2016 Membrane Technology CONFERENCE & EXPOSITION

West Basin's Universal Membrane System: Pressurized PVDF Performance Pilot Program Particulars

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AMTA
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WEST BASIN MUNICIPAL WATER DISTRICT

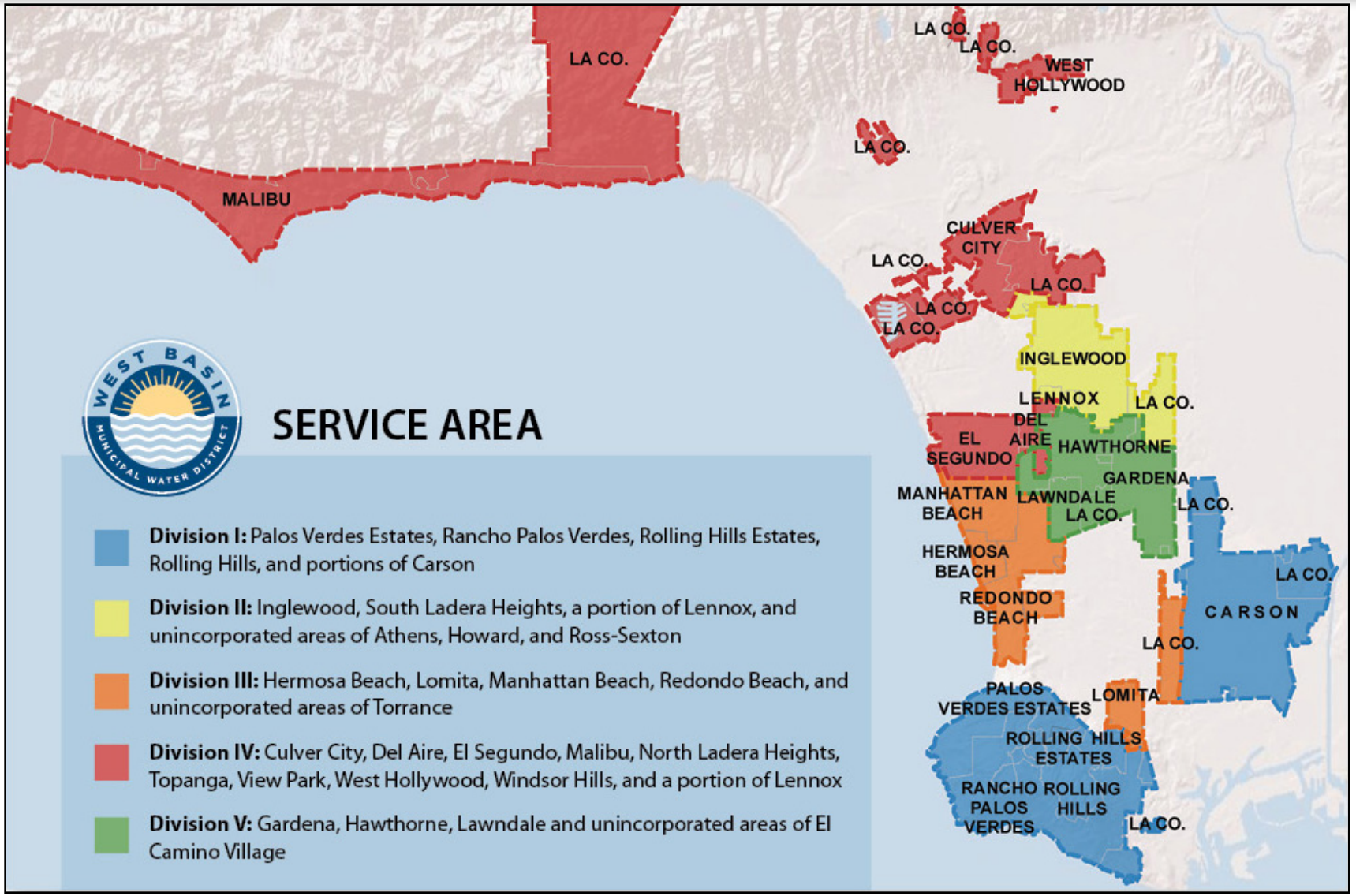
SPI

Introduction: Historically, MF Selection…

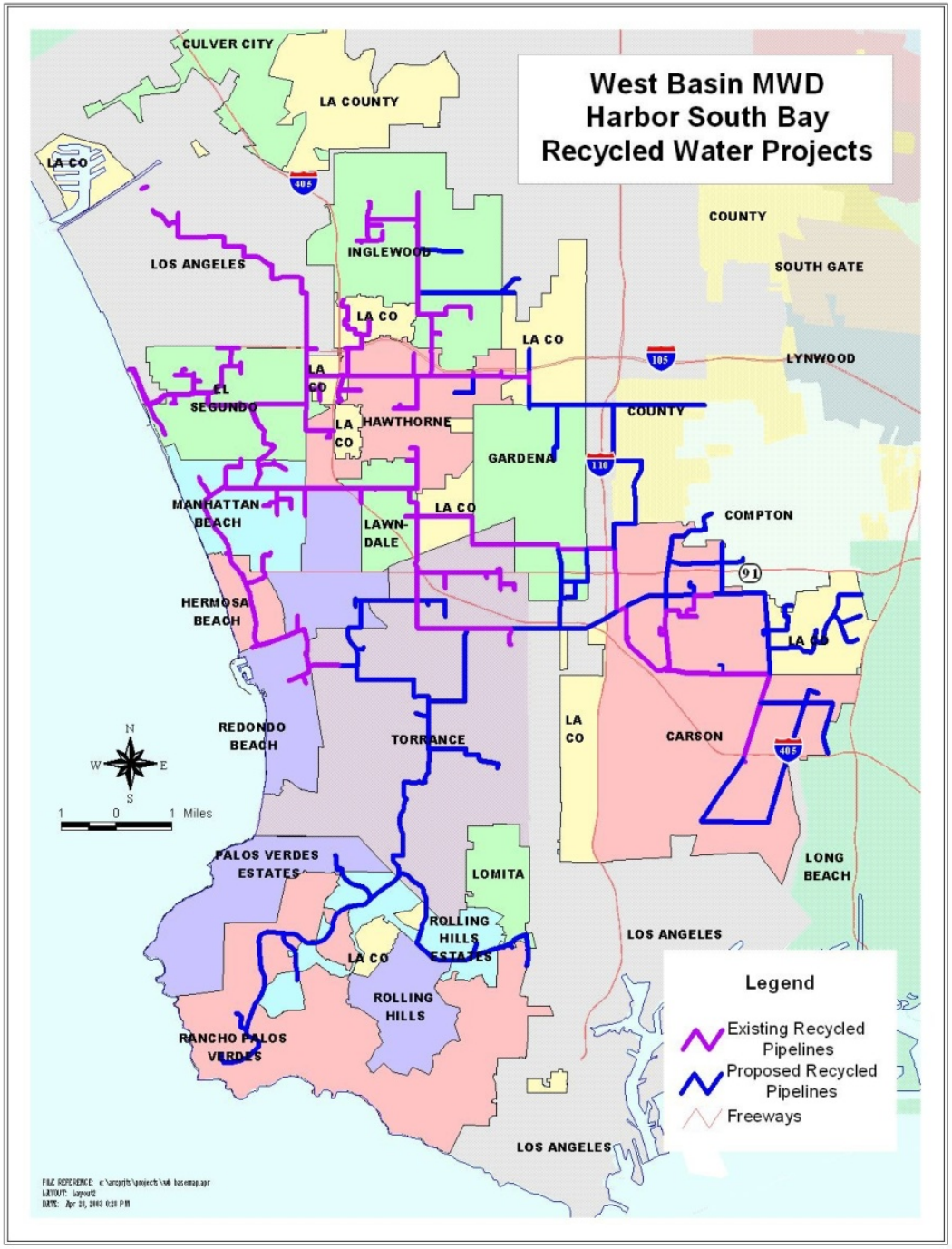
Presentation Overview

- West Basin MWD Overview
- Why Universal?
- The Pilot Unit
- Overview of Test Plan
- Pilot Results

West Basin MWD



Recycled Water Distribution:



- 120 Mi of pipeline.
- Invested $600M over 14 years
  - 1 Main plant
  - 3 Satellite facilities
- Over 150B gallons of recycled water

West Basin -20 years experience with MF

Current Installed Systems:

- Phase 2 - 6 x 90 M10C (Memcor-PP)
- Phase 3 – 10 x 90 M10C (Memcor-PP)
- Phase 4 – 6 x 432 M10S (Memcor-PP)
- Phase 5 – 6 x 140 (Pall-PVDF)
- ExxonMobil – 5 x 90M10C (Memcor-PP)
- Carson – 9 x 90M10C (Memcor-PP)

Phase IV Submerged MF

ExxonMobil MF

Phase V MF

Challenges of Operation

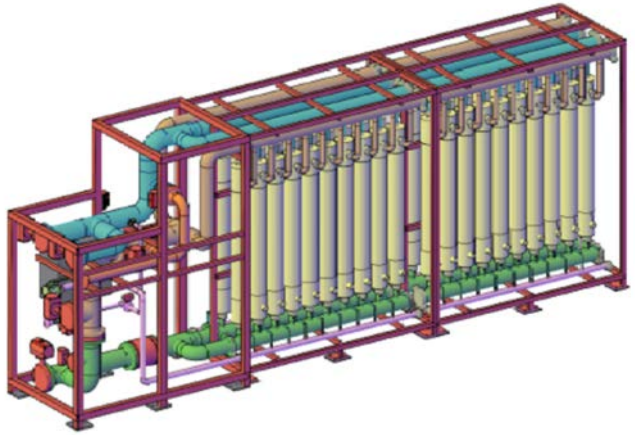
- Memcor
  - Ownership Turnover
    - Memcor, USFilter, Universal/Vivendi, Vieola, Siemens, Evoqua
  - Future Polypropylene Membrane Supply Questionable.
  - PVDF is not viewed as “direct replacement” based on recent piloting results at West Basin
- 90M10C
  - Cyclic Equipment Fatigue (Module Blocks and Valves)
  - Proprietary Replacement Parts Expensive
  - PVDF conversion deemed not cost effective

MF Cracked Block

Leaking MF (Video)…

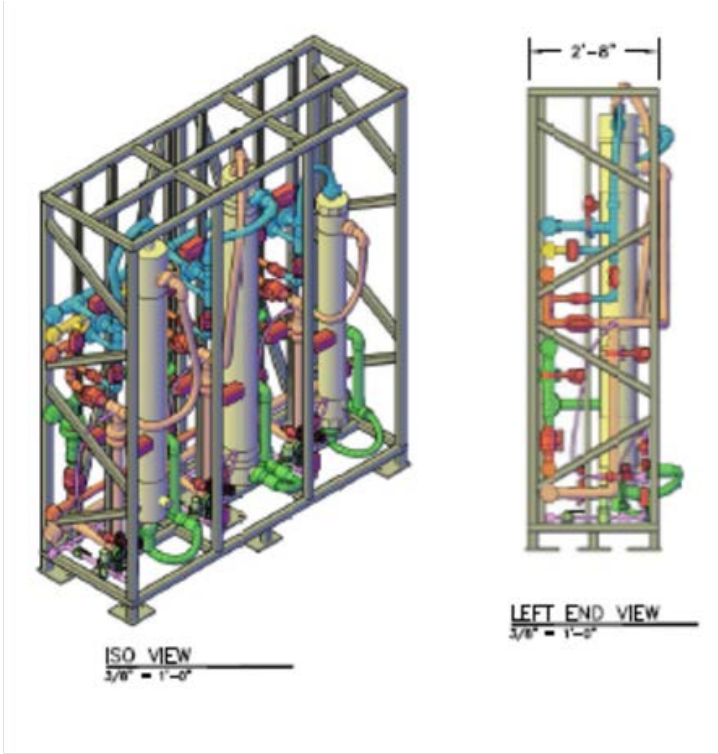
Benefits of Universal Approach?

- Expensive retrofit replacement costs
- Ability to Control Equipment Design
  - No proprietary replacement parts
- Open PLC programming
  - Flexible backwash, CEB, & CIP capabilities
- Competitive membrane replacement costs
  - Greater Selection in membrane alternatives



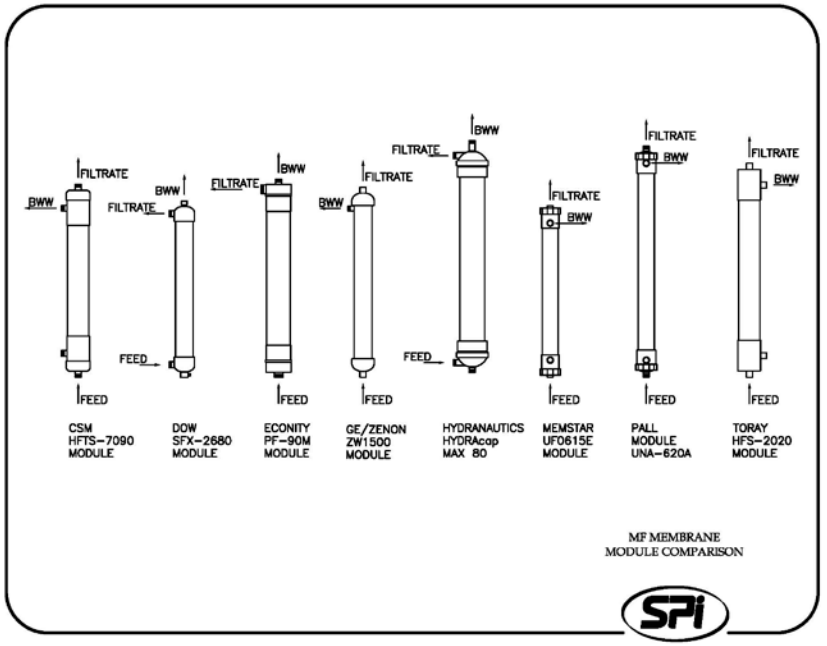
Pilot Unit Particulars

- 3 identical Module Sections
- Common Feed/Filtrate tanks
- Individually Programmable Backwash Sequence
- Common CIP/CEB tank supplied with RO permeate to minimize chloramine formation.
- Feed or Filtrate side Integrity Testing



Common Membrane Features…

- PVDF
- Vertically Oriented
- Up to 10-inches in Diameter
- Up to 8 feet in Length
- Bottom Feed / Drain & Air Scour
- Top Side or Top Center Filtrate
- Top Center or Top Side Upper Backwash Connection
- Similar Backwash and CEB protocols



Detailed Comparison of Pressure Membrane Modules

Preliminary Comparison of Self Contained Pressure Membrane Modules										
Membrane	units	Example	Dow	Econity	GE	Hydranautics	Pall	Puron	Scinor	Toray
General										
Material	Polymer	PES	PVDF	PVDF	PVDF	PVDF	PVDF	PVDF	PVDF	PVDF
Model	Part Number	XXX-1234	SFD-2880	PF-90M	ZW-1500	HYDRAcap MAX 80	UNA-620A	MP 8081-102	SMT600-P50	HFU-2020
Configuration	Direction	In-out	Outside In	Outside-In	Outside-In	Outside-In	Outside-In	Outside-In	Outside-In	Outside-In
MFG Process	Type	TIPS	DIPS/NIPS	TIPS+Stretch	TIPS	TIPS	TIPS	n/a	TIPS	TIPS
Supported	unsupported	unsupported	unsupported	unsupported	unsupported	unsupported	unsupported	Polyester	unsupported	unsupported
Number of Lumens	multibore	1 for single								
Pore Size	microns	0.03	0.03	0.1	0.02	0.08	0.1	0.03	0.1	0.02
Inside Diameter	mm	0.6	0.7	0.7	0.47	0.6	0.65	1.5	0.7	0.9
Outside Diameter	mm	1.2	1.3	1.2	0.9	1.2	1.1	2.6	1.3	1.5
Area	ft2	806	829	969	550	1130	538	546	538	775
Area	m2	75	77	90	51.1	105	50	50.75	50	72
Operating Flux	gfd	24-70	24-70	25-100	20-80	20-65	20-80	20-80	30-70	20-80
Operational										
Static Pressure	psi	45	90	38	40	73	45	45	60	44
Max. Forward TMP	psi	30	30	22	40	30	35	25	45	44
Backwash TMP	psi	45	38	38	40	30	35	10	35	44
Maximum Temperature	C	40	40	40	40	40	40	40	40	40
Operating pH Range	units	2-11	2-11	1-9	5-10	4-10	3-11		1-11	1-10
Backwash	type	air/water	air/water	air-water	air/water	air/water	air/water	air/water	air/water	air/water
Air Flow/module	SCFM	4 scfm	7 scfm			7.3-9.1 SCFM	3 SCFM	9 SCFM	3.1-7.5	3.5 SCFM
Water Direction	Feed/Filtrate	Filtrate	Filtrate	Filtrate	Filtrate	Feed	Filtrate	Feed/Filtrate	Filtrate	Filtrate
Cleaning										
Cleaning Temperature	C	40	40	40	40	40	40	40	40	40
Cleaning pH Range	units	2-11	2-11	2-11	2-11	1-13	3-12	1.8-10.5	1-13	0-12
Maximum Free Chlorine	mg/L	2000	2000	1000	1000	5000	5000	1000	5000	2000
Periodic Cleaning (CEB)	yes/no	yes	yes	yes	yes	yes	yes	yes	yes	yes
Frequency	hours	12-72	12-72	12-72	12-72	12-72	12-72	12-72	12-72	12-72
Duration	min	20-60	20-60	20-60	20-60	20-30	20-60	20-60	20-60	20-60
Chlorine Concentration	mg/L	200	200	200	200	200	200	?	200	200
Physical										
Length	mm	2360	2360	2000	1920	2340	2160	2060	2160	2160
Diameter	mm	225	225	260	180	250	180	220	180	216
Feed Connection	mm	50	50	80	50	50	50	32	50	50
Feed Connection	orientation	off axis	off axis	on-axis	on axis	on axis	on axis	off-axis	on axis	on axis
Feed Connection	Style	victaulic	victaulic	victaulic	victaulic	victaulic	victaulic	victaylic	victaulic	victaulic
Filtrate Connection	mm	50	50	80	50	50	50	32	50	50
Filtrate Connection	orientation	off axis	off axis	off axis	on axis	on axis	on axis	off-axis	on axis	on axis
Filtrate Connection	Style	victaulic	victaulic	victaulic	victaulic	victaulic	victaulic	victaulic	victaulic	victaulic
Backwash Connection	mm	50	50	65	32	50	32	32	32	50
Backwash Connection	orientation	on axis	on axis	on-axis	off axis	off axis	off axis	on-axis	off axis	off axis
Backwash Connection	Style	union	union	victaulic	union	victaulic	union	victaulic	union	victaulic
Air Scour Connection	Style	3/8"	3/8"	n/a	n/a	3/8"	n/a	1/2"	n/a	n/a
Air Scours Size	in/mm	OD Tube	NPT	n/a	n/a	NPT	n/a	OD Tube	n/a	n/a

The Universal Pilot

Overview of the Test Plan

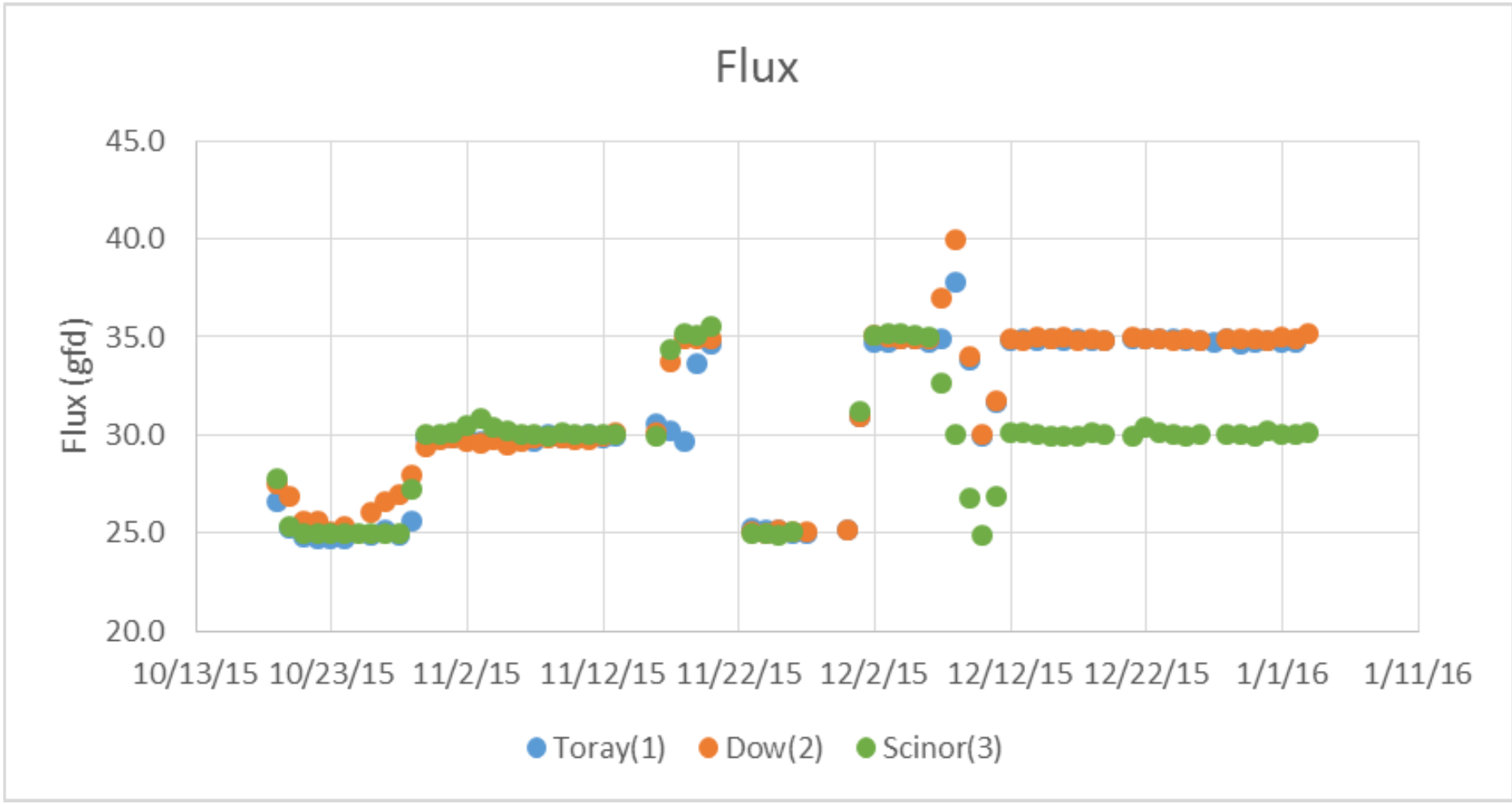
- 2 different Phases – 6 modules in total
- Test 3 Different Modules on same water.
- Test at: 25, 30, 35, & 40 gfd.
- Manufacturers Procedures Programmed
  - Backwash
  - CEB (Hypochlorite and/or Caustic, Citric)
- Run 21 to 30 Days at highest flux.

Feedwater Quality

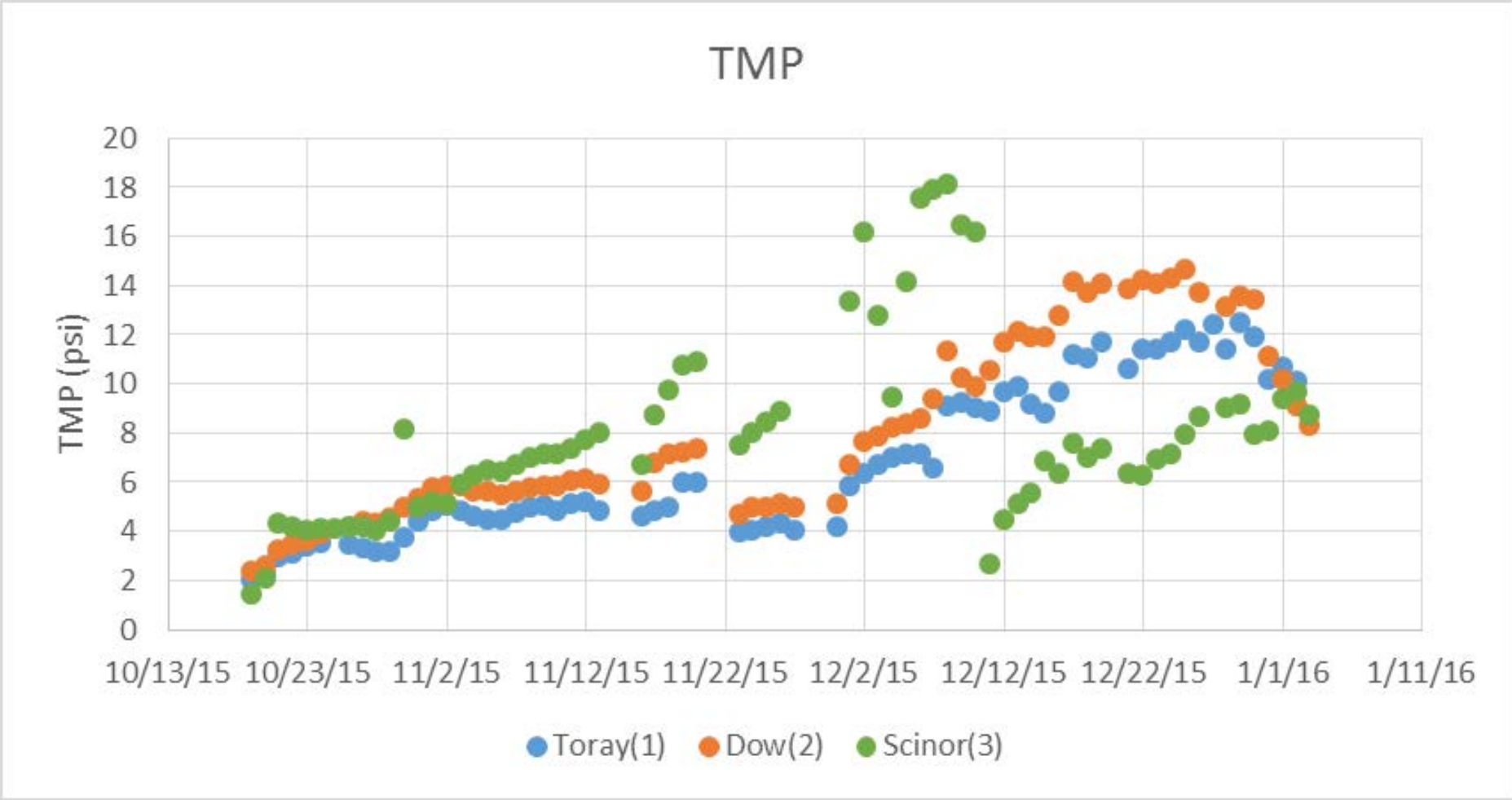
- Non-Nitrified Secondary Effluent intended for Ocean Discharge
- Hyperion WWTP Supply
- PureOX Process
- Short SRT/HRT
- Difficult for Microfilters
  - Low Flux
  - Frequent Cleaning
  - Process Upsets
  - Higher Conc CEBs/CIPs
- Tertiary Filtration at West Basin

Constituent	Average Concentration (mg/L)
Total Suspended Solids	2.2
Total Dissolved Solids	934
Alkalinity, Total	269
Turbidity (NTU)	1.3
Total Organic Carbon	10
Ammonia (as N)	41
Chloride	320
Sulfate	160
pH	7.1
Temperature (°C)	25

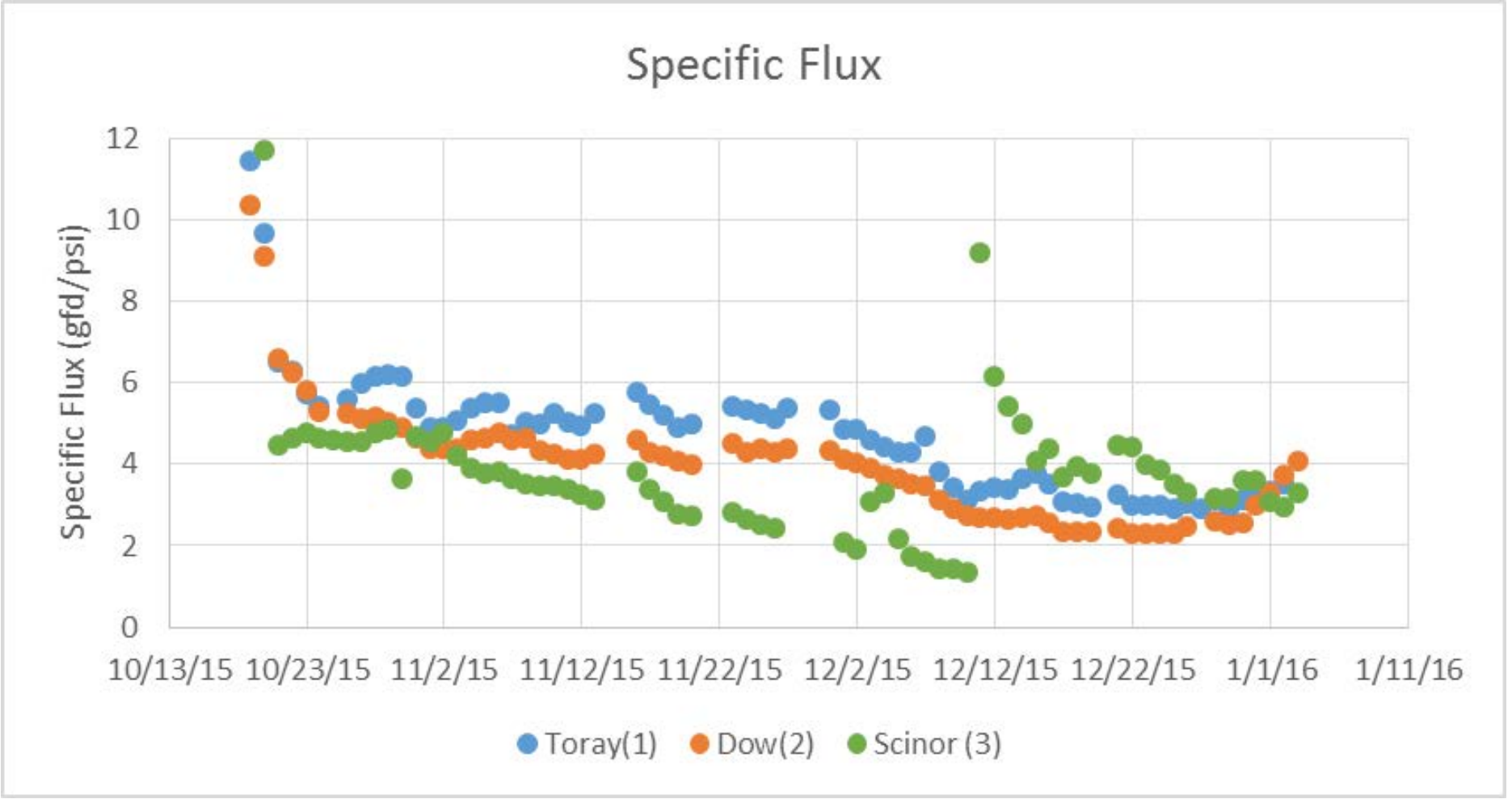
Pilot Results: Flux



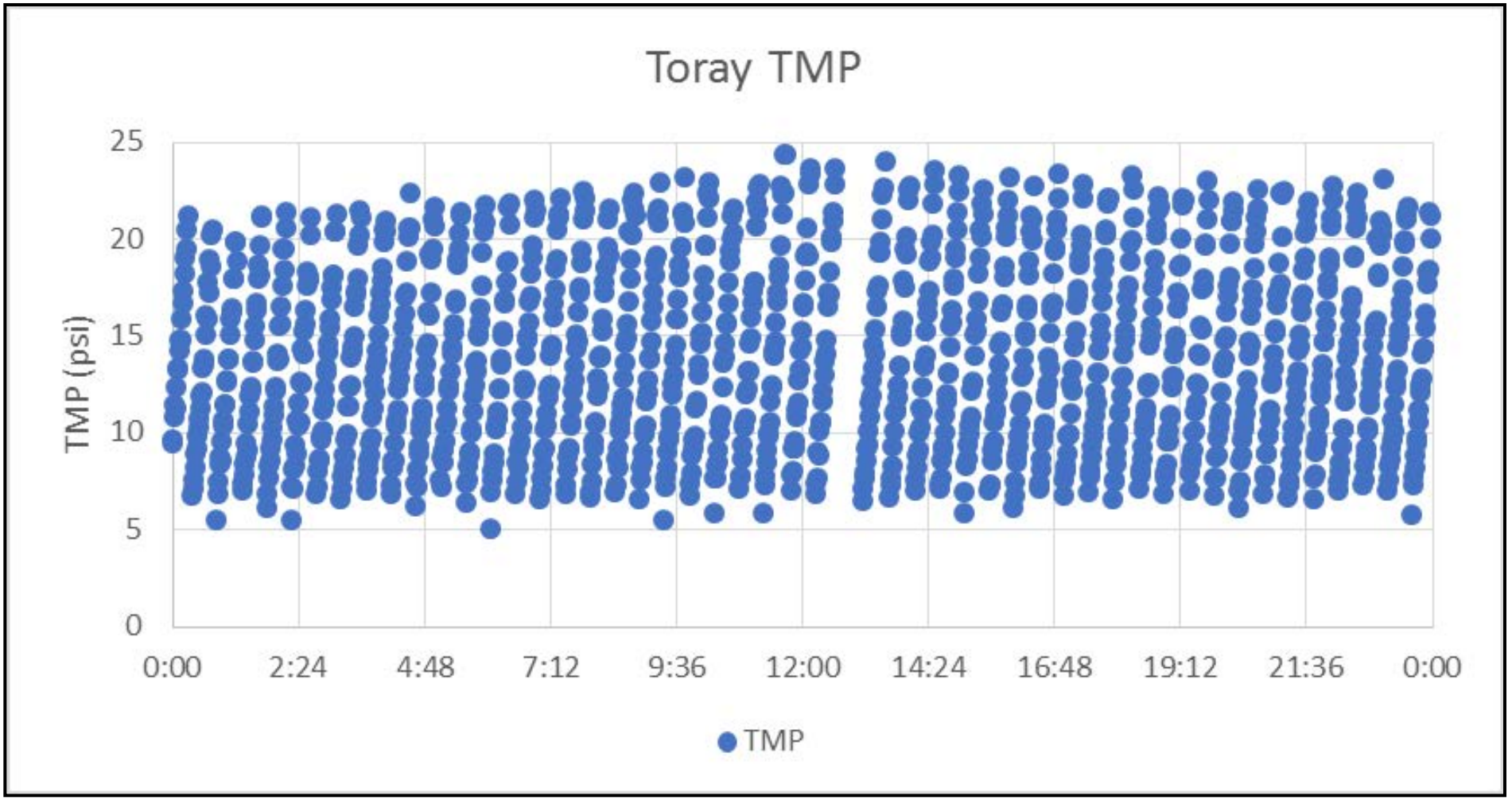
Pilot Results: TMP



Pilot Results: Specific Flux



Impact of Backwash on TMP:



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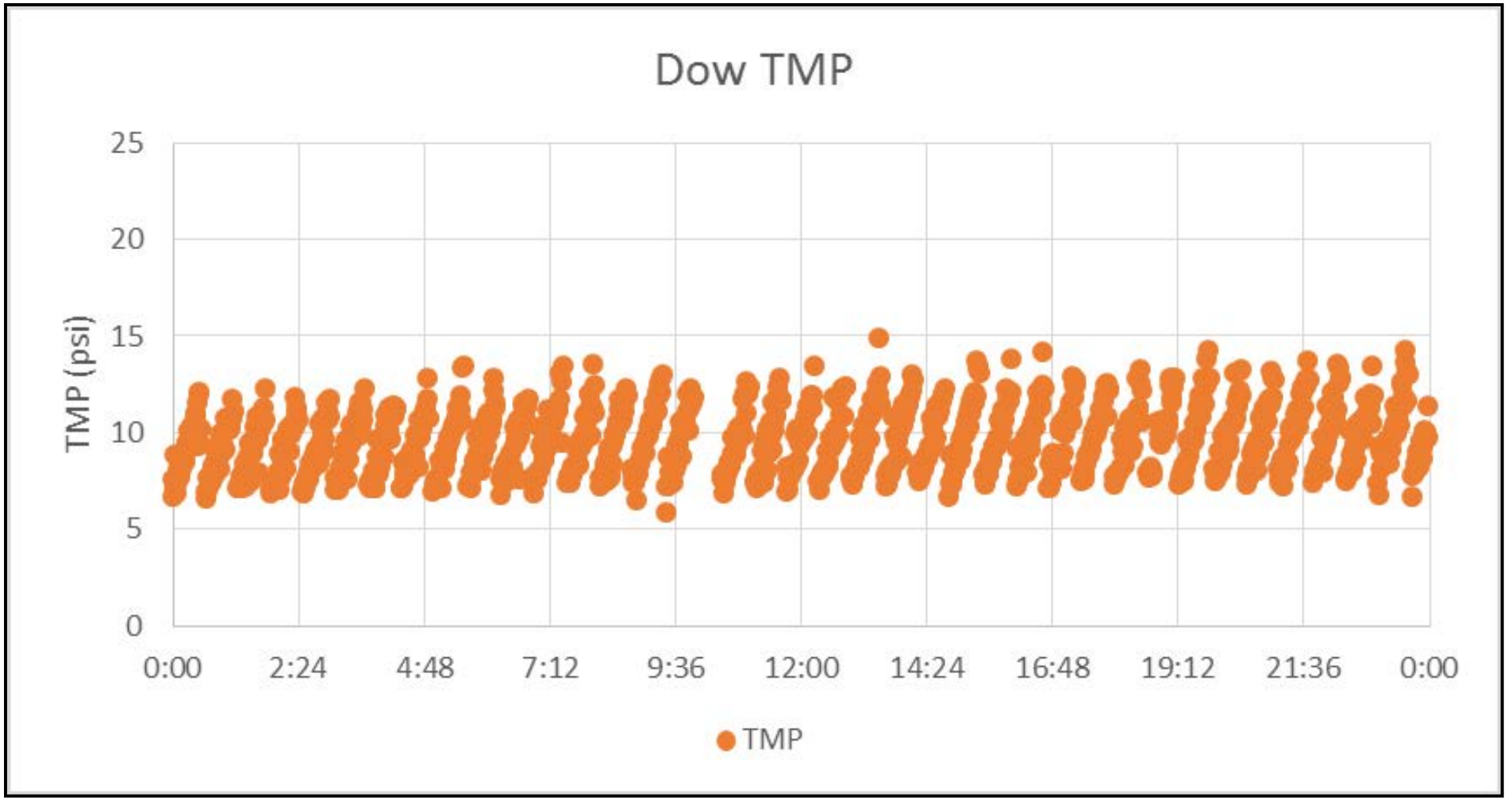

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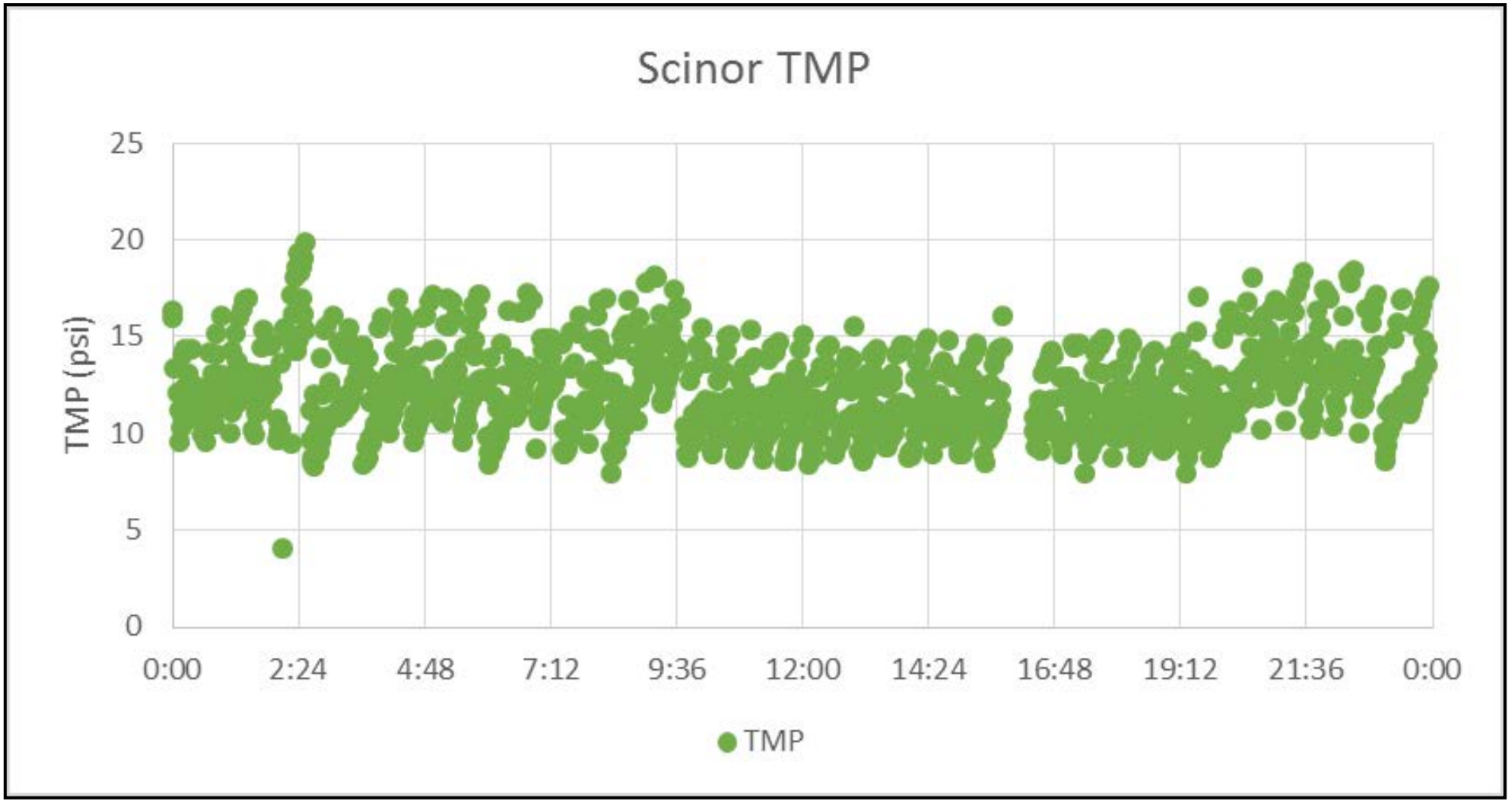

Conclusions

Why Universal?

- Greater control over the initial and future selection of membrane modules.
- Elimination of expensive replacement proprietary component parts.
- “Open Source” transparency in PLC and HMI programming.
- Improved functionality of the operator interface.
- Flexibility in instrumentation and valve selection.
- Customization of design to satisfy project specific space limitations.

Questions?

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