

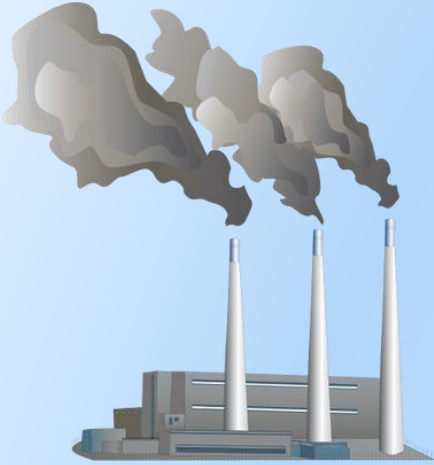
# BRINE TREATMENT AT A SEMICONDUCTOR FACTORY

SALINITY MANAGEMENT IN INDUSTRY

**WATER**  
OUR FOCUS  
OUR BUSINESS  
OUR PASSION

 **carollo**  
*Engineers...Working Wonders With Water®*

# Industrial Water Use and Wastewater Generation is Significant



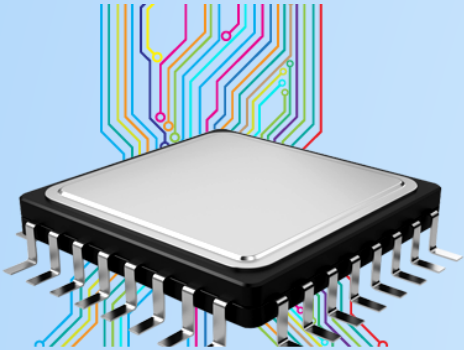
**Power**



**Food and Beverage**



**Oil and Gas**

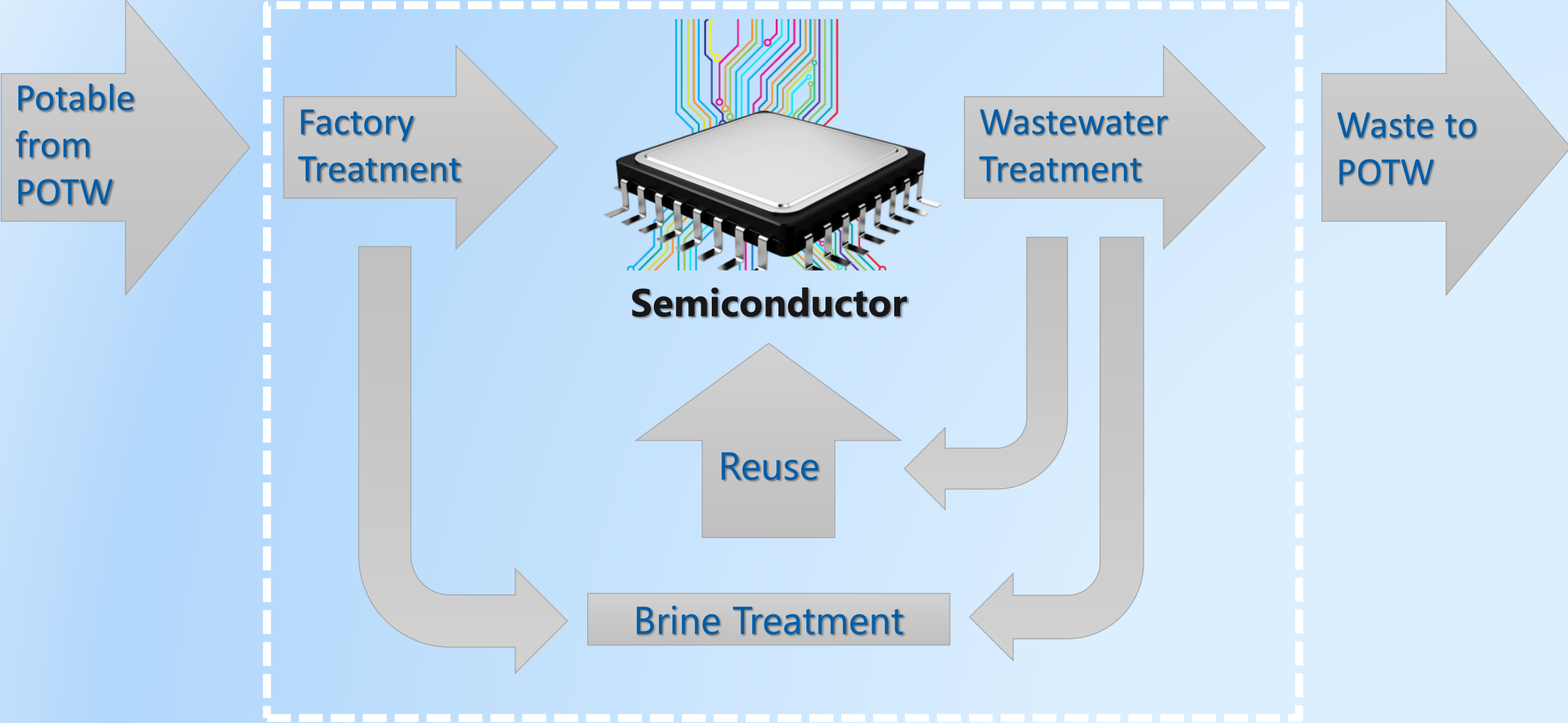


**Semiconductor**



**Mining**

# Industries Often Share Treatment Responsibility with Local POTWs



# Case Study: Semiconductor Industrial Reuse and ZLD

## Project Drivers

### Eliminate Discharge

- Prevent discharge of factory potable treatment waste to local WWTP
- Allow for expansion of manufacturing facility

### Resource Recovery and Sustainability

- Harvest high quality water for use in manufacturing
- Reduce potable demand

## Project Facts and Features:

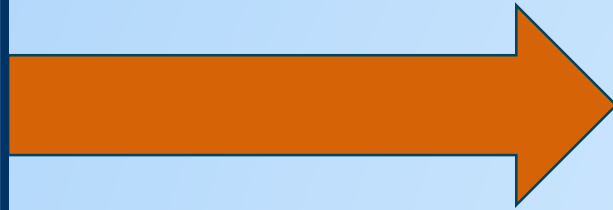
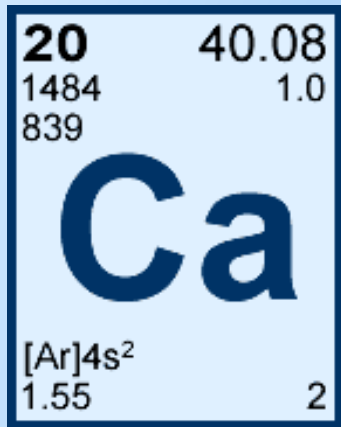
- **Capacity: ~2,000 gpm**
- **RO Recovery: 88-94 Percent**
- **Brine Concentrator Recovery: >66 percent**
- **Overall Recovery: 97 Percent**
- **Solid Residual Disposal: Landfill**
- **Brine Concentrator Blowdown Disposal: Evaporation Ponds**
- **Product Water Use:**
  - **Interim: Blending to lower TDS loading in industrial waste discharge**
  - **Long Term: Reuse in the manufacturing facility**
- **Project Cost: Between \$0 and \$1 Billion**



# Waste Stream from the Factory Treatment System Created Treatment Challenges

- High Calcium
  - Calcium Carbonate Scaling (RO)
  - Calcium Fluoride Scaling (RO)
- High Silica
  - RO Scaling
  - Thermal System Scaling
  - Pipeline Scaling
- High TOC
  - RO Fouling
- High Total Dissolved Solids (~3-4k mg/L)

# Calcium Scaling is Controlled by Removal, pH, and Prevention



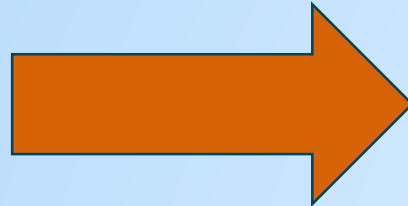
CHEMICAL SOFTENING  
(CALCIUM AND  
FLUORIDE REMOVAL)

PRE-RO  
ANTISCALANT  
(OPTIONAL)

PRE-FILTRATION ACID

PRE-BC CARBONATE  
REMOVAL

# Silica Scaling is Controlled by Removal, Solubility, and Prevention



CHEMICAL SOFTENING  
(CO-PRECIPIATION  
WITH MAGNESIUM)

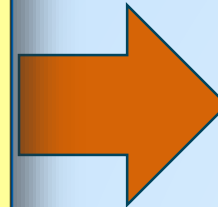
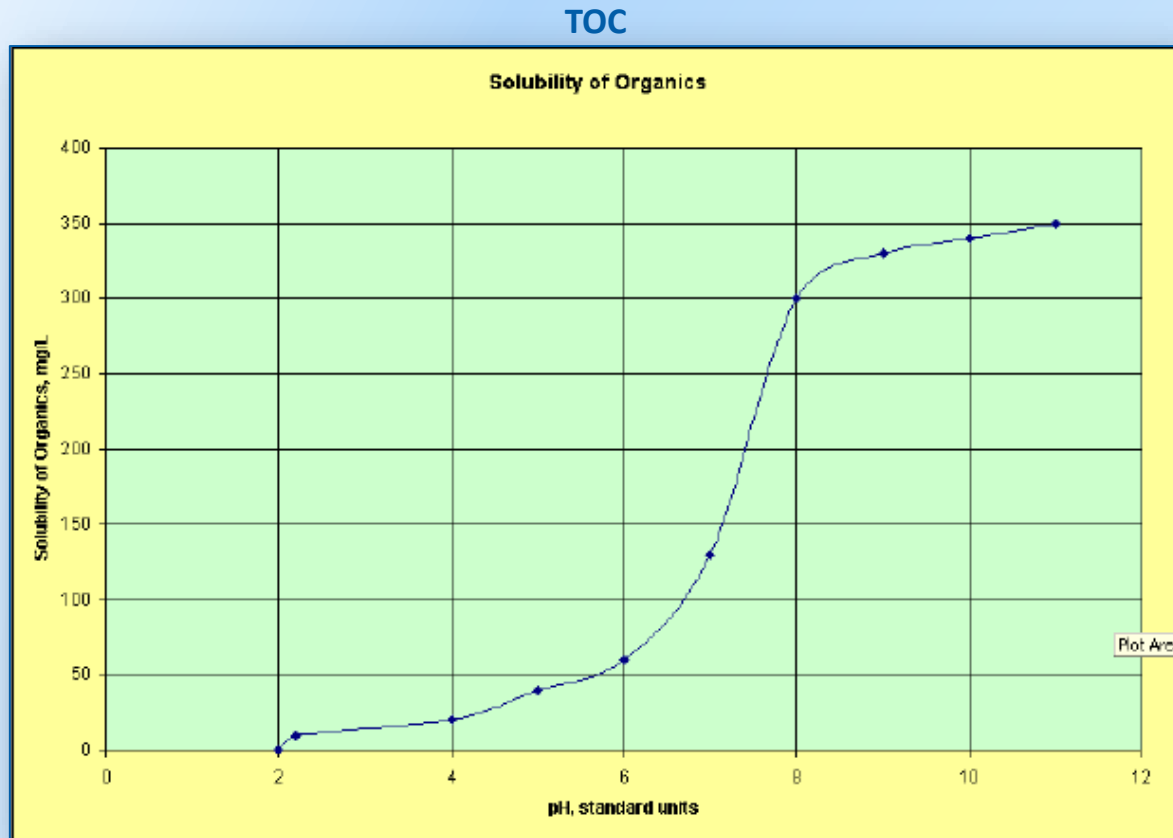
PRE-RO  
ANTISCALANT

HIGH pH OPERATION

HIGH TEMPERATURE  
IN BCS



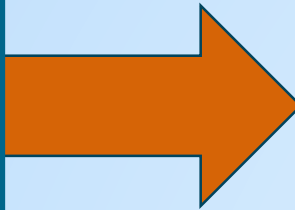
# TOC is Controlled by Removal and Solubility



**COAGULATION**  
(REMOVAL WITH MAGNESIUM  
HYDROXIDE PRECIPITATION)

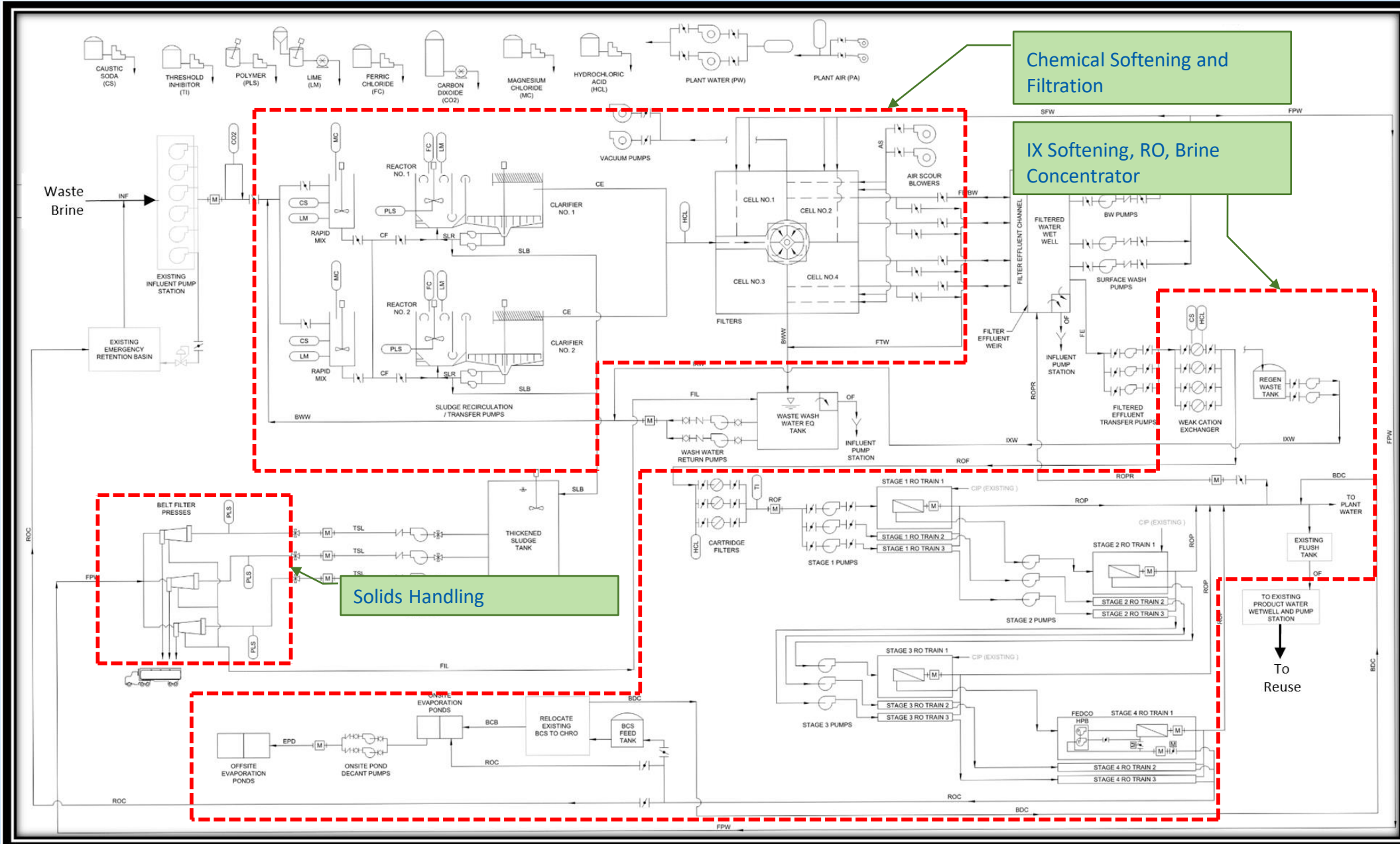
**HIGH pH  
OPERATION**

# TDS is Controlled by Removal



CONCENTRATION BY  
RO TO ~110K mg/L  
(LIMIT OF RO PROCESS)

CONCENTRATION IN  
BRINE CONCENTRATOR  
TO SODIUM CHLORIDE  
SATURATION



Chemical Softening and Filtration

IX Softening, RO, Brine Concentrator

Solids Handling

**Treatment Is Accomplished Through Integration of Three Major Vendor Systems, Each With Guaranteed Performance Goals**

# Project Status

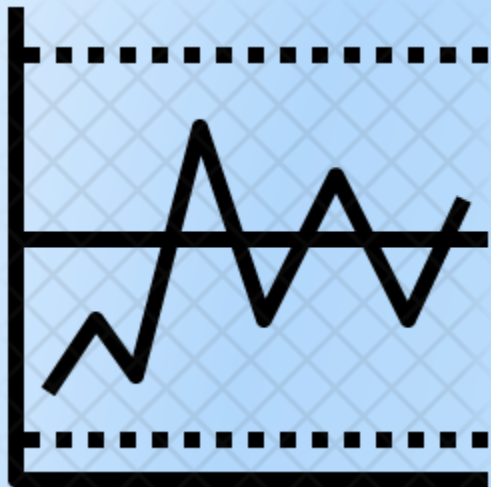
- Process online since 2014
- Upgrades since 2014
  - Modifications to optimize for actual water quality
  - Modifications to conform to factory standards for redundancy
  - Addition of conveyance to factory reuse systems

# What Are Challenges To Industrial Treatment for Salt?

Balancing ROI vs Good Neighbor vs Pro-Business



Variability: Treatment Changes with Business



Reactive vs Proactive Approach to Changing Regs

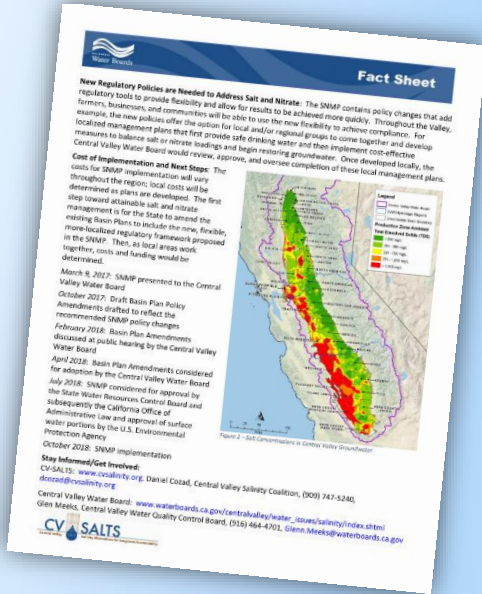


# Emerging Needs for Salt Management in Industry

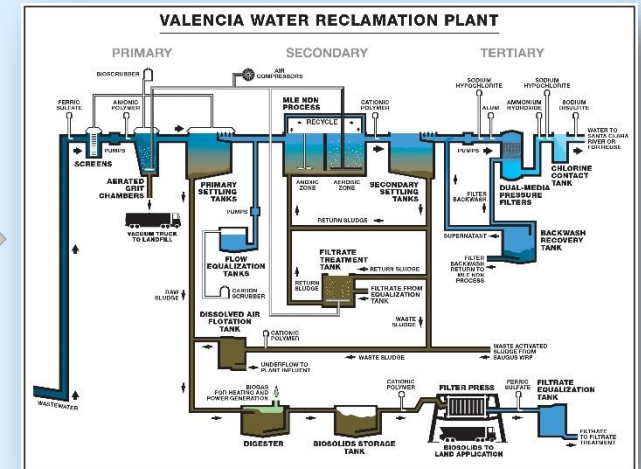
Blowdown from Cooling Towers  
(Data Centers, Power Plants)



Regulatory Focus on Salt



Industrial Salt Discharges to POTWs  
(Impacts on Reuse)



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OUR FOCUS  
OUR BUSINESS  
OUR PASSION

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