Pilot Testing of Zero Liquid Discharge (ZLD) Technologies Using Brackish Ground Water for Inland Desert Communities

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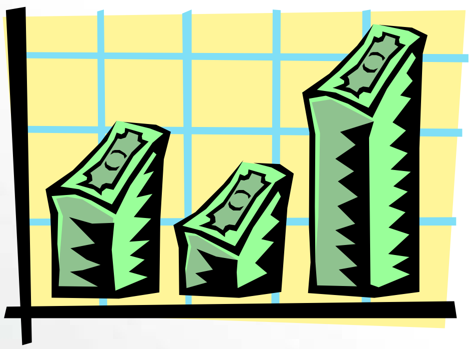
Presentation Outline



Project Costs

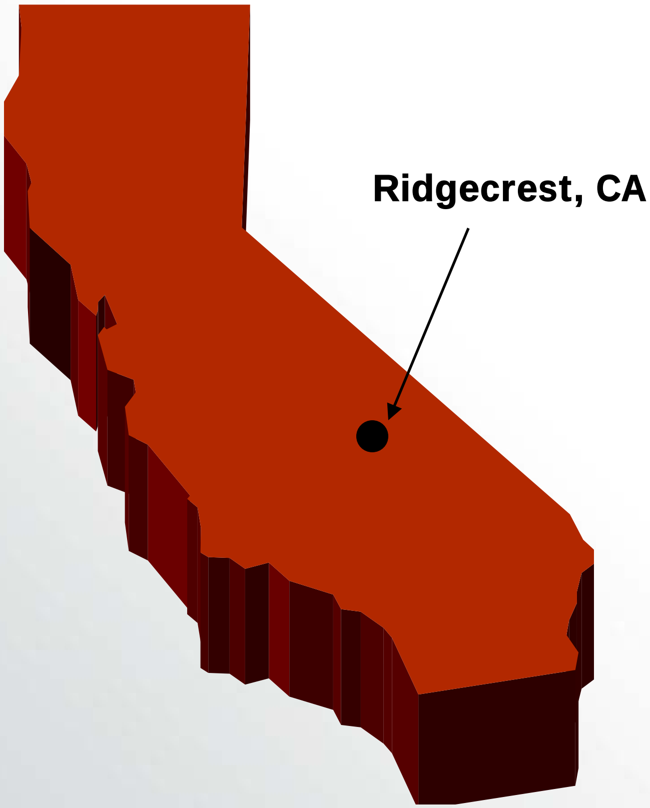
Project Background

Pretreatment

Electrodialysis Reversal

Reverse Osmosis

The Indian Wells Valley Water District is Located in the Mojave Desert



Influent Water Characteristics Present Challenges to Desalting

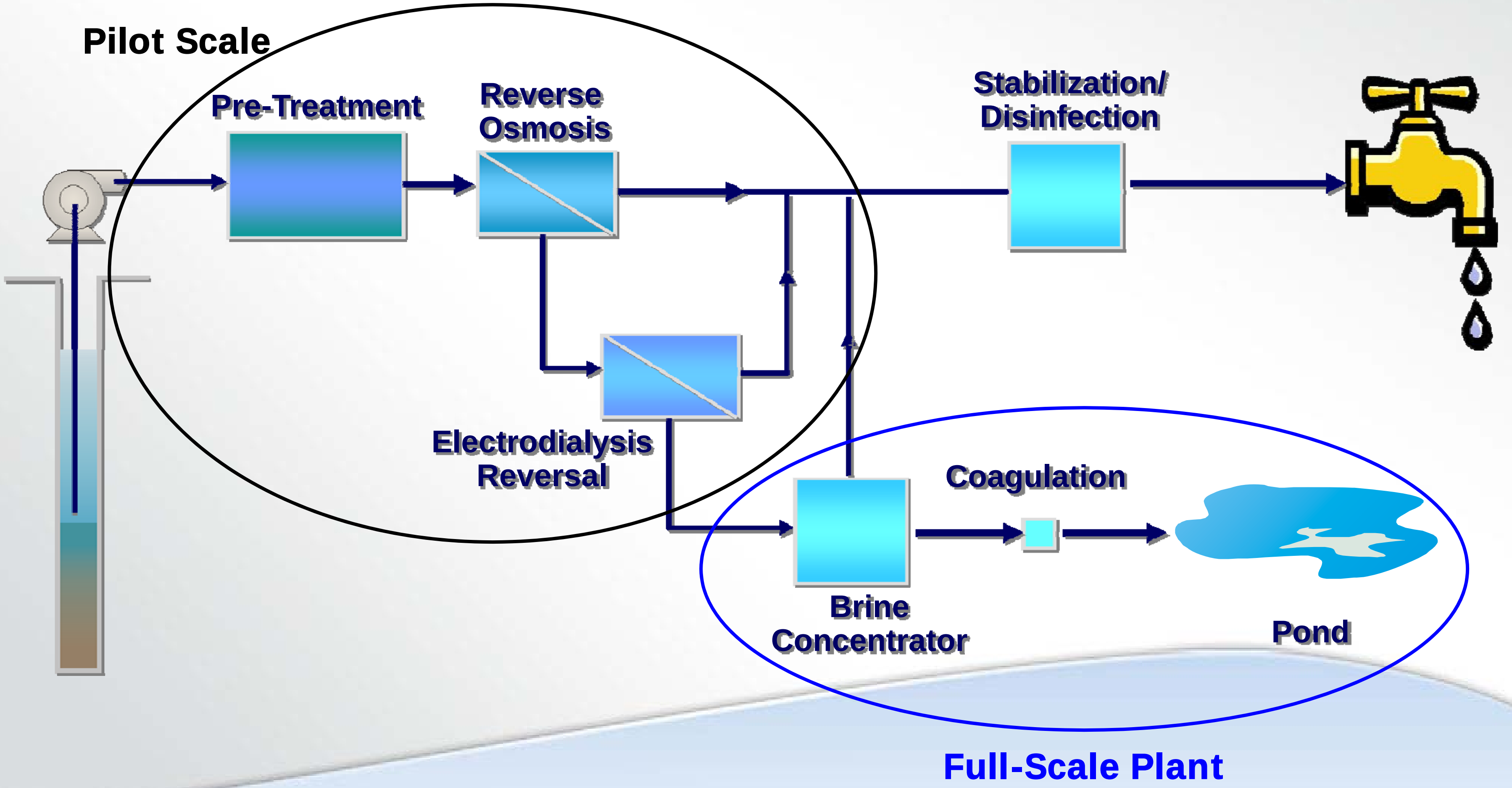
Well Water Quality

- pH = 7.1
- TDS = 1500 mg/L
- Hardness = 500 mg/L as $CaCO_3$
- Calcium = 140 mg/L
- Sulfate = 500 mg/L
- Silica = 50 mg/L
- Silt Density Index = 1.0

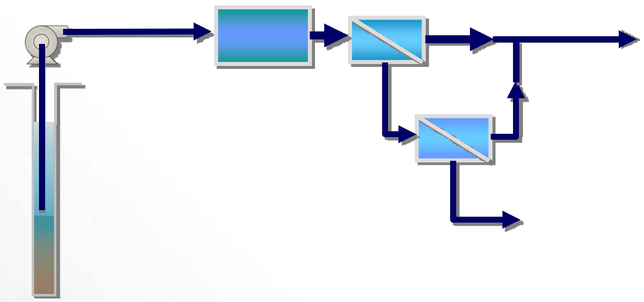
Contaminants of Concern

- Iron = 40 μg/L
- Manganese = 46 μg/L
- Arsenic = 6 μg/L
- Selenium = 40 μg/L

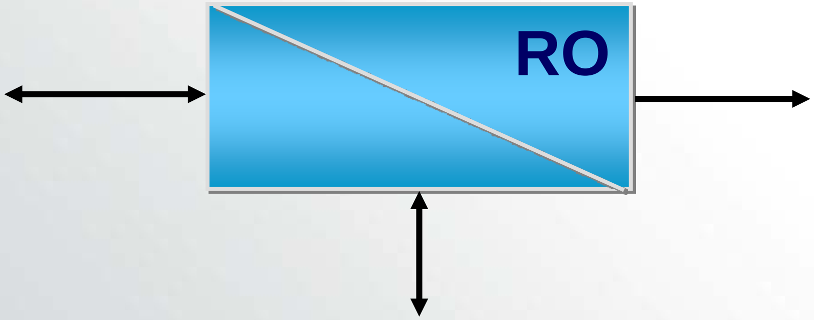
Despite the Many Challenges, Potable Water Can Be Obtained by a Zero Liquid Discharge Treatment Train



Pilot Project Objectives



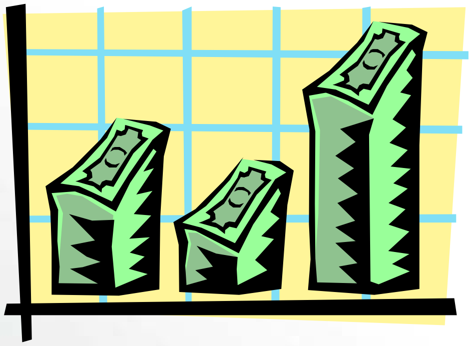
1. Demonstrate feasibility of selected treatment train.



2. Demonstrate primary RO and secondary EDR can achieve predicted recovery with minimal fouling.

3. Evaluate the effectiveness of a reversible RO configuration.

Pretreatment



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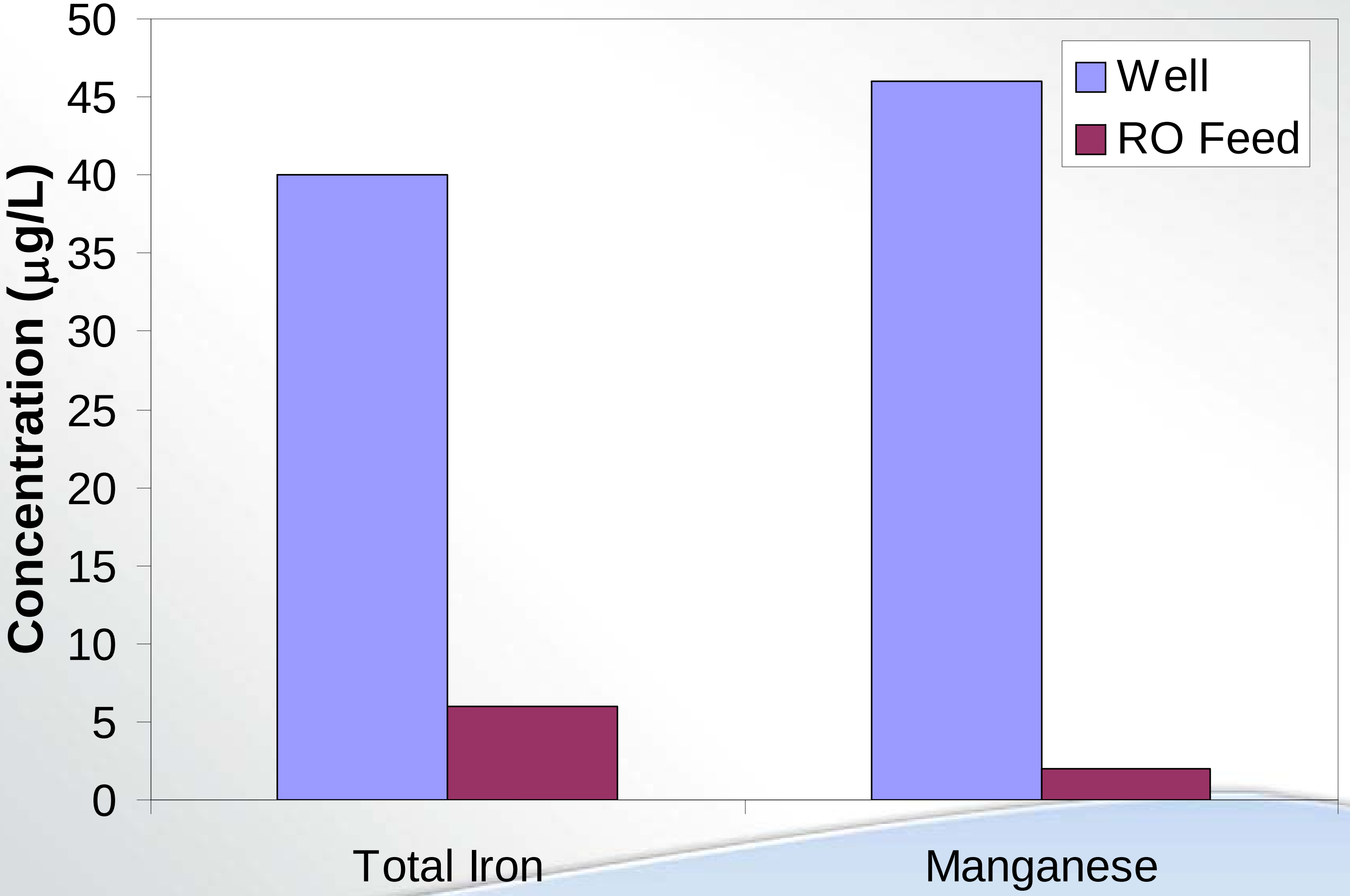
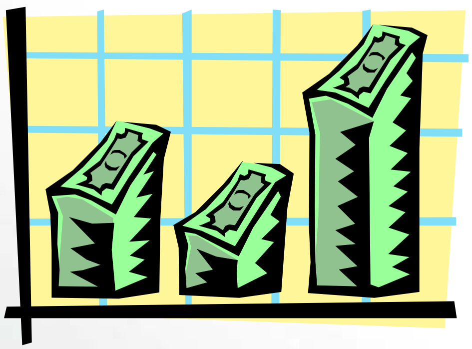
Pretreatment Can Effectively Remove RO Constituents of Concern

- Fe/Mn Removal
- Granular Media Filtration
    - Filtronics FV-03 Electromedia I

Pretreatment Can Effectively Remove RO Constituents of Concern



Reverse Osmosis



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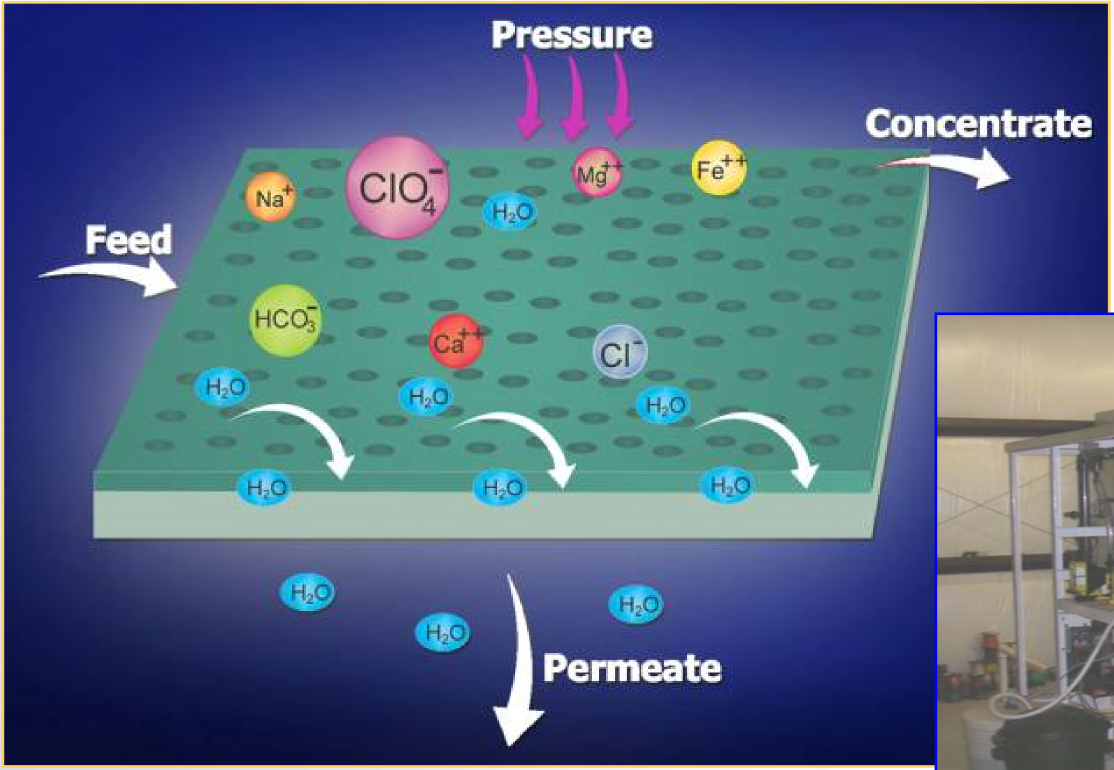
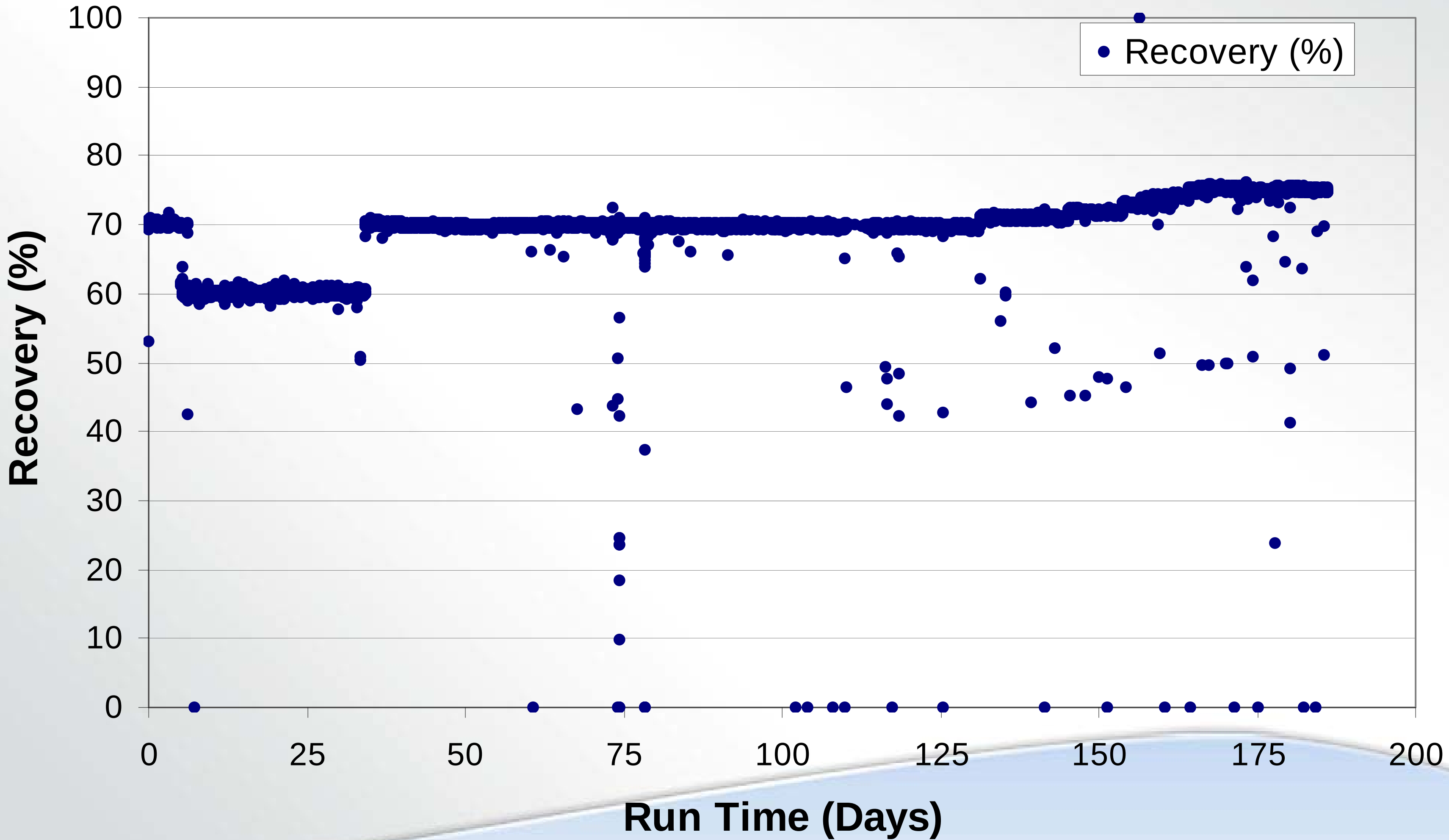
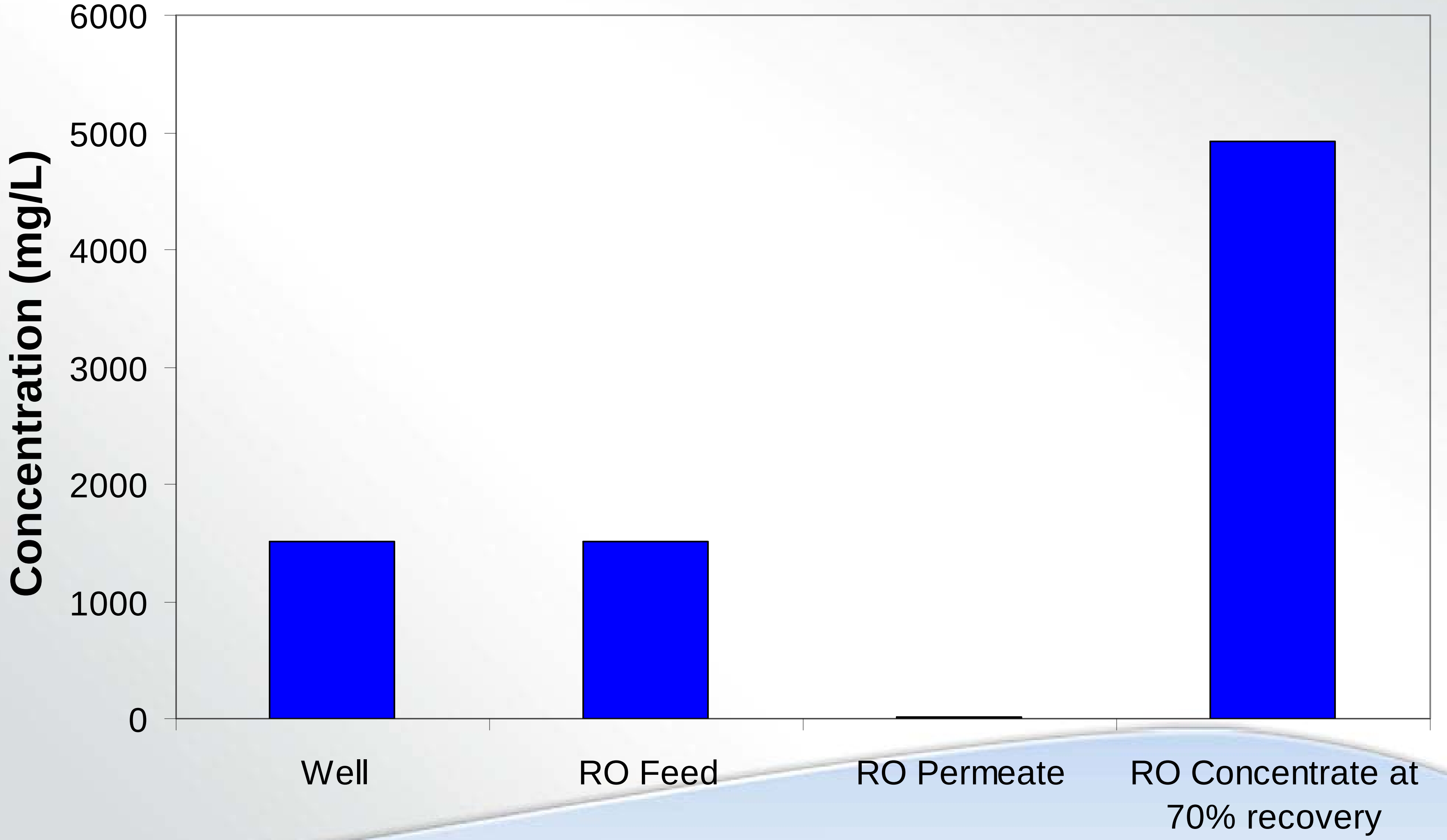
The RO Unit was Operated for Over 4,000 Hours



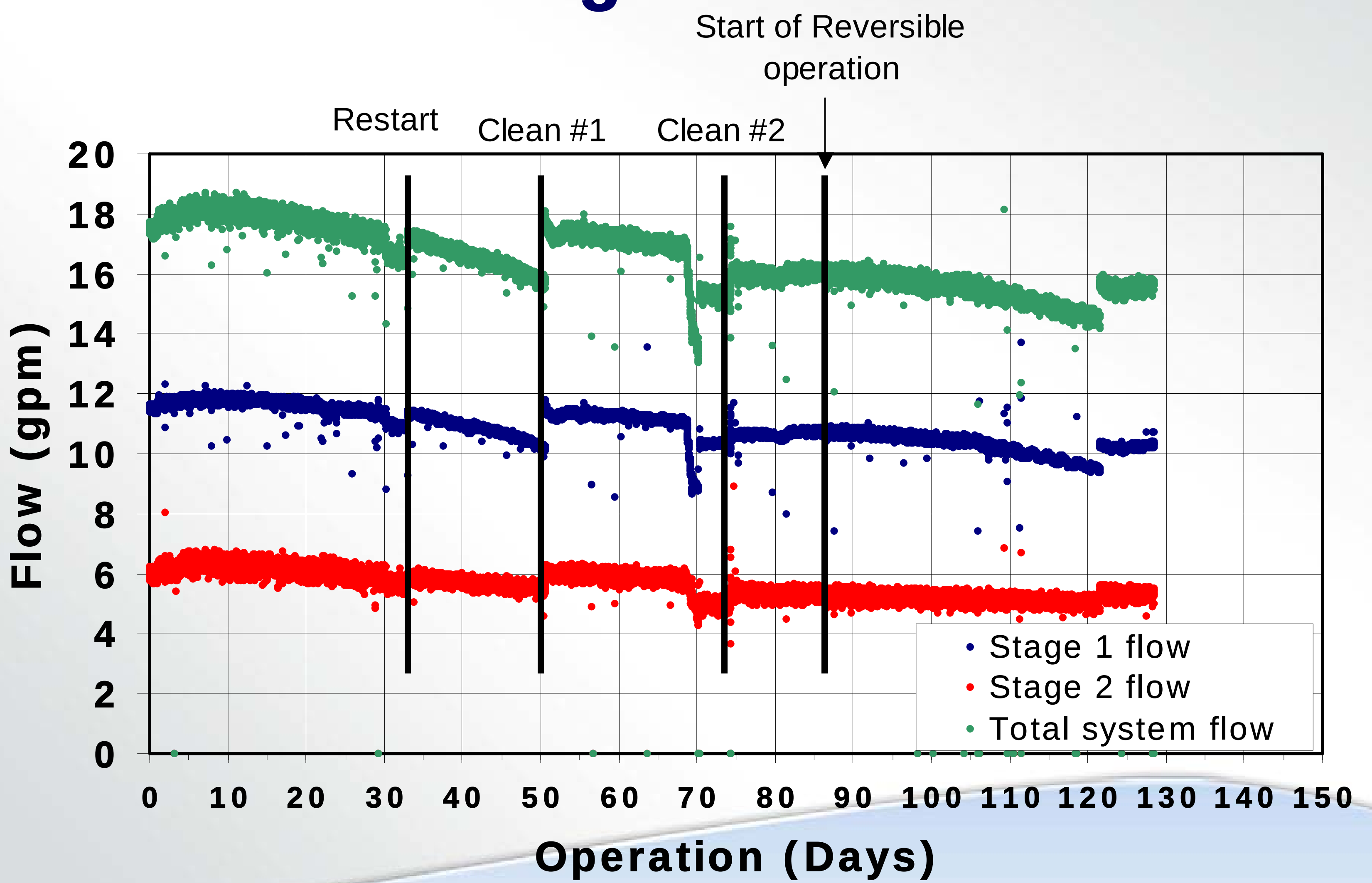
The RO Process Can Operate at High Recoveries



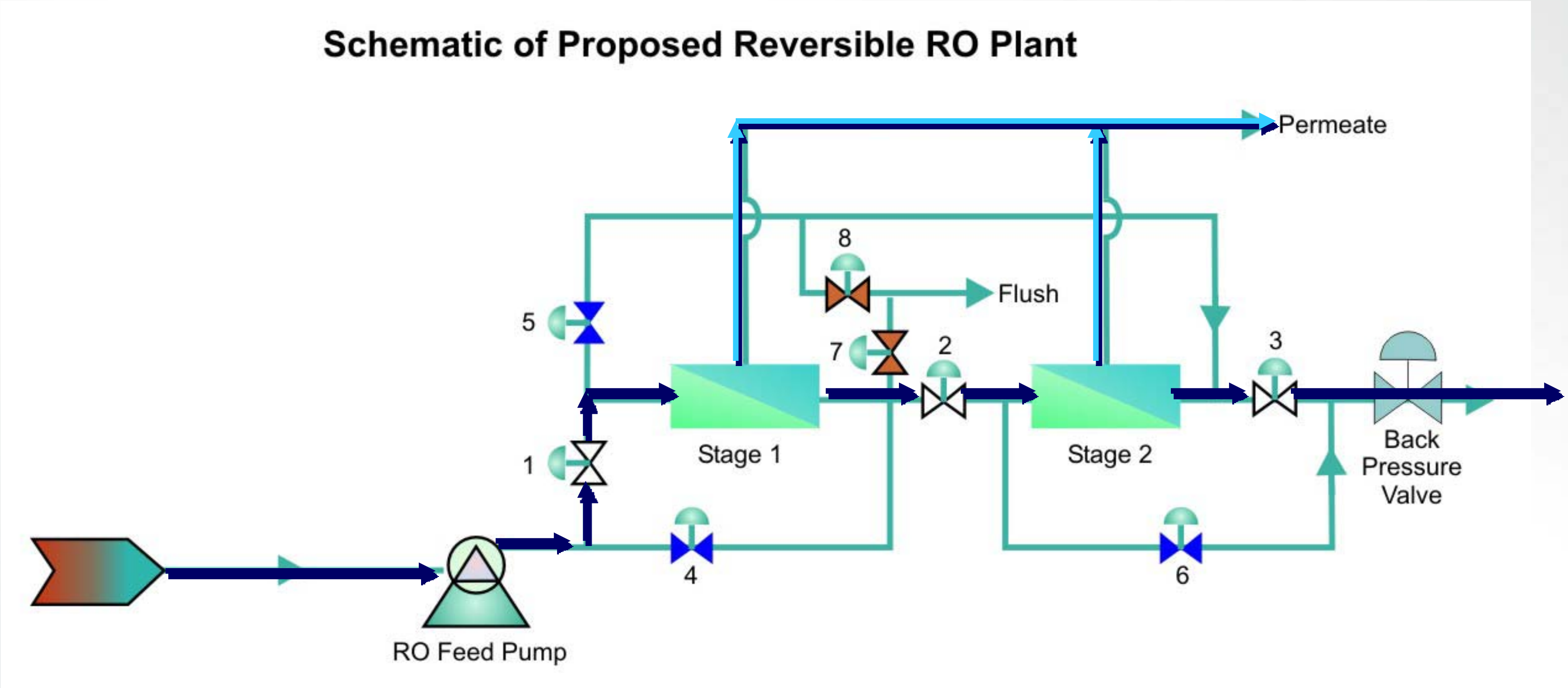
The RO Process Produces a Low Total Dissolved Solids (TDS) Product



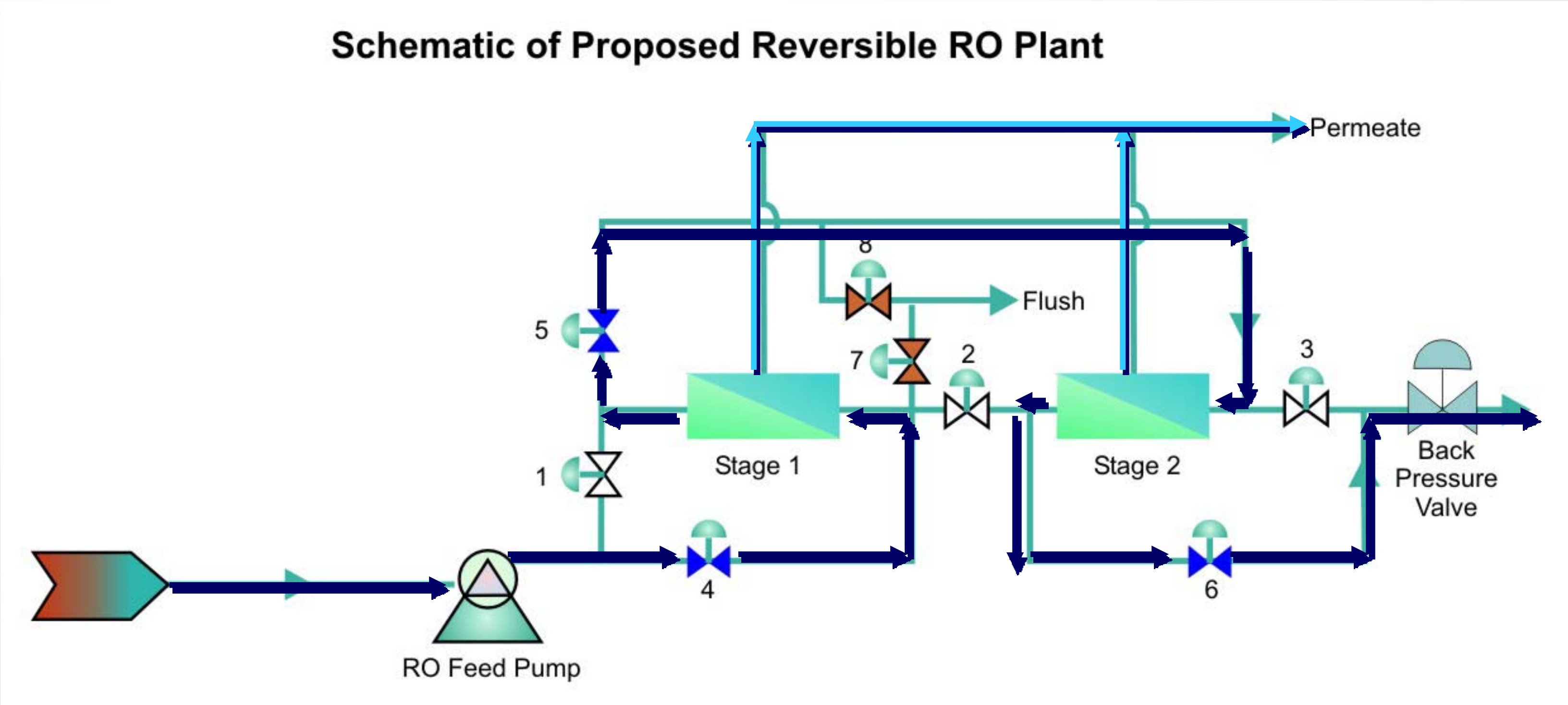
The RO Process Can Operate with Minimal Fouling



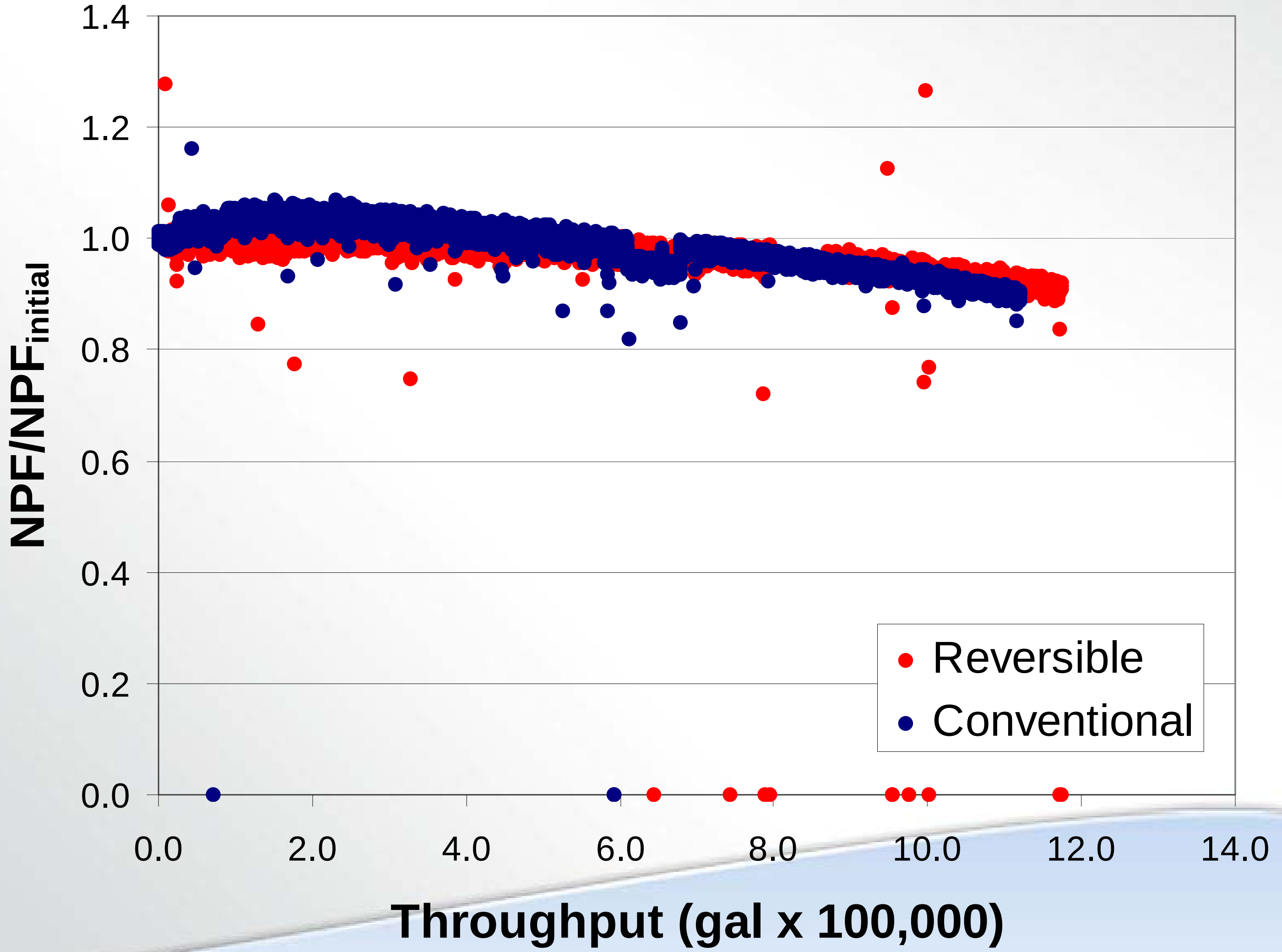
Reversible RO Configuration Has the Potential to Increase Recovery and Decrease Membrane Fouling



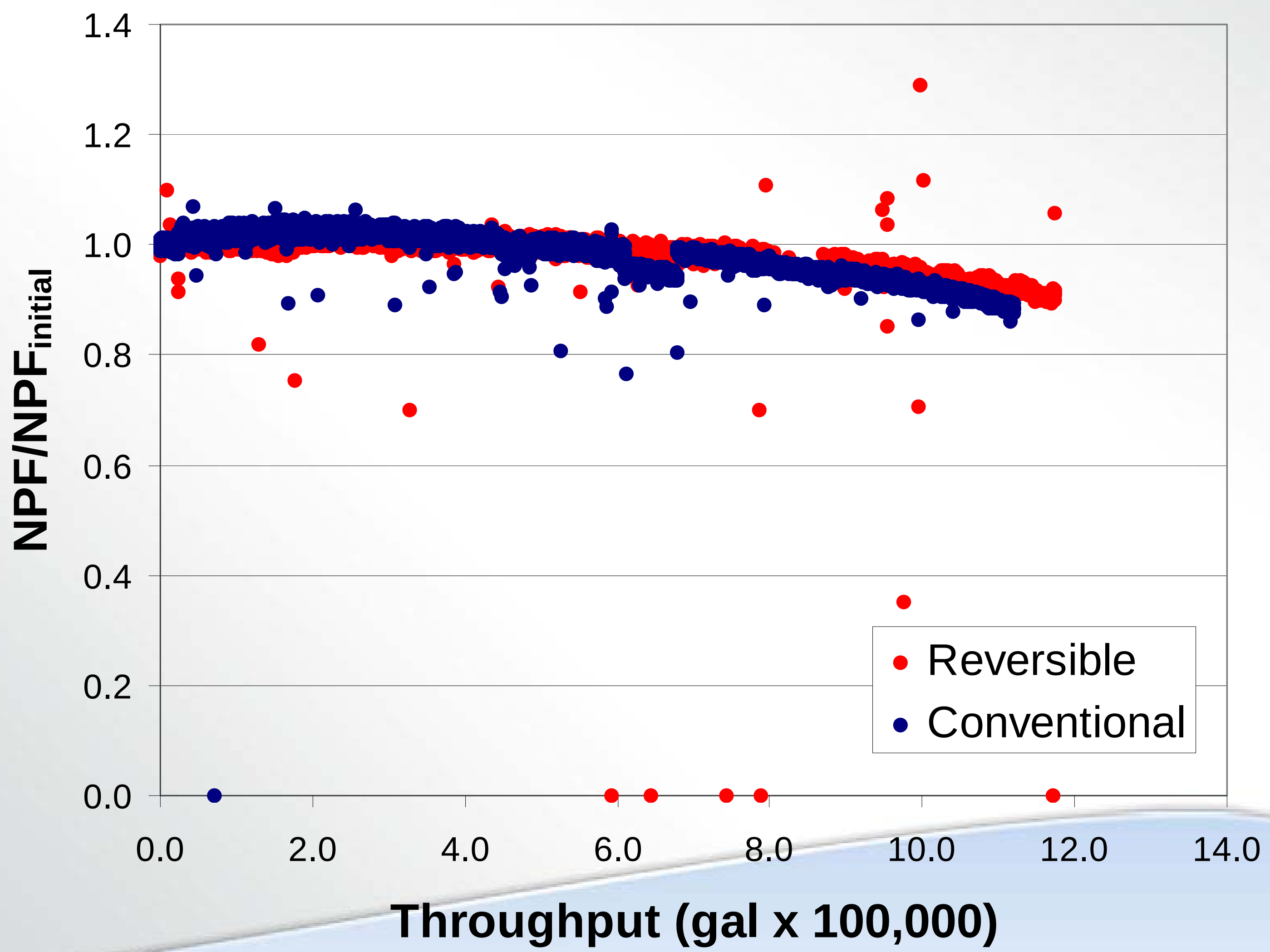
Reversible RO Configuration Has the Potential to Increase Recovery and Decrease Membrane Fouling



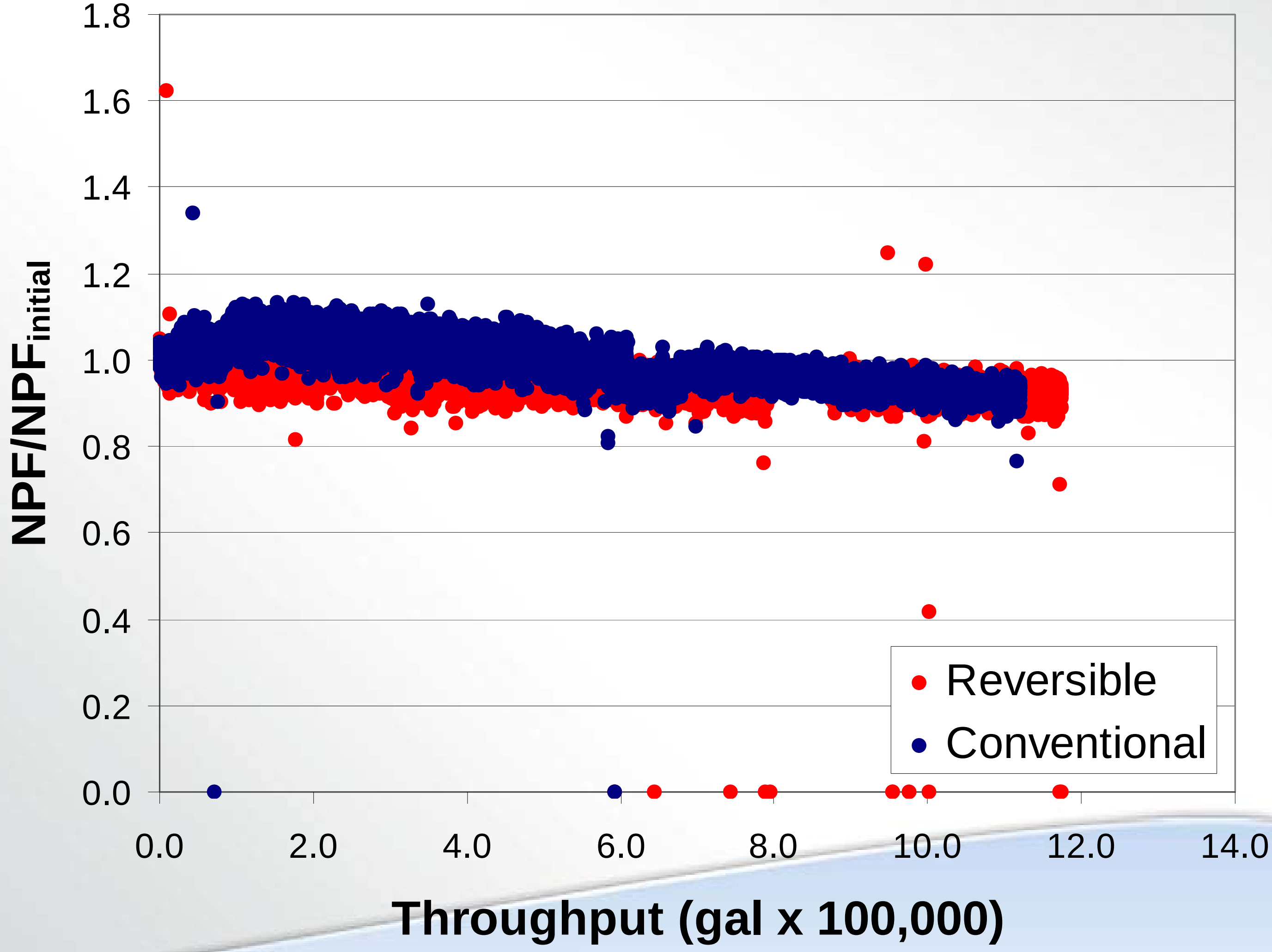
System Normalized Permeate Flow - Reversible Operation vs. Conventional Operation



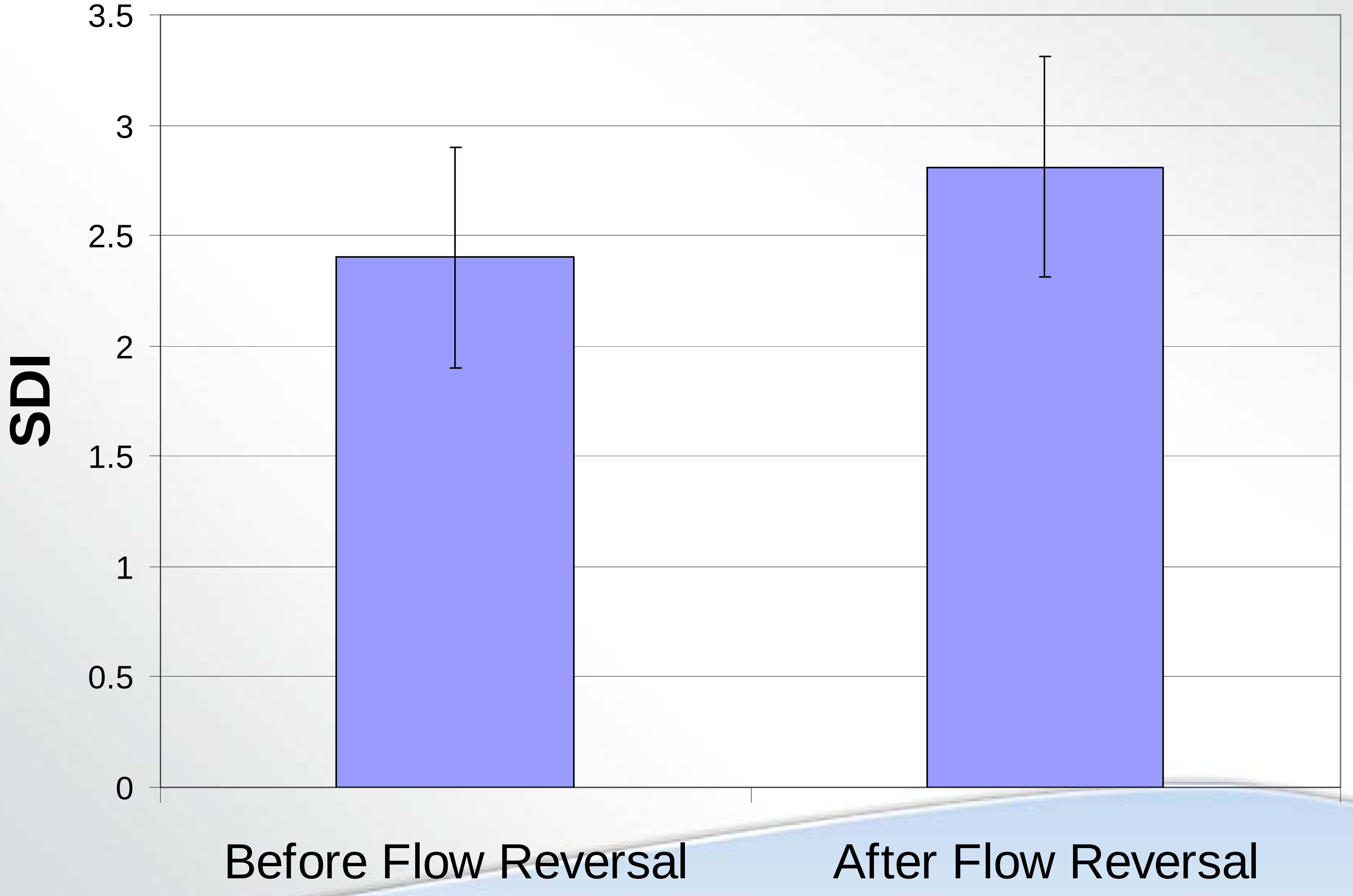
1st Stage Normalized Permeate Flow - Reversible Operation vs. Conventional Operation



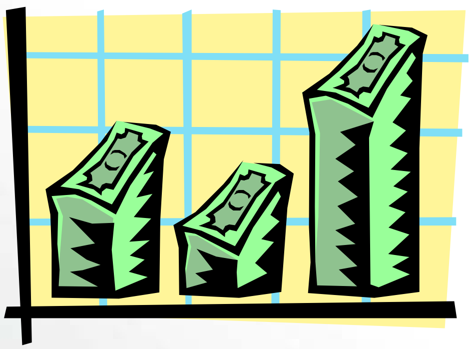
2^{nd} Stage Normalized Permeate Flow - Reversible Operation vs. Conventional Operation



RO Concentrate Silt Density Index (SDI) Indicates Particle Removal After Flow Reversal



Electrodialysis Reversal



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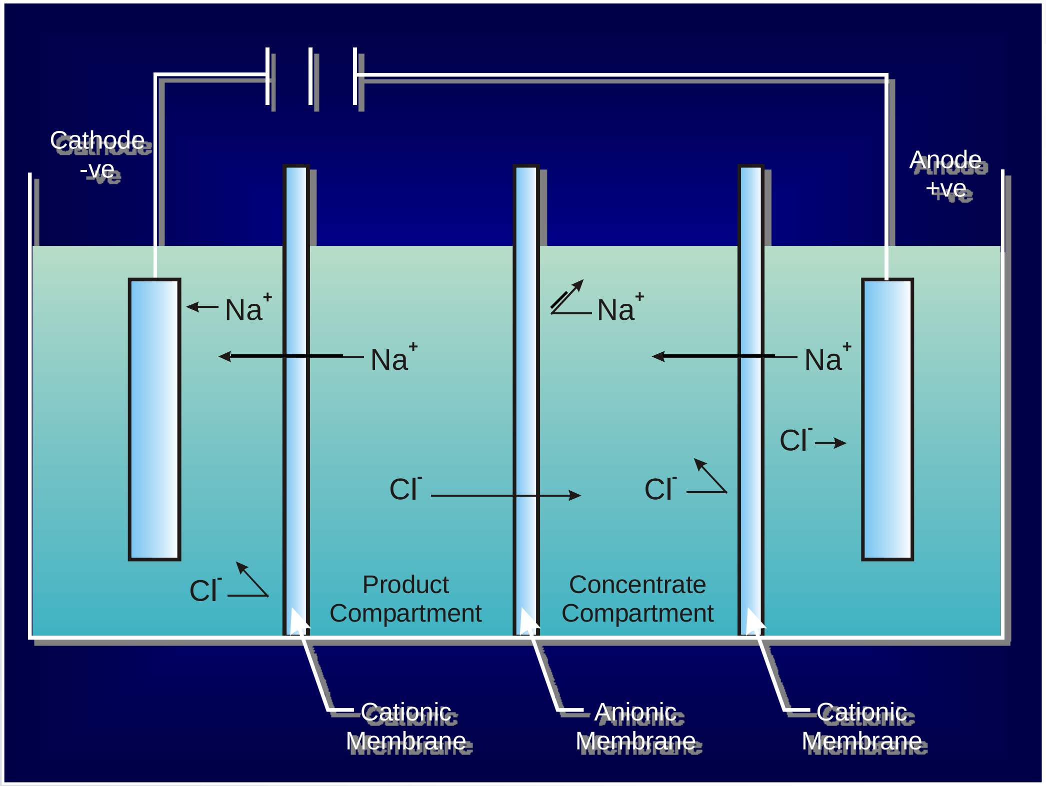
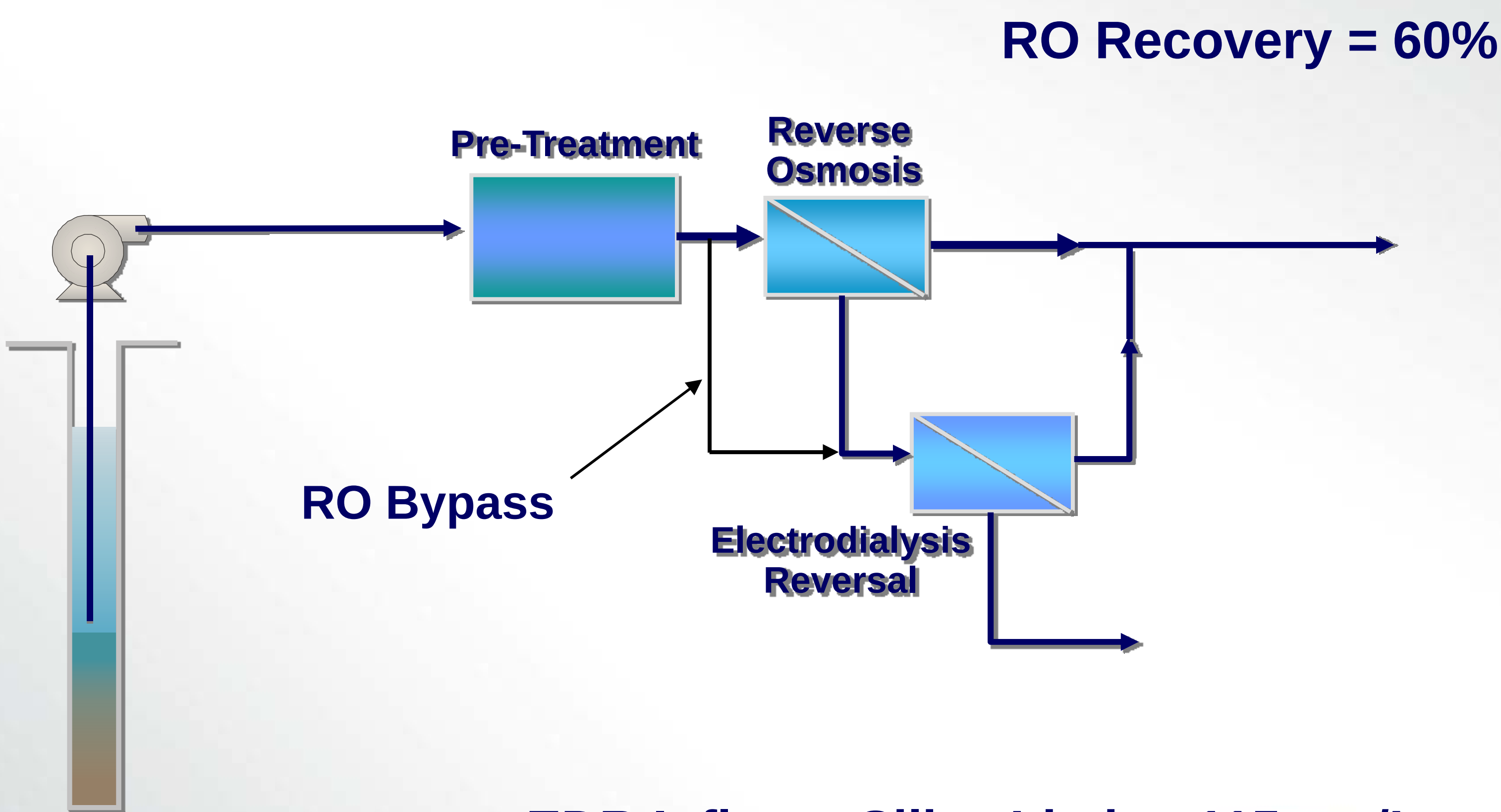
Reverse Osmosis

The EDR was Operated Continuously for Over 1,600 hours

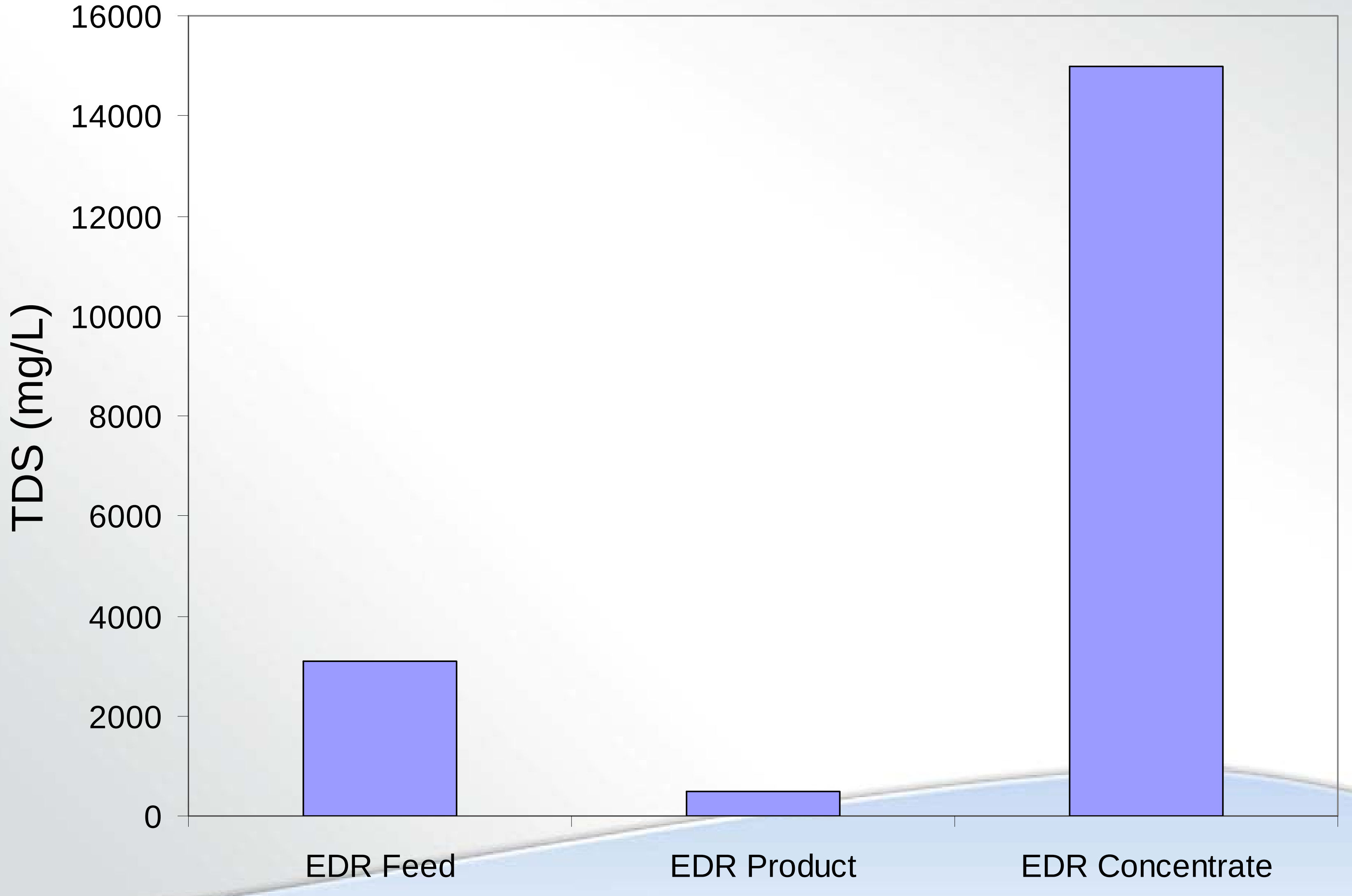


Reduced RO Recovery to Meet EDR Feed Requirements

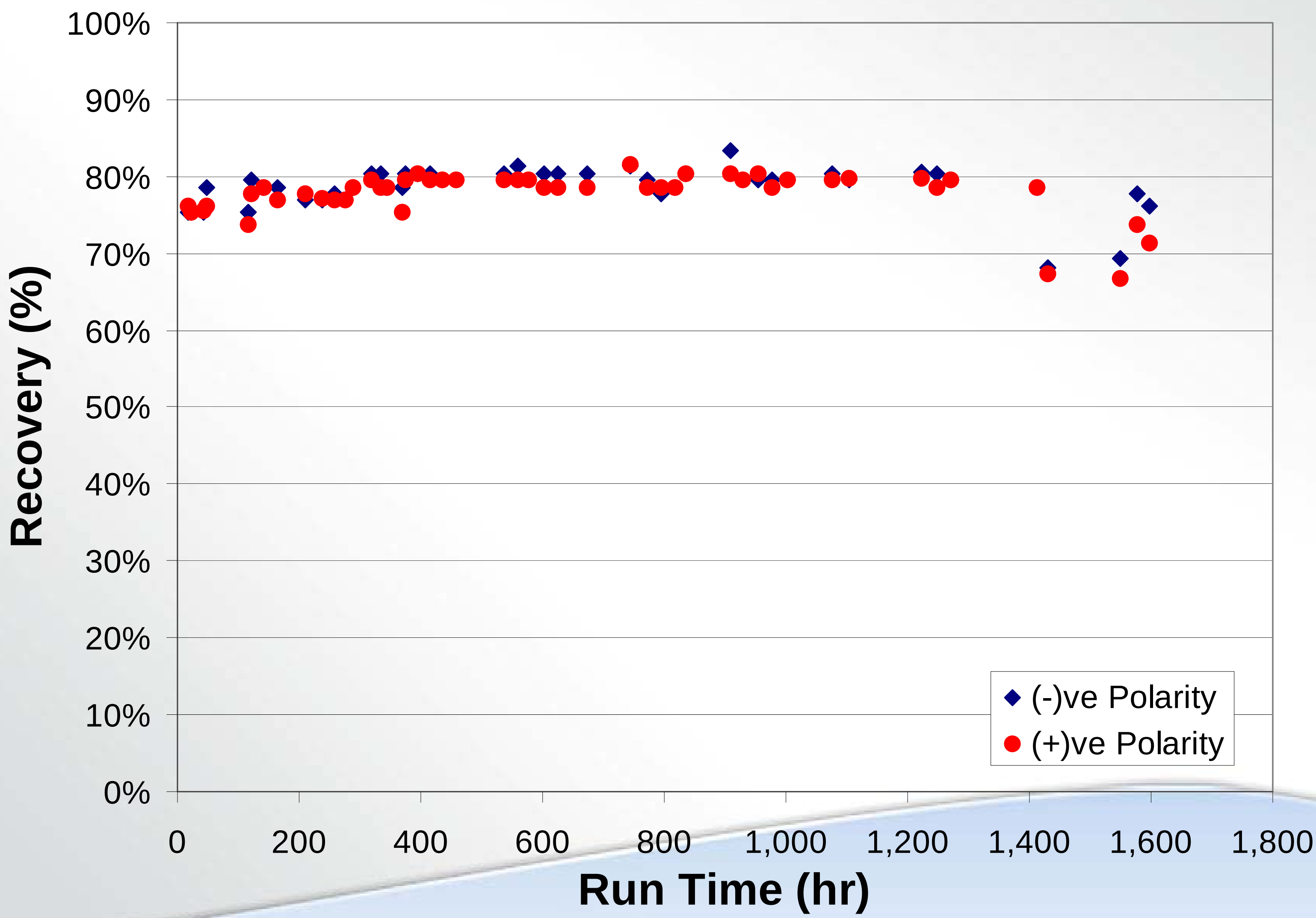


EDR Influent Silica Limit = 115 mg/L

EDR can Effectively Remove TDS from the RO Concentrate



EDR can Achieve High Recoveries



EDR Performance has been Stable

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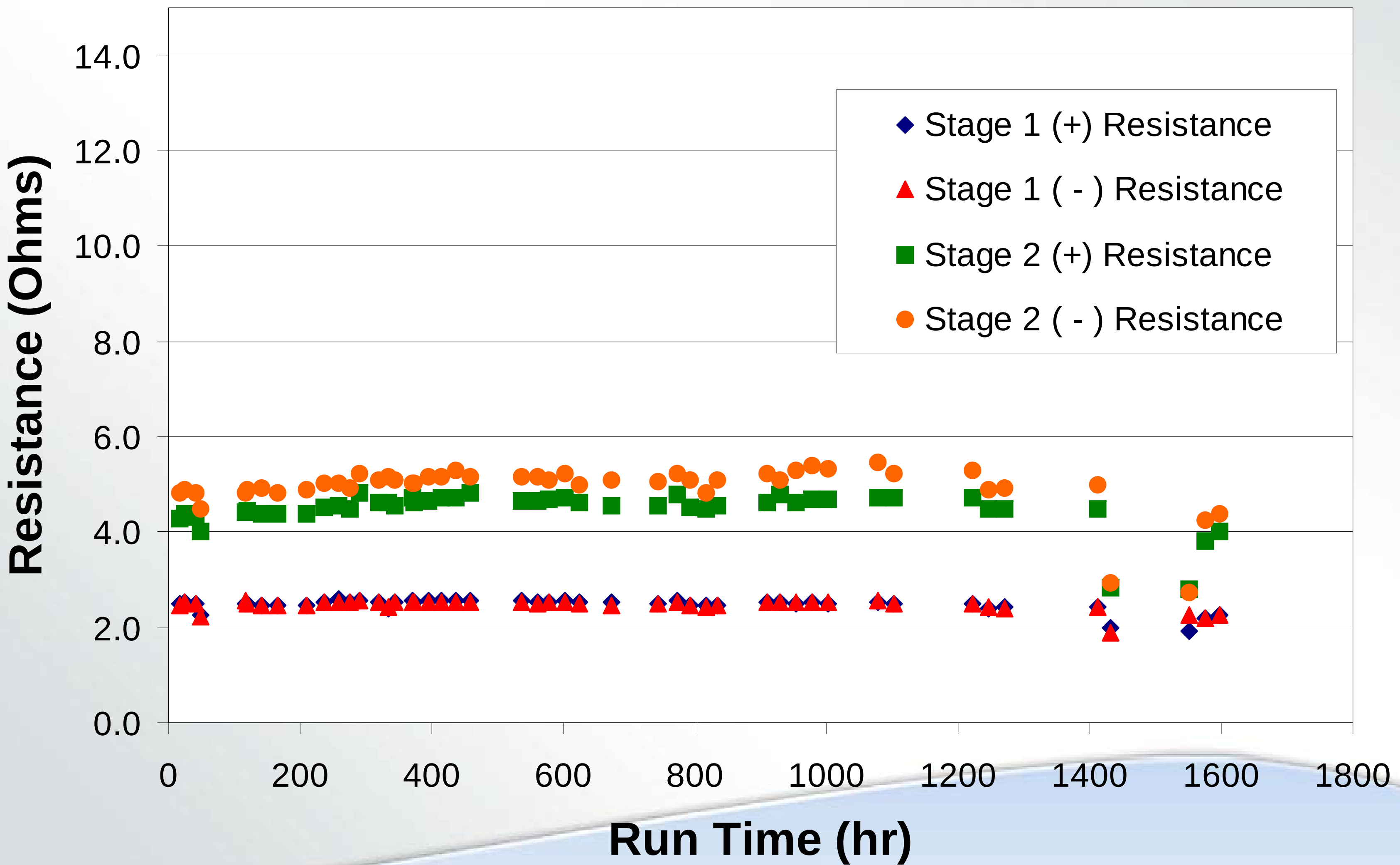
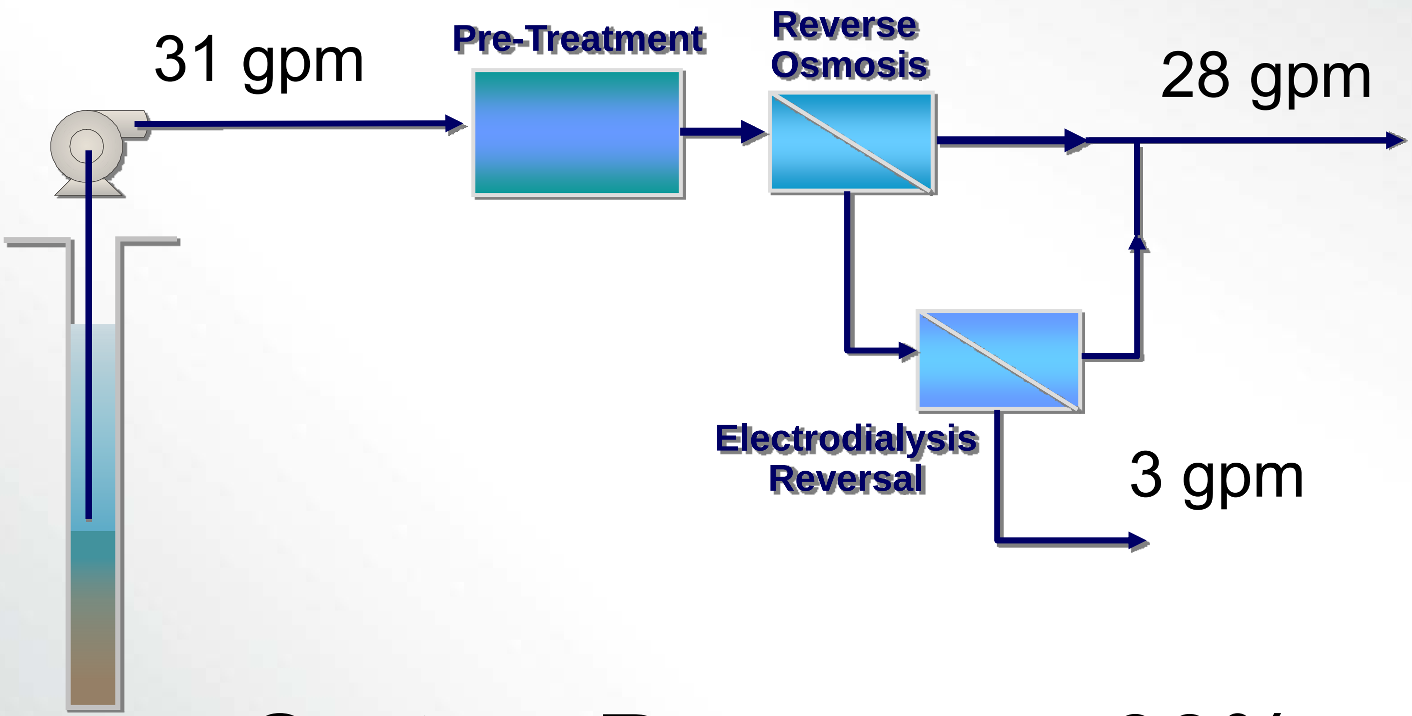
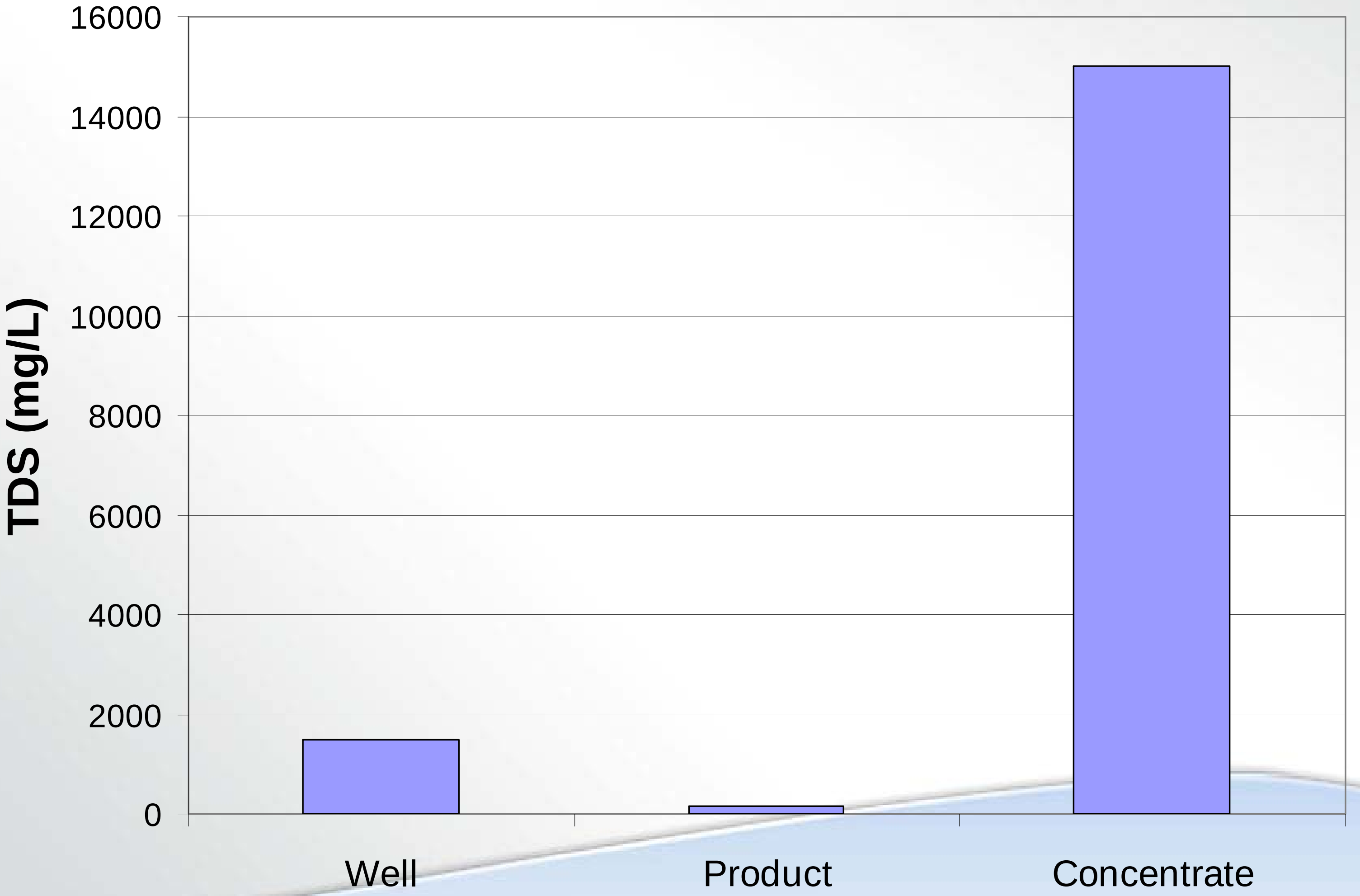


RO Primary Desalting and EDR Secondary Desalting can Achieve High Overall Recovery

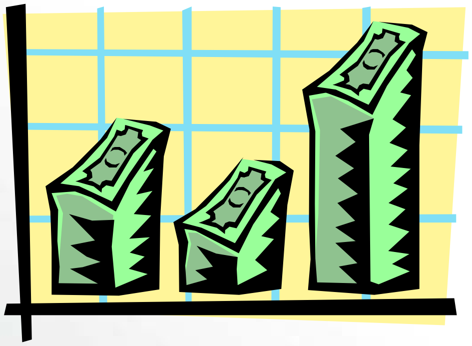


System Recovery = 90%

RO Primary Desalting and EDR Secondary Desalting can Produce a Low TDS Product



Project Costs



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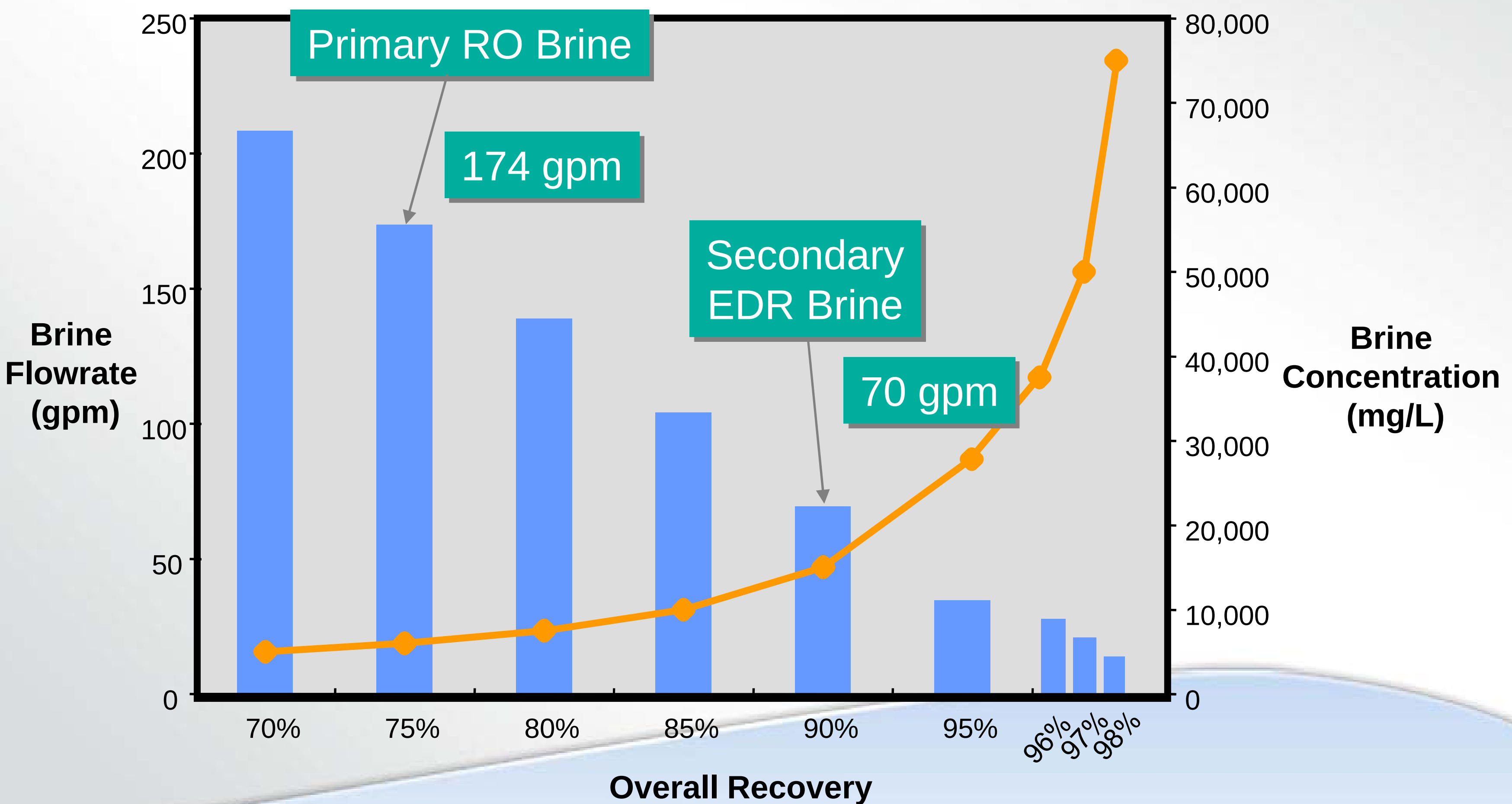
Limiting the Volume of Brine for Final Treatment Reduces Cost

Reverse Osmosis

Brine Concentration

Capital – 1 mgd	$2 million	$22 million
Power (kWh/1000 gal)	2.2	90

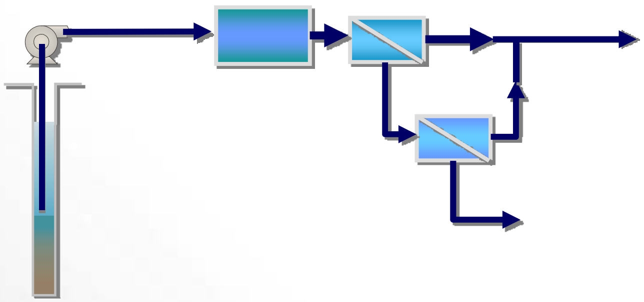
Impact of Overall Recovery is Significant – Example: 1-mgd Plant



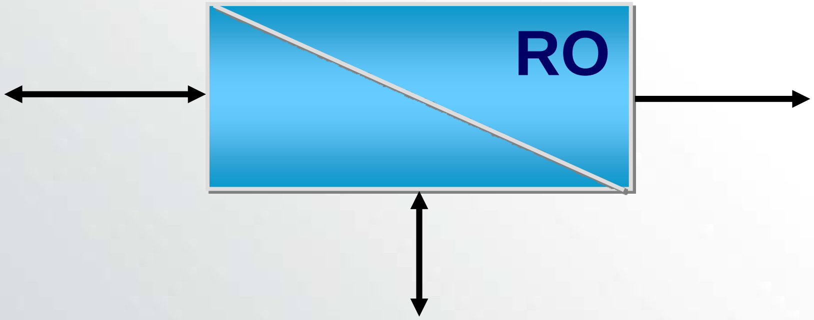
Limiting the Volume of Brine for Final Treatment Reduces Cost – Full-Scale Facility at 2.7 mgd

	Capital Cost (MM$/yr)	O&M Cost (MM$/yr)	Total Cost (MM$/yr)
RO + BC	2.8	3.7	6.5
RO + EDR + BC	2.4	2.6	5.0

Summary and Conclusions



1. Selected treatment train is feasible.



2. Primary RO and secondary EDR can achieve predicted recoveries.

3. The reversible function has potential to improve RO performance, but additional testing is needed.

Acknowledgements

- California Department of Water Resources (Chapter 6(a) of Proposition 50)
- Staff Indian Wells Valley Water District

Questions?

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INDIAN WELLS VALLEY WATER DISTRICT

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Comparing Water Costs Indicates that Costs are Reasonable Given Water Quality and Inland Location