



Idaho Water Resources Board

A Comparison of Treatment Technologies to Treat Algae through Pilot Testing of a New Surface Water Source



PNWS AWWA Conference

Presenters Ben Watson, P.E.

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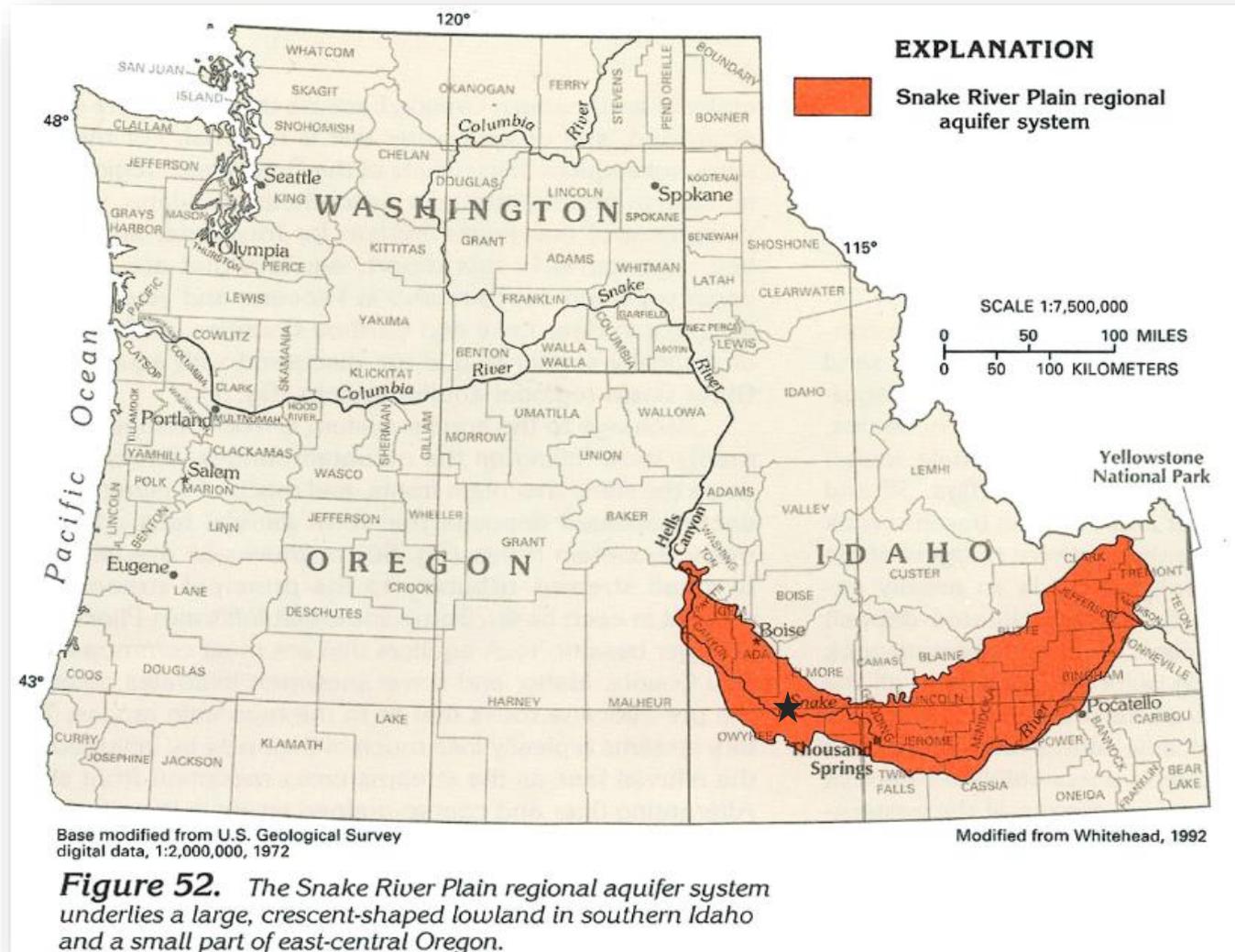
Outline

- Project Overview
- Pilot Plant Location
- 2017 Pilot Plant Operation Review
- 2018 Pilot Plant Operation
- Process Comparison

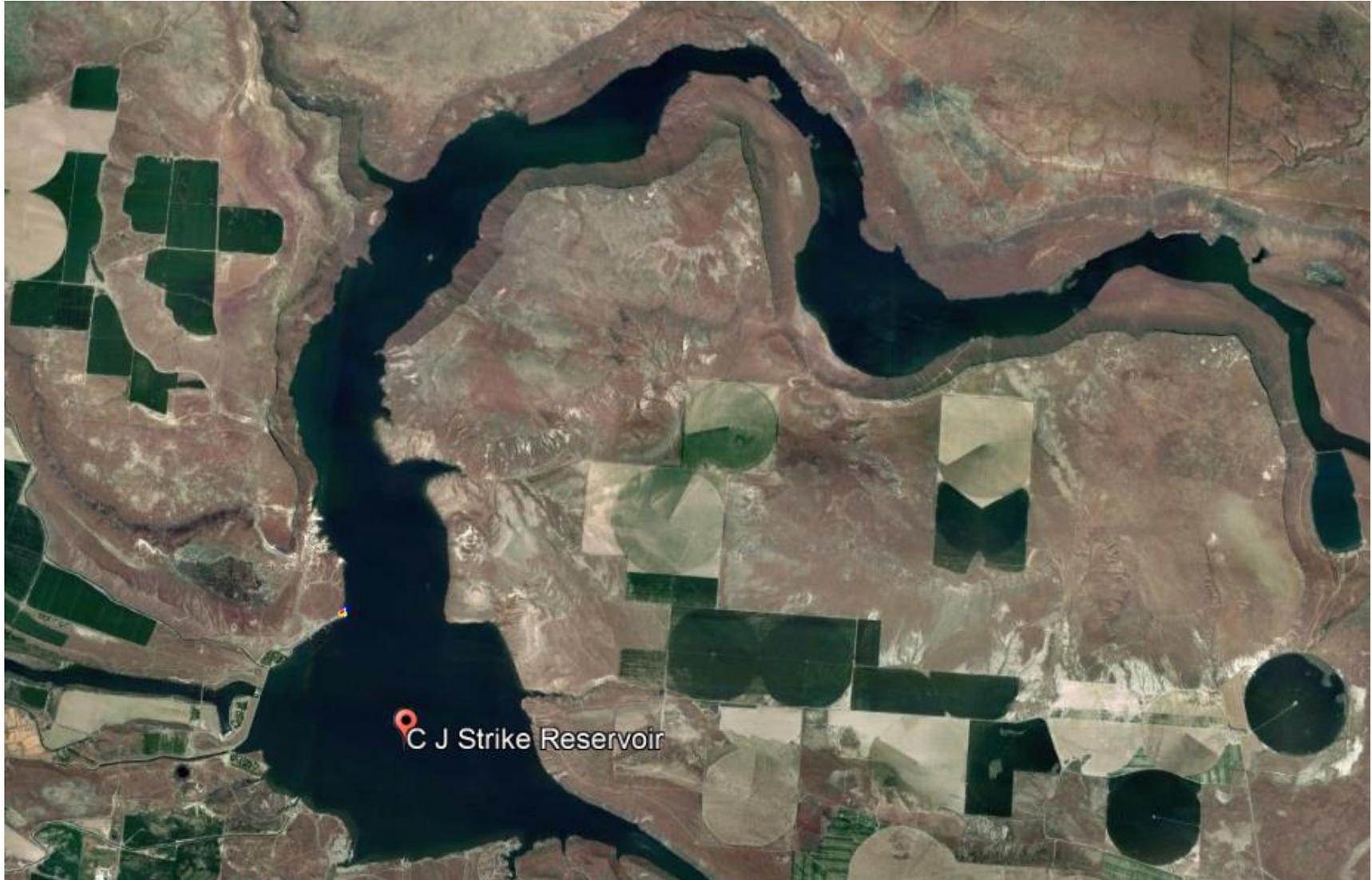


Filter and DAF Trailer

Project Background



New Drinking Water Source



Pilot Plant Location

- Access to reservoir water
- Proximity to intake structure
- Accessible utilities (i.e. Power)



Pilot Plant Location

- **Constraints:**
 - Limited cell phone service
 - Limited access to potable water
 - Health & Safety Provisions



Initial Data Review

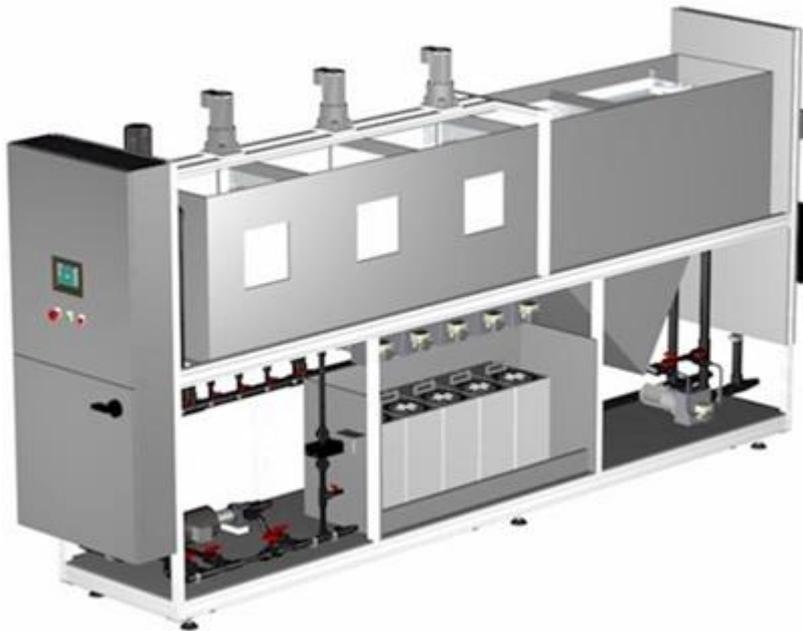
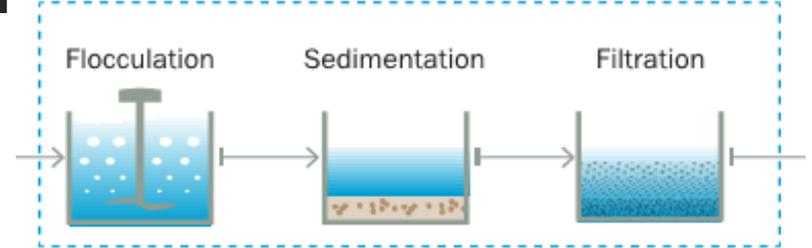
- Limited Historical Data
- Water Supply Planning Study by SPF Water Engineering
 - Low Turbidity, low-modest TOC
 - Average nutrients
 - Conventional filtration recommended by SPF

Raw Water Sampling (SPF 2016)				
Parameter	Unit	January	August	MCL
Turbidity	NTU	3.1	3.4	--
Total Organic Carbon	mg/L	1.0	1.6	--
Nitrate (as N)	mg/L	2.1	0.9	10
Nitrite (as N)	mg/L	0.02	0.03	1

2017 Pilot Plant System

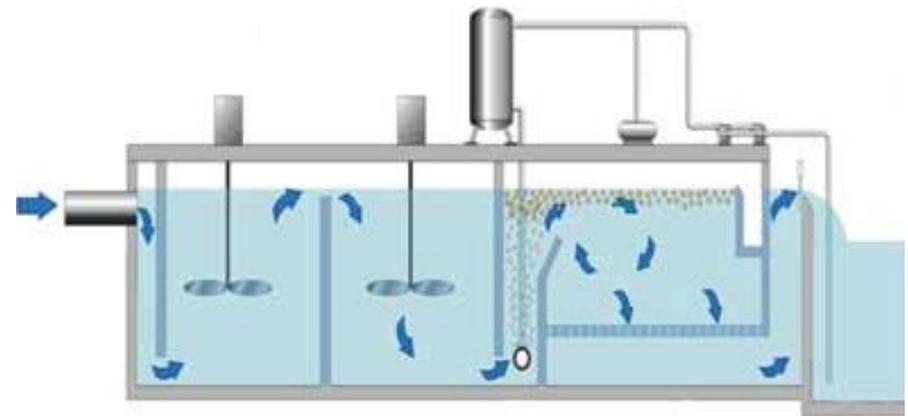
- Pilot Conventional Treatment
- Packaged system provided by vendor

2017 Pilot Study



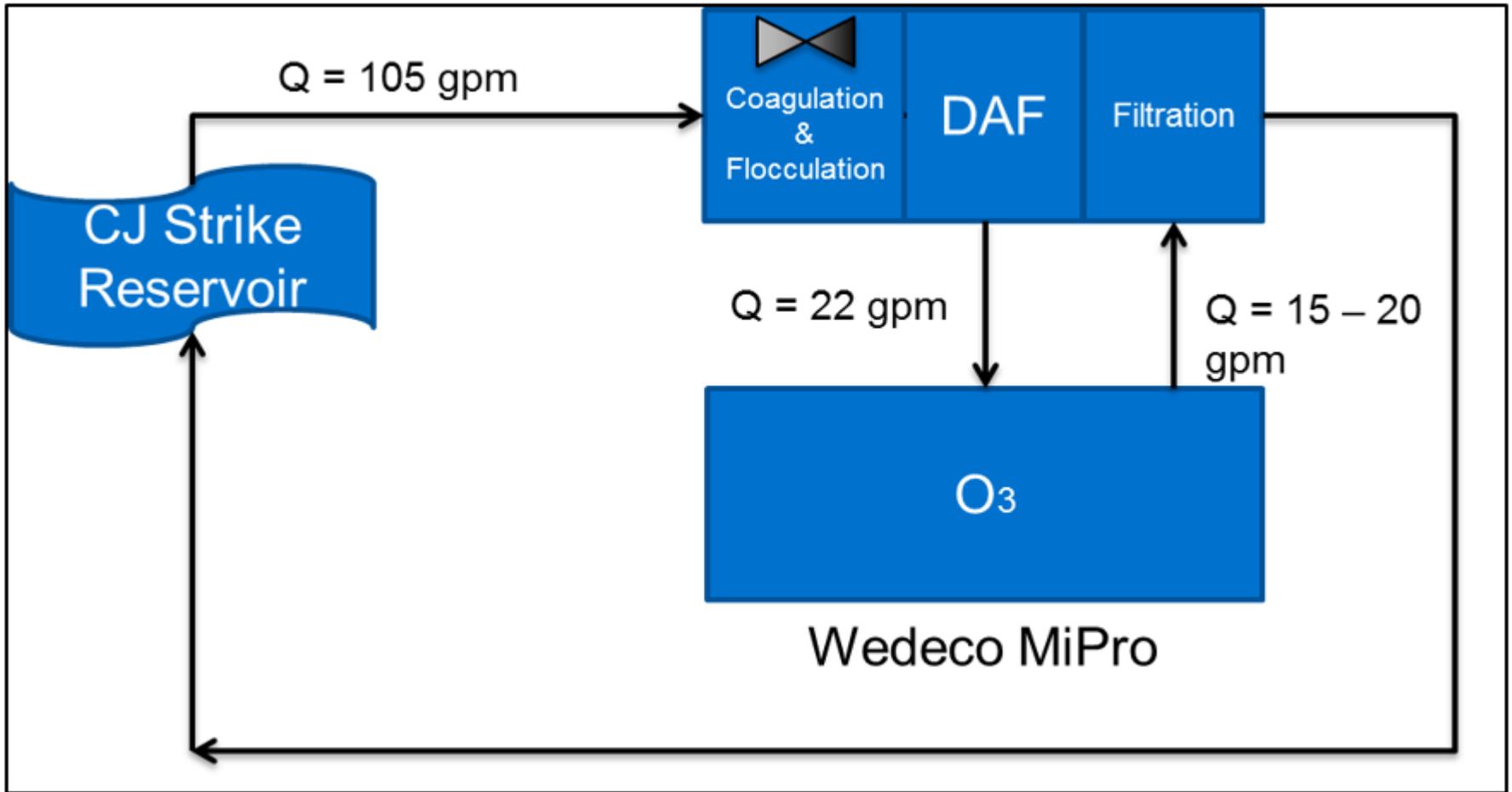
2017 Results

- Ended pilot early in September
- Conventional filtration plausible when algae not present
- Potential Algae Solutions
 - Covered Pre-Sed Basins
 - DAF
 - Ozone (*Potential Bromate*)
 - *Filtration*
- Proposed 2018 Pilot Plant Work



*Dissolved Air Flotation
Process*

2018 Pilot Plant System

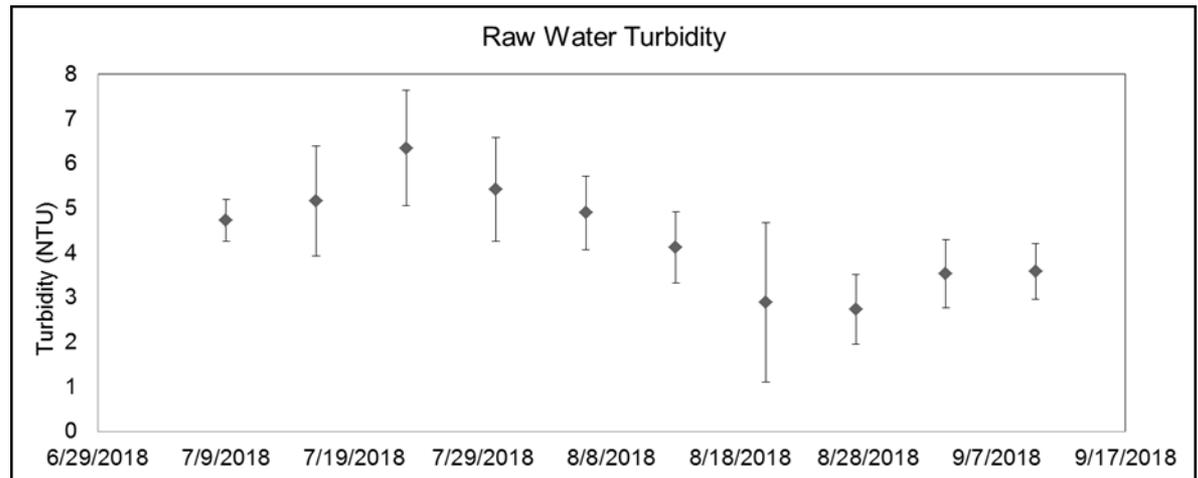
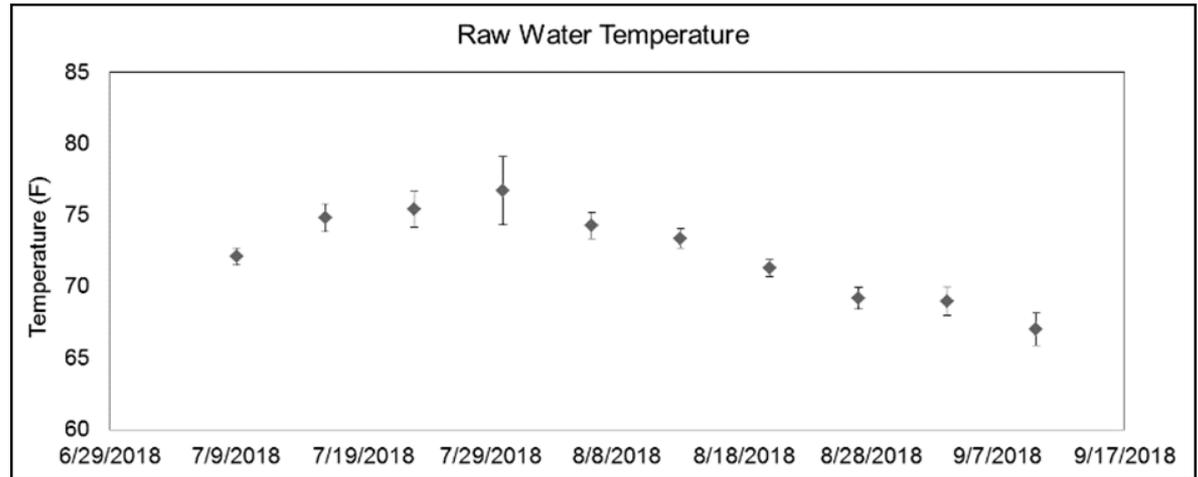


Assembly and Start-Up



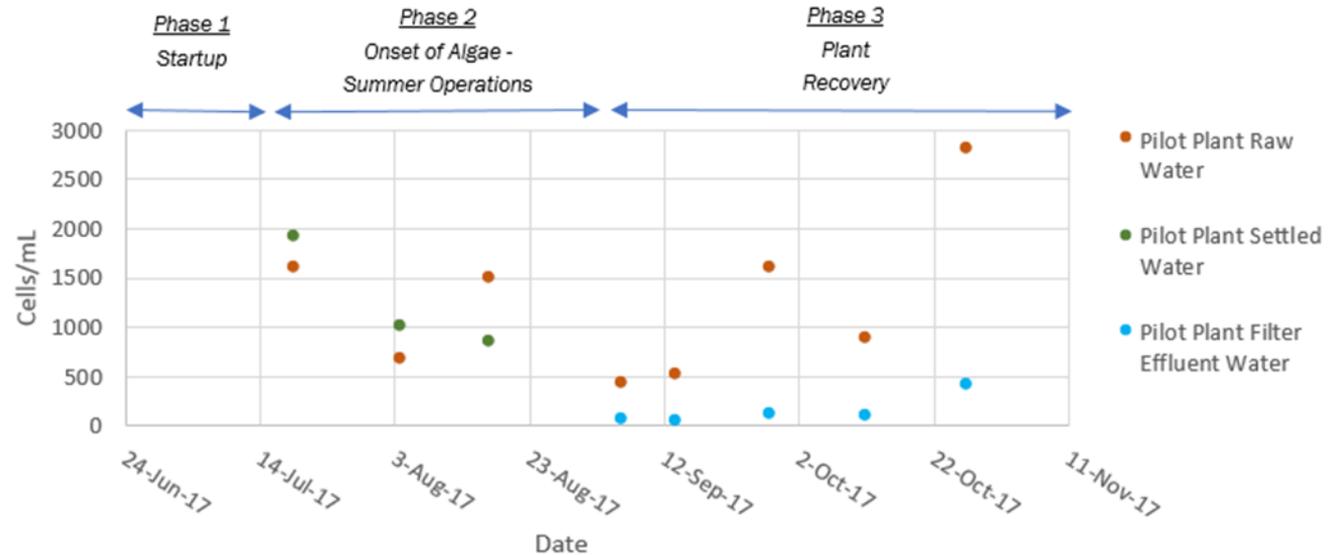
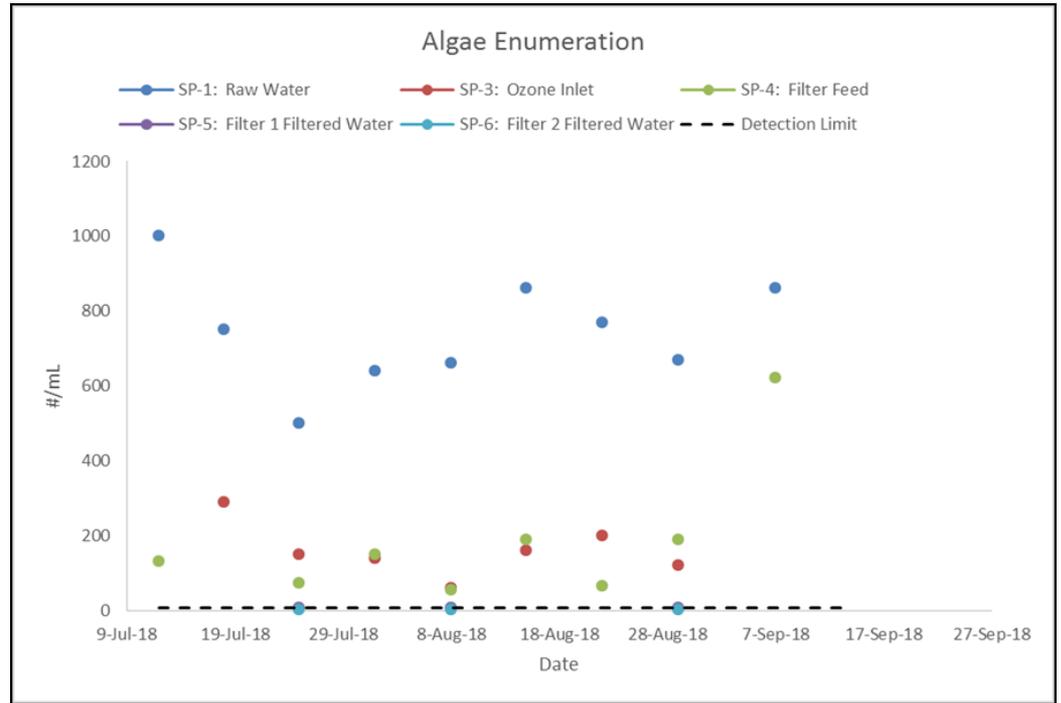
Raw Water Data

- Raw water temperature similar to 2017
- Raw water turbidity lower than 2017



Raw Water Data

- Algae Count higher in 2017



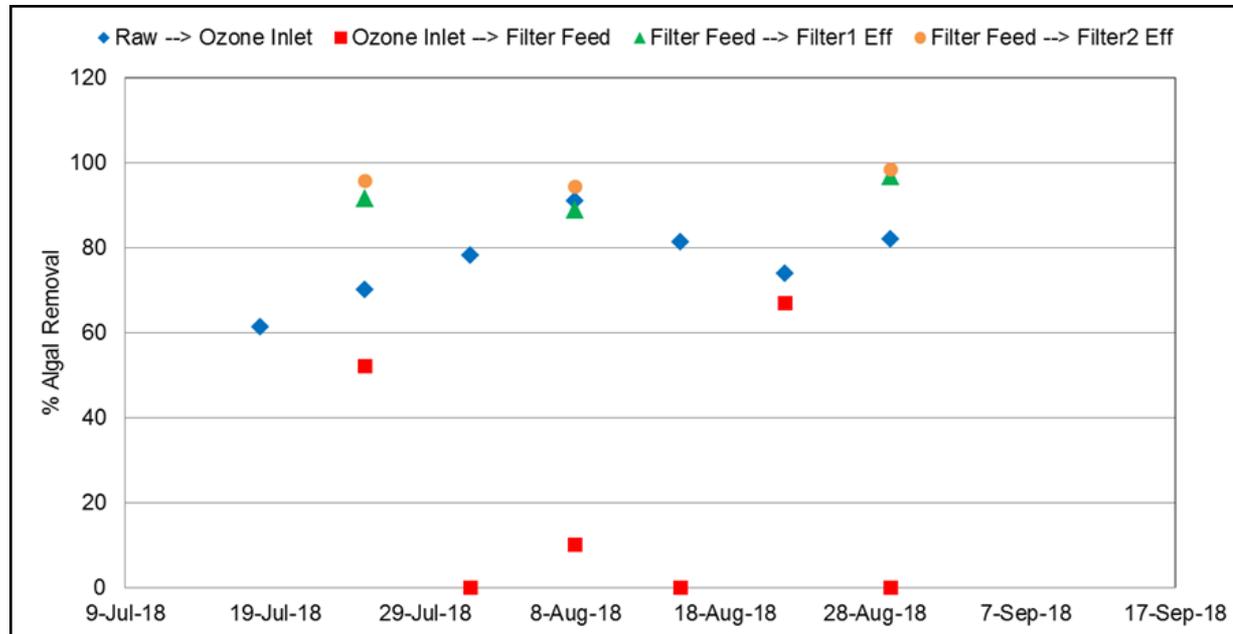
DAF Operations

- Flow 105 GPM
- Coagulant
 - PACL 30-40 mg/L
 - Alum 70 mg/L
- Recycle Rate 10%
- Sludge Production 0.1- 0.25%
- Solids Content 1-5%



DAF Algae Removal

- DAF Algae Remove 77%
- Ozone Algae Removal 20%
- Filter Algae Removal 95%
- System Algae Removal 99%



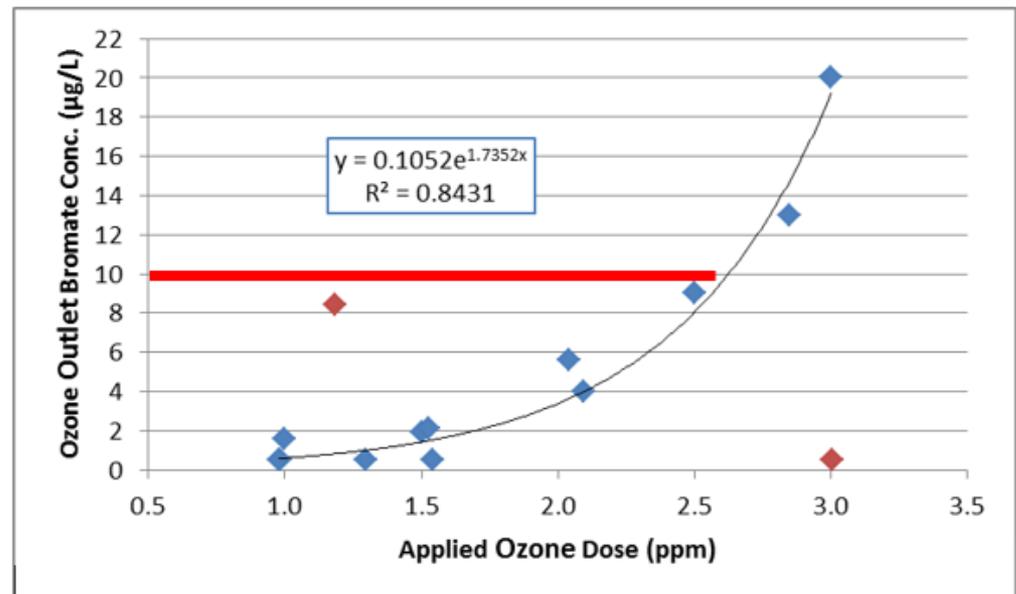
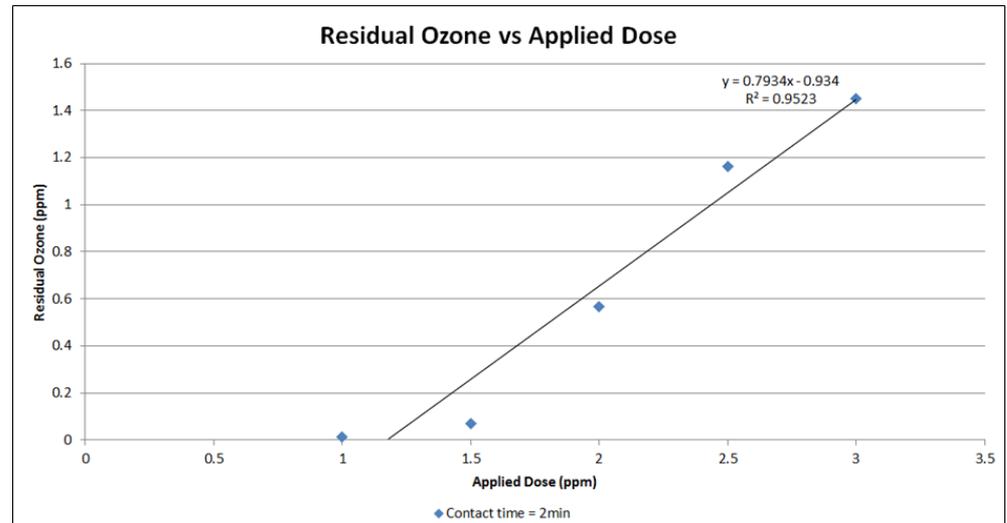
DAF Algae Operational Observation

- Algae blocked skimmer system and was pushed into coagulation tank
- High DAF turbidity was correlated to increase algae counts
- Algae was observed growing in filter columns both years



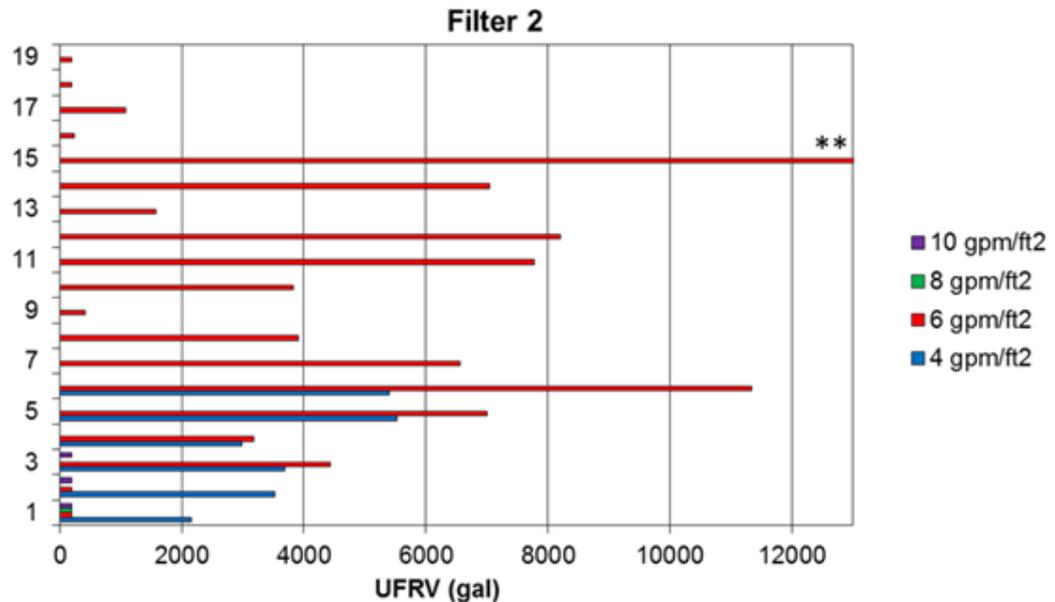
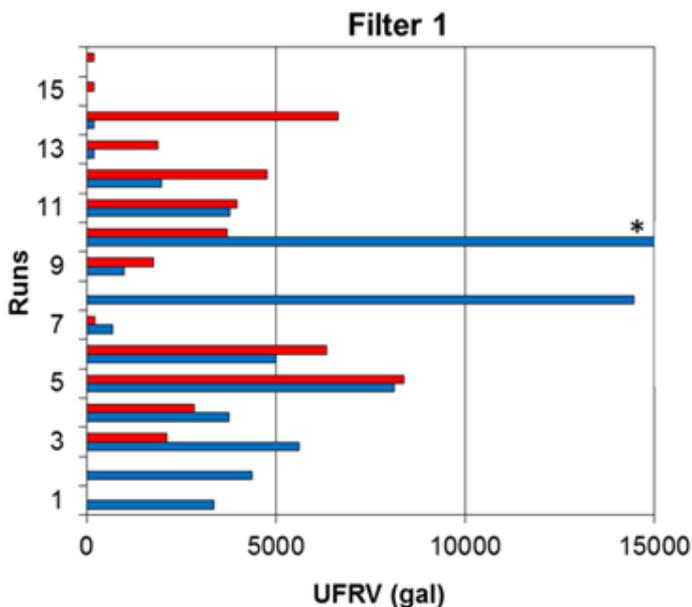
Ozone Application

- Breakthrough testing suggests an applied dose of 2 ppm
- Average 40 mg/L Bromide in Raw Water
- Maximum dose of 2.5 ppm ozone to limit bromate formation potential.
- No observable impact on filter operations



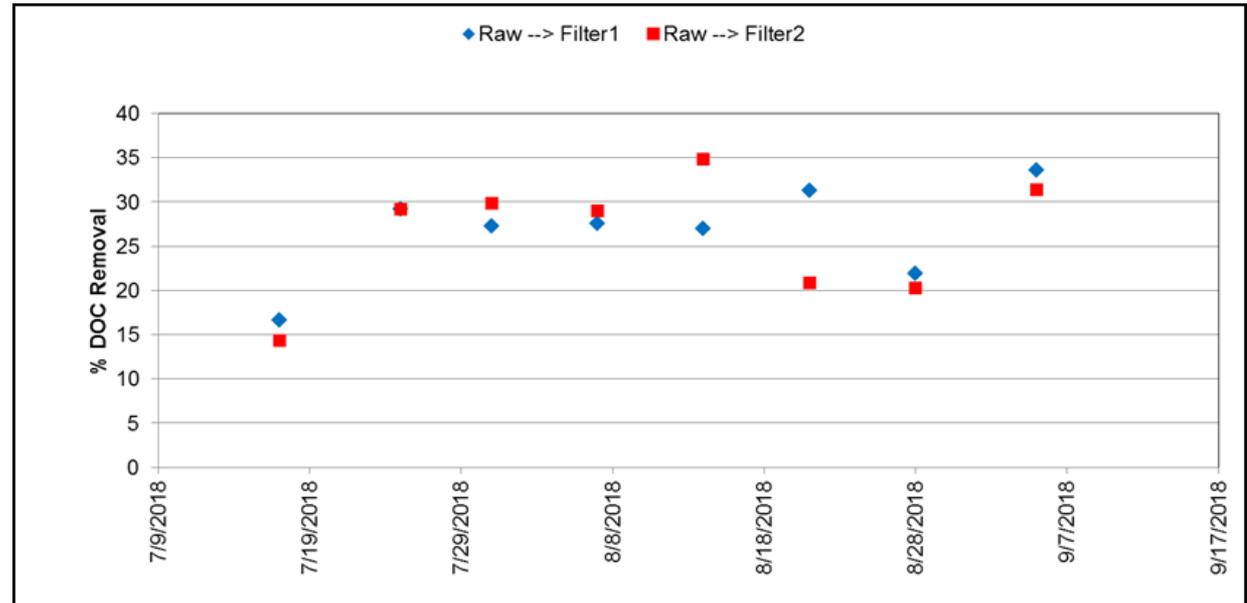
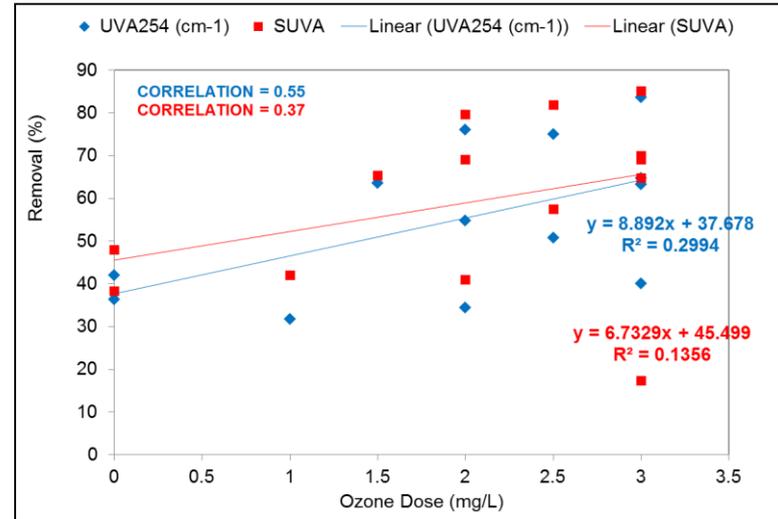
Filter Loading Rates

- GAC Media – 4 gpm/ft²
 - Average Run 6,000 gal/ft²
- Anthracite Media – 6 gpm/ft²
 - Average Run 6,000 gal/ft²
- Heavily Influenced by DAF Operation



DOC Removal

- Average 35% DOC Removal Achieved.
- No Difference between GAC and Anthracite
- UVA254 Correlated to Ozone Dose



Comparison Overview

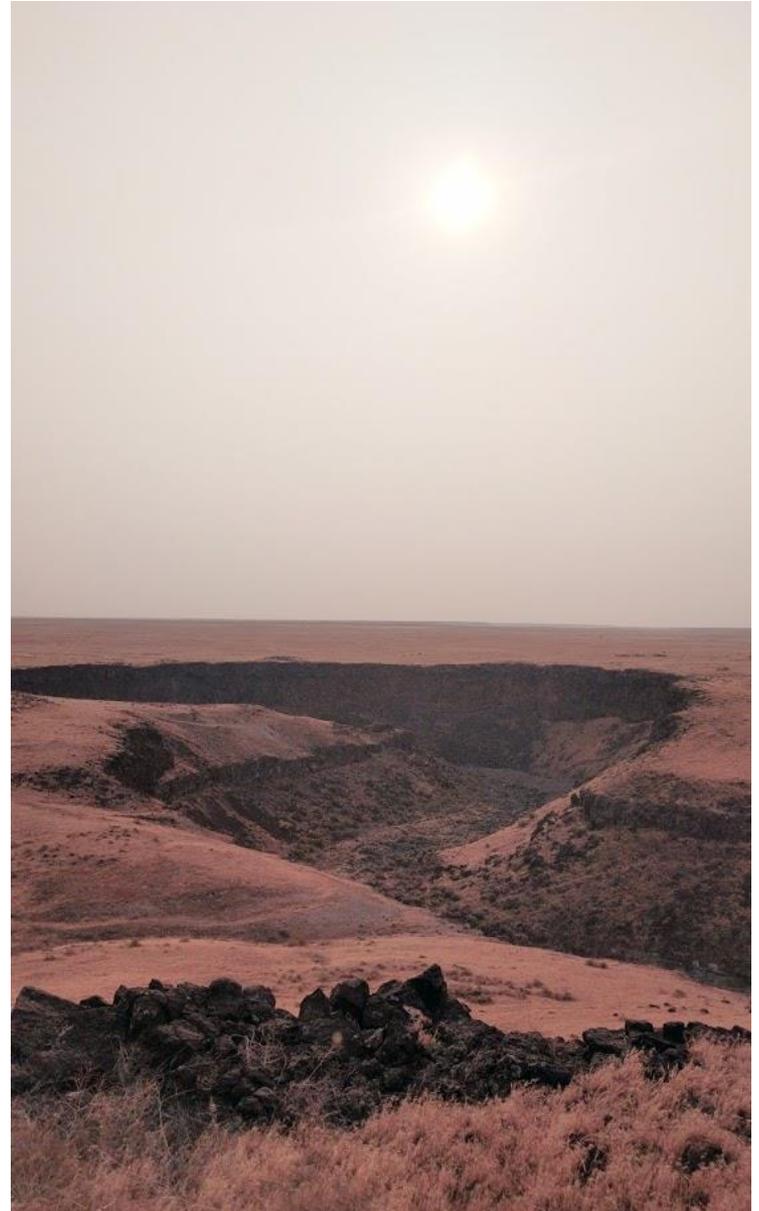
- DAF performed similar to Sedimentation prior to 2017 algae upset
- Very high UFRV's are achievable outside of algae period
 - Observed 7,000-15,000 gal/ft²
- Disinfection byproducts (TTHM, HAA5) were below drinking water limits both years
- DAF maintained acceptable filter runs through the algae period

Conclusions from 2018

- DAF can consistently produces <2.0 NTU
- DAF demonstrated an improved unit filter run time compared to sedimentation
- Acceptable loading rates are 4 gpm/ft and 6 gpm/ft for GAC and Anthracite respectively
- GAC and Anthracite achieved typical DOC removal
- Recommended Ozone dose will not result in excess Bromate formation

Special Thanks To:

- Xylem Operators
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 - Tyler Milko
- Brown and Caldwell Field Staff
 - Emily O'Marrow
 - Andrea Leonard





Questions?

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**Brown AND
Caldwell**

DAF Pilot Operations

Parameter	Values
DAF Influent Flow	105 gpm
Polymer Type	Ammonium Chloride Cationic and Dimethylamine Epichlorohydrin Copolymer
Coagulant Type	Polyaluminum Chloride and Aluminum Sulfate
Number of Flash Mix Tanks	1
Total Flash Mix Volume	620 gal
Number of Flocculation Tanks	2
Total Flocculation Volume	620 gal
Recycle Rate	10%
Saturator Pressure	80 psig
Sludge Production	0.1–0.25%
Sludge Solids	1–5%

Ozone Pilot Operation

Parameter	Values
Ozone Influent Flow	10–22 gpm
Applied Ozone Dose	0–3 mg/L
Ozone Injection Type	Sidestream Venturi and PRO ₃ MIX
Ozone Contact Volume	36 gal. (total, internal) 250 gal. (added)
Contact Time	1.5 – 30 Minutes

Filter Operations

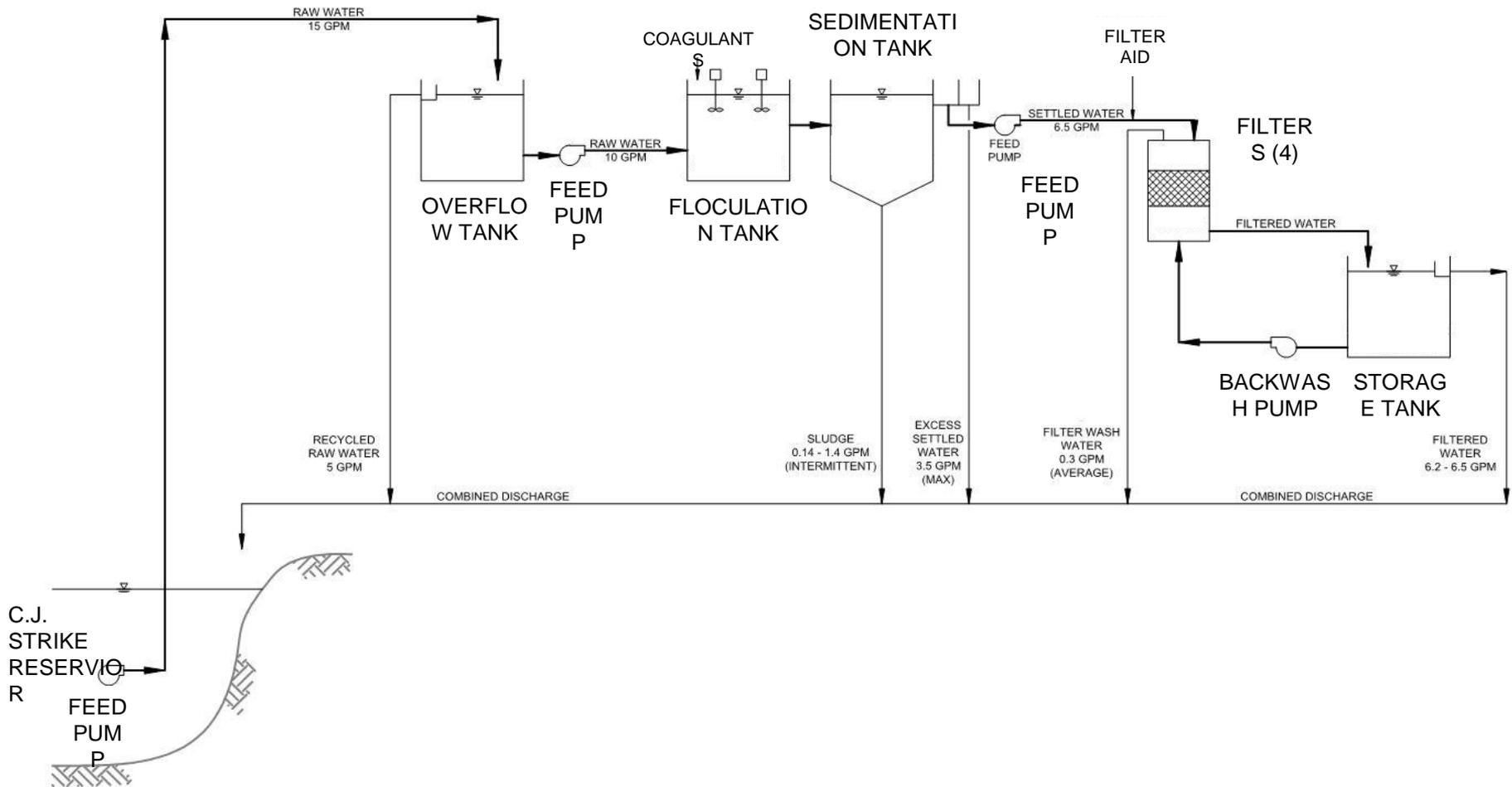
Parameter	Values
Filter Influent Flow (each)	4–12 gpm
Filter Aid Type	Emulsion Polyacrylamide Polymer
Number of Filters	2
Filter Surface Area (each)	1 ft ²
Filter #1 Media Bed Type/Depth	Sand = 12 in. Exhausted GAC = 48 in.
Filter #2 Media Bed Type/Depth	Sand = 12 in. Anthracite = 48 in.
Max. Filtration Headloss	10 feet of Water Column

Media	Effective Size (mm)	Uniformity Coefficient
Exhausted GAC	0.88 (MPD* = 1.46)	1.7
Anthracite	1.09	< 1.45
Sand	0.45–0.55	< 1.4

Filter Backwash

Phase	Rate	Duration
Procedure #1 (Used from July 12 to July 24)		
1: Air Scour	5 scfm/ft ²	2 min.
2: Air Scour Plus Low-Rate Rinse	5 scfm/ft ² (air) 5 gpm/ft ² (water)	1 min.
3: High-Rate Rinse	25–30 sgpm/ft ²	8 min.
Procedure #2 (Used from July 24 to end of pilot)		
1: Air Scour	5 scfm/ft ²	2 min.
2: Air Scour Plus Low-Rate Rinse	5 scfm/ft ² (air) 5 gpm/ft ² (water)	1 min.
3: High-Rate Rinse*	25–30 sgpm/ft ²	2 min.
4: Air Scour	5 scfm/ft ²	2 min.
5: Air Scour Plus Low-Rate Rinse	5 scfm/ft ² (air) 5 gpm/ft ² (water)	1 min.
6: High-Rate Rinse	25–30 gpm/ft ²	7–8 min.
7: Quiescent Settling Period for filter stratification	no flow	10 min
8: Filter to Waste Period**	No automation provided based on time during pilot testing.	

2017 Pilot Plant Process Flow Diagram



2018 Pilot Plant Process Flow Diagram

