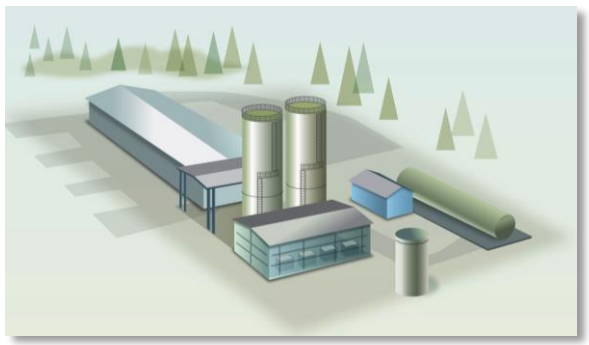
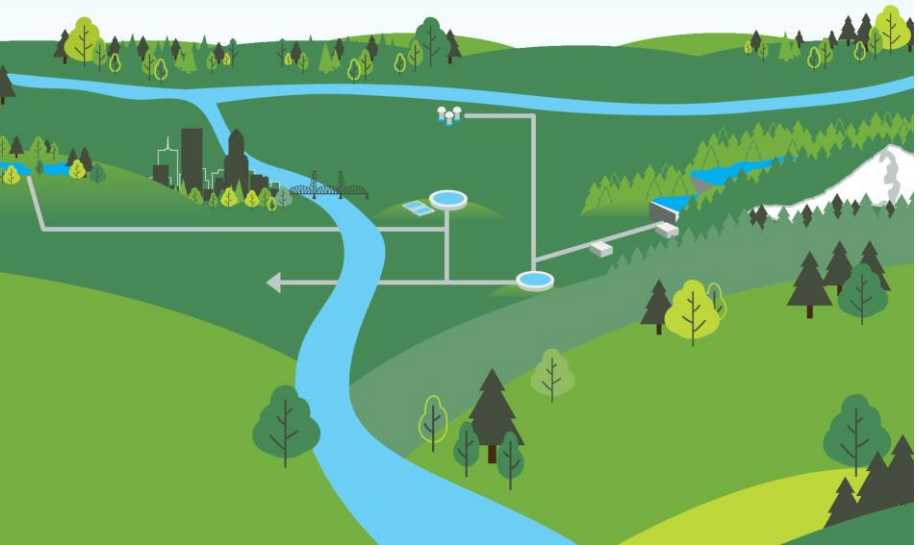




PORTLAND WATER BUREAU

Bull Run Treatment Program

Preliminary Findings from Portland's Bull Run Treatment Pilot Study

Anna Vosa (PWB), Lynn Stephens (BC), and Mac Gifford (PWB)

May 2, 2019

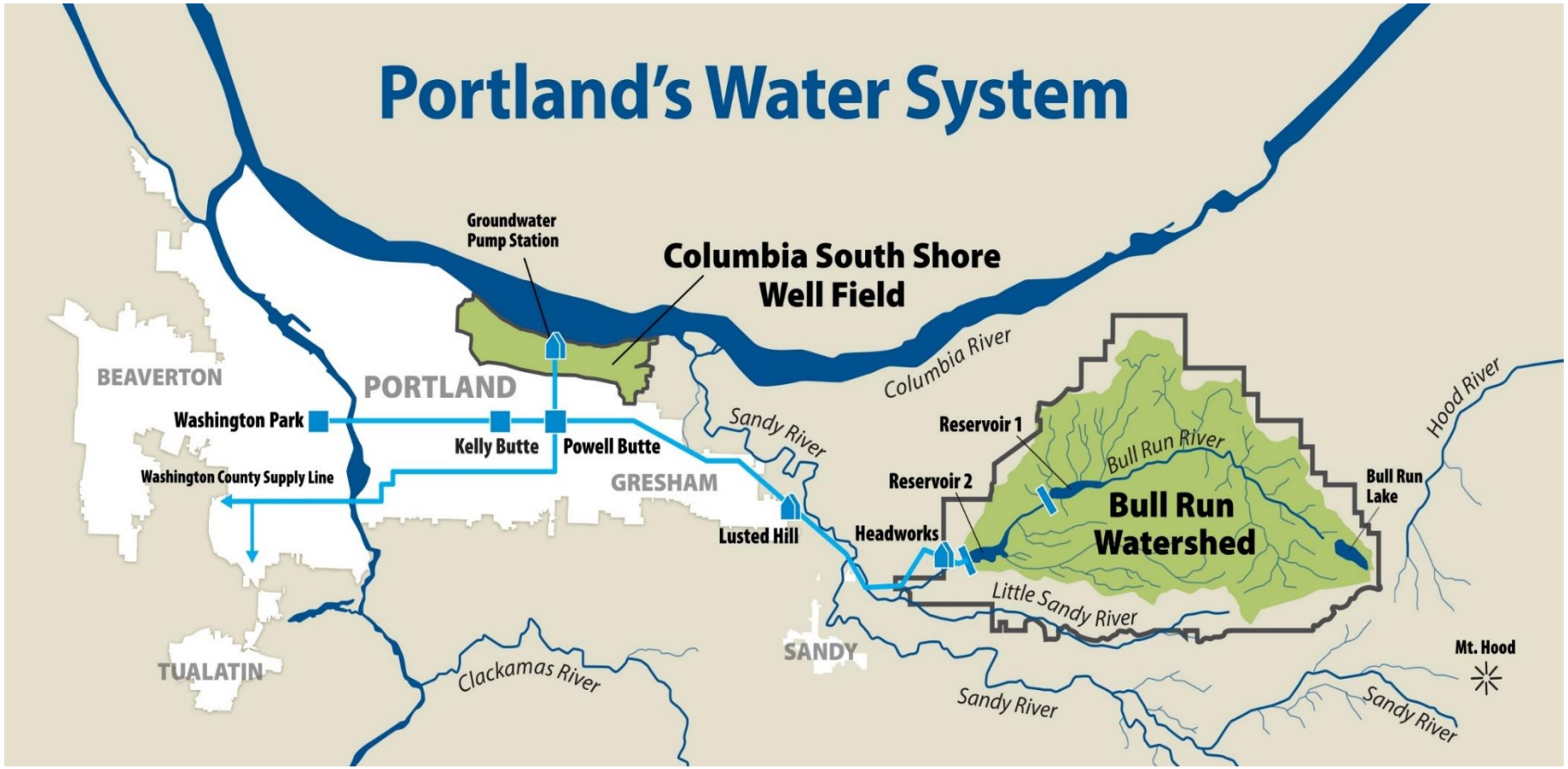
PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

CITY OF PORTLAND, OREGON 1851

Brown AND Caldwell

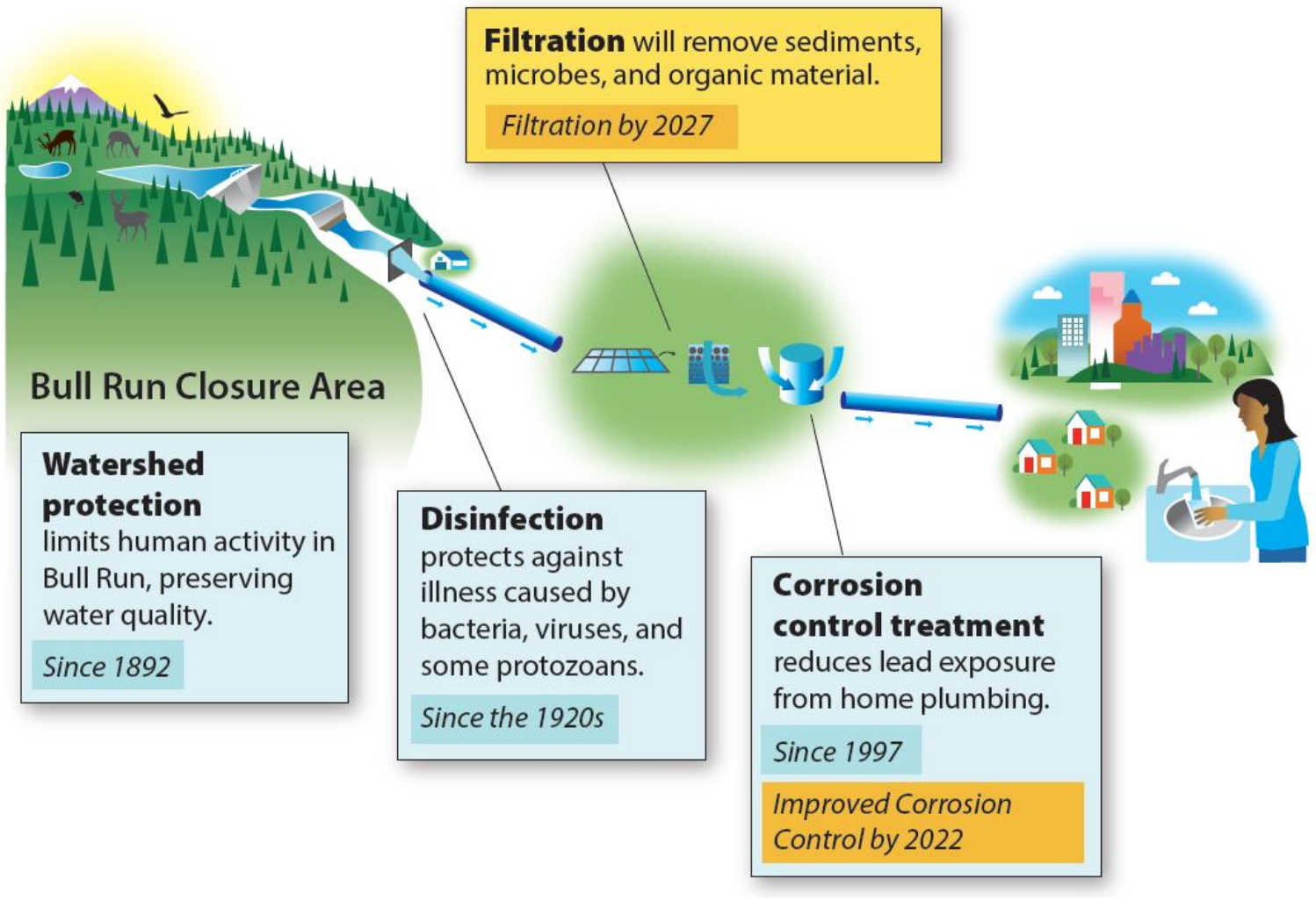
Outline

- Background
- Bench Testing Findings
- Pilot Study Planning



- Serves almost a million people, including 19 wholesale water districts
- 100 MGD average demand
- Primary supply is Bull Run unfiltered surface water

Bull Run Treatment Projects

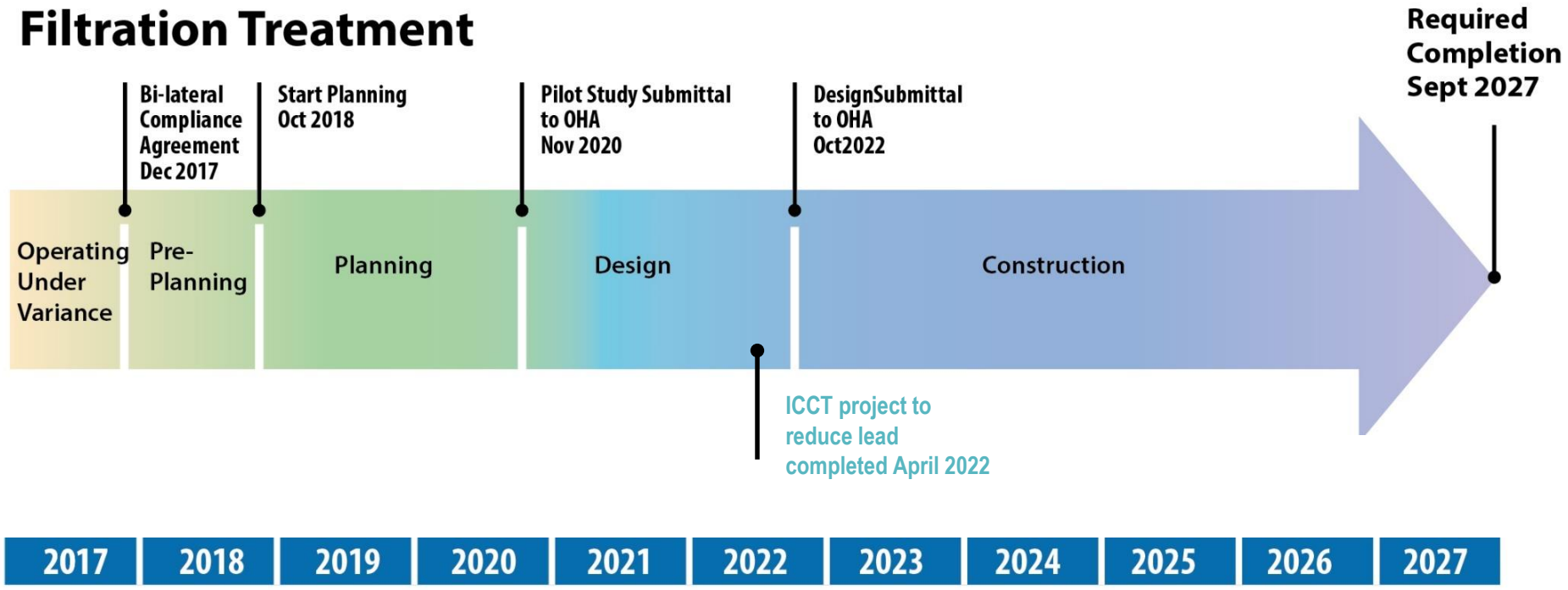


Why are the projects needed?

These projects are being built to comply with Environmental Protection Agency (EPA) regulations.

Oregon Health Authority has set compliance schedules.

Bull Run Filtration will be in operation by 2027



What are we piloting?

- **Capacity and Filtration Technology:**
  - 160 MGD capacity
  - Granular media, rapid rate filtration
- **Pilot will inform treatment processes and design criteria:**
  - Direct filtration or conventional? Hybrid?
  - Ozone?
  - Coagulants and coagulant aids?
  - Filter loading rate?
  - GAC or anthracite media?
  - Corrosion control?

Bull Run Lake

Pilot treatment units

Water Quality and Treatment Goals

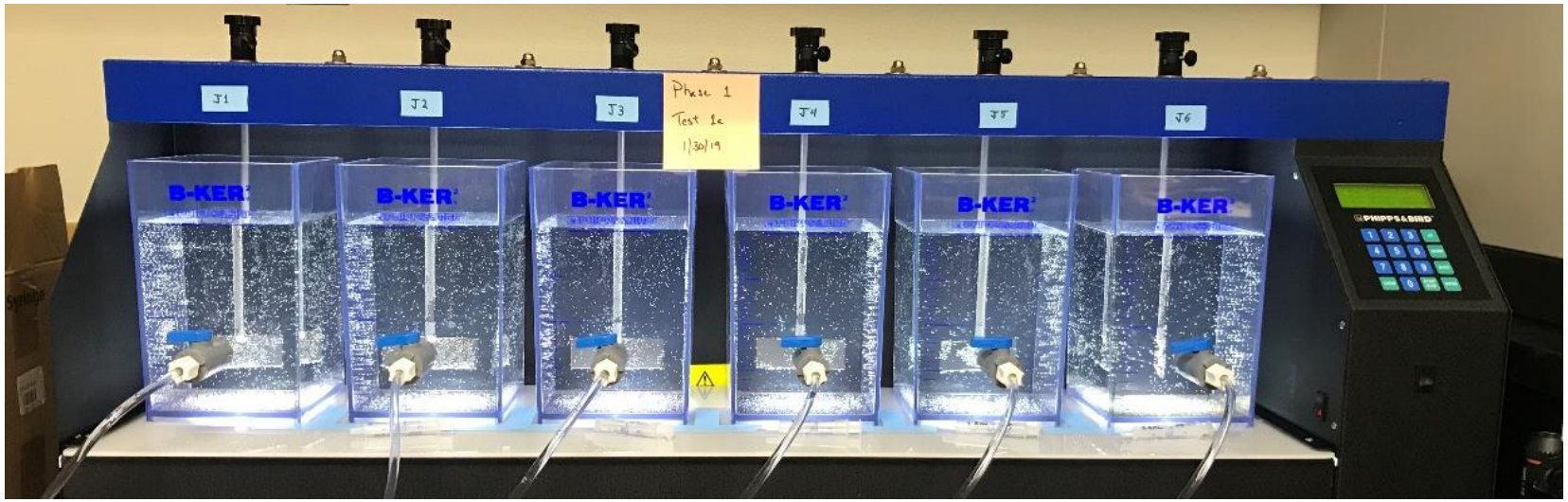
Parameter	Operational Goal	Notes
Turbidity	Settled Water: ≤ 2.0 ntu, 95% of time Filter Effluent: ≤ 0.10 ntu, 95% of time ≤ 0.30 ntu, 100% of time	"optimized" criteria (Partnership for Safe Water, OHA Area Wide Optimization Program)
Cryptosporidium	≥2-log reduction in 3-5µm particle range	Based on regulations for log reductions
Giardia	DF: ≥ 2.0-log reduction in 5-15 µm particle range CF: ≥ 2.5-log reduction in 5-15 µm particle range ***or,*** < 50 particles/mL in in 5-15 µm particle range	Based on regulations for log reductions
Disinfection Byproducts	TTHM: ≤ 40 µg/L HAA5: ≤ 30 µg/L Others: bromate, nitrosamines, HAA9	Target <50% of MCL's Evaluate through simulated distribution system (SDS) tests

Organics Iron & Manganese Algae / T&O Color

Lead & Copper / Corrosion Disinfectant Residual Stability

Jar Testing – Objectives

- Prepare for and inform pilot by evaluating:
  - A seasonal range of raw water (turbidity, alkalinity, organics, temperature)
  - Coagulants and dose ranges (alum, ferric chloride, PACl, and ACH) and coagulant aid polymers
  - Raw water pH and alkalinity impacts and adjustments needed
- Is jar testing a good tool to evaluate treatment of low turbidity water?

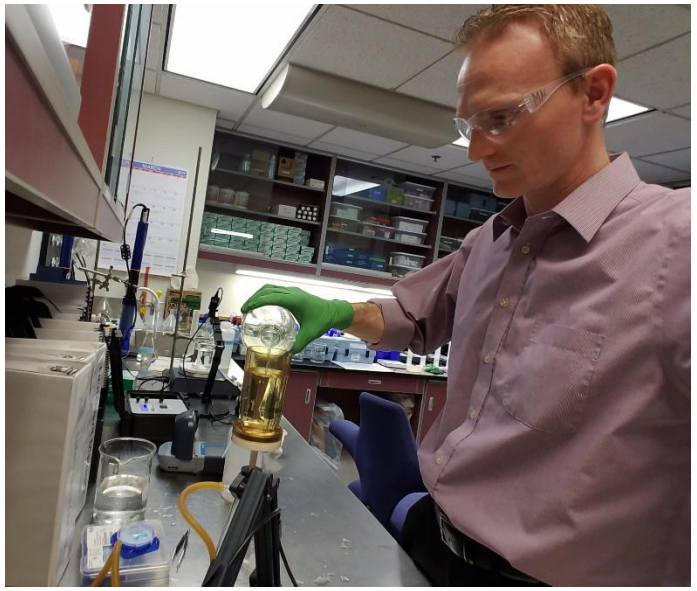


Jar Testing – Source Water Quality

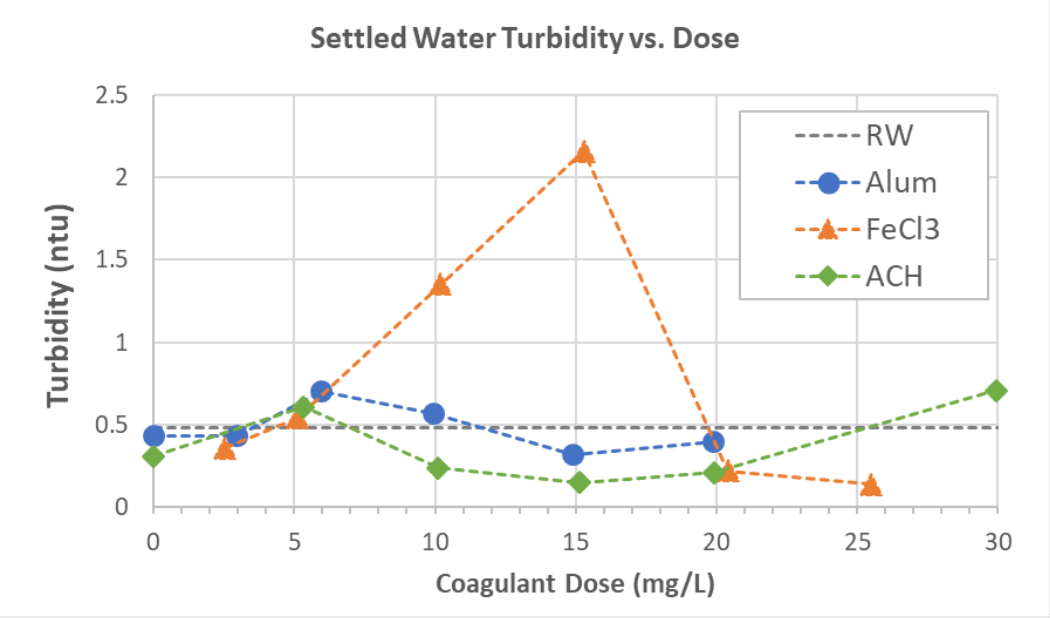
Parameter	Historic WQ Average (Range)	Early December "high organic water"	Early March "cold, clean water"	April "spring storm event"
Location	Primary Intake	Primary Intake	Primary Intake	South Fork Trib.
Temperature (°C)	**9.5** (2.5 – 18.7)	8.1	3.8	4.7
Turbidity (ntu)	**0.4** (0.1 - >20)	0.4	0.2	2.2 (2 – 3)
TOC (mg/L)	**1.1** (0.7 – 4.1)	1.5	0.9	2.3
UVT (%)	**90** (78 – 95)	86	91	82
Color (CU)	**11** (6 – 75)	15	10	23
pH	**7.1** (6.3 – 7.6)	7.0	7.0	6.8
Alkalinity (mg/L-$CaCO_3$)	**7.8** (4.1 – 18)	9.5	7.8	5.6

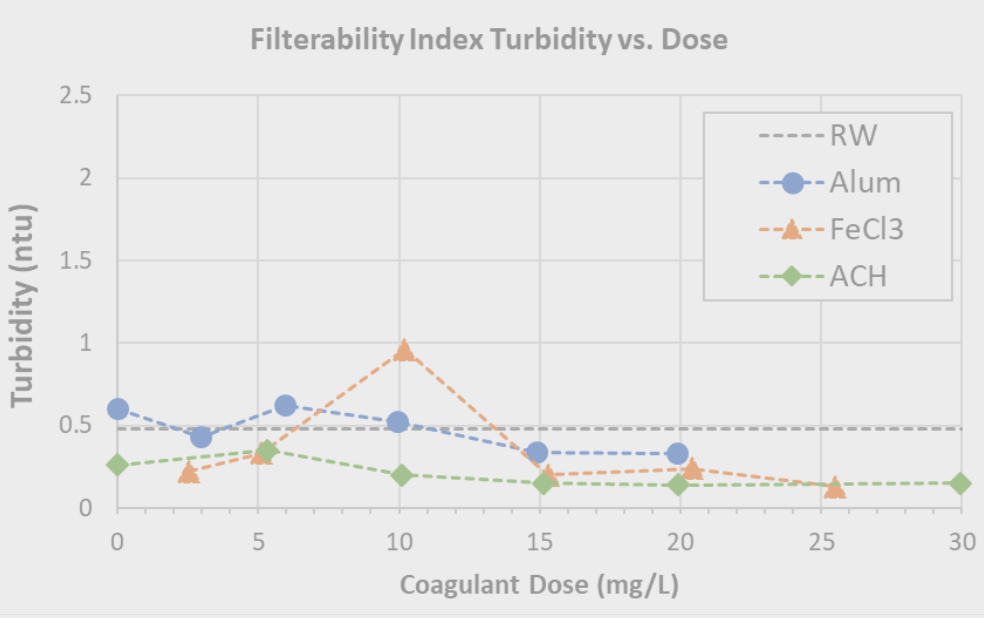
Jar Testing – Procedure

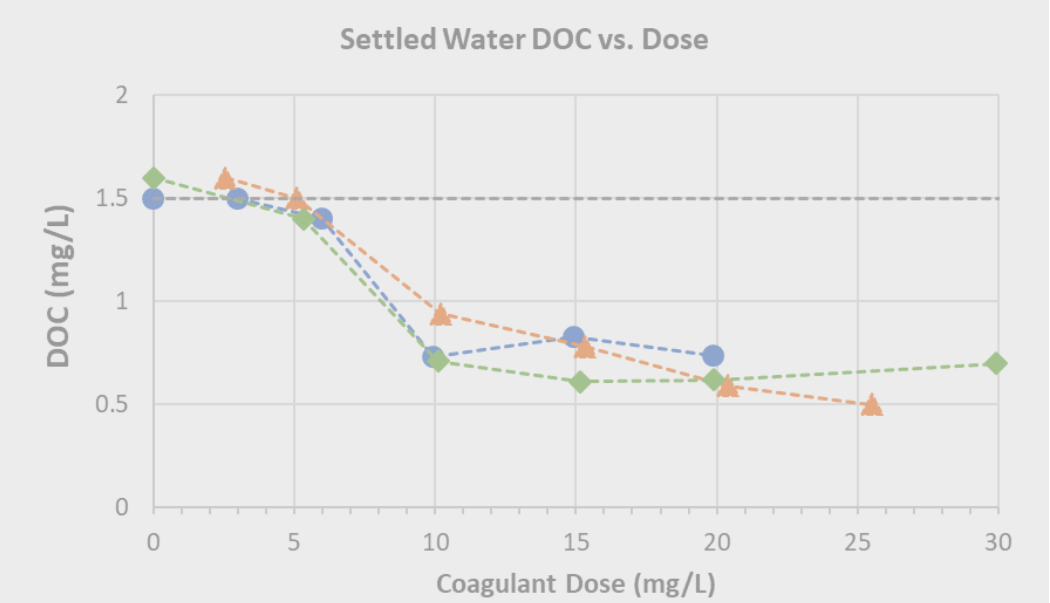
- Rapid mix (30 seconds) followed by three 10-min stages of tapered flocculation and 30 or 60 minutes of settling time
- Evaluate range of coagulant types and doses
  - Follow with evaluation of coagulant aid at “optimal” coagulant doses
  - Select tests supplemented alkalinity with sodium bicarbonate
- Visual observations: floc development and settling rate
- Water Quality Measurements:
  - Settled water: turbidity, temp, pH, alkalinity, TOC, color (“apparent”), UV254
  - Filtered through 0.45µm filter: DOC, color (“true”), UV254
- Evaluate filterability using “filterability index” test with 11µm Whatman filter paper (recorded filtered turbidity, filter time)

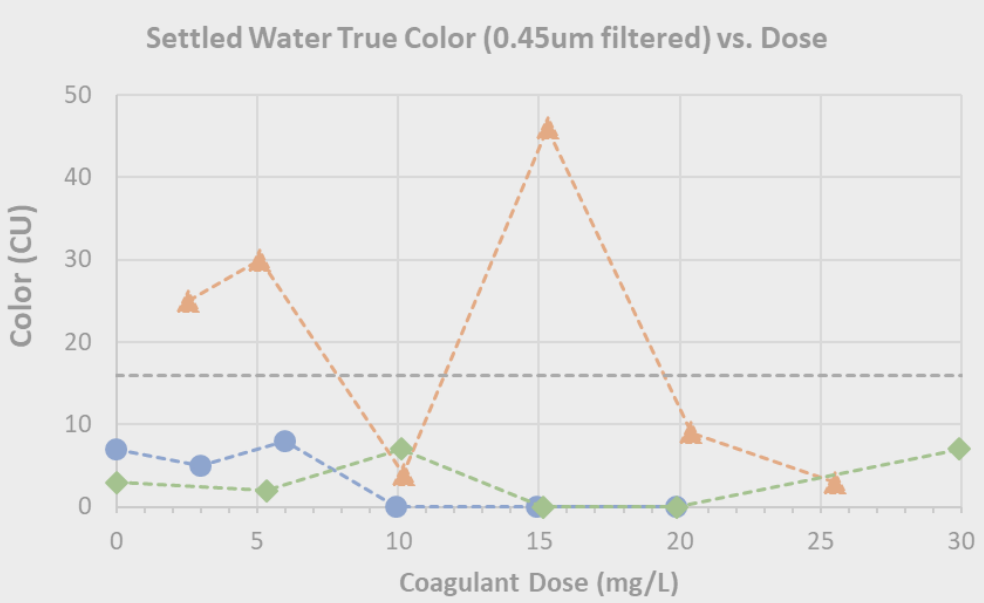


Jar Testing Results – December "high organic water"

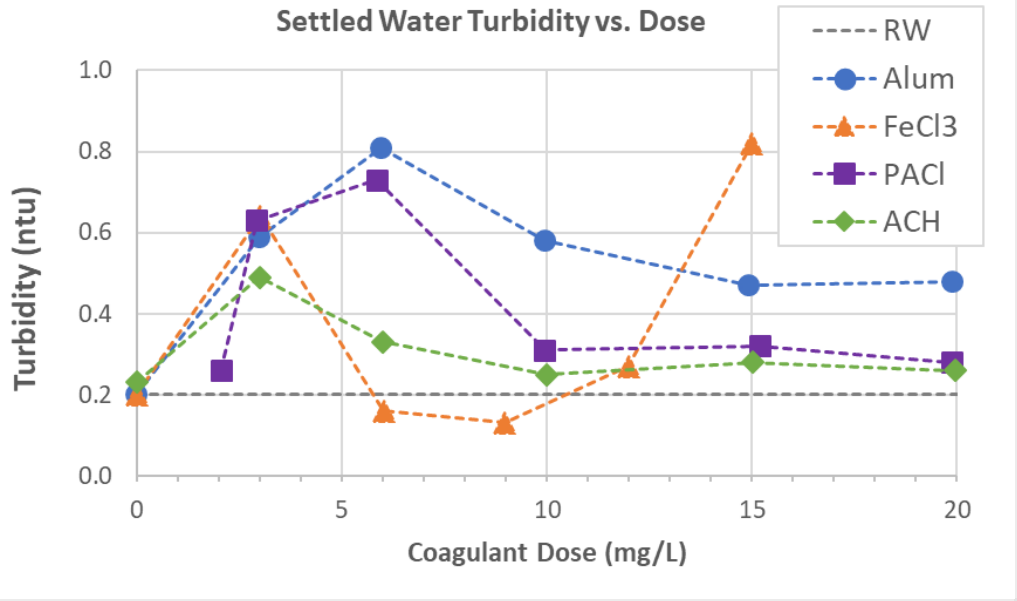


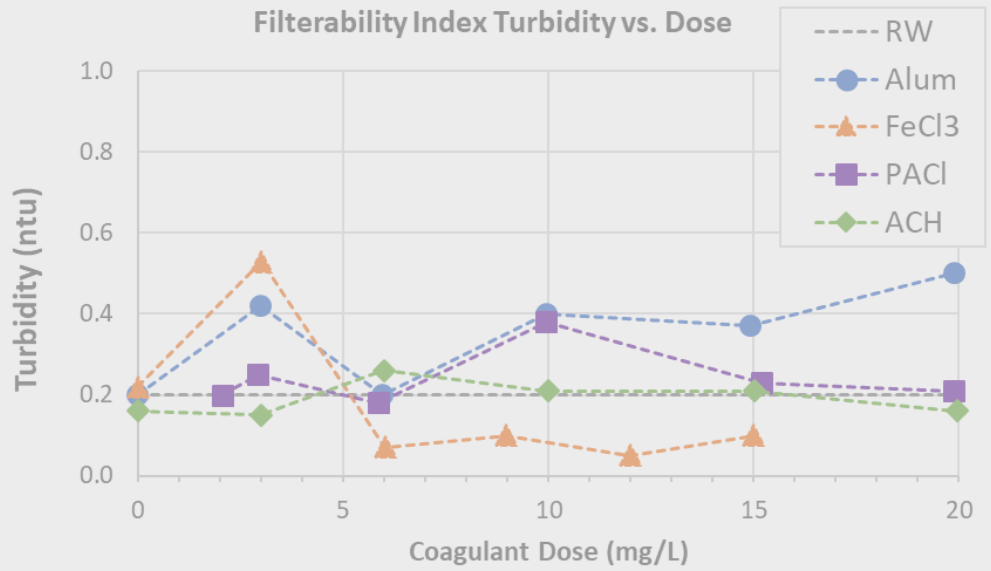


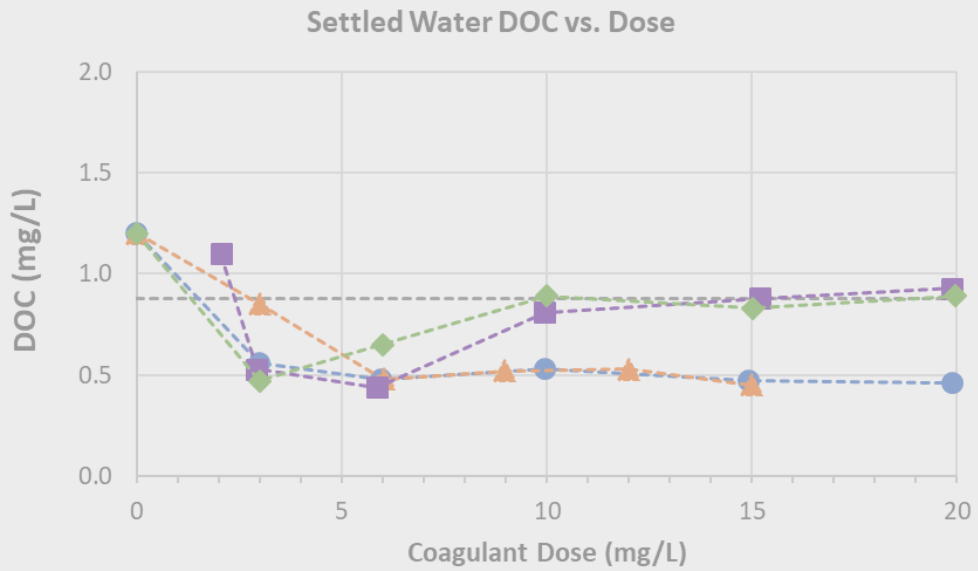


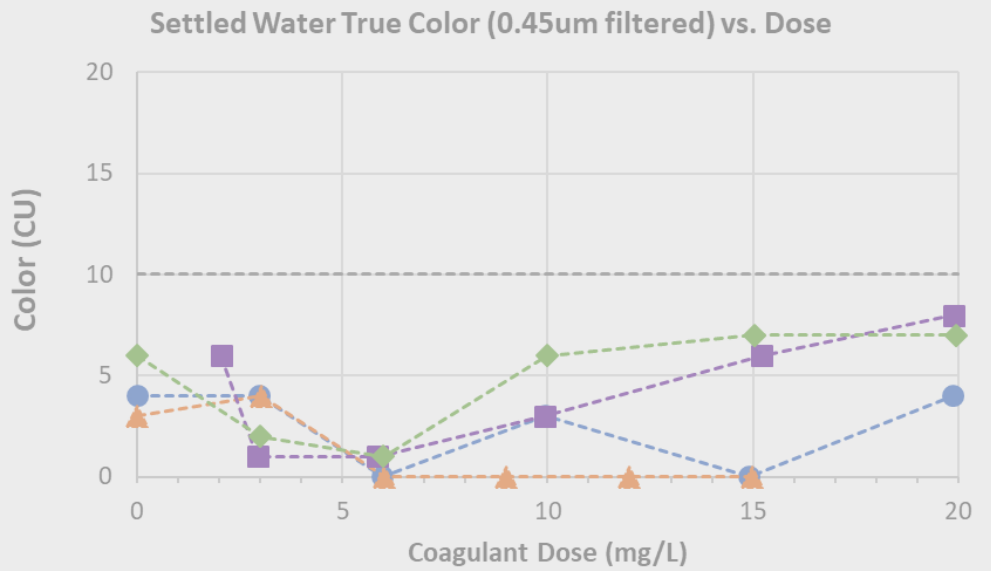


Jar Testing Results – March "clean, cold water"

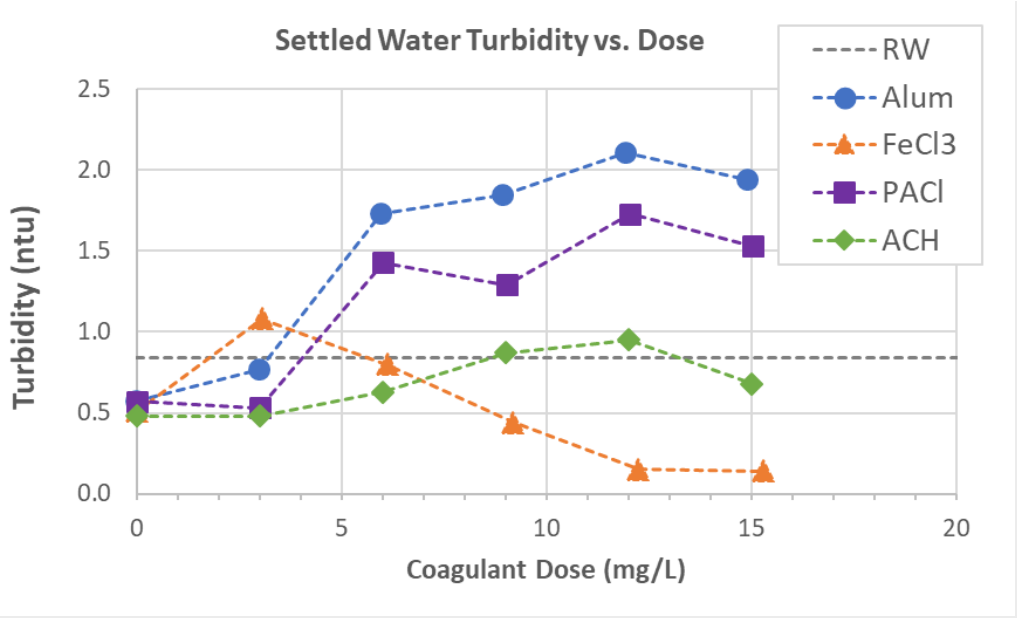


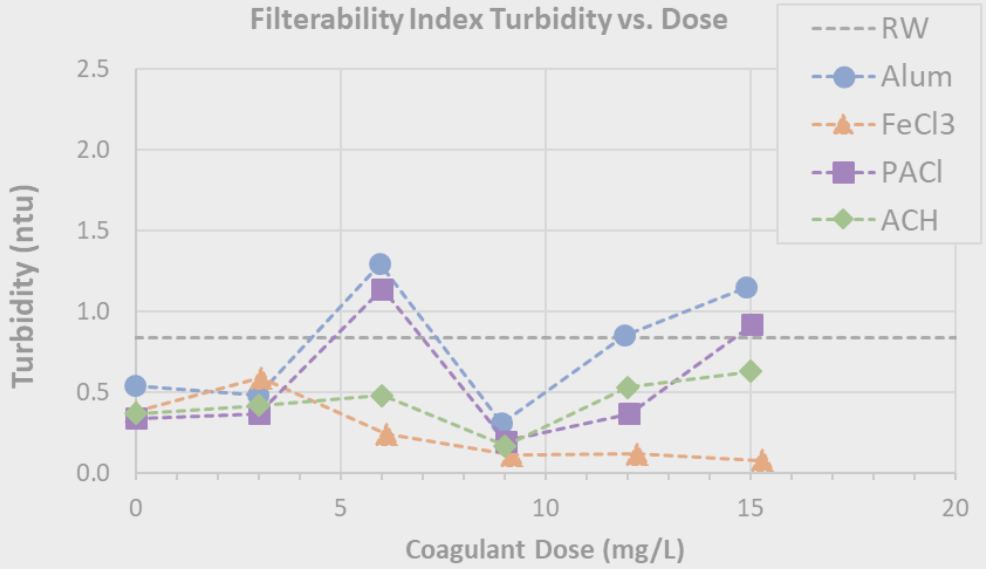


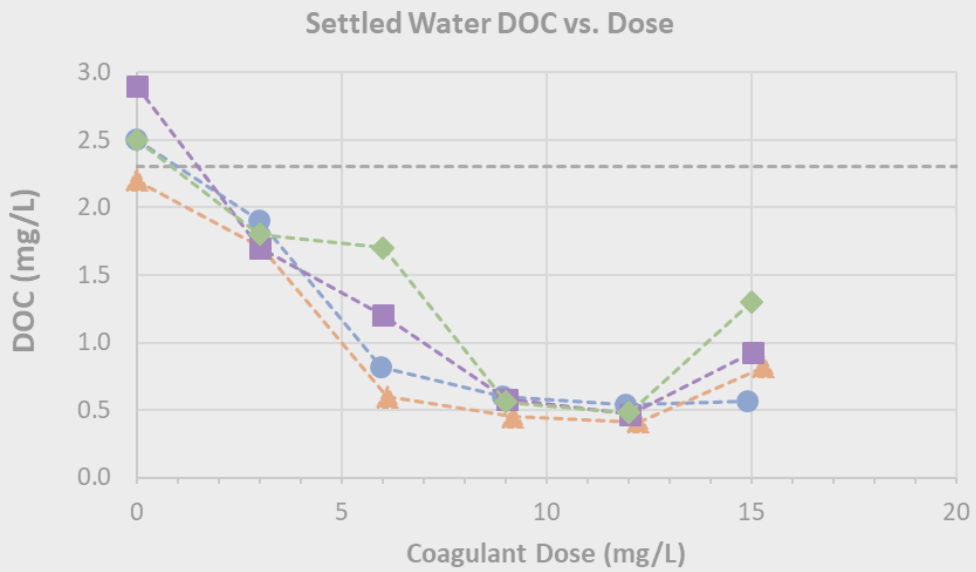


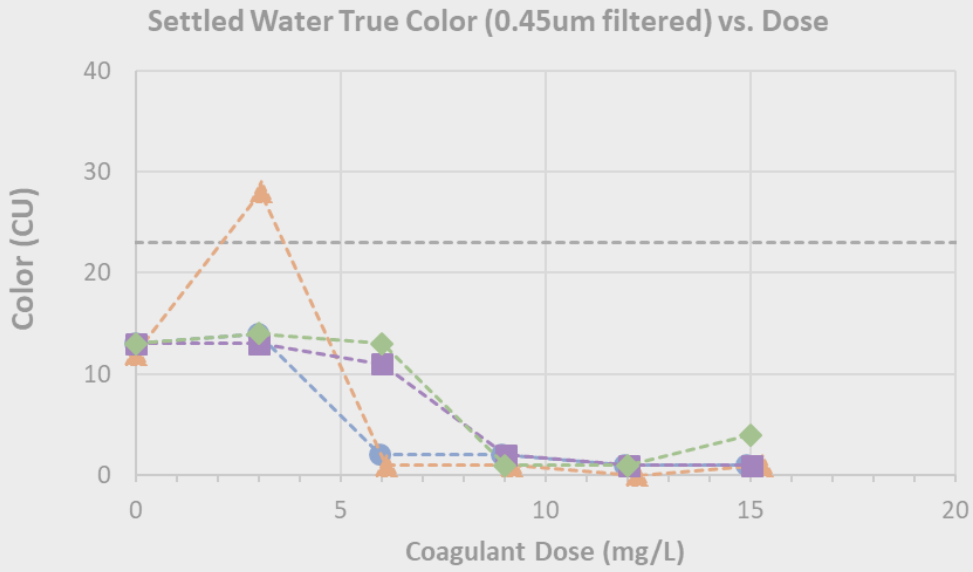


Jar Testing Results – April "spring storm event"









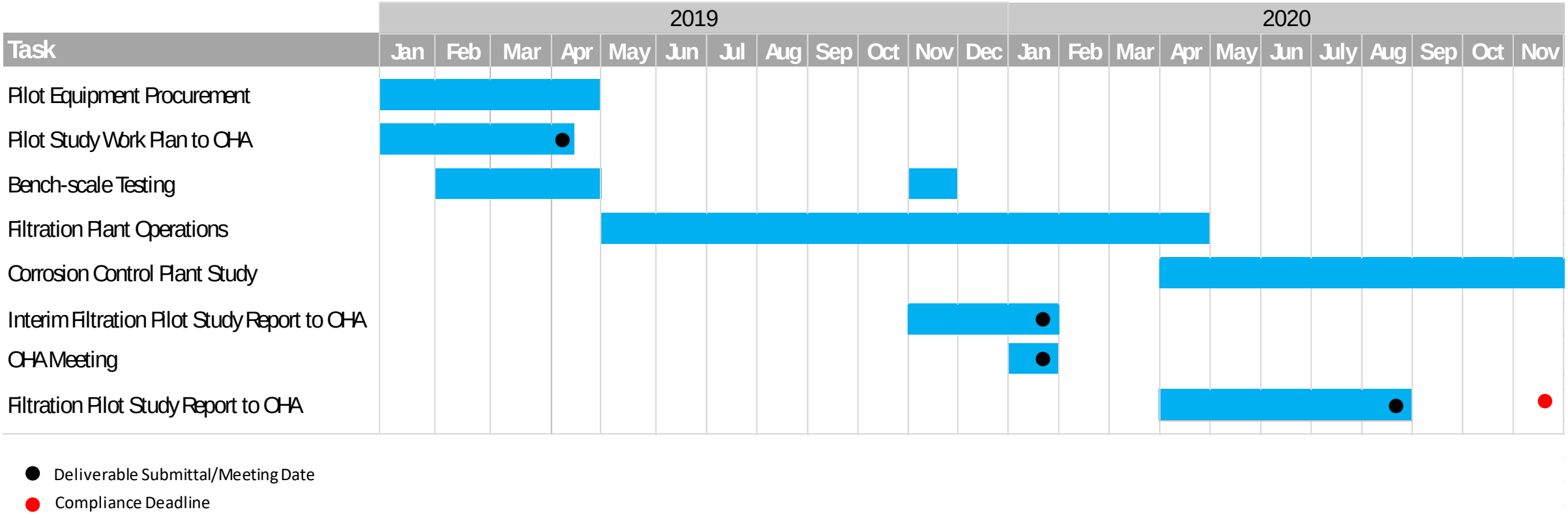
Jar Testing – Findings and Next Steps

- Bench testing evaluations have limitations for evaluating turbidity/particle removal for low turbidity water sources, but still beneficial for evaluating reduction of dissolved material
- Demonstrated excellent organics and color reduction for all raw water samples and coagulants tested
- Treatment effective when alkalinity maintained above ~3-4 mg/L-$CaCO_3$ and pH range of 6-7
- Visible floc formation may not be needed to achieve water quality goals for turbidity and other parameters; ferric only coagulant to reliably create visible floc
- Not all instruments/methods for turbidity and color analysis are equal – benchtop spec and laser turbidimeter found to provide more consistent, accurate data for treatability tests
- Did not eliminate any primary coagulants or coagulant aids

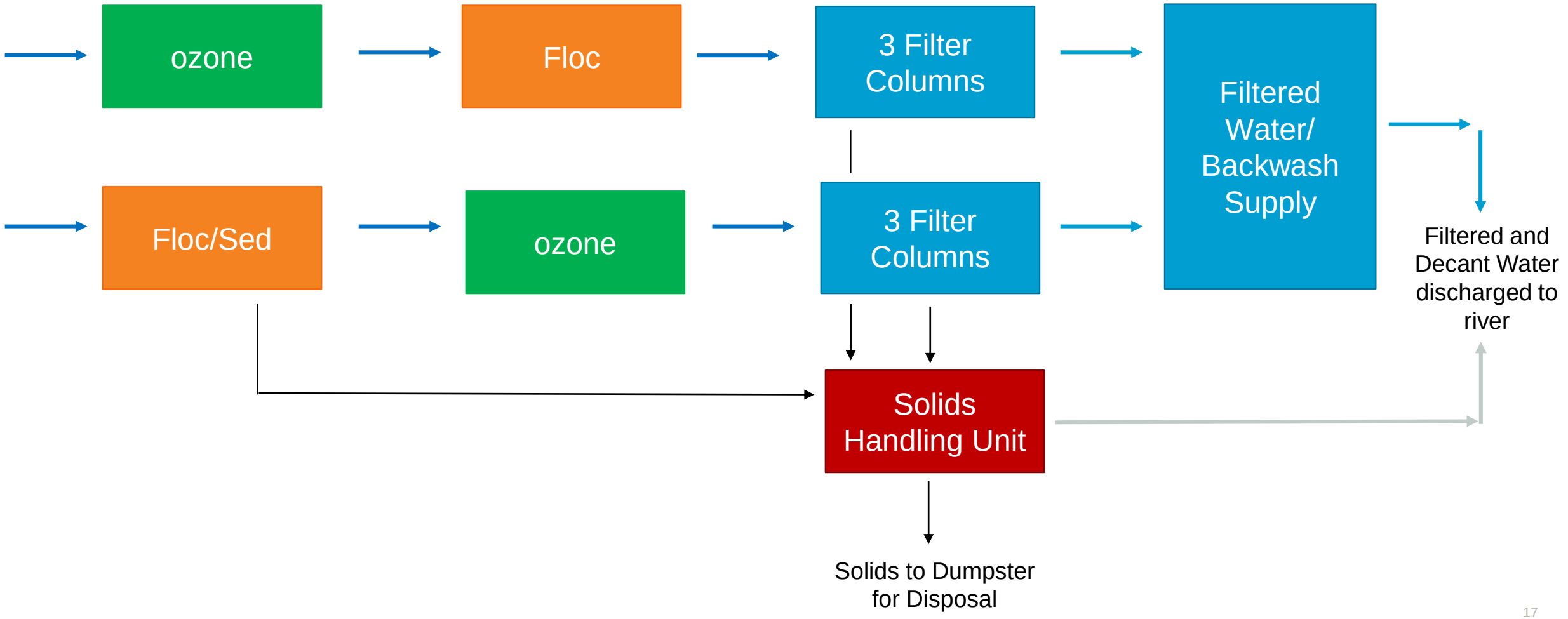
Pilot Plant Study - Objectives

- Support development of a sound, buildable, and operable basis of design that meets regulatory goals
- Inform treatment process selection
- Optimize operation of pilot study to inform design parameters and seasonal operating parameters
- Evaluate data for Partnership for Safe Water (PSW)/OHA's Area-Wide Optimization Program (AWOP)
- Serve as educational tool for operators and engagement in treatment process understanding

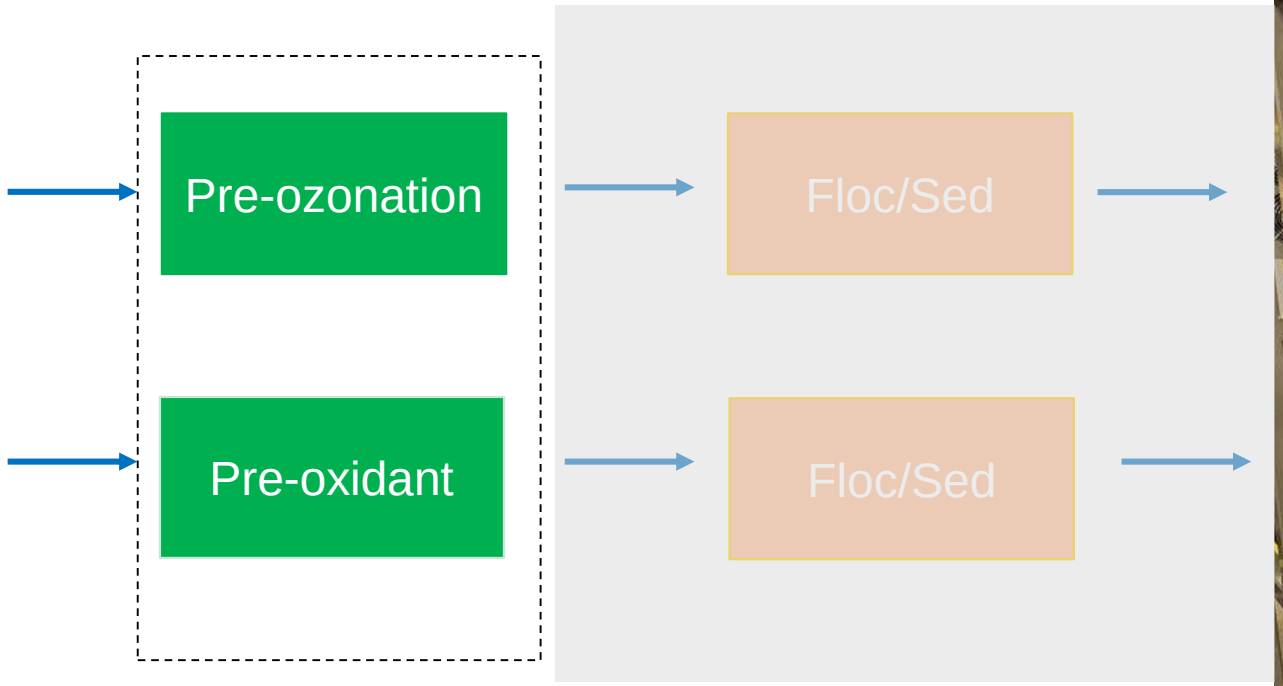
Pilot Plant Study – Work Plan and Schedule



Dual Treatment Train



Dual Treatment Train



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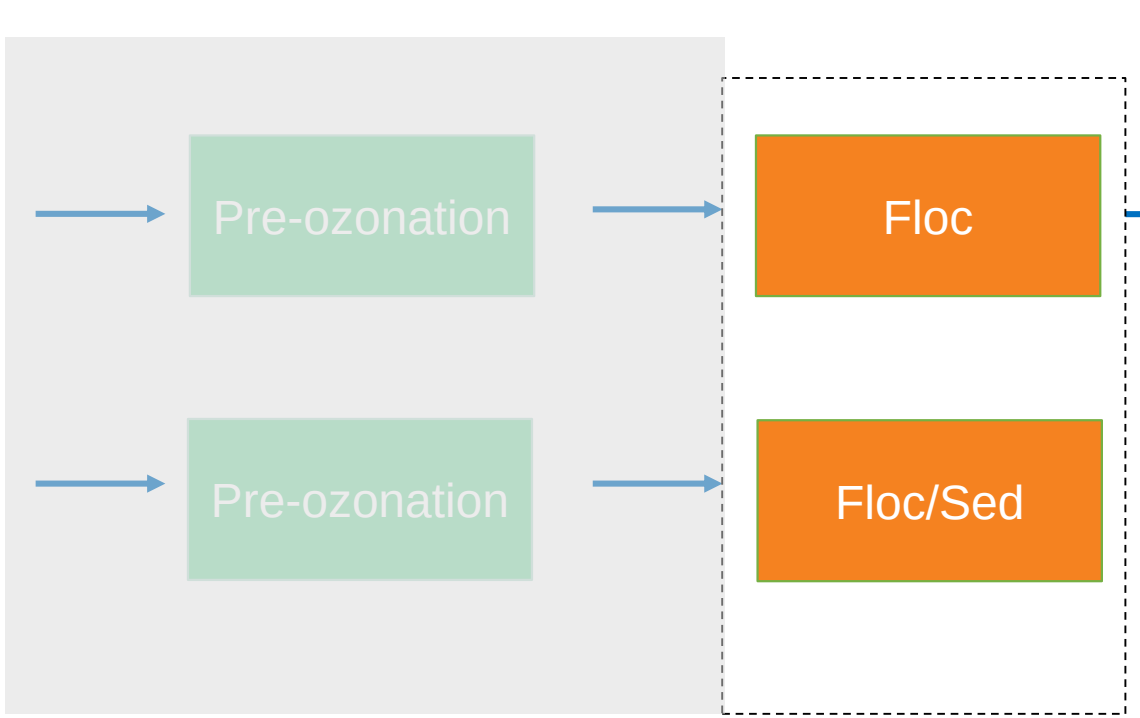
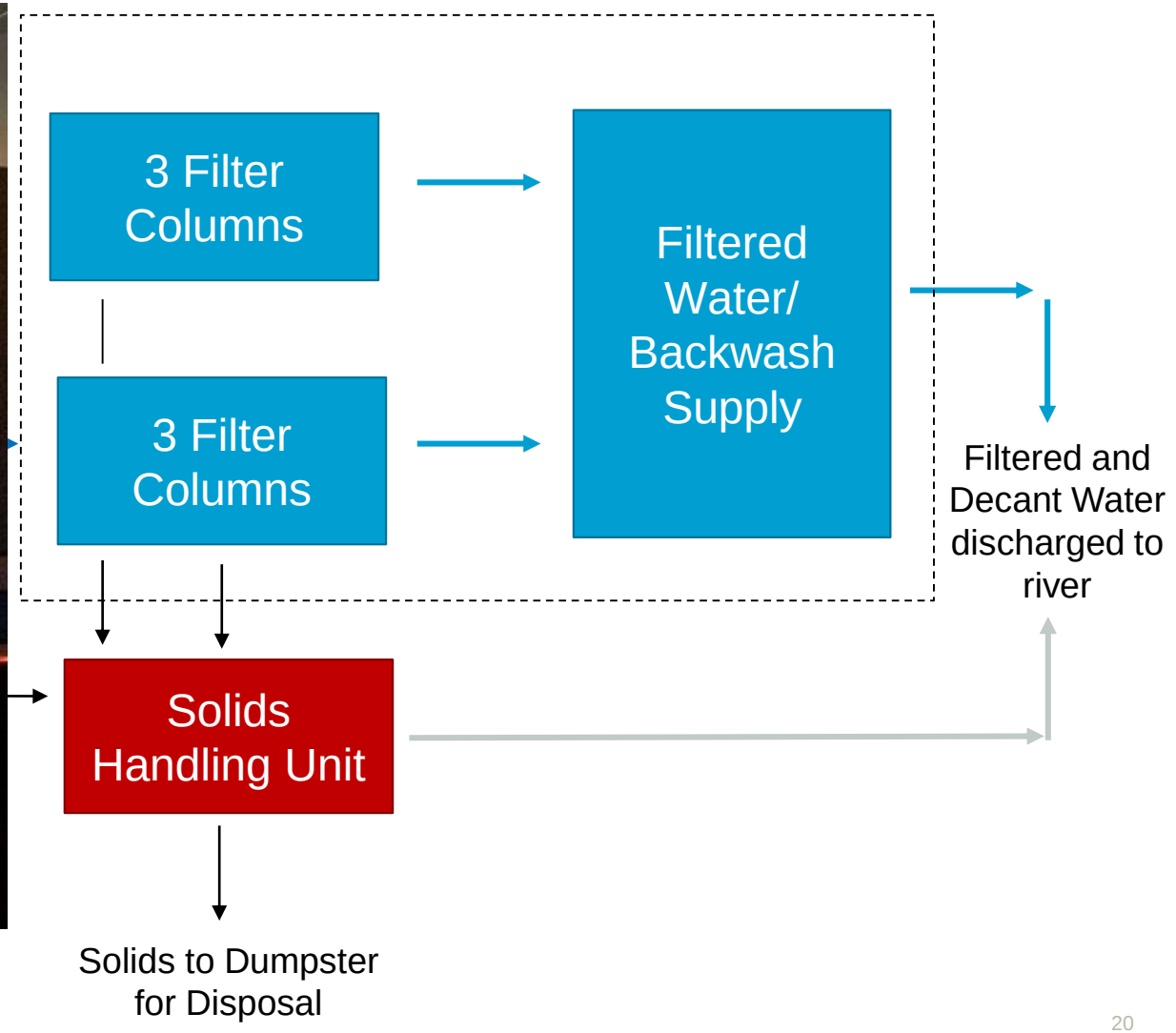
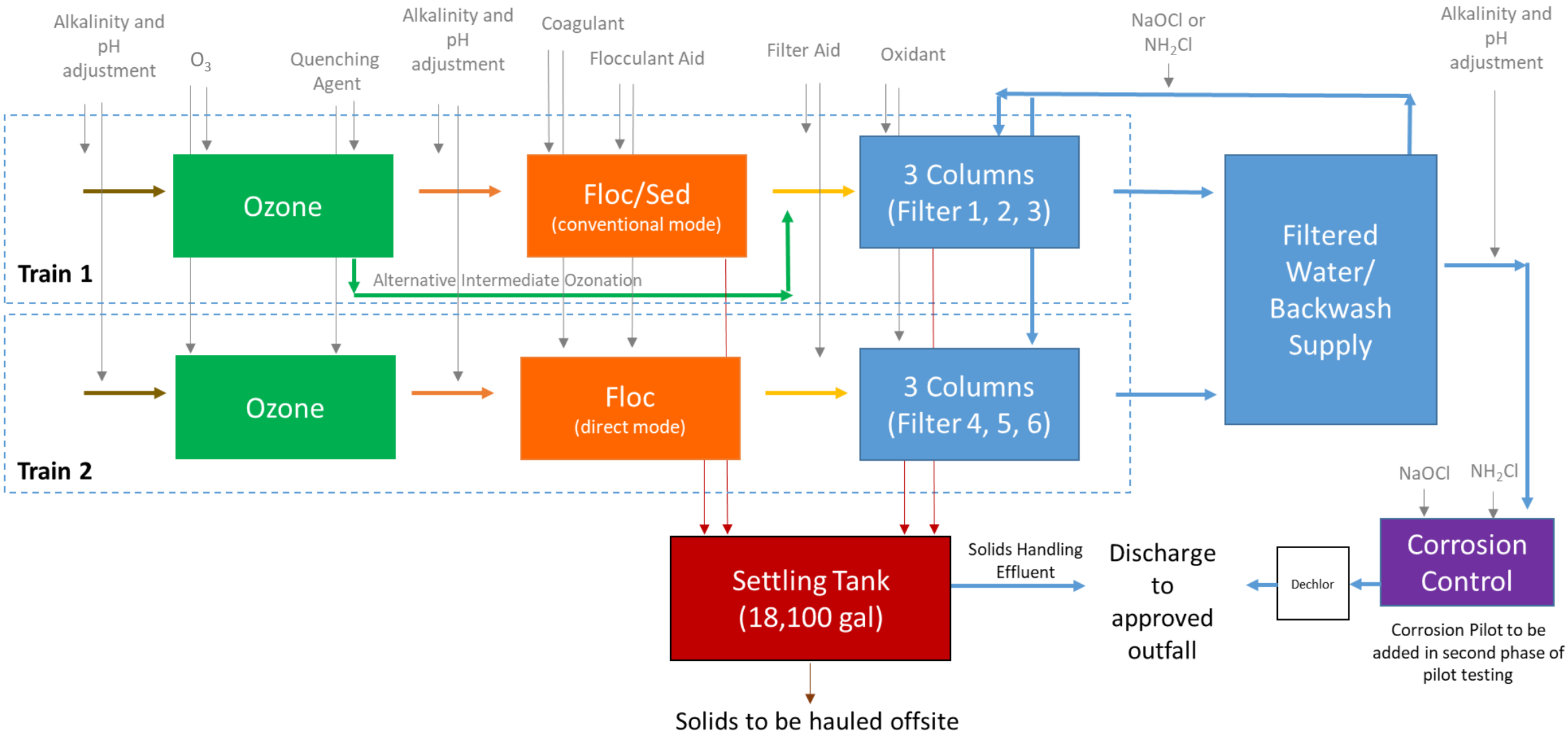


Dual Treatment Train



Process Overview/Schematic



Considerations for Greenfield WTP

- No existing WTP
  - Evaluation of all upstream processes
  - Discharge considerations
- Lack of existing infrastructure

Acknowledgements

- **Brown and Caldwell**: Mia Vijanderan, Bill Persich, Joanie Stultz
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- **PWB**: Yone Akagi, Kimberly Gupta, Lucas Allen, Tom Krause, Lillian Gehres, Anthony Dalton-Atha, PWB Lab, Bull Run Treatment Project Team