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## CONCENTRATE DISPOSAL FACILITIES

### 5.1 BACKGROUND

The Chino Desalters produce process waste that is characterized by high salinity. As part of the Chino Basin salt management strategy, the desalter process waste is disposed of through the Santa Ana Regional Interceptor (SARI) line. The SARI line allows transport of saline waste out of the watershed with disposal to the Pacific Ocean through the Orange County Sanitation District (OCSD) water reclamation facility and ocean outfall.

The SARI pipeline system was first envisioned in the early 1970's as a way to remove salt from the Santa Ana River Watershed and to collect and transport non-reclaimable brine that could not be effectively treated at local water reclamation facilities. The project was constructed by the Santa Ana Watershed Project Authority (SAWPA), which owns, operates, and maintains the SARI line within Riverside and San Bernardino Counties from the Orange/Riverside County line to the terminus points with each member agency/discharger.

In general, capacity in the SARI line is owned by four of the five SAWPA member agencies. San Bernardino Valley Municipal Water District (SBVMWD), Eastern Municipal Water District (EMWD), IEUA, and WMWD all own capacity in the SARI line. Orange County Water District (OCWD) is the only member agency that does not own SARI capacity. The pipeline capacity can be sold by individual member agencies to other entities requiring capacity and having discharges that meet specific SAWPA discharge requirements. The sale of capacity is made by individual agencies, not SAWPA.

SAWPA member agencies also own treatment capacity in the SARI system, which is separate from pipeline capacity. Treatment capacity represents a volume of effluent that may be passed through the OCSD treatment plant at Huntington Beach.

Table 5.1 summarizes SARI pipeline capacity and treatment capacity as of 2006.

Table 5.1 shows that all of the SARI pipeline capacity has been sold to member agencies and that the pipeline capacity exceeds the current (2006) treatment capacity owned by the member agencies.

An agency or business wishing to discharge into the SARI line usually contracts for needed pipeline and needed treatment capacity with the appropriate member agency. Permit requirements for discharge are set by SAWPA and may be administered by SAWPA or by the contracting member agency. Upon payment of a connection fee, the discharger may use the SARI line within the limits established by both the contract and the discharge permit.

<b>Table 5.1 SARI Ownership (2006) Chino Desalter Phase 3 PDR JCSD/Ontario/WMWD</b>		
<b>Agency</b>	<b>Pipeline Capacity (mgd)</b>	<b>Treatment Capacity (mgd)</b>
SAWPA	0.000	0.295
SBVMWD	7.198	0.152
EMWD	4.378	1.2
IEUA	7.800	5.600
WMWD	10.624	5.753
<b>TOTALS</b>	<b>30.000</b>	<b>13.000</b>
<i>Source: 2006 SARI Business Plan, SAWPA.</i>		

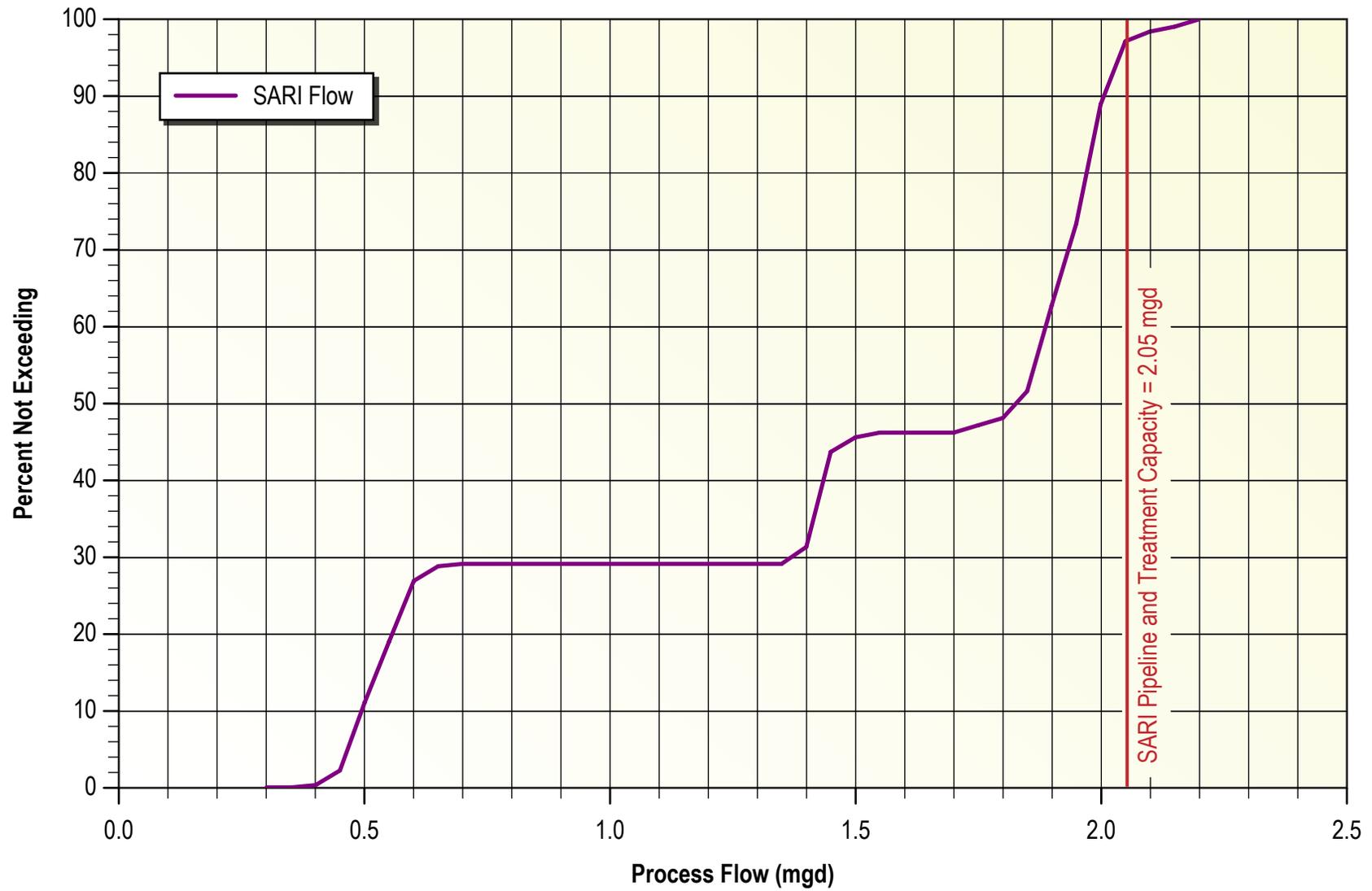
All waste discharged into the SARI line is ultimately treated at the OCSD facility in Huntington Beach before discharge into the Pacific Ocean. Discharges from the OCSD plant must conform to standards established for ocean discharge; therefore, the quality of waste streams discharged to the SARI line must be regulated. The discharge permit for the Chino II Desalter is included in Appendix E.1.

## **5.2 CHINO I SARI CAPACITY**

Chino I produces the majority of SARI brine waste from the RO treatment process but it also produces brine from the IX process. The calculated SARI capacity requirements for the existing Chino I facilities are shown in Table 5.2. The table also shows projected SARI capacity requirements assuming that the Chino I modifications to achieve nameplate capacity require the construction of two more RO trains in addition to the four existing RO trains.

The criteria applied in Table 5.2 indicate a SARI capacity requirement of 2.0 mgd for the existing Chino I facilities. Chino I currently has 2.05 mgd of both SARI pipeline and treatment capacity. A frequency distribution of daily Chino SARI discharge meter readings is shown in Figure 5.1.

Figure 5.1 indicates that 90 percent of the time the daily SARI discharge is less than the calculated SARI capacity requirement of 2.0 mgd for the existing facilities and 95 percent of the time the daily SARI discharge is less than the 2.05 mgd SARI capacity purchased by CDA for Chino I.



**Figure 5.1**  
**Chino I SARI Flow Frequency Distribution**  
**CHINO DESALTER PHASE 3 PDR**  
JCSD/ONTARIO/MMWD

<b>Table 5.2 Chino I SARI Capacity Requirements Chino Desalter Phase 3 PDR JCSD/Ontario/WMWD</b>				
	<b>Units</b>	<b>Existing</b>	<b>Modified</b>	<b>Total</b>
<u>Treatment Process Flows</u> <sup>a</sup>				
RO Capacity	mgd	6.7	3.4	10.0
IX Capacity	mgd	4.9	0.0	4.2
Total	mgd	11.6	3.4	14.2
<u>SARI Flows Under Conservative Criteria</u> <sup>a</sup>				
RO Concentrate @ 78% Recovery	mgd	1.88	0.94	2.82
IX Brine Waste @ 97.5% Recovery	mgd	0.13	0.00	0.09
Total	mgd	2.00	0.94	2.91
Note:				
a. Criteria are for worst case conditions assuming no VOC well flow and IX capacity is limited by TDS to nameplate capacity.				

Assuming that the calculated SARI capacity requirement of 2.0 mgd for the existing Chino I facilities is correct and appropriate for the proposed nameplate capacity modifications, then an additional 0.94 mgd of SARI discharge will be required by the nameplate capacity modifications, if they are necessary. A tabulation of the required SARI capacity purchases (both pipeline and treatment capacity) for Chino I is presented in Section 8 of this report.

### **5.3 CHINO II SARI CAPACITY**

Like Chino I, RO concentrate comprises the majority of SARI waste at the Chino II Desalter. At Chino II the RO concentrate is metered and the daily total is recorded, this represents the discharge to the SARI pipeline via the 15-inch brine pipeline in Harrel Street, running east from the desalter to Etiwanda Avenue where the brine pipeline connects to a 21-inch SARI lateral owned and operated by JCSD. The 21-inch lateral connects to the SARI pipeline (Reach IVD) at the intersection of Etiwanda and Bellegrave Avenues. IX brine waste is combined with high-salinity sample line discharges and the combined flow is measured at the Wineville SARI meter. The historical and calculated SARI capacity requirements for the existing and expanded Chino II facilities are presented in Table 5.3.

<b>Table 5.3 Chino II SARI Capacity Requirements Chino Desalter Phase 3 PDR JCSD/Ontario/WMWD</b>				
	<b>Units</b>	<b>Existing</b>	<b>Expansion</b>	<b>Total</b>
<u>Treatment Process Flows</u>				
RO Capacity	mgd	6.0	6.5	12.5
IX Capacity	mgd	4.0	4.0	8.0
Total	mgd	10.0	10.5	20.5
<u>Original Design Criteria for Waste Flows<sup>a</sup></u>				
RO Concentrate	mgd	1.2		
IX Brine Waste	mgd	0.2		
Total	mgd	1.4		
<u>Historical Waste Flows<sup>b</sup></u>				
RO Concentrate Flow				
Max Flow	mgd	1.48		
Average Flow	mgd	1.16		
IX Brine Waste Flow				
Max Flow	mgd	0.25		
Average Flow	mgd	0.07		
Total				
Max	mgd	1.61		
Average	mgd	1.23		
<u>SARI Flows Under Normal Operating Criteria</u>				
RO Concentrate @ 83.5% Recovery	mgd	1.19	1.28	2.47
IX Brine Waste @ 99% Recovery	mgd	0.04	0.04	0.08
Total	mgd	1.23	1.32	2.55
<u>SARI Flows Under Conservative Criteria</u>				
RO Concentrate @ 80% Recovery	mgd	1.50	1.63	3.13
IX Brine Waste @ 97.5% Recovery	mgd	0.10	0.10	0.20
Total	mgd	1.60	1.73	3.33
Note:				
a. Source: Process flow diagram (Chino II Desalter Onsite Improvements, Project No. DL02002, Record Drawings, Sheet I-4)				
b. From daily records 1/1/08 through 6/30/09.				

The separate measurements of RO concentrate and IX brine waste discharges are presented as frequency distributions in Figure 5.2, which indicates that 99 percent of the time the daily SARI discharge is less than the calculated SARI capacity requirement of 1.6 mgd for the existing facilities and that the daily SARI discharge has never reached the 1.62 mgd SARI pipeline capacity purchased by CDA for Chino II. The calculated SARI requirement of 1.6 mgd appears correct and appropriate for the existing facility with an additional 1.71 mgd of SARI discharge required at Chino II for the Phase 3 expansion.

The CDA Board authorized the purchase of SARI pipeline and treatment capacity for the existing Chino II facilities at the May 11, 2004 board meeting; copies of the agreement and memorandum are included in Appendix E.2. The same authorization resulted in CDA purchasing SARI capacity for the Chino I expansion. The 2004 SARI capacity purchase for Chino II included 1.62 mgd of pipeline capacity but only 1.3 mgd of treatment capacity. The agreement stipulated that IEUA allowed the CDA temporary use of an additional 0.32 mgd of treatment capacity until 2008, at which time it was anticipated that IEUA would be able to make a permanent sale of the temporary use capacity to CDA so that both SARI pipeline and treatment capacity would be 1.62 mgd.

There is no record available to us indicating that CDA ever purchased the additional 0.32 mgd of temporary use SARI treatment capacity; therefore, SARI discharge from Chino II continues to utilize the 0.32 mgd of temporary use treatment capacity. It will be necessary for the CDA to purchase 0.30 mgd of SARI treatment capacity so that the existing Chino II Desalter has both SARI pipeline and treatment capacity of 1.60 mgd, which is the calculated requirement for the existing desalter facilities.

The 0.02 mgd of SARI pipeline capacity currently owned by CDA above the calculated 1.60 mgd requirement for Chino II is surplus and will be purchased by the Phase 3 Sponsors as part of the Chino II buy-in. A tabulation of surplus capacity and required SARI capacity purchases (both pipeline and treatment capacities) for the Phase 3 expansion is presented in Section 8 of this report.

The situation is complicated somewhat by the fact that as of February 1, 2009 the Direct User Discharge Permit (included in Appendix E.1) issued by SAWPA for the Chino II Desalter facility gives the maximum flow limit as 1.80 mgd continuous flow. We have reviewed the apparent discrepancy with SAWPA and have confirmed by email (August 10, 2009 from David Ruhl, SAWPA Program Manager) that the Chino II permit (1.80 mgd) is in error and that the CDA purchase (1.62 mgd) is the correct SARI discharge capacity. A revision of the discharge permit by SAWPA is likely.

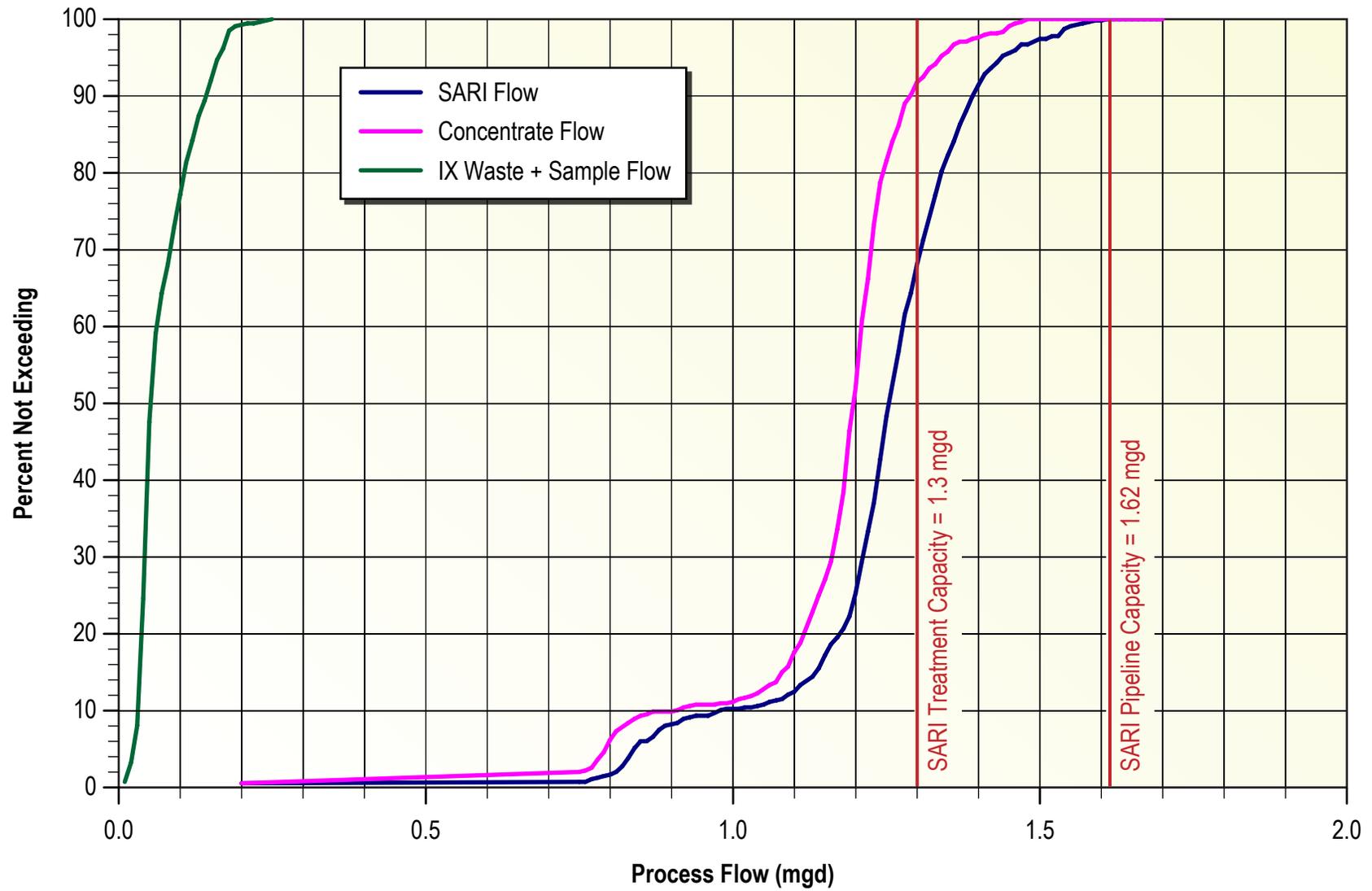


Figure 5.2  
 Chino II SARI Flow Frequency Distribution  
 CHINO DESALTER PHASE 3 PDR  
 JCSD/ONTARIO/WMWD

Our preliminary hydraulic analysis of the off-site brine pipeline capacity indicates that the 15-inch brine pipeline on Harrel Street, which carries Chino II RO concentrate, has sufficient capacity for the total RO concentrate discharge required by the Phase 3 expansion of Chino II (3.13 mgd) assuming that the 15-inch pipeline is not surcharged at the 21-inch SARI lateral manhole on Etiwanda Avenue. Hydraulic modeling conducted by SAWPA indicates that the SARI Reach IVD pipeline is not surcharged, now or in the future, at the manhole where the 21-inch SARI lateral enters at Bellegrave Avenue.

The combined waste streams from the IX brine waste and gravity trench drainage are disposed of separately from the Chino II RO concentrate. These combined waste streams are sent to an 8-inch diameter JCSD sewer pipeline in Harrel Street that is progressively enlarged to 10-inch, then 12-inch, moving westward on Harrel Street towards Wineville Avenue. The pipeline continues south on Wineville until it connects as a 24-inch pipe to SARI Reach IVD at Bellegrave Avenue.

The availability and potential cost of additional capacity in the JCSD SARI laterals in Etiwanda and Wineville Avenues are not available at the present time. For the present, it is assumed that a parallel 12-inch diameter brine pipeline along Harrel and Etiwanda to SARI Reach IVD is required for the additional 1.73 mgd of brine waste from the RO and IX expansion of Chino II. The concentrate reduction facilities described later in this section would eliminate the need for any additional brine pipeline capacity from Chino II.

## **5.4 CONCENTRATE REDUCTION OPTIONS**

The development of more efficient RO processes, that is, concentrate reduction processes, is the subject of significant research and development efforts today. Benefits of concentrate reduction to the Chino Desalters include the following:

- Reducing concentrate flow decreases the flow to the SARI system resulting in a reduced SARI capacity and operating costs.
- Concentrate reduction transforms a waste product (brine) into salable product water.
- Because concentrate is converted to product water, the process can either reduce the groundwater usage or increase the product water capacity.

The last point is an important consideration in the long-term sustainability of the Chino groundwater basin. Every million gallons of concentrate that is discharged to the SARI system leaves the basin forever. Concentrate that is converted to product water can be retained within the basin to a significant extent through recycling, reuse, or recharge.

A number of alternative technologies are available. The brief feasibility review presented herein is based on the concentrate reduction technology that was recently ranked as the number one alternative by the US Bureau of Reclamation. It has the further advantage of a footprint that fits within the Chino I and II sites.

The process uses a high rate pellet softener to remove calcium and silica from RO concentrate. After these fouling agents are reduced, the concentrate is applied as feedwater to a secondary RO treatment train. As a consequence, the recovery of the overall RO system is increased from the current 78 and 80 percent at Chino I and II, respectively, to approximately 94 percent.

Pellet softening is an established technology although it has not been applied to RO concentrate previously. Reasons to use pellet softening as part of a Chino Desalter concentrate reduction strategy include the following.

- Smaller footprint:
  - Conventional softening requires approximately 1.75 gpm per sq. ft. loading rate.
  - Pellet softening operates at up to 35 gpm per sq. ft. loading rate.
- Pellet softeners can use pressure vessels, thus preserving the pressure (i.e., energy investment) in the primary RO concentrate.
- Pellet softeners provide advantages in solids handling and dewatering:
  - Pellets are easily drainable, stored, and handled.
  - Conventional softener sludge requires large area or mechanical systems for dewatering and handling.

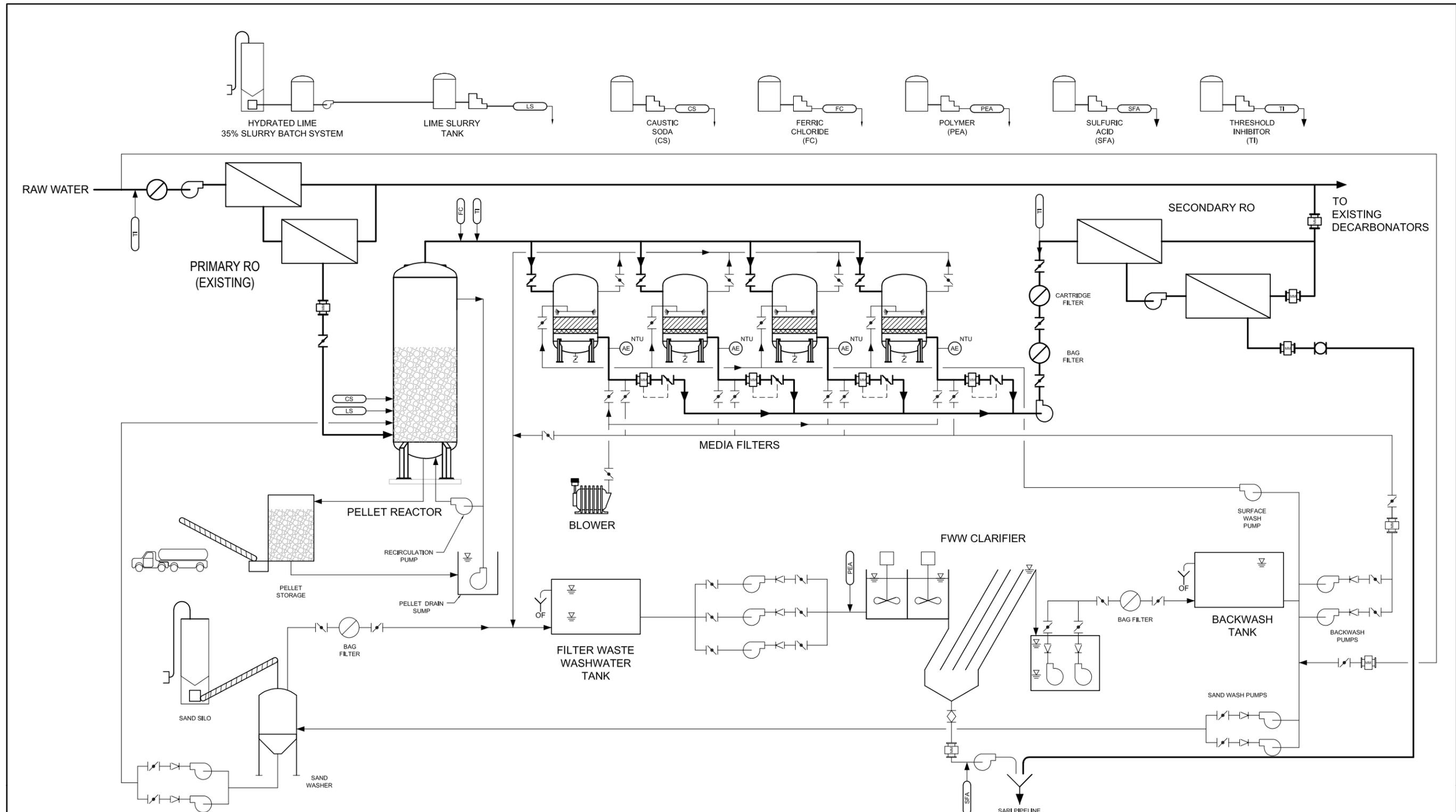
The increased efficiency of the concentrate reduction process offers two alternative choices:

- Reduce the raw water requirement (i.e., groundwater production) and maintain the given product water capacity, or
- Maintain the groundwater production and increase the product water capacity.

For the purposes of this evaluation we have elected to provide costs and criteria based upon maintaining groundwater production at 40,000 AF/year for the Chino Desalters and increasing the product water capacity. This choice allows the desalter operation to meet the groundwater withdrawal objective of the OBMP and it also simplifies the analysis. However, it would be possible to implement a concentrate reduction process with the objective of reducing groundwater production while still maintaining the original product water capacity objectives for the Chino Desalters. Proposed process flow criteria are shown in Table 5.4.

A process flow diagram for the proposed concentrate production process is shown in Figure 5.3. The same process is applicable to either Chino I or Chino II. In summary, the concentrate reduction process operates by removing the limiting foulants, calcium carbonate and silica, from the concentrate stream prior to a second pass through an RO system. Approximately 70 percent of the original primary RO concentrate is recovered as permeate (product water) and the remainder is discharged to the SARI pipeline.

<b>Table 5.4 Effect of Concentrate Reduction on Flows and Efficiencies            Chino Desalter Phase 3 PDR            JCSD/Ontario/WMWD</b>							
Description	Units	Chino I Desalter Criteria After Nameplate Mods		Change <sup>b</sup>	Chino II Desalter Criteria After Phase 3		Change <sup>b</sup>
		Without Concentrate Reduction	With Concentrate Reduction		Without Concentrate Reduction	With Concentrate Reduction	
Primary RO							
Recovery <sup>a</sup>	%	78	78	0.0	80	80	0.0
Permeate Flow	mgd	10.0	10.0	0.0	12.5	12.5	0.0
Feedwater Flow	mgd	12.8	12.8	0.0	15.6	15.6	0.0
Concentrate Flow	mgd	2.82	2.82	0.0	3.13	3.13	0.0
Secondary RO							
Recovery	%		70			70	
Permeate Flow	mgd		2.0	2.0		2.19	2.2
Feedwater Flow	mgd		2.82	0.0		3.13	0.0
Concentrate Flow	mgd		0.85	(2.0)		0.94	(2.2)
Summary of Overall RO							
Overall Recovery (Primary and Secondary)	%	78.0	93.4	15.4	80.0	94.0	14.0
Total Permeate Flow	mgd	10.0	12.0	2.0	12.5	14.7	2.2
IX System							
IX Effluent	mgd	4.2	4.2	0.0	8.0	8.0	0.0
IX Efficiency	%	97.5	97.5	0.0	97.5	97.5	0.0
IX Waste		0.11	0.11	0.0	0.21	0.21	0.0
Summary of Desalter <sup>c</sup>							
Total Feedwater (Primary RO + IX)	mgd	17.1	17.1	0.0	23.8	23.8	0.0
Total Permeate Flow	mgd	10.0	12.0	2.0	12.5	14.7	2.2
Total Product Water (Total Permeate + IX)	mgd	14.2	16.2	2.0	20.5	22.7	2.2
SARI Discharge	mgd	2.9	1.0	(2.0)	3.3	1.1	(2.2)
Overall Plant Recovery	%	82.9	94.4	11.5	86.0	95.2	9.2
Notes: a. Conservative criteria, as used for SARI purchase requirement calculations. b. "With Concentrate Reduction" minus "Without Concentrate Reduction." ( ) indicates negative number. c. Criteria are for worst case conditions (e.g., no RO/IX bypass), as used for SARI purchase requirement calculations.							



**Figure 5.3**  
**Chino Desalter Concentrate Reduction Schematic**  
**CHINO DESALTER PHASE 3 PDR**  
**JCSD/ONTARIO/WMWD**

The concentrate reduction process actually reduces the overall dissolved solids mass loading to the SARI pipeline because of the removal of large quantities of calcium carbonate and silica from the brine stream as solid precipitates. In other words, while the desalters continue to remove the same amount of dissolved solids from the groundwater basin, a smaller portion is discharged to the SARI pipeline as a liquid waste and a significant amount of solids leave the desalter site by truck in the form of solid pellets.

Process requirements include the following elements:

- Pellet reactors (softeners) to remove calcium carbonate and silica from the primary concentrate.
- Granular media pressure filters to polish the pellet reactor effluent and remove solids carryover.
- A secondary RO system treats the softened, filtered primary RO concentrate to produce permeate (product water) and brine (secondary RO concentrate).
- Backwash water (untreated raw water) is used to periodically clean the granular media filters.
- Filter waste washwater is stored in an equalization tank and pumped at a constant rate through a Lamella-plate clarifier.
  - Clarified filter waste washwater is recycled to the backwash system.
  - A small flow is wasted from the bottom of the clarifier to the SARI line.
- The following chemicals and materials are required:
  - Lime and caustic soda are used to raise the pH to allow precipitation of the dissolved solids within the pellet reactor.
  - Silica sand is washed and fed to the pellet reactor to act as the nucleus for softening reaction precipitation to allow operation at high rates and efficiencies.
  - Ferric chloride is applied as a coagulant prior to filtration to assist in removal of solids carryover and to slightly depress the pH to reduce the precipitation potential.
  - Threshold inhibitor (anti-scalant) is applied to the softener effluent and to the secondary RO feed to control precipitation.
  - Polymer flocculant aid is fed to the filter waste washwater clarifier to assist in removal of solids prior to recycling as backwash water.
  - Sulfuric acid is fed to the clarifier discharge to the SARI line to dissolve residual calcium carbonate solids and to prevent precipitation.

A proposed layout for construction of concentrate reduction facilities at the Chino I site is shown in Figure 5.4. Concentrate reduction facilities at Chino I are shown at the location of the existing bypass equalization basin. A new building is shown for the secondary RO system, although it is possible that the secondary RO could be accommodated in the expansion of the primary RO facilities to meet nameplate capacity.

A proposed layout for concentrate reduction facilities at the Chino II site is shown in Figure 5.5. It appears that there is enough unused area along the south CDA property line to accommodate all the new concentrate reduction facilities except for the secondary RO system. At the present time, it is proposed that the secondary RO system could be located on a new mezzanine level constructed above the existing primary RO skids. If this is not feasible then additional property purchase from JCSD or other adjacent property owner would be required for a new secondary RO building at Chino II.

Good vehicle access to the concentrate reduction facilities is necessary for deliveries of chemicals and sand brought to the site and for removal of large quantities of pellets. The chemical delivery and pellet removal frequency is shown in Table 5.5 along with an estimate of plant staff labor hours required to supervise deliveries and loading. The effects on total plant staff labor are shown in Table 5.6.

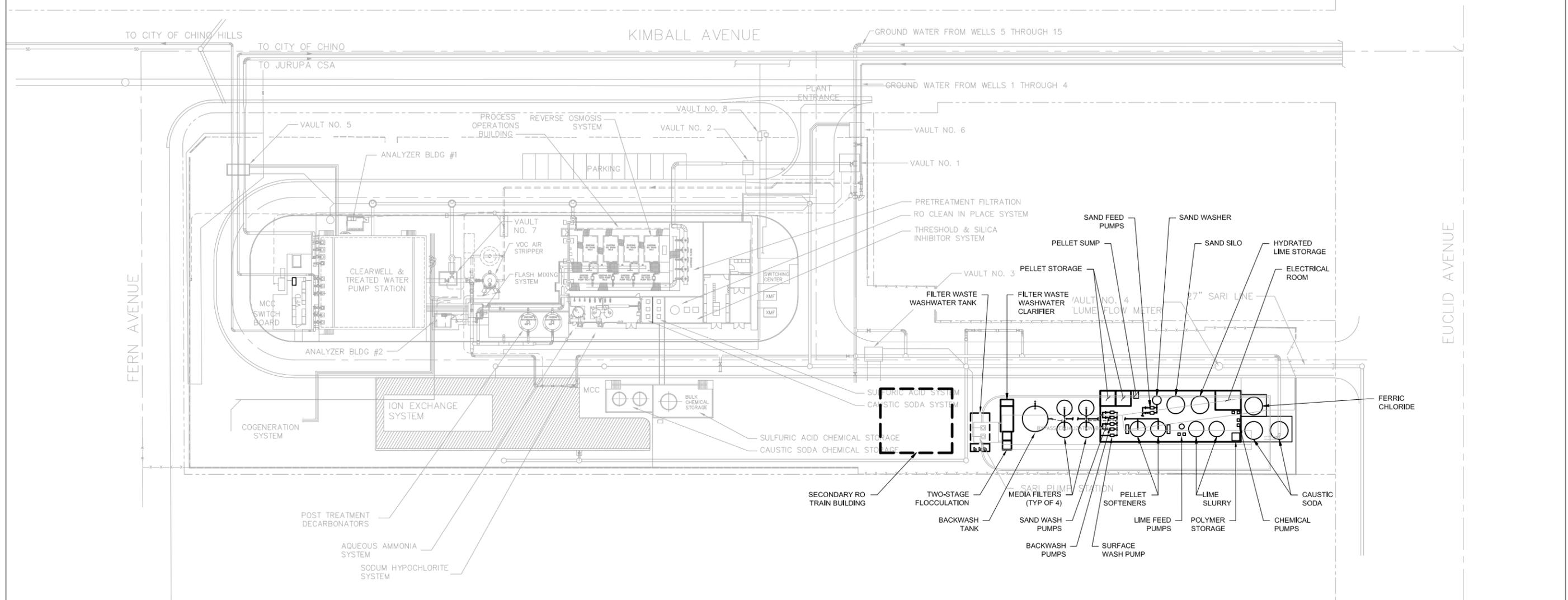
The incremental annual operation and maintenance (O&M) costs of the proposed concentrate reduction process for both Chino I and II are shown in Table 5.7. These costs include the costs of additional chemicals, energy, labor, and reserve fund contributions (e.g., membrane replacement) required to operate the concentrate reduction facilities. The table does not include annual SARI volumetric or readiness-to-serve charges because the concentrate reduction process results in a net decrease in SARI operating costs, which is included in a later tabulation.

The estimated construction costs of the concentrate reduction facilities are shown in Table 5.8. The capacities of the proposed Chino I and Chino II concentrate reduction facilities are within approximately 10 percent of each other and the same construction cost estimate is appropriate for either facility at this level of effort. The cost estimate assumes the secondary RO system is constructed as a stand-alone facility with a separate CIP system and building.

One of the driving forces in considering concentrate reduction facilities is the alternative cost of disposing of RO concentrate to the SARI system. The effects of the proposed concentrate reduction facilities on the required SARI system capacity for Chino I and II are shown in Table 5.9. This table shows that concentrate reduction facilities will eliminate the need to purchase any additional SARI capacity for the expansion of the Chino II Desalter to 20.5 mgd product water capacity or for the proposed addition of primary RO capacity at the Chino I Desalter in order to achieve nameplate capacity of 14.2 mgd.



SCALE : 1" = 80'-0"



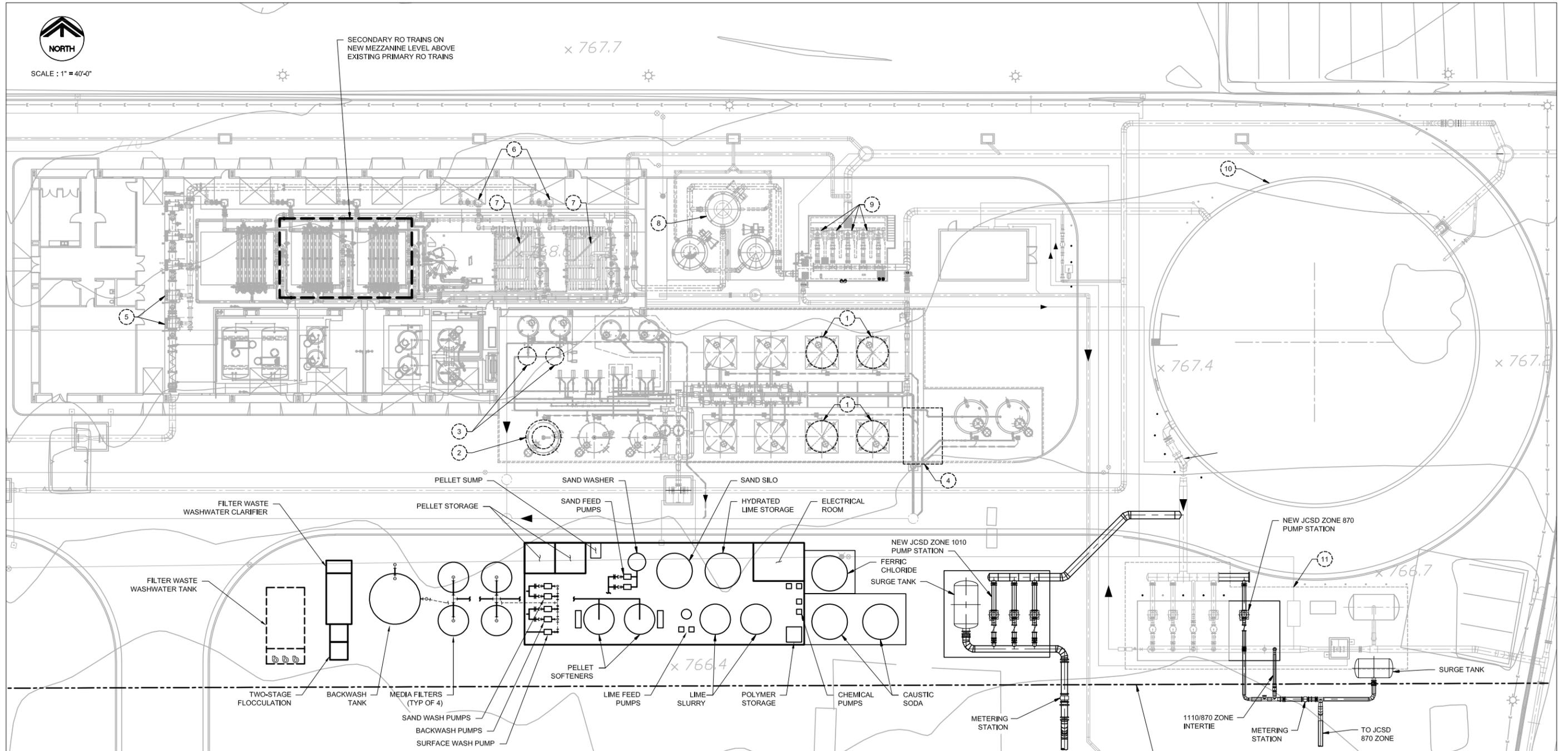
**Figure 5.4**  
**CHINO I CONCENTRATE REDUCTION SITE PLAN**  
**CHINO DESALTER PHASE 3 PDR**  
 JCSD/ONTARIO/WMWD



SCALE : 1" = 40'-0"

SECONDARY RO TRAINS ON NEW MEZZANINE LEVEL ABOVE EXISTING PRIMARY RO TRAINS

x 767.7



- ① NEW IX VESSELS
- ② NEW SALT STORAGE TANK
- ③ NEW SOFTENED WATER STORAGE TANKS
- ④ NEW BAG FILTERS (CONFIGURATION BY HUNGERFORD AND TERRY)
- ⑤ NEW CATRIDGE FILTERS
- ⑥ NEW RO FEED PUMPS
- ⑦ NEW RO TRAINS
- ⑧ NEW DECARBONATOR
- ⑨ NEW SST TRANSFER PUMPS (EXISTING MOTORS)
- ⑩ 3 MG CLEARWELL
- ⑪ EXISTING PRODUCT WATER PUMP STATION

**Figure 5.5**  
**CHINO II CONCENTRATE REDUCTION SITE PLAN**  
**CHINO DESALTER PHASE 3 PDR**  
**JCSO/ONTARIO/WMWD**



<b>Table 5.5 Concentrate Reduction Chemical Delivery Schedule            Chino Desalter Phase 3 PDR            JCSD/Ontario/WMWD</b>									
		Pellets	Sand	Lime	Caustic Soda	Ferric Chloride	Polymer	Sulfuric Acid	Total
Labor Time per Delivery <sup>a</sup>	hours	1.88	1.88	1.88	1.50	1.13	0.75	1.50	
<b><u>Time Between Deliveries</u></b>									
Chino I	days	0.6	2.5	2.3	2.3	64	59	13	
Chino II	days	0.6	2.5	2.3	2.4	64	59	14	
<b><u>Average Number (#) of Deliveries</u></b>									
Chino I									
Annual	#/yr	633	146	162	157	6	6	27	1137
Monthly	#/mo	53	12	13	13	0.5	0.5	2.3	95
Daily (5-Day Week)	#/day	2.4	0.6	0.6	0.6	0.02	0.02	0.10	4.4
Chino II									
Annual	#/yr	626	144	160	155	6	6	27	1124
Monthly	#/mo	52	12	13	13	0.5	0.5	2.2	94
Daily (5-Day Week)	#/day	2.4	0.6	0.6	0.6	0.02	0.02	0.10	4.3
<b><u>Labor for Deliveries</u></b>									
Chino I									
Annual	hrs/yr	1187	274	303	236	6	5	41	2052
Monthly	hrs/mo	99	23	25	20	0.5	0.4	3.4	171
Daily (5-Day Week)	hrs/day	4.6	1.1	1.2	0.9	0.02	0.02	0.16	7.9
Chino II									
Annual	hrs/yr	1174	270	300	233	6	5	40	2028
Monthly	hrs/mo	98	23	25	19	0.5	0.4	3.4	169
Daily (5-Day Week)	hrs/day	4.5	1.0	1.1	0.9	0.02	0.02	0.15	7.8
Note:									
a. Assumes a plant operator is present and completely occupied by the delivery activity.									

<b>Table 5.6 Concentrate Reduction Labor Requirements Chino Desalter Phase 3 PDR JCSD/Ontario/WMWD</b>			
	<b>Units</b>	<b>Criteria</b>	
		<b>Chino I</b>	<b>Chino II</b>
<b><u>Labor for Deliveries</u></b>	hrs/yr	2052	2028
<b><u>Labor for Basic Operating O&amp;M</u></b>			
Daily	hr/day	1.5	1.5
Annual	hr/yr	548	548
<b><u>Labor for Major Intermittent Activities</u></b>			
Injector Descaling			
Descaling Frequency	per year	18	18
Labor per Descaling	hrs	8	8
Annual Labor	hrs/yr	144	144
Reactor Descaling			
Descaling Frequency	per year	1	1
Labor per Descaling	hrs	40	40
Annual Labor	hrs/yr	40	40
Secondary RO Clean-in-Place			
CIP Frequency	per year	12	12
Labor per CIP	hrs	32	32
Annual Labor	hrs/yr	384	384
<b><u>Labor Summary</u></b>			
Annual Labor	hrs	3168	3144
Calculated Full-Time Equivalent	employees	1.5	1.5
Rounded Up FTE	employees	2	2

**Table 5.7 Chino Desalter Concentrate Reduction Operation and Maintenance Cost Estimates  
 Chino Desalter Phase 3 PDR  
 JCSD/Ontario/WMWD**

	Unit Cost	Units	Chino I <sup>a</sup>		Chino II <sup>a</sup>	
			Quantity	Annual Cost	Quantity	Annual Cost
Sulfuric Acid (lb H <sub>2</sub> SO <sub>4</sub> ):	\$0.030	lb/year	1,142,000	\$35,000	1,129,000	\$34,000
Threshold Inhibitor (lb of solution as product):	\$1.00	lb/year	38,000	\$38,000	38,000	\$38,000
Flocculant Aid Polymer (lb of solution as product)	\$1.00	lb/year	15,000	\$15,000	15,000	\$15,000
Sodium Hypochlorite (lb NaHCl):	\$0.050	lb/year	8,000	\$1,000	8,000	\$1,000
Sodium Hydroxide (lb NaOH):	\$0.180	lb/year	3,763,000	\$678,000	3,718,000	\$670,000
Lime (lb as 97% Ca(OH) <sub>2</sub> ):	\$0.120	lb/year	6,473,000	\$777,000	6,395,000	\$768,000
Sand (lb):	\$0.018	lb/year	5,840,000	\$103,000	5,770,000	\$101,000
Pellet Disposal Cost (lb):	(\$0.005) <sup>c</sup>	lb/year	28,214,500	(\$142,000)	27,886,000	(\$140,000)
Secondary RO CIP (per CIP)	\$2,000	CIP/yr	4	\$8,000	4	\$8,000
Energy (\$/kWh):	\$0.125	kWh/yr	4,400,000	\$550,000	4,680,000	\$585,000
Labor (\$/hr)	\$80.00	hr/yr	4,160	\$333,000	4,160	\$333,000
Reserve Fund Contribution <sup>b</sup>		\$/yr		\$200,000		\$200,000
<b>Total</b>				<b>\$2,596,000</b>		<b>\$2,613,000</b>

Notes:

- a. Only incremental costs of operating the Concentrate Reduction facilities are shown. SARI costs are shown elsewhere (Table 5.10) as a net reduction.
- b. Includes annual replacement of secondary RO membrane elements.
- c. Represents pellet sale price of \$10/ton FOB Chino II per "Market Survey for the Softening Pellets to be Generated at the Chino II Desalter," WQTS, Oct. 15, 2010, page 22 Option 3 (see Appendix E.3). Pellet sale income is shown as a negative value.

<b>Table 5.8 Chino Desalter Concentrate Reduction Capital Cost Estimate Chino Desalter Phase 3 PDR JCSD/Ontario/WMWD</b>		
RO Concentrate System		\$8,000,000
Pellet Softeners		\$1,000,000
Pellet Storage/Loading		\$500,000
Sand Feed		\$300,000
Polishing Filters		\$900,000
Backwash/FWW Storage		\$800,000
FWW Clarification		\$1,500,000
Lime System		\$800,000
Caustic Soda System		\$150,000
Ferric Chloride System		\$120,000
Polymer system		\$50,000
Sulfuric Acid System		\$50,000
Building		\$1,500,000
Sitework		\$300,000
Electrical and I&C		\$3,000,000
General Conditions		\$1,000,000
Contractor OH & P		\$2,000,000
Sale Tax		\$700,000
Construction Cost Subtotal		\$22,670,000
Contingency and Engineering (30%)		\$6,800,000
Administrative and Legal (5%)		\$1,130,000
Project Cost		\$30,600,000
Amortization Period (Years)	30	
Fixed Amortization Rate (Percent)	5%	
Annualized Capital (\$/Year)		\$1,990,000

<b>Table 5.9 Effect of Concentrate Reduction on SARI Capacity Costs Chino Desalter Phase 3 PDR JCSD/Ontario/MMWD</b>					
	<b>Capacity <sup>a</sup></b>		<b>Value <sup>b</sup></b>		
	<b>Pipeline Treatment (mgd)</b>	<b>(mgd)</b>	<b>Pipeline (\$)</b>	<b>Treatment (\$)</b>	<b>Total (\$)</b>
<b><u>CHINO I AFTER NAMEPLATE CAPACITY MODIFICATIONS</u></b>					
SARI Capacity Requirement					
Without Concentrate Reduction	2.82	2.82	\$10,580,000	\$31,960,000	\$42,540,000
With Concentrate Reduction	0.85	0.85	\$3,170,000	\$9,590,000	\$12,760,000
Difference	(1.97)	(1.97)	(\$7,410,000)	(\$22,370,000)	(\$29,780,000)
SARI Capacity Purchase/Sale					
Current CDA Ownership	2.05	2.05	\$7,690,000	\$23,230,000	\$30,920,000
Avoided Purchase <sup>c</sup>	0.77	0.77	\$2,890,000	\$8,730,000	\$11,620,000
Available for Sale <sup>d</sup>	(1.20)	(1.20)	(\$4,510,000)	(\$13,640,000)	(\$18,150,000)
Total Purchase and Sale <sup>e</sup>	1.97	1.97	\$7,400,000	\$22,370,000	\$29,770,000
<b><u>CHINO II AFTER PHASE 3 EXPANSION</u></b>					
SARI Capacity Requirement					
Without Concentrate Reduction	3.13	3.13	\$11,720,000	\$35,410,000	\$47,130,000
With Concentrate Reduction	0.94	0.94	\$3,520,000	\$10,620,000	\$14,140,000
Difference	(2.19)	(2.19)	(\$8,200,000)	(\$24,790,000)	(\$32,990,000)
SARI Capacity Purchase/Sale					
Current CDA Ownership	1.62	1.30	\$6,080,000	\$14,730,000	\$20,810,000
Avoided Purchase <sup>c</sup>	1.51	1.83	\$5,640,000	\$20,680,000	\$26,320,000
Available for Sale <sup>d</sup>	(0.68)	(0.36)	(\$2,560,000)	(\$4,110,000)	(\$6,670,000)
Total Avoided Purchase and Sale <sup>e</sup>	2.19	2.19	\$8,200,000	\$24,790,000	\$32,990,000
Notes:					
a. SARI capacity shown is from RO concentrate only and does not include IX discharge to SARI, or other.					
b. SARI pipeline capacity value = \$3,750,000 and SARI treatment capacity value = \$11,332,000.					
c. Avoided Purchase = SARI capacity requirement without concentrate reduction - Current CDA Ownership					
d. Available for Sale = SARI capacity requirement with concentrate reduction - Current CDA Ownership					
e. Total Avoided Purchase and Sale = sum of absolute values of Avoided Purchase and Available for Sale					

The concentrate reduction process would actually reduce the SARI capacity requirements for both desalters to less than the current SARI capacity owned by CDA. In this case it is assumed that the unneeded capacity is transferred or sold at the current replacement value. The value of SARI capacity is discussed in Section 8; a current replacement value of \$15,082,000 per mgd (\$3,750,000 for pipeline capacity and \$11,332,000 for treatment capacity) is used herein. The value of SARI capacity under the concentrate reduction project is the sum of both the avoided purchase and the SARI capacity available for sale or transfer.

Comparisons of the net difference between annual cost of operation with and without the proposed concentrate reduction process are presented in Table 5.10 for the nameplate capacity Chino I Desalter and the expanded Chino II Desalter. This table includes differences in annual O&M (including net change in SARI operating costs), annualized capital cost (including the annualized value of SARI capacity made available either as avoided purchase or available for sale) and the revenue from new product water (and LRP rebate) resulting from the proposed concentrate reduction process.

Table 5.10 shows that the net difference with and without concentrate reduction is within 10 percent for both Chino I and Chino II. Chino II has lower costs with concentrate reduction while Chino I shows lower costs without concentrate reduction. The difference between desalters is primarily due to the fact that the construction cost is assumed to be the same for both facilities but Chino I produces less new product water and therefore less new revenue.

The cost information presented herein is based on preliminary engineering judgments and reconnaissance-level assumptions. As an illustration of the sensitivity of the analysis to assumptions, we have prepared Figure 5.6 to show how the profitability (net annual benefit) of concentrate reduction is affected by the cost of disposal (or sale value) of the calcium carbonate pellets from the pellet reactor.

The amount of pellets generated by the concentrate reduction process at each desalter (nearly 40 tons per day) is so large that a small difference in the cost of disposal makes a large difference in whether the process is financially beneficial. The cost analysis presented in the Final PDR (June 2010) assumes the disposal cost of pellets is \$0.015/lb (\$30/ton) based upon the disposal cost reported for a smaller pellet reactor producing similar calcium carbonate pellets in the same local vicinity.

In order to reduce the uncertainty associated with the disposal of the concentrate reduction pellets, the Phase 3 Sponsors authorized a pellet market survey, conducted by Water Quality & Treatment Solutions, Inc (WQTS). The final report (WQTS, October 2010) is included in Appendix E.3.

The pellet market survey report includes the following conclusions:

- The market survey and face-to-face meetings with potential users suggest a “clear market demand for the pellets.”

- The sale price of the pellets may range from \$10/ton to \$20/ton at the Chino II Desalter, with transportation paid by the purchaser.
- Any of several potential purchasers is able to take the entire 38 ton/day pellet production from the Chino II Desalter.

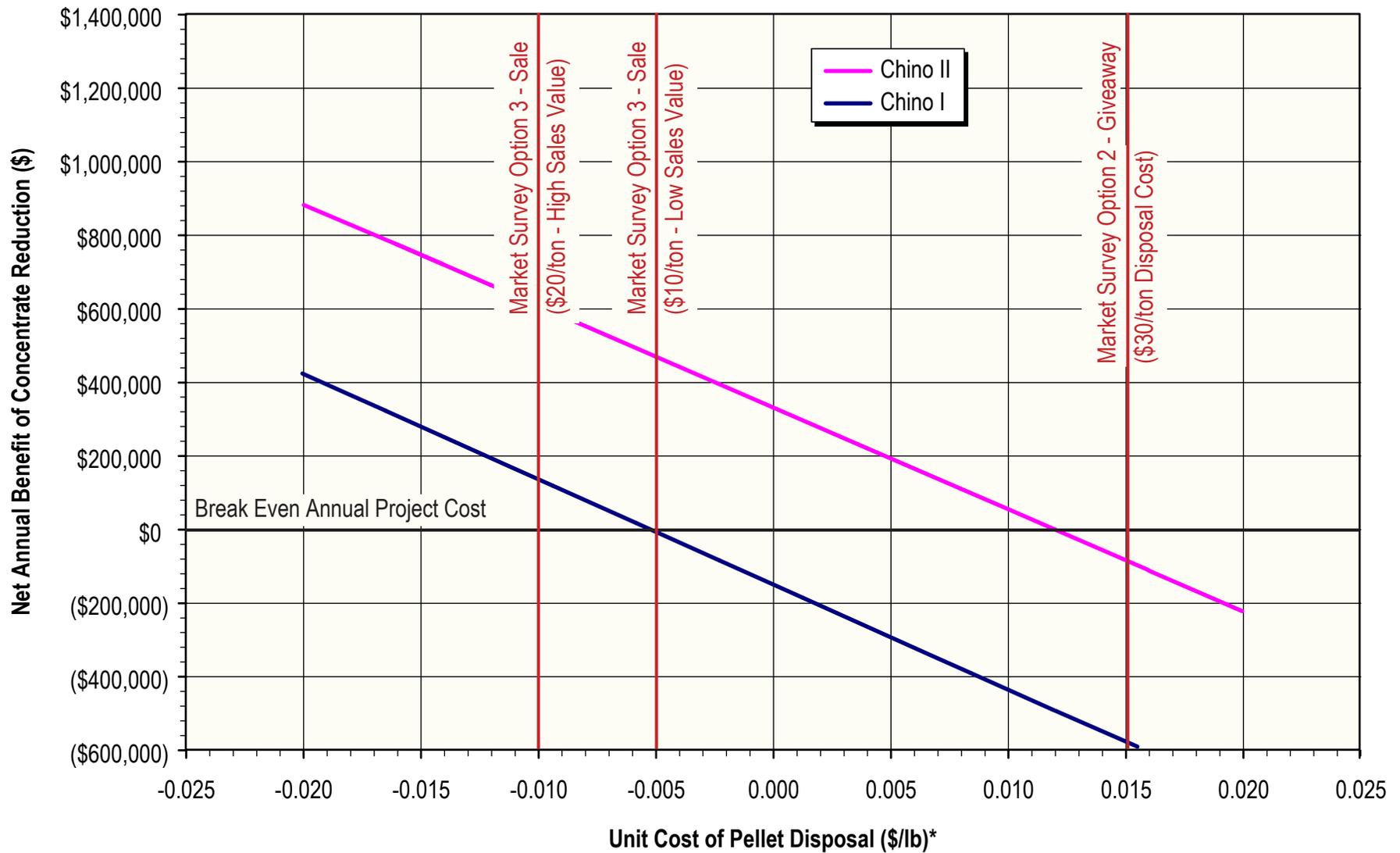
The high range (\$20/ton) and low range (\$10/ton) pellet sale values are shown in Figure 5.6, along with the “giveaway” disposal cost (\$30/ton) assumed previously in the May 2010 Final PDR, prior to the completion of the pellet market survey.

Based upon the positive response from potential purchasers, documented in the pellet market survey, a pellet sale price between \$10/ton and \$20/ton is assumed in the financial analysis presented in Section 8. Where a range is not presented in the analysis, the lower value (\$10/ton) is used as the conservative choice.

The following steps are recommended if it is decided to pursue the implementation of a concentrate reduction process at the Chino Desalters.

- Coordinate with SAWPA to identify potential issues with secondary RO concentrate discharge to the SARI system.
- Coordinate with California DPH to identify requirements for process implementation, such as pilot or demonstration-scale studies.
- Coordinate with desalter staff to develop improved site layouts and cost estimates.
- Identify potential grant funding.
- Identify and acquire additional property adjacent to the Chino II site for construction of concentrate reduction facilities.
  - Authorize initial property negotiations.
  - Actual purchase is contingent upon successful completion of concentrate reduction feasibility investigations (e.g., pellet market study, pilot study, etc.).

<b>Table 5.10 Concentrate Reduction Annual Cost Comparison Chino Desalter Phase 3 PDR JCSD/Ontario/WMWD</b>				
	<b>Chino I After Phase 3 Expansion</b>		<b>Chino II After Phase 3 Expansion</b>	
	<b>Without Concentrate Reduction</b>	<b>With Concentrate Reduction</b>	<b>Without Concentrate Reduction</b>	<b>With Concentrate Reduction</b>
<u>Costs</u> <sup>a</sup>				
Annual O&M Costs	\$ 830,000 <sup>b</sup>	\$ 2,600,000 <sup>c</sup>	\$ 920,000 <sup>b</sup>	\$ 2,610,000 <sup>c</sup>
Annualized Capital Cost	\$1,940,000 <sup>d</sup>	\$1,990,000 <sup>e</sup>	\$2,150,000 <sup>d</sup>	\$1,990,000 <sup>e</sup>
<u>Revenues</u> <sup>a</sup>				
Product Water Value	\$0	(\$1,530,000) <sup>f</sup>	\$0	(\$1,700,000) <sup>f</sup>
MWD LRP Rebate	\$0	(\$280,000) <sup>g</sup>	\$0	(\$310,000) <sup>g</sup>
<b>Costs less Revenues</b>	<b>\$2,770,000</b>	<b>\$2,780,000</b>	<b>\$3,070,000</b>	<b>\$2,590,000</b>
<b>Notes:</b> a. Costs are shown as positive values and revenues are shown as negative values for consistency with the balance of the report. b. O&M costs without concentrate reduction represent SARI volumetric and fixed pipe and treatment costs for the difference between RO concentrate production with and without concentrate reduction (see Table 5.10) using the 2010-12 SAWPA fee schedule (see Table 8.3), assuming 90 percent desalter operation factor. c. Incremental O&M costs for RO concentrate reduction (see Table 5.7). d. Annualized cost of SARI capacity value (sum of avoided purchase and available for sale from Table 5.9) at 5 percent over 30 years. e. Annualized capital cost of concentrate reduction facilities (see Table 5.8) at 5 percent over 30 years. f. Value of new product water (primary RO concentrate that is converted to product water) is assumed equal to the value of MWD Tier 1 treated water plus Delta Supply Surcharge (\$701/AF + \$69/AF = \$770/AF), per MWD rate schedule effective 9/1/2009. Annual product water volume assumes 90 percent desalter operation factor. g. LRP rebate of \$139/AF for volume of new product water (primary RO concentrate that is converted to product water). Annual product water volume assumes 90 percent desalter operation factor. LRP rebate value per e-mail from Jack Safely 10/29/10.				



\* Negative Value Indicates Sale of Pellets

**Figure 5.6**  
**Effect of Pellet Disposal Cost on Concentrate Disposal Cost**  
**CHINO DESALTER PHASE 3 PDR**  
 JCSD/ONTARIO/WMWD