



Bench-Scale Testing as an Alternative to Pilot Testing

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AGENDA

- Project(s) Background
- Bench Scale Testing Descriptions
- Results Discussion
- Next Steps/Full Scale Results



Background Information

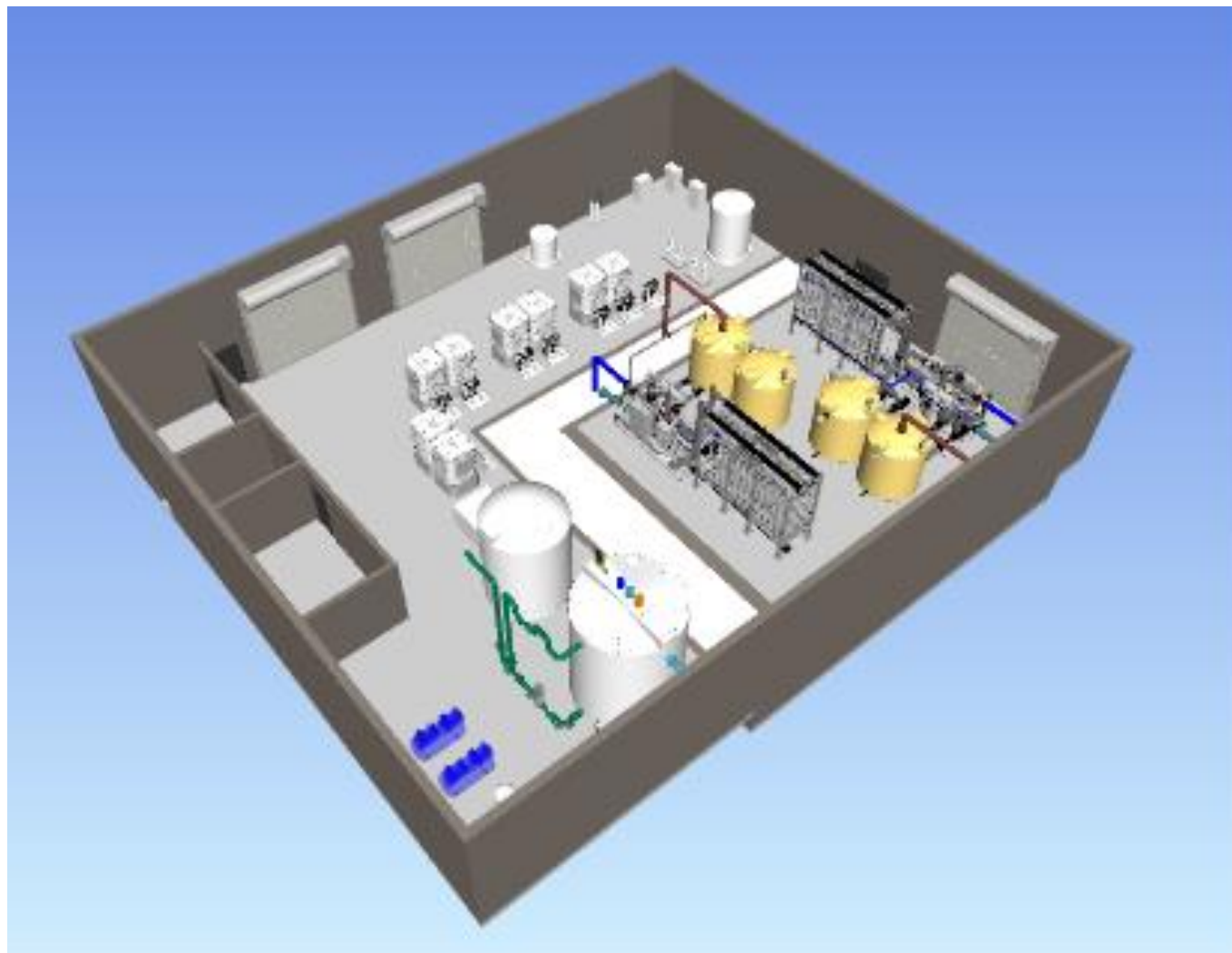
- Public Utility District No. 1 of Skamania County
- Serves City of Carson, WA
- Drinking water sources:
 - Existing direct filtration plant (45 year old)
 - Unable to treat surface water > 2 NTU
 - 1 well for high turbidity/peak demands





Replacement of Existing Plant

- Replacement of existing plant with low-pressure membrane filtration plant
- 30% design effort for funding application
- 1 MGD expandable to 2 MGD
- Limited historic WQ data available





Pilot Requirements

- New filtration technology requires pilot per WAC 246-290-676
- Prequalification process approved two modules:
 - Torray HGUF-2020AN
 - Asahi UNA-620A
- 3-months piloting planned for winter months
- Price ~ \$75k-\$125k



Typical Pilot Unit (Courtesy of Westech)



Pilot Alternative

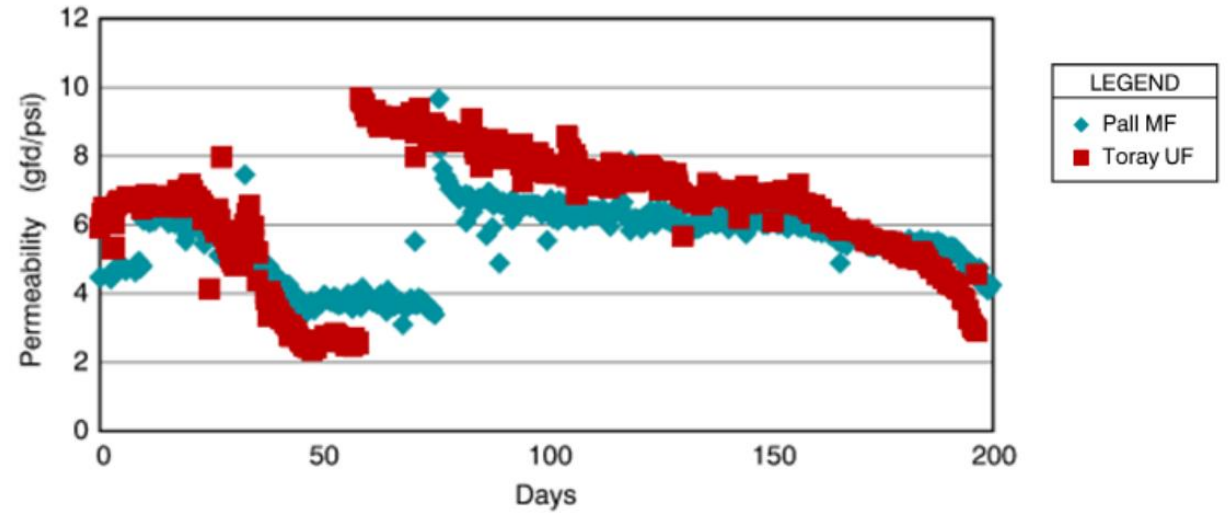
- DOH Small System Waiver
 - Existing well known water source w/5+ years of WQ data
 - DBP formation potential evaluation
 - Algae impact on UF/MF
 - Evaluation of abrasive WQ constituents
 - Prescreening
 - Must include ability to dose coagulant
 - Tours of other facilities for operations





Pilot Alternative

- Bench scale testing along with 1-year of additional WQ data testing proposed
- Bench scale testing to include:
 - Membrane Performance Index (MPI) testing performed by Aria Filtra (formerly Pall water)
 - Simulated Distribution System testing for DBP formation potential evaluation performed by 3rd party lab
- Asahi and Torray Modules considered equal
 - Both on WA DOH approved list of membrane modules per WAC 331-617

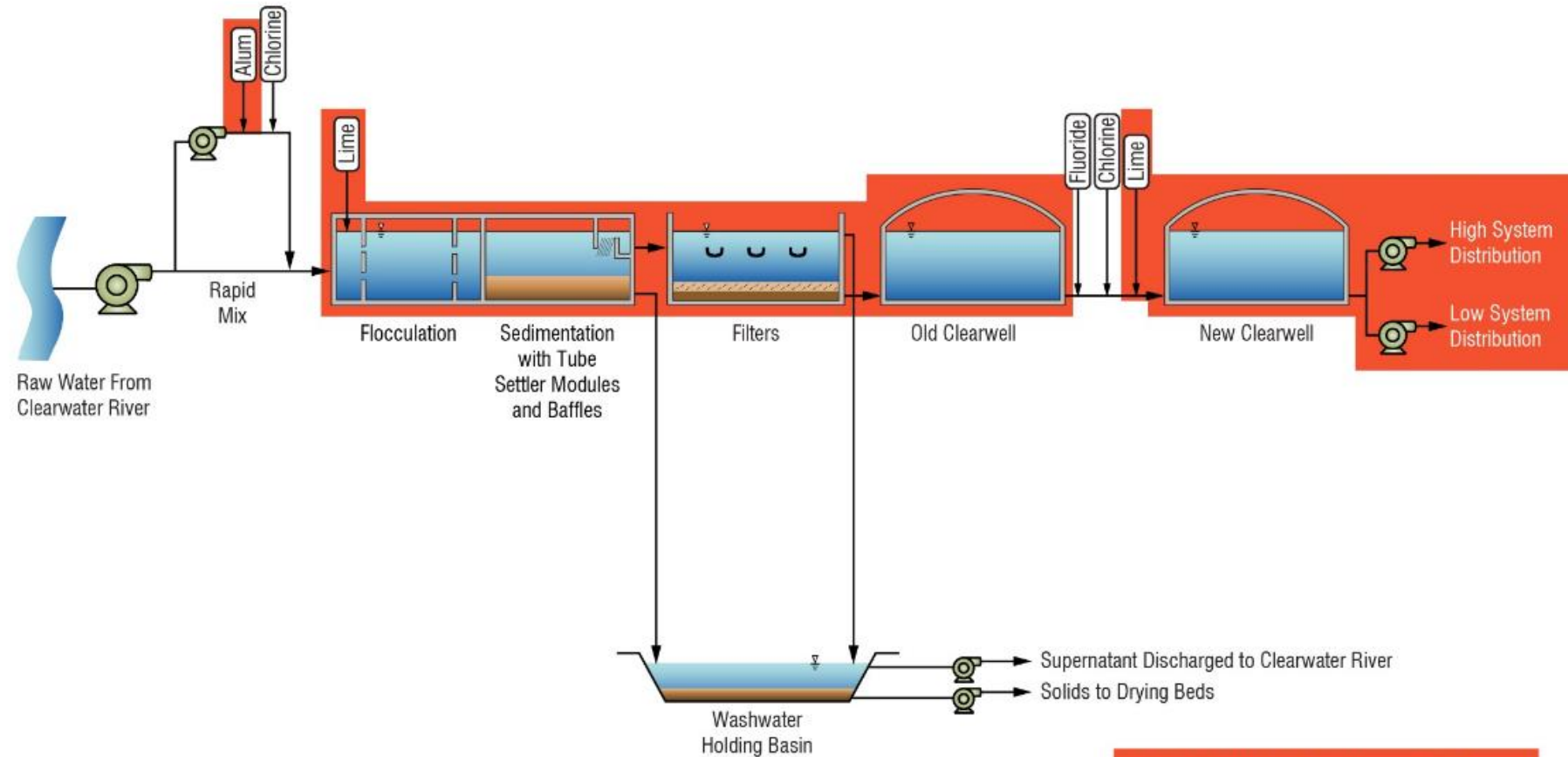


Pall and Torray module performance comparison



Background Information

- Lewiston, ID
- Serves 6,000 residential and commercial metered customers
- Drinking water sources:
 - 7 wells
 - 100-year-old WTP treating Clearwater River



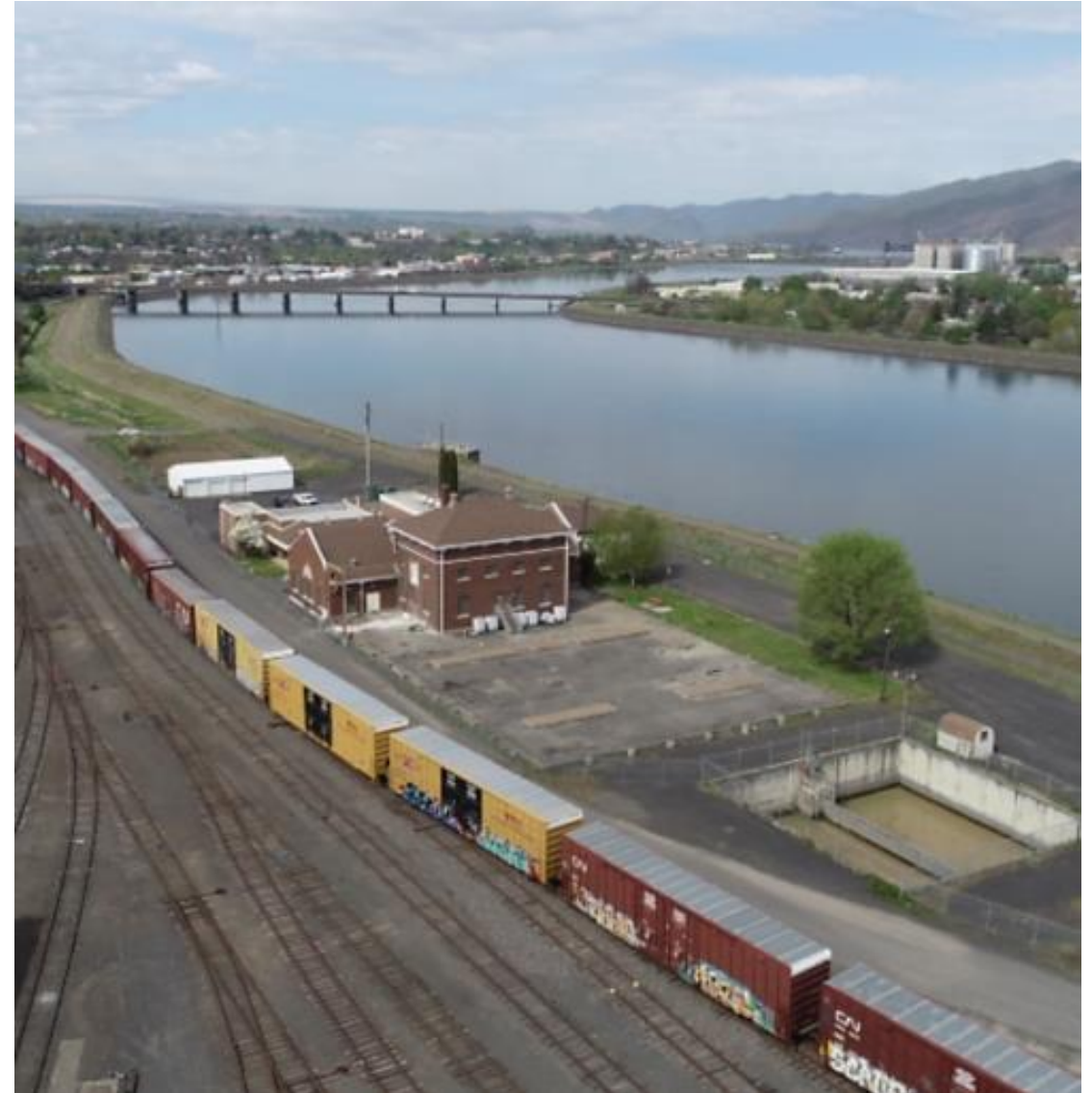
Units highlighted in red have "fatal" or "severe" criticality with no remaining useful life or "unsatisfactory" condition.





Pilot Requirements

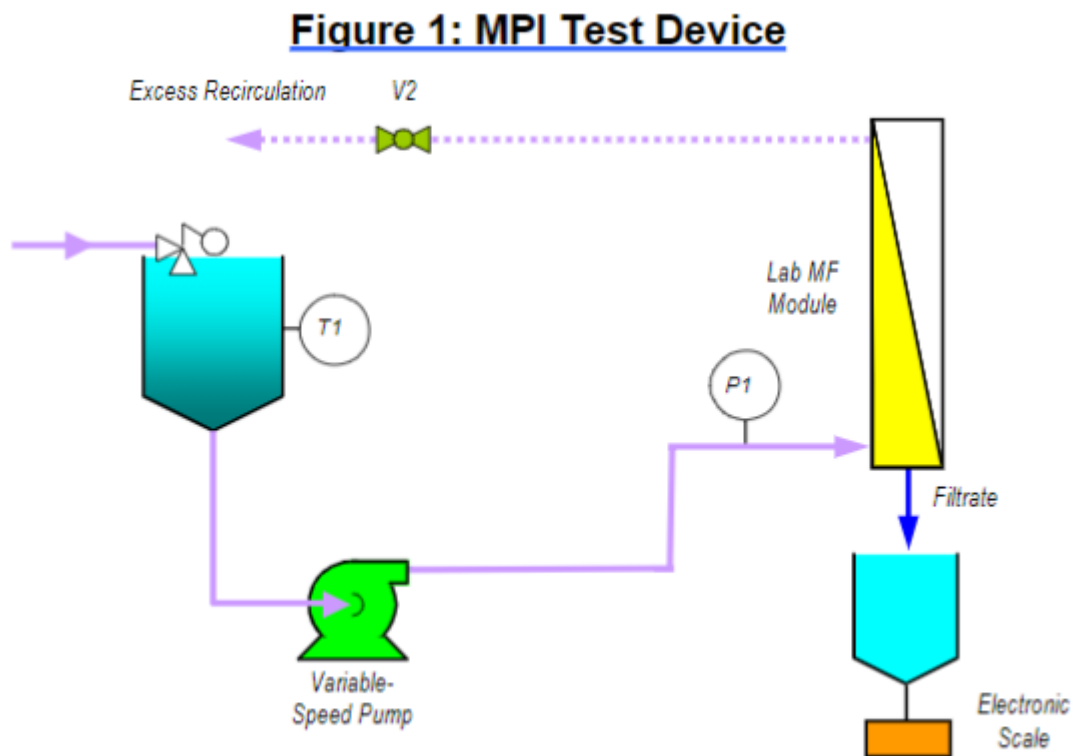
- No pilot required by IDEQ
- Nearby MF Plant for comparison using same water source (Orifino WTP)
- No evaluation of multiple membranes required
- Demonstrate performance and estimate coagulant dose using MPI and SDS testing





Bench Scale Testing Description – MPI Testing

- Raw water sample shipped overnight to University of New Hampshire
- Raw water pumped through “pencil” module
- Pressure and total volume recorded
- Parameters tested on raw water and filtrate at various coagulant doses



Process Flow Diagram for testing procedure



Bench Scale Testing Description – MPI Testing

Results (given for raw, uncoagulated, and coagulated water):

- pH
- Turbidity
- MPI – defined as the slope of the linear graph of TMP vs volume
- TOC/DOC
- SUVA
- Fe and Mn
- Volume treated

Source:	Average Raw Water Feed (Average ± St Dev)	Raw Water Membrane Filtered (Average ± St Dev)
pH	7.26 ± 0.01	7.53 ± 0.02
Turbidity (NTU)	0.90 ± 0.03	0.07 ± 0.01
UV ₂₅₄ (abs/cm)	0.022 ± 0.001	0.016 ± 0.000
MPI		0.14
Est. Flux (GFD)		> 100
TOC (mg/L)	0.72 ± 0.01	
DOC (mg/L)		0.76 ± 0.00
Color (Pt Co units)	UMR ¹	UMR ¹
Fe, total (mg/L)	<0.05 ²	<0.05 ²
Mn, total (mg/L)	<0.005 ³	<0.005 ³

Source:	3.0 mg/L PAX-XL1900 coagulant Membrane Filtered (Average ± St Dev)	6.0 mg/L PAX-XL1900 coagulant Membrane Filtered (Average ± St Dev)
pH	7.71 ± 0.00	7.81 ± 0.00
Turbidity (NTU)	0.05 ± 0.00	0.06 ± 0.00
UV ₂₅₄ (abs/cm)	0.007 ± 0.000	0.009 ± 0.001
MPI	0.06	0.01
Est. Flux (GFD)	>100	>100
TOC (mg/L)		
DOC (mg/L)	0.75 ± 0.03	0.75 ± 0.01
Color (Pt Co units)	UMR ¹	UMR ¹
Fe, total (mg/L)	<0.05 ²	<0.05 ²
Mn, total (mg/L)	<0.005 ³	<0.005 ³



What Does and Doesn't MPI testing Tell you

MPI Testing Indications:

- Starting point for operational settings
- Fouling potential of raw water source
- Optimal coagulant dosing for various water conditions
- General performance of membrane system

DOESN'T give:

- Membrane flux



Scilog FilterTec System for Membrane Performance Index (MPI) Testing at UNH





Simulated Distribution System Testing

Filtrate from MPI samples tested along with existing plant filtrate for comparison

Chlorine dose (at plant rate)

Stored for 5 days @ 20 deg-C

Samples taken for TTHM/HAA-5s

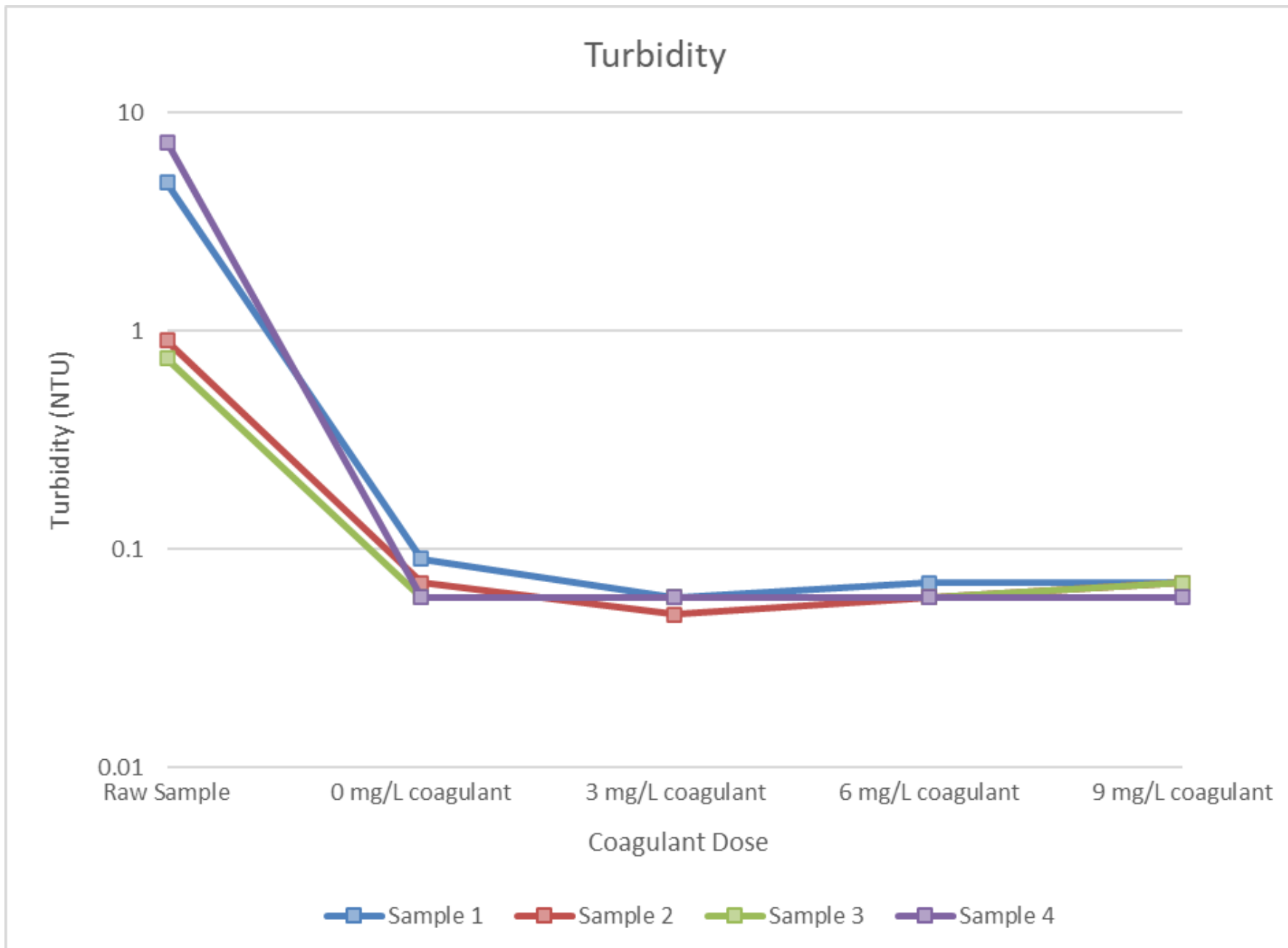
Residual chlorine analyzed for chlorine decay

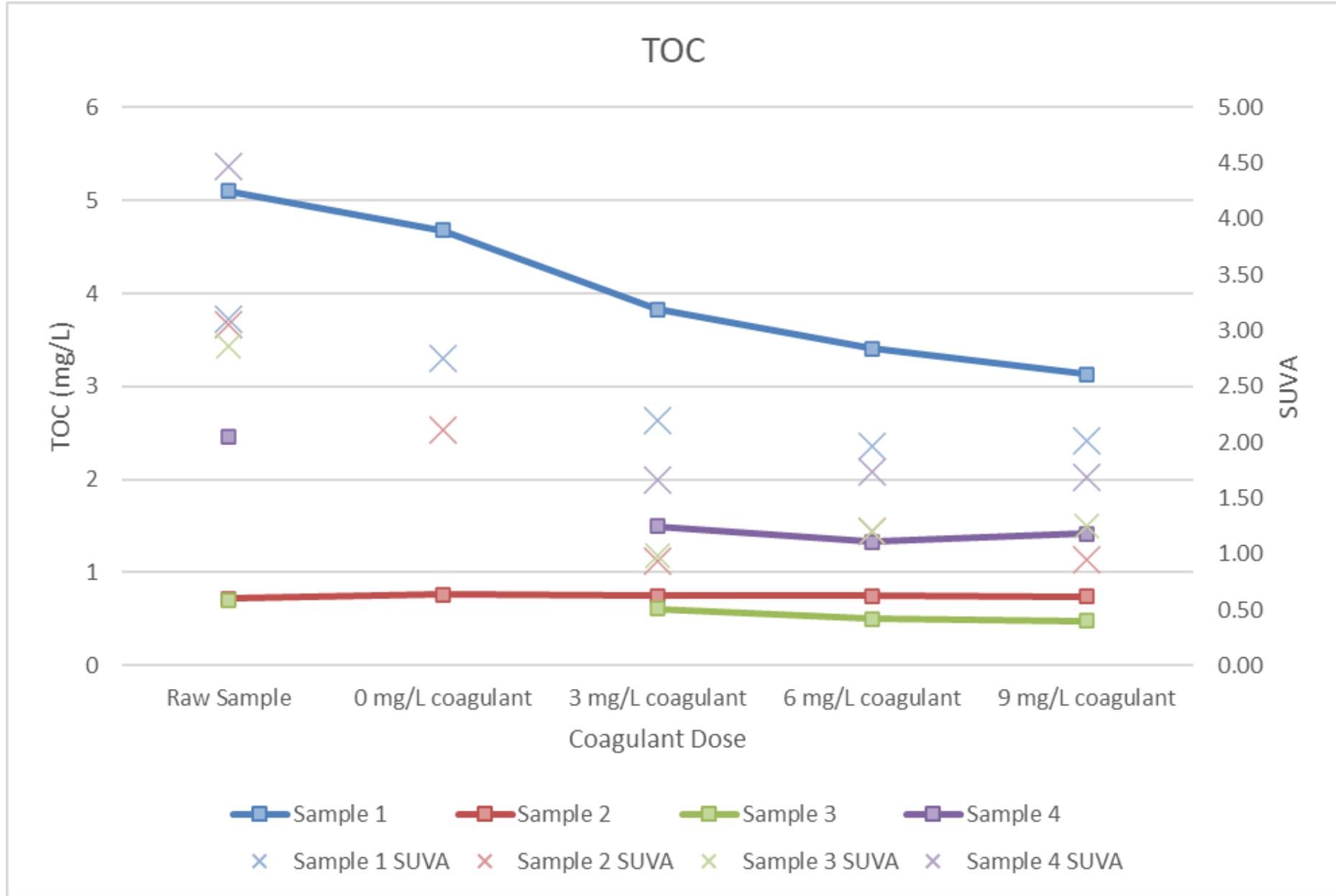


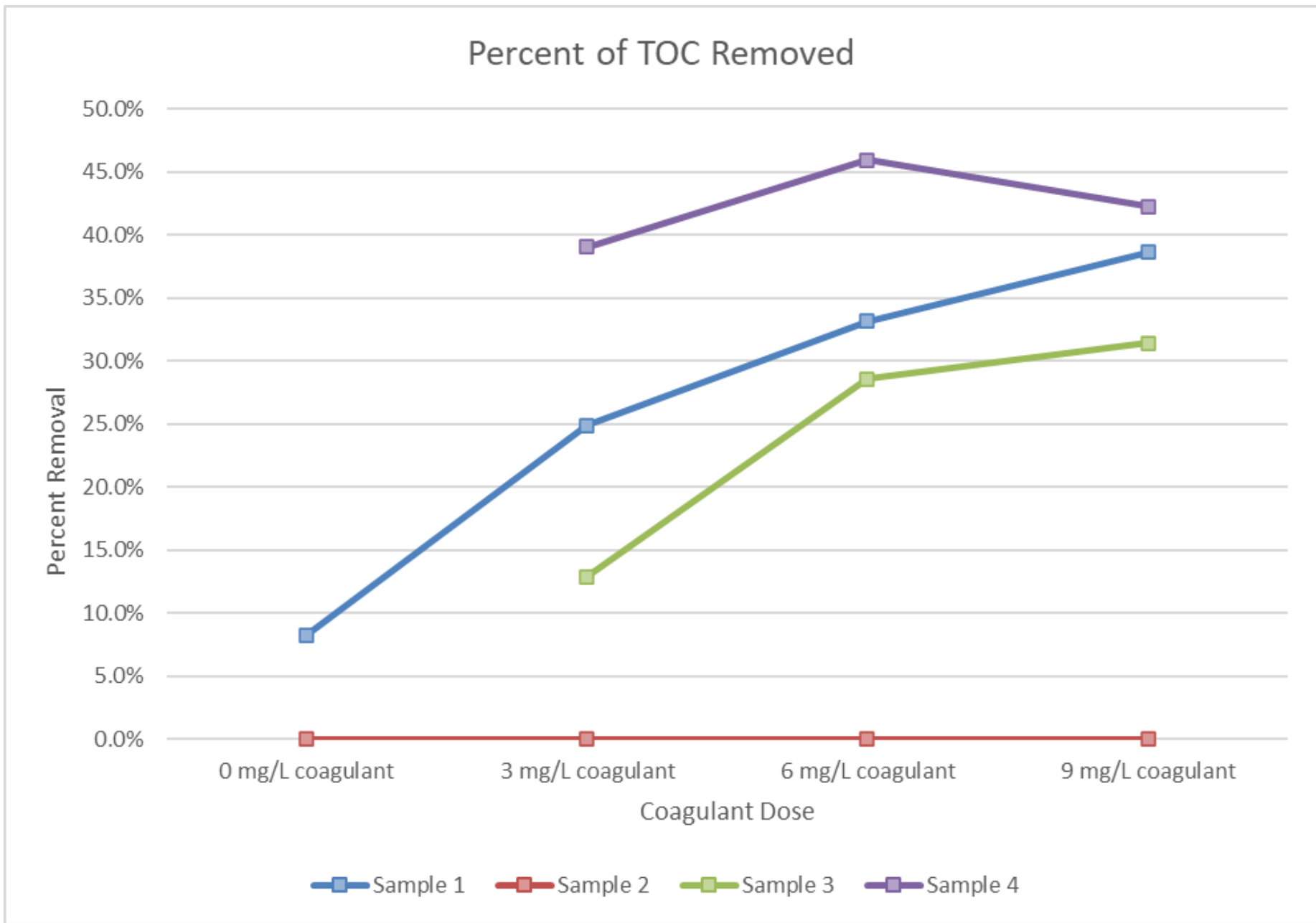


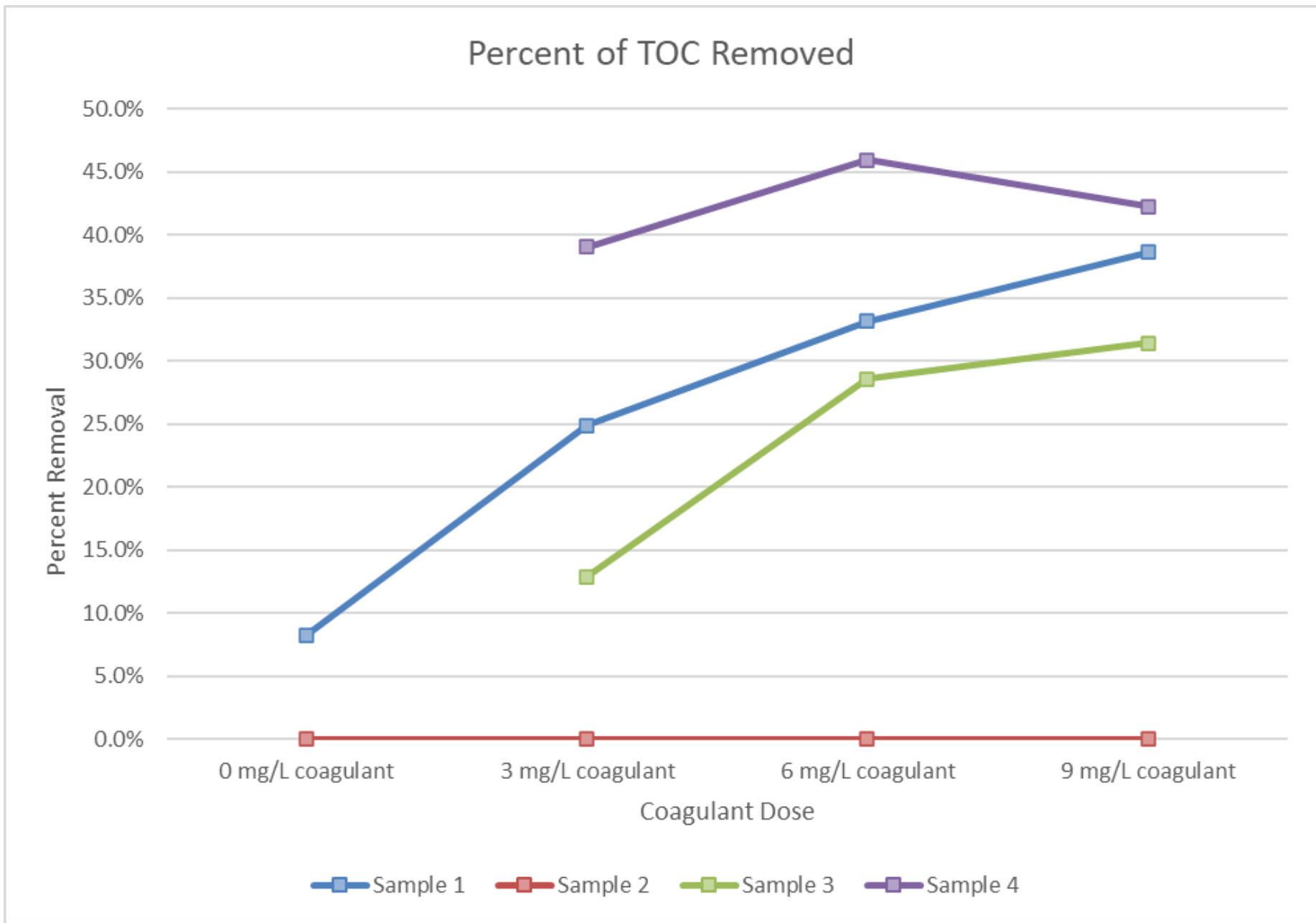
RESULTS – CARSON WTP

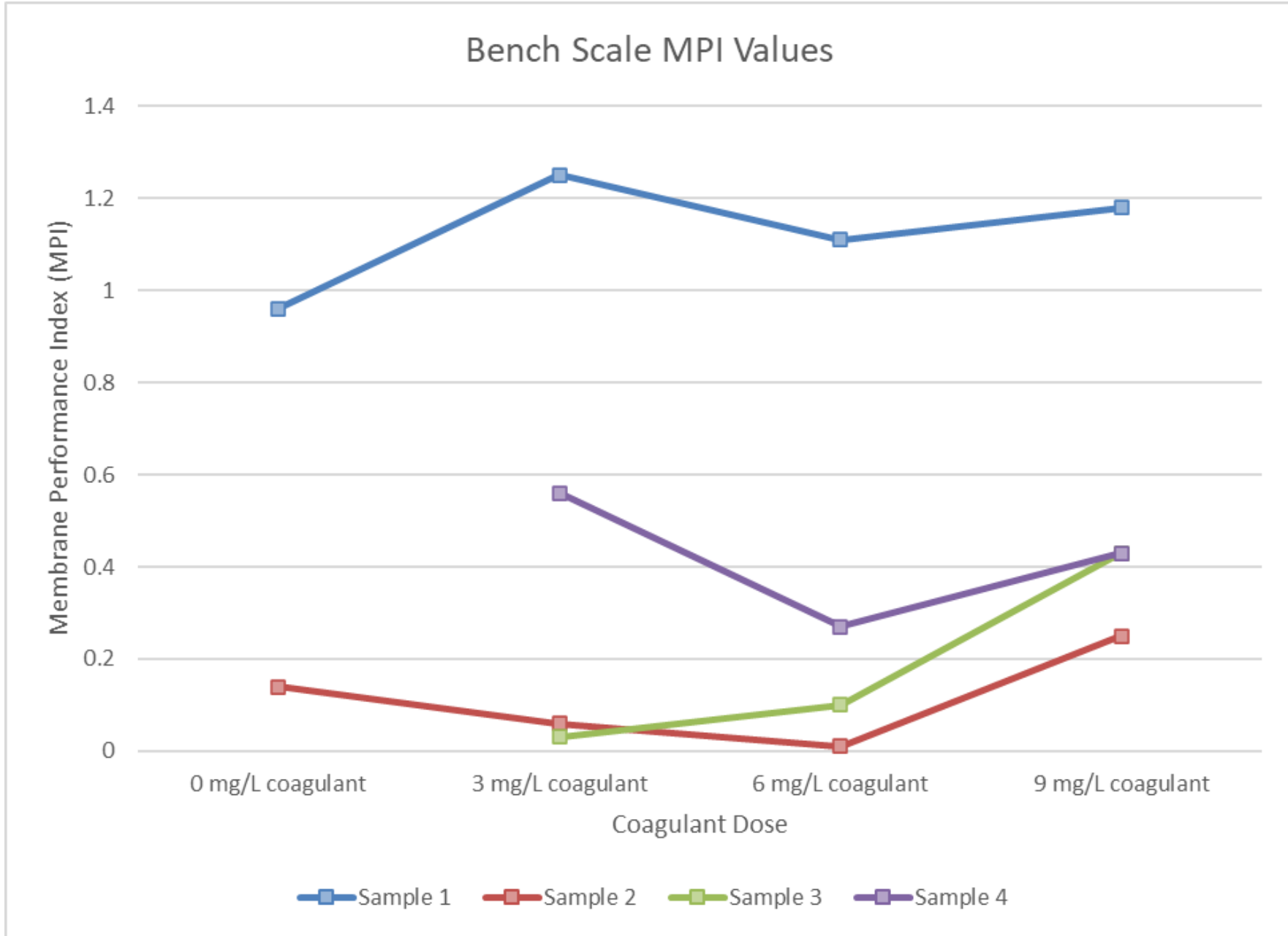






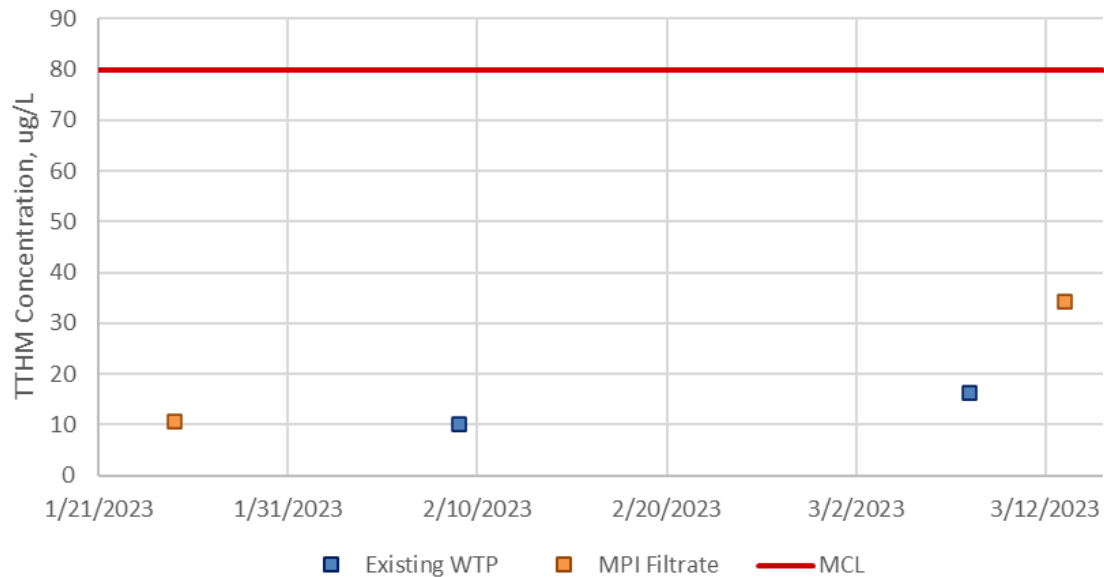




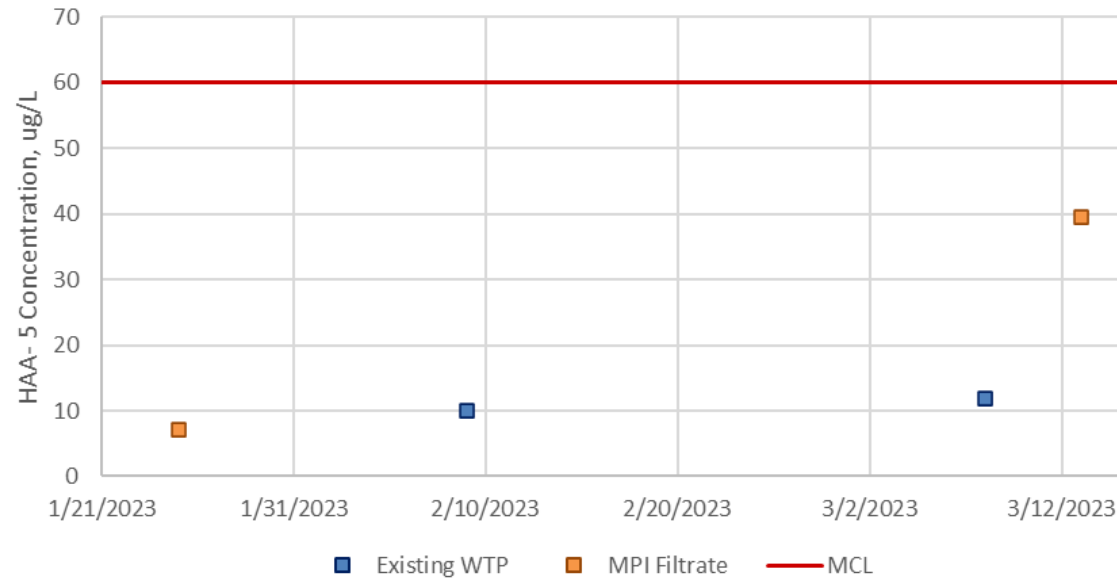




TTHMs



HAA-5

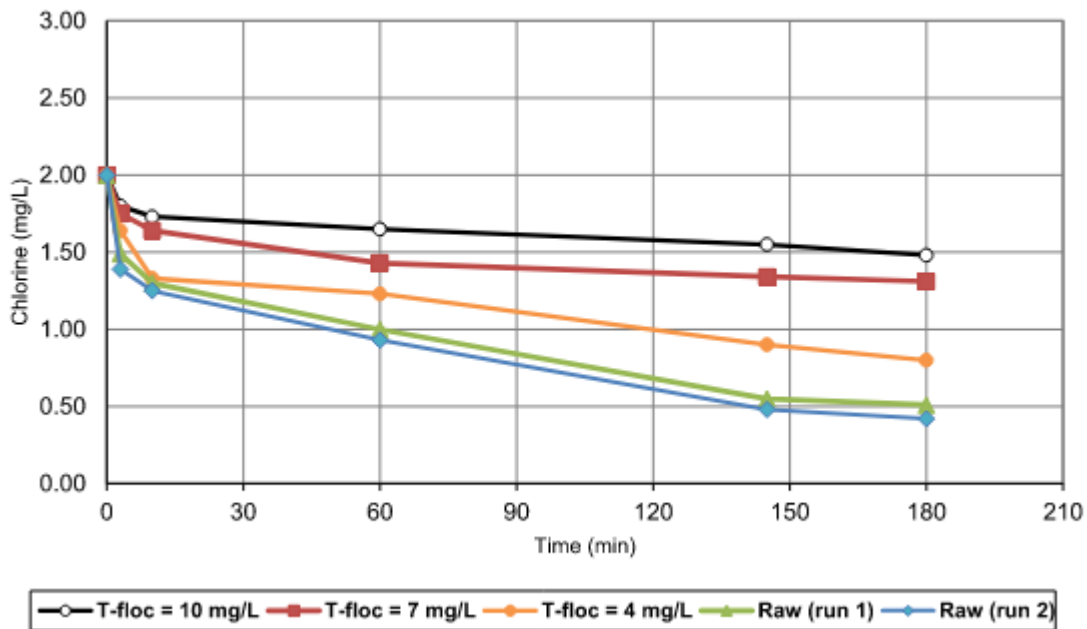


- Similar performance in DBP formation
- Well below MCL indicates TOC removal by coagulant



RESULTS – Lewiston WTP





	No coagulant Membrane Effluent	3-mg/L ACH Membrane Effluent	6-mg/L ACH Membrane Effluent	9-mg/L ACH Membrane Effluent
Constituent	Value	Value	Value	Value
TOC Removal (% Removal)	7.5%	38.6%	48.7%	53.9%
UV254 (abs/cm)	0.073	0.036	0.025	0.021
Turbidity (NTU)	0.06	0.05	0.04	0.05
SUVA (L/mg-m)	2.27	1.55	1.40	1.31
MPI	2.91	0.61	0.23	0.23

Conclusions:

- Effective treatment by membrane filtration
- Successful TOC removal through coagulant use
- Membrane performance increased up to ~6 mg/L
- Confirmation of key design criteria (flux/recovery/cleaning frequency)



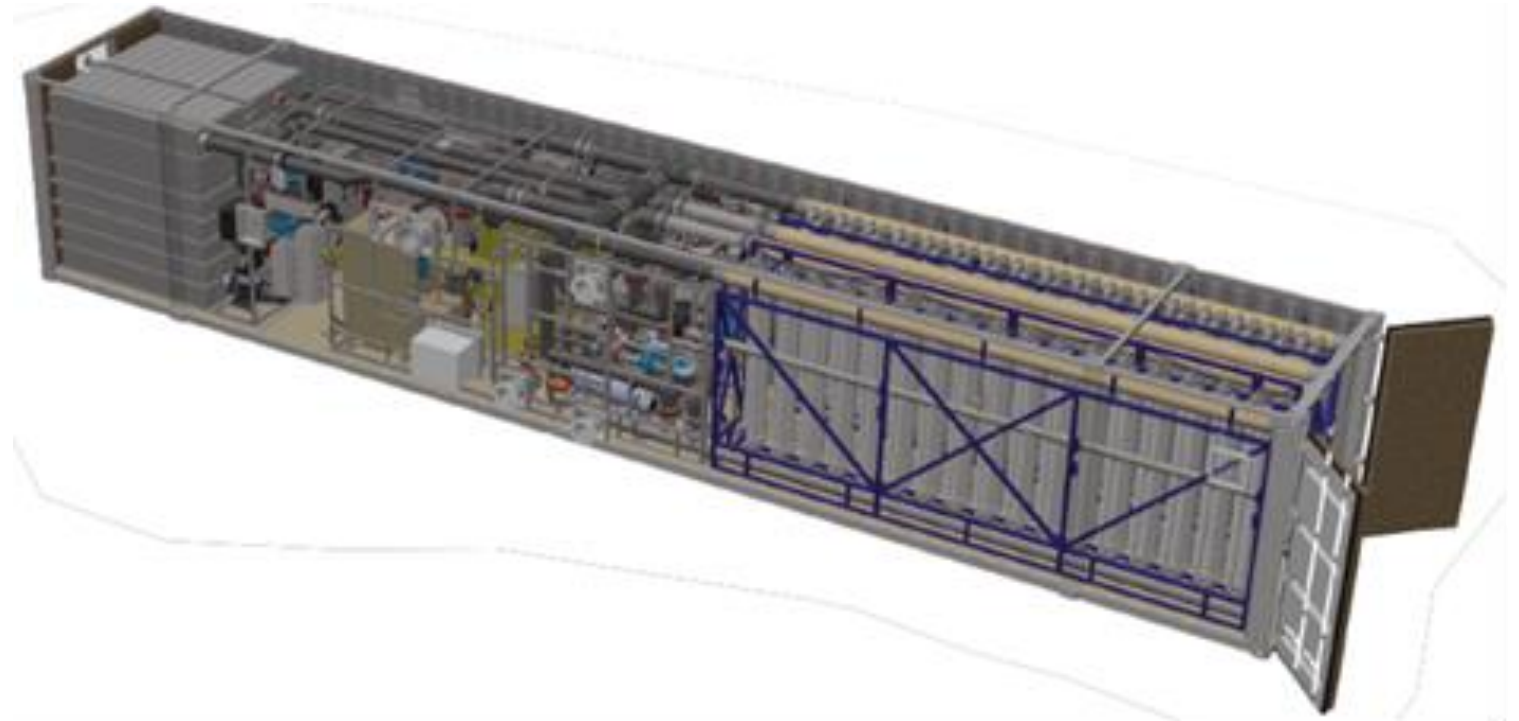
Next Steps/Full Scale Implementation





Project Status – Carson WTP

- Pilot test report accepted by DOH
- 30% Design completed in April of 2023
- Conceptual design of alternative treatment system to reduce cost (containerized MF units)



Containerized membrane filtration system by H2O Innovation



Project Status - Lewiston

- Plant commissioned and online
- Successful treatment of Clearwater River water
- Confirmation of design points





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