American Water Works Association
Pacific Northwest Section

Jacobs
Challenging today.
Reinventing tomorrow.

High Rate Filtration Pilot Study and the Impacts of the Chlorine Shortage

May 4th, 2023

Tessora Young

PNWS AWWA Conference 2023

Kennewick, WA

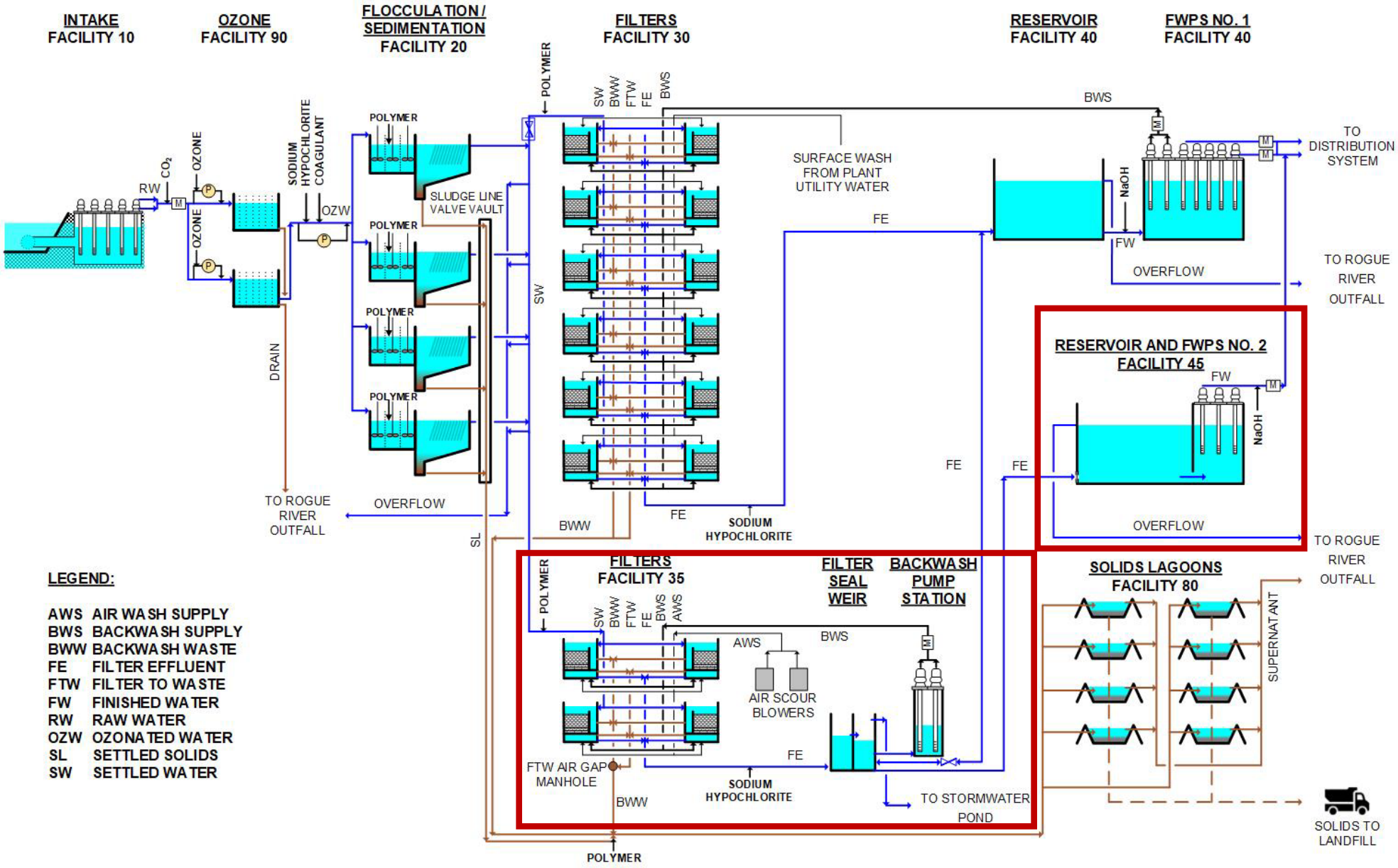
Overview

- Facility Overview
- Goals for Piloting
- Pilot Filter Layout
- Results and Discussion
- Key Take Aways

Facility Overview

Facility Overview – Robert A. Duff Water Treatment Facility

Facility Overview – Process Flow Diagram



Goals for Piloting

Why do we run pilot testing?

- For regulatory approval
- Test high filtration rate
- Compare media configurations
- Capitol investment cost savings
- Validate performance before construction

Pilot Filter Layout

Pilot Testing Plan

- Operate concurrently with 2021 operating season
- Test two filter media configurations and control column
- Turbidity Performance Criteria:
  - EPA Regulations: <0.3 NTU 95% of the time, <1.0 NTU 100% of the time
  - MWC Performance Goal: <0.1 NTU 95% of the time, <0.3 NTU 100% of the time

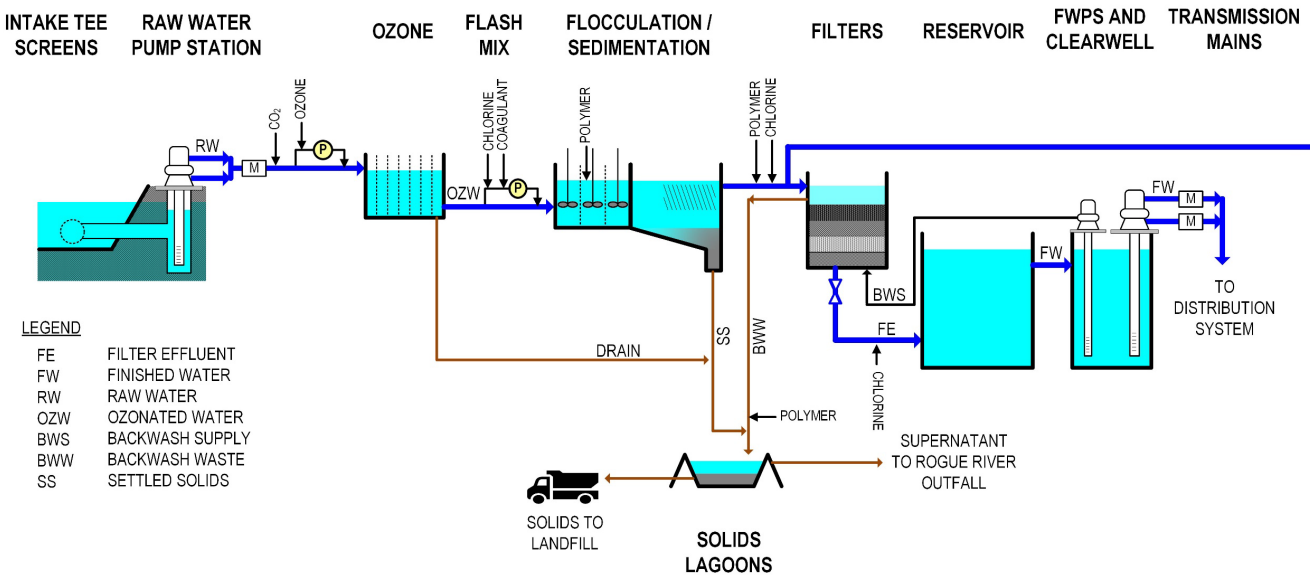
- Operational Goals

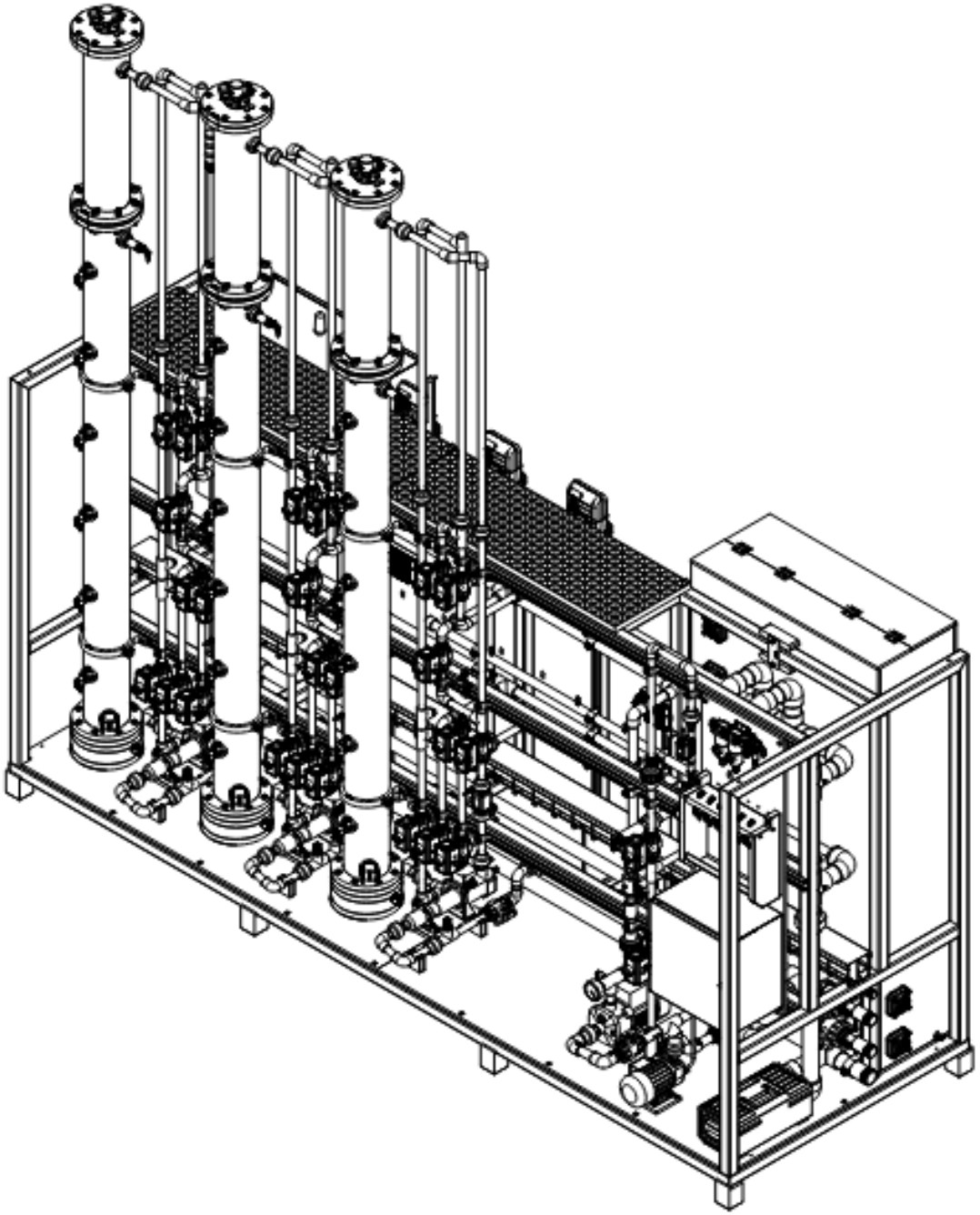
Parameter	Unit	Goal
Unit Filter Run Volume (UFRV)	gal/ft^2	10,000
Maximum Loading Rate	gpm/ft^2	12.0
Turbidity Breakthrough Level	NTU	0.1
Terminal Headloss	feet	8.0

Filter Media Configuration

Parameter	Control Column	Column 1 (PF01 – 69”)	Column 2 (PF02 – 84”)
Anthracite Depth	18-inches	60-inches	72-inches
Anthracite Effective Size	1.0-mm	1.4-mm	1.5-mm
Sand Depth	9-inches	9-inches	12-inches
Sand Effective Size	0.5-mm	0.6-mm	0.6-mm
Garnet Depth	3-inches	N/A	N/A
Garnet Effective Size	0.3-mm	N/A	N/A
L/d	1,168	1,470	1,727
Total Media Depth	30-inches	69-inches	84-inches

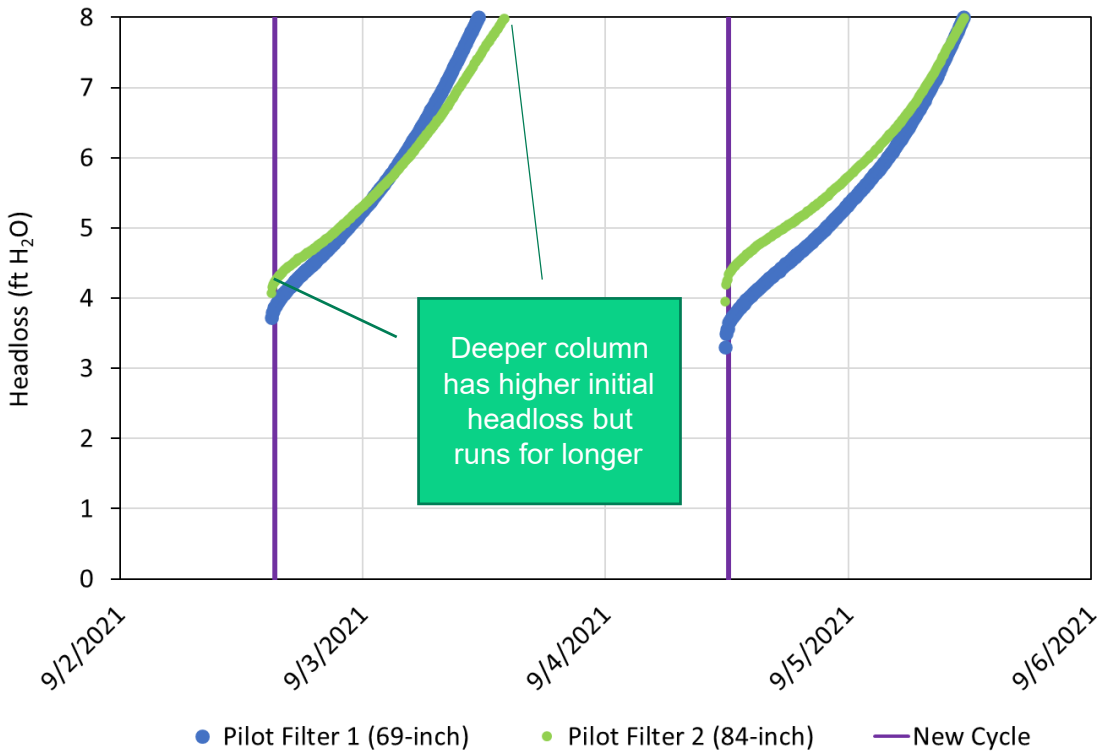
Pilot Filter Skid Layout

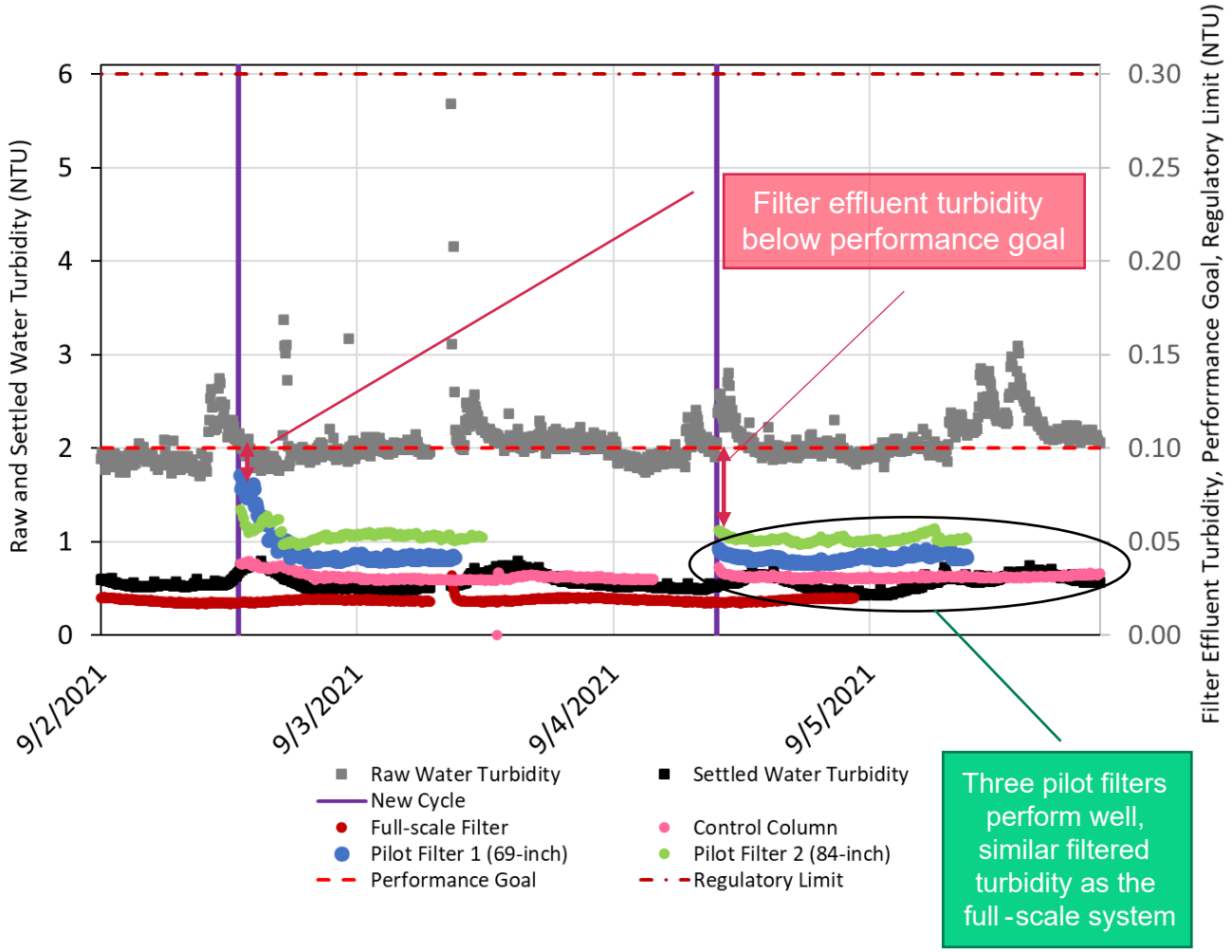




Results and Discussion

Results – Example Filter Run (12 gpm/sf loading)





Initial Challenges – Chlorine Shortage June/July 2021

KUOW.ORG 94.9

npr Network

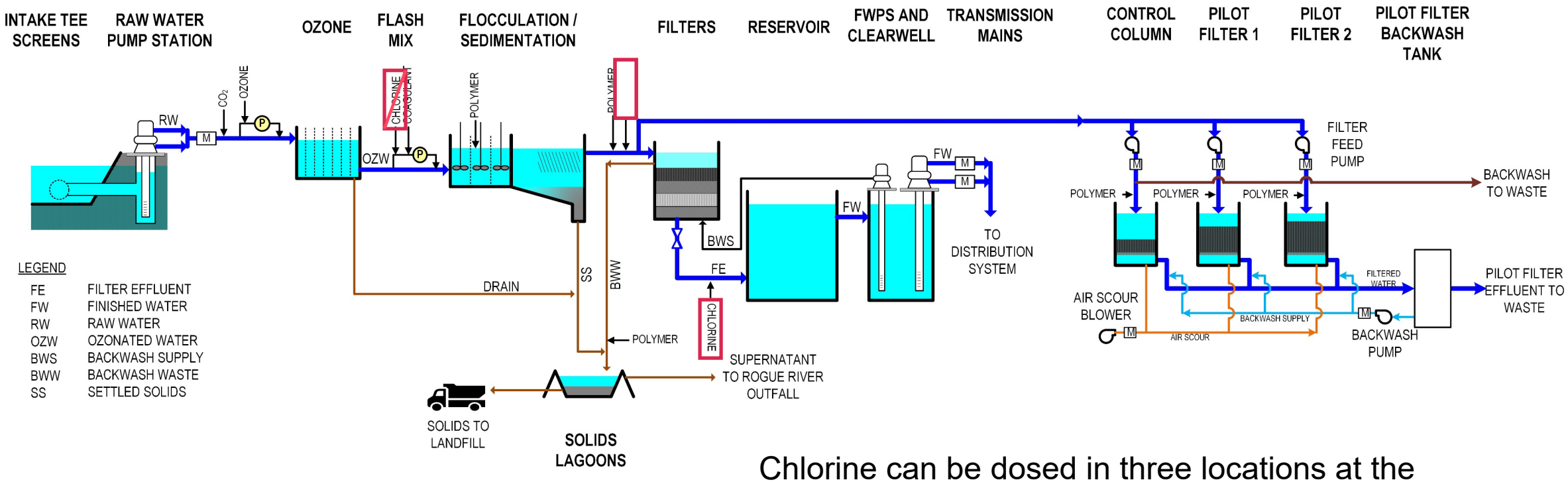
Chlorine shortage hits Northwest drinking water suppliers

John Ryan

June 18, 2021 / 6:44 pm

Water utilities in Washington and Oregon are scrambling to keep customers supplied with safe drinking water following an equipment failure at the Northwest's main supplier of chlorine.

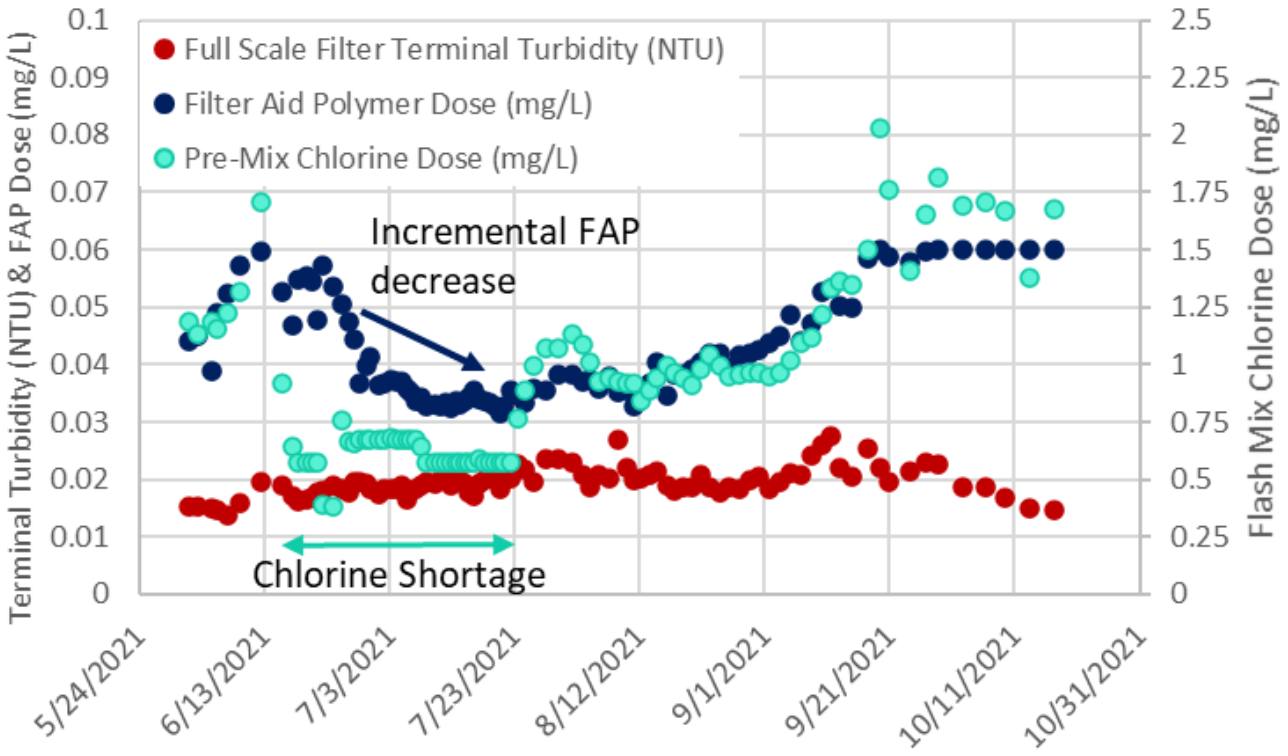
Initial Challenges – Chlorine Shortage June/July 2021



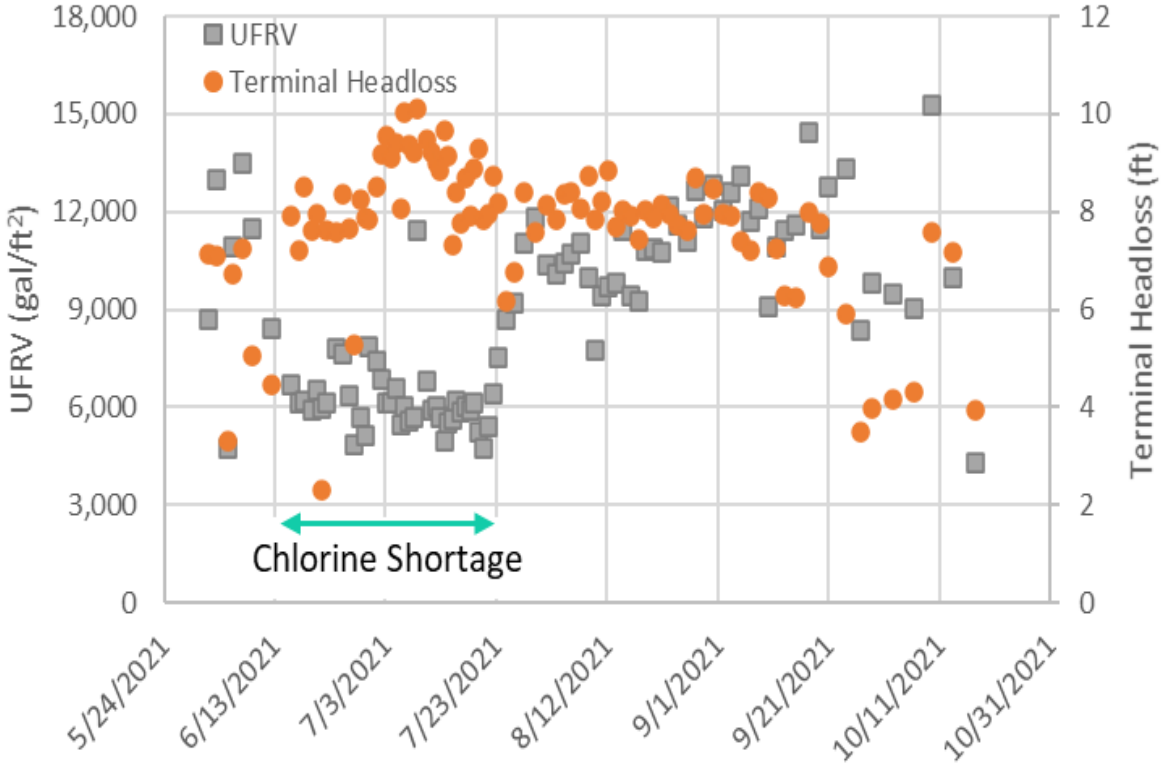
Chlorine can be dosed in three locations at the Duff Water Treatment Facility

Pre-oxidation was limited to preserve hypochlorite for disinfection

Initial Challenges – Chlorine Shortage June/July 2021



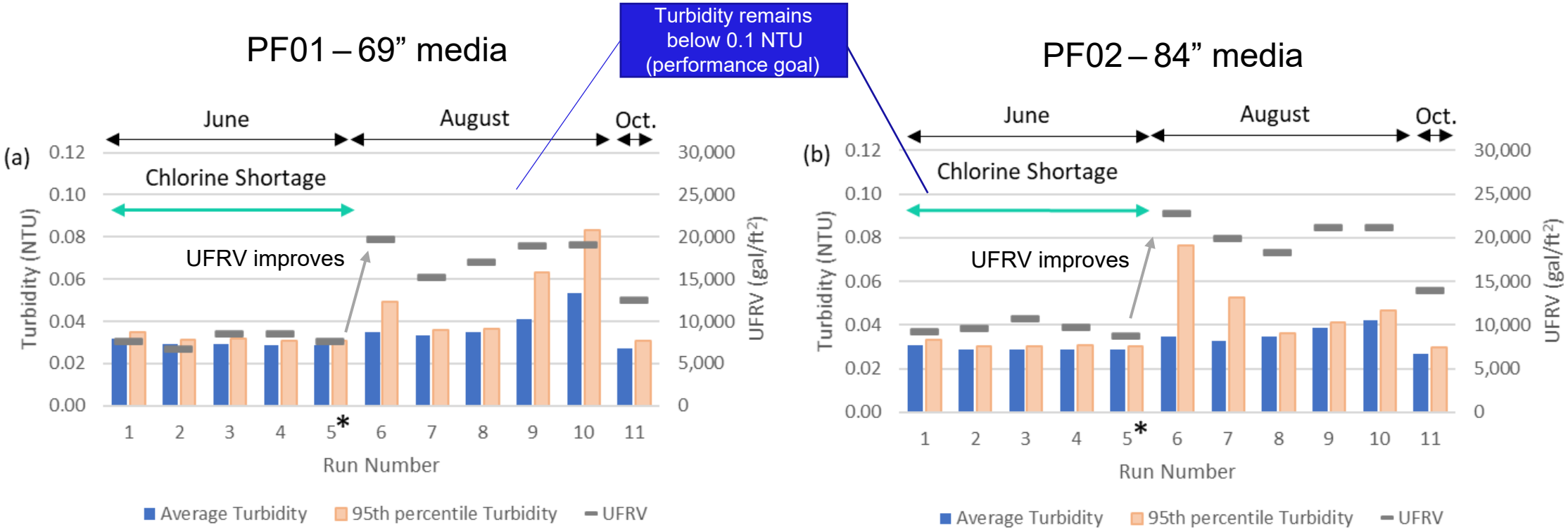
Less pre-oxidation negatively impacted the filter run time and filter aid polymer was decreased in response



Full scale filter performance during the sodium hypochlorite shortage

Initial Challenges – Chlorine Shortage June/July 2021

- Pilot filter performance at 10 gpm/sf loading rate



Results – Performance Results

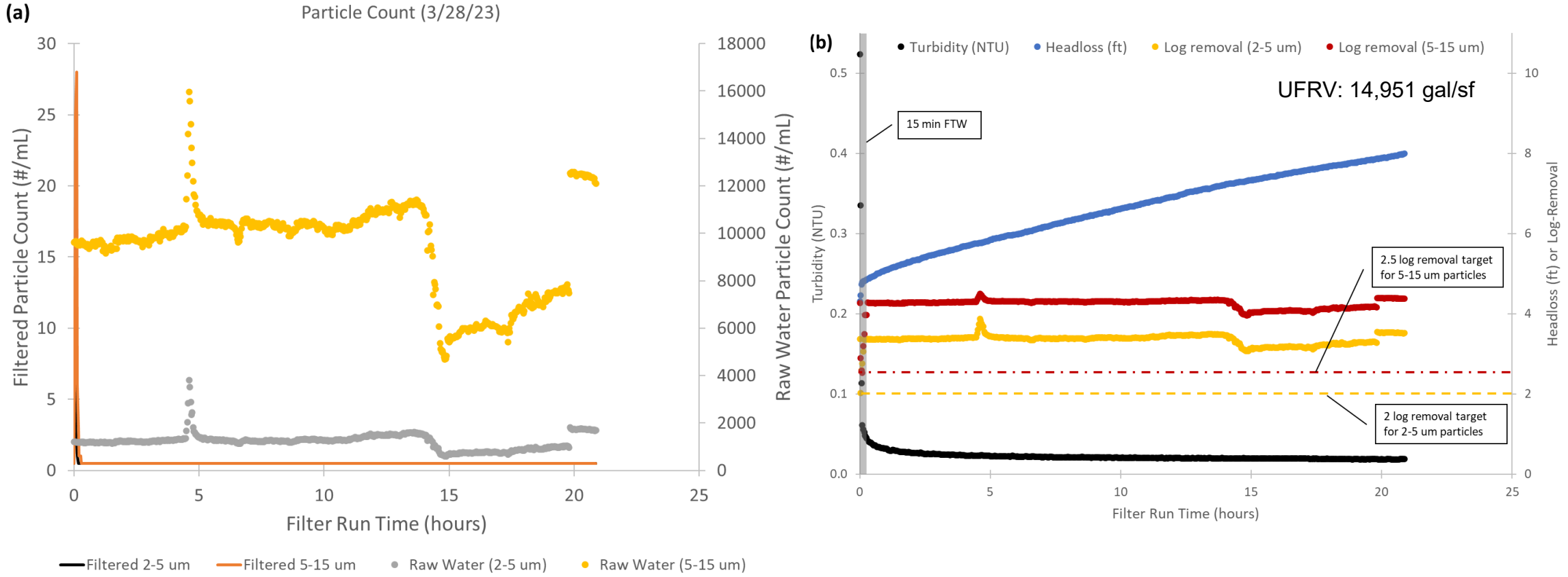
- Turbidity and Hydraulic Efficiency Results

Parameter	PF01 (69-inch Media)	PF02 (84-inch Media)	PF01 (69-inch Media)	PF02 (84-inch Media)	PF01 (69-inch Media)	PF02 (84-inch Media)
	8 gpm/ft ^{2}		10 gpm/ft ^{2}		12 gpm/ft ^{2}	
Percent below 0.1 NTU	99.6 ✓	99.7	100	100	100	100
Percent below 0.3 NTU	100	100	100	100	100	100
Percent below 1.0 NTU	100	100	100	100	100	100
Turbidity Breakthroughs	1 of 10	1 of 10	0 of 11	0 of 11	0 of 24	0 of 23
Average UFRV (gal/ ft^2)	20,500	23,400	12,800	15,000	10,300	11,000
Number of Runs Above 10,000 gal/ ft^2	10 of 10	10 of 10	6 of 11	7 of 11	8 of 24	11 of 23

✓ Meets regulatory requirement, ✓ Meets MWC performance goal

Results – Challenge Testing Spring 2023

- 12 gpm/sf loading rate, 84” pilot column



- Confirm chlorine shortage impacts are distinct from a challenging natural occurrence: Rain event and spring run off

Results – Media Selection

- Pilot filter performance improved after regular chlorine supply was restored
- The deeper media was selected due to consistently higher UFRV

		PF01 (69-inch Media)	PF02 (84-inch Media)	PF01 (69-inch Media)	PF02 (84-inch Media)	PF01 (69-inch Media)	PF02 (84-inch Media)
		8 gpm/ft ^{2}		10 gpm/ft ^{2}		12 gpm/ft ^{2}	
All Runs							
Average UFRV (gal/ft^2)		20,500	23,400	12,800	15,000	10,300	11,000
New Filter Net Production (MGD)		34.9	35.1	42.4	42.8	49.4	49.7
Filter Run Time (hr)		42.7	48.8	21.3	24.9	14.3	15.3
Runs Excluding Chlorine Shortage Data							
Average UFRV (gal/ft^2)		N/A[a]	N/A[a]	17,000	19,500	15,000	15,900
New Filter Net Production (MGD)		N/A[a]	N/A[a]	43.1	43.3	50.9	51.1
Filter Run Time (hr)		N/A[a]	N/A[a]	28.4	32.4	20.8	22.0
[a]Chlorine shortage did not impact the 8 gpm/ft ^{2} filter runs due to the timing of these runs							

Key Take Aways

Key Take Aways

- Pilot testing provides validation for a given site
- Fosters Innovation
- Opportunity for challenge testing
- Things do not always go as planned

Thank you!

Questions?

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Important

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