER"

- EPA 8327
- EPA 537
- DoD QSM
- ASTM D7979
- EPA 8328
- EPA 537 rev 1.1
- EPA 537m
- EPA 537.1
- EPA 533

STANDARD versus ISOTOPE DILUTION

EPA 8327

EPA 537

DoD QSM

ASTM D7979

EPA 8328

EPA 537 rev 1.1

EPA 537m

EPA 537.1

EPA 533

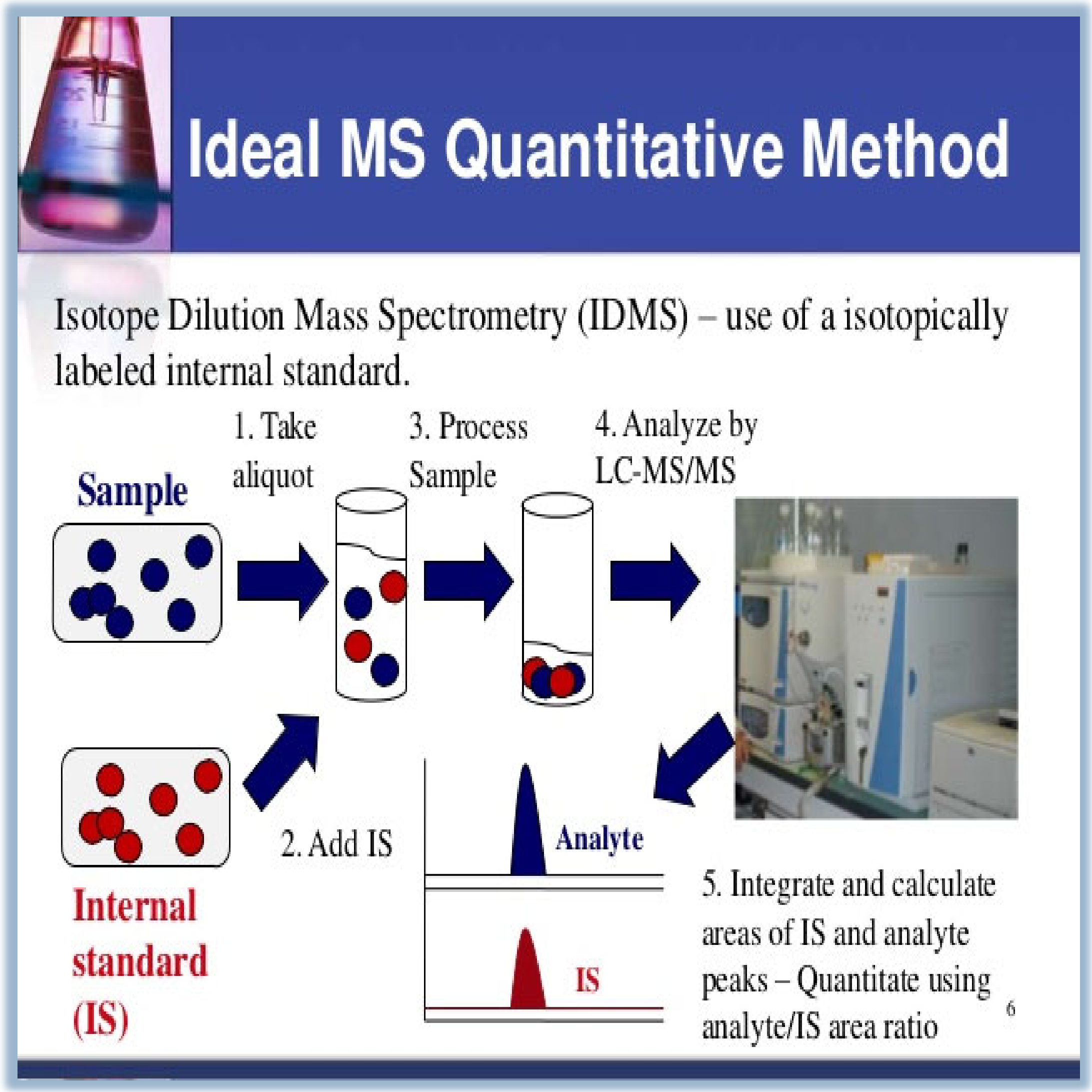
AND NOW THE TECHNICAL STUFF

AND NOW THE TECHNICAL STUFF



METHOD	ASTM D7979	EPA 8327	EPA 537	EPA 537 rev1.1	EPA 537.1	EPA 533	EPA 537m	EPA 8328
MATRIX	Water	Water	Drinking Water	Drinking Water	Drinking Water	Drinking Water	All	All
EXTRACTION	Direct Inject	Direct Inject	SPE SDVB	SPE SDVB	SPE SDVB	SPE	SPE	SPE
ANALYSIS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS
QUANTITATION	External Calibration	External Calibration	Internal Std. Calibration	Internal Std. Calibration	Internal Std. Calibration	Isotope Dilution	Isotope Dilution	Isotope Dilution
ANALYTES	21	24	6	14	18	25	27	25

ISOTOPE DILUTION = RELIABILITY



DOD QSM = VERIFICATION

DoD/DOE QSM 5.2
Appendix B
2019

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Aqueous Sample Preparation	Each sample and associated batch QC samples.	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., Aqueous Film Forming Foam (AFFF) formulations). Inline SPE is acceptable. Entire sample plus bottle rinsate must be extracted using SPE. Known high PFAS concentration samples require serial dilution be performed in duplicate. Documented project approval is needed for samples prepared by serial dilution as opposed to SPE.	NA.	NA.	Samples with >1% solids may require centrifugation prior to SPE extraction. Pre-screening of separate aliquots of aqueous samples is recommended.
Solid Sample Preparation	Each sample and associated batch QC samples.	Entire sample received by the laboratory must be homogenized prior to subsampling.	NA.	NA.	NA.
Biota Sample Preparation	Each sample and associated batch QC samples.	Sample prepared as defined by the project (e.g., whole fish versus fileted fish).	NA.	NA.	NA.

ANALYTES FOR CALIFORNIA ORDERS

EPA Method 537 Rev 1.1* (14 PFAS analytes)		EPA Method 537.1* (18 PFAS analytes)	
Analyte	**Detection Limit[1] (ng/L)**	**Analyte**	**Detection Limit[1] (ng/L)**
PFBS	3.1	PFBS	1.8
PFHxA	1.6	PFHxA	1.0
PFHpA	0.5	PFHpA	0.71
PFHxS	2.0	PFHxS	1.4
PFOA	**1.7**	**PFOA**	**0.53**
PFOS	**1.4**	**PFOS**	**1.1**
PFNA	0.7	PFNA	0.7
PFDA	0.7	PFDA	1.6
NMeFOSAA	6.5	NMeFOSAA	2.4
PFUnA	2.8	PFUnA	1.6
NEtFOSAA	4.2	NEtFOSAA	2.8
PFDoA	1.1	PFDoA	1.2
PFTrDA	2.2	PFTrDA	0.72
PFTA	1.7	PFTA	1.1
		HFPO-DA	1.9
		ADONA	0.88
		9Cl-PF3ONS	1.4
		11CL-PF3OUdS	1.5

*in reagent water

TABLE 1. PFAS Analytes Subject to Analysis

Chemical Name	Abbreviation	Chemical Abstracts Service (CAS) No.
2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid	HFPO-DA	13252-13-6*
10:2 Fluorotelomer sulfonic acid	10:2 FTS	120226-60-0*
2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy) propanoic Acid	HFPA-DA	13252-13-6 *
Perfluorooctadecanoic acid	PFOcDA	16517-11-6*
N-Ethyl perfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2*
Perfluorooctane sulfonic acid	PFOS	1763-23-1
Perfluoroundecanoic acid	PFUnDA	2058-94-8
N-Methyl perfluorooctane sulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-Methyl perfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7*
Perfluoropentanoiic Acid	PFPeA	2706-90-3
Perfluoropentane sulfonoic acid	PFPeS	2706-91-4
6:2 Fluorotelomer sulfonic acid	6:2 FTS	27619-97-2
N-Ethyl perfluorooctane sulfonamidoacetic acid	NEtFOSAA	2991-50-6
Perfluorohexanoic acid	PFHxA	307-24-4
1.0Perfluorododecanoic acid	PFDoDA	307-55-1
N-Methyl perfluorooctane sulfonamide	MeFOSA	31506-32-8*
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorodecane sulfonic acid	PFDS	335-77-3
4,4,5,5,6,6,6-Heptafluorohexanoic Acid	3:3 FTCA	356-02-5*
Perfluorohexane sulfonic acid	PFHxS	355-46-4
Perfluorobutanoic acid	PFBA	375-22-4
Perfluorobutane sulfonic acid	PFBS	375-73-5
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluoroheptane sulfonic acid	PFHpS	375-92-8
Perfluorononanoic acid	PFNA	375-95-1
Perfluorotetradecanoic acid	PFTeDA	376-06-7
2H,2H,3H,3H-Perfluorodecanoic acid	7:3 FTCA	812-70-4*
8:2 Fluorotelomer sulfonic acid	8:2 FTS	39108-34-4
N-Ethyl perfluorooctane sulfonamide	EtFOSA	4151-50-2*
Perfluorononane sulfonic acid	PFNS	474511-07-4*
Perfluorohexadecanoic acid	PFHxDA	67905-19-5*
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorooctanesulfonamide	FOSA	754-91-6
4:2 Fluorotelomer sulfonic acid	4:2 FTS	757124-72-4
Perfluoro(2-((6-chlorohexyl)oxy)ethanesulfonic acid)	9Cl-PF3ONS	756426-58-1*
2-[(8-Chloro-1,1,2,2,3,3,4,4,5,5,6,6,7,7,8,8-hexadecafluorooctyl)oxy]-1,1,2,2-tetrafluoroethanesulfonic acid	11Cl-PF3OUdS	763051-92-9*
2H,2H,3H,3H-Perfluorooctanoic Acid (CAS 914637-49-3)	5:3 FTCA	914637-49-3*
4,8-Dioxa-3H-perfluorononanoic acid	Adona	919005-14-4*

Note: Only the 23 analytes without the asterisk (*) are required to be analyzed as part of this Order. The analytes with the asterisk (*) are included in some but not all lists provided by accredited laboratories and are encouraged to be analyzed as part of this effort.

ANALYTES FOR UCMR5



PFAS Method Scope

Draft Method 533	Both Methods	Method 537.1
1H, 1H, 2H, 2H-perfluorodecane sulfonic acid (8:2 FTS)	11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)[1]	N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
1H, 1H, 2H, 2H- perfluorohexane sulfonic acid (4:2 FTS)	9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS)[2]	N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
1H, 1H, 2H, 2H-perfluorooctane sulfonic acid (6:2 FTS)	4,8-dioxa-3H-perfluorononanoic acid (ADONA)[3]	Perfluorotetradecanoic acid (PFTA)
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	Hexafluoropropylene oxide dimer acid (HFPO-DA)*	Perfluorotridecanoic acid (PFTrDA)
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	Perfluorodecanoic acid (PFDA)	
Perfluoro-3-methoxypropanoic acid (PFMPA)	Perfluorododecanoic acid (PFDoA)	
Perfluoro-4-methoxybutanoic acid (PFMBA)	Perfluorohexanoic acid (PFHxA)	
Perfluorobutanoic acid (PFBA)	Perfluoroundecanoic acid (PFUnA)	
Perfluoroheptanesulfonic acid (PFHpS)	**Perfluorobutanesulfonic acid (PFBS)**	
Perfluoropentanesulfonic acid (PFPeS)	**Perfluoroheptanoic acid (PFHpA)**	
Perfluoropentanoic acid (PFPeA)	**Perfluorohexanesulfonic acid (PFHxS)**	
	Perfluorononanoic acid (PFNA)	
	Perfluorooctanoic acid (PFOA)	
	Perfluorooctanesulfonic acid (PFOS)	

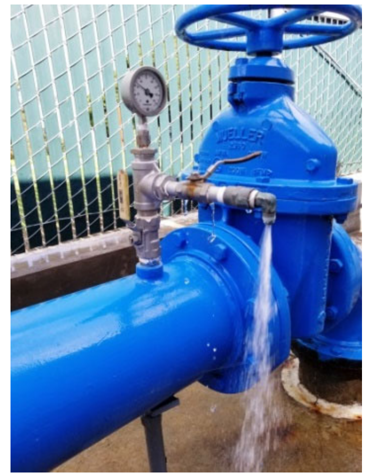
[1] 11Cl-PF3OUdS is also available as potassium salt
[2] 9Cl-PF3ONS is also available as potassium salt
[3] ADONA is also available as sodium salt and ammonium salt

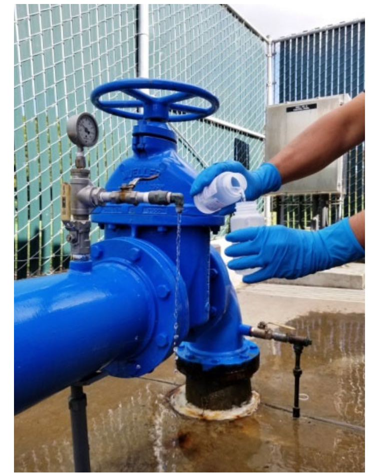
Bold= monitored under UCMR 3
* GenX chemical

ANALYTES FOR A SINGLE METHOD

Analyte Description	CAS Number
Perfluorobutanoic acid (PFBA)	375-22-4
Perfluoropentanoic acid (PFPeA)	2706-90-3
Perfluorohexanoic acid (PFHxA)	307-24-4
Perfluoroheptanoic acid (PFHpA)	375-85-9
Perfluorooctanoic acid (PFOA)	335-67-1
Perfluorononanoic acid (PFNA)	375-95-1
Perfluorodecanoic acid (PFDA)	335-76-2
Perfluoroundecanoic acid (PFUnA)	2058-94-8
Perfluorododecanoic acid (PFDoA)	307-55-1
Perfluorotridecanoic Acid (PFTriA)	72629-94-8
Perfluorotetradecanoic acid (PFTeA)	376-06-7
Perfluorobutanesulfonic acid (PFBS)	375-73-5
Perfluoropentanesulfonic acid (PFPeS)	2706-91-4
Perfluorohexanesulfonic acid (PFHxS)	355-46-4
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8
Perfluorooctanesulfonic acid (PFOS)	1763-23-1
Perfluorononanesulfonic acid (PFNS)	8789-57-2
Perfluorodecanesulfonic acid (PFDS)	335-77-3
Perfluorooctane Sulfonamide (FOSA)	754-91-6
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6
4:2 FTS	757124-72-4
6:2FTS	27619-97-2
8:2FTS	39108-34-4
Adona	958445-44-8
HFPO-DA (GenX)	13252-13-6
F-53B	STL02459

SAMPLE COLLECTION





PFAS TAKE HOME MESSAGE



1. Consider what to test for and have an action plan in place beforehand
2. Use common sense in collection procedures or outsource
3. Let the data results determine next steps and confirm best practices
4. Apply the right method for each sample type
5. Share data and experiences

Thank You

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Senior Account Manager

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Speaker #6

Pump Design & Applications

Daniel Pichardo

General Pump Company

dpichardo@genpump.com

WRD
WATER REPLENISHMENT DISTRICT
OF SOUTHERN CALIFORNIA

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Pump Design & Applications

December 11, 2019

Serving the Water Industry for Over 60 Years

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Introduction

- Presenter Introduction
- Pumps 101
- Deep Well Pump Types & Applications
  - Submersible
  - Open Line Shaft
  - Enclosed Line Shaft
    - Oil Lube
    - WATER FLUSH

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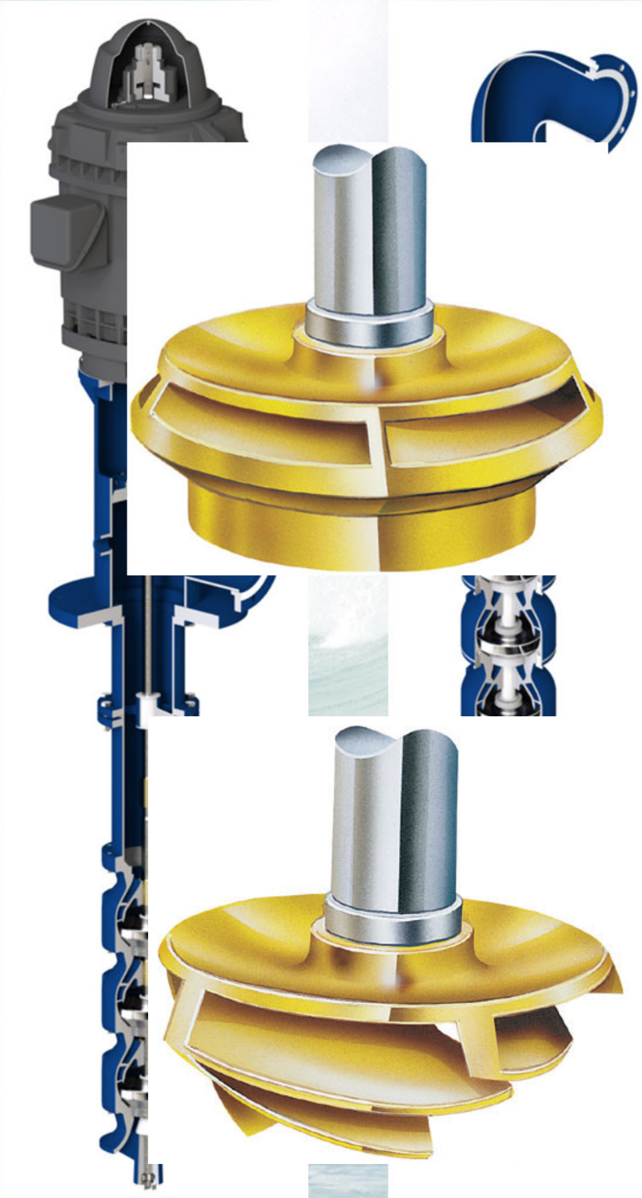
Pump Basics

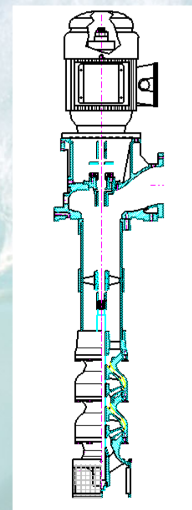
- Bowl assembly, column pipe, and driver
- Bowl assembly contains impellers
- Impellers spin at the nominal rpm of the driver, which generates pressure in the bowl assembly
- This pressure pushes water to the surface



GENERAL PUMP COMPANY

Well Pump Design

- Well Construction Details
- Test Data
- Submersible or Line Shaft
- Oil or Water Lubricated
- Water Flush
- Design Range
- Bowl Efficiency
- Specific Speed (N_s)
- Maximum Pressure (TDH)
- Motor Speed
- Materials
- Manufacturer



- Natural Gas/Electric/Combo
- Bowl Lateral
- Hydraulic thrust
- Column losses (new or used pipe and enclosing tube)
- Shaft Critical
- Motor Selection
- Pump Head
- Suction pipe and losses
- Strainer Type/Material
- Column Pipe & Coating
- Warranty

GENERAL PUMP COMPANY

2 Types of Well Pumps

1. **Submersible**

2. **Line Shaft**
   - A. **Open Line Shaft (Product/Water Lubricated)**
   - B. **Enclosed Line Shaft (Oil Lubricated or Water Flush)**

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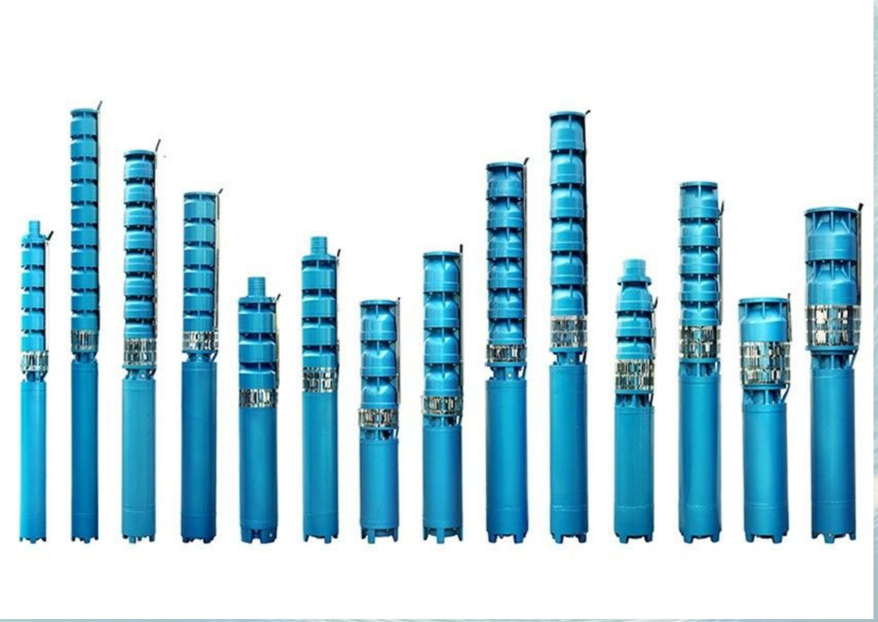
VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Enclosed

Water Flush

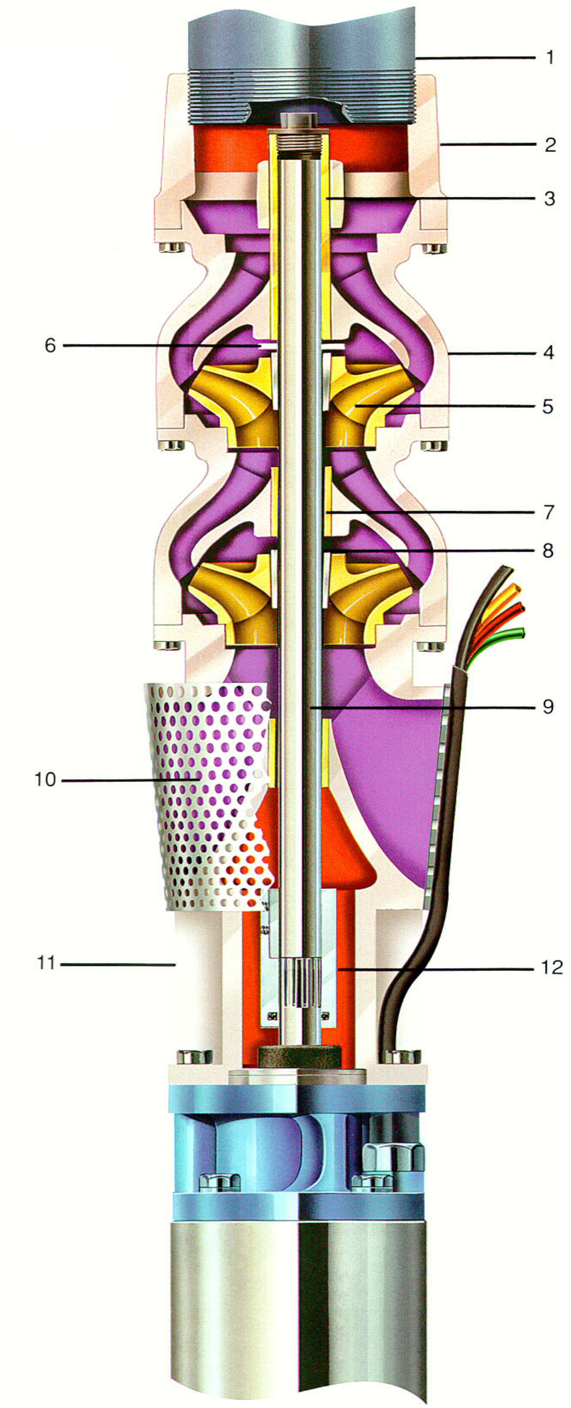
GENERAL PUMP COMPANY

Submersible Pumps



GENERAL PUMP COMPANY

VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F



Submersible Pump Main Features

1. Discharge Pipe
2. Discharge Bowl
3. Discharge Bearing
4. Intermediate Bowl
5. Impellers
6. Upthrust Collar
7. Intermediate Bowl Bearing
8. Lock Collets
9. Pump Shaft
10. Suction Inlet
11. Suction Adapter
12. Pump/ Motor Coupling

Submersible
“Pros” and “Cons”

Pros

Quiet (no building required)

No maintenance

Can be installed in a crooked well

No moving above ground parts (no building or fence required)

Cons

Less efficient

Motor repairs are substantially more expensive

Down time for motor repairs are substantially longer

Less reliable

Requires water to cool motor

Not VFD, sand, or air friendly.

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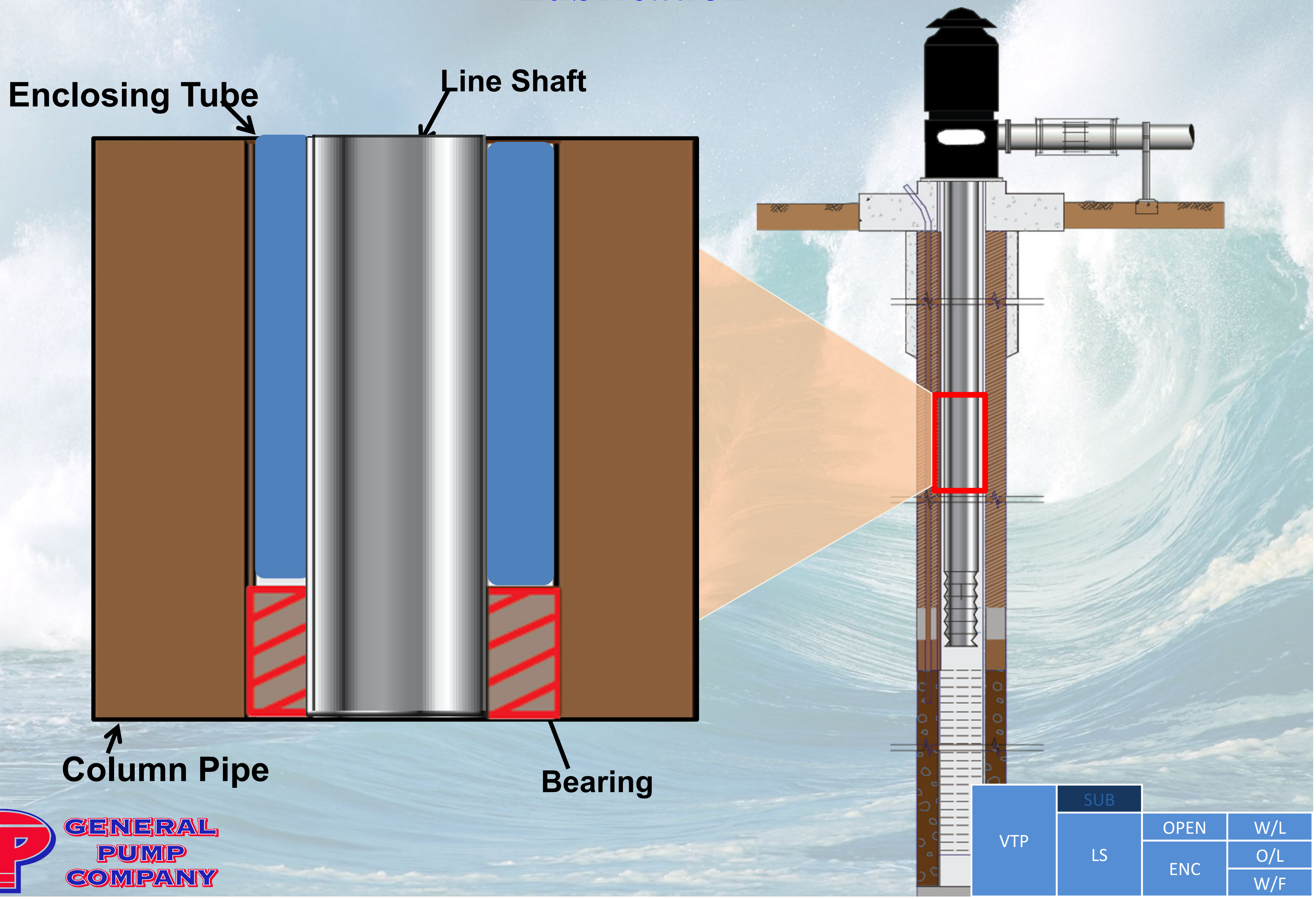
Vertical Turbine Line Shaft Pumps Require Bearing Lubrication



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The Methods of Lubrication are:

1. Oil Lubricated (Conventional)

2. Water / Product Lubricated (No Pre-Lube)

3. Water Flush

GENERAL PUMP COMPANY

Enclosed Line Shaft – *Oil Lubricated*

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W/F

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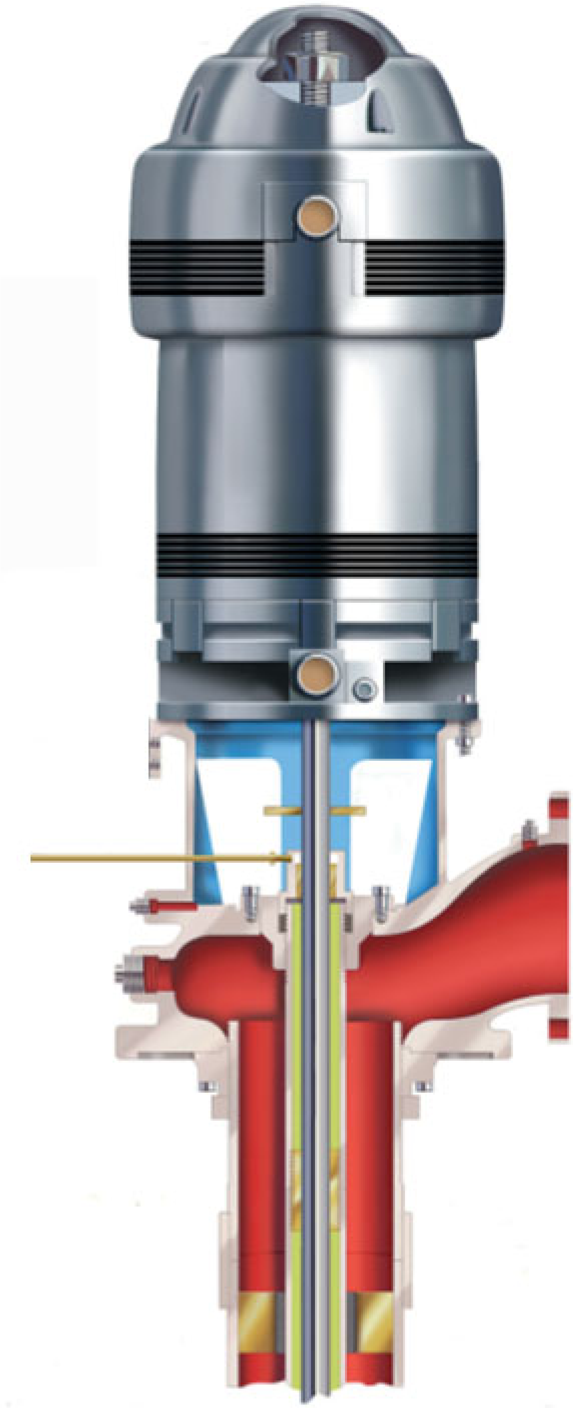

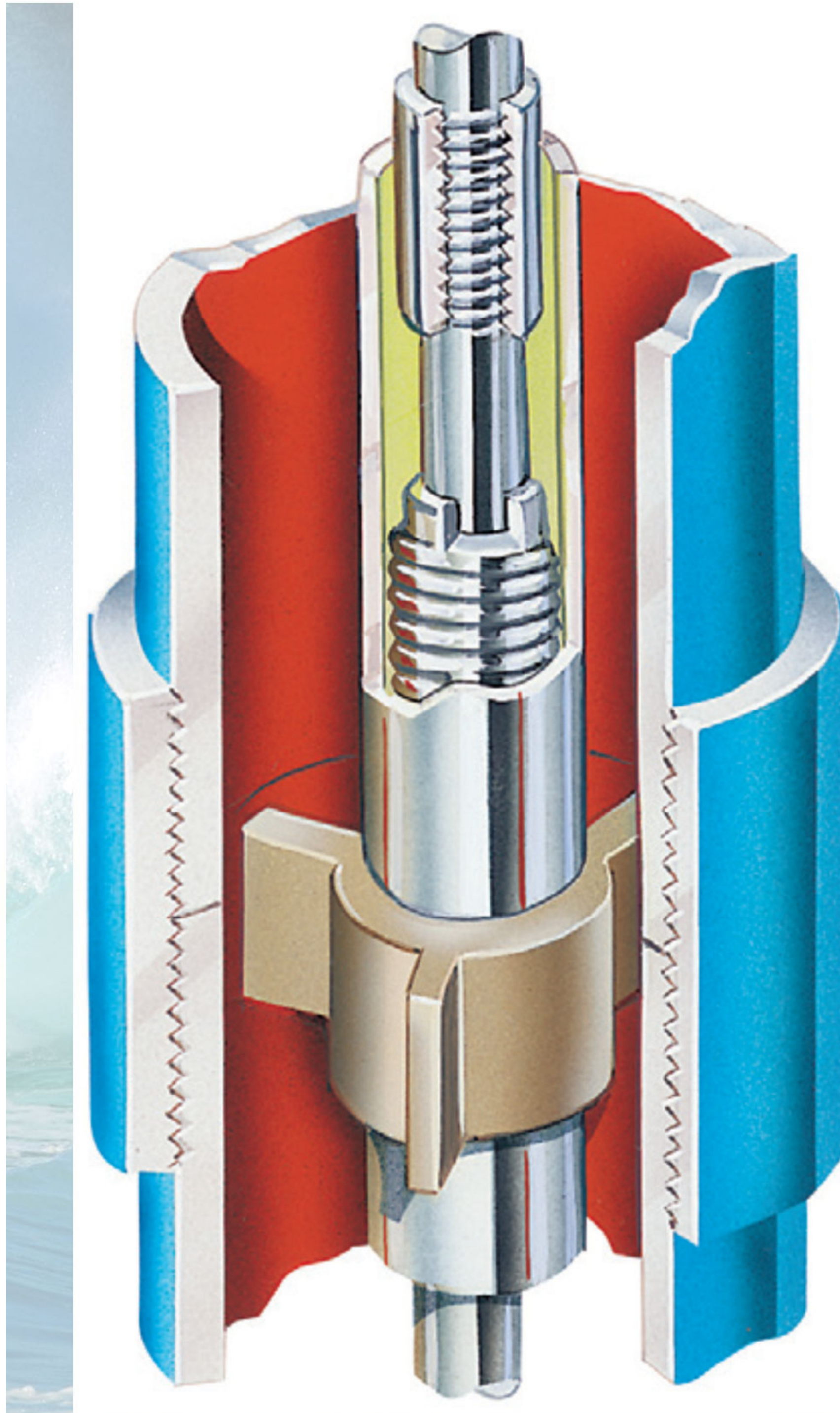

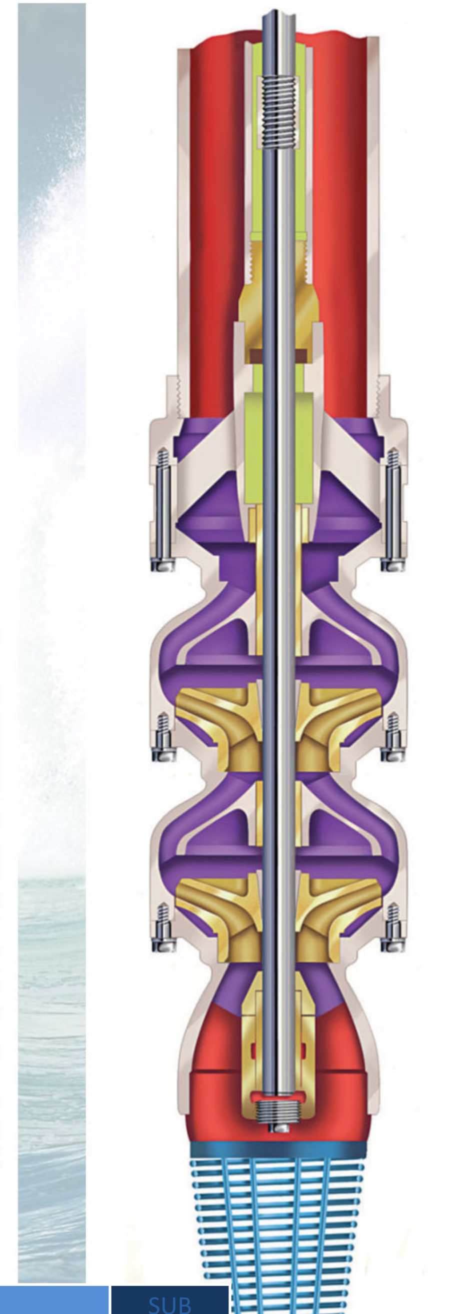

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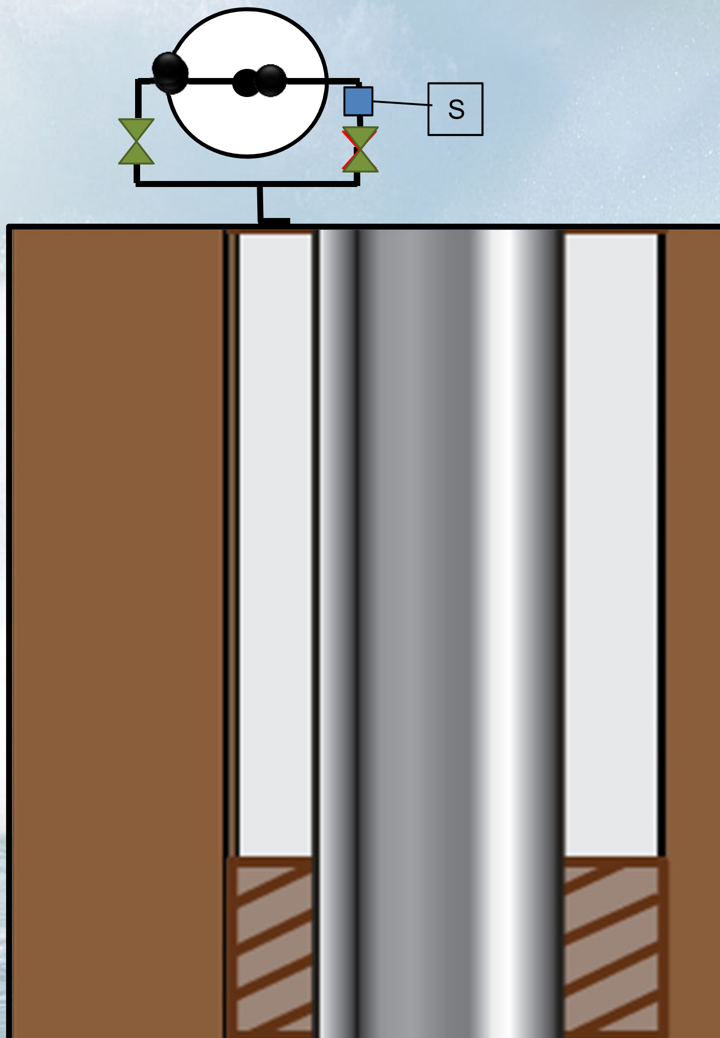
Oil Lubricated



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Oil Lube
Pros and Cons

Pros

Best bang for your buck.

Longest life of the three options

Designed for shallow and deep sets.

Motor can be quickly repaired without pulling the entire pump.

Not an issue for VFDs or critical speeds.

Lower maintenance cost.

Cons

Oil required for lubrication.

Oil can be pumped into reservoirs or treatment plants.

Oil in the system.

Oil is an issue for the State Health.


Mobil
Mobil DTE Oil Light
Premium Performance
Circulating Lubricant
Properties
ISO Viscosity Grade : 32
Kinematic Viscosity @40°C : 31 cSt
Kinematic Viscosity @100°C : 5.5 cSt
Viscosity Index : 102
Density @15°C : 850 kg/m³
Flash Point : 218 °C
Pour Point : -36 °C
Metalworking Fluids
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G722106/0072 707
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www.metalworkingfluids.net


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Open Line Shaft / Product Lubricated

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VTP
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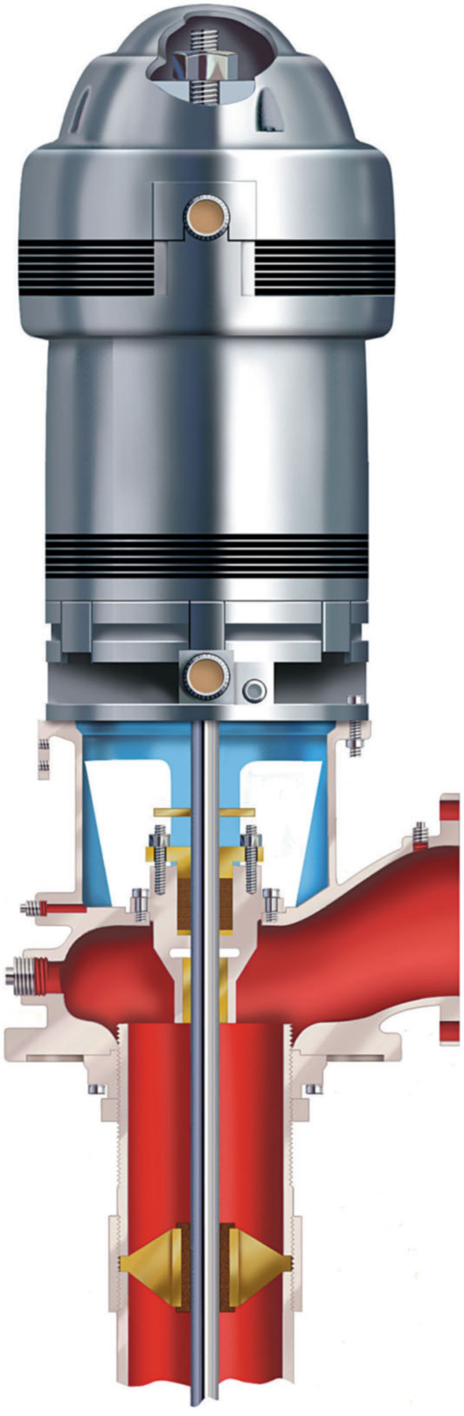
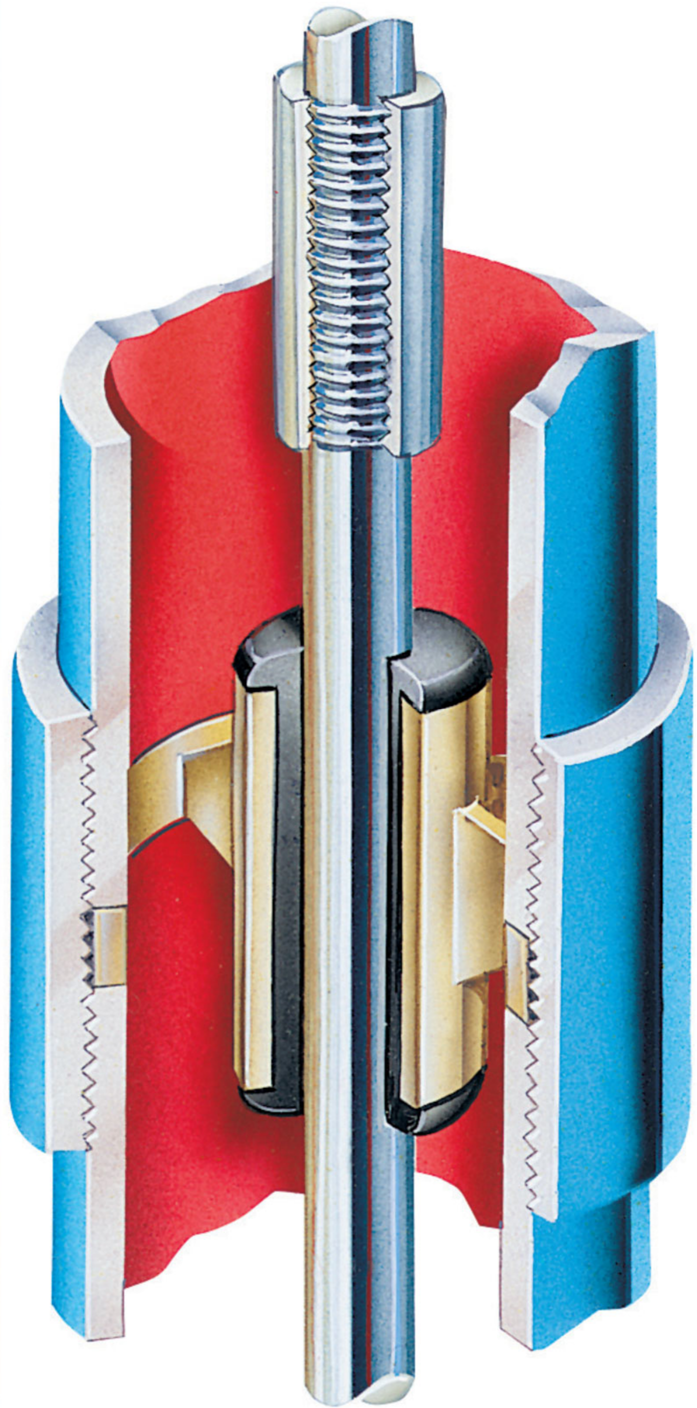
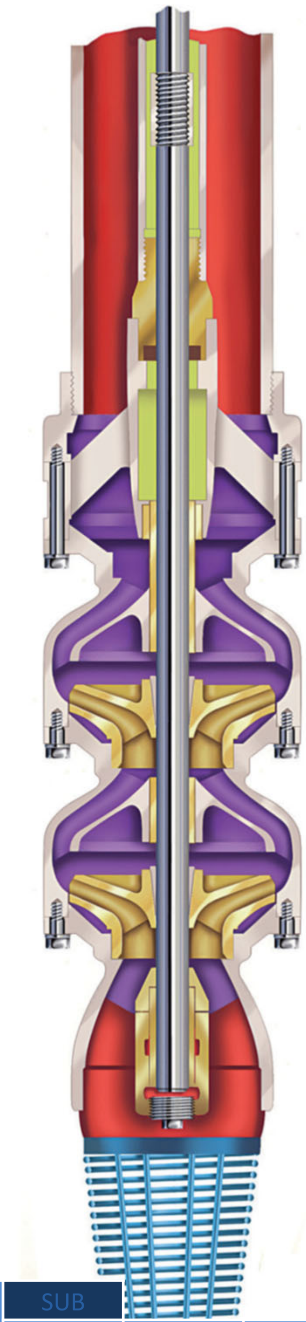
W/F







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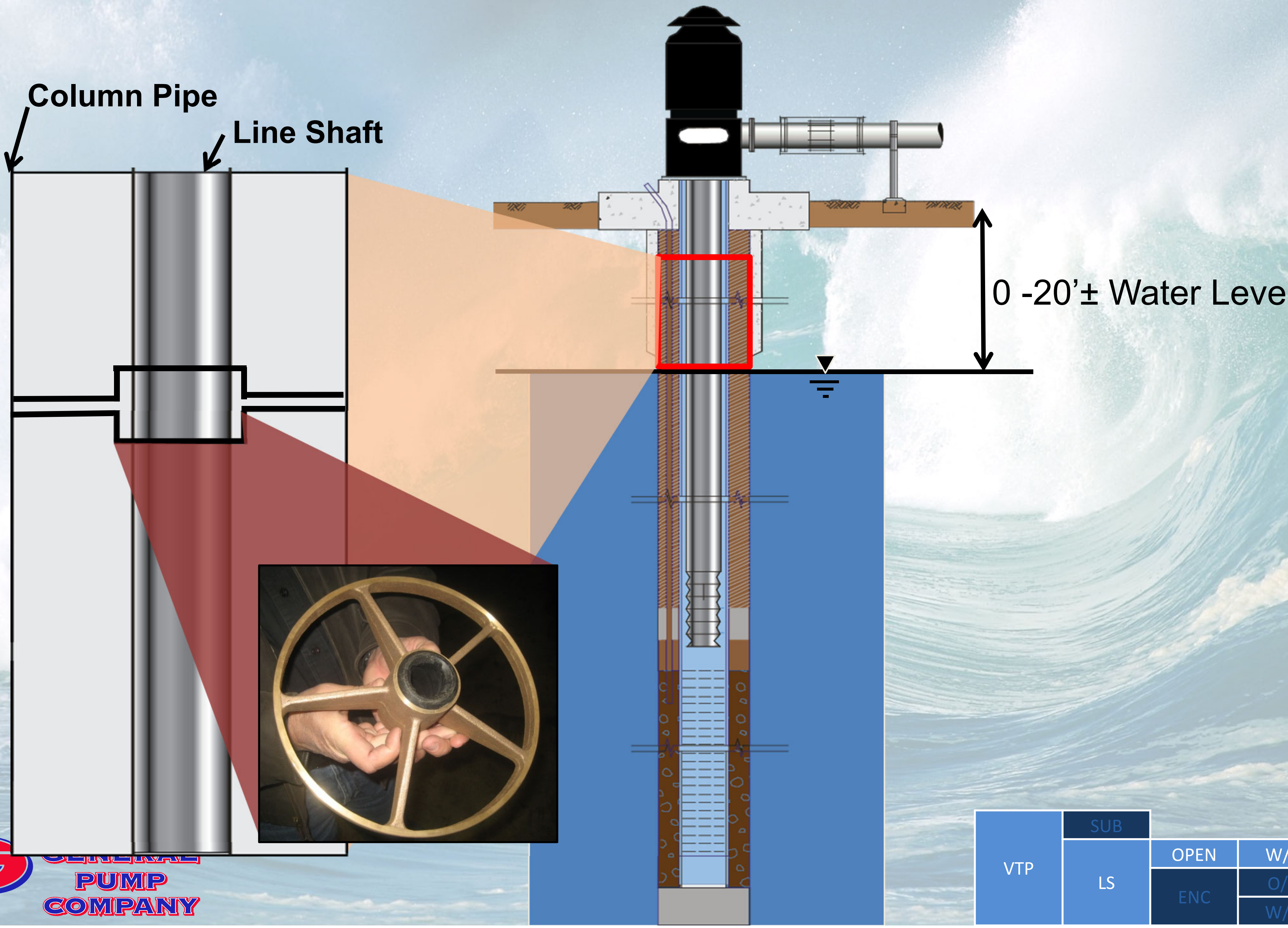
Water / Product Lubricated (No Pre-Lube)



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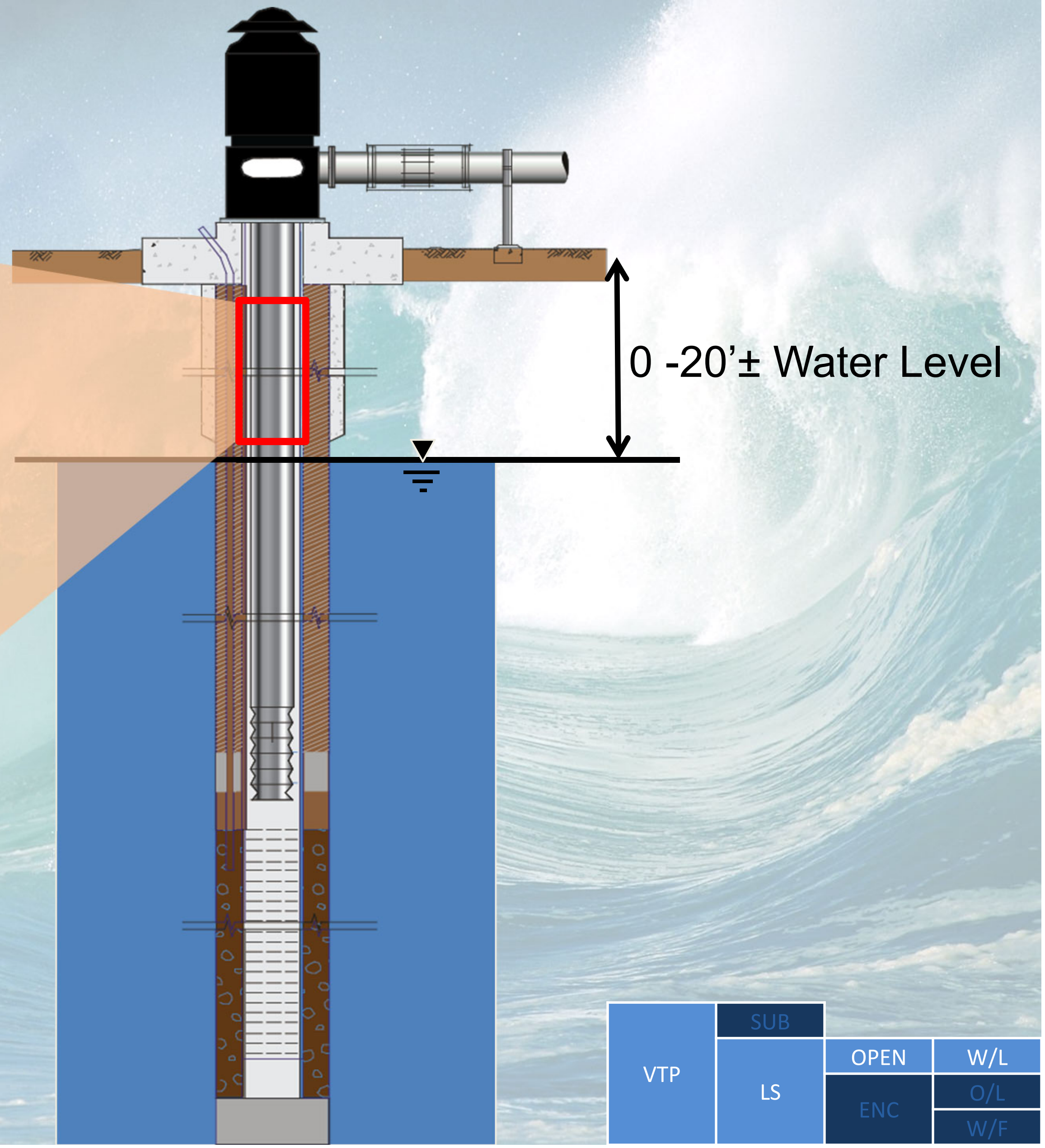
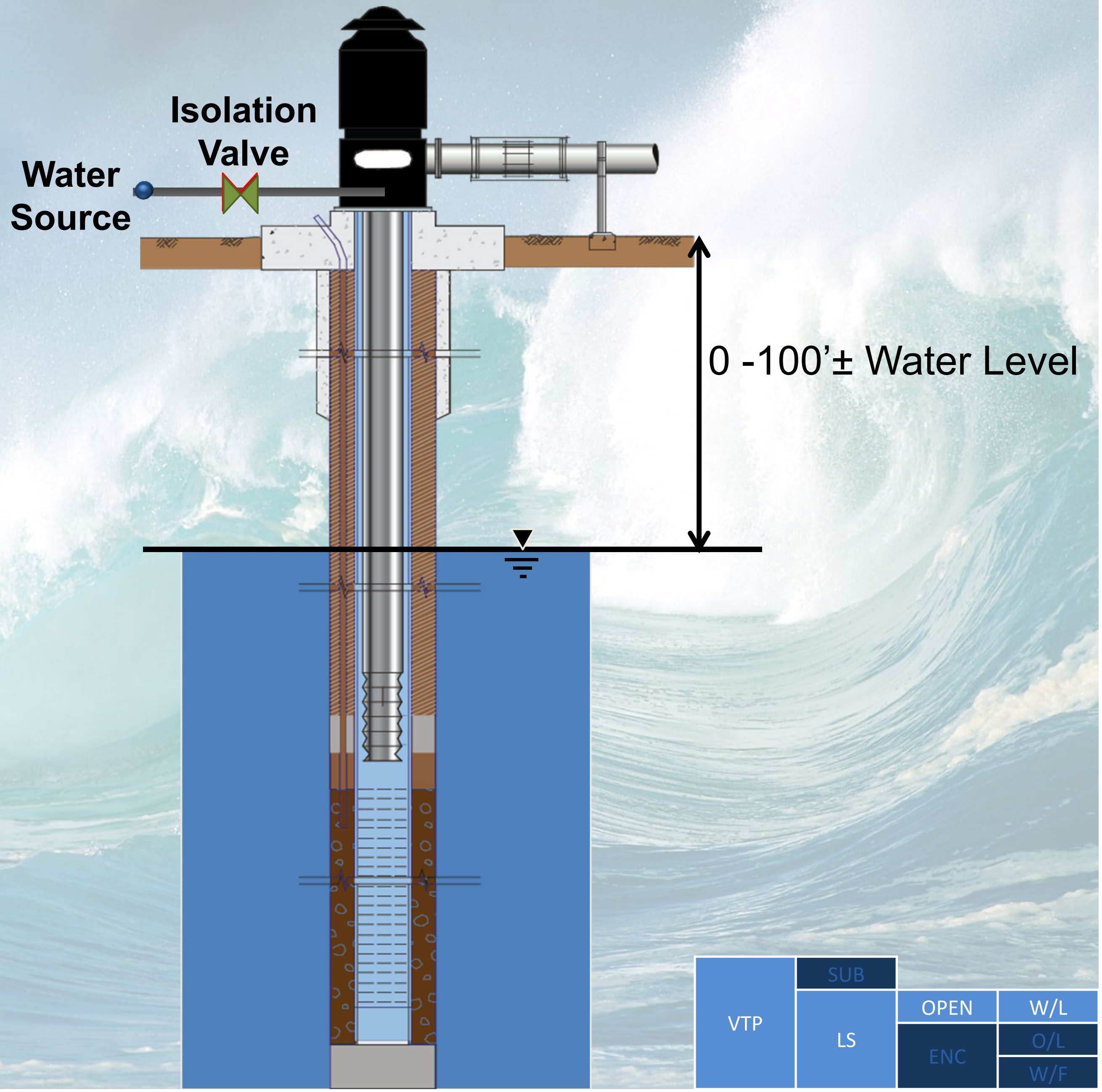
VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Water / Product Lubricated (No Pre-Lube)



Water Lubricated (Pre-Lube)



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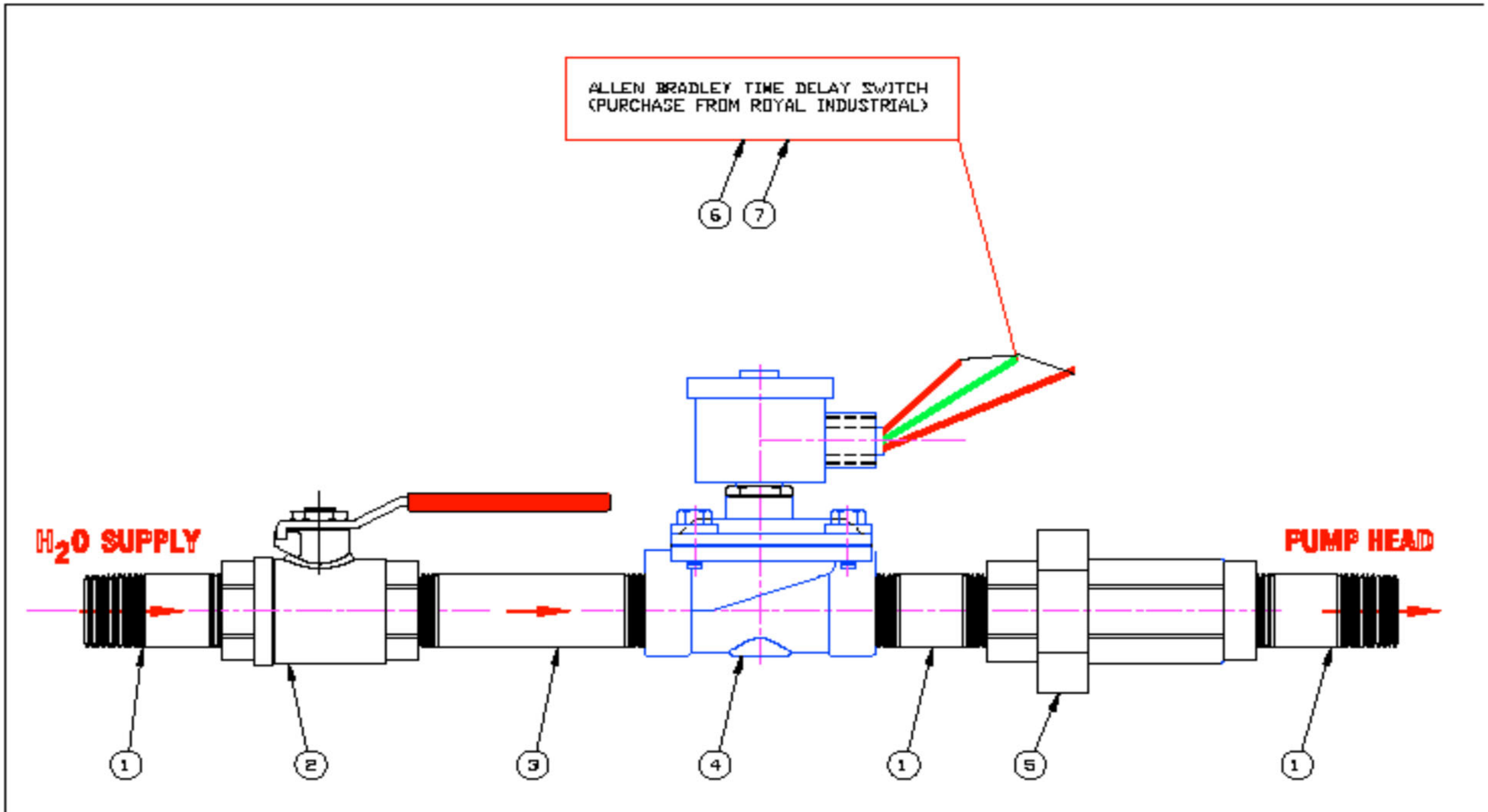
Product / Water Lube System



ITEM	NAME	PART NO.	QTY
7	8 PIN SOCKET RELAY	ALLEN BRADLEY P/N: 700-HN125	1
6	TIME DELAY SWITCH	ALLEN BRADLEY P/N: 700-HRM12TA17C	1
5	BACKFLOW PREVENTER	McMASTER-CARR #49230K82 - 1" FEMALE NPT	1
4	SOLENOID VALVE	ASCO P/N: 8210G94 - 1" NPT 120 VOLT	1
3	PIPE NIPPLE	McMASTER-CARR # 4568K228 - 1" BRONZE	1
2	BALL VALVE	McMASTER-CARR #47865K25 - 1" BRONZE	1
1	PIPE NIPPLE	McMASTER-CARR # 4568K224 - 1" BRONZE	3

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San Dimas, Ca 91773
Phone (909) 599-8606
Fax (909) 599-6230

GENERAL PUMP COMPANY
WATERWELL & PUMP SERVICE SINCE 1952

CUSTOMER:		
DESCRIPTION : WATER PRE-LUBE ASS'Y.		
MATERIAL :		DWG NO. 80###PL
PCS. REQ'D : 1	GPC ENGINEERING	
BY: MICHAEL G	DATE: 12-18-2018	JOB NO. 80###

COMPANY

Water Lubricated (Open Line Shaft or Product Lube)

Pros and Cons

Pros

Product water is used for lubrication.

Substantially more efficient than a submersible.

Substantially more reliable than submersible.

Motor can be repaired quickly without pulling the complete pump.

Upper bushings can be lubricated with a pre-lube. Rubber bushings below the water are properly lubricated at all times of operation.

Cons

Bushings above water table will run dry unless a foot valve is used.

Not designed for deep static water levels.

Can have critical speed issues.

Deep set pumps can be very expensive to purchase and repair.

Requires quick ramp up speeds not recommended for engine drives.

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Enclosed Line Shaft – *Water Flush*

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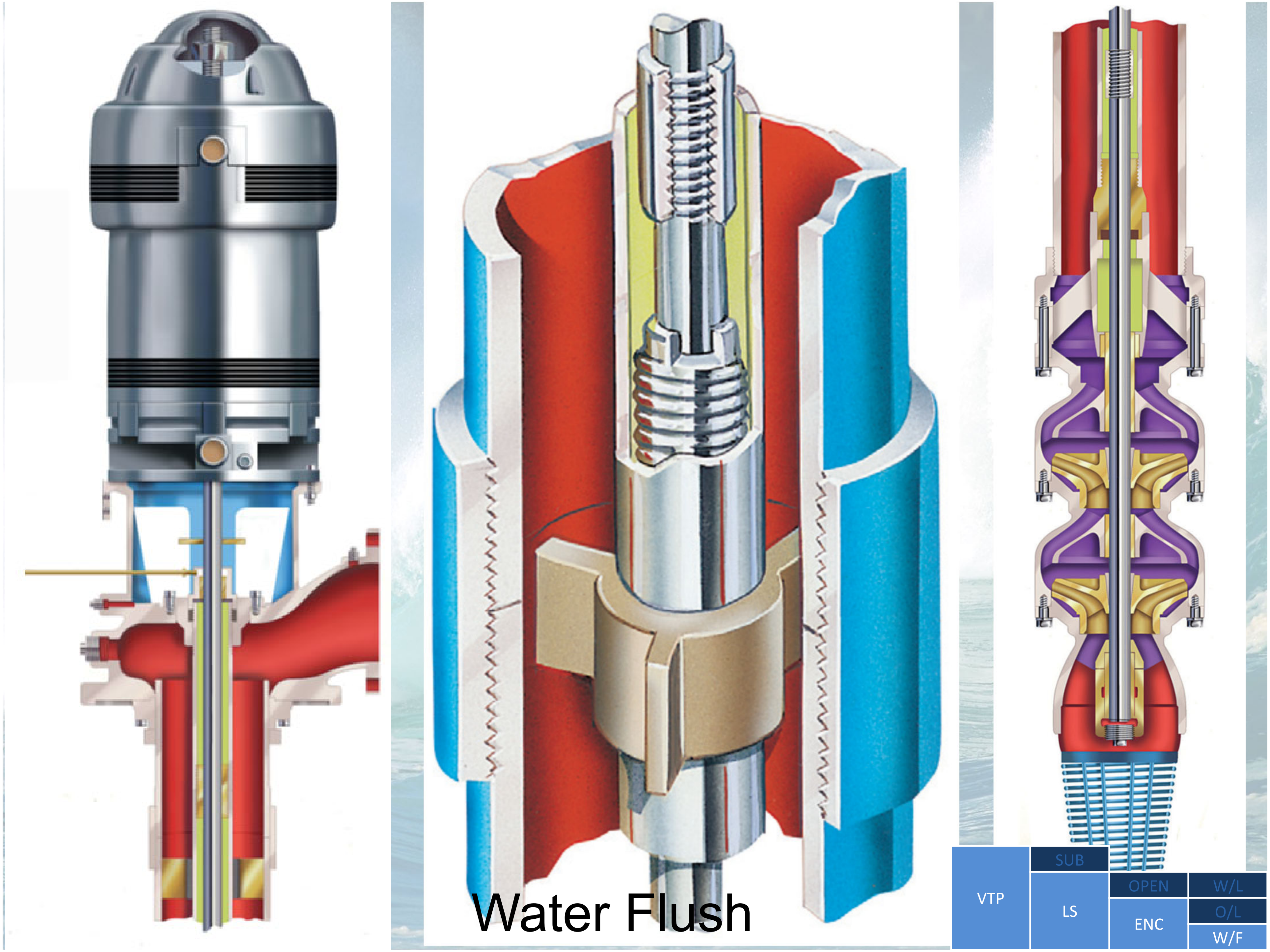
W/F

GENERAL PUMP COMPANY


Water Flush
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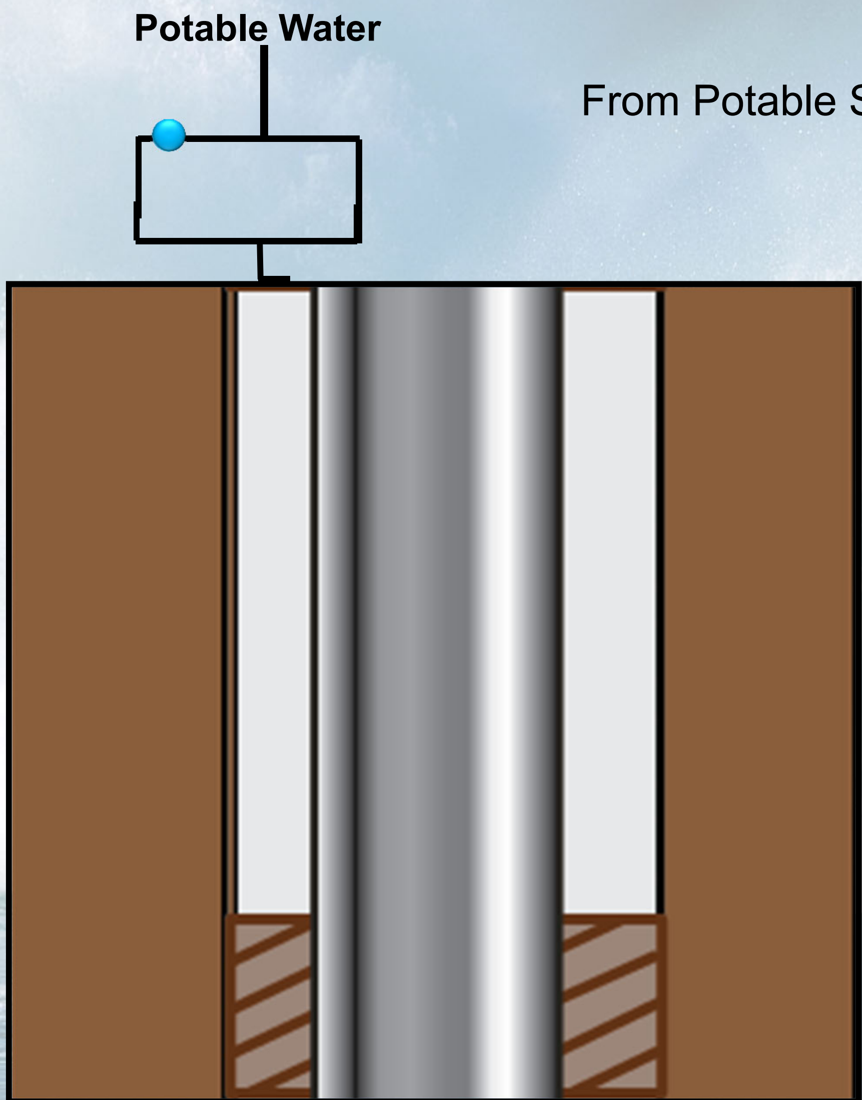
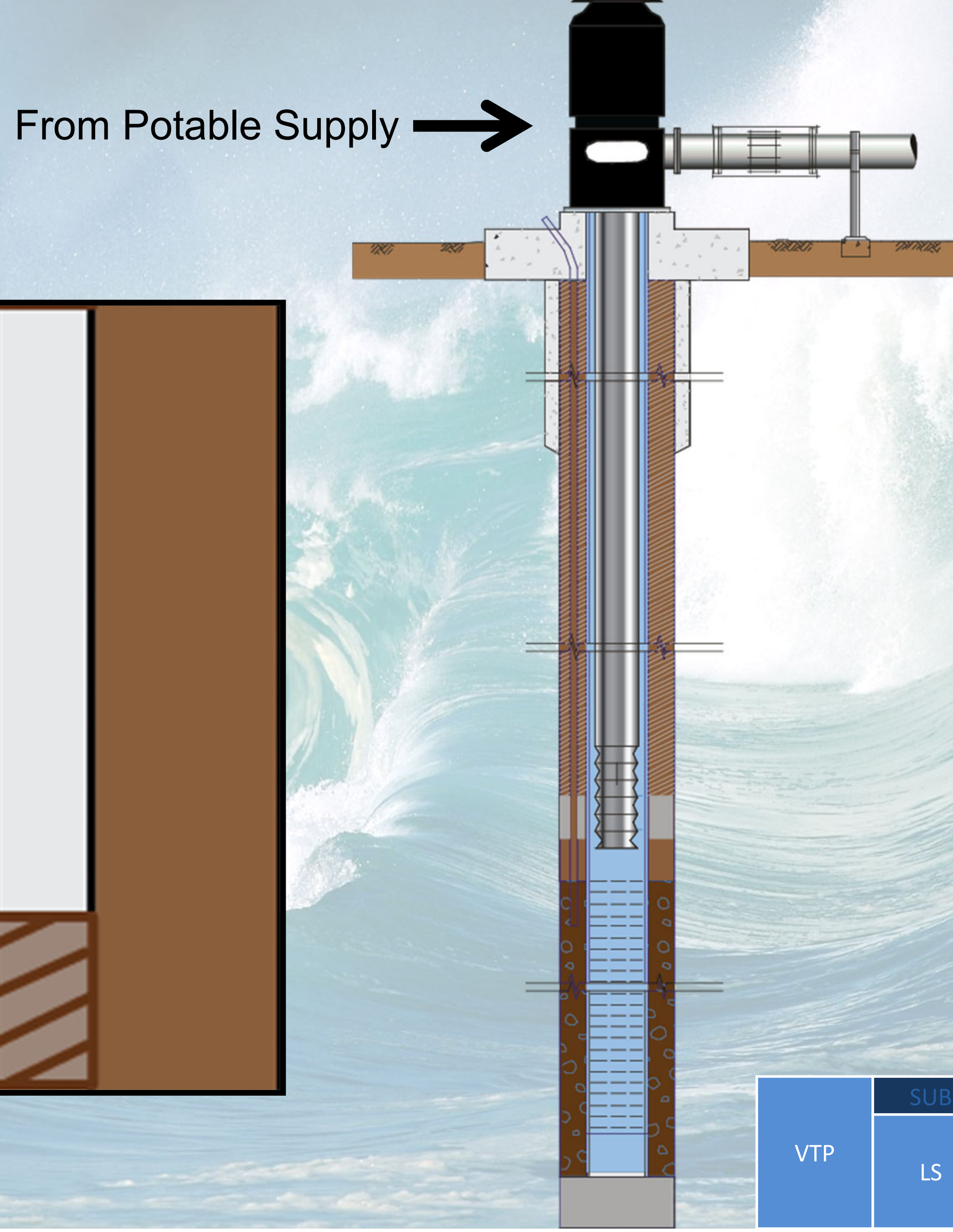
W/F

Water Flush





GENERAL PUMP COMPANY

VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Considerations for Water-Flush Applications

- **Pumps set in or below perforations**
- **Aboveground infrastructure - Reduces impacts to:**
  - **Arsenic Media**
  - **Granular Activated Carbon (GAC)**
  - **Reverse Osmosis (RO)**
- **Wells that have or will experience static water level decline in the aquifer**

GENERAL PUMP COMPANY

VTP SUB LS OPEN ENC W/L O/L W/F

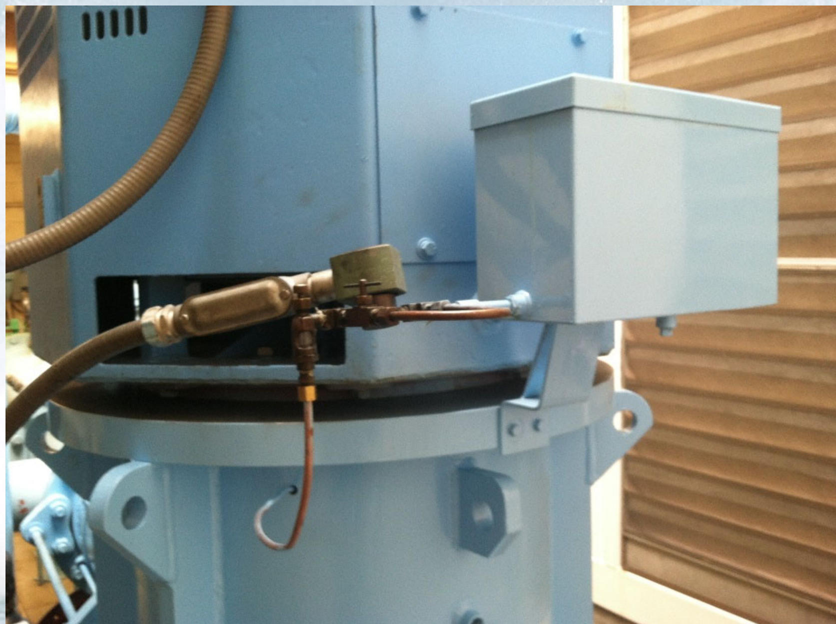
Motor / Discharge Head / Lubrication

GENERAL PUMP COMPANY

VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Lubrication Assembly

Oil Lube



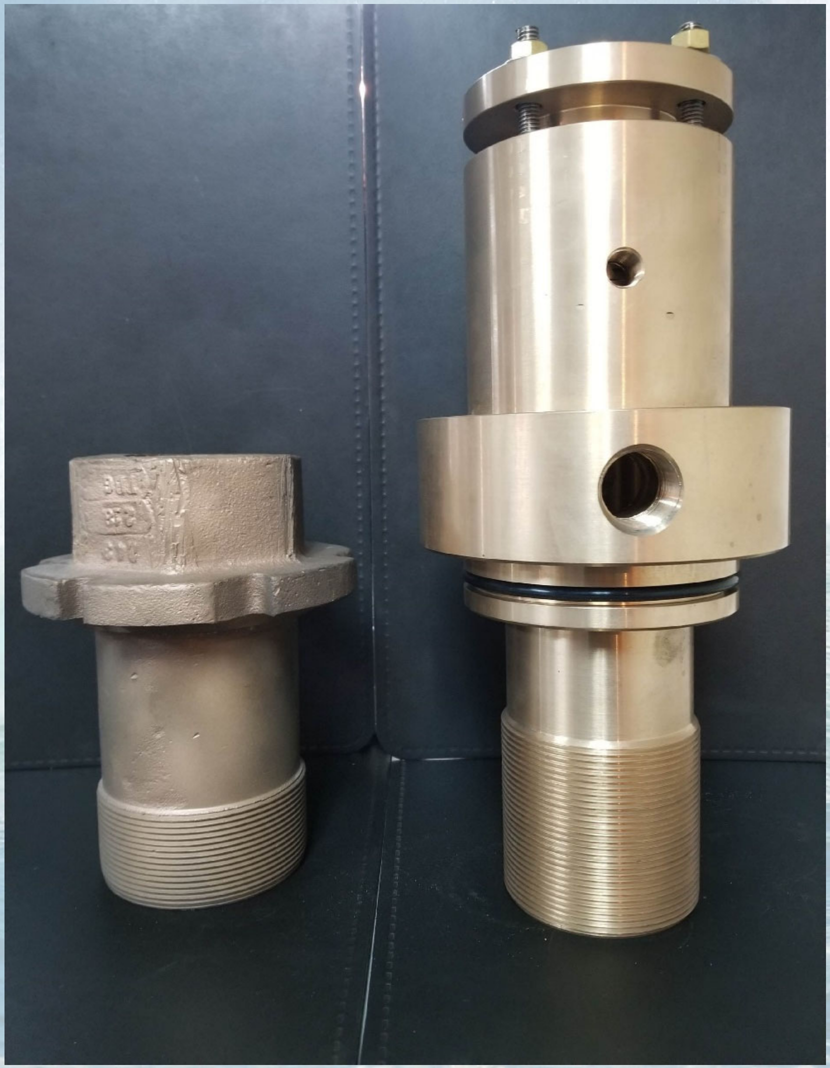
Water Flush

GENERAL PUMP COMPANY

VTP SUB LS OPEN ENC W/L O/L W/F

Tension Assembly

Oil Lube Water Flush



GENERAL PUMP COMPANY

VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Tube Bearings

Oil Lube Water Flush

GENERAL PUMP COMPANY

VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Tube Bearings

Oil Lube Water Flush

GENERAL PUMP COMPANY

VTP	SUB		
	LS	OPEN	W/L
		ENC	O/L
			W/F

Water Flush
Pros and Cons

Pros

Low daily maintenance costs

No risk of oil in well bore or distribution system

Designed for shallow and deep sets

Motor can be quickly repaired without pulling the entire pump

Works well with VFDs

Cons

Injection water quality is important to keep grooves clear from particulates or fouling

Water lubrication characteristics inferior to oil which requires a constant flow of water

Higher upfront costs

GENERAL PUMP COMPANY

VTP SUB LS OPEN ENC W/L O/L W/F

Questions or Comments

GENERAL PUMP COMPANY

Over 65 Years of Water Well & Pump Service

- Two Full-Service Pump Repair & Well Rehab Facilities
- Over 50 Municipal Maintenance Contracts across Southern California
- Multiple Engineers & Hydrogeologists on Staff
- A Fleet of 45 Rigs, Cranes, & Service Trucks to Support Field Operations
- Well Evaluation & Rehabilitation
- Vertical Turbine & Horizontal Booster Pump Repair & Manufacturing

159 North Acacia Street
San Dimas, California 91773

934 West Verdulera Street
Camarillo, California, 93010

www.genpump.com

909.599.9606
805.482.1215
engineering@genpump.com

Speaker #7

Treatment Options for PFAS

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Treatment Options for PFAS

December 11, 2019

Presented by:

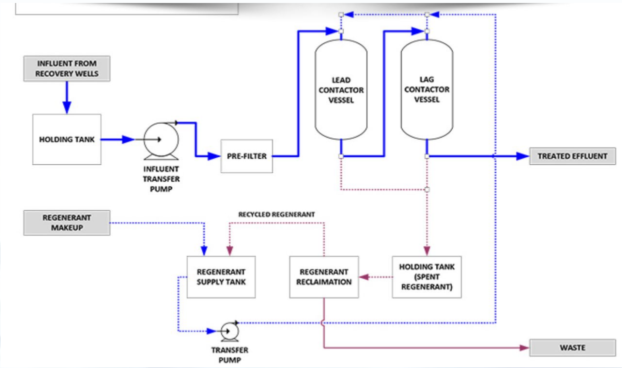
Kelsey Hakes, AqueoUS Vets and

Cathy Swanson, Purolite

Treatment Options for PFAS Removal


Foam Fractionation


Membrane Filtration



Regenerable Resin


Carbon Adsorption

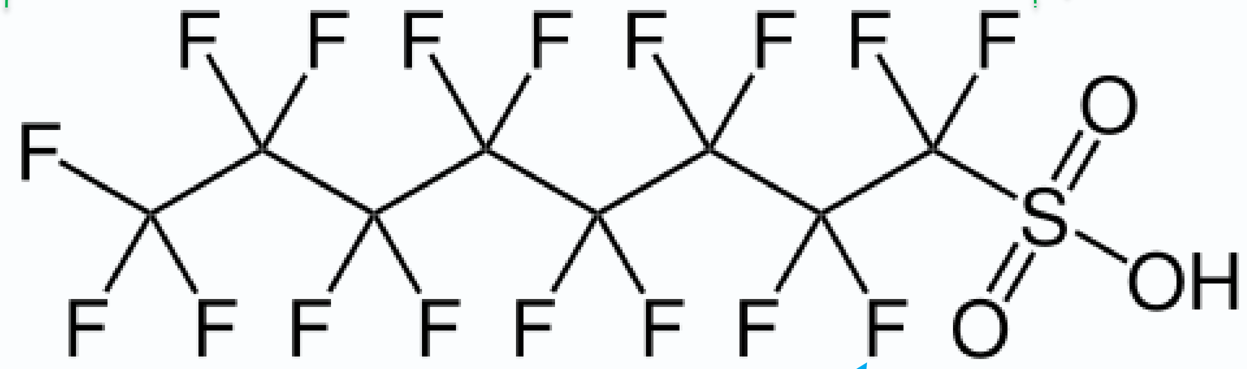
Single-Use Resin

AqueoUSVETS™ Purolite®

PFOS – Perfluorooctance Sulfonic Acid

Hydrophobic "Tail"

Ionized "Head)



GAC
removes by adsorption
using hydrophobic "Tail"

PFAS - Selective IX Resins
removes by both ion exchange and adsorption
using both "Head" &
"Tail"

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PFAS Removal: GAC or IX?

- Factors to consider
  - Short Chain vs Long Chain PFAS
  - NOM concentration
  - Competing Synthetic Organics (VOC’s and Pesticides)
  - Competing Inorganics (Metals, Perchlorate, Nitrates)
  - Footprint
- Life Cycle Costs
  - Capital Equipment Cost
  - Operational Costs
    - Media Exchange Costs
    - Head loss across pressure vessel Systems
    - Head loss across Media
    - Energy Costs applied to GAC & IX Systems

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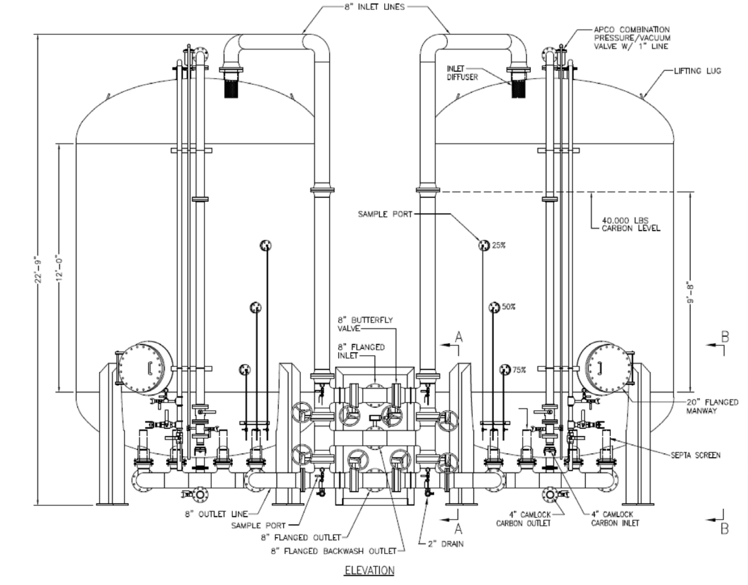
Treatment Options – GAC

GAC – Granular Activated Carbon

- **>**10 min empty bed contact time
- 12’ dia. “40,000lb” vessels → 1,000 gpm, Height 22’ 9”, 11 psi DP
- Removes all organics in the water
  - Can be good if you need to treat all organics
  - PFAS long chains easier to remove than short chains
  - Higher levels of TOC limit the carbon bed life



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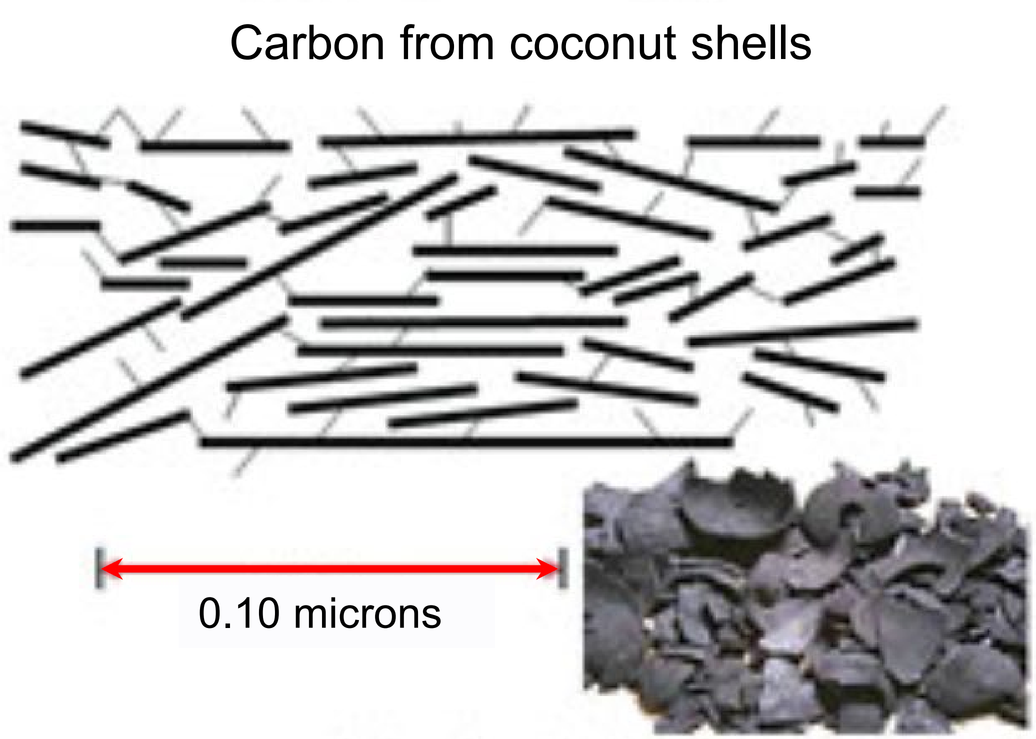
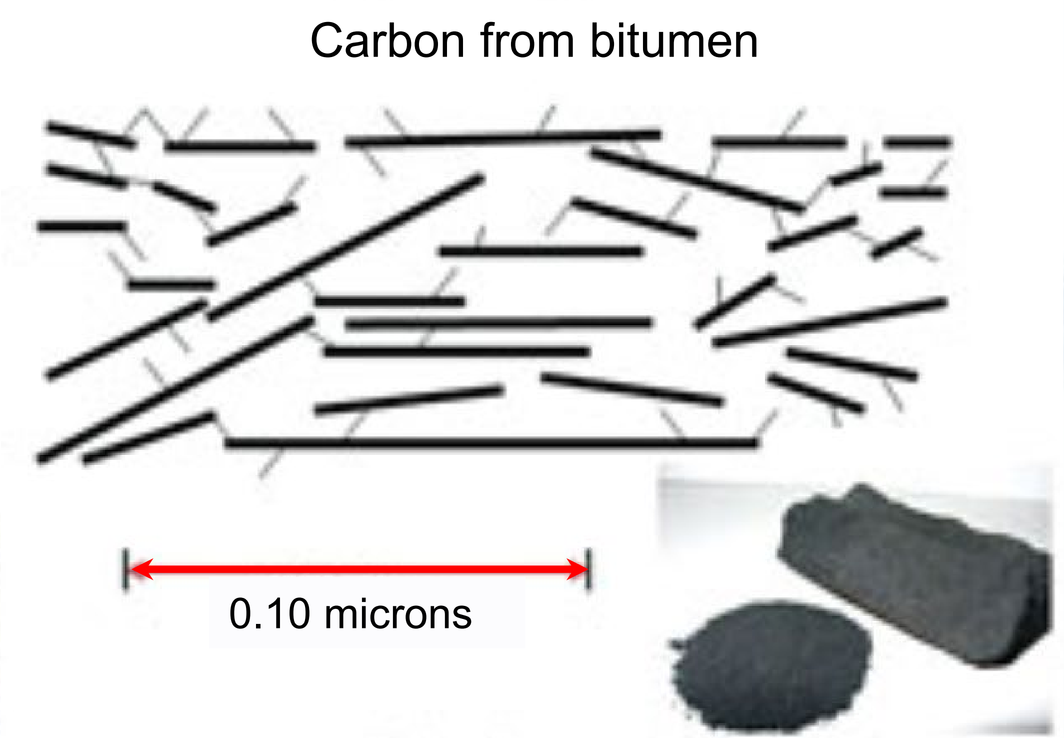
How GAC works





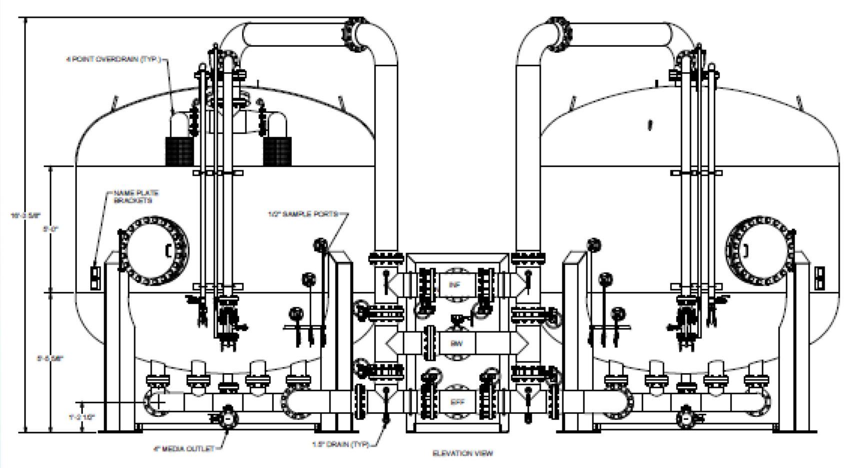
- Organics diffuse into the pore structure = Van Der Waals forces
- Takes contact time to develop a mass transfer zone for adsorption

Photo Source:
http://www.gasprocessingnews.com/features/201608/manage-activated-carbon-effects-on-mdea-solution-foaming.aspx

Treatment Options – IX Single Pass Resin

IX – Ion Exchange

- >1.6 min empty bed contact time
- 12’ dia. 494 cu ft. vessels → 2,000 gpm
- Height 16’4”, 23 psi DP
- PFAS Selective Resin
  - Competing anion concentrations (SO_4, NO_3, HCO_3, Cl, TOC) allow us to predict resin life
  - Background anions affect resin throughput



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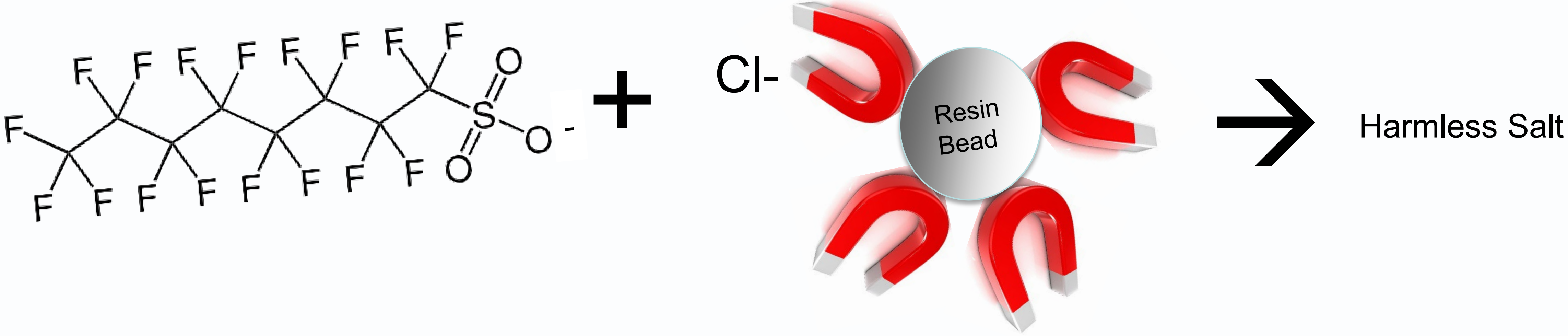
Ion Exchange – How it works



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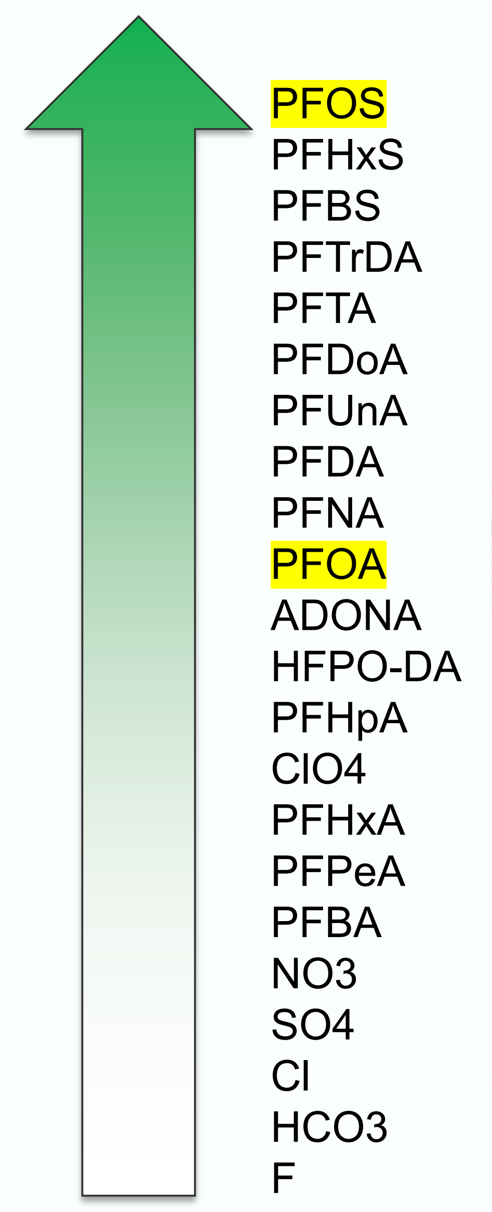
PFA694E Performance

Resin Selectivity – PFAS Selective

In General

- Sulfonic acids are removed more easily than carboxylic acids
- Longer chains are removed more easily than shorter chains

On the right, this is an approximation of selectivity based on data, molecular weight, functional groups, octanol/water coefficient (Koc), and hydrophobicity.



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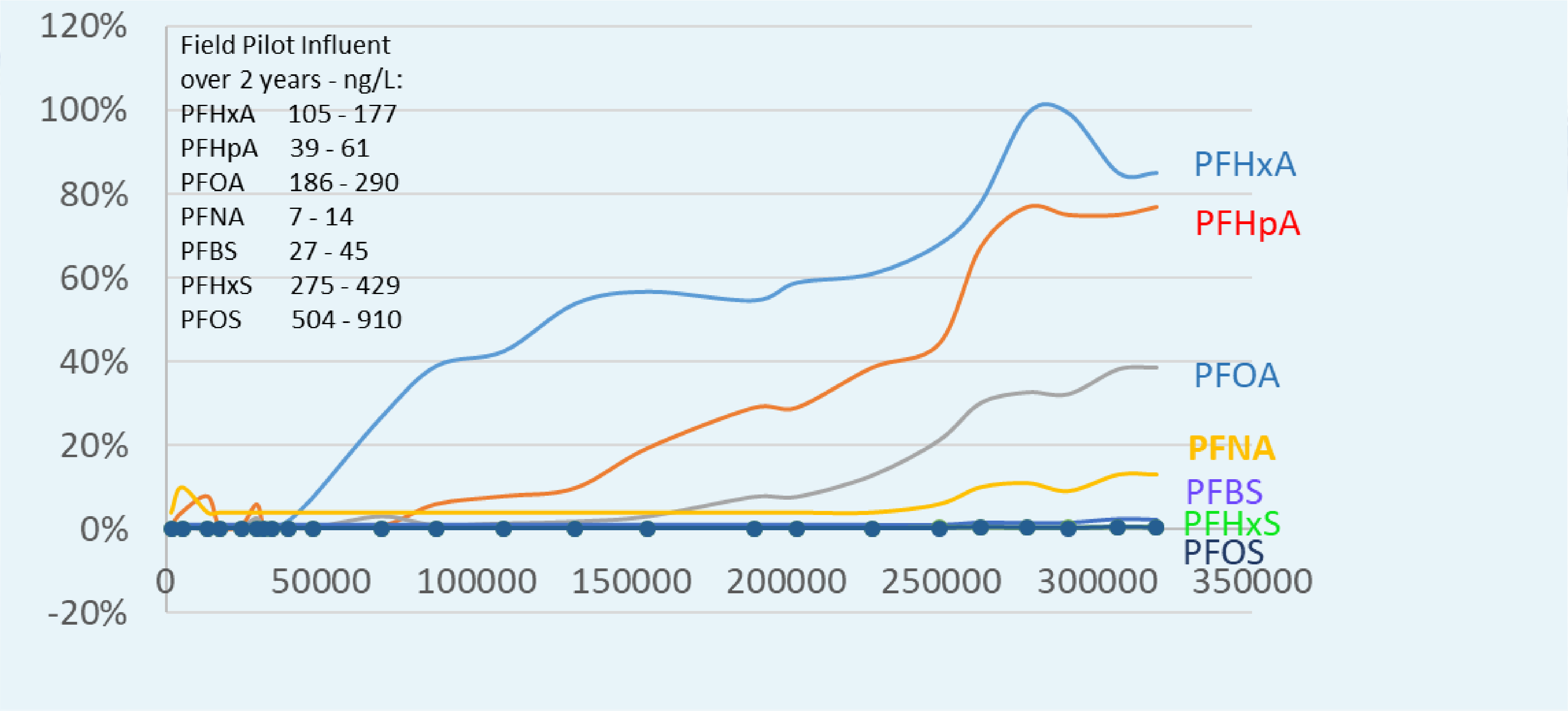
PFA694E Resin – Order of PFAS Breakthrough

PFHxA < PFHpA < PFOA < PFNA < PFBS < PFHxS < PFOS

% Breakthrough



Bed Volumes

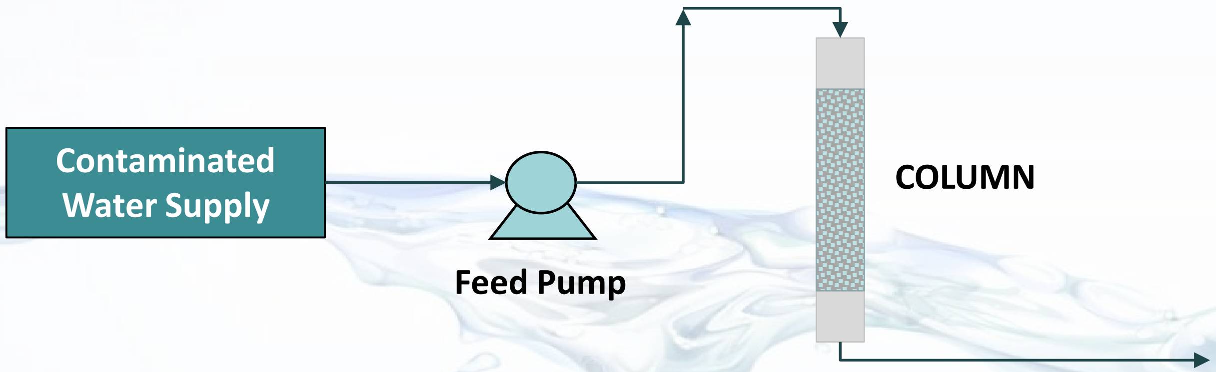
Important Pretreatment Considerations

Pretreatment may be needed for	RO / NF or GAC or IX
Harmful Parameters:	
Oil & Grease, TOC, VOC	✓
Oxidants	
Suspended Solids	
Iron/manganese	
Scaling compounds	
Microbes	

Laboratory Testing for GAC Usage Determinations

- Bottle Point Isotherm Testing
  - Water From Site
  - K and 1/n Values Determined Experimentally
  - Static Test, Does a Poor Job of Estimating the Impact of Interfering Constituents
  - Can provide relative performance of similar medias
- Rapid Small-Scale Column Testing (RSSCT)
  - Uses Water From Site (Can Use Spiked Water)
  - Dynamic Test, Takes Into Account Interferences
    - Does not account for changing water quality over time
    - Source of water, Seasonality
  - Can be Used to Predict Performance of Full-Scale System
    - Only based on water quality included in test
    - Limits predictability and reliability

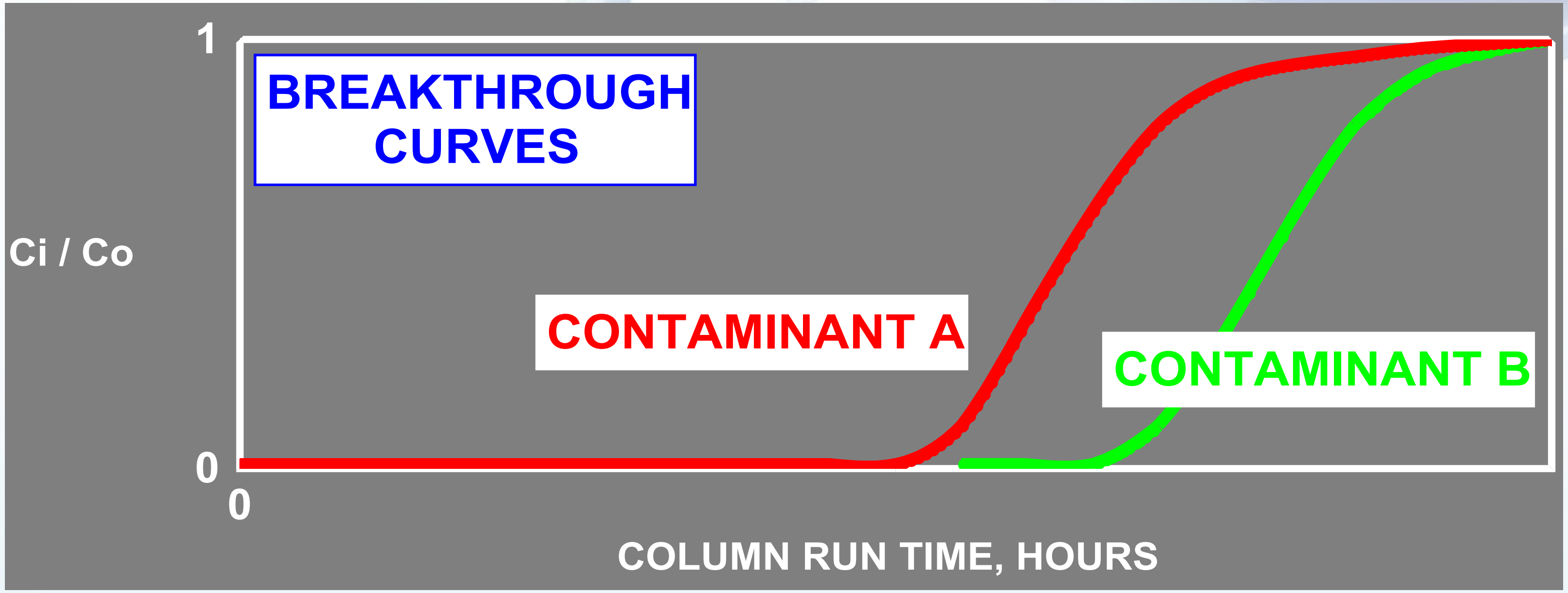
Rapid Small Scale Column Tests (RSSCT)



1-10 Grams 60x80 Mesh Carbon

10-200 Gallons Water

1-10 Days

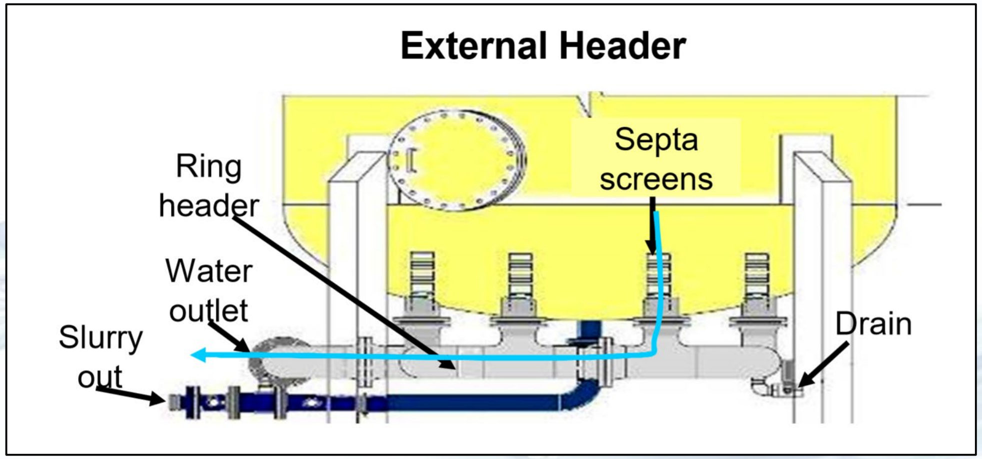


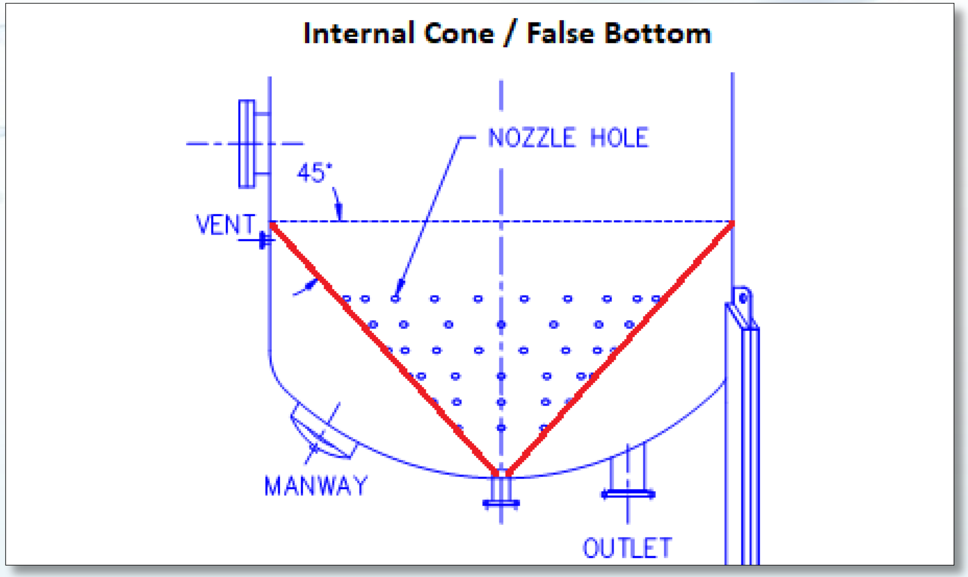
Underdrain System Design

Carbon “20,000 lb” example

- **External Ring Header**
  - **Pressure Loss**
  - **10’ dia. @ 750 GPM = 6 psi**
  - **12’ dia. @ 1,000 GPM = 6 psi**

- **Internal Cone / False Bottom**
  - **Pressure Loss**
  - **10’ dia. @ 750 GPM = 12 psi**
  - **12’ dia. @ 1,000 GPM = 15 psi**





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PFAS Selective Single Use Ion Exchange Resin	Granular Activated Carbon
• Smaller footprint – smaller vessels and no backwash • Longer throughput – 3 to 20 times that of GAC • Better uptake of short chain PFAS – especially sulfonic acids • Typical lower capital costs • No nitrate sloughing • GAC can slough shorter chain PFAS • Easy to model based on data • Run accelerated pilots	• Less head loss across the systems, meaning lower overall energy costs • Removes other organics in the water • lower individual vessel change out costs. • Less susceptible to TSS fouling the carbon bed. • Difficult to model but RSSCT Lab testing & pilots cans be conducted to estimate bed life

REMEMBER: EVERY SITE IS DIFFERENT

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Case Studies for PFAS Removal: GAC Systems

- California American Water - Sacramento, CA
- Procurement Vehicle
  - Design Build - expedited in 12 weeks
- Operational Conditions
  - 975 GPM
  - 1.4 MGD since start up in August 2017
  - Influent 180 ppt PFOA/PFOS combined
  - TOC/NOM concentrations, <1 ppm
  - After 90,000 BV (45k BV through lead vessel)
    - Low detection in primary vessels for PFOA/PFAS
    - Low PPT breakthrough detected for short chain PFAS
      - PFHxS, PFHpA, PFBS, etc.

AqueoUS VETS™
Experienced. Proven. Reliable.

A SERVICE DISABLED VETERAN OWNED SMALL BUSINESS

PROJECT LOCATION
Rancho Cordova, CA

PROJECT TYPE
Construction

PROJECT TIMEFRAME
April 2017 – August 2017

PROJECT PHASE
Complete

CONSTRUCTION COST
$1.3M Total
$640k by Proposer

PROPOSERS % OF WORK
49% System

END USER
California American Water
Sacramento, CA

GENERAL CONTRACTOR
Auburn Constructors, Inc.
Sacramento, CA

DESIGN ENGINEER
Brown and Caldwell
Rancho Cordova, CA

AQUEOUS VETS™ TEAM
Robert Craw – Vice President of Business Development
Chris Perry – Manufacturing & Installation Manager

Nut Plains PFOA/PFOS Well Treatment System

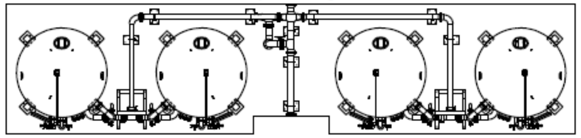
Aqueous Vets™ (AV) is pleased to team with Auburn Constructors and Brown and Caldwell in the design-build project for the Nut Plains Well Granular Activated Carbon Treatment System for California American Water.

Project Details

California American Water is committed to delivering the highest quality of potable water to its consumers, and provides a product that meets or exceeds current drinking water standards. As suggested by the U.S. EPA health advisory issued on May 19, 2016, California American Water seeks to ensure that potential levels of Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS) in drinking water served to customers in California American Water's Suburban Rosemont system remain below 70 parts per trillion (ppt).

California American Water selected our team to design, build, and install a GAC treatment system to ensure that it meets its commitment of providing high quality potable water to the community. California American Water does this while maximizing the use of budgeted funds to complete the project on time, and with minimal disruption to ongoing operations and surrounding community.

Project Site Design



Aqueous Vets™ provided two engineered low-profile GAC systems, each consisting of dual ten-foot diameter vessels that contain 20,000 pounds of granular activated carbon. Each system is configured for parallel or lead-lag operation and contains system header and bypass piping. At an overall height of less than 16-feet, the AV low-profile systems are designed to meet the building height code associated with the project site.

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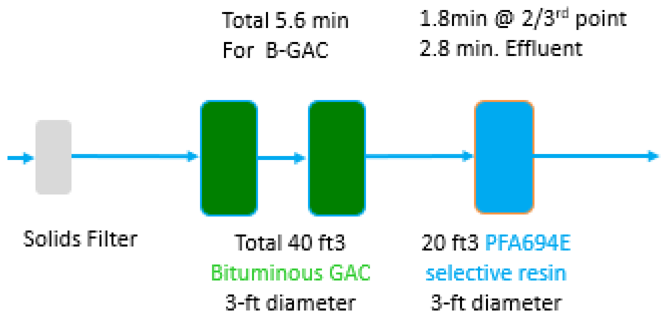
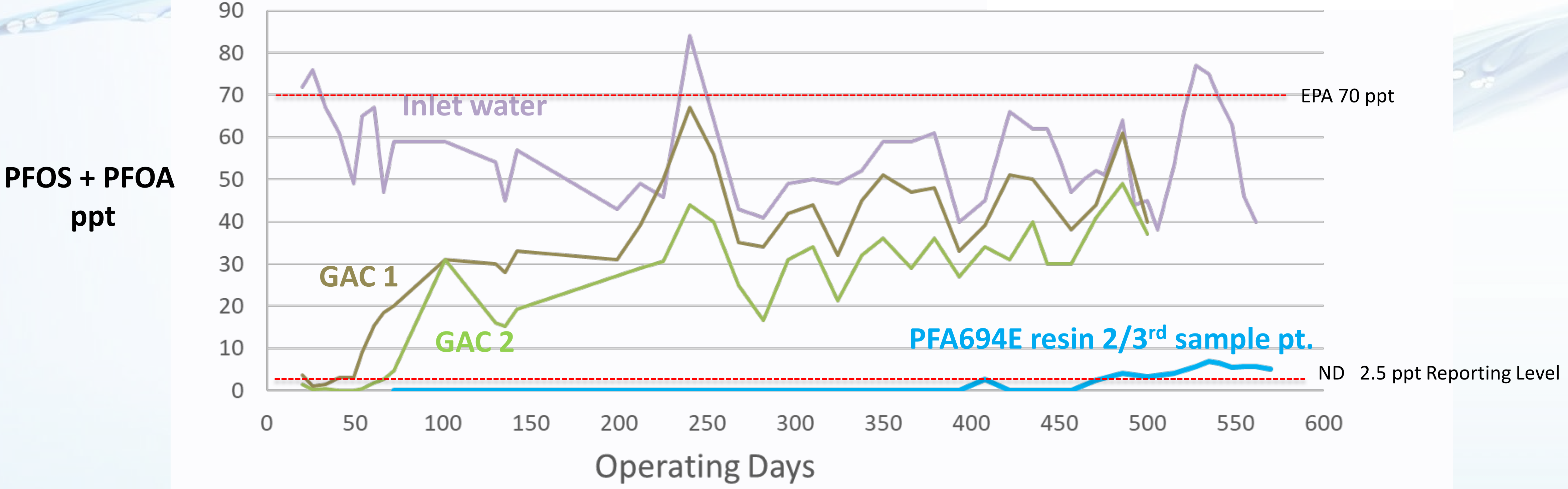
Horsham Township, PA Well 10

PFOS + PFOA Removal – In service for 570 days



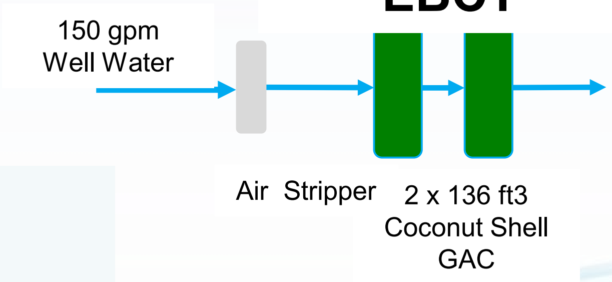


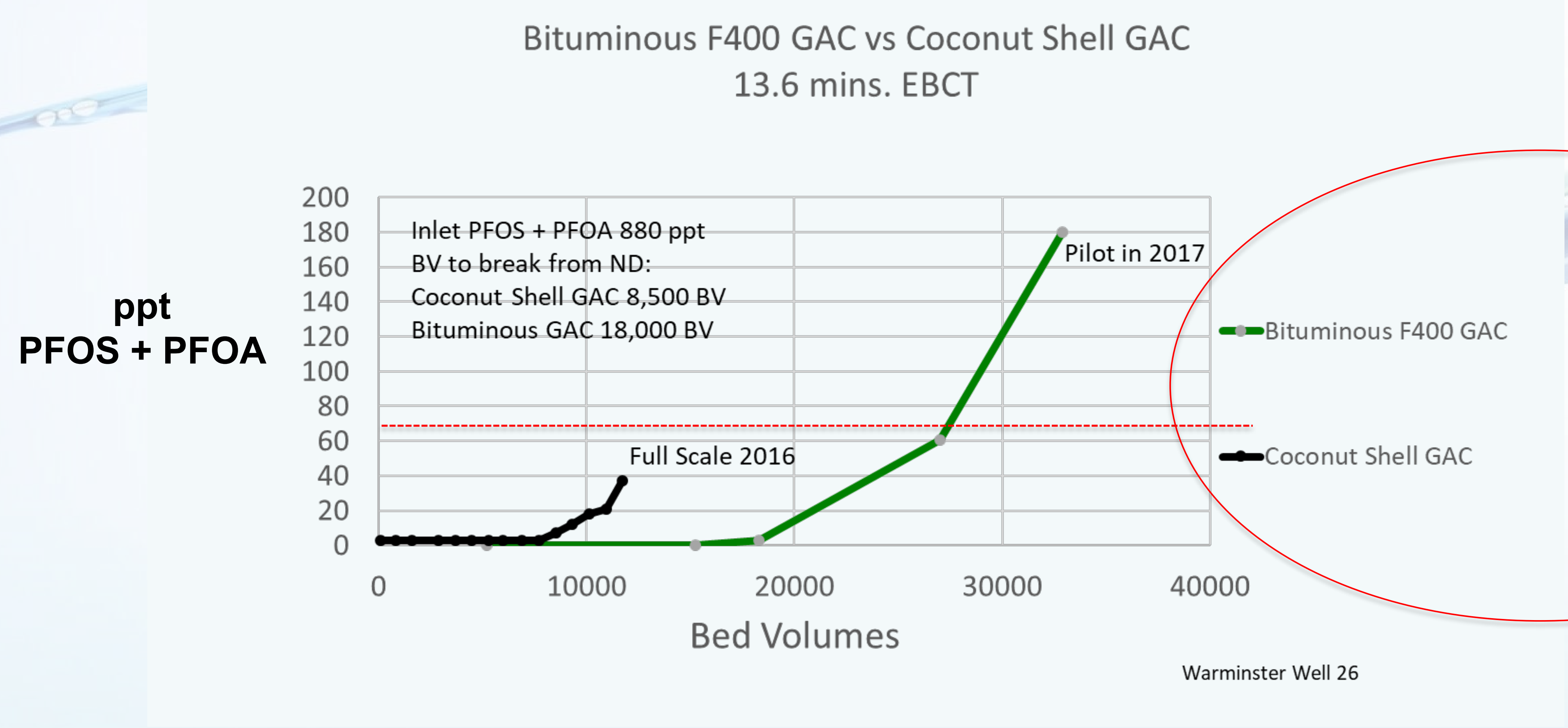
1 liter resin treats > 456,000 liters of water to ND

Warminster, PA Well 26

Coconut Shell GAC Full Scale (2016)
Bituminous F400 GAC Pilot (2017)

Total 13.6 min EBCT





~ 6 months

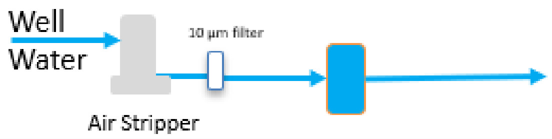
< 3 months to 70 ppt

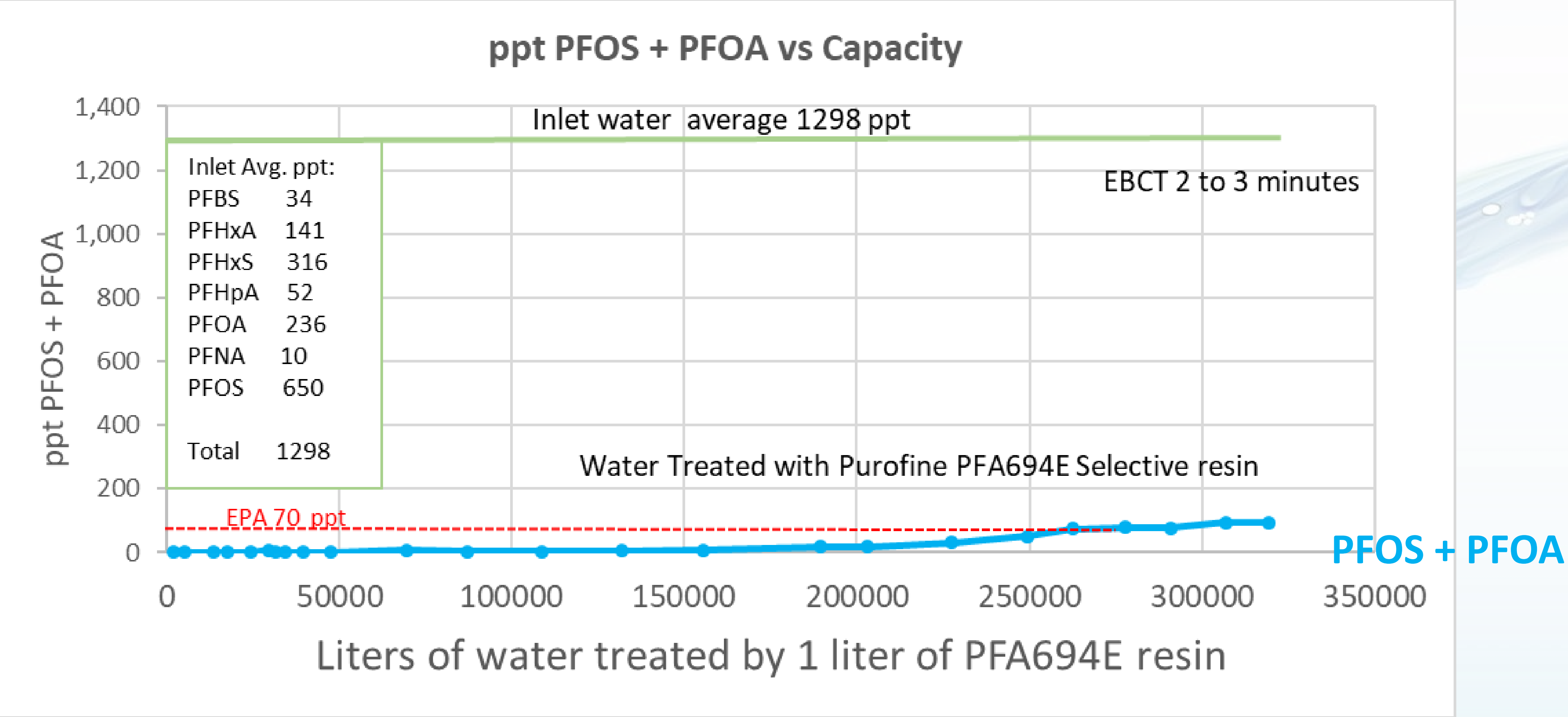
Coconut Shell GAC: 80 days; Bituminous GAC: 170 days

Warminster, PA Well 26

Consistent Non-Detect @0.4 ppt PFOS + PFOA

> 200,000 BV (> 416 days) (single vessel)





Equivalent to > 400,000 BV for lead-lag vessels to ND ex lag

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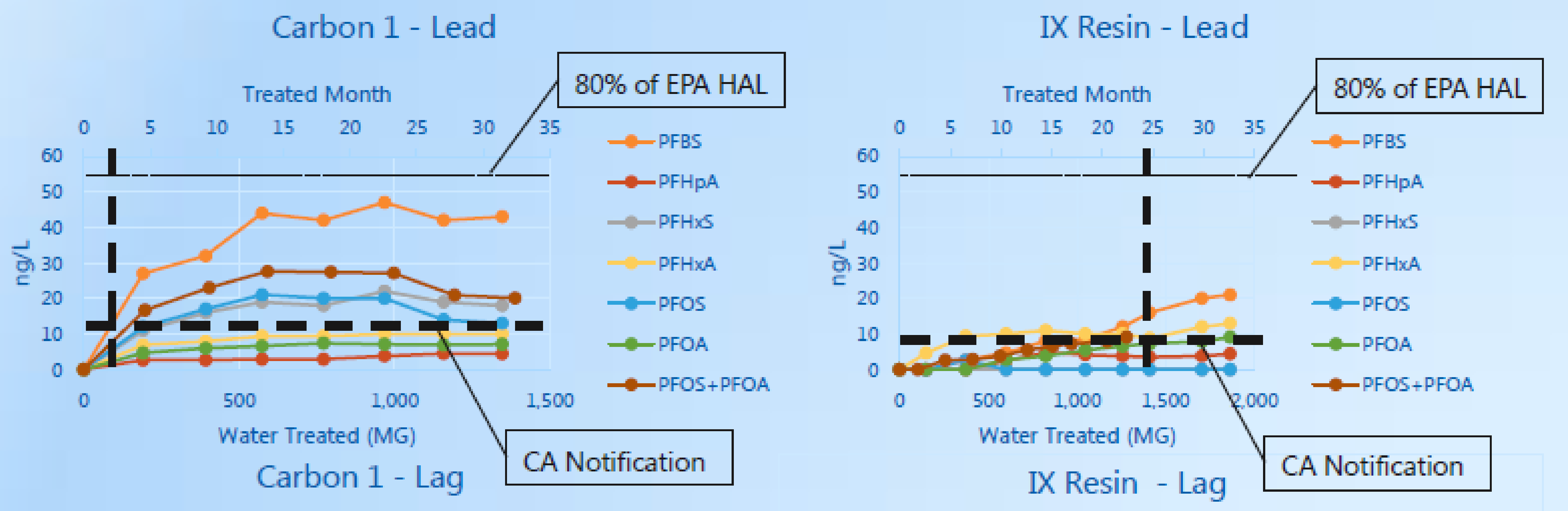
Arizona RSSCT Study

GAC	2-3 month bed life
PFA694E	25 month bed life



Source:
Removing PFOA and PFOS from Drinking Water: A Case Study at an Arizona Wellfield
Phoenix/Chandler PFAS & Other Emerging Contaminants Information Exchange Workshop – American Groundwater Trust, July 11, 2019, Dean Alford, PG, PMP, CEM, City of Tempe
Mark Gross, PE, Carollo Engineers

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California Report

RSSCT and Isotherm for GAC, Modified Isotherm for IX

GAC	Estimate to reach PFOA NL of 5.1 ng/L BVs	Estimate to reach PFOA NL of 5.1 ng/L Months of Operation at 10-min EBCT	Estimate to reach PFOS NL of 6.5 ng/L BVs	Estimate to reach PFOS NL of 6.5 ng/L Months of Operation at 10-min EBCT
F400	17,500	4.0	55,100	12.6
HD4000	19,200	4.4	54,800	12.5
UC1240LD	25,400	5.8	76,000	17.4
A1240	17,300	4.0	62,900	14.4

IX Results:

Based on PFOA breakthrough, the results suggest that the IX resins may be able to treat between 118,000 and 200,000 BVs before 50% breakthrough takes place, with the most probable value being 154,000 BVs. For an IX system designed with an EBCT of 2 minutes, these values translate into an operating time range between 5.4 and 9.1 months, with a most probable operating time of 7 months until 50% PFOA breakthrough takes place.

We had predicted 130,000 BV

Source: **BENCH-SCALE TESTING OF PFAS REMOVAL FROM THE N WELL USING GAC OR ION-EXCHANGE RESINS,** Prepared by WATER QUALITY & TREATMENT SOLUTIONS, INC. LOS ANGELES, CALIFORNIA, October 25, 2019

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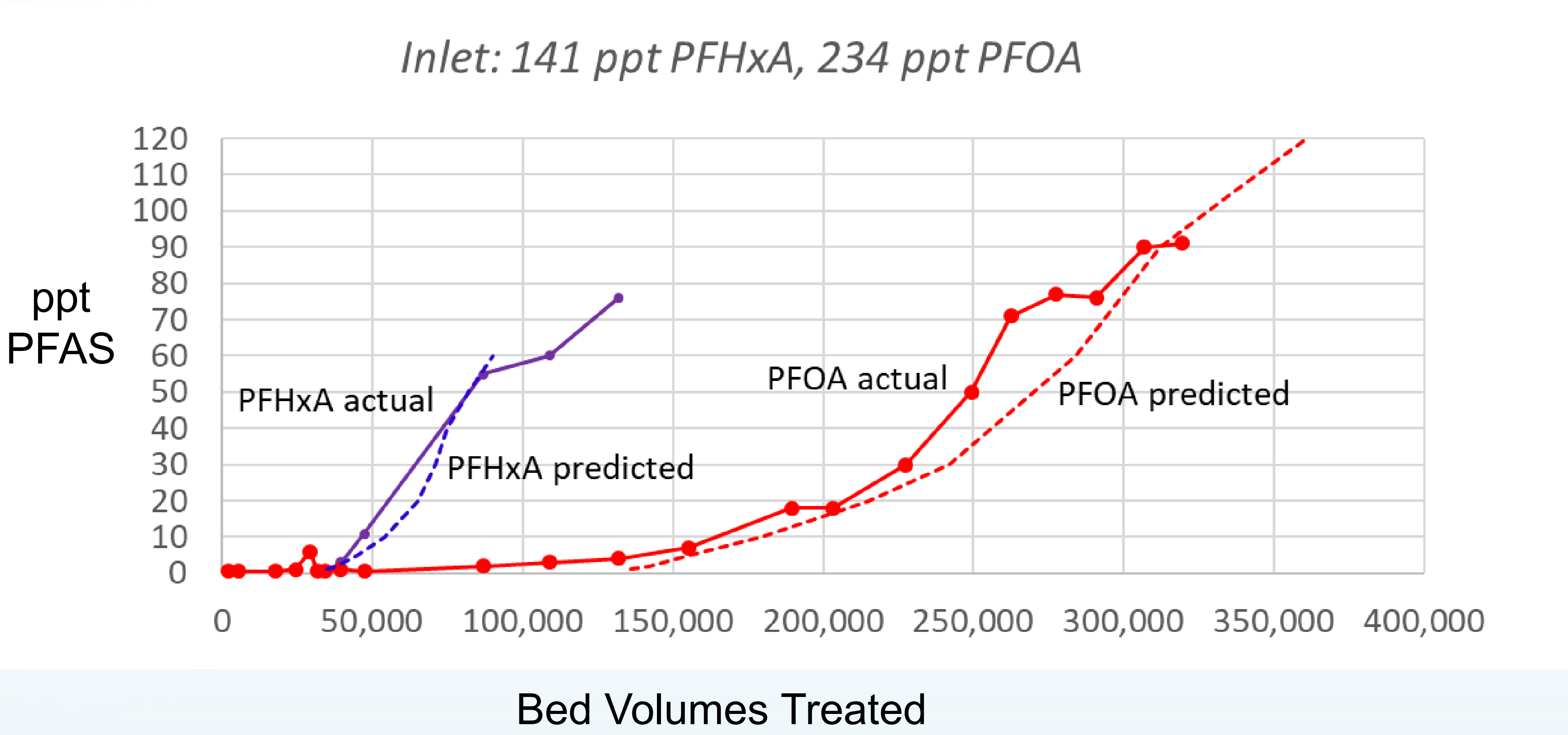
PFAS IX Projections Very Accurate



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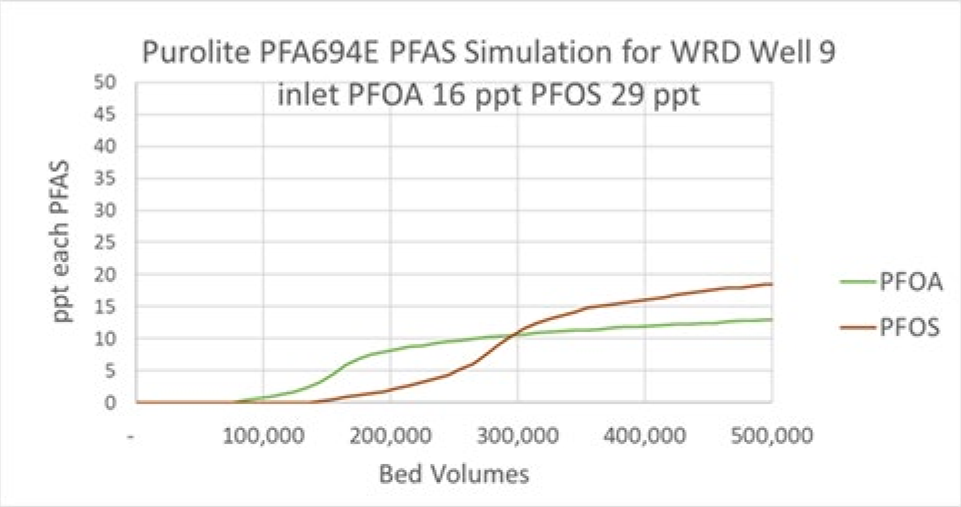
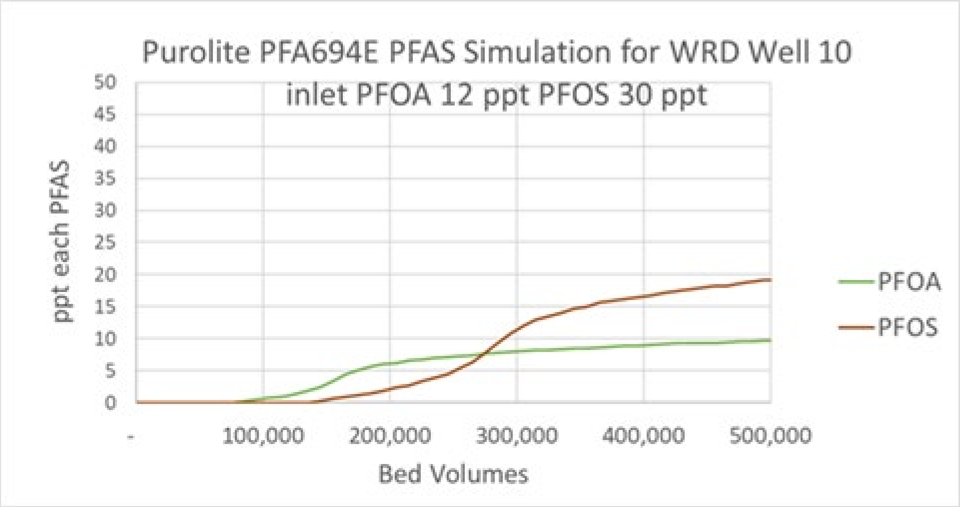
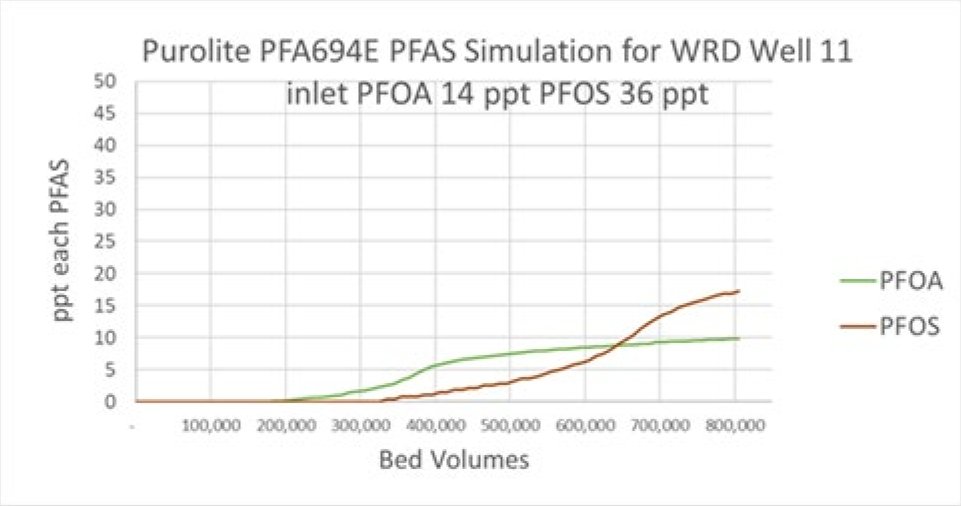
WRD PFAS Selective IX Resin Projections







What is the endpoint?
→ Dramatically affects cost

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Comparing Well 11 – Treating to 5.1 ppt PFOA

Budgetary Comparison of PFA694A vs GAC for PFAS Treatment	Purolite PFA694 Resin	GAC
Total System flow - gpm	2500	2500
Vessel Diameter - ft	12	12
Number of trains	2	3
Flow per train - gpm	1250	833
Total number of vessels for all trains (lead + lag)	4.0	6
Vessel Crossection - ft2	113.1	113.1
Linear Velocity - gpm/ft2 - between 2 and 20 gpm/ft2	11.1	7.4
Pounds of GAC		36,826
Media volume per vessel - ft3	494.0	1096
Bed depth - ft - min of 3.2 ft for IX	4.4	9.7
Specific flowrate - gpm/ft3	2.53	0.76
EBCT Contact time per vessel - minutes	2.96	9.84
Estimated BV for lead vessel to 50% break ex lead vessel	**380,000**	**35,000**
Est. Capacity of one lead vessel - gals/ft3	2,842,780	261,835
Total Water Treated Until Change-out of Lead Vessels – MMGals	2,809	861
Total Water Treated per Year - (full flow, 24/7) MMgals/year	1,314	1,314
Total Water Treated per Year - (full flow, 24/7) acre feet/year	4,033	4,033
Days Between Lead Vessel Change-outs	780	239
Change-outs per year	**0.47**	**1.53**
Volume of Media Required per Year - CF	**462**	**5018**

Projection

Guess

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Comparing Well 11 – Treating to 5.1 ppt PFOA

Media Change-out Costs ("Change-out" is replacement of media in lead vessels)	Unit price ($)		Units	$/ IX Changeout	$/GAC Change-out
	IX	**GAC**			
Volume of Media per Vessel	494	1096	Cu ft		
Media Cost per pound		$ 1.40	$/lb		
Media Cost per cubic foot	$ 280.00	$ 47.04	$/ft3	**$276,640**	**$ 154,668**
Labor per cu ft	$ 20.00		$/ft3	$19,760	
Trucking	$ 6.00		$/ft3	$2,964	$ -
Profiling	$ 800.00	$500	$/test	$800	$ 500
Incineration	$ 20.00		$/ft3	$19,760	
Service Cost per Event sub-total - $				**$43,284**	**$500**
Total Change-out Cost per Event - $				**$319,924**	**$155,168**
Total Capital Cost for all vessels, including first fill of media cost - $				**$ 1,465,500**	**$ 1,670,500**
Amortization Period	$ 10				
Interest Rate	2.5%				
Amortized cost over 10 years at 0.025 interest rate				**$ (167,446)**	**$ (190,869)**
OPEX per year $/AF				$ 37	$ 59
CAPEX (over 10 years) $/AF				$ 42	$ 47
10 year lifecycle cost $/AF				$ 79	$ 106

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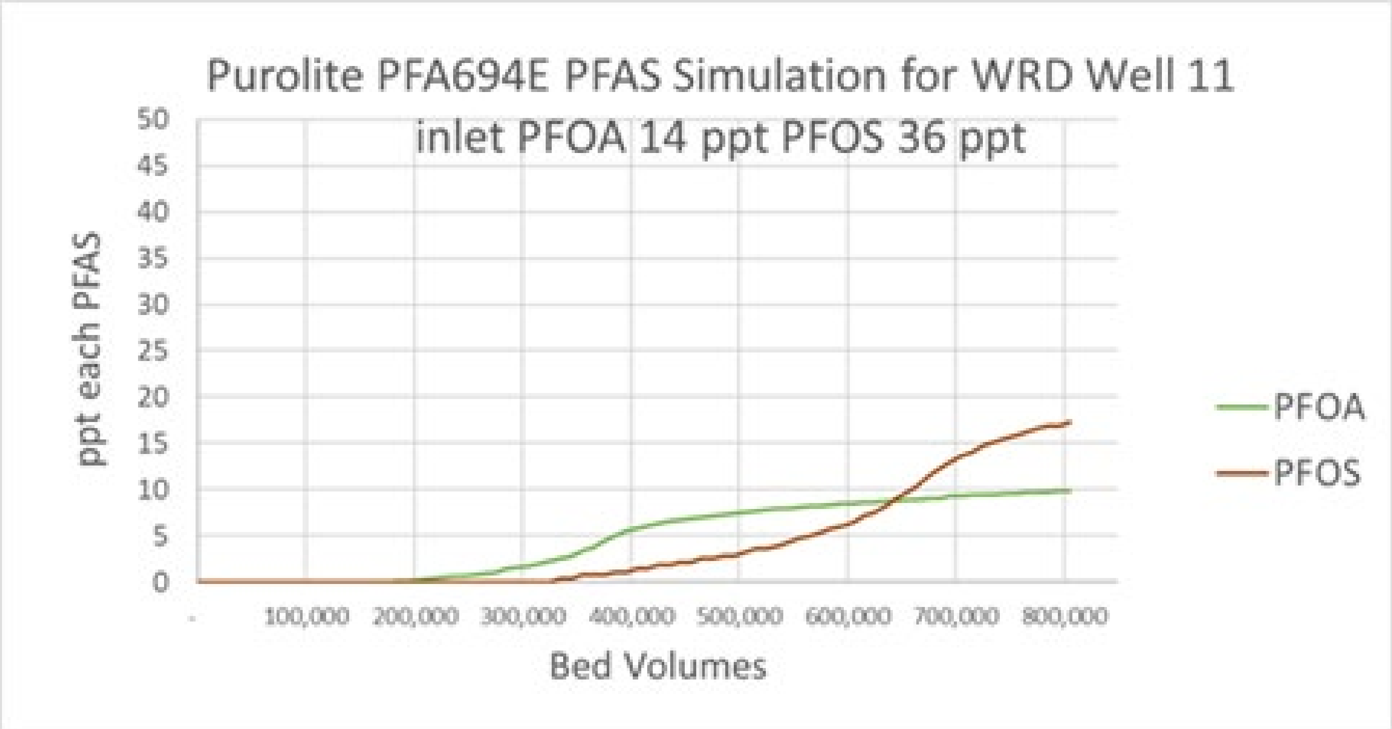
Comparing Well 11 – Treating to 10 ppt PFOA



Budgetary Comparison of PFA694A vs GAC for PFAS Treatment	**Purolite PFA694 Resin**	**GAC**
OPEX per year $/AF	$ 20	$ 41
CAPEX (over 10 years) $/AF	$ 42	$ 47
10 year lifecycle cost $/AF	$ 62	$ 88

GAC = Less Energy to Pump
Pressure Drop Energy Costs – Well 11

					Single System		*All Systems*		
System Description	System Pressure Drop (psi)	System Head Loss (ft of H_2O)	Power Required (HP)	System Energy Use (KWH/yr)	Annual Energy Cost ($/yr)	Energy Cost Delta ($/yr)	No. of Systems	Annual Energy Cost ($/yr)	Energy Cost Delta ($/yr)
AV® 12' Septa - IX	12.5	29	9	78,116	$7,444	-	2	$14,889	-
AV® 12' Septa - GAC	7.6	18	4	31,663	$3,017	-$4,427	3	$9,052	-$5,836

Assumptions:

1. Flow rate of 1,230 gallons per minute (gpm) for the 12-foot IX systems, or 820 gpm for the 12-foot GAC systems (2,459 gpm flow split across 2 IX systems and 3 GAC systems).
2. Pump motor efficiency of 75%
3. Energy cost of $0.08/KWH.
4. Demand cost of $10/KW per month.
5. Pump operating time of 24 hours per day.
6. The annual energy costs shown are based on head loss only, and do not reflect actual pumping costs.

Note: This analysis is for comparison purposes only - the engineer and/or owner should perform their own analysis for the purposes of final engineering designs and bid submittals.

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Total Life Cycle Cost Well 11-Energy, Capital, and Media

Treatment to 10 ppt PFOA

System Type	IX	GAC
No of Systems	2	3
Single System Energy Cost	$7,444	$3,017
All Systems Annual Energy Cost ($/yr)	$14,889	$9,052
GAC Savings in Yr 1 ($/yr)	-	($5,837)
GAC Savings over 10 years, 2.5% escalation on energy	-	($72,866)
Capital and Operating Cost per AF (treating to 10 ppt)	$62	$88
Cost per year Yr 1	$250,016	$354,861
IX Savings per year Yr 1	($104,845)	-
IX Savings, 10 years, with 2.5% escalation / amortization	($1,308,835)	-
Life Cycle Cost Differential over 10 years	($1,235,969)	

Guess

AqueoUS VETS™ Purolite®

Treatment Process Timeline – GAC or IX

Discovery
- Collect Water Quality and Site Design Paraments

Budgetary Proposal
- Proposal for Both GAC and IX treatment systems for capital comparison

Feasibility Study
- Engineering firm to evaluate hydraulics and upgrades if necessary
- Geological evaluation for treatment pad

Pilot Testing/ RSSCT Lab Testing
- Carbon and Resin site testing to confirm media bed life for O&M costs

Design –Bid - Build or Design Build
- Design Build is a faster process where materials can be ordered in parallel with final design efforts

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Life cycle costs and footprint considerations main drivers → Site Specific

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Thank you. Questions?

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Speaker #8

Safe Drinking Water Program & Disadvantage Communities Program

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WRD

WATER REPLENISHMENT DISTRICT
OF SOUTHERN CALIFORNIA

SAFE DRINKING WATER PROGRAM & DISADVANTAGED COMMUNITIES PROGRAM

SECURING OUR WATER FUTURE TODAY

WRD Safe Drinking Water Program

Program History

The WRD Safe Drinking Water Program (formerly the WRD Wellhead Treatment Program) was implemented in 1991 to promote groundwater cleanup by extracting and treating contamination at specific well locations.

The program provides grant or loan assistance for wellhead treatment at groundwater wells impacted by man-made or natural sources.

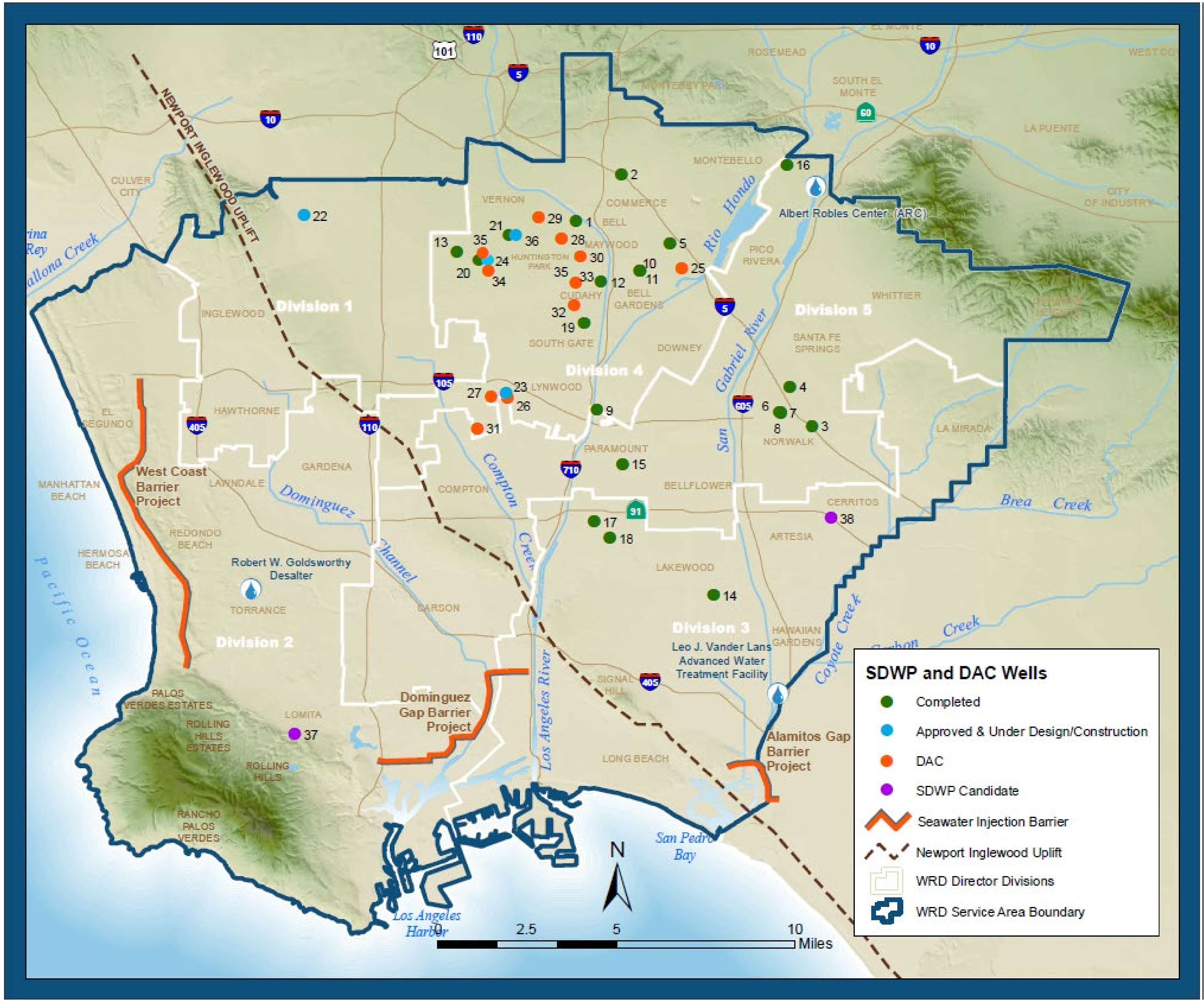
Safe Drinking Water & DAC Projects

Success of the WRD Safe Drinking Water Program

Since the creation of the program, the District has funded:

- Thirteen (13) grant projects to remove Volatile Organic Compounds (VOCs),
- Four (4) loan projects to remove Secondary Constituents and
- One (1) demonstration project researching various media for Arsenic removal.

The WRD Safe Drinking Water Program has restored the use of 17 production well facilities (approximately 38,000 acre-feet per year).



Safe Drinking Water for Disadvantaged Communities

- WRD instituted a program by which we help small systems in our service area access grant funding to improve water quality and decrease their reliance on imported water
- WRD provides the small systems with technical assistance which includes grant writing, engineering, planning and design so that the small system has a “turn key” operation at the conclusion of the project.
- WRD has been very successful with the program which started with $1M allocated by then Assemblyman and now Speaker Rendon through AB240.
- Currently there are eleven water systems participating in the program and nearly $4 million in funding obtained.

Safe Drinking Water for Disadvantaged Communities

- The Safe Drinking Water Disadvantaged Communities Program was developed to take WRD assistance beyond wellhead treatment.

- Through the DAC Program, WRD provides small systems with technical assistance to apply for funding for other water quality improvements such as aging infrastructure, storage capacity and other deficiencies in the system that could jeopardize water quality and/or system reliability.

DAC Program Success

Maywood Mutual Water Company No. 1

- Maywood Mutual Water Company No. 1 serves 13% of its water to the City of Maywood. The Company owns and pumps two groundwater wells with elevated manganese concentrations.
- The system secured State funding for $4.3 million for a treatment system and a reservoir replacement but the system remained idle without the permit to operate.
- WRD assisted the water system in securing the operation permit.

Program Guidelines

Type of Assistance	Contamination	Assistance Policy
GRANT	Volatile Organic Compounds (VOCs) Primary constituents of man-made origin exceeding the Maximum Contaminant Level (MCL).	WRD will design and construct the treatment system at any drinking water well with a consistent trend of VOC contamination.
LOAN *Through* *Revolving Fund*	Secondary or naturally occurring primary constituents exceeding the MCL. (Non-VOCs)	WRD will provide to the owner interest-free financing to design & construct treatment equipment for Non-VOC removal.
DAC OUTREACH ASSISTANCE	VOCs and Non-VOCs	WRD will provide State funding application assistance for water systems in disadvantaged communities (DACs).

Safe Drinking Water & DAC Projects – Funding Efforts

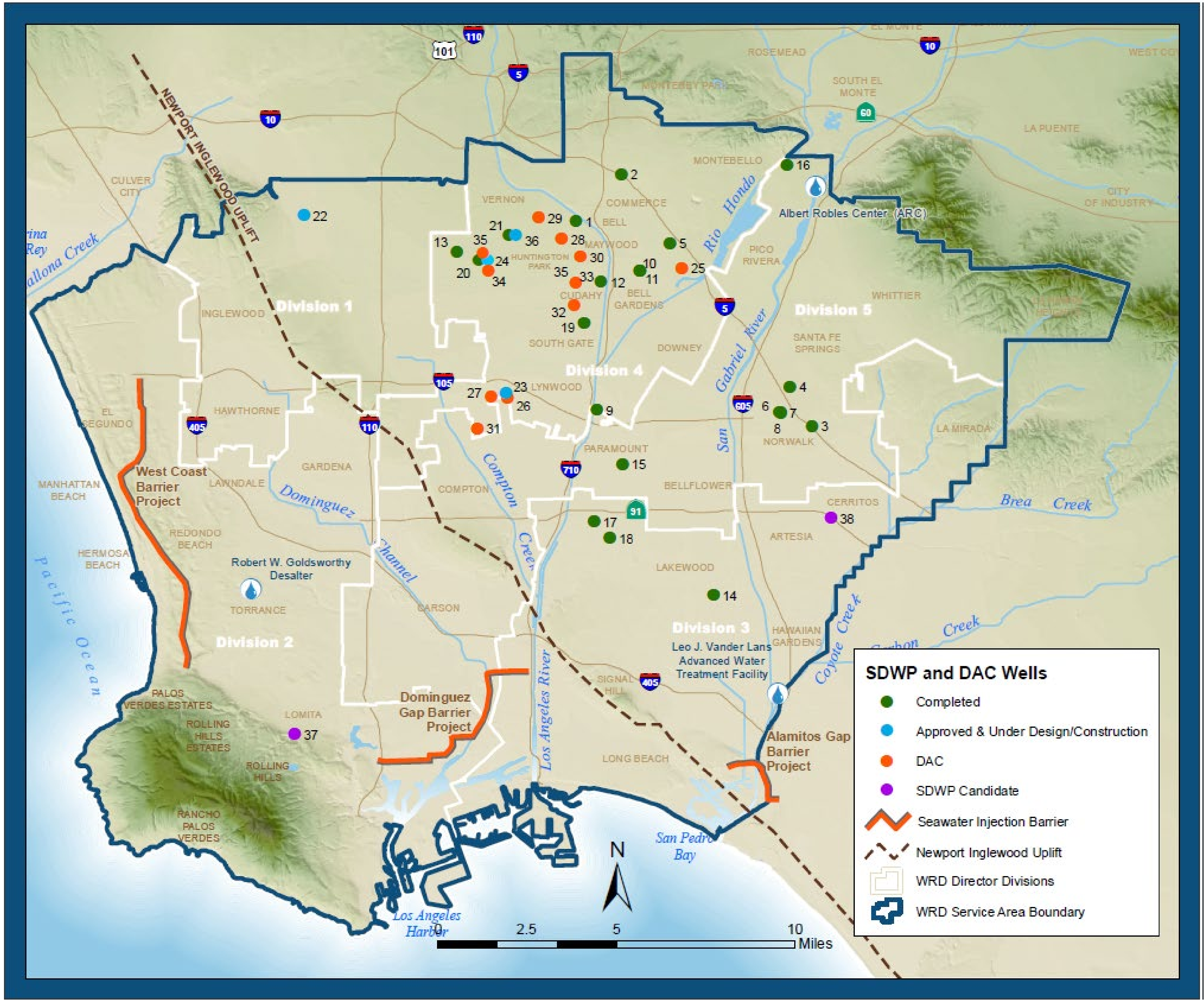
PFAS TREATMENT

The Safe Drinking Water Program provides grants for the removal of constituents such as PFAS. To date, there are three widely applied technologies for PFAS removal: Granular Activated Carbon, (GAC), Ion Exchange (IX), and Membrane Filtration (Nanofiltration and/or Reverse Osmosis).

Through the Safe Drinking Water DAC Program, WRD will provide assistance to water systems serving disadvantaged communities with applying for State funding for PFAS removal.

"Improve Water Quality"

For more information about the WRD Safe Drinking Water & DAC Program, contact Charlene King, Program Manager.



WATER INDEPENDENCE NOW

WRD
WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

ALBERT ROBLES CENTER
WATER RECYCLING & ENVIRONMENTAL LEARNING

THANK YOU

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