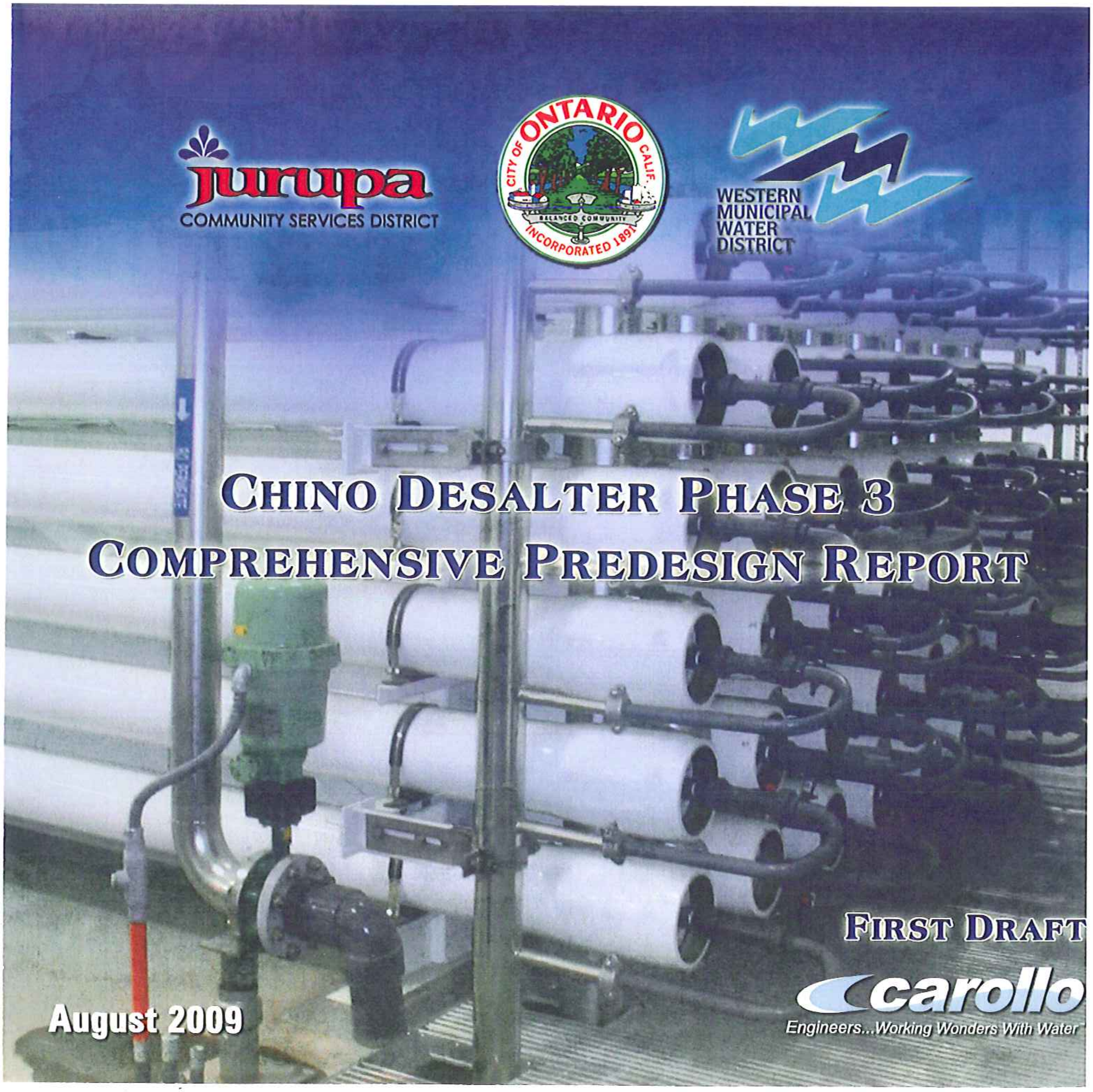
Jurupa COMMUNITY SERVICES DISTRICT

CITY OF ONTARIO CALIF. INCORPORATED 1891

WESTERN MUNICIPAL WATER DISTRICT



CHINO DESALTER PHASE 3 COMPREHENSIVE PREDESIGN REPORT

FIRST DRAFT

August 2009

carollo

Engineers...Working Wonders With Water™

GROUNDWATER AND WELLS

2.1 INTRODUCTION

As shown previously in Table 1.1, to reach the 40,000 AF/yr desalter raw water objective requires an additional 12,040 AF/yr of groundwater pumping and will result in 10,600 AF/yr of additional product water, assuming an average desalter operating efficiency of 88 percent. Of the additional groundwater pumping, 5,000 to 7,700 AF/yr must come from new wells located to achieve hydraulic control of the Chino Basin. The proposed hydraulic control wells are known as the Chino Creek Well Field (CCWF). The balance of the additional groundwater withdrawal, above the CCWF yield, should come from an area within the Chino Desalter well field allowing greatest sustainability.

The analysis of groundwater characteristics and flow (geohydrology) is a specialty discipline. The following geohydrologic consulting firms have provided assistance in the preparation of the Chino Phase 3 PDR:

- GEOSCIENCE Support Services, Inc. (GEOSCIENCE) is a consultant employed by the Sponsors to provide services in modeling Chino well field operation, locating new wells, and providing services for design and construction oversight for new wells.
- Wildermuth Environmental, Inc. (Wildermuth, or WEI) is a consultant for the Chino Basin Watermaster in providing information on basin water quality and as a third party expert to certify whether the project scope will meet hydraulic control objectives.

2.2 HYDRAULIC CONTROL

The Chino Groundwater Basin in the vicinity of the Chino Desalter well fields is comprised of the following horizontal layers:

- Layer 1: the upper alluvial aquifer system characterized by higher nitrate and TDS levels relative to Layer 2.
- Layer 2: the lower alluvial aquifer system characterized by lower nitrate and TDS levels relative to Layer 1.

Layer 1 and Layer 2 are separated by confining material of relatively low hydraulic transmissivity. The primary flow within Layer 1 and Layer 2 is horizontal.

The objective of hydraulic control is achieved when Layer 1 does not discharge flow to the Santa Ana River. This condition can be evaluated using models showing unit flow vector arrows to indicate the direction of groundwater flow. Hydraulic control is demonstrated when modeling indicates that all unit flow vectors for Layer 1 indicate a direction of flow terminating at a desalter well.

The Sponsors and their consultants are not responsible for certifying that the Chino Phase 3 Project will achieve hydraulic control. The Chino Basin Watermaster, using an independent consultant (Wildermuth), will review the Phase 3 scope and determine whether the project scope will achieve hydraulic control objectives.

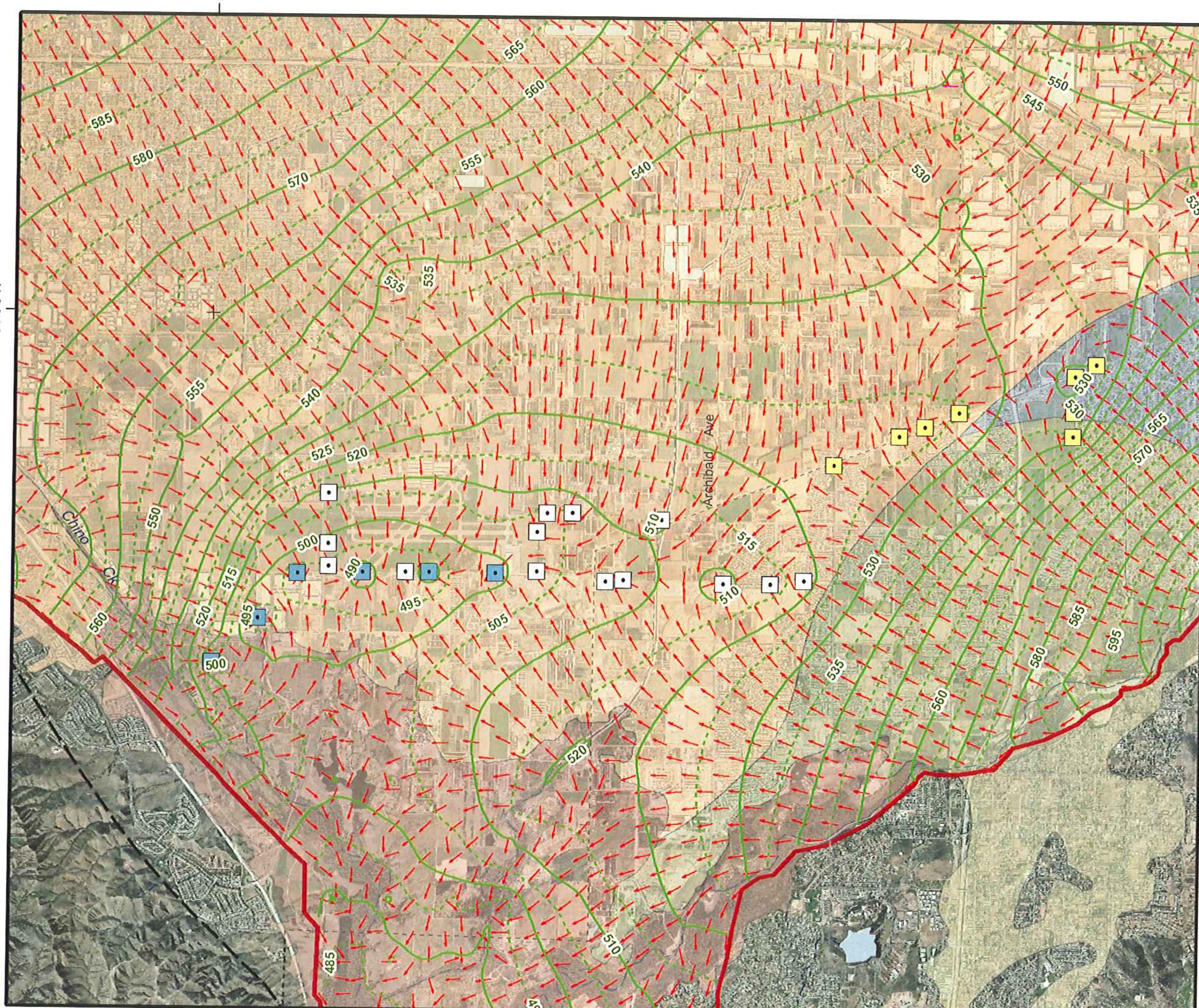
Figure 2.1, provided by Wildermuth, shows a Chino Desalter well field model scenario that achieves this result (Wildermuth Model Alternative 1C). The key to achieving hydraulic control is the construction and operation of the CCWF.

2.2.1 Chino Creek Well Field (CCWF)

The CCWF is intended to intercept flow to the Santa Ana River and achieve hydraulic control when operated in conjunction with the existing Chino Desalter wells. Six CCWF wells have been proposed and located in terms of general vicinity by Wildermuth. Two CCWF alignments have been under consideration. Both would achieve hydraulic control but they have the following significant differences:

- CCWFA: This well field location provides the shortest length of raw water pipeline and is, therefore, the more cost-effective well field location.
- CCWFB: This well field location would provide containment for more of the Chino airport VOC contaminant plume.

Although the CCWFB alignment would have potential benefits in remediation of the Chino airport plume, the potentially responsible parties have not provided any assurances that they would participate in the costs of construction of the more expensive CCWFB alignment or the subsequent VOC treatment. Without such financial contributions, the CCWFB alignment is more expensive for the Sponsors. In addition, the CCWFB alignment also locates wells deeper into the Prado Flood Control and Conservation Basin, which poses concerns of dewatering near riparian habitat. For these reasons, the CCWFA alignment has been selected by the Sponsors.



Groundwater Elevation Contours (feet above mean sea-level)

Existing Chino 1 Desalter Well

Existing Chino 2 Desalter Well

Proposed Chino Creek Well

Groundwater Flow Direction

Other Features

Groundwater Management Zone

Chino-East

Chino-North

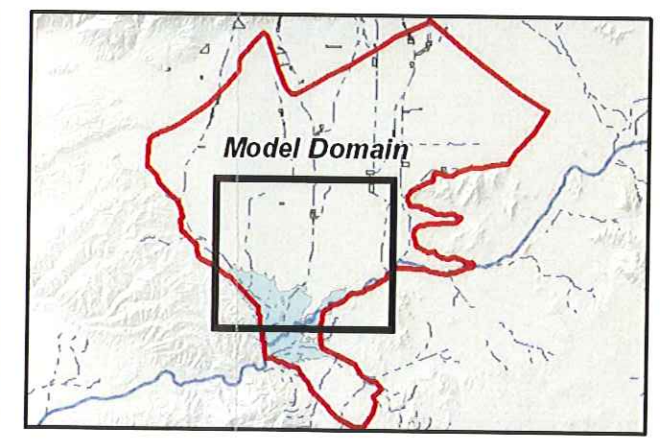
Chino-South

Prado Basin

MODFLOW Groundwater Flow Model Boundary

Flood Control and Conservation Basins

Streams, Rivers, and Flood Control Channels



Produced by:

WILDERMUTH ENVIRONMENTAL INC

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Lake Forest, CA 92630
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Alternative 1C in Layer 1 - Year 2023

Author: MJC

Date: 20080208

File: Figure_5-6.mxd

Source: "Final Report, 2007, CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description," November 2007, Wildermuth

Scale: 0, 1, 2 Miles; 0, 1, 2, 3 KM

Peace II Completion Report

Recommended Monitoring and Field Validation of Results

Figure 2.1
Groundwater Elevation Contours and Flow Direction in the Vicinity of the Desalters
CHINO DESALTER PHASE 3 PDR
JCSD/ONTARIO/WMWD

2.3 CHINO DESALTER WELL FIELDS

In this report, Chino Desalter wells are designated as either CDA I (equipped to pump to the Chino I hydraulic gradeline), or CDA II (equipped to pump to Chino II hydraulic gradeline). At the present time there are 14 CDA I wells and eight CDA II wells, for a total of 22 Chino Desalter wells. Both CDA I and CDA II wells are numbered sequentially; however, each well field has a missing well in the sequence; CDA I–12 and CDA II–5 were never constructed. A summary of well construction details and pump equipment for existing Chino Desalter Wells is presented in Table 2.1.

Table 2.1 Summary of Existing Chino Desalter Well Equipment[a]
Chino Desalter Phase 3 PDR
JCSD/Ontario/WMWD

Well No.	Pump Type [b]	Drive [b]	Design Capacity (gpm)	Design TDH (ft)	Motor Size (hp)	Pump Column Diameter (inches)
CDA I-1	VTLS	VFD	600	352	75	8
CDA I-2	VTLS	VFD	300	360	40	6
CDA I-3	VTLS	VFD	600	347	75	8
CDA I-4	VTLS	VFD	300	348	40	6
CDA I-5	VTLS	VFD	1,200	284	125	10
CDA I-6	VTLS	VFD	1,200	301	125	10
CDA I-7	VTLS	VFD	1,200	313	125	10
CDA I-8	VTLS	VFD	900	286	100	10
CDA I-9	VTLS	VFD	1,200	250	100	10
CDA I-10	VTLS	VFD	1,200	242	100	10
CDA I-11	VTLS	VFD	1,200	259	125	10
CDA I-13	Submersible	VFD	2,000	320	300 [c]	10 [d]
CDA I-14	Submersible	VFD	2,200	288	300 [c]	10 [d]
CDA I-15	Submersible	VFD	2,000	280	300 [c]	10 [d]
CDA II-1	Submersible	VFD	2,000	425	300	10 [d]
CDA II-2	Submersible	CS	2,000	390	300	10 [d]
CDA II-3	Submersible	CS	2,000	390	300	10 [d]
CDA II-4	Submersible	VFD	2,000	401	300	10 [d]
CDA II-6	Submersible	VFD	2,000	NA	300	10 [d]
CDA II-7	Submersible	VFD	1,500	NA	250	10 [d]
CDA II-8	Submersible	CS	1,500	NA	200	10 [d]
CDA II-9A	Submersible	CS	2,000	NA	300	10 [d]

Notes:

a. Sources of information are Chino I O&M manual (Tables 2.3-2, 3, and 4) for wells CDA I-1 through 11 and "Well Pump Data Summary and Procurement Specification," March 2009, Carollo (Tables 4.0.1 - 11) for all other wells, unless noted otherwise.
b. Abbreviations: VTLS = Vertical Turbine Line-shaft; VFD = Variable Frequency Drive; CS = Constant Speed; NA = Not Available
c. Manufacturer data sheet lists motor as 250 hp. CDA maintenance records indicate motor is 300 hp with nameplate derating to 250 hp. VFD is listed as 300 hp in the contractor's bill of materials.
d. Pump column pipe diameter per construction drawings.

2.3.1 Models

The one of the design objectives of the Chino Phase 3 Project is to provide hydraulic control and continued desalter operation in the most sustainable manner. Achieving hydraulic control requires construction of the CCWF. Sustainability implies expansion of additional groundwater capacity where long-term drawdown will have the least effect on operation of the Chino Desalter well fields. Groundwater models for operation of the expanded Chino Desalter well fields have been provided by Wildermuth and GEOSCIENCE. Both sets of models are referred to in this report.

2.3.1.1 <u>GEOSCIENCE Groundwater Model</u>

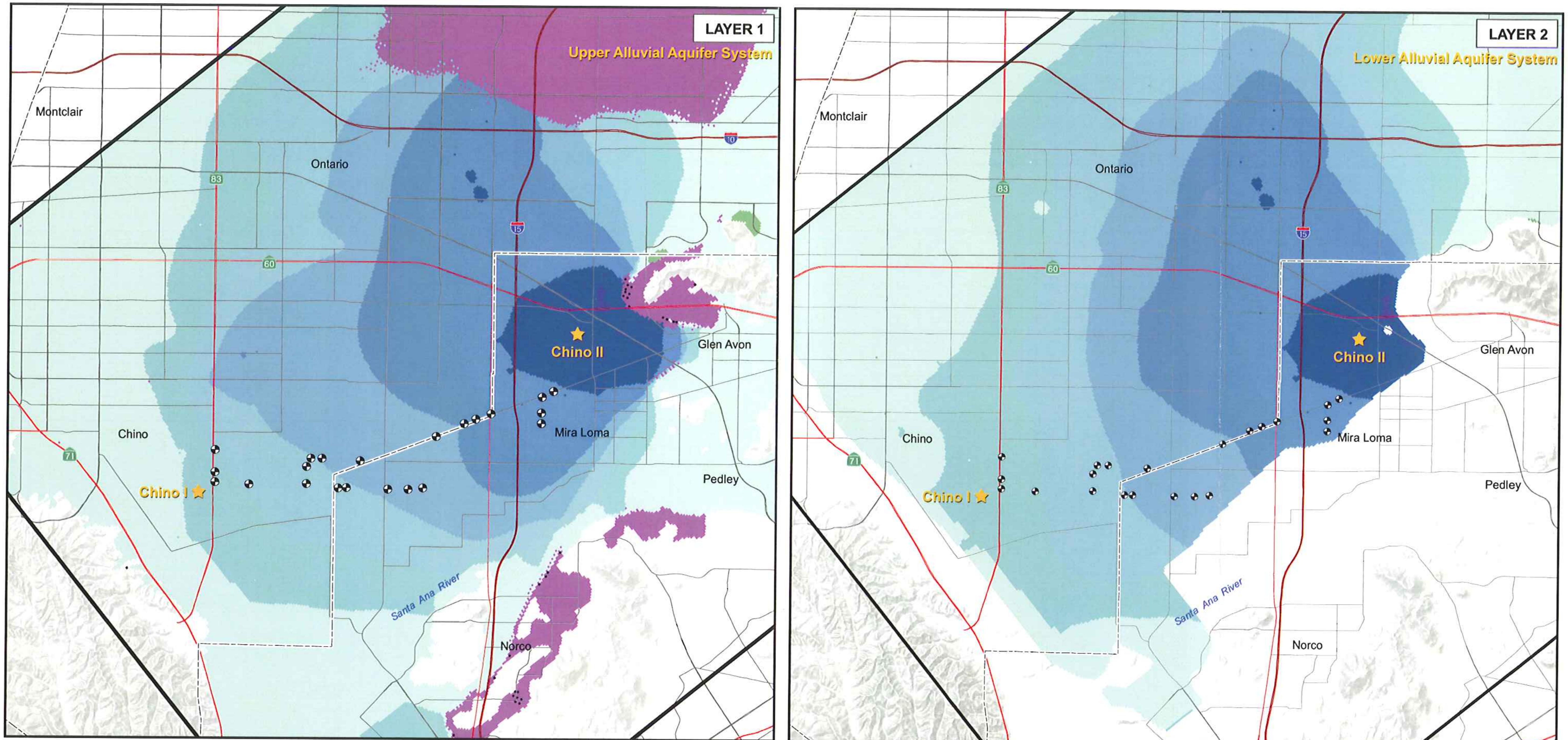
Under contract to the CDA, GEOSCIENCE presented groundwater modeling results for three different operating scenarios (GEOSCIENCE, 2008). The three scenarios are:

- Scenario 1 (Baseline): This scenario models Chino I producing at nameplate capacity and Chino II producing at approximately 20 percent greater than nameplate capacity.
- Scenario 2: This scenario models the Scenario 1 (Baseline) well field production plus pumping 5,200 AF/yr from the proposed CCWFA.
- Scenario 3: This scenario models Scenario 2 production plus pumping 12,040 AF/yr from five new Chino II wells to supply the Chino II Desalter expansion.

The Scenario 1, 2, and 3 model results are presented graphically in Figures 2.2 through 2.4, respectively, which show the predicted change in groundwater level in feet of additional drawdown between 2005 and 2017 for both Layer 1 (upper aquifer) and Layer 2 (lower aquifer). Figure 2.2 (Scenario 1) shows increasing drawdown over time in the vicinity of Chino II under baseline conditions. The addition of the CCWFA in Figure 2.3 (Scenario 2) adds a heavy localized drawdown in the vicinity of the CCWF, which is the intended objective in order to achieve hydraulic control. It should be noted that the GEOSCIENCE model shows the CCWF wells withdrawing water primarily from Layer 2 (lower aquifer); however, in order to achieve hydraulic control it will be necessary to achieve drawdown in Layer 1 (upper aquifer), which discharges to the Santa Ana River. Figure 2.4 (Scenario 3) shows the superposition of Scenario 2 (hydraulic control through the CCWFA) with the additional well field expansion needed for a full 40,000 AF/yr withdrawal achieved by constructing five new wells approximately midway between Chino I and Chino II, in the area of lowest drawdown.

CHINO BASIN DESALTER AUTHORITY

CHINO DESALTER GROUND WATER FLOW MODEL UPDATE



Scenario 1: Baseline

Existing Chino I Wells = 16,100 AF/YR
Existing Chino II Wells = 14,560 AF/YR
Total Chino Desalter Wells = 30,660 AF/YR

EXPLANATION

Model-Generated Change in Ground Water Levels 2005 - 2017 (feet)

- Dry Model Cells
- Area of Positive Ground Water Level Change
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- >80

- Chino Desalter Authority Well Location
- Ground Water Model Boundary
- County Boundary
- Freeway
- State Highway
- Street

NORTH

0 2 4 Miles

Source: "Chino Desalter Groundwater Flow Model Update," Sep 2008, Geoscience

15-Sep-08

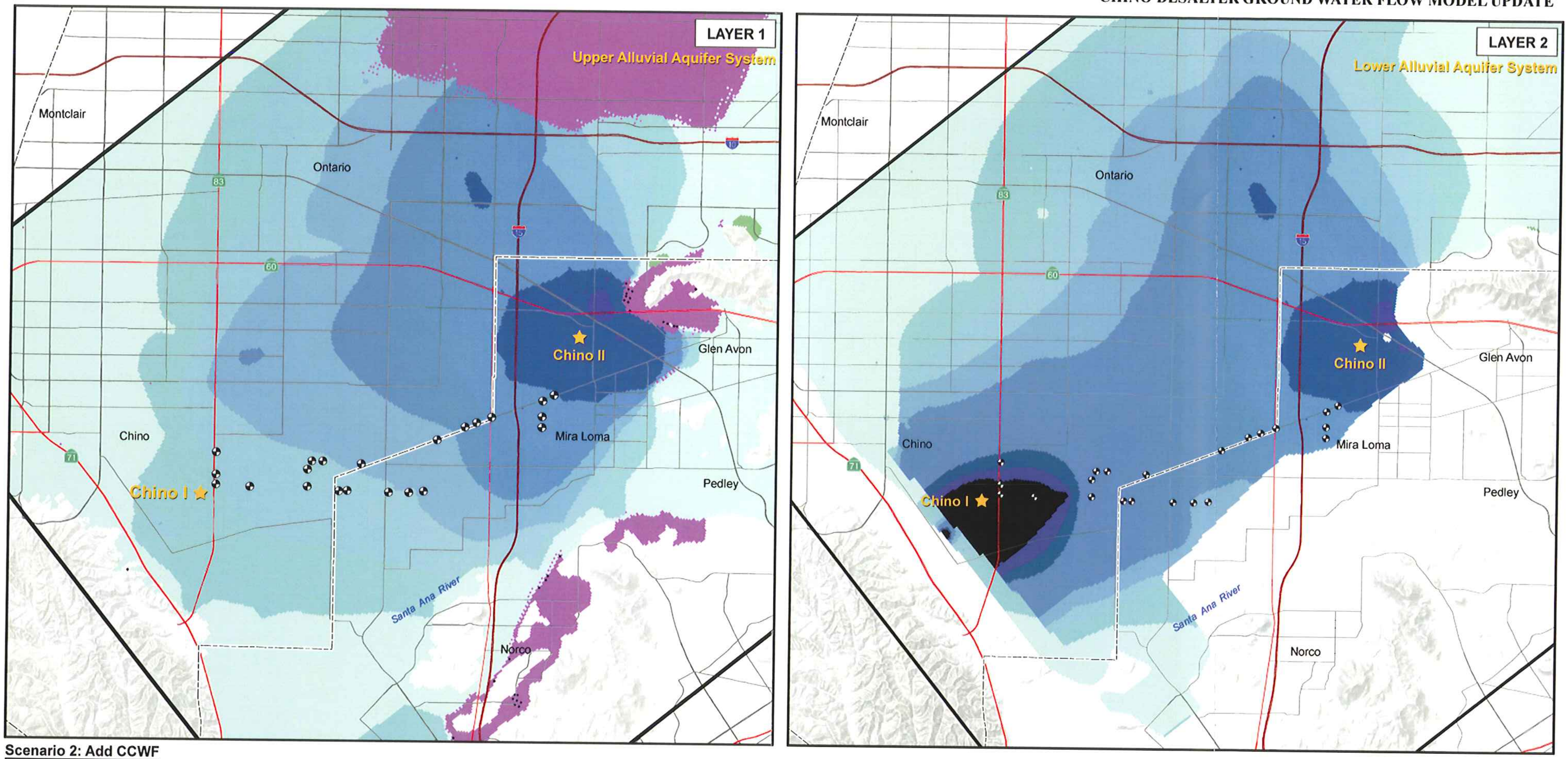
Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

Figure 2.2
Geoscience Scenario 1 Model Groundwater Level Changes
CHINO DESALTER PHASE 3 PDR
JCSD/ONTARIO/WMWD

CHINO BASIN DESALTER AUTHORITY

CHINO DESALTER GROUND WATER FLOW MODEL UPDATE



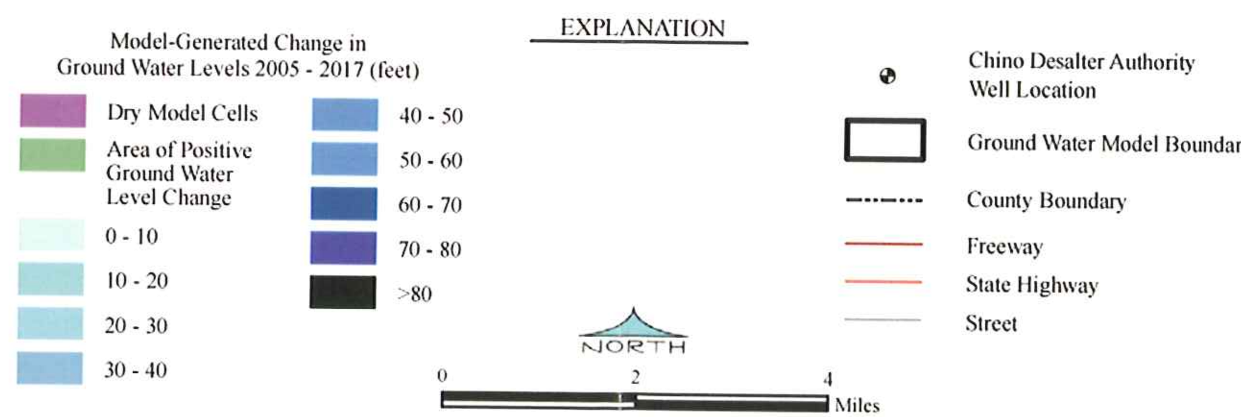
Scenario 2: Add CCWF

Existing Chino I Wells	= 10,900 AF/YR
CCWF	= 5,200 AF/YR
Total Chino I Wells	= 16,100 AF/YR
Existing Chino II Wells	= 14,560 AF/YR
Total Chino Desalter Wells	= 30,660 AF/YR

15-Sep-08

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

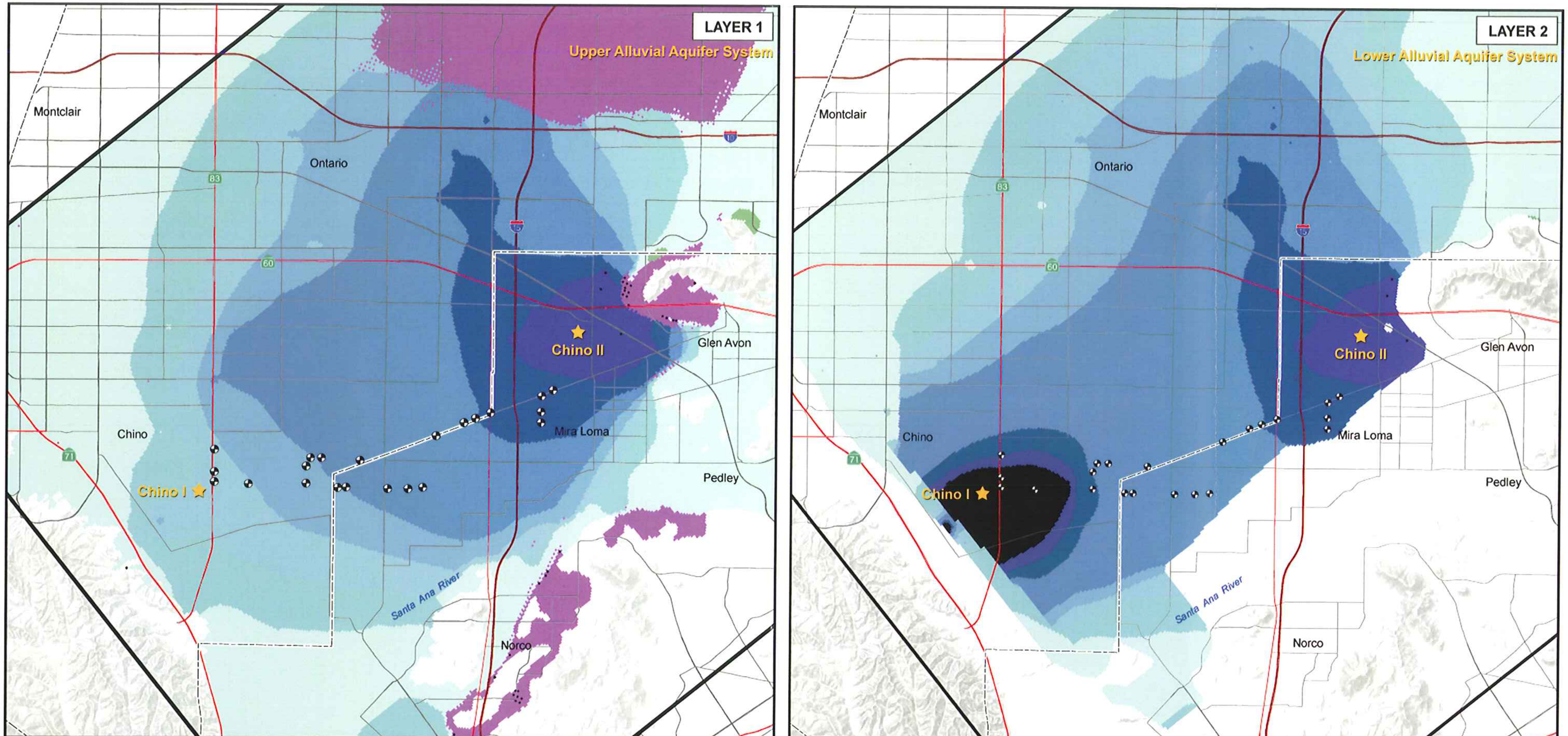


Source: "Chino Desalter Groundwater Flow Model Update," Sep 2008, Geoscience

Figure 2.3
Geoscience Scenario 2 Model Groundwater Level Changes
CHINO DESALTER PHASE 3 PDR
JCSD/ONTARIO/WMWD

CHINO BASIN DESALTER AUTHORITY

CHINO DESALTER GROUND WATER FLOW MODEL UPDATE



Scenario 3: Add CCWF + Expand Chino II

Existing Chino I Wells	= 10,900 AF/YR
CCWF	= 5,200 AF/YR
Total Chino I Wells	= 16,100 AF/YR
Existing Chino II Wells	= 14,560 AF/YR
Additional Chino II Wells	= 12,040 AF/YR
Total Chino II Wells	= 26,600 AF/YR
Total Chino Desalter Wells	= 42,700 AF/YR

15-Sep-08

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

EXPLANATION

Model-Generated Change in Ground Water Levels 2005 - 2017 (feet)

- Dry Model Cells
- Area of Positive Ground Water Level Change
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- >80

- Chino Desalter Authority Well Location
- Ground Water Model Boundary
- County Boundary
- Freeway
- State Highway
- Street

NORTH

0 2 4 Miles

Source: "Chino Desalter Groundwater Flow Model Update," Sep 2008, Geoscience

Figure 2.4
Geoscience Scenario 3 Model Groundwater Level Changes
CHINO DESALTER PHASE 3 PDR
JCSD/ONTARIO/WMWD

The following conclusions are based on review of the GEOSCIENCE modeling and reported results (GEOSCIENCE, 2008):

- Under baseline conditions (without expansion of the Chino Desalter Wellfield) the groundwater level decline will affect operation of existing CDA wells, and also the wells of other users.
- In order to achieve hydraulic control the CCWF wells will have to draw primarily from Layer 1 even though this will likely adversely affect the well water quality. A letter to this effect from Chino Basin Watermaster is included in Appendix A.1.
- Additional groundwater withdrawal to achieve 40,000 AF should come from the area of least projected decreased in groundwater levels, which is located approximately midway between Chino I and Chino II.

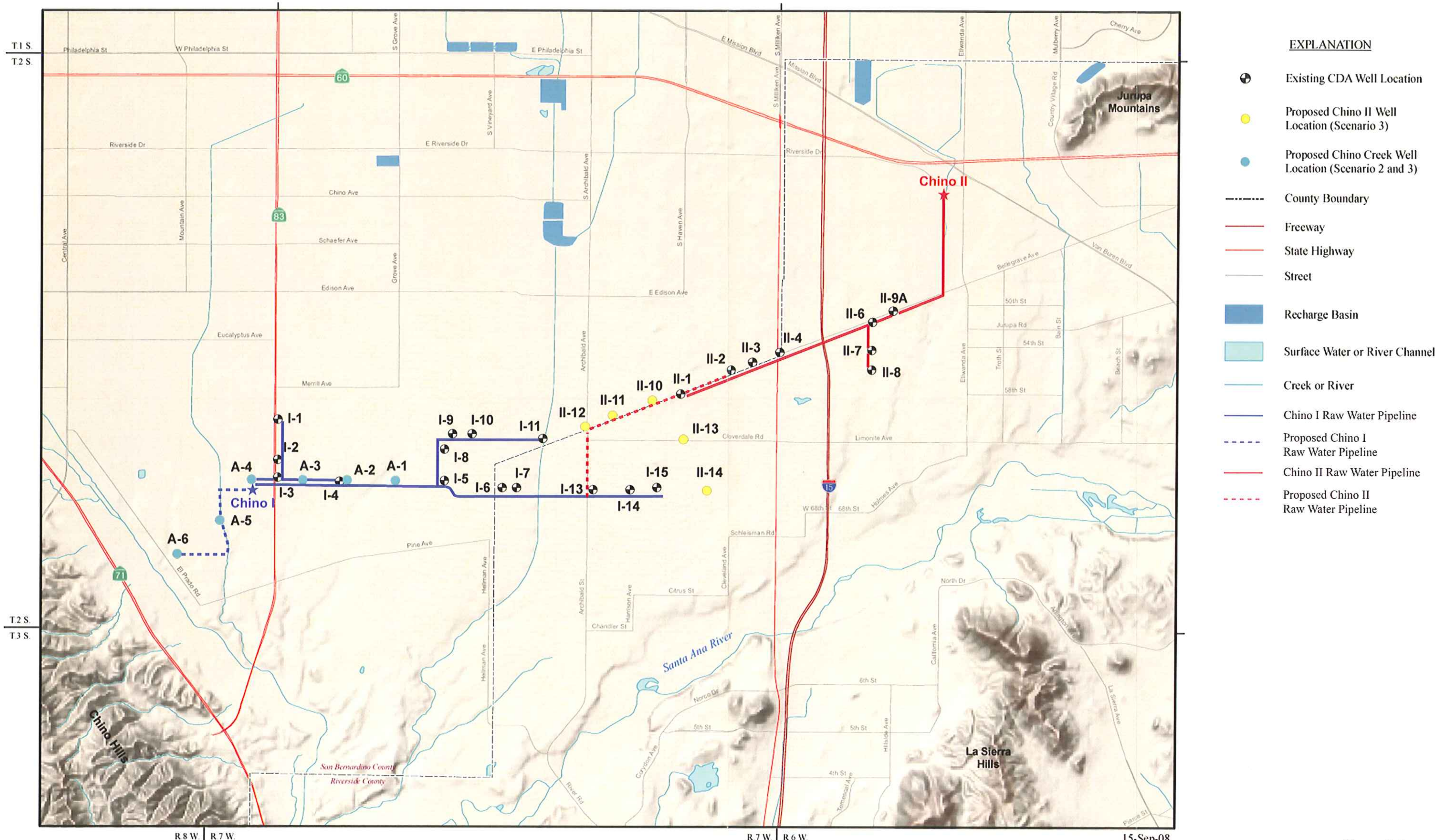
The GEOSCIENCE model (Scenario 3) assumes that additional Chino Desalter Wellfield Expansion will require new wells constructed midway between Chino I and Chino II Desalters. These wells have been designated CDA II–10, 11, 12, 13, and 14 because they would provide the raw water supply required for expansion of the Chino II Desalter. The general well site locations proposed by GEOSCIENCE are shown in Figure 2.5.

2.3.1.2 Wildermuth Model

An alternative to the construction of new Chino II wells midway between Desalter I and II was modeled by Wildermuth. The Wildermuth model scenario includes the CCWFA wells pumping at an annual rate of 7,488 AF/yr from the Layer 1 aquifer in order to achieve hydraulic control. However, rather than reducing the yield of existing CDA I wells by a corresponding amount, the Wildermuth model transfers wells CDA I–13, 14, and 15 to the Chino II raw water supply. The yield of these three existing Chino I wells is roughly equivalent to the proposed capacity of the CCWFA wells. The basis for the Wildermuth model, Alternative 1C, is discussed elsewhere (Wildermuth, 2008). The model achieves hydraulic control objectives; results were presented previously in Figure 2.1.

The significant difference between the GEOSCIENCE model (Scenario 3) and Wildermuth model is in the well field operation factor. The operation factor is defined as the required well field capacity divided by the design capacity of the well field. Table 2.2 summarizes the individual well production modeled by Wildermuth and GEOSCIENCE, along with the design capacity of the wells, both existing and proposed. The Wildermuth model shows that the average well field operation factor is less than 65 percent; in other words, more than

35 percent of the wellfield design capacity is unused. By constructing five additional wells (CDA II–10, 11, 12, 13, and 14) the GEOSCIENCE model reduces the operation factor to approximately 55 percent; that is, nearly 45 percent of the wellfield design capacity is unused.



Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 1 2 Miles

15-Sep-08

Figure 2.5
Chino Desalter Well Locations
CHINO DESALTER PHASE 3 PDR
JCSD/ONTARIO/WMWD

Table 2.2 Summary of Groundwater Model Well Production Rates
Chino Desalter Phase 3 PDR
JCSD/Ontario/WMWD

Well No.	Wildermuth Model (Alternative 1C) Modeled Rates (AF/yr)	Modeled Rates (gpm)	Design Capacity (gpm)	Operating Factor (% Used)	Geoscience Model (Scenario 3) Modeled Rates (AF/yr)	Modeled Rates (gpm)	Design Capacity (gpm)	Operating Factor (% Used)
CDA I 1	586	363	600	61%	291	180	600	30%
CDA I 2	391	242	300	81%	109	67	300	22%
CDA I 3	586	363	600	61%	472	292	600	49%
CDA I 4	391	242	300	81%	253	157	300	52%
CDA I 5	977	606	1,200	50%	136	84	1,200	7%
CDA I 6	716	444	1,200	37%	357	221	1,200	18%
CDA I 7	977	606	1,200	50%	235	145	1,200	12%
CDA I 8	781	484	900	54%	164	102	900	11%
CDA I 9	977	606	1,200	50%	273	169	1,200	14%
CDA I 10	977	606	1,200	50%	593	368	1,200	31%
CDA I 11	1,302	807	1,200	67%	956	592	1,200	49%
CDA I 13	2,763	1,713	2,000	86%	1,422	881	2,000	44%
CDA I 14	2,512	1,557	2,200	71%	1,978	1,225	2,200	56%
CDA I 15	2,512	1,557	2,000	78%	1,136	704	2,000	35%
CDA II 1	1,847	1,145	2,000	57%	3,307	2,049	2,000	102%
CDA II 2	1,847	1,145	2,000	57%	3,080	1,908	2,000	95%
CDA II 3	1,847	1,145	2,000	57%	3,189	1,976	2,000	99%
CDA II 4	1,847	1,145	2,000	57%	3,008	1,863	2,000	93%
CDA II 6	2,463	1,527	2,000	76%	1,823	1,129	2,000	56%
CDA II 7	1,847	1,145	1,500	76%	107	66	1,500	4%
CDA II 8	1,847	1,145	1,500	76%	17	10	1,500	1%
CDA II 9a	1,847	1,145	2,000	57%	61	38	2,000	2%
CDA II 10	-	-	-	-	2,410	1,493	2,000	75%
CDA II 11	-	-	-	-	2,410	1,493	2,000	75%
CDA II 12	-	-	-	-	2,410	1,493	2,000	75%
CDA II 13	-	-	-	-	2,410	1,493	2,000	75%
CDA II 14	-	-	-	-	2,410	1,493	2,000	75%
CCWFA 1	1,522	943	1,260	75%	1,289	799	1,070	75%
CCWFA 2	1,510	936	1,250	75%	1,289	799	1,070	75%
CCWFA 3	1,510	936	1,250	75%	1,289	799	1,070	75%
CCWFA 4	1,440	893	1,200	74%	1,289	799	1,070	75%
CCWFA 5	1,100	682	910	75%	1,289	799	1,070	75%
CCWFA 6	398	247	330	75%	1,289	799	1,070	75%
Total		**24,377**	**37,300**	**65%**		**26,484**	**47,520**	**56%**

	Wildermuth (AF/yr)	(mgd)	Geoscience (AF/yr)	(mgd)
CDA I	8,660	7.7	8,376	7.5
CCWF	7,480	6.7	7,735	6.9
Chino I Total	**16,140**	**14.4**	**16,111**	**14.4**
Required	16,140		16,140	
CDA II	15,393	13.8	14,590	13.0
CDA II EXP	7,787	7.0	12,048	10.8
Chino II Total	**23,180**	**20.7**	**26,638**	**23.8**
Required	23,860		23,860	
Desalter Total	**39,320**		**42,729**	
Required	40,000		40,000	

Proposed OWOW Wells

2900 AFY = ~2.6 mgd

2.3.1.3 Conclusions from Groundwater Models

Declining groundwater levels will result in well pumping levels (within the well casing) that are lower than the top of the screened intervals or lower than the current pump setting for some Chino Desalter Wells. Implications include the following:

- If pumping levels drop below pump settings then pumps must be lowered.
- If pumps are lowered into screened intervals, baffling is recommended to prevent high local velocities from disturbing the filter pack.
- Lower pumping levels will result in decreased pump capacity or increased motor horsepower to maintain capacity.
- Dewatering screen intervals may result in reduced well yield or decreased specific capacity.
- In some cases, dewatered screen intervals may result in cascading water and air entrainment.

Table 2.3 summarizes the current and projected pumping levels in relation to current pump settings and screen intervals. Under the GEOSCIENCE Scenario 1 (baseline) model for current (2008) conditions, six of the twenty-two existing Chino Desalter wells have pumping levels below the top of the first screen interval and the following three wells are operating within ten feet of the pump setting:

- Well CDA I-6
- Well CDA I-13
- Well CDA II-4

The GEOSCIENCE Scenario 1 model projects that by 2017 the baseline conditions (without the Phase 3 expansion) will result in an additional drawdown at the existing Chino Desalter Wells ranging from 10 to 60 feet. By the year 2017, the GEOSCIENCE baseline model predicts that sixteen of the twenty-two existing wells will have pumping levels below the top of the first screened interval and three wells will have more than 50 percent of the screened length dewatered. When the same baseline condition model is projected to the year 2017, the following eight wells have pumping levels within 10 feet of the pump setting:

Table 2.3 Current and Projected Conditions for Pump Setting and Screens
Chino Desalter Phase 3 PDR
JCSD/Ontario/WMWD

		GEOSCIENCE: Scenario 1 (2008)				GEOSCIENCE: Scenario 1 (2017)				Scenario 1 (2008 - 2017) Δ Water Depth (ft)	GEOSCIENCE: Scenario 3 (2017)				Scenario 1 to 3 (2017) Δ Water Depth (ft)	Wildermuth: Alternative 1C (2023)			
				Dewatered Screen				Dewatered Screen					Dewatered Screen					Dewatered Screen	
Well No.	Current Pump Setting (ft BGS)	Estimated Pumping Groundwater Level (ft BGS)	Water Depth Above Pump (ft)	Length (ft)	Percent (%)	Projected Pumping Groundwater Level (ft BGS)	Water Depth Above Pump (ft)	Length (ft)	Percent (%)		Projected Pumping Groundwater Level (ft BGS)	Water Depth Above Pump (ft)	Length (ft)	Percent (%)		Projected Pumping Groundwater Level (ft BGS)	Water Depth Above Pump (ft)	Length (ft)	Percent (%)
CDA I-1	260	248	12	0	0	263	-3	0	0	-15	316	-56	**26**	**23**	-53	141	119	0	0
CDA I-2	340	232	108	0	0	242	98	0	0	-10	317	23	**57**	**41**	-75	125	215	0	0
CDA I-3	285	164	121	0	0	175	110	0	0	-11	254	31	**19**	**10**	-79	125	160	0	0
CDA I-4	290	232	58	**32**	**19**	253	37	**53**	**31**	-21	261	29	**61**	**36**	-8	121	169	0	0
CDA I-5	255	140	115	0	0	167	88	**7**	**6**	-27	177	78	**17**	**14**	-10	124	131	0	0
CDA I-6	170	171	-1	0	0	199	-29	**24**	**19**	-28	209	-39	**34**	**26**	-10	125	45	0	0
CDA I-7	175	155	20	0	0	183	-8	**3**	**3**	-28	194	-19	**14**	**12**	-11	125	50	0	0
CDA I-8	285	152	133	0	0	180	105	0	0	-28	190	95	**10**	**6**	-10	132	153	0	0
CDA I-9	185	131	54	0	0	160	25	0	0	-29	170	15	0	0	-10	138	47	0	0
CDA I-10	175	131	44	0	0	161	14	0	0	-30	172	3	0	0	-11	143	32	0	0
CDA I-11	275	178	97	**18**	**18**	211	64	**51**	**51**	-33	224	51	**64**	**64**	-13	141	134	0	0
CDA I-13	190	184	6	**4**	**2**	214	-24	**34**	**20**	-30	228	-38	**48**	**28**	-14	124	66	0	0
CDA I-14	140	122	18	**22**	**6**	154	-14	**62**	**18**	-32	167	-27	**88**	**26**	-13	122	18	**22**	**6**
CDA I-15	150	112	38	**12**	**6**	144	6	**44**	**22**	-32	158	-8	**67**	**33**	-14	126	24	**26**	**13**
CDA II-1	298	145	153	0	0	178	120	**23**	**11**	-33	195	103	**40**	**19**	-17	157	141	**2**	**1**
CDA II-2	325	150	175	0	0	188	137	**32**	**20**	-38	202	123	**46**	**29**	-14	170	155	**14**	**9**
CDA II-3	335	151	184	0	0	195	140	**35**	**21**	-44	208	127	**48**	**29**	-13	173	162	**13**	**8**
CDA II-4	154	148	6	0	0	196	-42	**40**	**22**	-48	208	-54	**52**	**28**	-12	173	-19	**17**	**9**
CDA II-6	305	151	154	**1**	**1**	205	100	**55**	**38**	-54	215	90	**65**	**45**	-10	180	125	**30**	**21**
CDA II-7	255	133	122	0	0	188	67	**48**	**46**	-55	198	57	**58**	**56**	-10	164	91	**24**	**23**
CDA II-8	240	130	110	0	0	184	56	**54**	**54**	-54	194	46	**64**	**64**	-10	157	83	**27**	**27**
CDA II-9a	200	162	38	0	0	222	-22	**58**	**55**	-60	230	-30	**74**	**71**	-8	191	9	**11**	**11**
Total No. of Wells with:																			
Dewatered Pumps			3				8					9					2		
Dewatered Screens			5				16					20					10		

Notes:
a. Values in shaded box indicate water depth less than 10 feet above the current pump setting.
b. Bold values indicate dewatered screened intervals.
c. GEOSCIENCE model pumping levels include an estimate of localized losses through material adjacent to well, filter pack, and screen.
d. Wildermuth model pumping levels represent the modeled cell containing the well but do not include allowance for losses across adjacent material, filter pack, and screen.

- Well CDA I-1
- Well CDA I-6
- Well CDA I-7
- Well CDA I-13
- Well CDA I-14
- Well CDA I-15
- Well CDA II-4
- Well CDA II-9A

The GEOSCIENCE Scenario 3 model data predict that the Phase 3 expansion will result in additional drawdown at the other existing Chino Desalter Wells ranging from 8 to 17 feet over the Scenario 1 baseline drawdown, by the year 2017. Under Scenario 3 one additional well will have a pumping level within 10 feet of the pump setting. In other words, the modeling shows that the greatest impact on the Chino Desalter well fields is the current, baseline operation. The Phase 3 expansion has a relatively small impact.

We recommend the following:

- CDA should monitor future well pumping levels and make the appropriate adjustments (e.g., lowering pumps) with costs shared by all CDA members.
- The Phase 3 expansion project should include use of wells CDA I-13, 14, and 15 to supply the Chino II expansion with the costs shared by the Sponsors.
- The CDA should purchase sites for wells CDA II-10, 11, and 12 so that these wells can be constructed in the future, if required.

A complete presentation of model data is tabulated in Appendix A.2. A graphical comparison of historical and projected water levels and flow rates under all model scenarios for each well is presented in Appendix A.3 as Figures A.1 through A.22.

2.4 NEW WELL FACILITIES

The proposed scope for the Chino Phase 3 expansion includes six new wells constructed as the CCWFA, located near Chino I, and three new well sites for potential future wells, located as shown by GEOSCIENCE approximately midway between Chino I and Chino II.

2.4.1 Well Construction Standards and Criteria

Design criteria for well construction of the CCWF wells were prepared by GEOSCIENCE in the CCWF and Chino II well field expansion PDR (GEOSCIENCE, May 2009), which is included for reference as Appendix A.4. Comments from Chino Basin Watermaster regarding the well field PDR are included in Appendix A.1.

2.4.2 Well Equipping Standards and Criteria

The following sections describe typical or standard criteria for new well equipment. Site specific criteria such as flow, head, and pump setting will be determined after the completion of test pumping, conducted as part of the well drilling program.

2.4.2.1 Pump and Driver

New wells will be equipped with deep well submersible pumps unless motor requirements exceed 300 horsepower (hp) or casing constraints do not allow installation of a submersible motor. Submersible pumps will be installed without a building enclosure around the wellhead or piping.

If a line shaft pump is required because of motor horsepower or well casing constraints then the discharge head and motor will be enclosed within a ventilated building with noise mitigation features such as internal acoustical panels and acoustical louvers in ventilation wall penetrations.

A proposed specification for submersible pumps is included in Appendix B.1. This specification was developed for the CDA as part of an interchangeable spare pump development project. Pump motors will be suitable for operation with a variable frequency drive (VFD). It is presumed in this report that the new CCWF wells will be equipped with submersible pumps.

2.4.2.2 Column Pipe

Pump column pipe for a submersible well pump is typically referred to as drop pipe. We recommend a non-metallic, flexible drop pipe for the submersible pumps installed in the CCWF wells. The proposed flexible drop pipe (Boreline) is NSF-61 approved and carries a 10-year warranty. A product cut sheet is included in Appendix B.2. Boreline flexible drop pipe has the following advantages over rigid, metallic drop pipe:

- It is non-metallic and therefore non-corrosive.
- Scale will not adhere to the flexible pipe surface.
- The flexible column pipe is a single continuous length without intermediate flanged or threaded connections; therefore, installation and removal is easier and quicker.
- The flexible pipe can be stored on a spool, which eliminates the need for site space to allow column pipe lay down and storage.
- Boreline is approximately 20 percent of the capital cost of the equivalent stainless steel, rigid column pipe system.

Preliminary CCWF well sizing criteria indicate a column pipe diameter of six inches will be adequate. The operating pressure of a 6-inch Boreline flexible column pipe is 310 psi, which would accommodate a pumping water level as low as 100 feet above mean sea level. The CCWF wells will draw water primarily from upper aquifer, which is characterized by higher TDS levels. Boreline drop pipe would be well suited for this application.

In the event that pump capacity, operating pressure, or other conditions (i.e., a requirement for a line shaft pump) preclude the use of flexible column pipe then 316L stainless steel rigid pipe is recommended. Column pipe segments should be limited to 10-foot lengths with interconnection using flanges rather than threaded connections to reduce the risk of crevice corrosion. Bolts should be 316L stainless steel with silicon-bronze nuts to minimize the potential for galling.

2.4.2.3 Downhole Appurtenaces

We recommend installation of a solid (non-drilled) check valve at the discharge of each submersible pump with an additional check valve at each 200 foot length of pump column below the water level. The purpose of the check valve is to keep the pump drop pipe filled with water to the elevation of the ground surface when the pump is not operating. This allows the pump to start against pressure with the thrust bearings firmly seated. If the thrust bearings are not seated then the thin layer of fluid required to lubricate the bearing is absent, resulting in premature bearing failure. Documentation of this recommendation is presented in Appendix B.3.

A specialty submersible pump check valve with a break off plug will allow draining the pump column when the pump is pulled for maintenance. Cut sheets and additional documentation reviewing the recommendation for submersible check valves are contained in Appendix B.3.

An additional recommendation that will help prolong thrust bearing life, while also increasing motor winding longevity, is to set the pressure against the bearing as quickly as possible during pump startup. Across-the-line startup of submersible pumps is recommended when possible. In the case of VFD-equipped pumps, quickly ramping the speed up to achieve 30 hertz (50 percent speed) within 1 second and 60 percent speed within 4 seconds is recommended. In addition to extending bearing life, these criteria will dissipate the heat of the motor startup inrush current more quickly than an extended, low-speed ramp up, thus avoiding premature motor winding failure due to high temperature operation.

2.4.2.4 Wellhead Piping and Appurtenances

We recommend submersible pump discharge heads constructed of 316L stainless steel with a glass-bead blast finish. Discharge piping downstream of the discharge head will be 316L stainless steel, with shop-welded joints and connections that are also shop-cleaned and passivated. Field welding of stainless steel will be prohibited. Stainless steel piping will transition to plastic piping below grade in order to prevent ultraviolet (UV) deterioration of plastic piping.

Exposed (above-grade) discharge piping will be fully restrained with flanged connections, restraining grooved couplings, or dismantling joints. Buried piping will be restrained with concrete thrust blocks.

The well water level will be measured with a downhole pressure transmitter. The pressure transmitter will be submerged below the pumping water level and the cable will be secured to the drop pipe.

Valves and other appurtenances will be constructed of 316L stainless steel. A sample well equipment elevation and typical site plan layout are shown in Figure 2.6.

2.4.2.5 Surge Control

Surge tanks will be provided at each new well unless recommended otherwise by surge analysis conducted after the individual well capacities are identified following test pumping during well construction. For installations requiring surge tanks of 1,000 gallons or less, a bladder-type of surge tank will be provided. Facilities which exceed this volume will use pneumatic surge vessel systems with air-water level controls and an air compressor. Surge tanks will be pressurized, horizontal steel, American Society of Mechanical Engineers (ASME) code-stamped tanks. The steel tanks will have an epoxy coated tank lining. Appurtenances will include the following:

- General:
  - Surge tank isolation butterfly valve (flanged)
  - Tank drain connection with air gap
  - Inlet-outlet energy dissipation device
- Hydro-pneumatic Surge Tanks:
  - Air compressor and controls
  - Tank level control system
  - Level sight tube
  - Pressure relief/safety valve
- Bladder Tanks:
  - NSF-61 bladder
  - Bladder pressure gauge and air-fill connection

For the purposes of this PDR, it is assumed that 750 gallon bladder-type surge tanks will be required at each of the CCWF wells.

2.4.2.6 Electrical Equipment

Electrical equipment at well sites equipped with submersible pumps will be housed in weatherproofed enclosures mounted on concrete pads a minimum of 4 inches above finished grade. The interior of the electrical equipment enclosure will be cooled by a refrigerated air conditioning unit supplied with the electrical enclosure, which will be sized for the heat loads imposed by VFDs and other electrical equipment.

Electrical transformers will be supplied by Southern California Edison (SCE) and will be installed in accordance with SCE standards and located within the site perimeter wall.

The existing Chino I and Chino II Desalter facilities do not include standby power for treatment or product water pumping. The addition of standby power to the treatment facilities is not included within the Phase 3 expansion scope of work; consequently, raw water is not required during a power outage of the electrical supply system. A localized power failure affecting a limited number wells can be accommodated by the well redundancy within the extensive well field.

2.4.2.7 Instrumentation and Control

The well pump and power actuated valves will have local control stations. However, the wells are typically operated remotely from the appropriate desalter facility. Remote operation will be either automatic or manual.

Communication for remote control and monitoring will be via radio telemetry using an antenna mounted at the well site. This is the current communications protocol for the existing Chino Desalter Wells. Parameters monitored remotely will include the following:

- Well water level
- Well discharge head pressure
- Control status (local/remote)
- Pump run status (run/stop/fail)
- Pump flow
- Valve status:
  - Pump discharge valve (open/close)
  - Pump-to-waste valve status (open/close)
- VFD speed

General well operation will be as follows:

- Well startup:
  - The well discharge valve is closed on startup.

- The pump-to-waste valve is opened on startup; an orifice plate in the waste line will provide sufficient backpressure so that the pump thrust bearing does not lift due to excessive flow.
- The pump will ramp up to achieve 50 percent speed within 1 second and 60 percent speed in 4 seconds to set the thrust bearing and achieve the appropriate flow for dissipating inrush current heat.
- After a set period of time the pumped waste valve will begin to close; simultaneously, the pump-to-waste valve will begin to open.
- The pump VFD speed will be controlled to maintain a pressure set point at the desalter, either manually or automatically.

- Shutdown:
  - When the well pump receives a shutdown signal the pump-to-waste valve will begin to open.
  - As the pump-to-waste valve opens the pump discharge valve will begin to close.
  - The VFD speed will ramp down and the pump motor will stop at a preset minimum speed.
  - The pump-to-waste valve closes after the pump motor stops.
- Power Failure:
  - Upon a power failure the pump motor will immediately stop; the surge tank and discharge check valves will keep pressure transients within acceptable limits.
  - Upon restoration of power, valves will return to normal shutdown positions.
  - The pump motor will not restart until the plant operator resets the power outage alarm and restarts the well.

2.4.2.8 <u>Site Work</u>

Subject to local zoning requirements, the entire site perimeter will be surrounded by a masonry block wall for security and as a visual barrier. Any buffer strips, if required by local ordinances, outside the block wall will be landscaped as necessary. The entire site within the perimeter wall will be paved with asphalt pavement over a structural base material. Concrete equipment pads, housekeeping pads, drainage gutters and curbs will be constructed as appropriate.

The perimeter wall will have a single entrance/exit with a concrete drive approach and visual-barrier metal gate. The entrance/exit gate will consist of a motorized panel sliding parallel to the block wall. Gate access is controlled either remotely through the SCADA system or via a local key pad. Site security will include the following:

- Appropriate site lighting, activated either from local on/off switches or motion detectors.
- Intrusion switches on doors to electrical enclosures.
- Automatic closing gate (time delay).