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 should come from new wells located as directed by Watermaster. The proposed new 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 support Watermaster's 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 in the vicinity of the CCWF; however the influence of the confining layer separating Layer 1 and Layer 2 diminishes as one moves east and the layers tend to merge.

Chino Basin Watermaster's objective of hydraulic control is promoted 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 support hydraulic control. The Chino Basin Watermaster, using an independent consultant (Wildermuth), will review the Phase 3 scope and determine whether the project scope will support hydraulic control.

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

2.2.1 Chino Creek Well Field (CCWF)

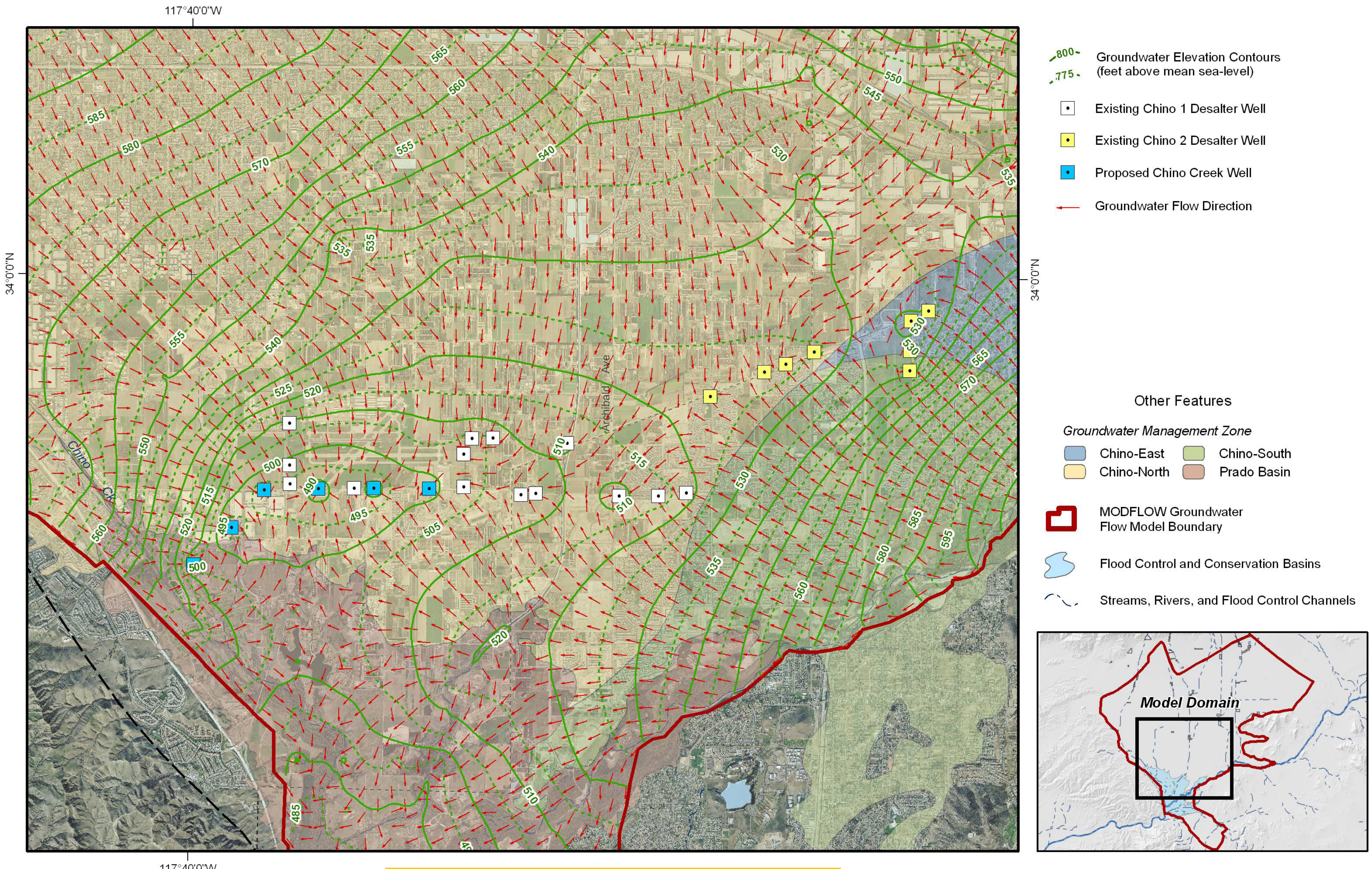
Watermaster intends that the CCWF will intercept flow to the Santa Ana River and promote hydraulic control when operated in conjunction with the existing Chino Desalter wells. Six CCWF wells have been proposed and located in terms of general vicinity by Wildermuth. Two CCWF alignments have been under consideration. Both would promote 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.

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). This nomenclature is consistent with previous geohydrology reports where “CDA” indicates the well owner. 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.



Produced by:

WILDERMUTH ENVIRONMENTAL INC.

23692 Birtcher Drive
Lake Forest, CA 92630
949.420.3030
www.wildermuthenvironmental.com

Alternative 1C in Layer 1 - Year 2023

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

Author: MJC
Date: 20080208
File: Figure_5-6.mxd

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

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)**	**Current[c] Capacity (gpm)**	**Design TDH[b] (ft)**	**Current[c] TDH (ft)**	**Motor Size (hp)**	**Pump Column Diameter (inches)**	
CDA I-1	VTLS	VFD	600	407	352	297	75	8	
CDA I-2	VTLS	VFD	300	225	360	370	40	6	
CDA I-3	VTLS	VFD	600	670	347	316	75	8	
CDA I-4	VTLS	VFD	300	240	348	328	40	6	
CDA I-5	VTLS	VFD	1,200	1,241	284	243	125	10	
CDA I-6	VTLS	VFD	1,200	358	301	287	125	10	
CDA I-7	VTLS	VFD	1,200	226	313	292	125	10	
CDA I-8	VTLS	VFD	900	975	286	265	100	10	
CDA I-9	VTLS	VFD	1,200	1,149	250	241	100	10	
CDA I-10	VTLS	VFD	1,200	1,197	242	244	100	10	
CDA I-11	VTLS	VFD	1,200	818	259	292	125	10	
CDA I-13	Submersible	VFD	2,000	1,694	320	303	300 [d]	10 [e]	
CDA I-14	Submersible	VFD	2,200	2,522	288	249	300 [d]	10 [e]	
CDA I-15	Submersible	VFD	2,000	2,468	280	233	300 [d]	10 [e]	
CDA II-1	Submersible	VFD	2,000	2,062	425	403	300	10 [e]	
CDA II-2	Submersible	CS	2,000	1,902	390	381	300	10 [e]	
CDA II-3	Submersible	CS	2,000	2,021	390	383	300	10 [e]	
CDA II-4	Submersible	VFD	2,000	1,963	401	384	300	10 [e]	
CDA II-6	Submersible	VFD	2,000	1,923	NA	410	300	10 [e]	
CDA II-7	Submersible	VFD	1,500	1,419	NA	395	250	10 [e]	
CDA II-8	Submersible	CS	1,500	1,518	NA	359	200	10 [e]	
CDA II-9A	Submersible	CS	2,000	1,775	NA	412	300	10 [e]	

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. Current capacity and TDH are the most recent (2008 or 2009) results of Southern California Edison performance tests from "Chino Desalter Well Field Info" spreadsheet (received from Tom O'Neil 11/13/09).

d. 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.

e. Pump column pipe diameter per construction drawings.

2.3.1 Models

One of the design objectives of the Chino Phase 3 project is to help Watermaster achieve 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 GEOSCIENCE Groundwater Model

Under contract to the CDA, GEOSCIENCE presented groundwater modeling results for three different operating scenarios (GEOSCIENCE, 2008). Pumping rates modeled by GEOSCIENCE were based on well production volumes selected after thorough discussion with CDA personnel. The three scenarios are:

- Scenario 1 (Baseline): This scenario models Chino I producing at less than nameplate capacity and Chino II producing at approximately 20 percent greater than RO/IX nameplate capacity by using the raw water bypass.
- Scenario 2: This scenario models Chino I at nameplate capacity with 5,200 AF/yr from the proposed CCWFA; production from the existing Chino I wells is reduced by a corresponding amount. Chino II production is the same as in Scenario 1.
- Scenario 3: This scenario models Scenario 2 production plus pumping 12,048 AF/yr from five new Chino II wells to supply the Phase 3 Chino II Desalter expansion.

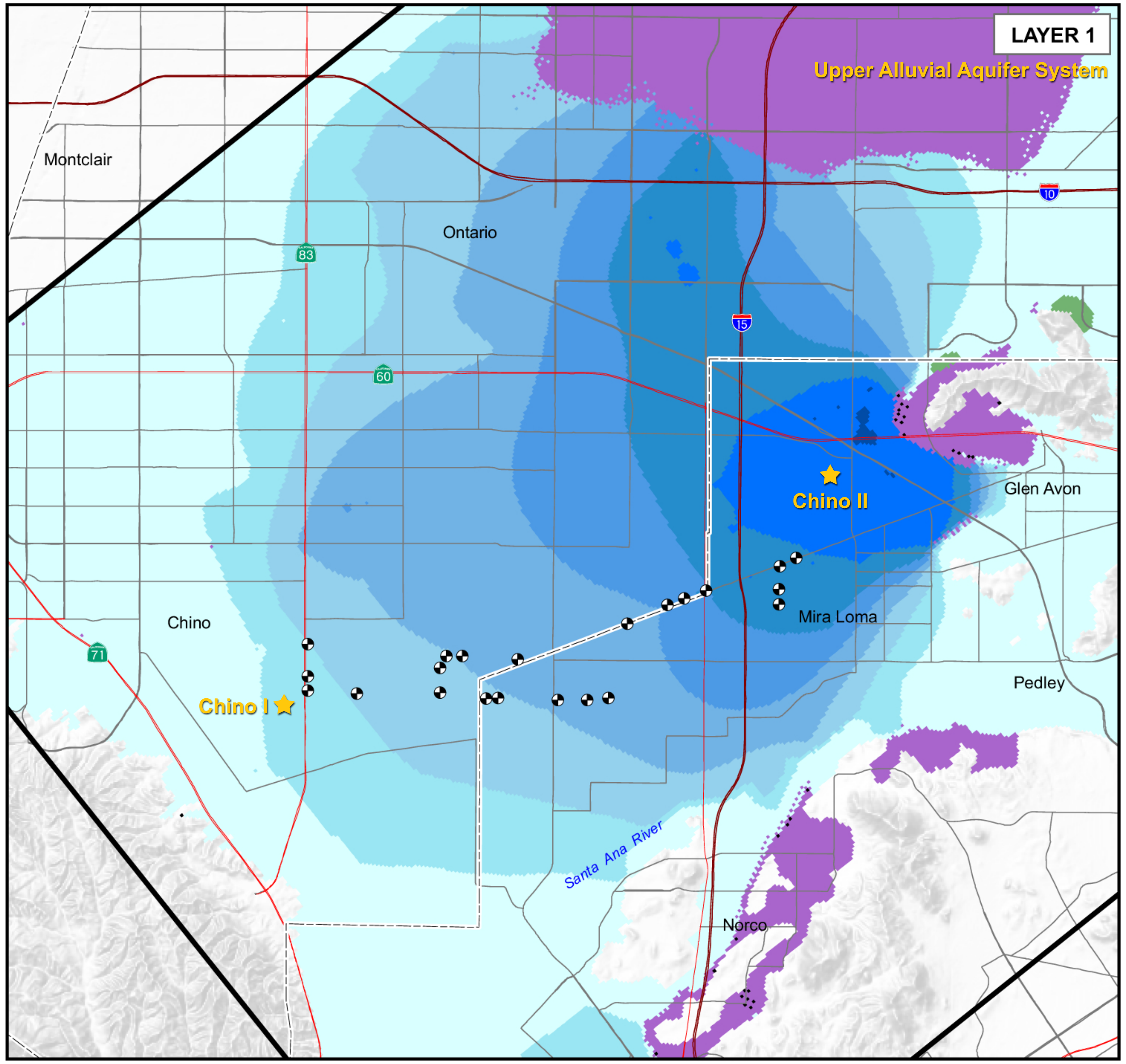
The Scenario 1, 2, and 3 model results are presented graphically in Figures 2.2 through 2.4, respectively, which show the predicted change in groundwater level in feet of additional drawdown between 2005 and 2017 for both Layer 1 (upper aquifer) and Layer 2 (lower aquifer). Figure 2.2 (Scenario 1) shows 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 Watermaster's intended objective in order to promote hydraulic control. Figure 2.4 (Scenario 3) shows the superposition of Scenario 2 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.

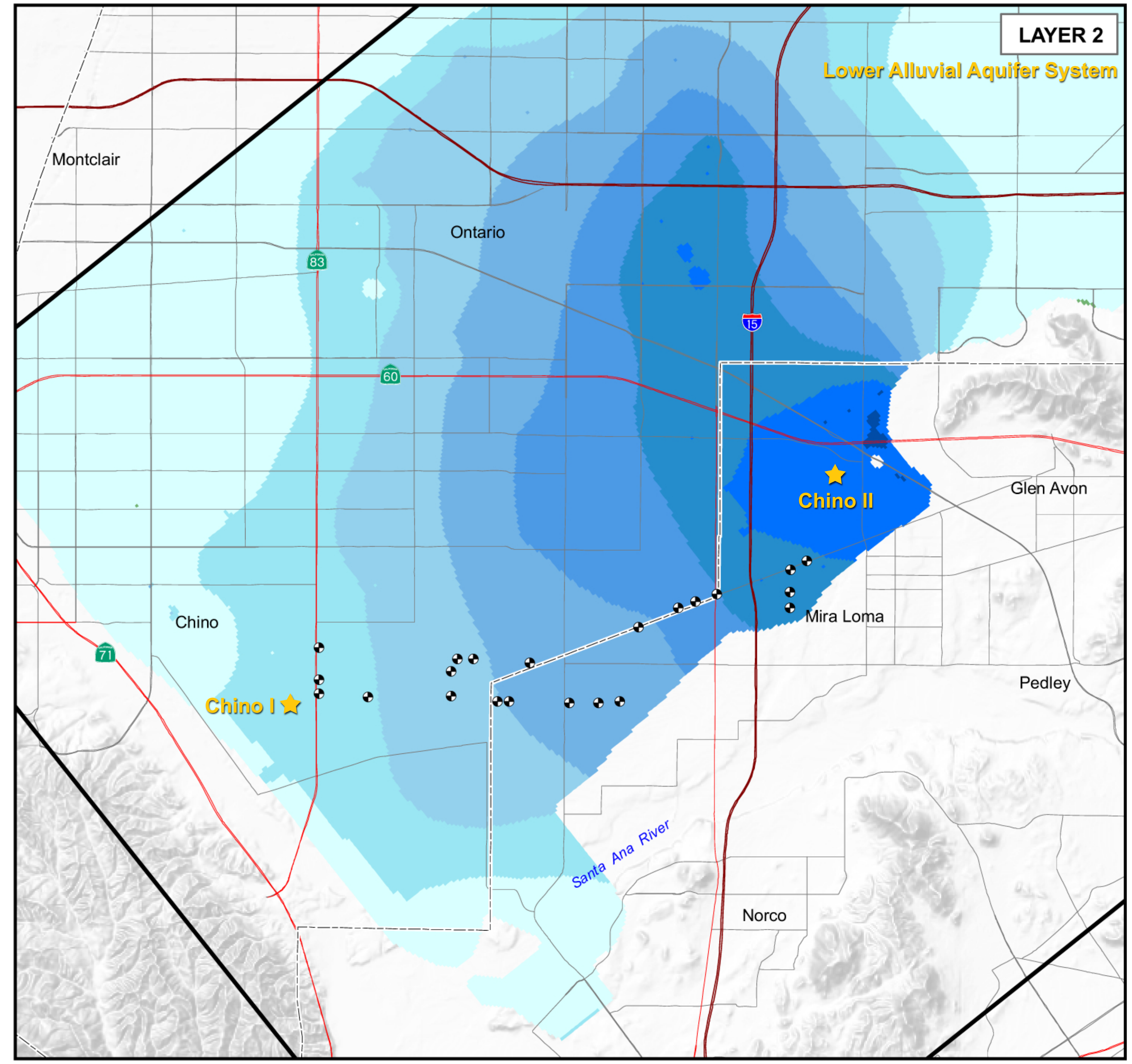
The following conclusions are based on review of the GEOSCIENCE modeling and reported results (GEOSCIENCE, 2008):

- 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.

CHINO BASIN DESALTER AUTHORITY

CHINO DESALTER GROUND WATER FLOW MODEL UPDATE





Scenario 1: Baseline

Existing Chino I Wells = 14,073 AF/YR

Existing Chino II Wells = 14,590 AF/YR

Total Chino Desalter Wells = 28,663 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

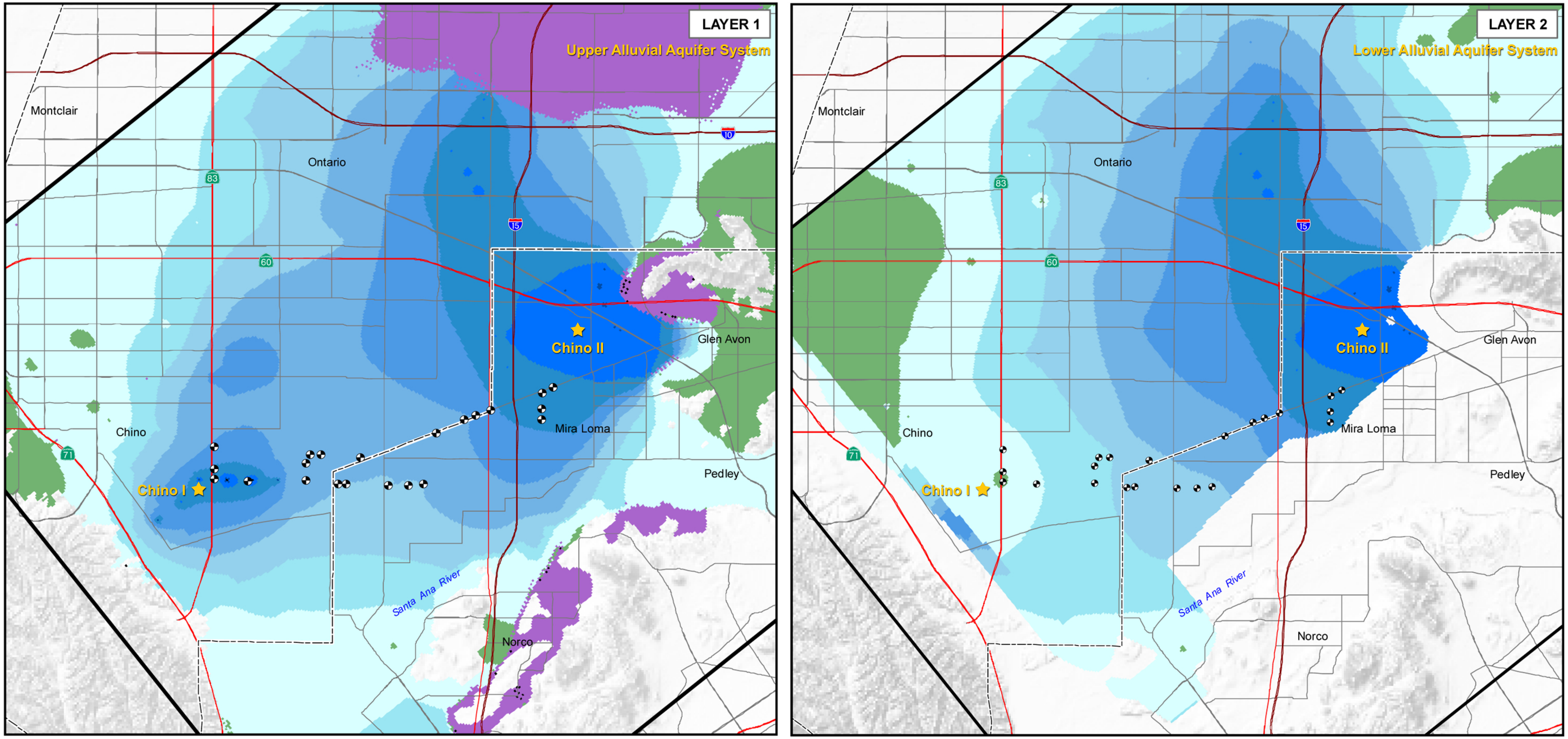
Prepared by: DWB

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
(NOV 2009 REVISED SCENARIOS)



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

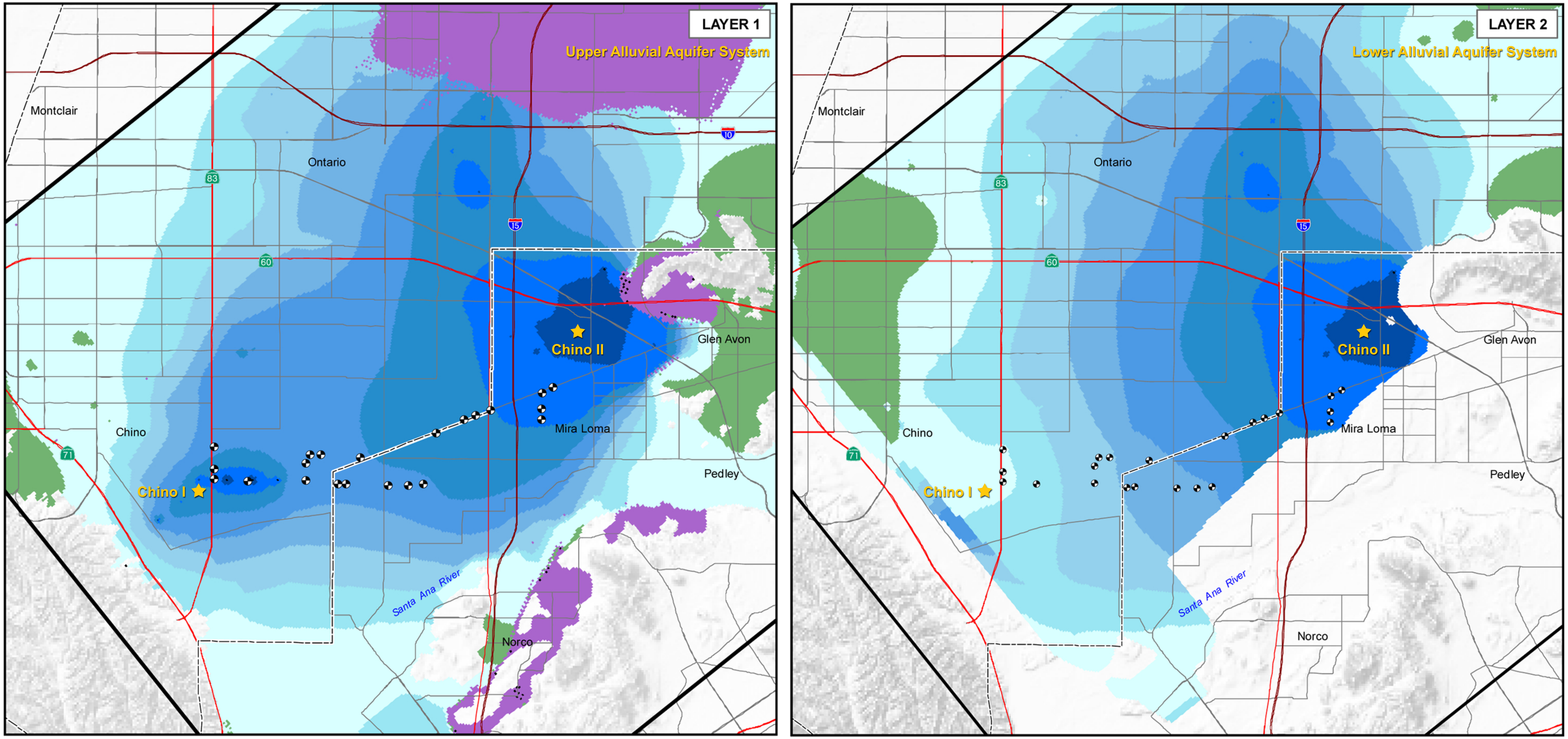
Source: GEOSCIENCE Dec 2009 Update

3-Dec-09

Prepared by: DWB

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

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



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: GEOSCIENCE Dec 2009 Update

3-Dec-09

Prepared by: DWB

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

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

- In order to promote Watermaster's objective of hydraulic control the CCWF wells will have to draw 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.

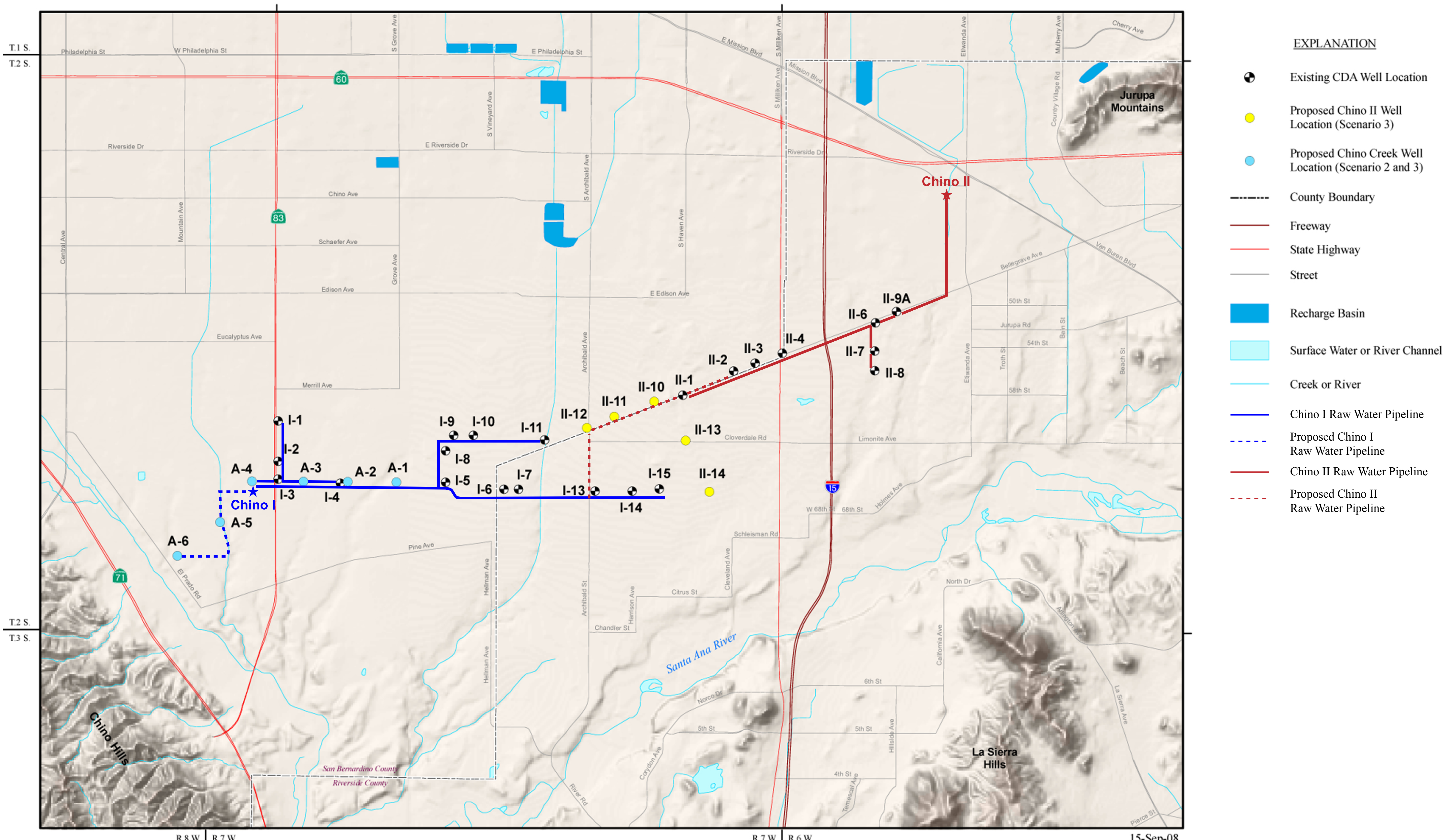
The GEOSCIENCE model (Scenario 3) assumes that additional Chino Desalter Wellfield Expansion will require new wells constructed midway between Chino I and Chino II Desalters. These wells have been designated CDA II–10, 11, 12, 13, and 14 because they would provide the raw water supply required for expansion 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. 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 indicates support of Watermaster's 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 actual capacity of the well field, where the individual well capacities are current capacities represented by the most recent (2008 or 2009) results of Southern California Edison (SCE) performance tests (see Appendix B.1 for complete SCE performance test data).

Table 2.2 summarizes the individual well production modeled by Wildermuth and GEOSCIENCE, along with the current capacity of the wells, both existing and proposed. The Wildermuth model shows that the average well field operation factor is 70 percent; in other words, 30 percent of the wellfield's current 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 60 percent; that is, nearly 40 percent of the wellfield current capacity is unused.



Prepared by: DWB

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

NORTH

0 1 2 Miles

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)				Geoscience Model (Scenario 3)			
		Modeled Rates		Current Capacity	Operating Factor	Modeled Rates		Current Capacity	Operating Factor
		(AF/yr)	(gpm)	(gpm)	(% Used)	(AF/yr)	(gpm)	(gpm)	(% Used)
CDA I	1	586	363	407	89%	291	180	407	44%
CDA I	2	391	242	225	108%	109	67	225	30%
CDA I	3	586	363	670	54%	472	292	670	44%
CDA I	4	391	242	240	101%	253	157	240	65%
CDA I	5	977	606	1,241	49%	136	84	1,241	7%
CDA I	6	716	444	358	124%	357	221	358	62%
CDA I	7	977	606	226	268%	235	145	226	64%
CDA I	8	781	484	975	50%	164	102	975	10%
CDA I	9	977	606	1,149	53%	273	169	1,149	15%
CDA I	10	977	606	1,197	51%	593	368	1,197	31%
CDA I	11	1,302	807	818	99%	956	592	818	72%
CDA I	13	2,763	1,713	1,694	101%	1,422	881	1,694	52%
CDA I	14	2,512	1,557	2,522	62%	1,978	1,225	2,522	49%
CDA I	15	2,512	1,557	2,468	63%	1,136	704	2,468	29%
CDA II	1	1,847	1,145	2,062	56%	3,307	2,049	2,062	99%
CDA II	2	1,847	1,145	1,902	60%	3,080	1,908	1,902	100%
CDA II	3	1,847	1,145	2,021	57%	3,189	1,976	2,021	98%
CDA II	4	1,847	1,145	1,963	58%	3,008	1,863	1,963	95%
CDA II	6	2,463	1,527	1,923	79%	1,823	1,129	1,923	59%
CDA II	7	1,847	1,145	1,419	81%	107	66	1,419	5%
CDA II	8	1,847	1,145	1,518	75%	17	10	1,518	1%
CDA II	9a	1,847	1,145	1,775	65%	61	38	1,775	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**	**34,973**	**70%**		**26,484**	**45,193**	**59%**

	Wildermuth (AF/yr)	Wildermuth (mgd)	Geoscience (AF/yr)	Geoscience (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	

Blue indicates Chino I raw water supply.

Red indicates Chino II raw water supply.

"Current Capacity" from the most recent (2008 or 2009) results of SCE performance tests.

The planning and construction of the original Chino II well field and the Chino I well field expansion (referred to as the "Project" in the text below) was based upon a operation factor of 70 percent. For example, the decision to not construct Well CDA II-5 was based upon a recommendation from RBF that included the following explanation of the targeted operation factor, referred to as the "utilization rate" in this document.

> During the planning phase of the Project, it was projected that nine (9) wells would be necessary to deliver a total raw water flowrate of 8,200 gpm, with a target utilization rate for each well at 70%...the utilization rate was agreed to by the CDA and RBF Project Team, based upon sound engineering and operational experience with wellfields similar to the Chino II Desalter wellfield. The utilization rate indicates that in the course of one year, each well would be operational, on average, 70% of the time.

(Memorandum from RBF to Tom O'Neil, CDA Project Manager, October 29, 2004)

In selecting the well field strategy recommended in this PDR, it is our objective to maintain the same operation factor of 70 percent that was adopted by CDA in the original Chino II well field construction. Reducing the well field operation factor in the Phase 3 project would diminish the reliability of the desalter raw water system; on the other hand, increasing the well field operation factor would result in betterment of the system at the sole cost of the Sponsors.

The essential objective is that the operating factor for the entire CDA well field is not greater than 70 percent. In addition, it would be desirable that the new CCWF wells are equipped to provide a 70 percent operating factor for each of the individual wells; however, this may not be a reasonable approach if a 70 percent operating factor requires the drilling of additional CCWF wells. The individual pumping equipment capacities of the new CCWF wells will be determined after drilling and testing is completed.

We recommend constructing the CCWF with capacity as proposed in the Wildermuth model and allowing wells CDA I-13, 14, and 15 to pump to the Chino II raw water system. The model of these capacities demonstrates support of Watermaster's hydraulic control objective and will maintain a 70 percent well field operation factor for the current well capacities based upon the most recent SCE flow measurement. The Sponsors will pay the costs of these improvements. If well capacities decline in the future then additional wells (e.g., CDA II-10, 11 and 12) can be constructed by the CDA to maintain the target 70 percent well field operation factor, if necessary.

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.
- 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, none of the twenty-two existing Chino Desalter wells have pumping levels below the top of the first screen interval and none of the wells are operating within ten feet of the pump setting:

The GEOSCIENCE Scenario 1 model predicts 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 ten of the twenty-two existing wells will have pumping levels below the top of the first screened interval. When the same baseline condition model is projected to the year 2017, the following three wells have pumping levels within 10 feet of the pump setting:

- Well CDA I-14
- Well CDA II-4
- Well CDA II-9A

The GEOSCIENCE Scenario 3 model data predict that, with the exception of one well, the Phase 3 expansion will result in additional drawdown at the other existing Chino Desalter Wells of less than 20 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.

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

Well No.	Current Pump Setting (ft BGS)	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)			
		Projected Pumping Level in Well (ft BGS)	Water Depth Above Pump (ft)	Dewatered Screen Length (ft)	Dewatered Screen Percent (%)	Projected Pumping Level in Well (ft BGS)	Water Depth Above Pump (ft)	Dewatered Screen Length (ft)	Dewatered Screen Percent (%)		Projected Pumping Level in Well (ft BGS)	Water Depth Above Pump (ft)	Dewatered Screen Length (ft)	Dewatered Screen Percent (%)		Projected Pumping Level in Well (ft BGS)	Water Depth Above Pump (ft)	Dewatered Screen Length (ft)	Dewatered Screen Percent (%)
CDA I-1	260	149	111	0	0	163	97	0	0	-14	156	147	0	0	7	141	119	0	0
CDA I-2	340	138	202	0	0	148	192	0	0	-10	140	240	0	0	8	125	215	0	0
CDA I-3	285	123	162	0	0	135	150	0	0	-12	121	182	0	0	14	125	160	0	0
CDA I-4	290	122	168	0	0	143	147	0	0	-21	192	146	0	0	-49	121	169	0	0
CDA I-5	255	105	150	0	0	132	123	0	0	-27	150	120	0	0	-18	124	131	0	0
CDA I-6	170	115	55	0	0	144	26	0	0	-29	158	36	0	0	-14	125	45	0	0
CDA I-7	175	110	65	0	0	139	36	0	0	-29	153	42	0	0	-14	125	50	0	0
CDA I-8	285	114	171	0	0	142	143	0	0	-28	160	141	0	0	-18	132	153	0	0
CDA I-9	185	113	72	0	0	142	43	0	0	-29	159	33	0	0	-17	138	47	0	0
CDA I-10	175	116	59	0	0	145	30	0	0	-29	161	22	0	0	-16	143	32	0	0
CDA I-11	275	127	148	0	0	160	115	0	0	-33	174	123	0	0	-14	141	134	0	0
CDA I-13	190	119	71	0	0	149	41	0	0	-30	163	55	0	0	-14	124	66	0	0
CDA I-14	140	102	38	0	0	134	6	**25**	**7**	-32	147	2	**38**	**11**	-13	122	18	**22**	**6**
CDA I-15	150	100	50	0	0	133	17	**28**	**14**	-33	146	8	**42**	**21**	-13	126	24	**26**	**13**
CDA II-1	298	131	167	0	0	164	134	**2**	**1**	-33	178	126	**17**	**8**	-14	157	141	**2**	**1**
CDA II-2	325	137	188	0	0	175	150	**14**	**9**	-38	186	144	**25**	**16**	-11	170	155	**14**	**9**
CDA II-3	335	138	197	0	0	182	153	**16**	**10**	-44	192	148	**27**	**16**	-10	173	162	**13**	**8**
CDA II-4	154	137	17	0	0	185	-31	**23**	**13**	-48	194	-35	**33**	**18**	-9	173	-19	**17**	**9**
CDA II-6	305	139	166	0	0	193	112	**38**	**26**	-54	201	110	**45**	**31**	-8	180	125	**30**	**21**
CDA II-7	255	120	135	0	0	176	79	**31**	**30**	-56	184	77	**38**	**36**	-8	164	91	**24**	**23**
CDA II-8	240	117	123	0	0	171	69	**35**	**35**	-54	179	67	**43**	**43**	-8	157	83	**27**	**27**
CDA II-9a	200	148	52	0	0	207	-7	**20**	**19**	-59	213	-7	**28**	**27**	-6	191	9	**11**	**11**
Total No. of Wells with:																			
Dewatered Pumps			0				3					4					2		
Dewatered Screens			0				10					10					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.

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). Comments from Chino Basin Watermaster regarding the May 2009 well field PDR are included in Appendix A.1. GEOSCIENCE issued a revised Well Field PDR ("Preliminary Design Report for the Chino Creek Well Field and Well Field Chino II Expansion, Chino Desalter Phase 3 Project" September 1, 2009), which is included for reference as Appendix A.4. A letter from the Watermaster, dated October 13, 2009, acknowledging that the September 2009 Well Field PDR revisions incorporate the Watermaster's previous comments is included in Appendix A.1.

In order to alleviate concerns about subsidence, project negotiations have determined that the CCWF wells will be screened only in the upper alluvial aquifer system (Layer 1). The aggregate raw water production of the six planned CCWF wells cannot be determined prior to well drilling and well development testing procedures at each site. However, the decision to screen solely in Layer 1 may create a potential situation that requires more than the PDR-defined and negotiated six CCWF wells in order to produce the 5,000 to 7,700 AF/yr CCWF groundwater withdrawal objective. In this event, the Sponsors will limit their financial contribution to six CCWF wells, as defined in the PDR, and other parties to the Peace II Agreement will be responsible for any additional wells required to achieve Watermaster's goal of hydraulic control or other OBMP objectives.

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 <u>Pump and Driver</u>

New wells will be equipped with vertical turbine line-shaft well pumps because of CDA preference based on experience with both line-shaft and submersible well pumps. For the purposes of cost estimates, it is assumed that 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. Pump motors will be suitable for operation with a variable frequency drive (VFD).

Selection of pump materials is important because of the potentially corrosive conditions. Each component should be composed of materials resistant to corrosion from the water being pumped. We recommend the use of 316L stainless steel for the pump column, bowls, and bowl housing. The line-shaft should be composed of 17-4 PH stainless steel. Bearings should be composed of Graphalloy® or babbitted carbon.

An open line-shaft is recommended with water lubrication of the bearings. In order to provide initial lubrication of the bearings before starting the well pump, we recommend installation of water pre-lubrication. A solenoid operated valve on a pipeline around the pump discharge check valve (from the raw water pipeline to the pre-lube system) will allow well startup except when the raw water pipeline is not pressurized (i.e., when the raw water system is completely shut down).

There are several options to allow the startup of wells after a complete raw water shutdown:

- <u>A pressurized hydropneumatic tank with sufficient volume to provide for pre-lube.</u> Several wells equipped with such tanks (or connections for a portable tank) would allow the flexibility to start up the raw water system from a complete shut down.
- <u>A connection from the local drinking water distribution system (with an approved backflow prevention device) to the pre-lube system.</u> The effect of the drinking water chlorine residual on the RO membranes could be mitigated by:
  - A small GAC filter on the pre-lube connection, or
  - An extended flush-to-waste startup period, or
  - Calculation and confirmation of adequate dilution of pre-lube chlorine in the total raw water flow.

Selection of the pre-lube options should be completed after further discussion during final design.

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.

Preliminary CCWF well sizing criteria indicate a maximum column pipe diameter of eight inches will be adequate for each of the wells. For an eight-inch flanged column pipe, the well casing should be a minimum of 18 inches in inside diameter, which is consistent with the layouts shown in the Well Field PDR (see Appendix A.4).

2.4.2.2 Wellhead Piping and Appurtenances

We recommend 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. Handling, protection, and installation of stainless steel require care that must be described in specifications prepared during the design phase. 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 without concrete thrust blocks, whenever possible, in order to minimize congestion.

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.

2.4.2.3 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. After wells are drilled, tested, and key water quality parameters are established it can be decided whether the steel tanks will have an epoxy coated tank lining or whether stainless steel construction is required. 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 (non-oil lubricated) 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.

2.4.2.4 <u>Electrical Equipment</u>

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. Exposed electrical panels should have sunscreen shades. 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. Air conditioning systems shall have filter differential pressure gauges.

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 Desalters do not include standby power for treatment or product water pumping. The addition of standby power to the desalters is not included within the Phase 3 expansion scope of work. Existing Chino I wells have standby power (engine generator sets). Chino II wells were designed to allow installation of standby power in the future.

We do not recommend installation of standby power at the new CCWF wells for the following reasons.

- The CCWF wells are in close proximity to Chino I (one of the wells is located on the Chino I site) and there is no standby power at Chino I. This close proximity increases the likelihood that a power outage affecting one of the CCWF wells will also affect Chino I and if there is no power available at Chino I to treat the CCWF well production there is no need to operate the CCWF wells because operation of the CCWF wells will require power at Chino I to provide treatment for removal of TDS.
- The CDA established a precedent for not installing standby power at Chino I wells by constructing the Chino I expansion wells (Wells I-13, 14, and 15) without standby power. In our view, it is unreasonable to hold the Sponsors to a higher (and more expensive) standard than the CDA established for itself.
- The Phase 3 desalter expansion options that are recommended in this report (see Section 8) include the interconnection of the Chino I and Chino II raw water systems. This will result in the ability to transfer water from Chino II wells to the Chino I raw water supply system. Although the Chino II wells do not have standby power, the raw water intertie will decrease the likelihood that a local power outage affecting the CCWF wells will also affect all the wells capable of supplying raw water to Chino I.

We recommend constructing the CCWF wells to the same standard as the Chino I expansion wells (Wells I-13, 14, and 15): without standby power (initially) but with a design that accommodates the future installation of standby power.

2.4.2.5 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 backpressure equivalent to the distribution system.
  - After a set period of time the pump-to-waste valve will begin to close; simultaneously, the discharge valve will begin to open.
  - The pump VFD speed will be controlled to maintain a pressure or flow set point (as selected by the Operator), 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

2.4.2.6 Site Work

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 or Portland cement concrete pavement over a structural base material. Pervious concrete pavement should also be considered in design. Concrete equipment pads, housekeeping pads, drainage gutters and curbs will be constructed as appropriate.

The perimeter wall will have a man-gate entrance/exit with a concrete drive approach and a separate vehicle gate (visual-barrier metal) The drive approach should allow a vehicle to pull out of traffic lanes prior to opening the gate. 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 photocells (fail to on).
- Intrusion switches on doors to electrical enclosures.
- Security motion detectors and cameras.