PNWS-AWWA | Spring Conference

Treatment Train Selection and Pilot Testing for Aquifer Storage and Recovery (ASR)

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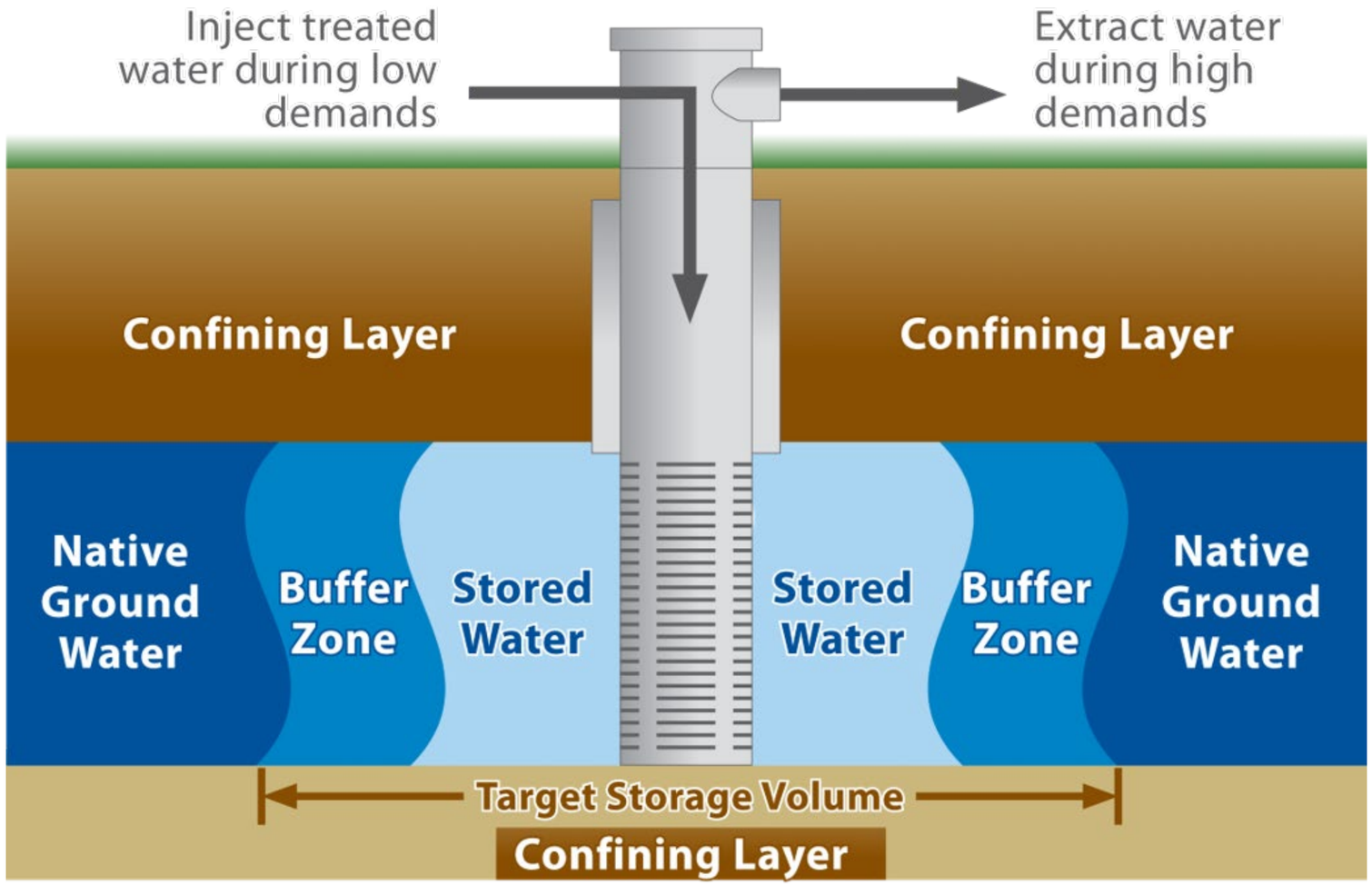
AGENDA

1. Background/Water Source Comparison
2. Surface Water Pilot Implementation
3. Surface Water Pilot Results
4. Surface Water Pilot Next Steps
5. Stormwater Treatment Train Selection
6. Stormwater Results
7. Stormwater Next Steps
8. Q & A

Background

Project Background

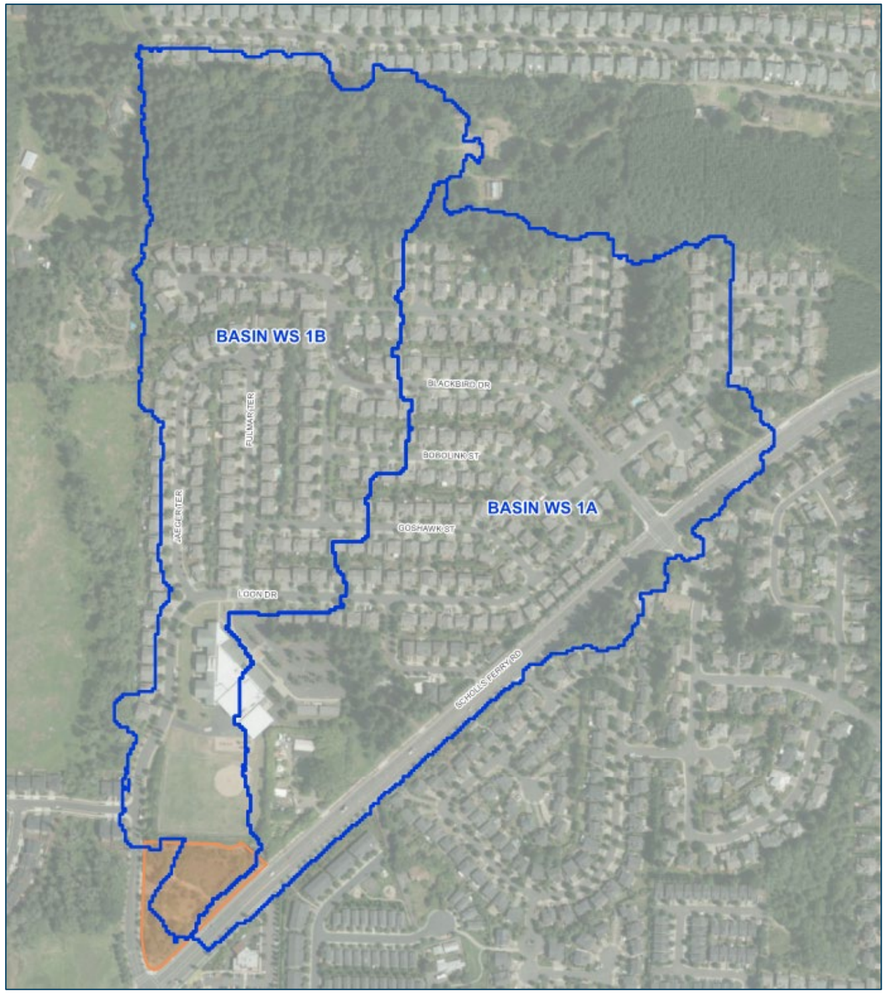
- ASR injection using two different sources
  - ✓ Columbia River Irrigation Water
  - ✓ Stormwater
- Subconsultant for treatment selection/startup



Project Locations

ASR Phase 2 Pilot, Othello, WA

Sterling Park ASR Pilot, Beaverton, OR



Water Source Comparison

Surface Water (Columbia River)	Storm Water
Well documented water quality	Unknown water quality
Moderate to low turbidity	Highly variable turbidity
Low inorganics	Moderate to high inorganics
No emerging contaminants	Emerging contaminant concerns (PFAS, pesticides, etc.)
Low TOC	Moderate to high TOC

Surface Water Pilot Background

- **Location:** Othello, WA
- **Pilot treatment for ASR Injection**
- **Pilot size:** 1 MGD (source water dependent)
- **Project goals:** Treat 500 acre-ft in six months for demonstration
- Industrial growth triggered water resources concerns

Project Background

Pilot Unit

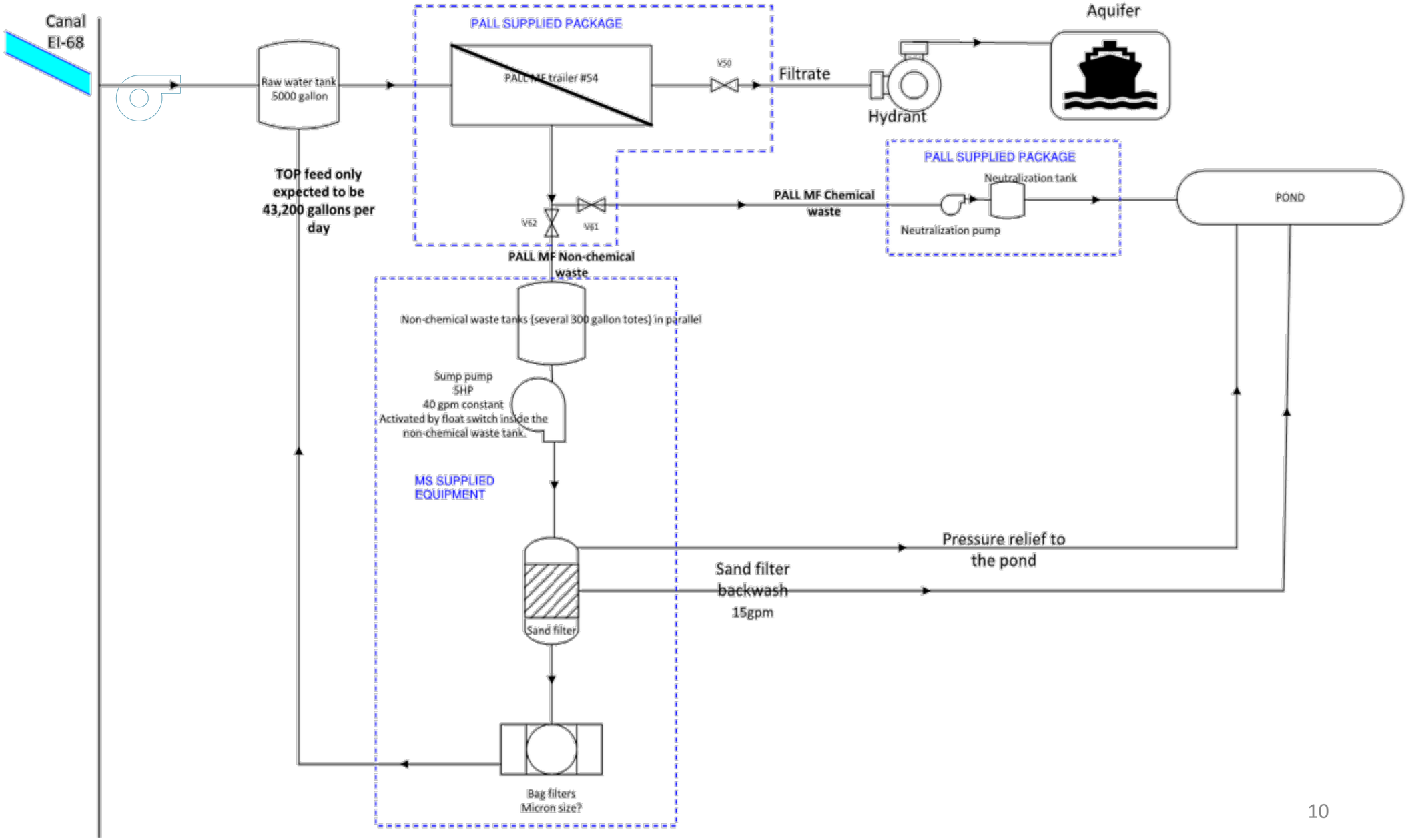
- Pall MF/UF Pilot trailer
- Pall Neutralization skid
- Contractor supplied Raw water/Neutralization tank

Goals/Specifications

Filtrate Quality

- Typical Turbidity: < 0.02 NTU
- Maximum Turbidity: < 0.1 NTU
- Typical SDI: < 2.5
- Maximum SDI: < 3
- Microorganisms like Cryptosporidium and Giardia cysts removed with more than 5 log RR or 99.999%

Project Background



Lessons Learned

- Alarms, alarms, alarms!
- Water Quality Events
- Support your large pipe!

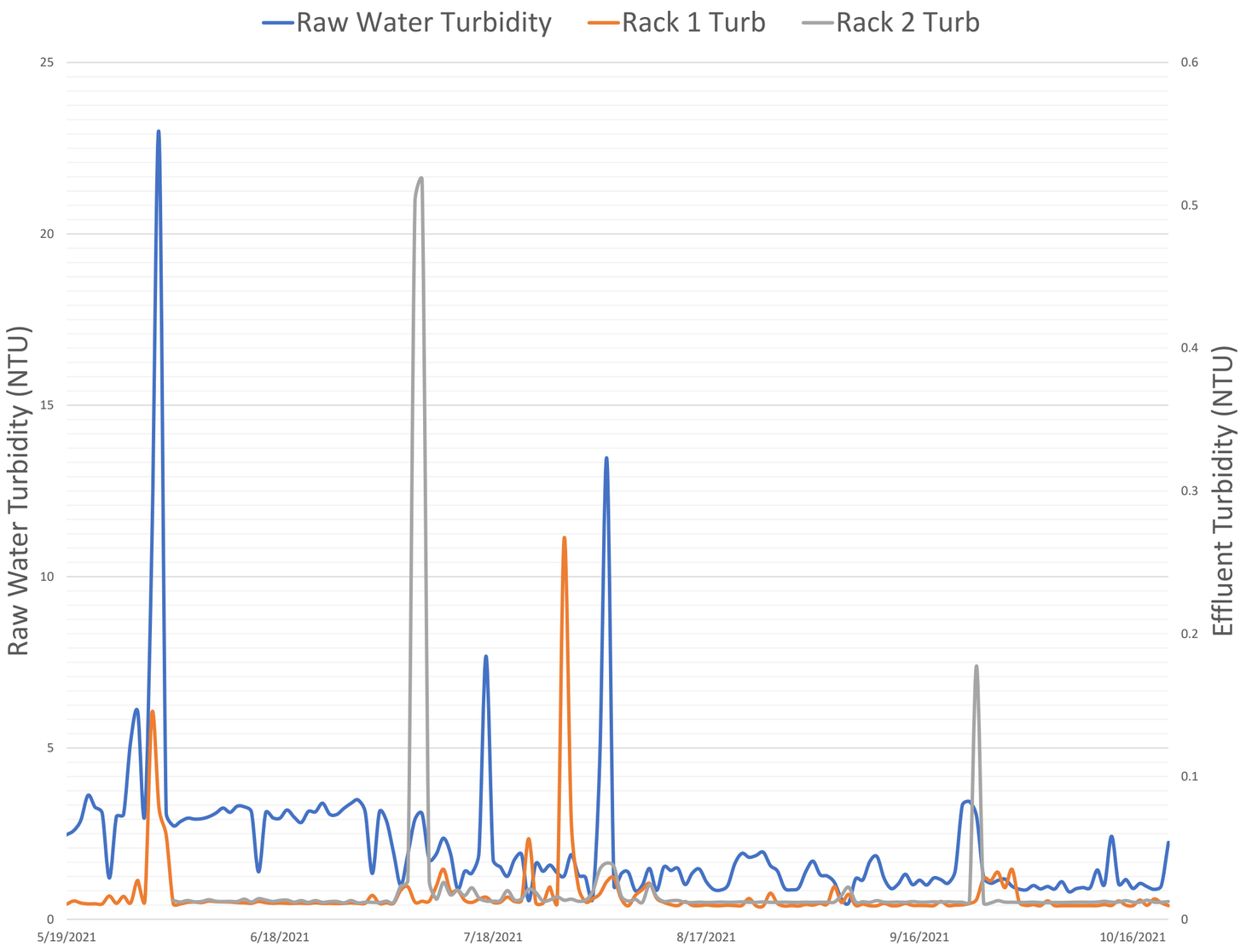
Results

Pilot Results

- Total filtrate produced - 330 acre-ft
- Turbidity levels met
  - ✓ 0.01 NTU avg
- Successful demonstration!

Lessons Learned

- Alarms, alarms, alarms!
- Water Quality Events
- Support your large pipe!



Next Steps

- State approval for potable use
- Full scale implementation

Stormwater Water Pilot Background

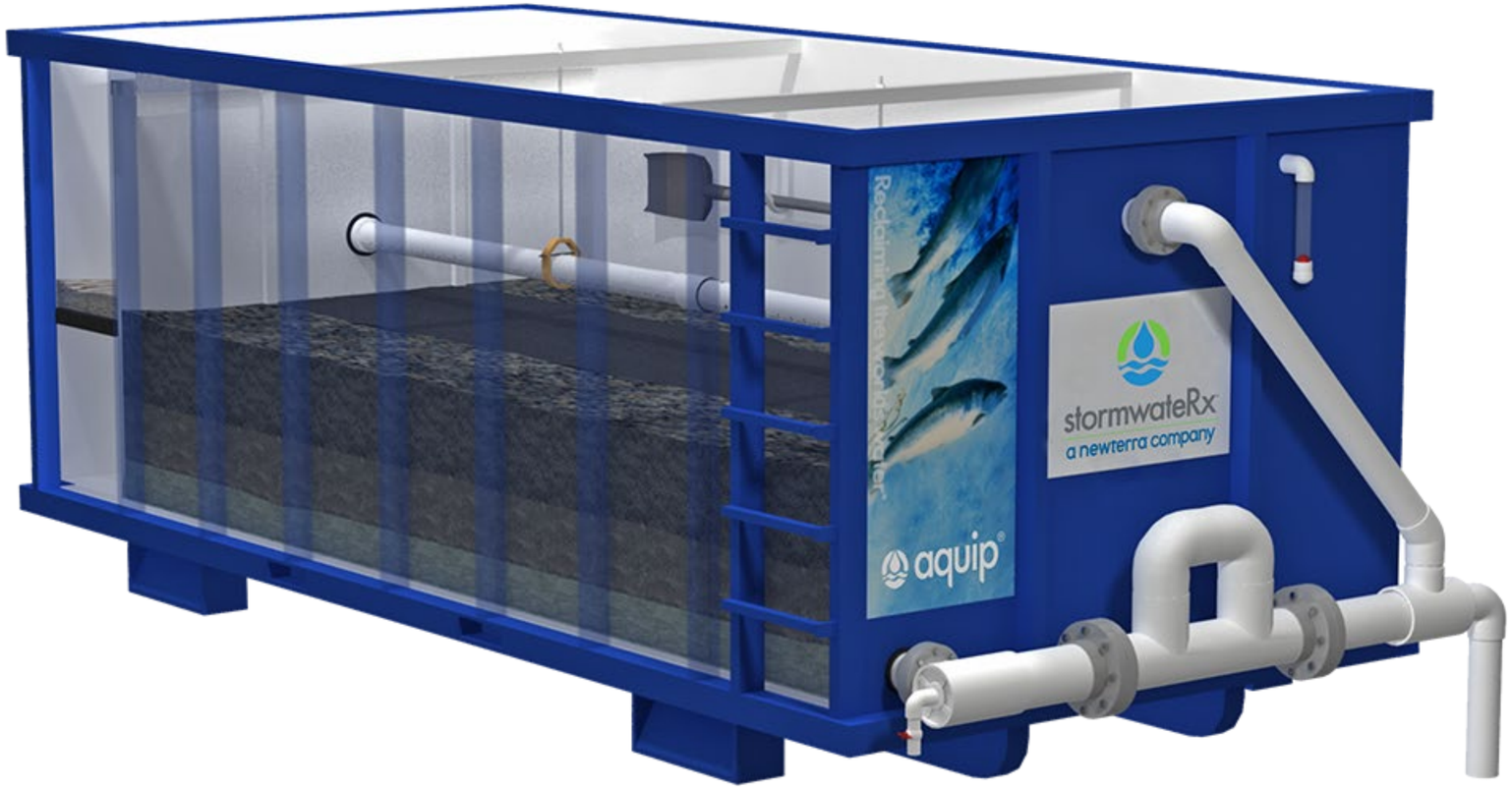
- **Location:** Beaverton, OR
- **Pilot treatment for ASR Injection**
- **Pilot size:** 0.5 to 4 gpm
- **Project goals:** Determine best possible treatment train to enhance existing pilot

Stormwater Treatment Selection

Background

Original Pilot Unit

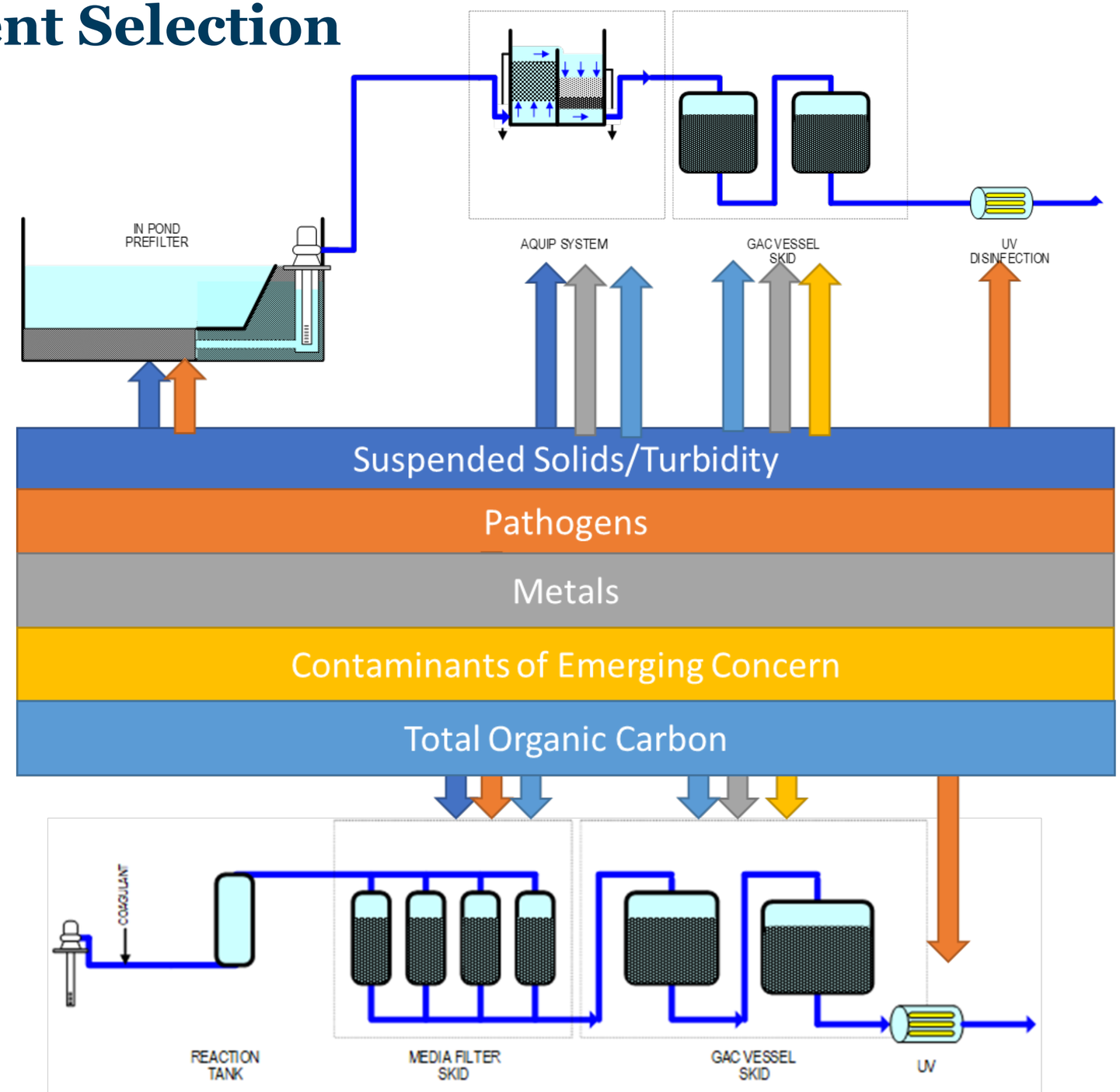
- Aquip Filtration System
  - ✓ No pretreatment
- UV disinfection



Stormwater Treatment Selection

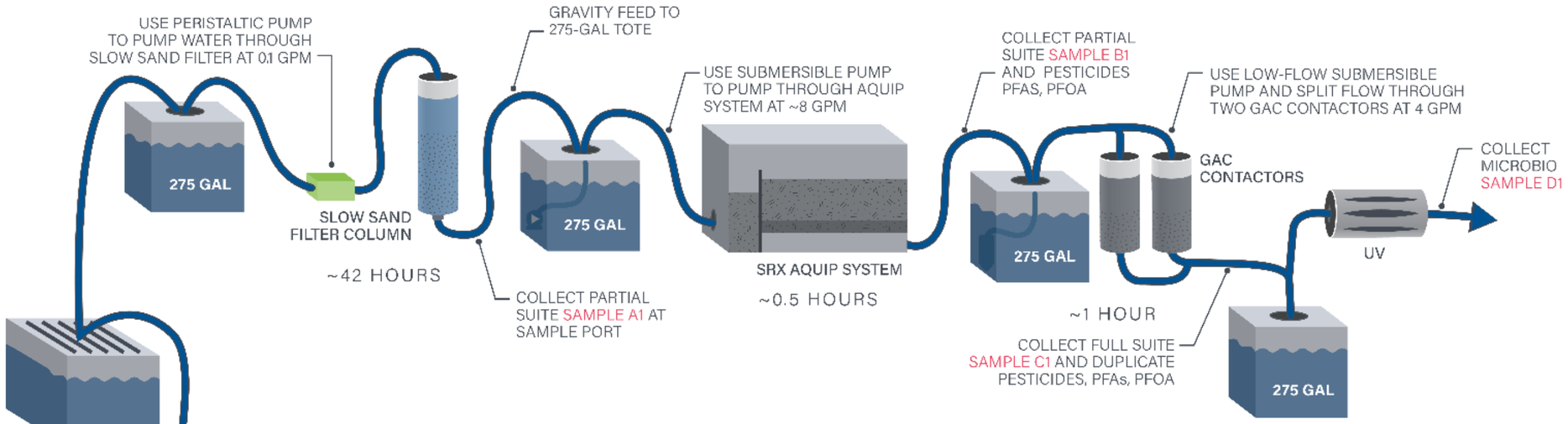
Treatment Goals

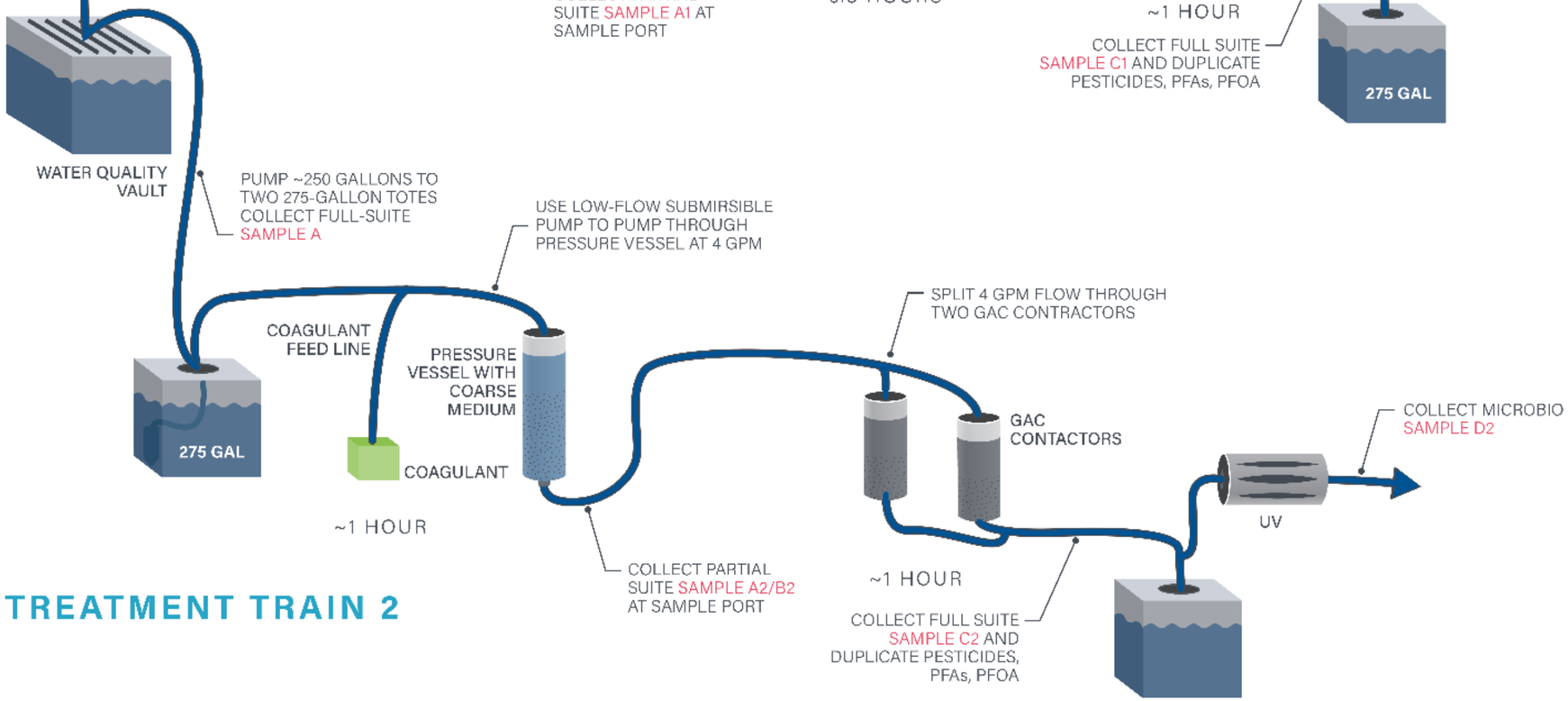
- Robust treatment train to provide multiple barriers against:
  - ✓ Pathogens
  - ✓ Inorganics
  - ✓ TOC
  - ✓ Turbidity
  - ✓ Emerging Contaminants



Stormwater Treatment Selection

TREATMENT TRAIN 1





TREATMENT TRAIN 2

Stormwater Treatment Selection

Pre-Treatment Goals

Parameter	Treatment Objective
Effluent Turbidity	< 1 NTU
Effluent Total or Fecal Coliform	< 5 CFU/mL
Filter Run Length	> 30 days
Color	< 5 SCU
CFU/mL = colony forming units per milliliter *NTU = nephelometric turbidity units* *SCU = standard color units*	

Stormwater Treatment Selection

Key Evaluation Parameters	Treatment Train 1 In-pond filtration, Aquip, GAC, UV	Treatment Train 2 Coagulation, filtration, GAC, UV
Treatment Efficiency	• Very effective • Multi-barrier system • Successful contaminant removal without further modification	• Effective • Multi-barrier system • GAC process required further optimization to achieve consistent target removal of synthetics
O&M Considerations	• Largely passive • Periodic harrowing of slow sand filter and Aquip system • Less frequent replacement of filter media(s)	• More intensive startup operation • More intensive maintenance to optimize coagulant dose and filter run time • Backwashing required for filter performance
Capital and O&M costs	Costs are comparable between the two proposed systems.	

Stormwater Treatment Results

- Pilot Testing Nov 13-16

		Slow Sand	Rapid Sand	Head	Nalco	Formazin	GAC	Head
	Sample	Flow	Flow	Loss	8150 Dose	Turbidity	Flow	Loss
Date	Number	Time	(gpm)	(psi)	(mg/L)	(FTU)	(gpm)	(psi)
11/13	Start		2.0	1	1.53	4		
	1		2.0	2	1.53	12		
	2		3.9	2	0.78	13		
	3		4.0	2	0.76	22		
	4		4.0	2	0.76	6		
	5						4.0	2
	6						4.0	2
	7						4.0	2
11/15	8		4.0	1	3.2	14		
	9		4.0	1	4.5	4		
	10		4.0	1	6.5	1		
	11		4.0	1	7.4	1		
	12		4.0	1	10.2	1		
	13		4.0	1				

Stormwater Treatment Results

- Pilot Testing Nov 15

		Slow Sand	Head	Formazin	GAC	Head
	Sample	Flow	Loss	Turbidity	Flow	Loss
Date	Number	(gpm)	(psi)	(FTU)	(gpm)	(psi)
11/14	1	0.05	2	>9		
11/15	2	0.05	2			
11/16	3	0.05	2	1	4.0	2

Stormwater Treatment Results

Analyte	Influent Concentration	**Treatment Train 1** Effluent Concentration	**Treatment Train 2 Effluent Concentration**
Turbidity	12	1	1
Fecal Coliform	2,420	1	<1
TSS	6	1	8
Copper	2.6	ND	ND
PFHxA	0.0046	ND	0.00355
PFOA	0.0045	ND	0.0038
PFOS	0.0064	0.0021	0.0044
2, 4-D	1.7	ND	0.14

Stormwater Treatment Results

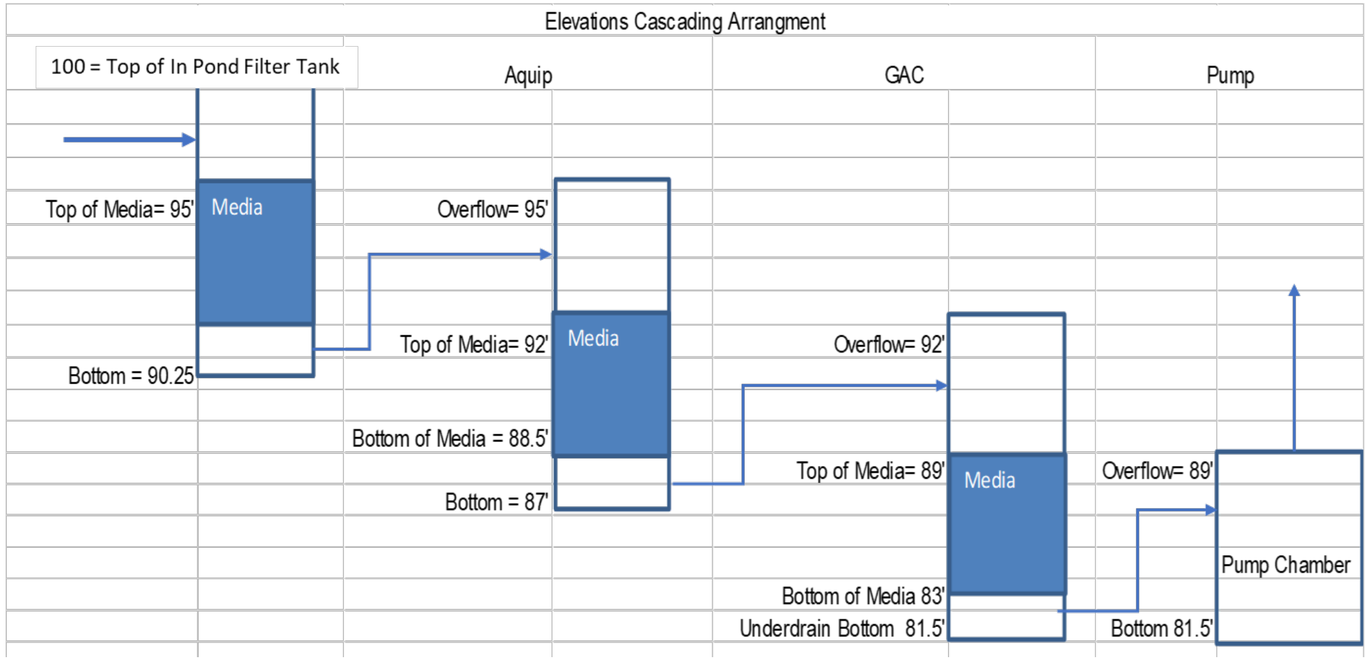
Results

- Both trains provided good treatment
  - ✓ Treatment Train 1 provided better removal of emerging contaminants
- Treatment Train 1 Selected

Stormwater Treatment Next Steps

Recommended Process Train/Design Criteria

Equipment Design Criteria Summary	Sterling Park
Capacity, Gal/day	288,000
Plant Capacity (gpm)	200
Operating Pressure, psig	3
Run Time (hours/day)	24
Average Day Run Time (hours/day)	24
Stage 1 - In Pond Gravity Filter (Slow Sand Filter)	
Loading Rate, gal/sq ft/day	96
Sand Depth, in	36
Media Depth, in	57
Stage 2 - Aquip Filter Model 210S	
Number of Filters	1
Loading Rate, gpm/sq ft	0.7
Media Depth, in	42
Overal Depth, Ft	7
Stage 3 - GAC Filters	
Surface areas, per vessel, sq ft	100
Number of Filters	1
EBCT, min per filter	22
Stage 4 – UV Disinfection	Meet OHA approval



Stormwater Treatment Next Steps

Full Scale
Design Concept

Q&A

Thank you!