11 Years on the Road to (High) Recovery

The Chino Concentrate Reduction Story

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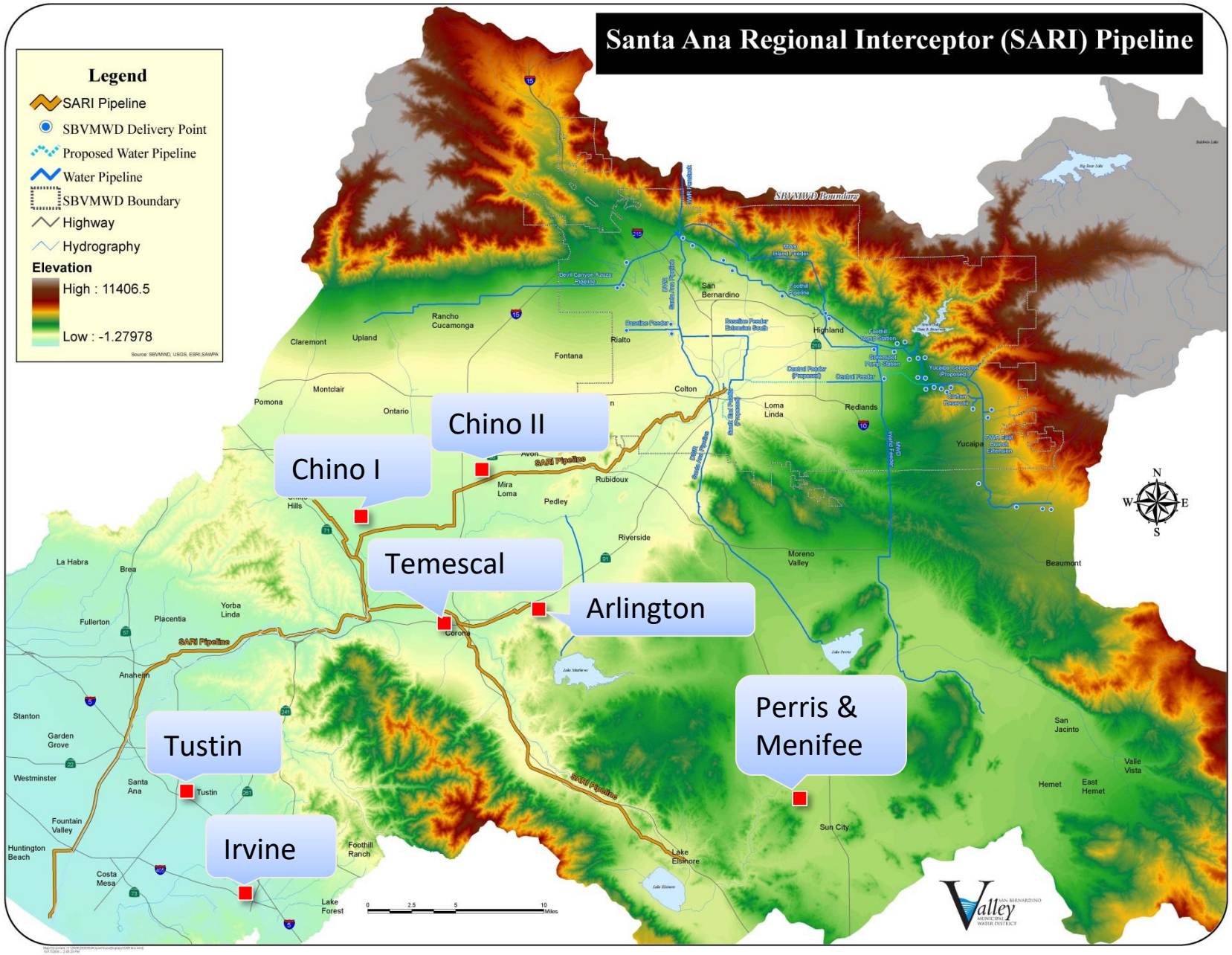
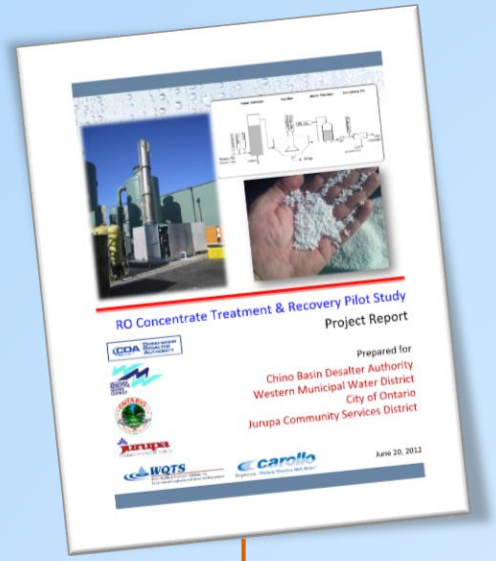
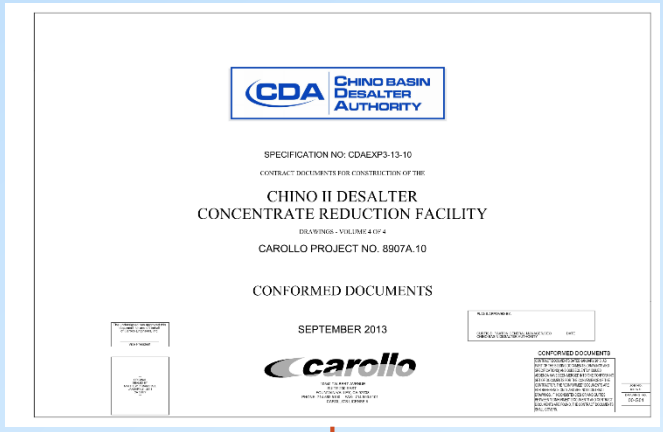
Project Background

- Chino Basin Desalter Authority (CDA) is a Joint Powers Authority consisting of 8 members
- The CDA owns the Chino Desalters (I and II)
- Chino II Desalter began operation in 2006 (10-mgd)
- Expanded to 20.5-mgd in 2011
- Brine disposal costs, coupled with construction-related grant funding, prompted the CDA to move forward with brine reduction process

The Brine Challenge



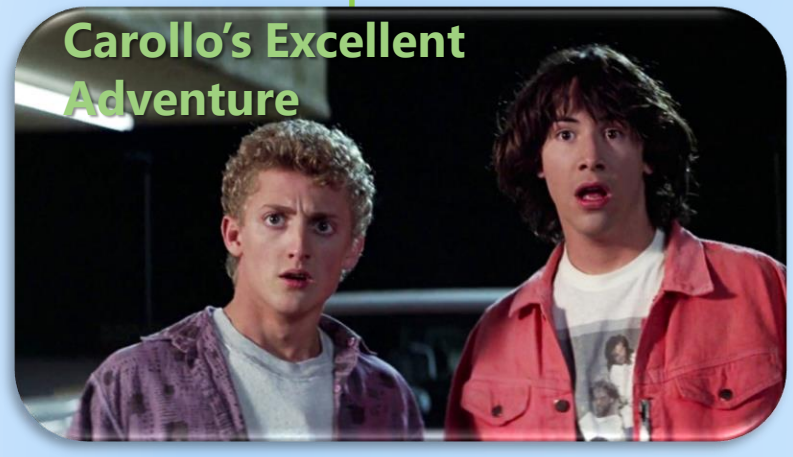




WESTERN MUNICIPAL WATER DISTRICT

CITY OF ONTARIO

2006 → 2009 → 2010 → 2011 → 2012 → 2013 → 2017



Chino II Desalter Expansion

CRF Startup

Brine Reduction and Mineral Recovery At the Chino II Concentrate Reduction Facility

Project Drivers

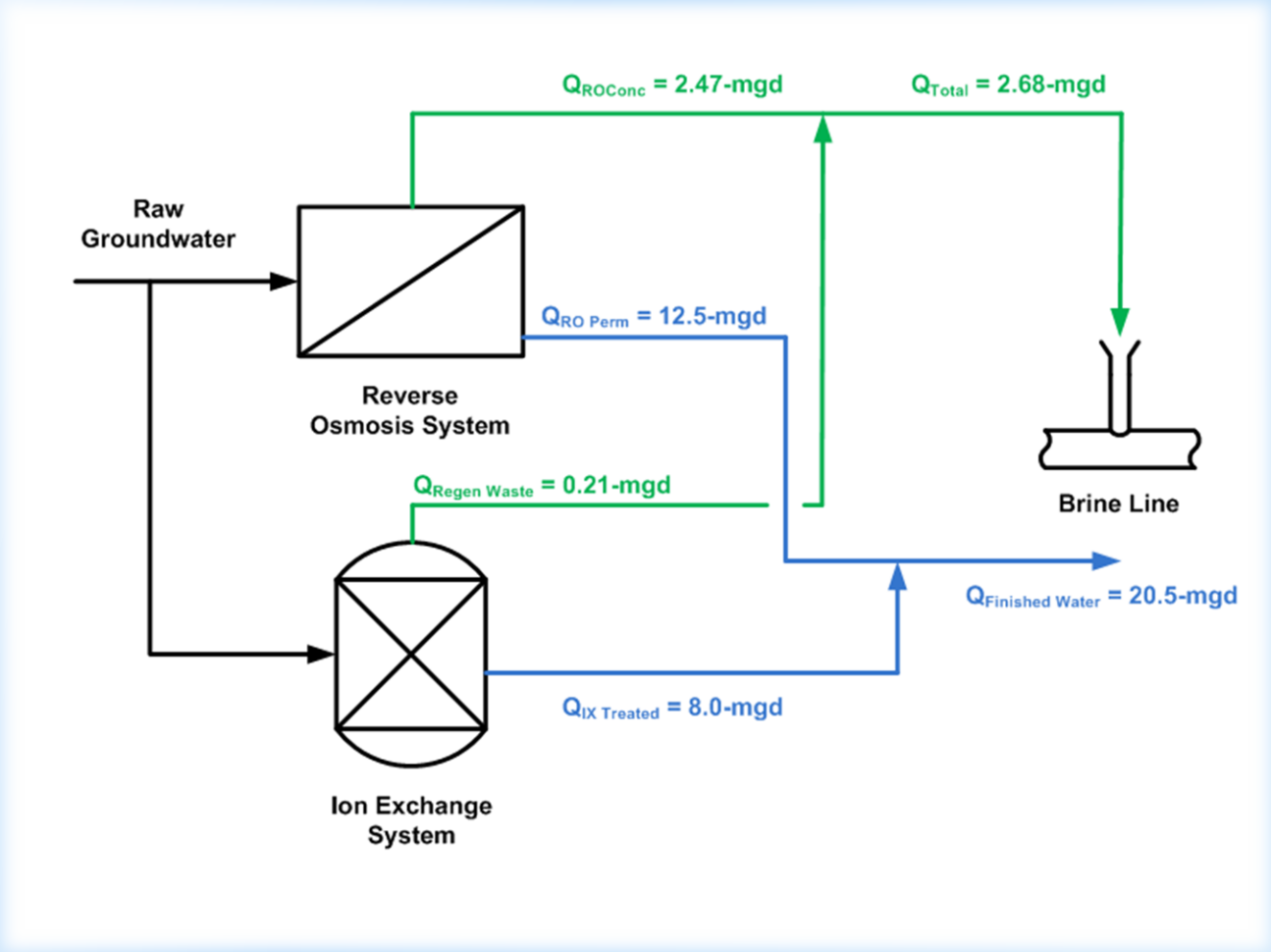
Reduce Discharge To Brine Line

- Allow for Expansion of Chino II Desalter
- Utilize Capital Project Specific Grant Funding

Resource Recovery and Sustainability

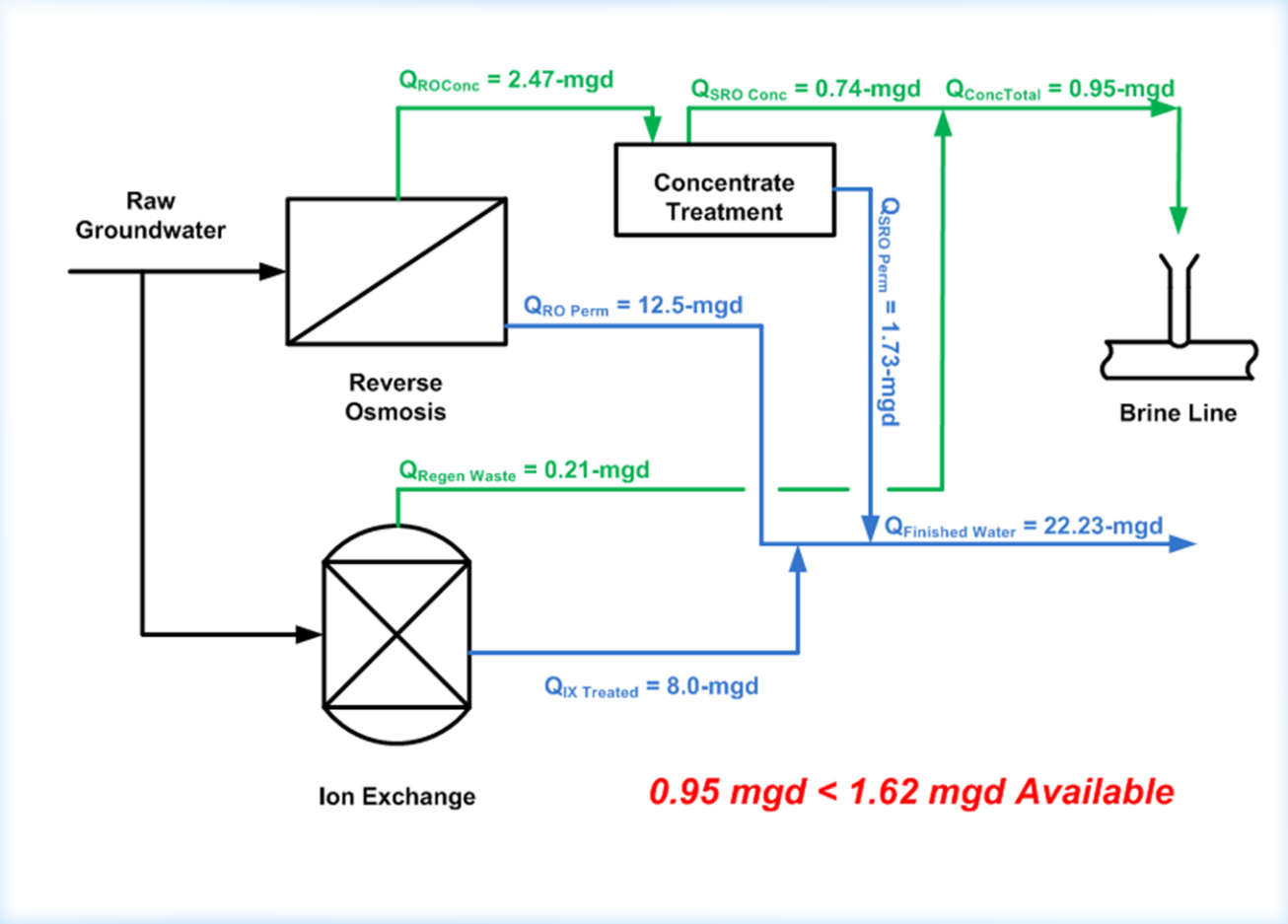
- Recover Additional Potable Water from Wellfield
- Produce Residuals That Have Beneficial Reuse (Economic and Environmental)
- Reduce Scaling Potential In Brine Line

The Concentrate Reduction Facility (CRF) Provides an Option to Purchasing Additional Brine Line Capacity



Expanded brine volume of 2.68-mgd exceeds current brine line capacity of 1.62-mgd.

The CRF allows Chino II to meet disposal goals and recover potable water



A large portion of solid residuals have beneficial use value.

Existing Chino II RO recovery is limited by hardness and silica concentrations

Flow Stream	Chino II Concentrate	CRF Secondary RO Feed
Ca^{2+} (mg/L)	679	7
Mg^{2+} (mg/L)	102	4
Alkalinity (mg/L as $CaCO_3$)	1,145	302
Ca Hardness (mg/L as $CaCO_3$)	1,697	17
Mg Hardness (mg/L as $CaCO_3$)	420	16
Total Hardness (mg/L as $CaCO_3$)	2,116	33
TDS (mg/L)	3,319	2,718
Si (mg/L)	**194.3**	74.8
pH	7.61	9.47

Chemical softening removes scaling precursors in the primary RO concentrate

Secondary RO recovery of 66% (and higher) achieved through:

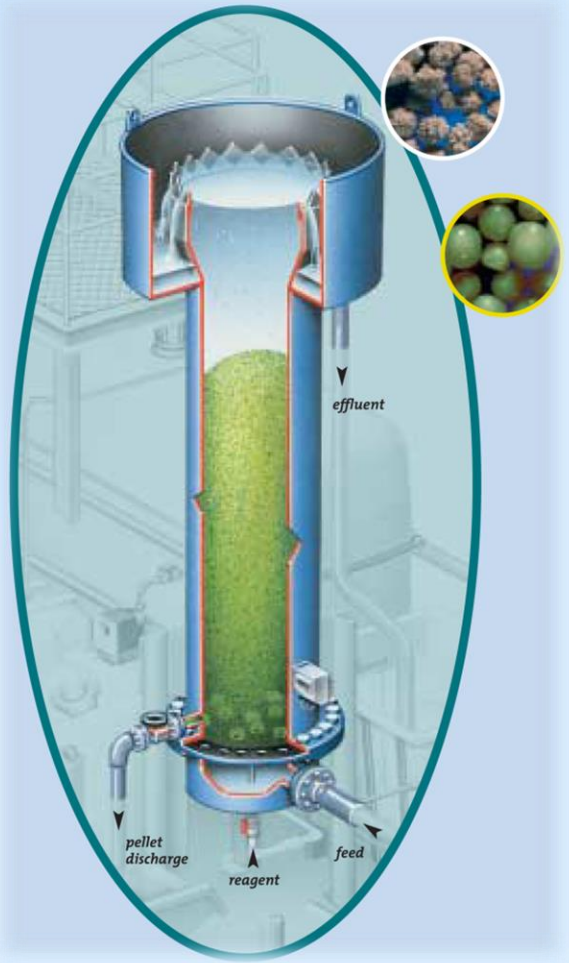
- Calcium reduction
- Magnesium reduction
- Alkalinity reduction
- Silica reduction

CHINO CRF TREATMENT GOALS

Silica	Calcium
180 mg/L	1,700 mg/L
↓	↓
<80 mg/L	<40 mg/L

Pellet reactors were selected as the primary chemical softening configuration

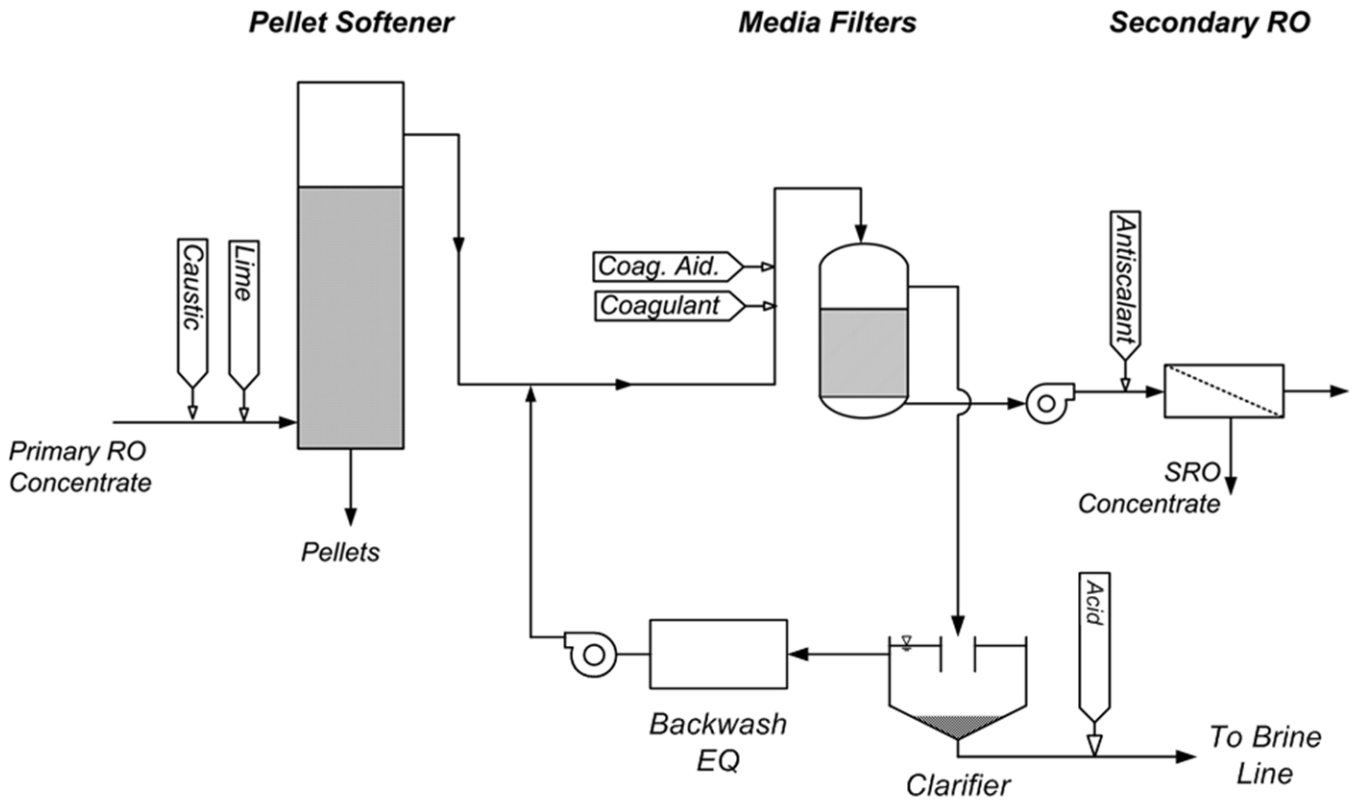
- Basics
  - Upflow, fluidized bed
  - Lime and/or caustic is injected at bottom of bed
  - Seed (sand or $CaCO_3$) introduced to provide crystal growth sites
  - Pellet blowdown frequency determines size
- Benefits
  - High rate (small footprint)
  - Easily dewatered residuals



Dried pellets have marketable value and are easier to store and transport

- Pellets are value-added products
  - Industrial applications: concrete block manufacturers, specialty mineral suppliers
- Convert waste stream to usable commodity

Based on past pilot data, the preliminary process was established

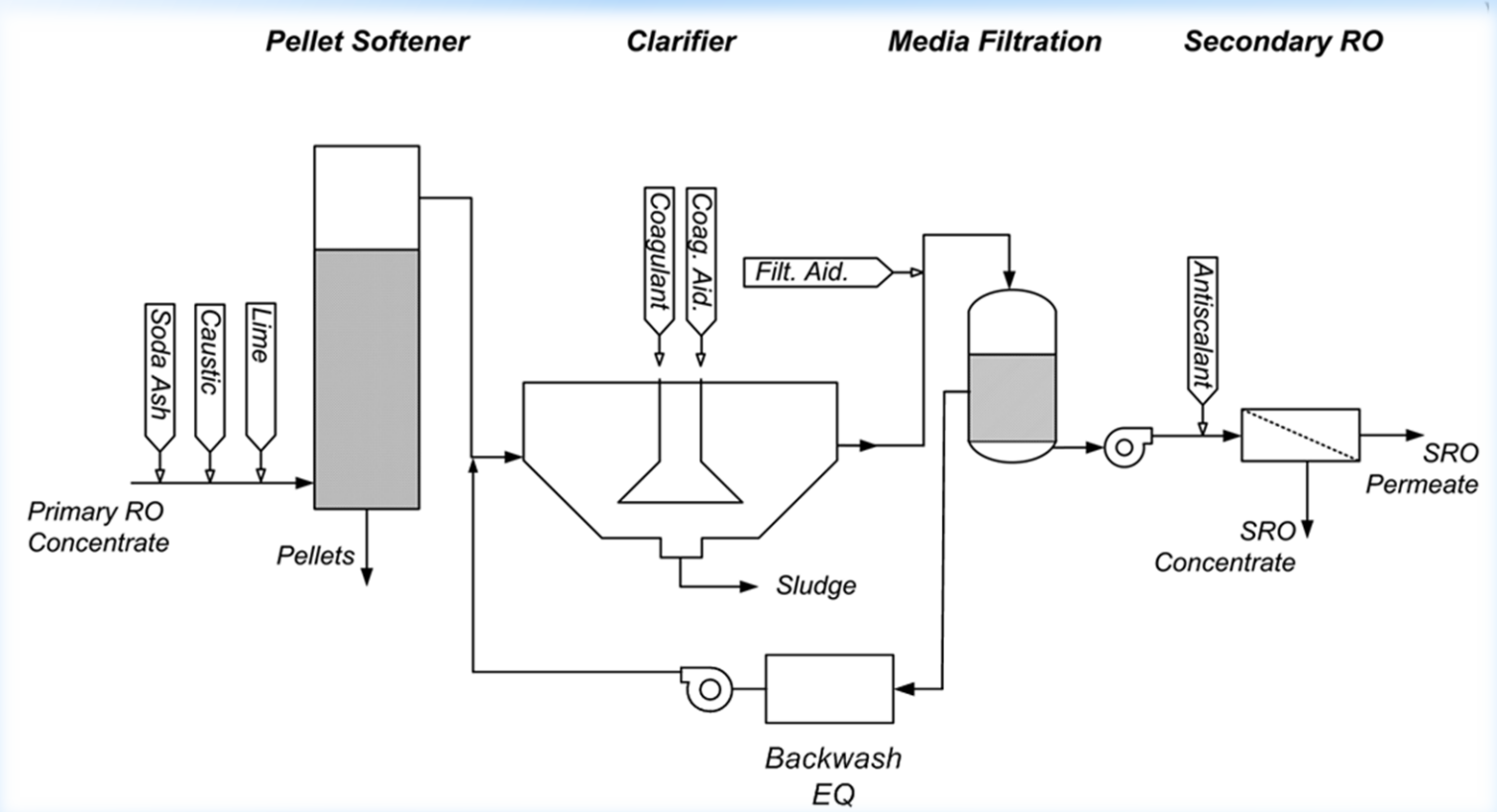


Data from Arlington Desalter showed good silica removal and filterable softener effluent

Chino II Desalter pilot study revealed treatment challenges not previously experienced

- High turbidity carryover from Ca-Mg-Si precipitate
- Poor filterability
- Did not meet Ca, Si removal goals

Clarification step moved from backwash treatment to pellet reactor effluent

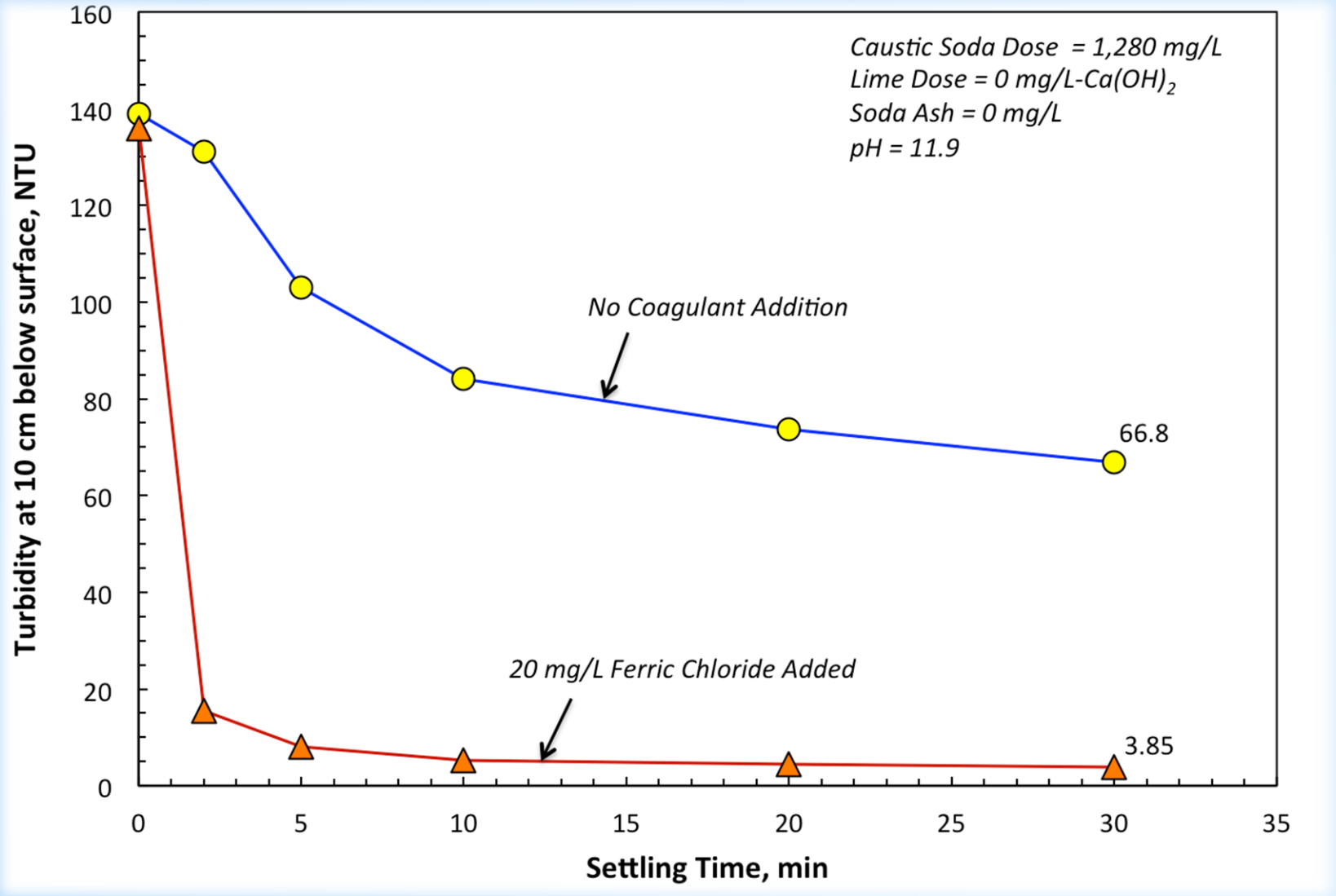


- Allows for magnesium precipitation aftet the pellet reactor
- Process reaches equilibrium before media filters
- Dewatering added for non-pellet residuals

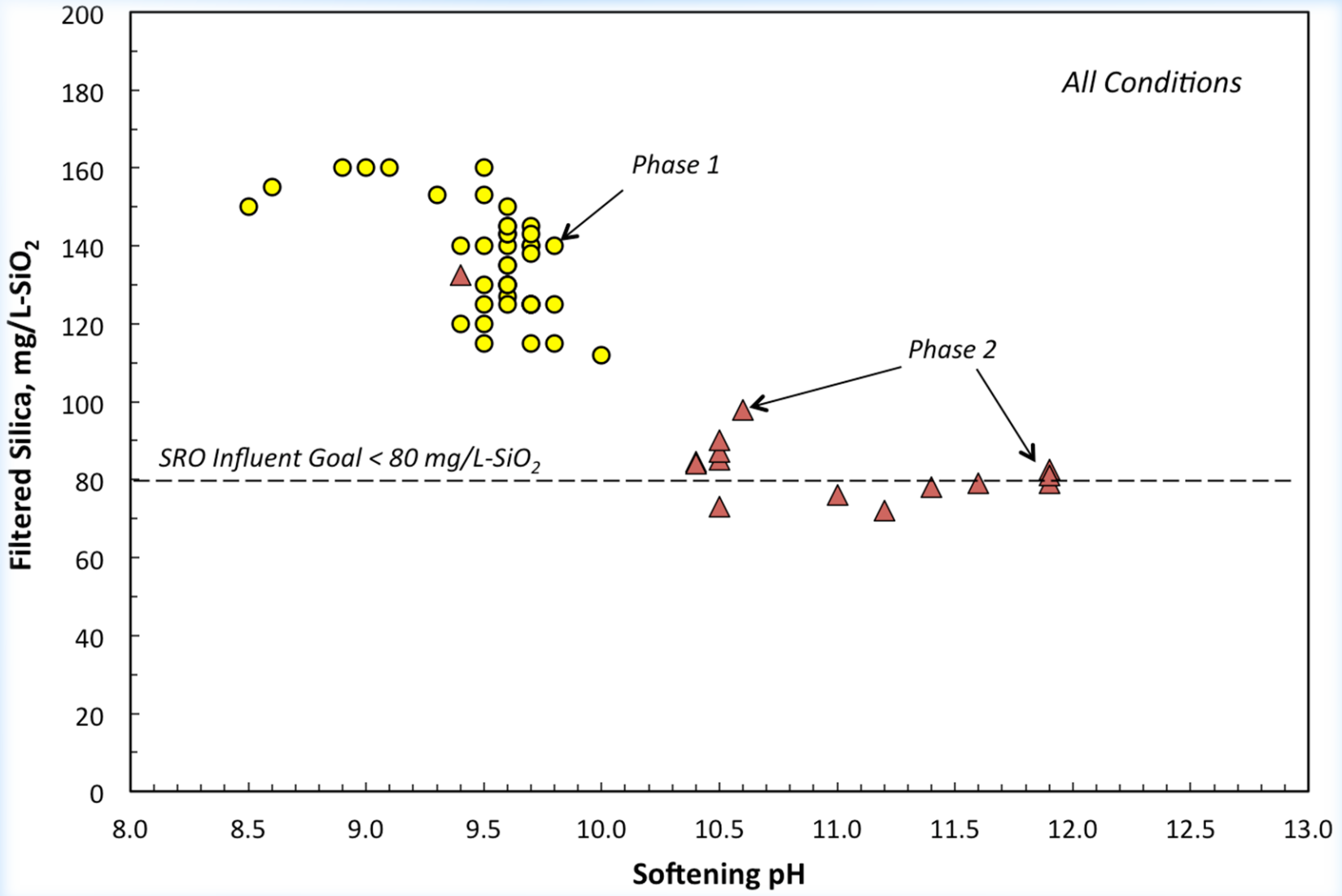
High rate solids contact clarifiers are used to treat pellet reactor effluent and backwash waste

- High rate sludge thickening clarifier/softener in single unit (small footprint)
- Combines internal and external sludge recirculation and tube settling clarification
- Footprint is 25-50% smaller than a conventional clarifier
- Loading rate up to 11 gpm/sq.ft
- Sludge concentration up to 20% solids

The addition of the clarifier dramatically improved filterability and solids loading on the filters

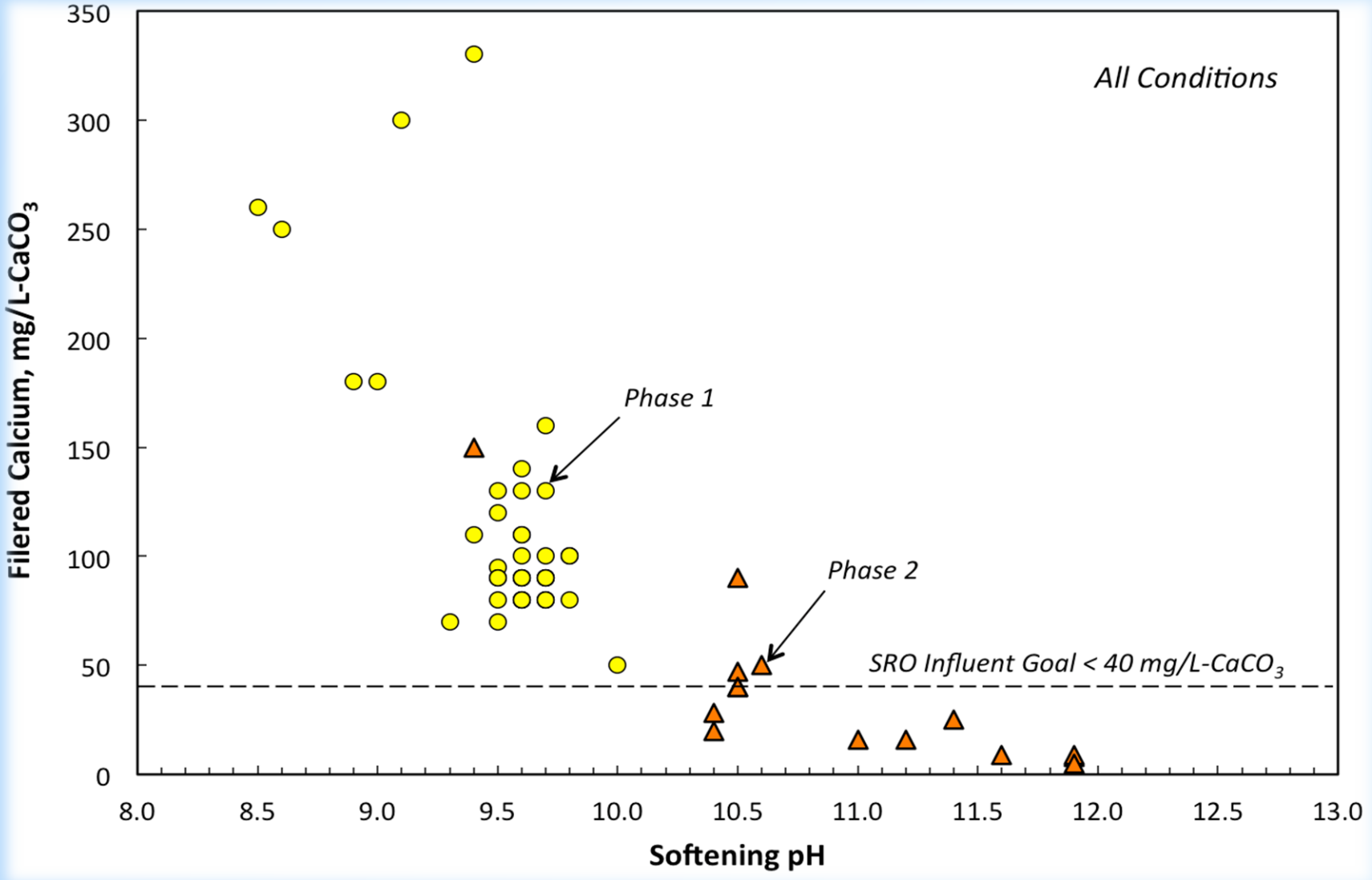


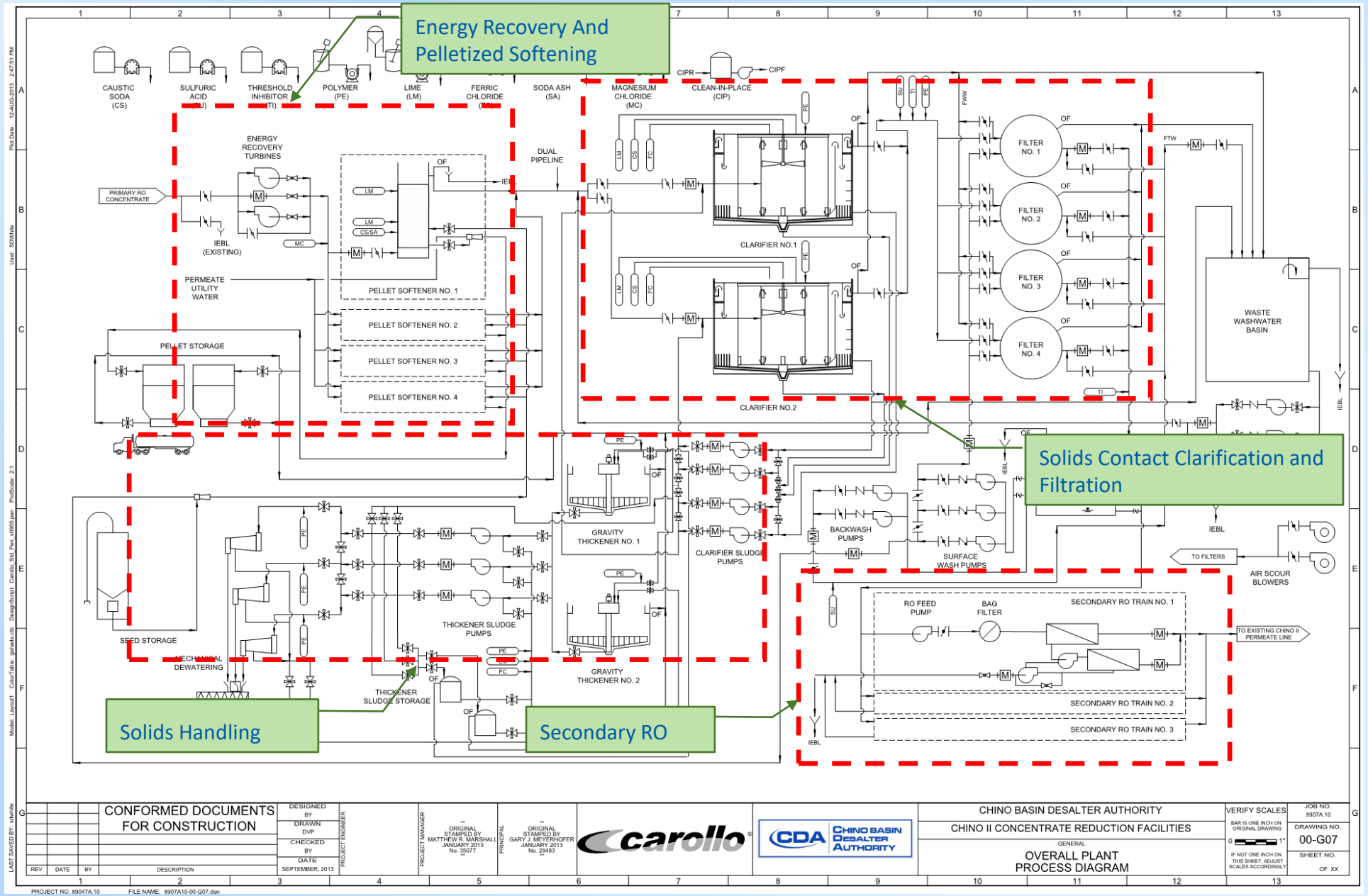
Silica removal goals achieved via magnesium co-precipitation



Magnesium chloride system included to increase silica removal, if required.

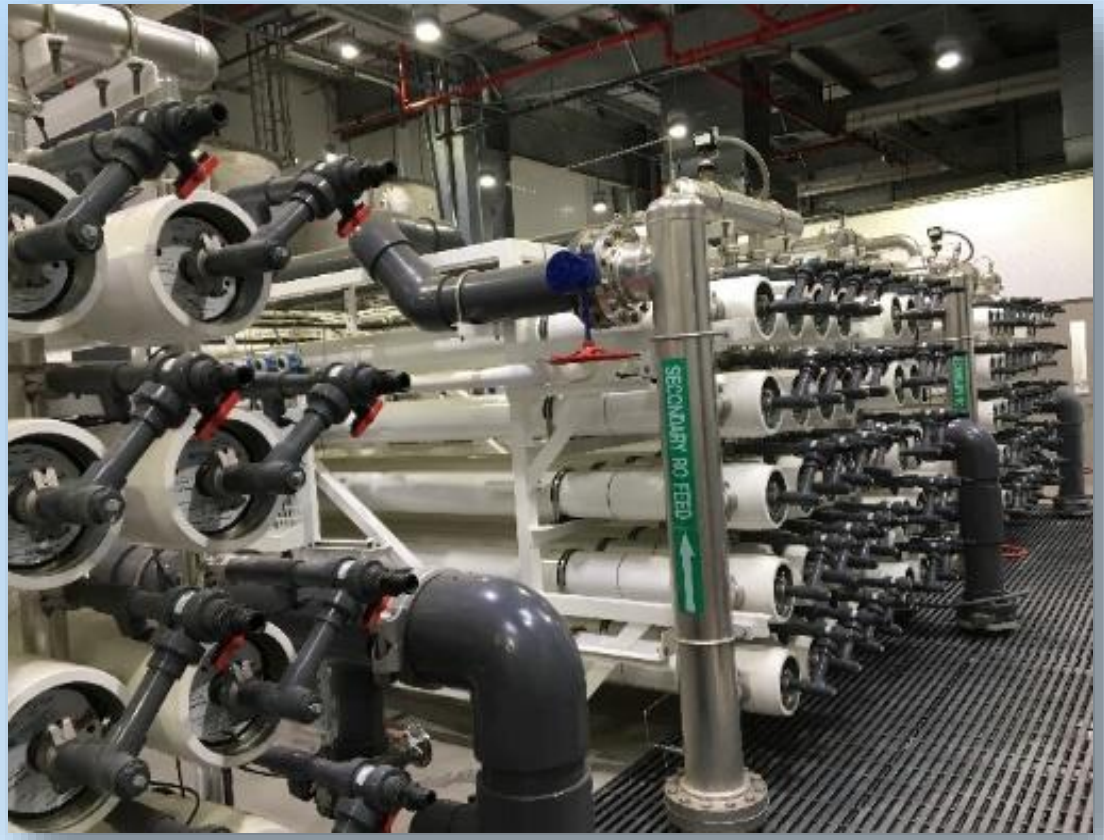
Calcium removal goals exceeded when softening at pH >11 was allowed




Energy Recovery And Pelletized Softening
Solids Contact Clarification and Filtration
Solids Handling
Secondary RO
CAUSTIC SODA (CS)
SULFURIC ACID (SU)
THRESHOLD INHIBITOR (TI)
POLYMER (PE)
LIME (LM)
FERRIC CHLORIDE (FC)
SODA ASH (SA)
MAGNESIUM CHLORIDE (MC)
CLEAN-IN-PLACE (CIP)
ENERGY RECOVERY TURBINES
PRIMARY RO CONCENTRATE
IEBL (EXISTING)
DUAL PIPELINE
PERMEATE UTILITY WATER
PELLET SOFTENER NO. 1
PELLET SOFTENER NO. 2
PELLET SOFTENER NO. 3
PELLET SOFTENER NO. 4
PELLET STORAGE
CLARIFIER NO.1
CLARIFIER NO.2
FILTER NO. 1
FILTER NO. 2
FILTER NO. 3
FILTER NO. 4
WASTE WASHWATER BASIN
GRAVITY THICKENER NO. 1
GRAVITY THICKENER NO. 2
CLARIFIER SLUDGE PUMPS
BACKWASH PUMPS
SURFACE WASH PUMPS
AIR SCOUR BLOWERS
SEED STORAGE
MECHANICAL DEWATERING
THICKENER SLUDGE PUMPS
THICKENER SLUDGE STORAGE
RO FEED PUMP
BAG FILTER
SECONDARY RO TRAIN NO. 1
SECONDARY RO TRAIN NO. 2
SECONDARY RO TRAIN NO. 3
TO EXISTING CHINO II PERMEATE LINE
TO FILTERS
CONFORMED DOCUMENTS FOR CONSTRUCTION
CHINO BASIN DESALTER AUTHORITY
CHINO II CONCENTRATE REDUCTION FACILITIES
OVERALL PLANT PROCESS DIAGRAM
DRAWING NO. 00-G07

Facility Facts and Features

- **Capacity:**
  - **Influent: Up to 2.47 mgd of primary RO concentrate**
  - **RO Permeate: >1.73 mgd**
  - **Brine and IX Waste: < 0.94-mgd**
- **Influent Energy Recovery, pelletized softening, solids contact clarification and media filtration**
- **Secondary RO Recovery: 66-85 Percent**
- **Overall Facility Recovery: >94 Percent**
- **Solid Residual Disposal:**
  - **Pellets: Sold to local specialty minerals distributer**
  - **Dewatered solids: Landfill with option for composting**
- **Product Water Use: Potable**



Completed 7-Day Performance Testing in May 2017

Acknowledgments

- CDA
  - Curtis Paxton and Todd Minten
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Questions?

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