

A Streamlined Approach for Adsorptive Media Bench Testing

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How is adsorptive media pilot and bench testing helpful?

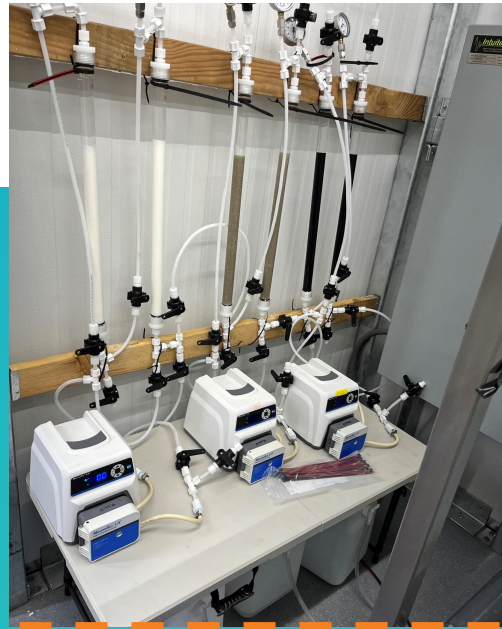
**Media selection, performance,
location, life**

Pilot-scale

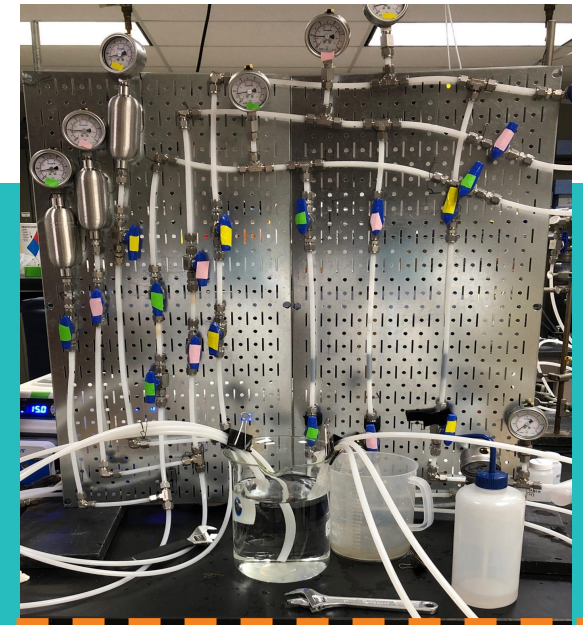


Bench-scale
testing

Column tests



Rapid small-scale



What media to select?
What test type to select?
How is adsorptive media pilot and bench testing helpful?

Is pretreatment required?
Is spiking required?
When do I need data?

Media selection, performance, location, life

System run time?

Onsite maintenance available?

Water volume required for testing?

Time to exhaust the media?

Media susceptibility to constituents in the feed water?

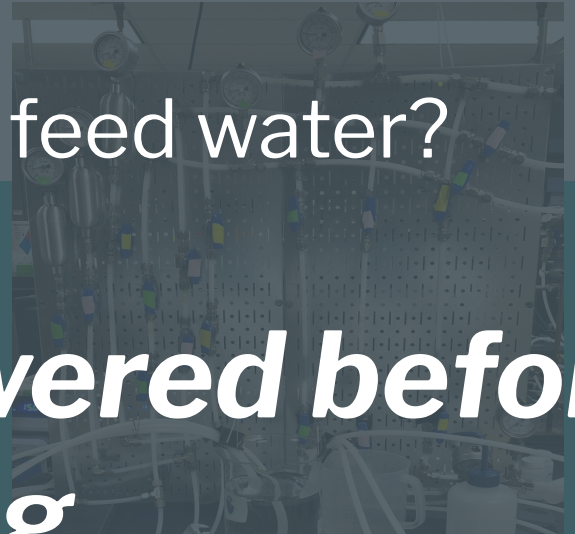
Pilot-scale



Bench-scale testing



Rapid small-scale

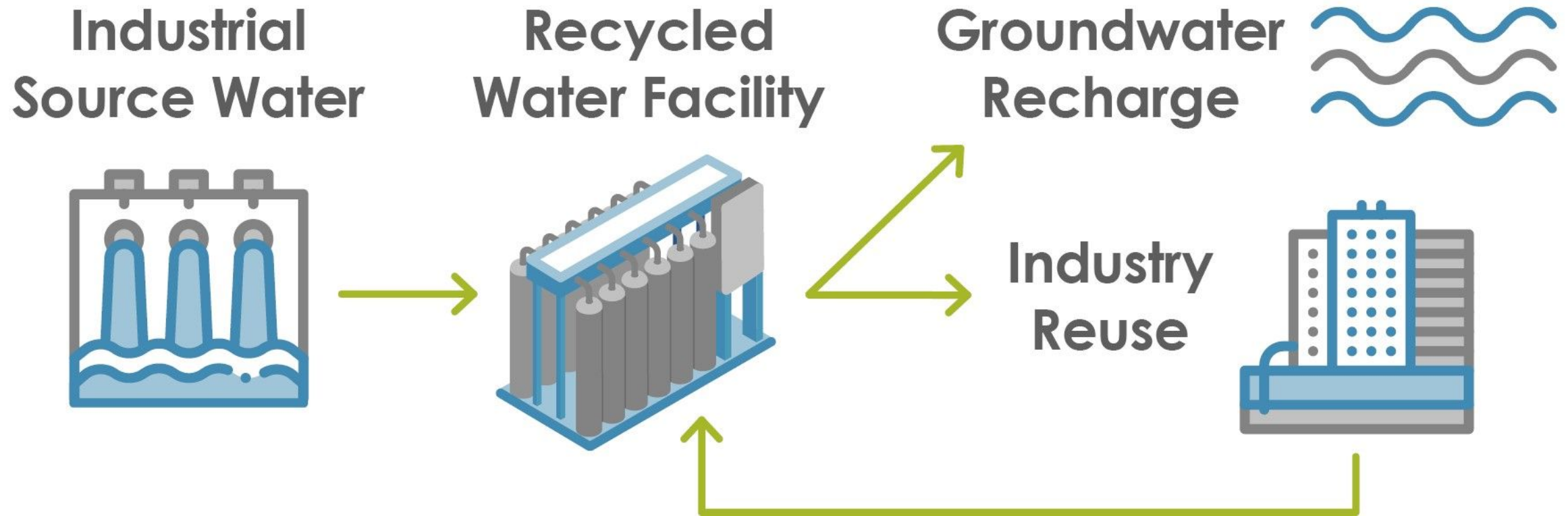


Many questions need to be answered before starting media testing

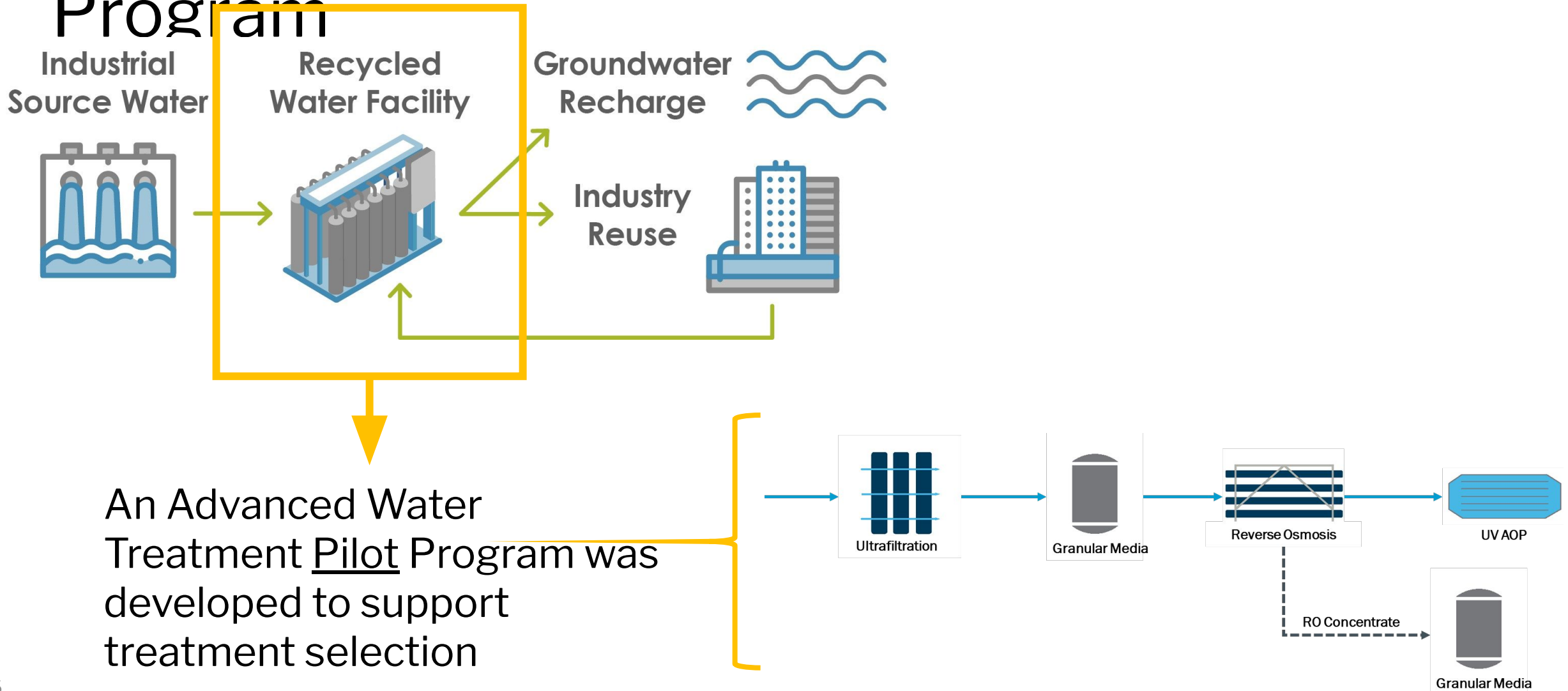
Case study: adsorptive media testing for City of Boise's Advance Water Treatment Pilot



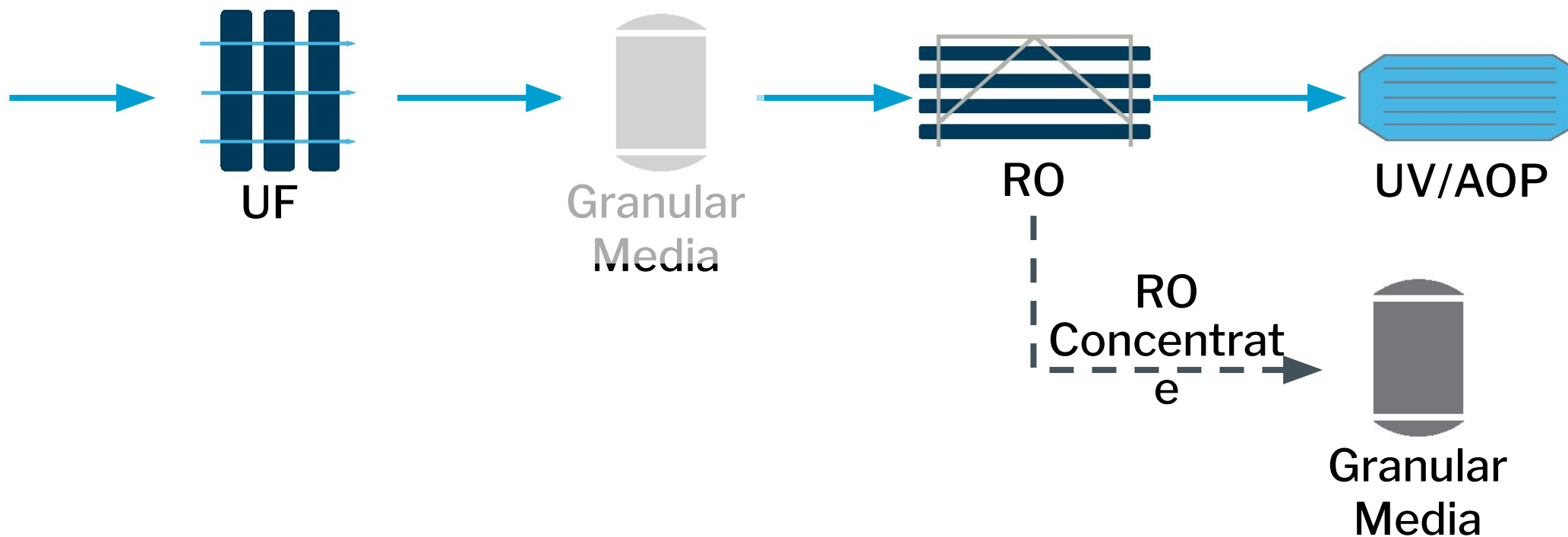
The City of Boise's the Recycled Water Program



The City of Boise's the Recycled Water Program



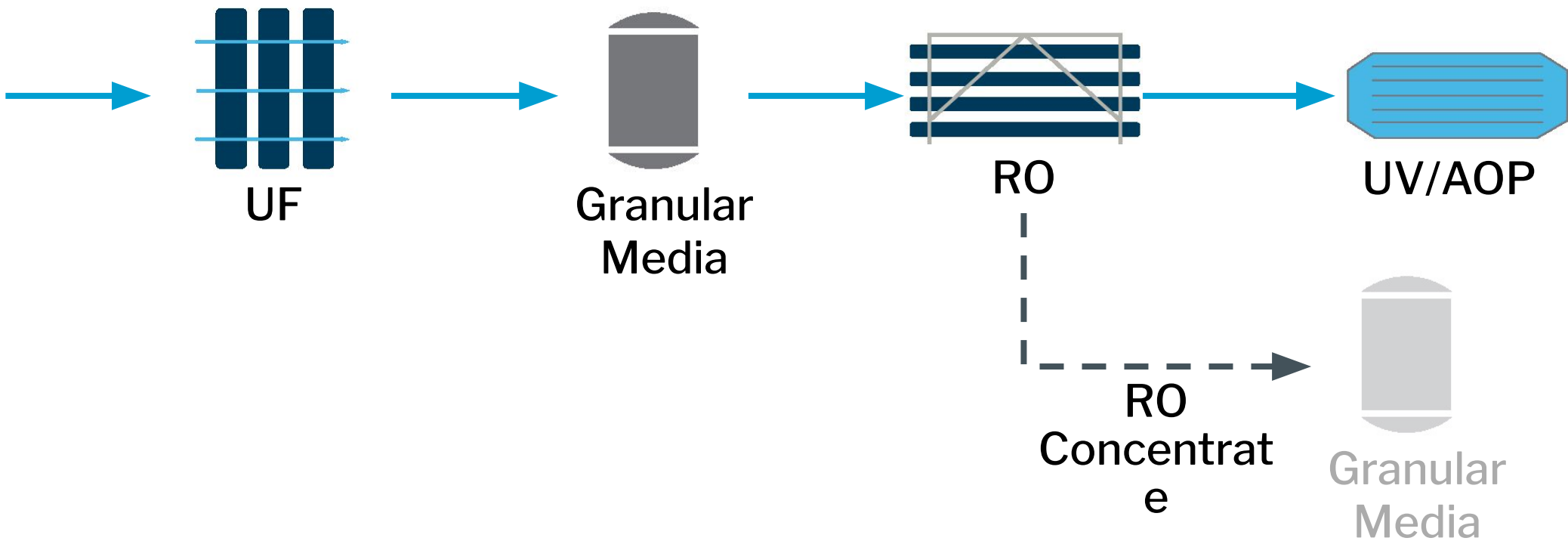
Piloting was performed in two phases



Phase 1: Remove constituents in concentrate stream

Piloting was performed in two phases

Phase 2: Remove PFAS before RO system



Objectives for adsorptive media testing

1. Remove PFAS before RO to keep it out of the ROC
2. Remove PFAS from the ROC



Limitations for pilot media contactors...

Only 1 media type

Only 1 treatment stream

Long test time (> 60 d)

Intermittent flow (evening and weekend shutdowns)



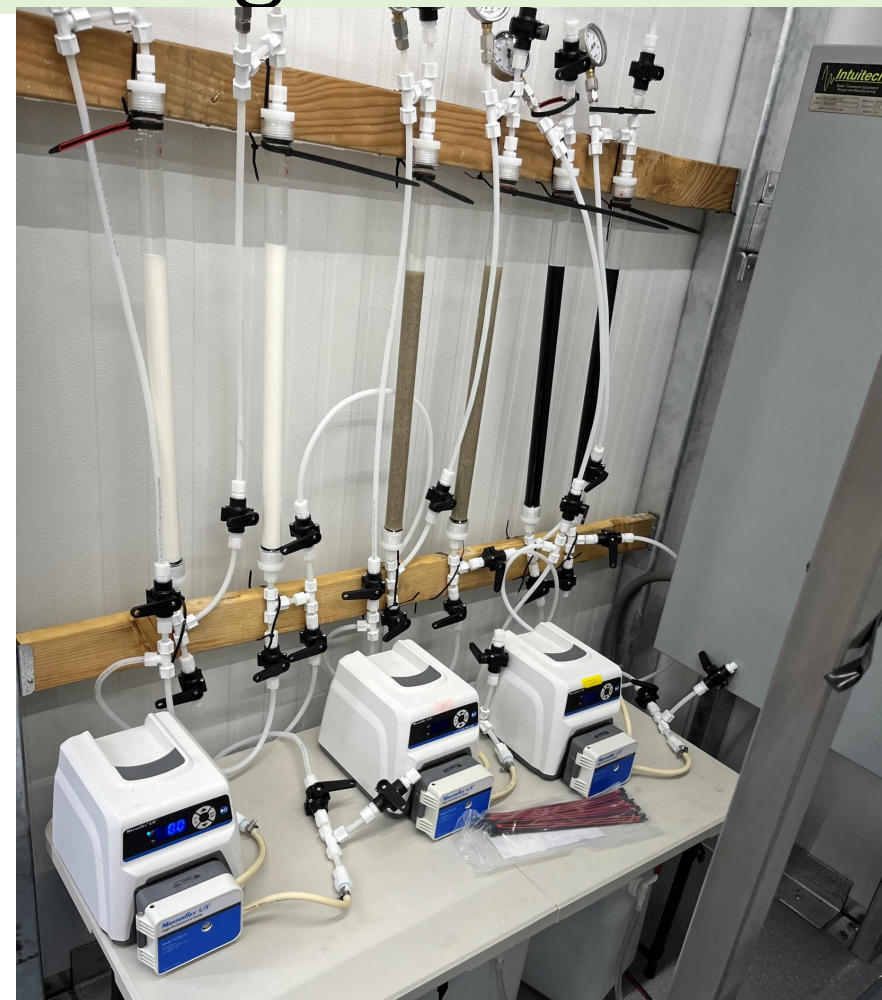
...lead us to bench-scale media testing

Evaluate multiple media

Evaluate multiple streams

More bed volumes (> 60 days run time in same period)

Not impacted by intermittent flow



Approach for selecting bench-scale adsorptive media tests



Comparing bench-scale adsorptive media tests

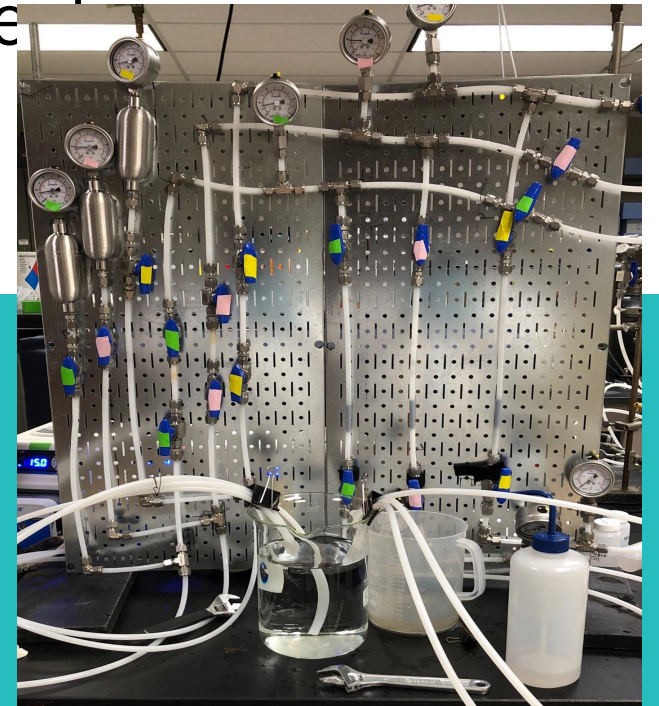
Onsite bench-scale column tests

- Larger diameter columns
- Normal (unground) media
- Long operational time (>100 d)
 - long test

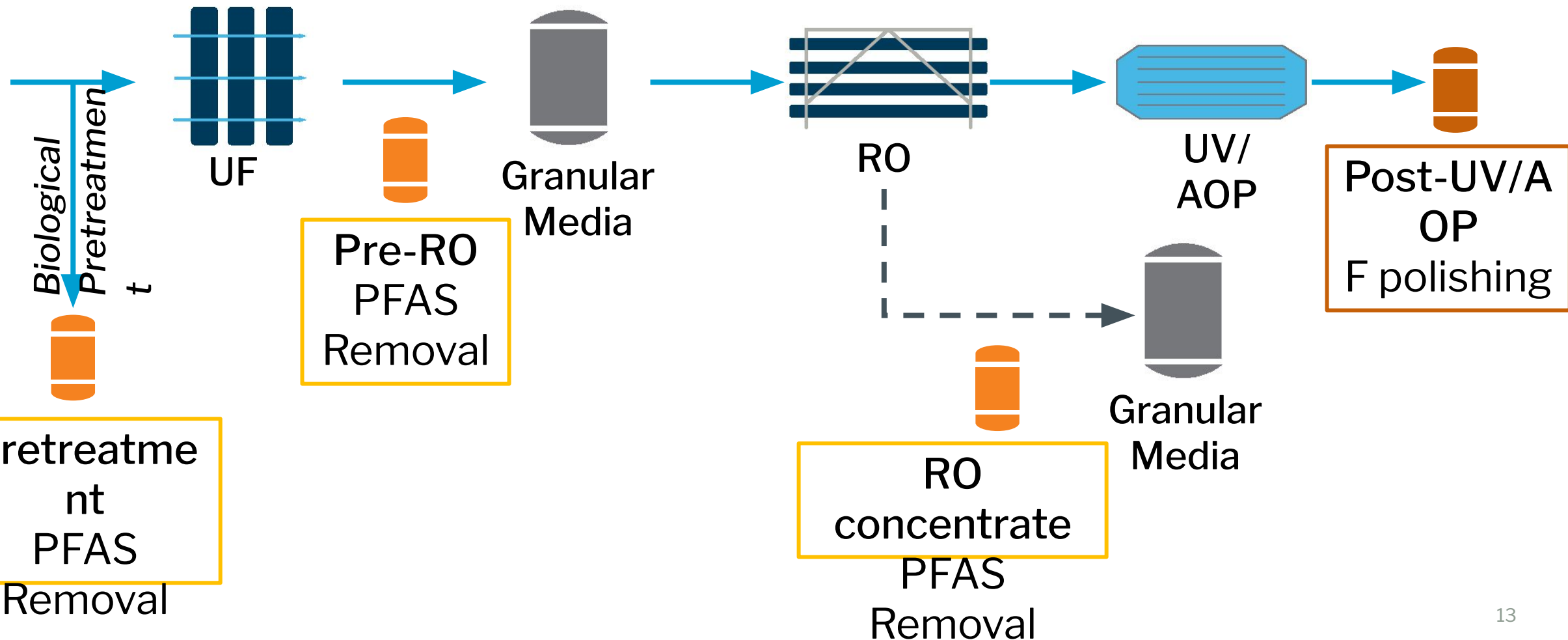


Rapid small-scale tests

- Smaller diameter columns
- Grind media and pack into small columns
- Longer operational time (>100 d)
 - shorter test






We used bench tests to look at sorptive treatment in many locations






Approach to select bench-scale test type

Test method	Test duration?	Able to spike?	Simulation of operational time	Translation to full-scale?		Can evaluate multiple locations
				Exhaust Media?	Feed water quality	
Onsite bench columns	Months to a year	No (not practical)	~ 100 days	No (not typically)	Variable water quality	Good
RSSCT	Weeks	Yes	Up to 250 days	Yes	Snapshot in time	Better

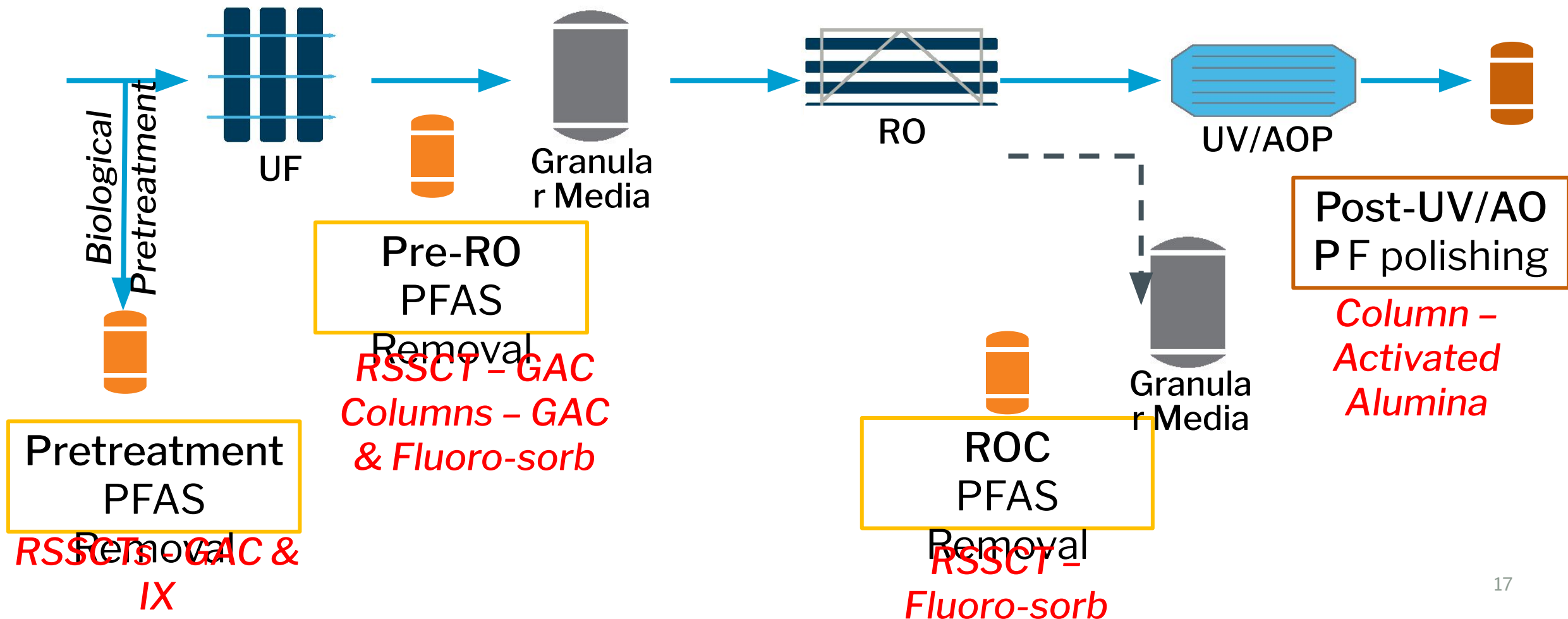
Feed water quality considerations for media selection

Media	Susceptibility to organic matter loading	Susceptibility to dissolved solids loading	Susceptibility to biofouling
Ion Exchange (CalRes™ 2301) 	Higher	Higher	Higher
GAC (F400) 	Higher	Lower	Moderate
Fluoro-sorb 	Lower	Lower	Lower

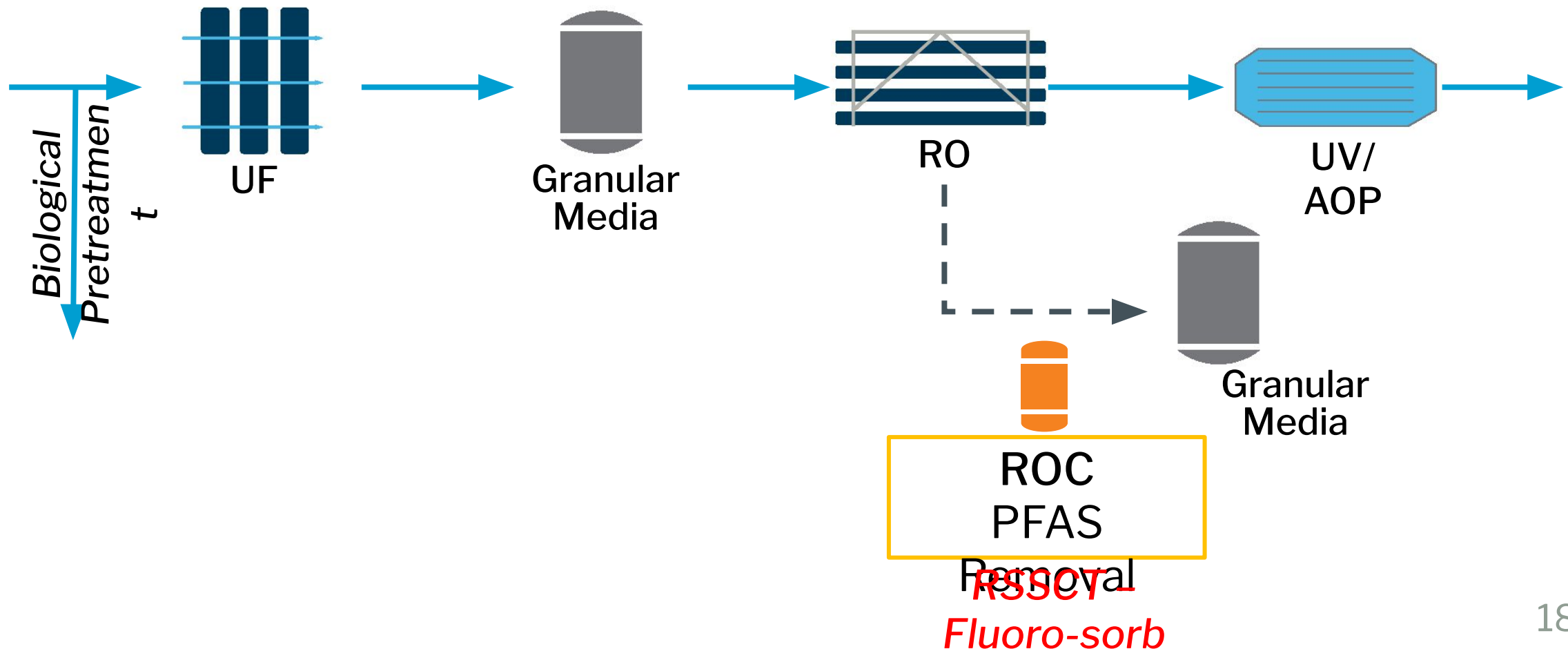
Additional considerations for media selection

Media		Footprint	Bed Volumes Capacity
Ion Exchange		Small	High
GAC		Large	Moderate
Fluoro-sorb		Small	Moderate/High

Selected adsorptive media tests to evaluate treatment performance



We started with evaluating PFAS removal at the reverse osmosis concentrate stream (post-RO)



Treating the ROC in the pilot was hard, with RSSCT testing it proved impossible

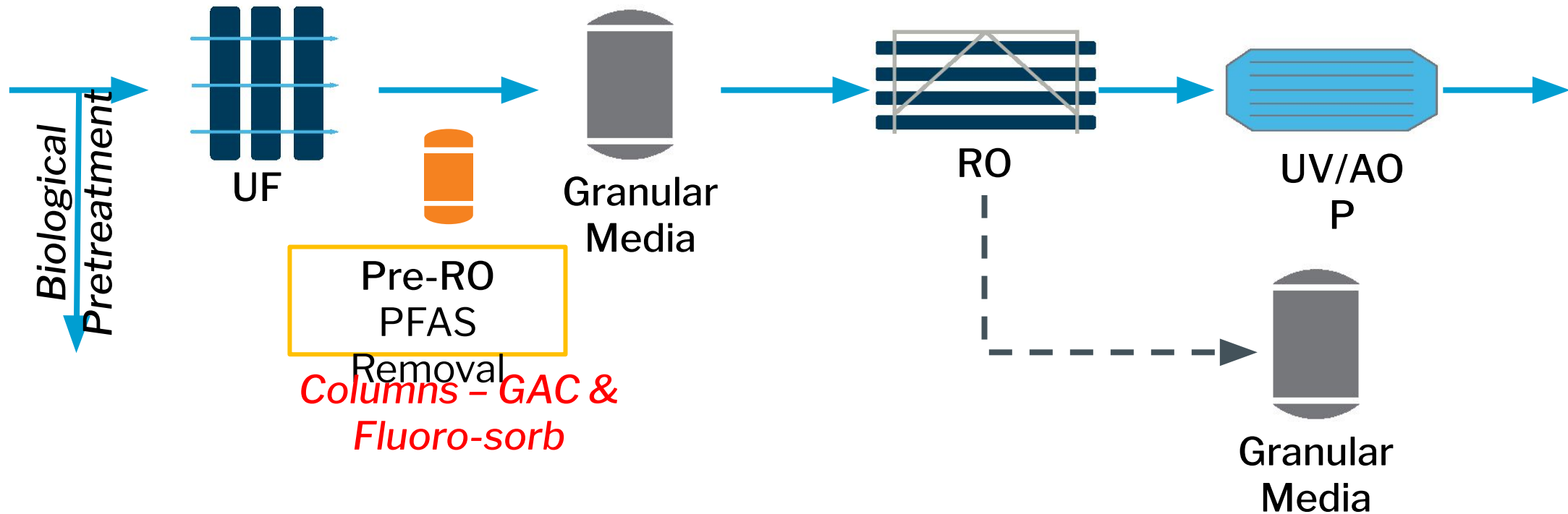


Pressure
increase
(>50 psi)

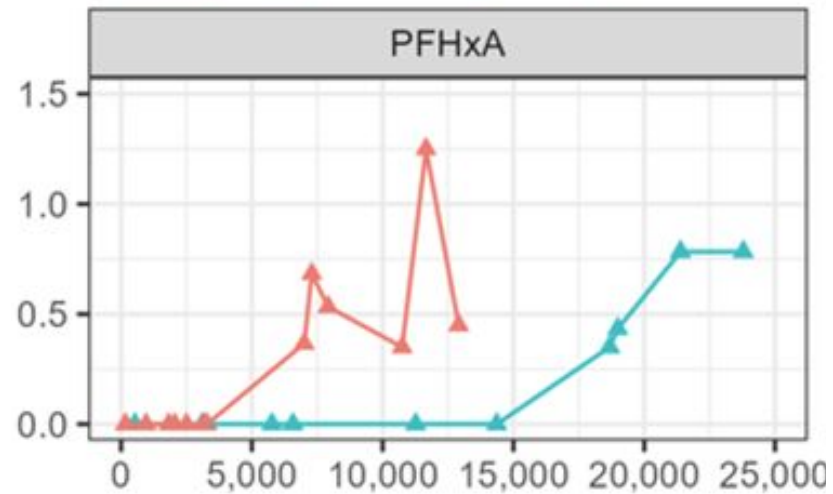


Pre-filter
issues with
clogged feed
line and
misplacement

Onsite columns looking at pre-RO treatment were more successful, but still challenging

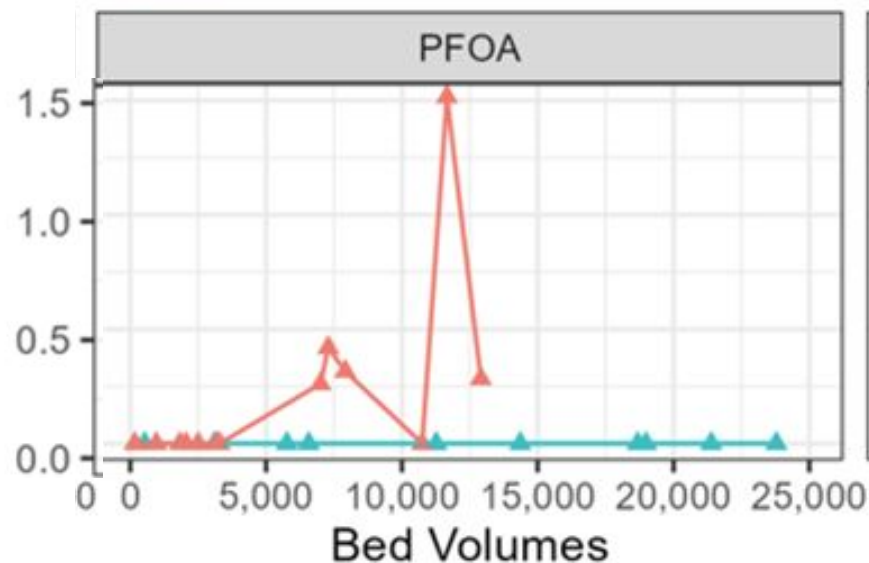


Onsite column test results for selected PFAS



Fluorosorb @UFE (Bench)

GAC @UFE (Bench)



Takeaways:

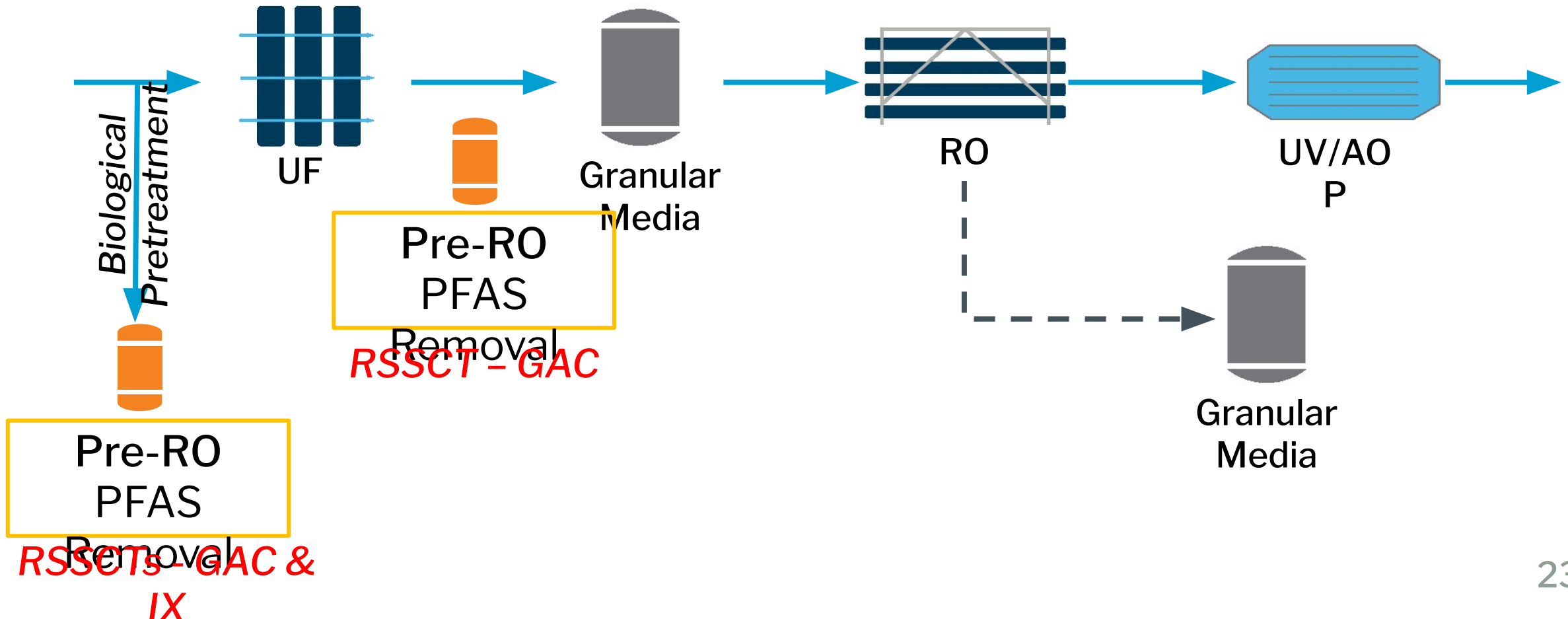
- Fluoro-sorb was significantly better at removal of PFAS over 25,000 bed volumes
- TOC removal was low
- Challenges with operating GAC columns believed to have negatively impacted performance



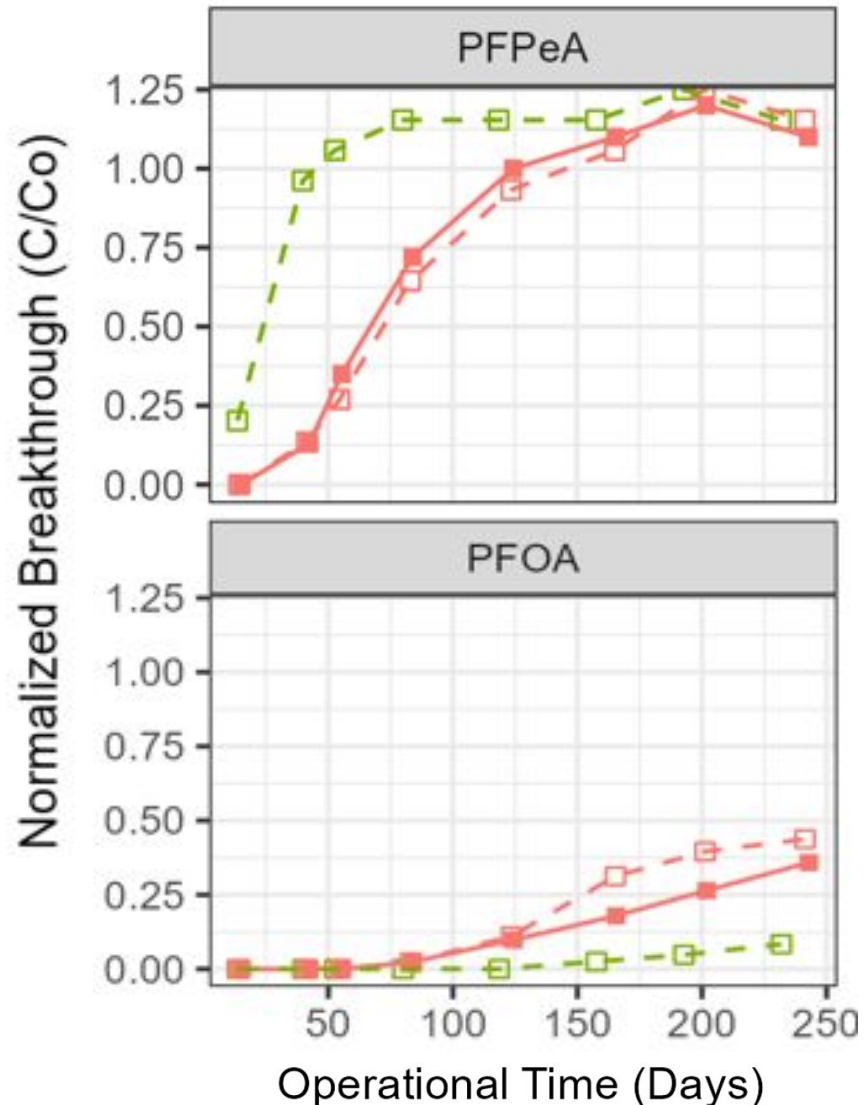
Onsite bench column operational challenges

- Column channeling and “pockets”
- Backwashing challenges with Fluoro-sorb smaller particle size
- Maintaining reservoir feed added to the task list

Rapid small-scale tests were used to evaluate pre-treatment and media type on PFAS removal



RSSCT results for selected PFAS – Pre-RO

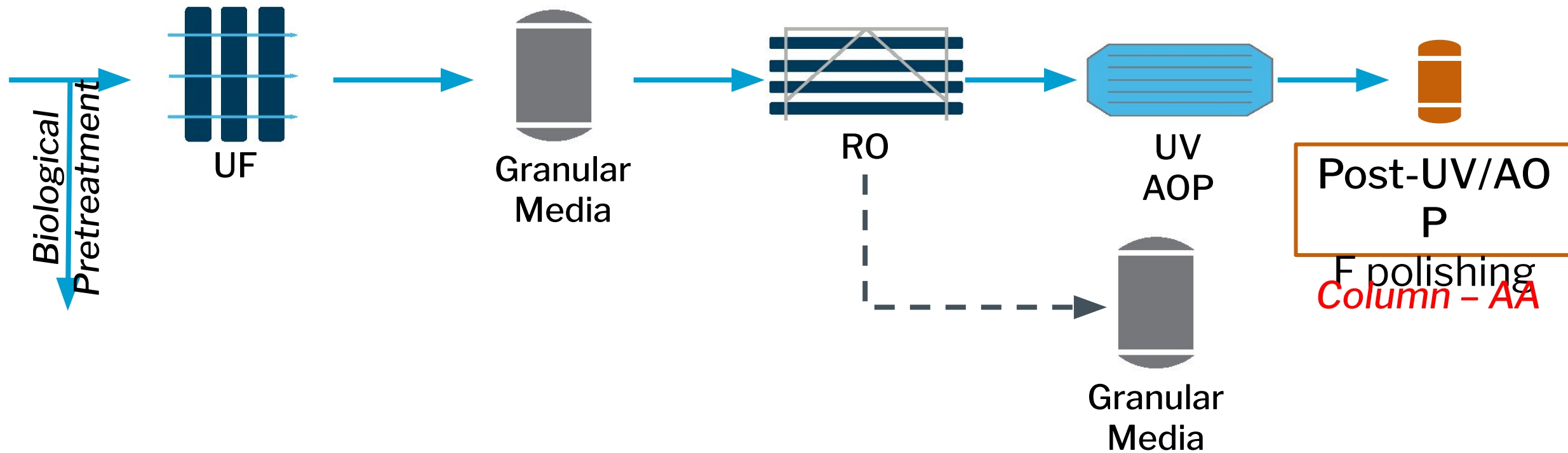


- GAC – biological reactor
- GAC – UF effluent
- IX – biological reactor effluent

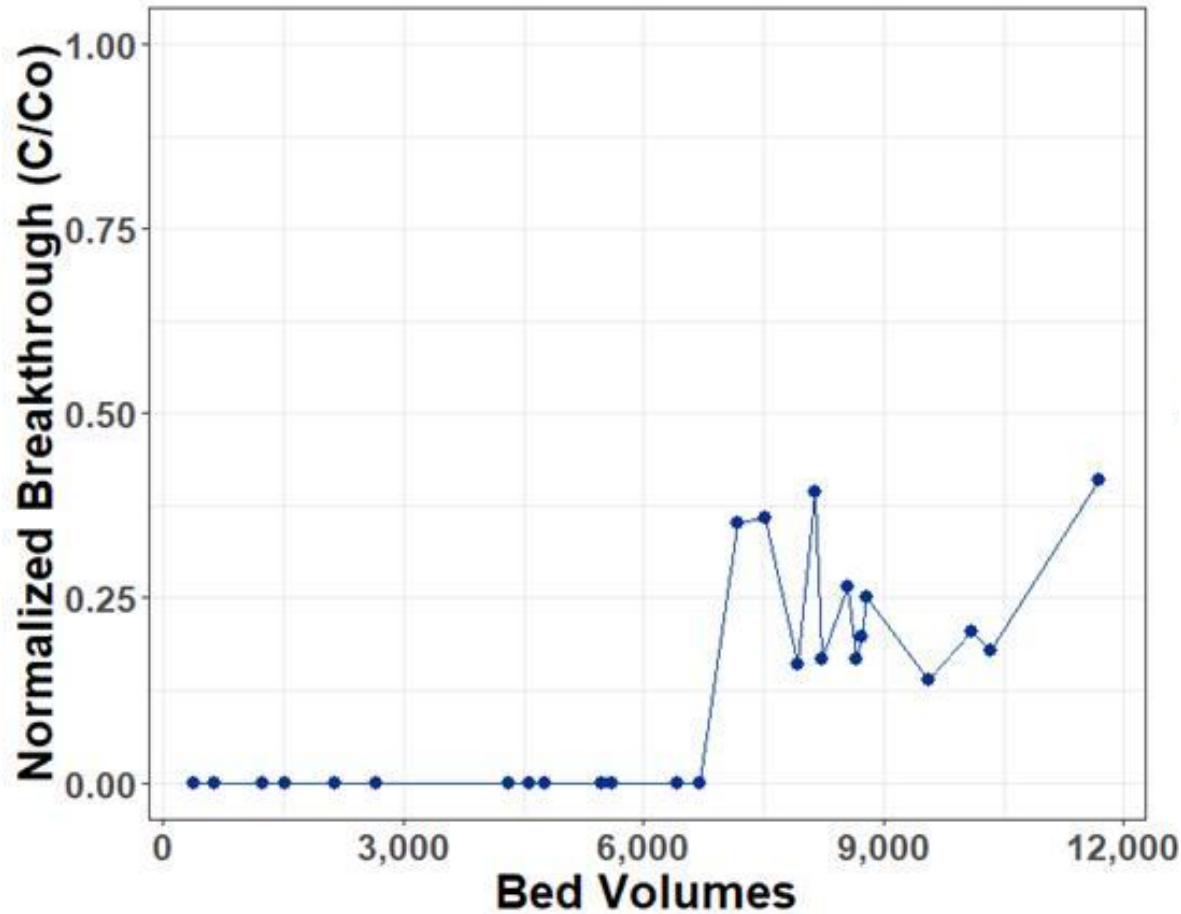
Takeaways:

- Little difference w/biotreatment
- IX was better than GAC for regulated PFAS (PFOA, PFOS, PFNA, PFHxS, and PFBS)
- GAC was better for shorter-chain unreg'l PFAS (PFPeA, PFHxA, PFHpA, PFMPA)

An onsite activated alumina column was used to evaluate fluoride polishing



Onsite column tests for AA on ROP were much easier



Takeaways:

- Reduced fluoride to non-detect for >7,000 BVs before regeneration (this is good!)
- Quenched residual hydrogen peroxide from UV-AOP

Summary of applied approach and lessons learned



Considerations when selecting bench-scale media testing

Column vs RSSCT

- Treatment goal (how will you use the data?)
- Feed water prep needs
 - Spiking required?
 - Pretreatment (filtration) required?
- Available Time

Media Selection

- Feed water quality
 - Organic carbon
 - Total dissolved solids
 - Inorganic constituents
- Target constituents (e.g., PFAS, TOC, fluoride, other)

Field Operational Considerations

- Tending the columns
 - Tweaking valves
 - Trouble shooting
 - Line clogging
 - Col'n conditioning/flushing
- Feed water flow and required tankage

Acknowledgements



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Brandon
Pechin

BC Contributors



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Daniel
Wolgemuth



Sydney
Vinge

(and many more!)

Thank you.

Questions?

Brown AND **Caldwell** :



