

How Ion Exchange Shoehorns PFAS Treatment into a Tight Site

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Jacobs

Challenging today.
Reinventing tomorrow.



Agenda



What are PFAS?



PFAS Regulations



Project Background



Treatment Alternatives



System Design



Lessons Learned

What Are PFAS?

- Man-made compounds since the 1940s
- Large family of compounds
 - Not dealing with one specific chemical
 - Different chemical characteristics
- Properties which make these compounds useful also result in their persistence in the environment



firefighting foam



paints and stains



stain-resistant carpets



water-repelling fabrics



nonstick cookware



food packaging

PFAS Were Used in a Variety of Everyday Items



Carpets



Non-stick cookware



Cosmetics



Food packaging



Furnishings



Carpets cleaning products



Clothing



Adhesives and sealants



Protective coating



Outdoor gear



Carseats



Firefighting foam

Federal Regulatory Timeline

2009

EPA health advisory
PFOA 400 ng/L
PFOS 200 ng/L

2013-2015

Water utilities perform testing of water supplies as part of UCMR3 program

PFOS, PFOA, PFBS, PFHxS, PFHpA, and PFNA

2016

EPA health advisory for 70 ppt PFOA, PFOS

2020

EPA Council on PFAS created

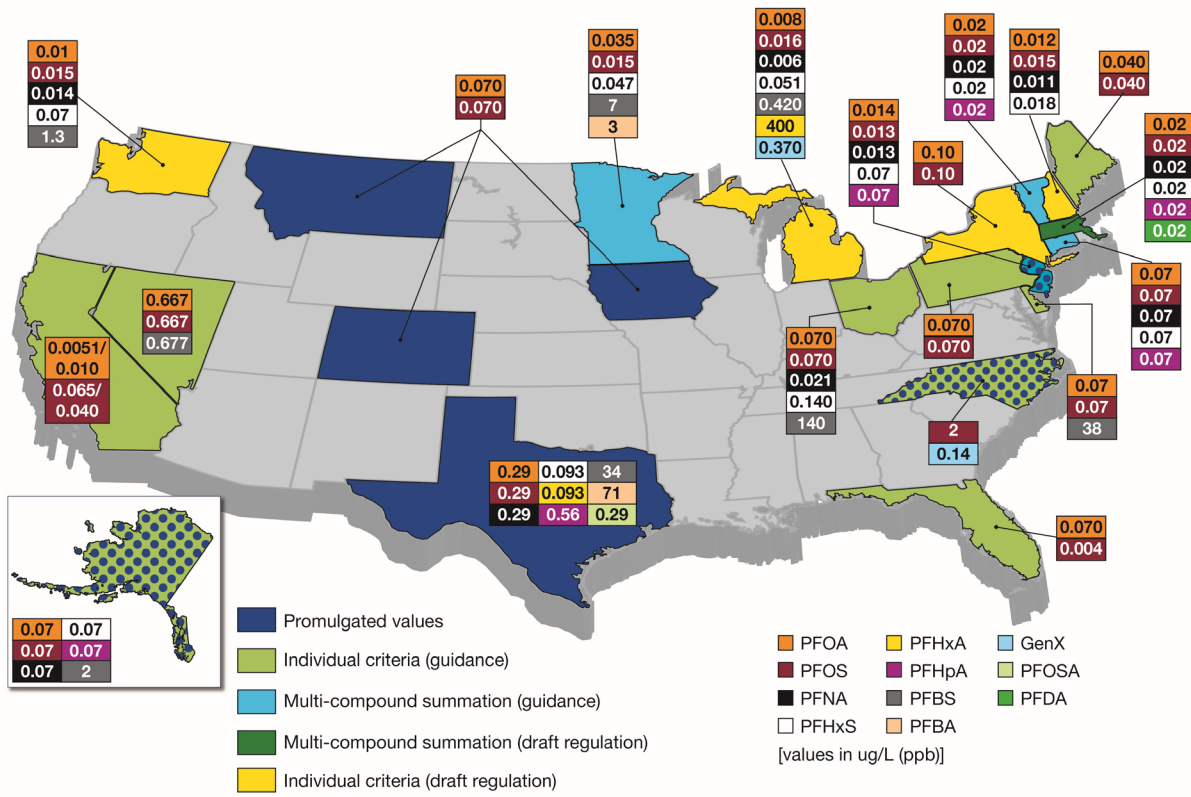
2021-2024

EPA PFAS Strategic Roadmap

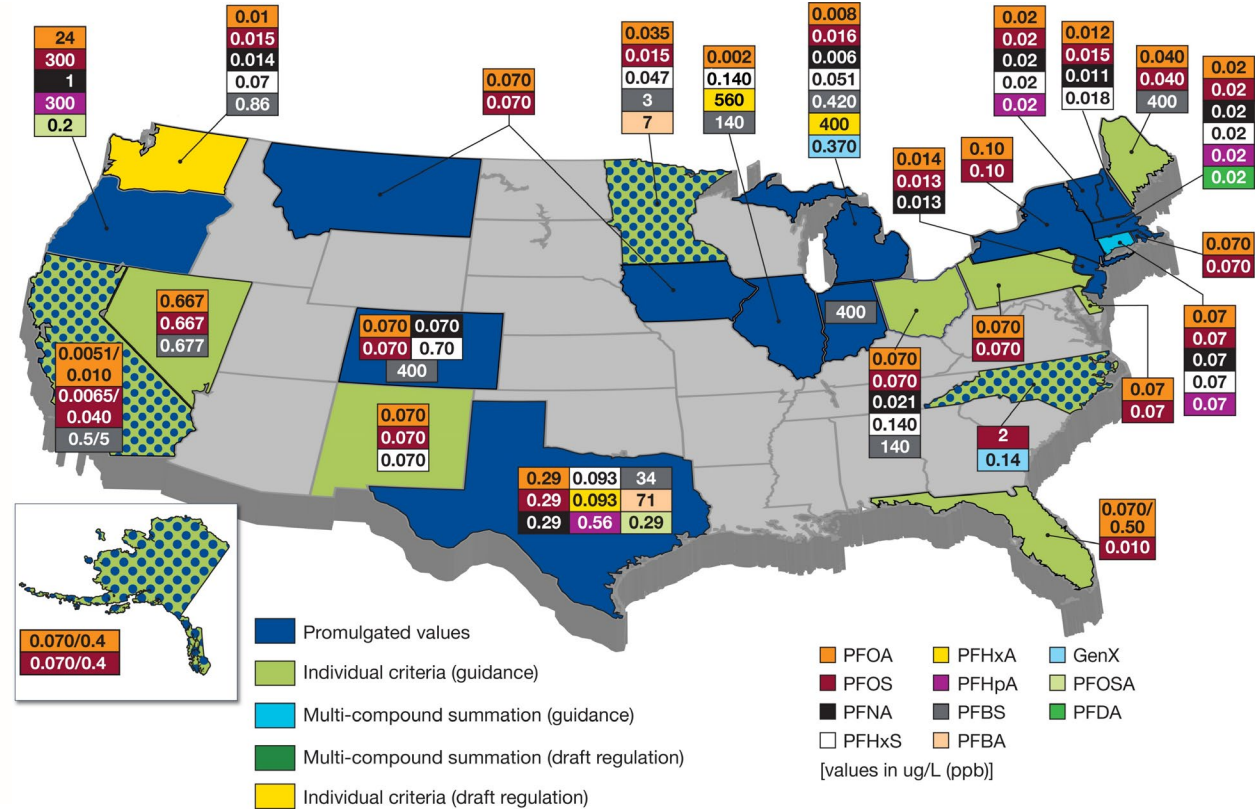
Establish national primary drinking water regulation for PFOA and PFOS

- Proposed Rule expected Fall 2022
- Final Rule expected Fall 2023

State Regulations Evolving



July 2020



vs

June 2021

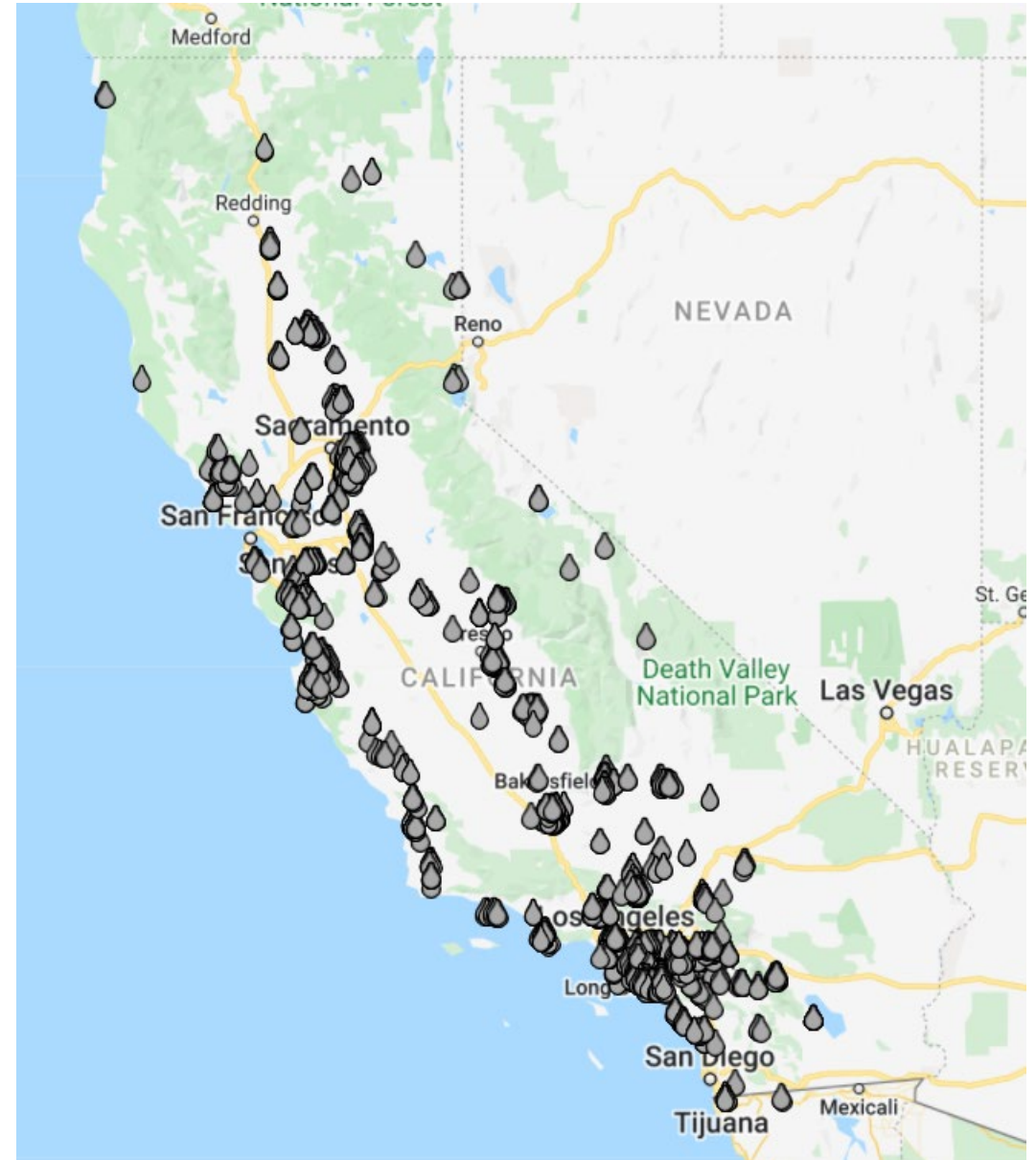
Current PFAS Regulations

Federal Regulation	EPA Health Advisory	Washington	Oregon	Idaho
In progress, estimated Fall 2023	70 ppt PFOA and PFOS individually or combined	State Action Levels for PFOA 10 ppt PFOS 15 ppt PFNA 9 ppt PFHxS 65 PFBS 345 ppt	Health Advisory Levels for PFOA 30 ppt PFOS 30 ppt PFNA 30 ppt PFHxS 30 ppt	None

California

- Community water systems that exceed response levels based on a running four quarter average for PFAS compounds must
 - Install treatment for PFAS removal
 - Notify customers of PFAS detections exceeding response levels, or
 - Remove the source from the drinking water supply

PFAS	Notification Level	Response Level
PFOA	5.1 ppt	10 ppt
PFOS	6.5 ppt	40 ppt
PFBS	500 ppt	5,000 ppt



Source: [GeoTracker PFAS Map](#)

California

Impact:

- Producers can turn off well and purchase imported water (~2x price)
- Add wellhead treatment

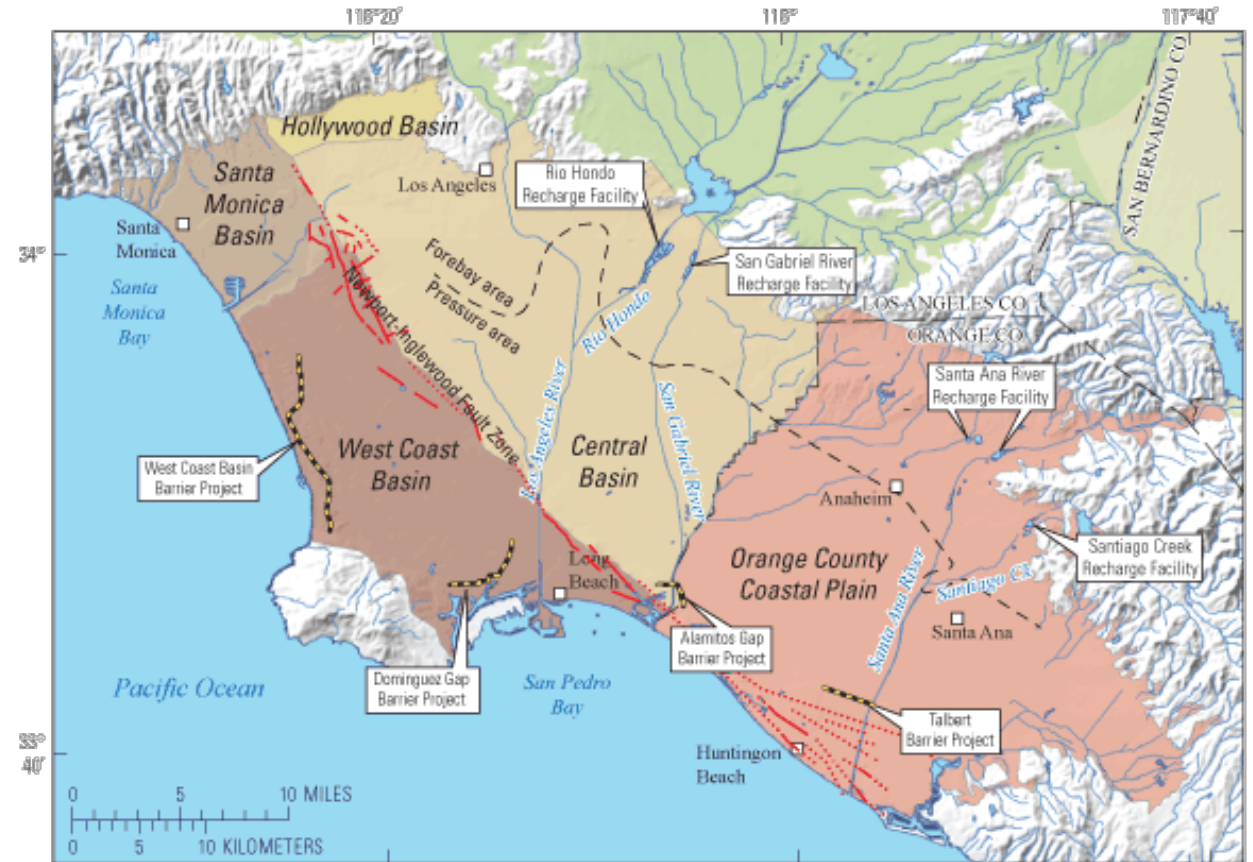
Challenges:

- Financial – Costs not fully budgeted
- Treatment – Limited space at wellsite
- Schedule and Implementation
- Public Relations



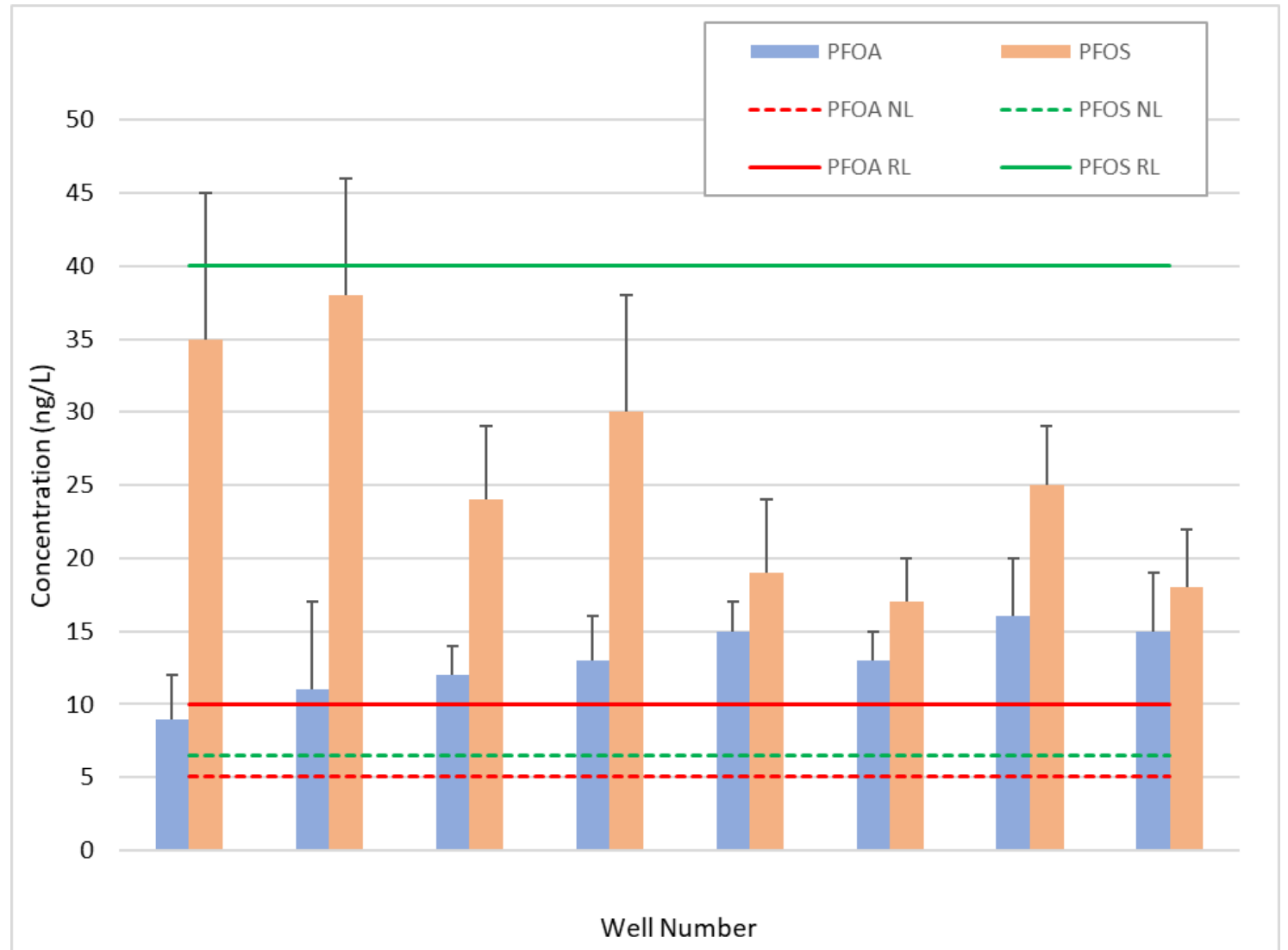
Case Study

- Confidential water provider in the Los Angeles water basin
 - Serves population 50,000+ people
- Existing water system
 - 8 active groundwater wells across 5 sites



Project Background

- PFOA & PFOS above the Notification Level in every well
- PFOA above Response Level in every well
- PFAS treatment to be installed for 4 sites to meet peak demands



Project Schedule



- Aggressive initial schedule resulting in concurrent project delivery paths
 - Process/media Rapid Small Scale Column Testing (RSSCT) evaluations
 - System hardware procurement – “Dual” Multi-Use Systems
 - Conceptual -> 65% -> 90% -> 100% Design
- Pause in Schedule due to funding limitations
 - Split construction contracts into 2 phases
 - Phase 1 bid ranged from \$4,700,000 - \$6,000,000

Treatment Alternatives

Granular Activated Carbon (GAC)

- Use adsorption to remove contaminants

Ion Exchange (IX)

- Resinmedia to exchange undesirable ions in water with ions on resin surface to remove contaminants

Membrane Separation (RO, NF)

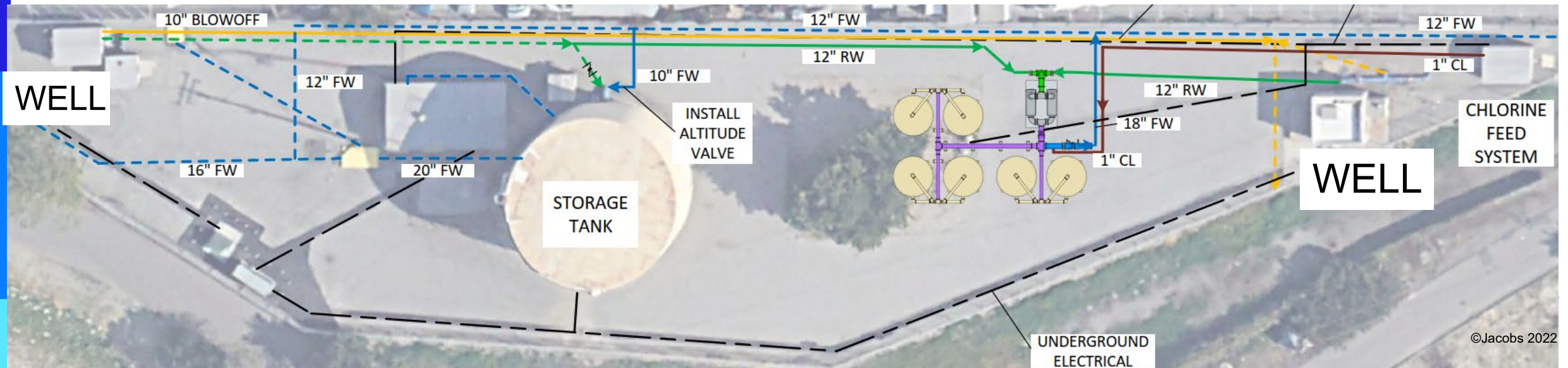
- Water forced through semi-permeable membranes to exclude contaminants

Treatment Alternatives

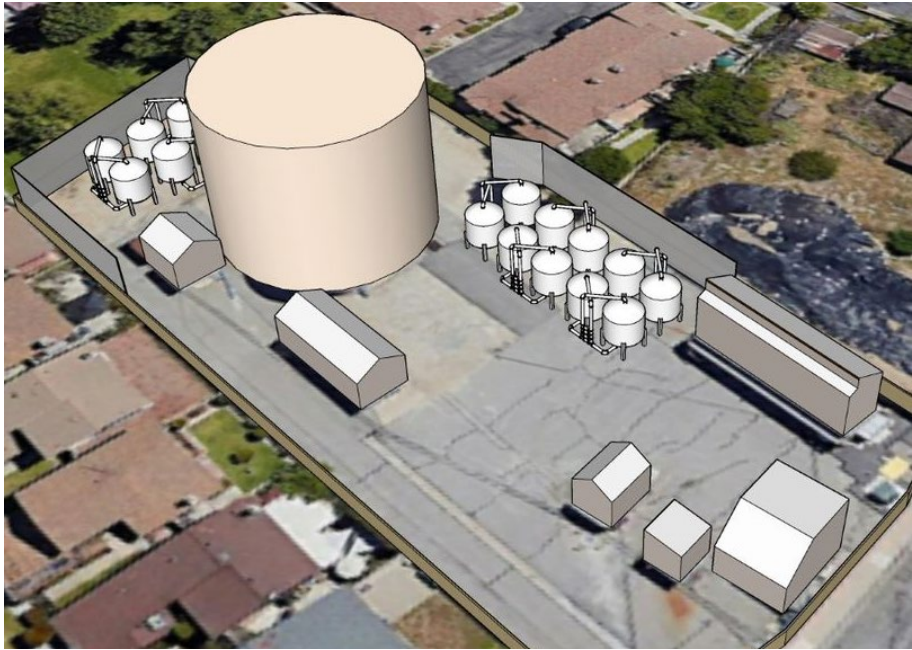
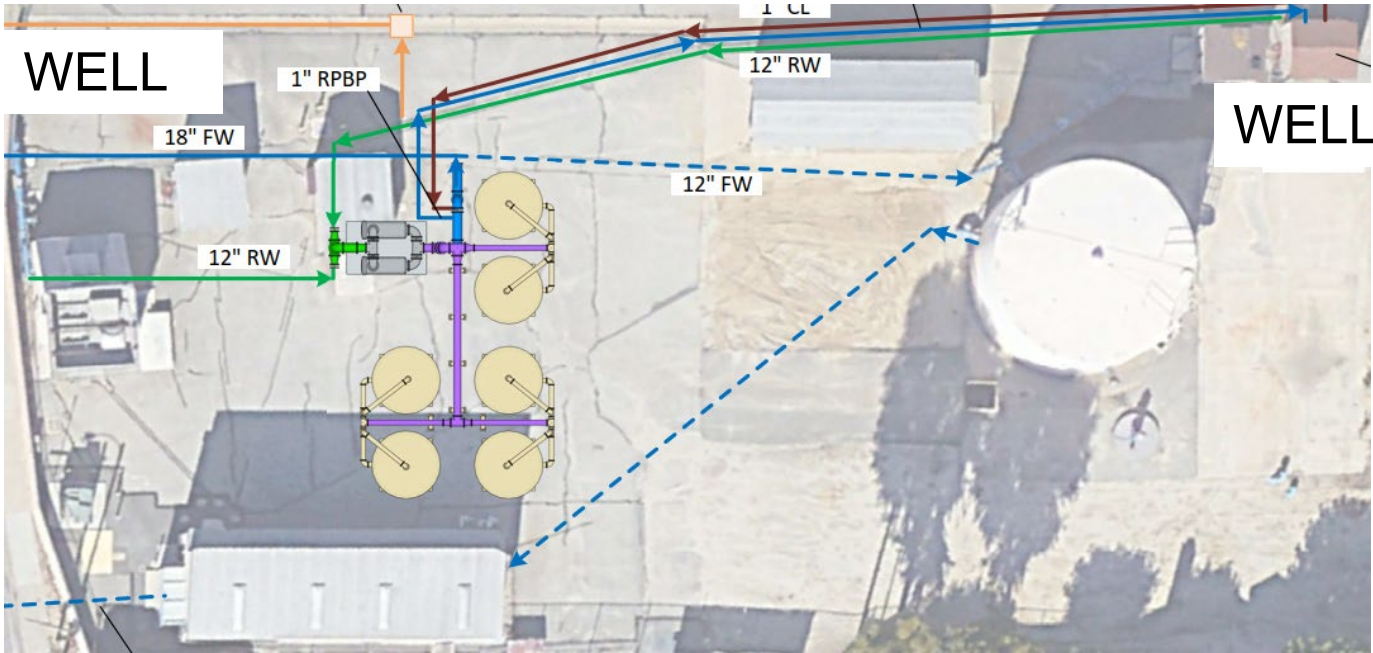
Treatment Alternative	GAC	IX	Membrane RO, NF
Pretreatment	Not required	Required	May be required
Process Feed Requirements	Low	Low	High
Cleaning, Regeneration, and Waste Disposal	Media may be reactivated and reused, or disposed of periodically	Media rinse may be required following resin replacement and will require disposal	Generates concentrated liquid waste stream that consumes significant treated water volumes and is difficult to dispose of
Footprint	Larger than IX footprint due to larger EBCT and SLR required with GAC	Smallest footprint	Moderate to large footprint
Process and Operational Complexity	Low	Low	High
Relative Capital Cost	Moderate	Lower	High
Relative O&M Costs	Low to moderate	Moderate	High

Conceptual Layout Examples

- Jacobs Replica Parametric design tool
 - Suite of digital twins solutions software
 - Software generates conceptual level designs
- Navigate various site constraints

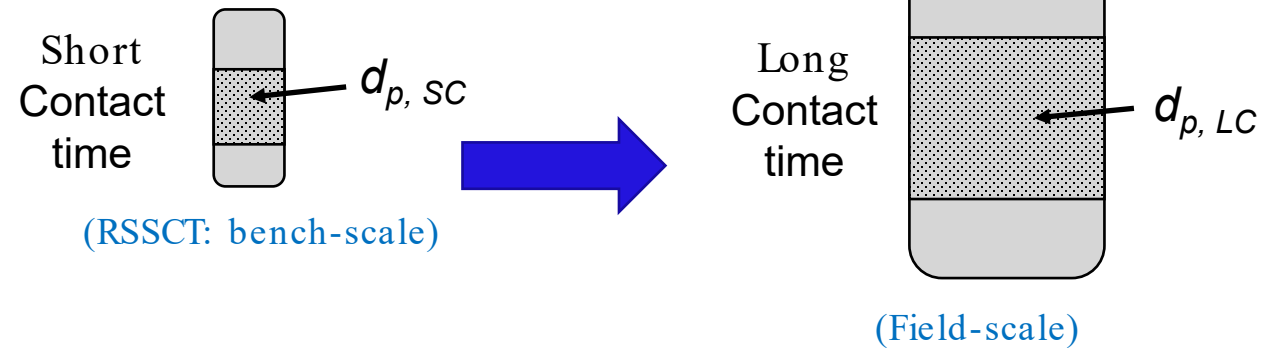
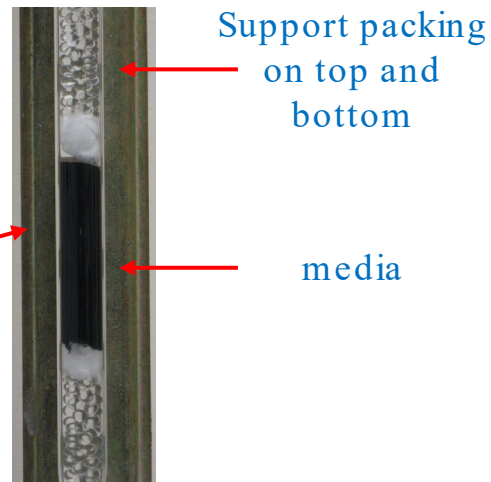


Conceptual Layout Examples – Site Constraints



What is an RSSCT? Why is it Important?

- Performed side by side comparison of various IX resins
- RSSCT testing to evaluate adsorbent performance with well water
 - Provide life cycle cost data
 - Valuable for comparative IX product performance



Rapid Small Scale Column Test (RSSCT)

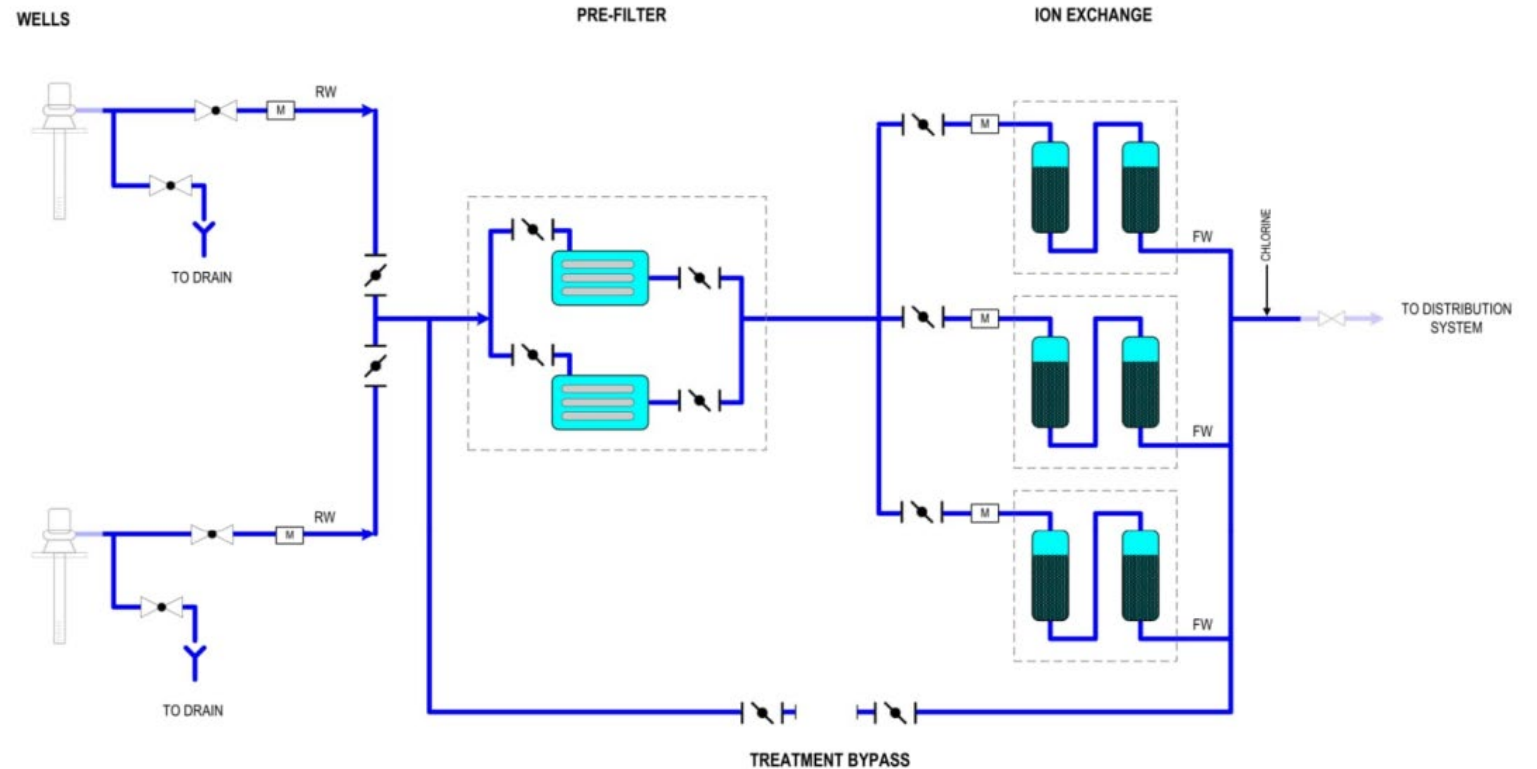
RSSC Testing

- Evoqua PSR2+
 - Gel resin
- Calgon CalRes 2301
 - Chlorine tolerant
 - Macroporous resin; more resistant to fouling
- Simulated lead-lag model for field-scale operations to predict full-scale performance and establish sampling and changeout thresholds



Process Flow Diagram

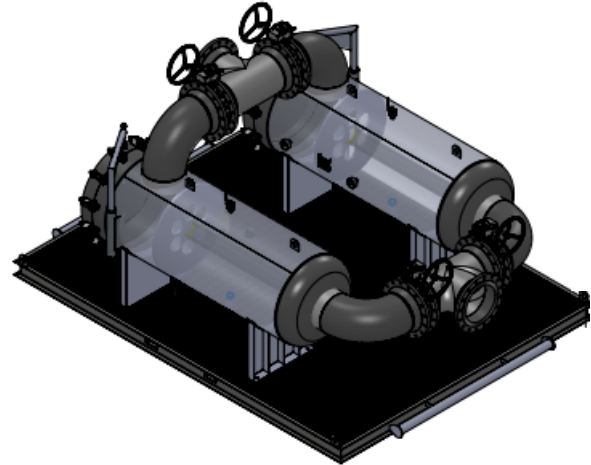
- Wellhead modifications
- Pre-Filtration
- IX Lead-lag system
- Maintain existing disinfection system



IX System Design Parameters

- Prefiltration

- 2 cartridge filters per site
- 19 filter cartridges per vessel
- 5 micron filter cartridge rating



- IX

- Design flow per vessel per site: 4,500 gpm
 - Three trains, two lead-lag vessels per train
- 2.11 minutes Empty Bed Contact Time
- 13.3 gpm/sf Surface Loading Rate
- Target PFOA, PFOS concentration <2 (non-detect)



Example of Initial Start -Up

Sampling Location	Constituent
Pre-Filter Influent	PFAS Chloride, Total Sulfate as SO4 Nitrate as N Alkalinity as CaCO3 Bac-T Total Organic Carbon Total Dissolved Solids
IX Lead Vessel Effluent	PFAS
IX Rinse Water	PFAS Bac-T Nitrosamine
IX Combined Effluent	PFAS Bac-T Nitrosamines

vs Routine Monitoring

Sampling Location	Constituent
Pre-Filter Influent	Bac-T
	PFAS
IX Train Lead Vessel Effluent	PFAS
IX Train Vessel Effluent	PFAS
IX Combined Effluent (Compliance Sampling Point)	Bac-T
	PFAS
Finished Water	Chlorine Residual
	Bac-T

Lessons Learned

- Supply chain concerns
 - Valves longer lead time than piping
 - AIS products were 2-6 weeks longer than non-AIS products
- Prepurchased
 - Pre-filters, IX vessels, IX resin, Butterfly valves
- Coordination with regulatory agencies
 - PFAS is a new topic
 - Regular communication to minimize surprises in design process
 - Provide sufficient time to review



Questions?

Thank you

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