2021 Membrane Technology CONFERENCE & EXPOSITION

AMTA American Membrane Technology Association | American Water Works Association

Upgrading a Drinking Water Membrane Plant with Ceramic Membranes, a Case Study

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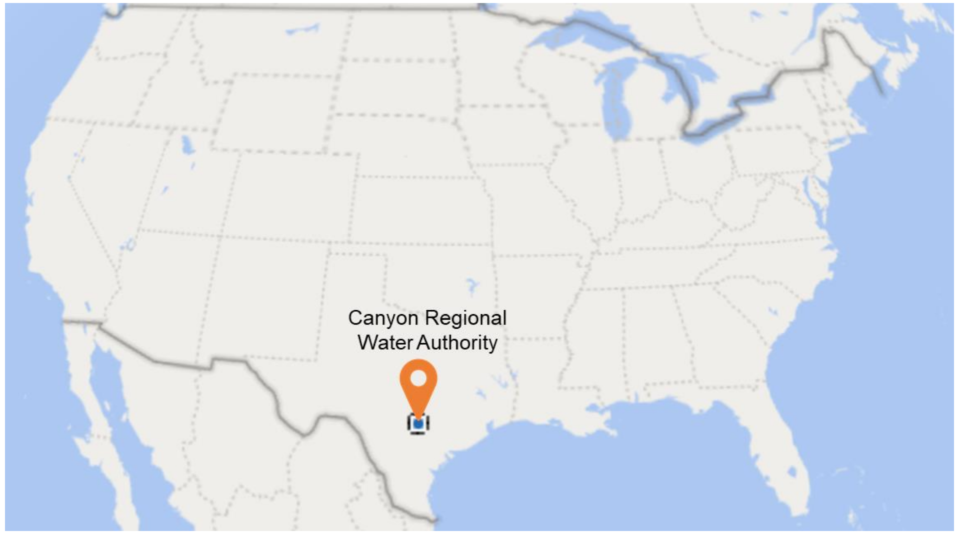
Nanostone Water

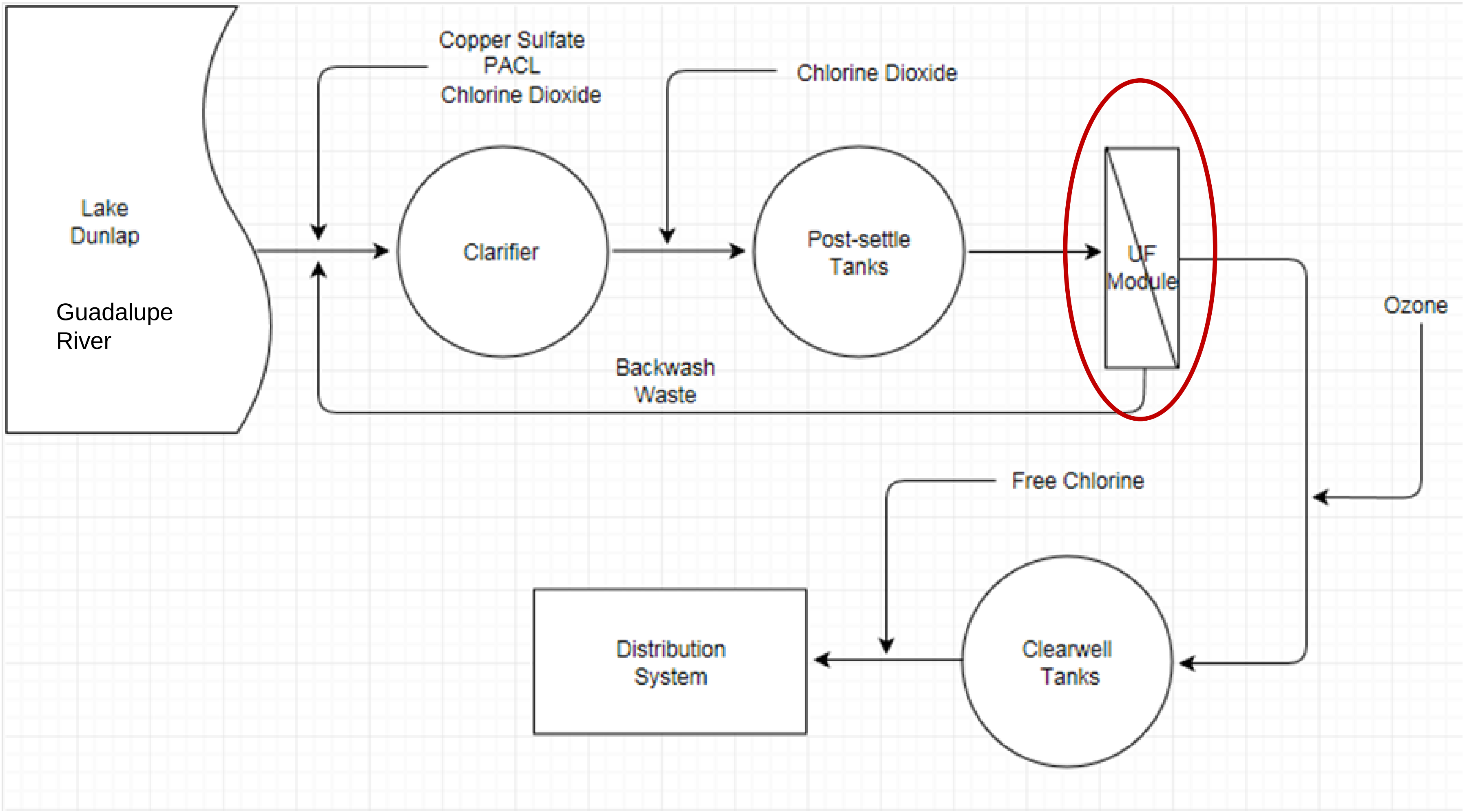
nanostone water

Canyon Regional Water Authority(CRWA)

- CRWA's Lake Dunlap Water Treatment Plant is located in **New Braunfels, Texas**
- The plant treats surface water from the **Guadalupe River**
- Licensed to produce 14.4 MGD (55 MLD)



Operations rely on robust MF / UF System

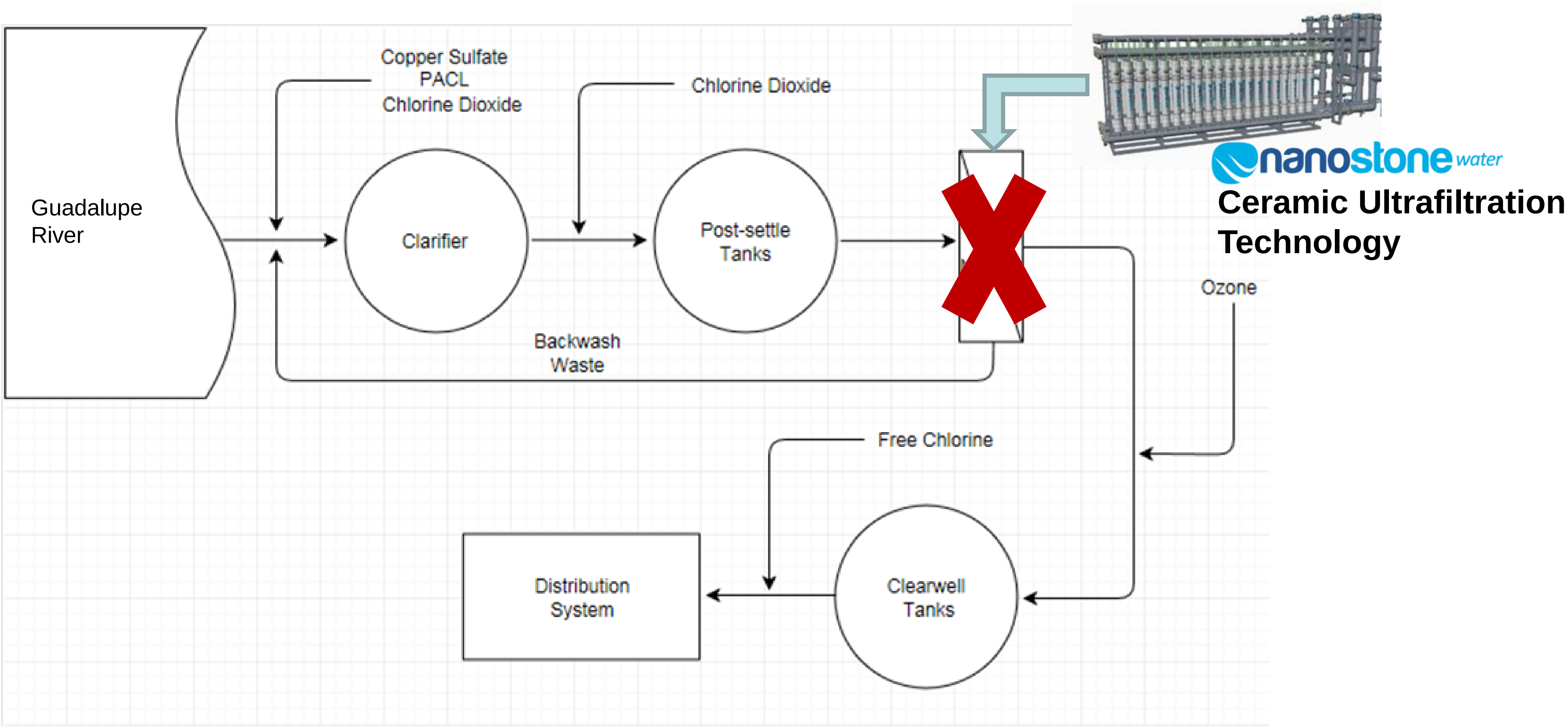


Struggling polymeric MF system rendered the system unable to meet capacity

CHALLENGES

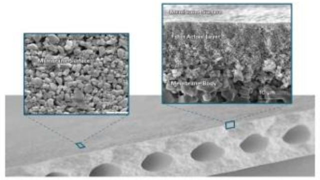
- Difficulty meeting capacity due to high downtime for membrane cleaning and repairs
- Frequent membrane fiber breakage threatened water quality
- Low water recovery rate of 83%; high amount of wasted water and environmental impact
- High labor, chemical and power costs

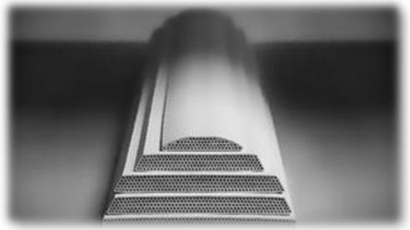
To meet capacity, CRWA needed a robust alternative

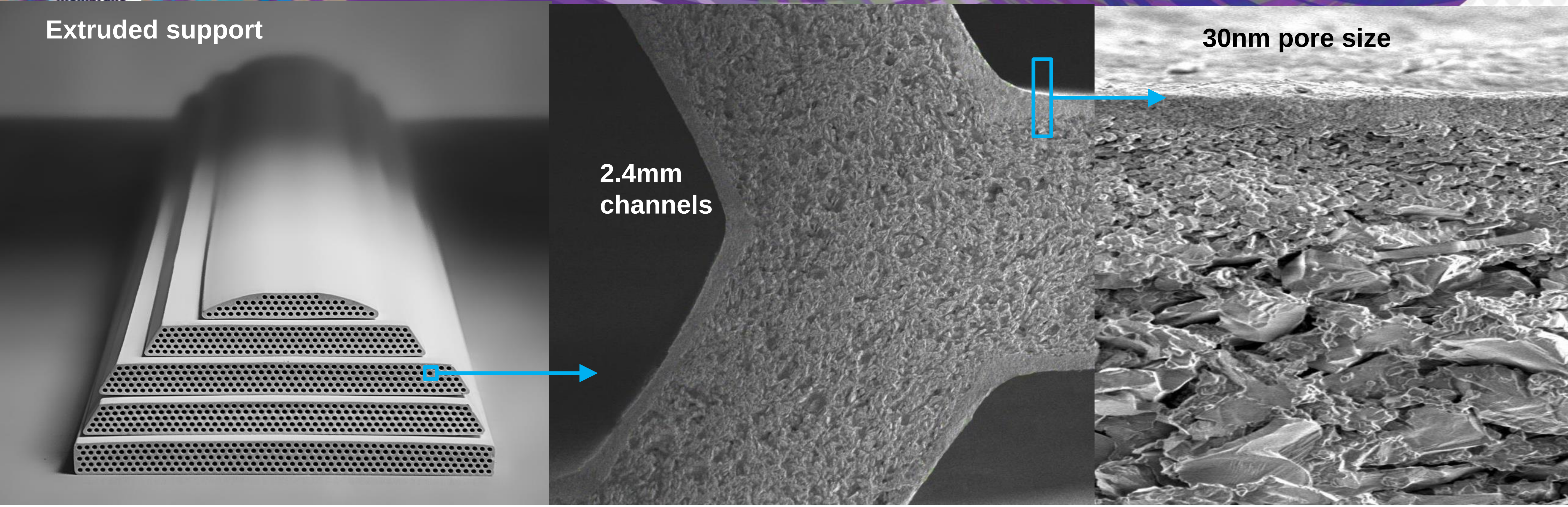


What is a Ceramic Membrane?

- Ceramic membranes are membranes that have at least one layer made of ceramic material
- This definition includes:
  - Inorganic membranes on a metal or glass support
  - Hybrid membranes with an organic template or top layer
- Most common membrane materials used are:
  - Alumina (aluminium oxide Al_2O_3)
  - Silica (silicon dioxide SiO_2)
  - Titania (titanium dioxide TiO_2)
  - Zirconia (zirconium dioxide ZrO_2)
  - Silicon carbide (SiC)
  - Zeolites
  - Combinations of the above







- Ceramic membranes have a robust construction that maintains operation and integrity for >20 years
- Wide feed channels tolerant of high solids loading and allow high system recovery
- Tight pore size distribution leads to dependable filtrate quality and reliable operation

Ceramic membrane have many differentiating features

- Operate at **high flux** (3–6 times higher than polymeric UF)
- **Higher recovery** than polymeric MF/UF
- Runs stably at **high solids loading**, especially inorganics
- **Dosing of coagulant is well-tolerated** and even improves performance
- **Stable operation** without pre-treatment (ceramic UF eliminates the need for clarifiers and multi-media filters which are often used before polymeric UF)
- **CapEx-competitive** on a system-to-system basis with **compact footprint**
- **pH resistance** from 1–13 in cleaning, 2–12 in operation
- **Operational temperature** 33 –113 °F (0.5 –45 °C)
- Depending on application, membranes may be **guaranteed for up to 20 years**
- **Robust and reliable** (no fibers to break or repair)
- **Lower operational complexity and cost** (no air scour required, fewer chemicals and electricity when removing treatment steps, higher water recovery)

Direct retrofit of existing membrane system

One for one membrane replacement utilizing the existing infrastructure (racks, pumps, piping & valves)

TCEQ Protocol for Capacity Rating

Key Client Objectives	
Water Quality	Filtrate turbidity below 0.3 NTU
Plant Capacity	14.4 MGD (55 MLD) net production
Recovery	>93.5%

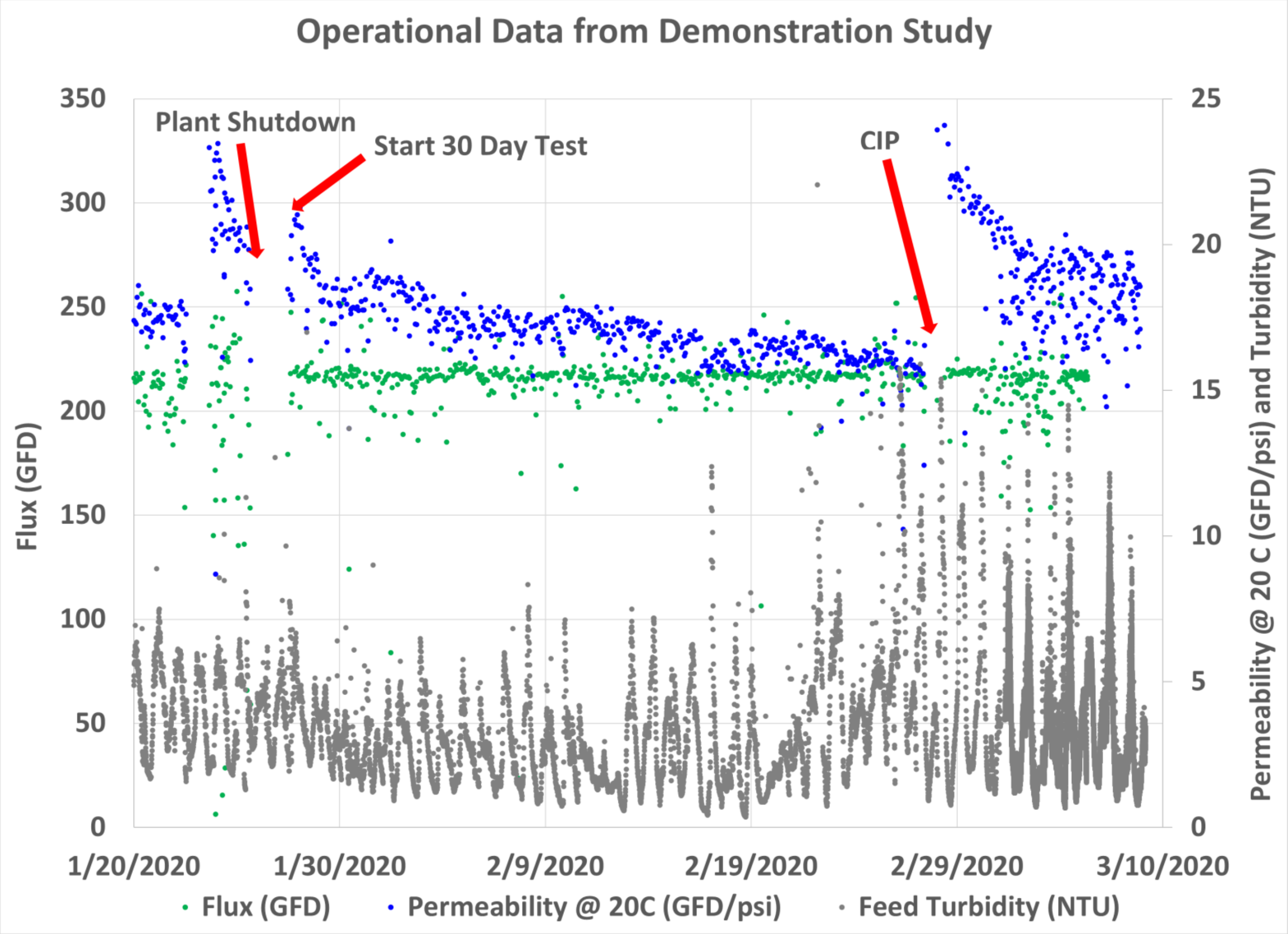
Approved Protocol:

- 30 day demonstration period
- Full CIP
- 10 day recovery demonstration

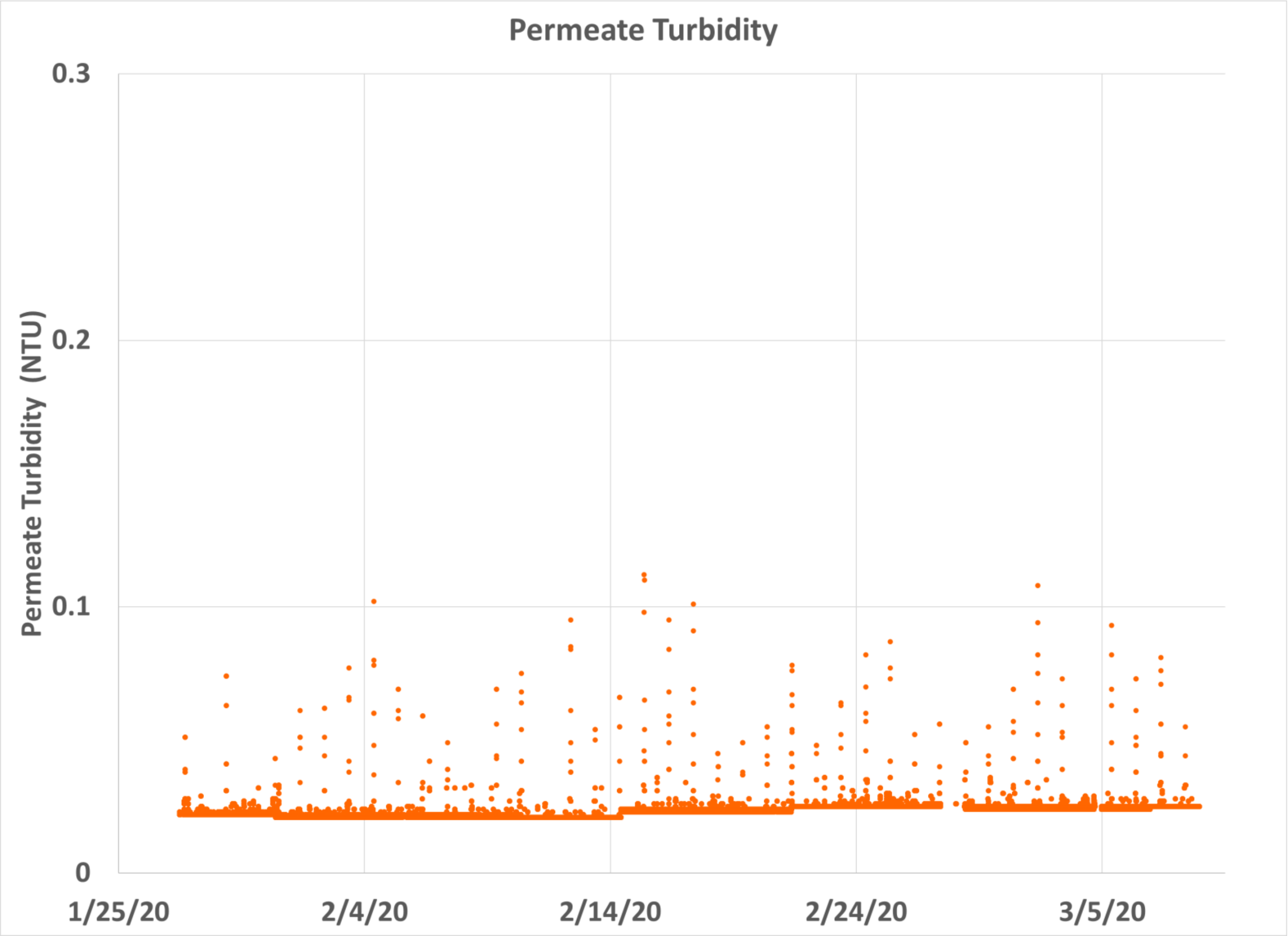
Demonstration settings to exceed objectives

Key Operational Parameters	
Flux	217 GFD (365 LMH)
Filtration Cycle	90 min
Backwash Sequence	Backwash 294 GFD (500 LMH), 30 sec Reverse feed flush 217 GFD (365 LMH), 40 sec
Maintenance Wash	NaOCl Chemically Enhanced Backwash, 1 per 12 cycles
Resulting Recovery	97.7%

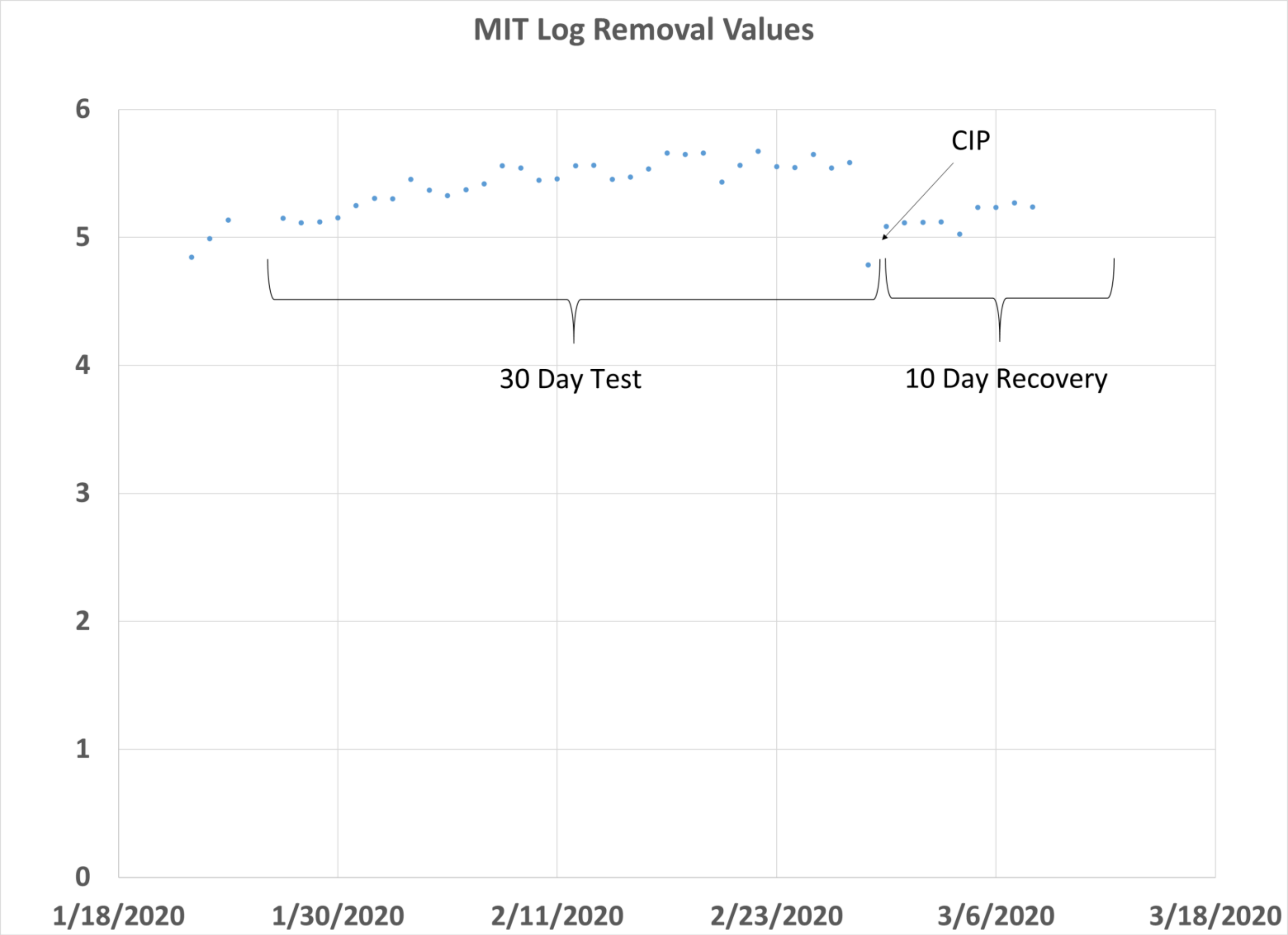
Sustainable operation through demonstration study



Stable water quality throughout study



Stable integrity testing



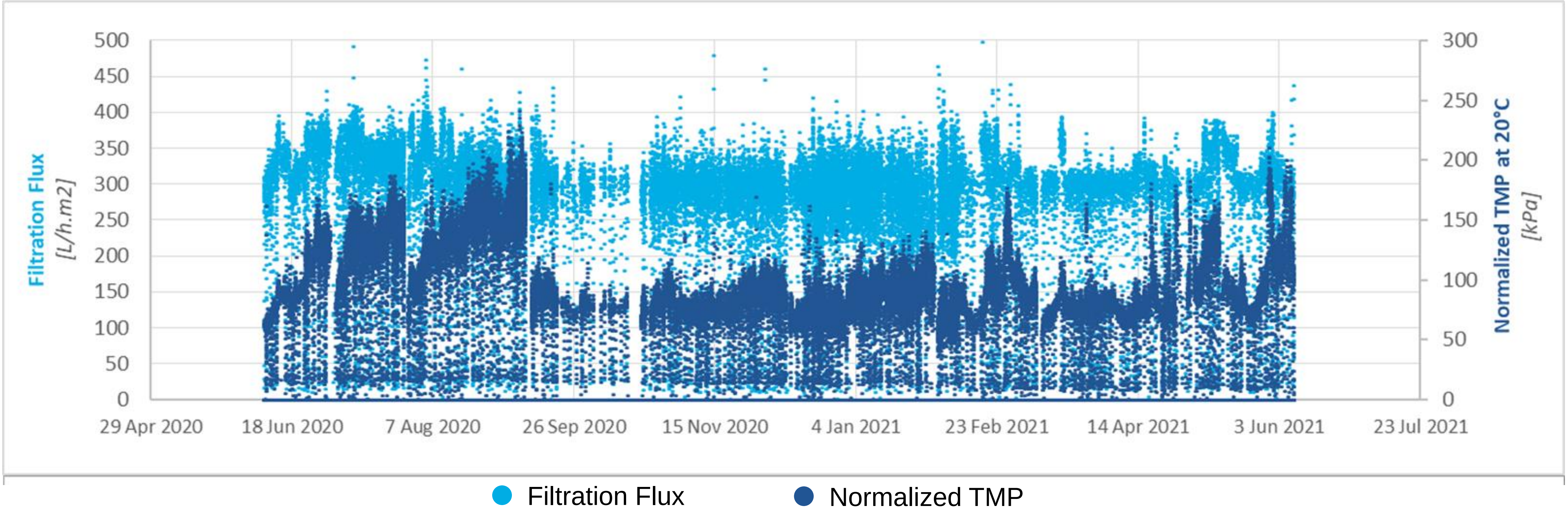
Expanded treatment capacity by 40% in same footprint while greatly reducing operational costs

	Incumbent	**Nanostone**
Net Production	10.2 MGD	14.4 MGD
Membrane System Recovery	83.6%	97.7%
Water Quality	0.074 NTU (95%)	0.025 NTU (95%)

Annual Operational Savings	
Labor	$30,000
Chemicals	$3,665
Energy	$65,380
Membrane Replacement	$71,280
Total	**$170,325**

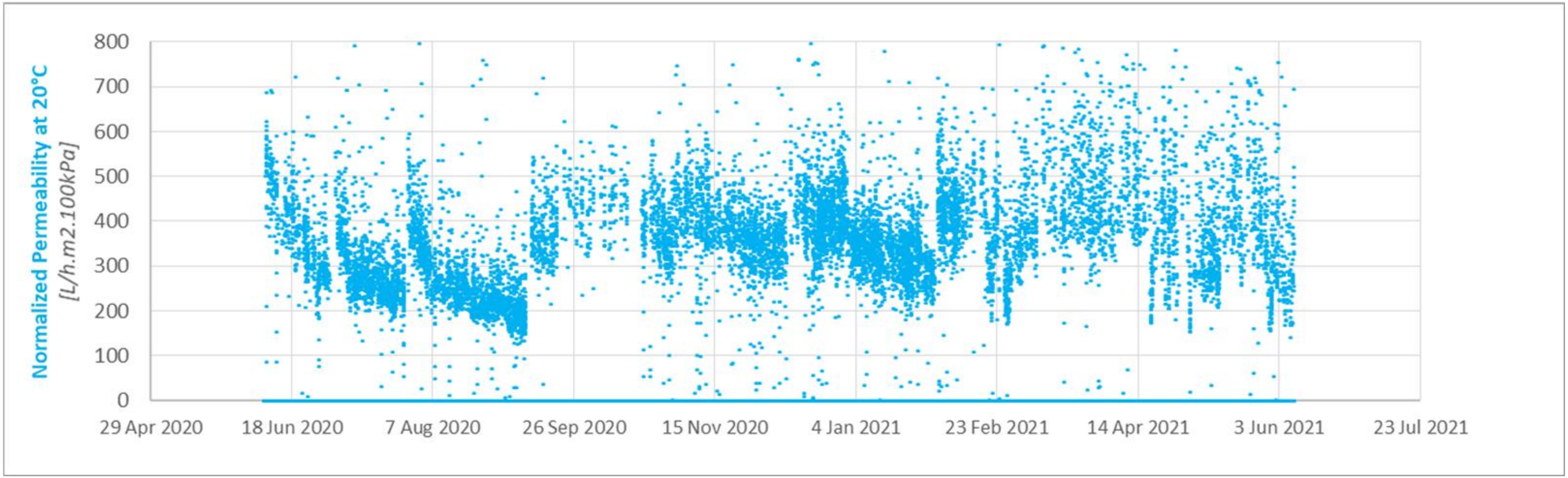
Stable operation continues since 2019

Filtration flux and normalized TMP at 20 ℃



Ceramic membrane system operation data

Normalized System Permeability at 20 ℃



Ceramic membranes are the solution CRWA needed

Capacity: 14.4 MGD

Installation Date: June, 2019

97.7%
Water recovery rate;

50%
Reduction in Power use.

NANOSTONE SOLUTION

Able to achieve full rated capacity of plant within existing plant
Easily passes daily integrity tests without operator intervention; improved water quality
Recovery rate improved to 97%
Significant cost reduction including 50% less power consumption

Thank you!

"Nanostone has been the answer to our problems. The ceramic membranes are robust, low maintenance and use less process water."

Adam Telfer | CRWA Operations Manager