TDS/Nitrogen Management Plan for the Santa Ana River Basin Groundwater Monitoring Requirements

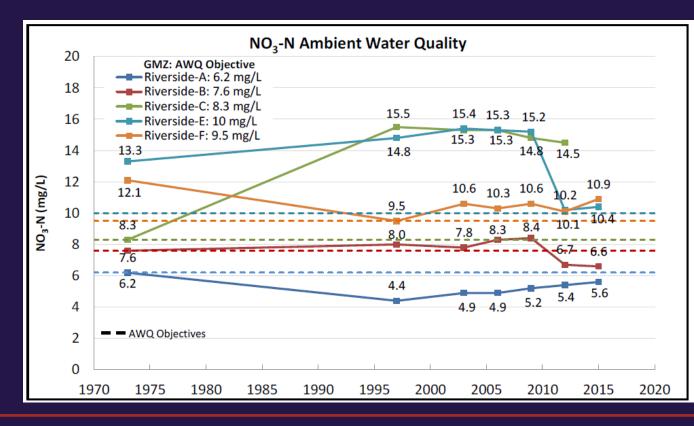
August 16, 2017



Objective

The Basin Plan requires the implementation of a watershed-wide monitoring program to:

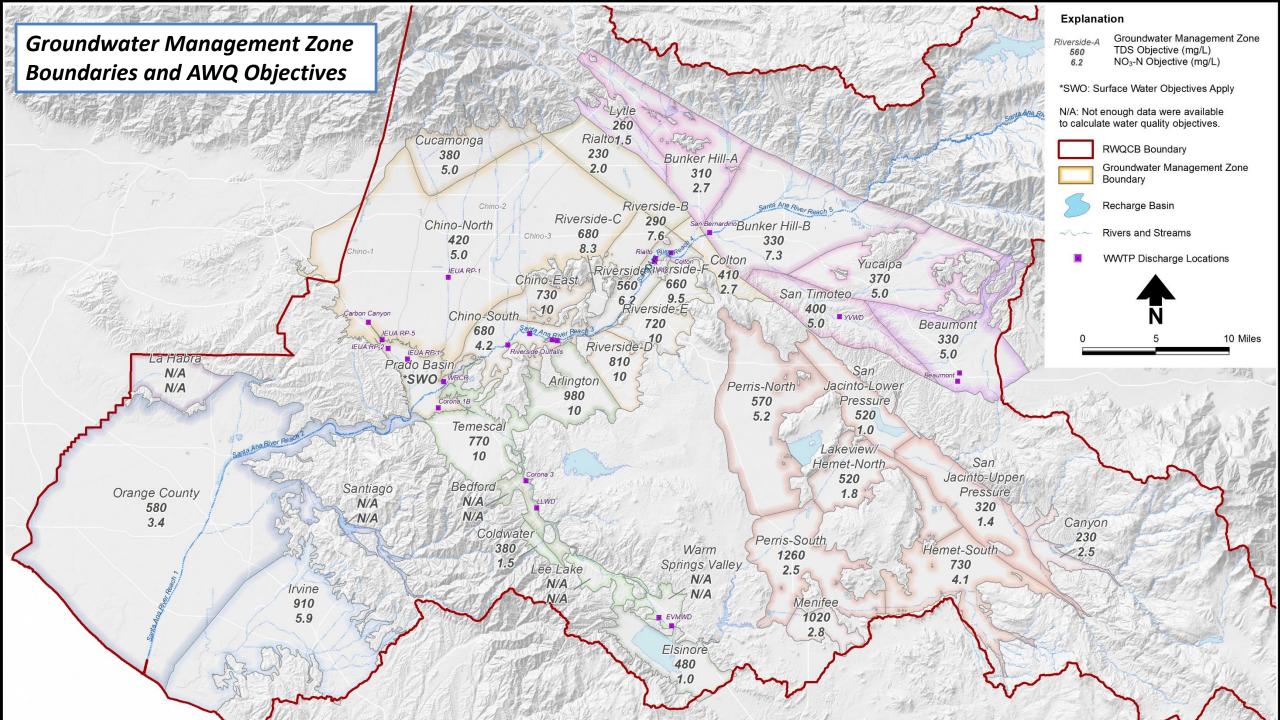
- determine ambient water quality in groundwater
- assess compliance with groundwater quality objectives, and
- determine if assimilative capacity exists in groundwater management zones.



Background

- In 1995, a Task Force was formed to study the impacts that salt and nitrate have on the long-term sustainability of groundwater supply. The Task Force including the Regional Board:
 - revised groundwater basin boundaries
 - set new water quality objectives based on a better data set
 - developed a rigorous scientific method for computing the volumeweighted ambient water quality

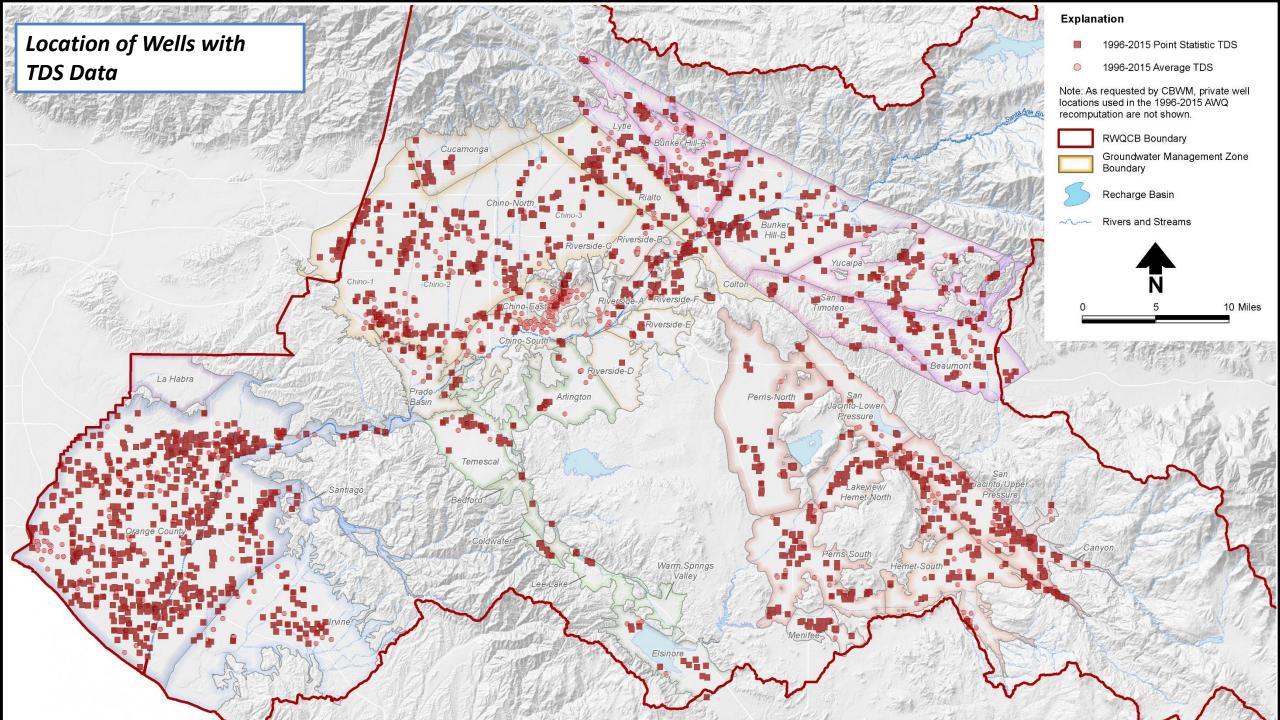


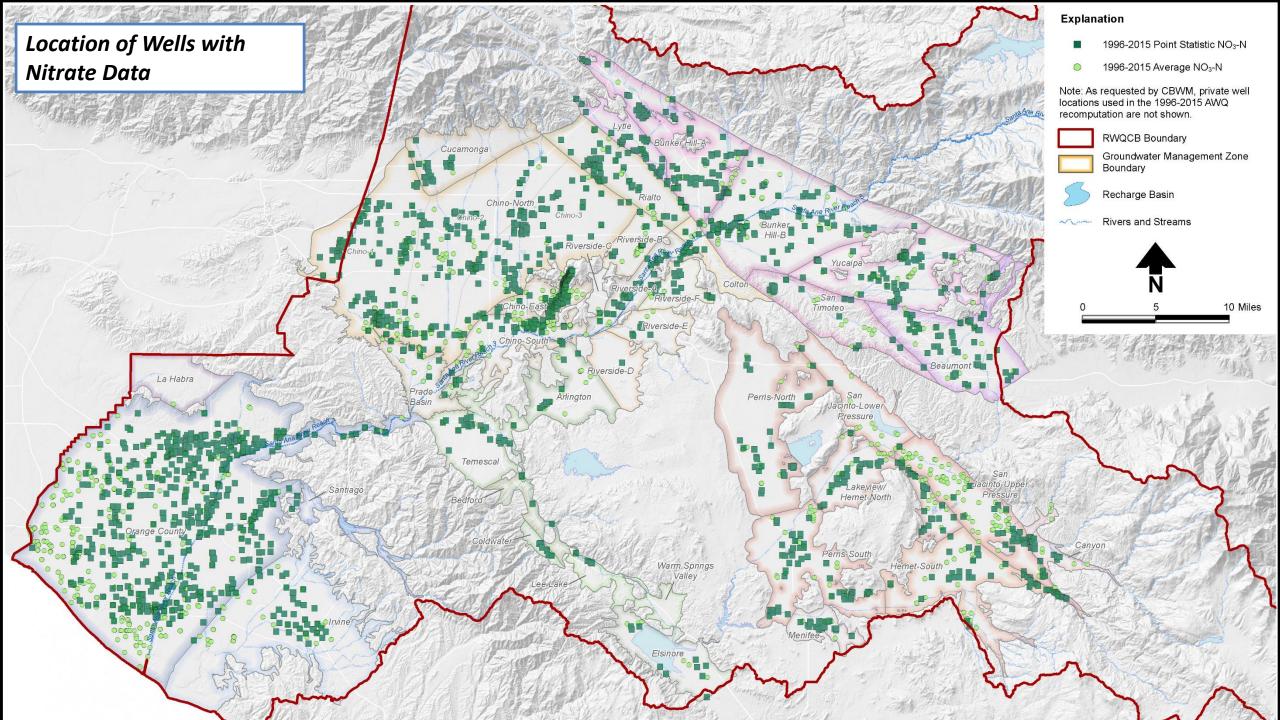


Current - 1996 to 2015 - Recomputation

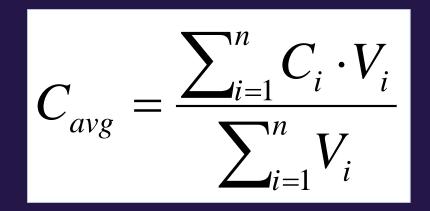
- Data compilation
- QA/QC, process, and upload recent historical data
- Calculate water quality point statistics
- Draw groundwater elevation and water quality contour maps
- Digitize contours and using geospatial tools, estimate volumeweighted ambient water quality in each groundwater management zone







Volume Weighted Estimate of AWQ



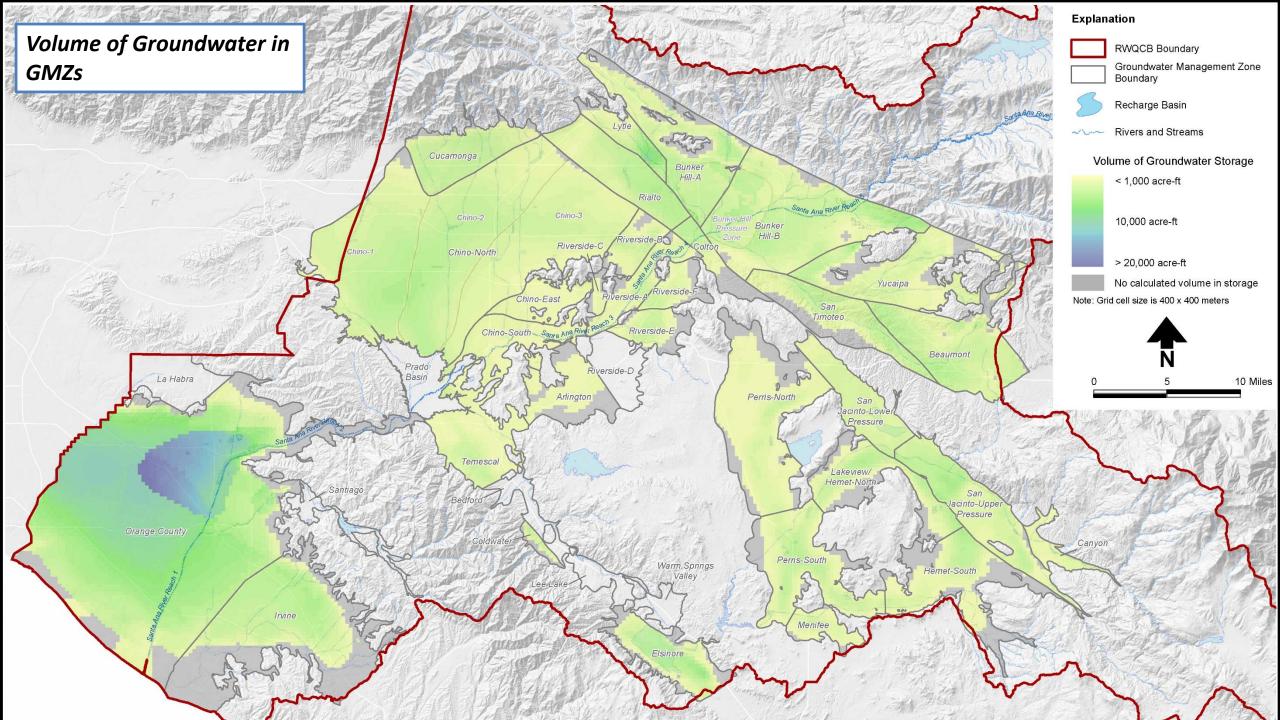
where C_{avg}

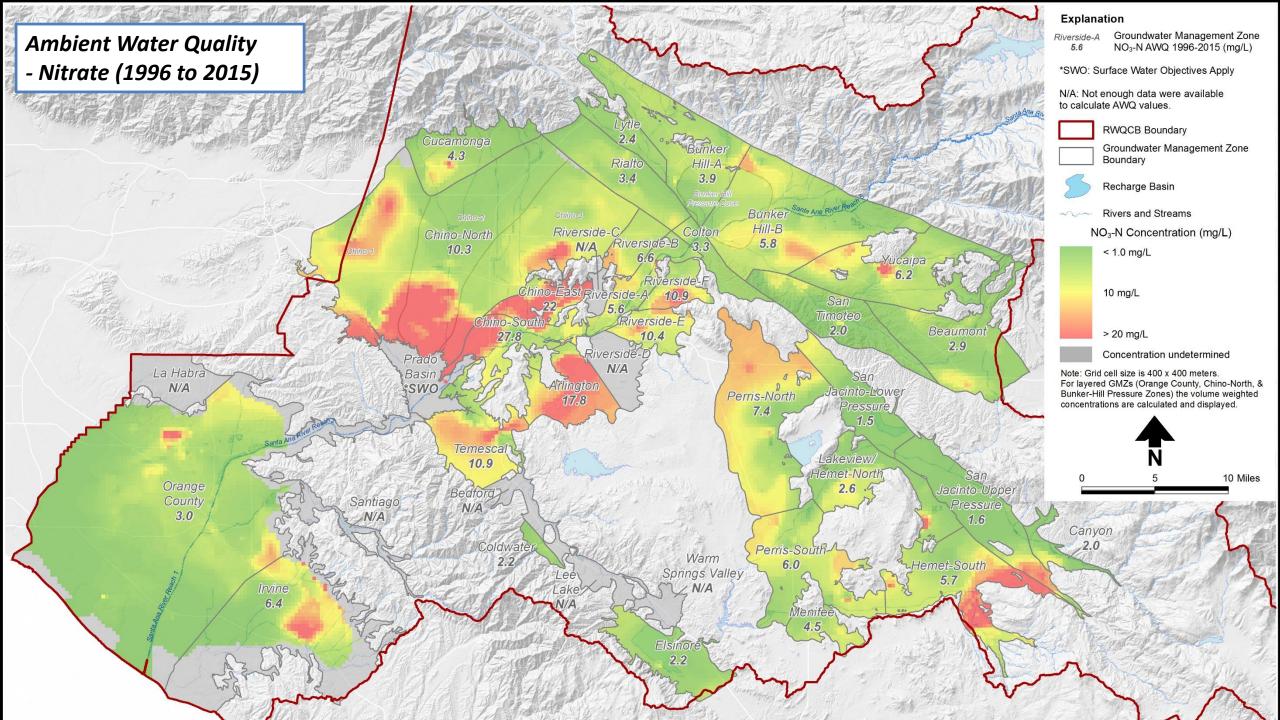
 C_i

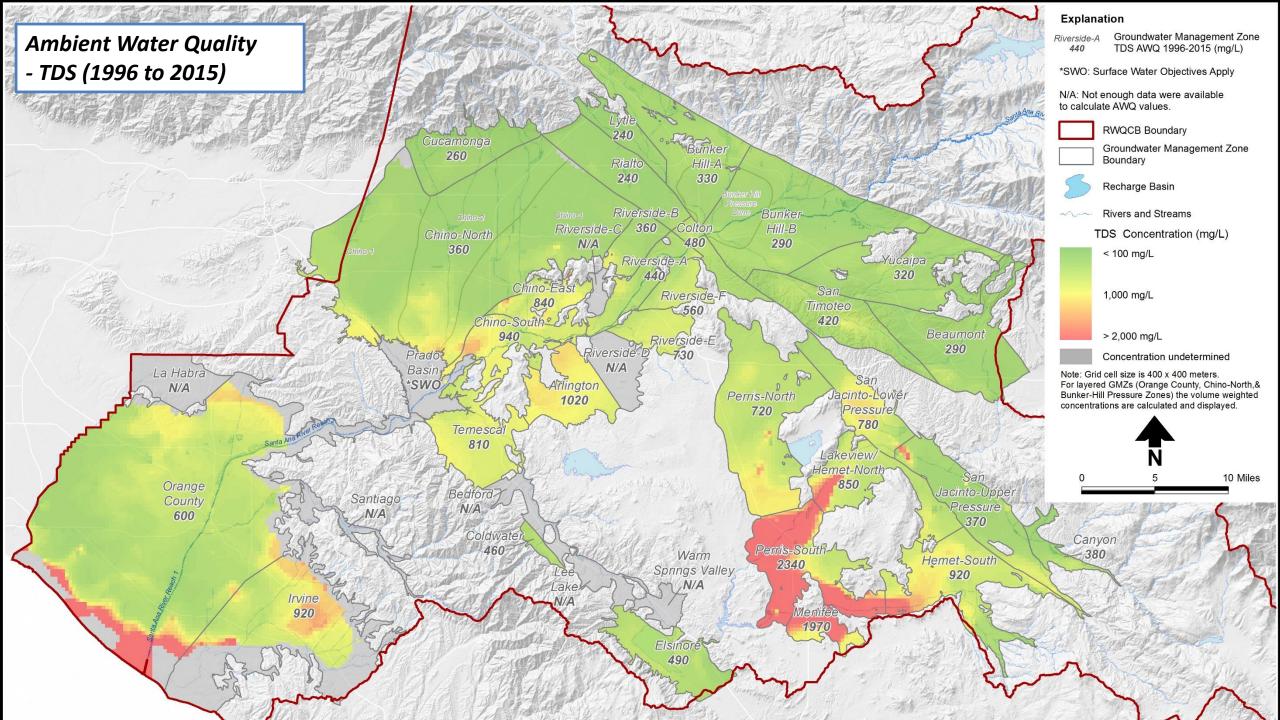
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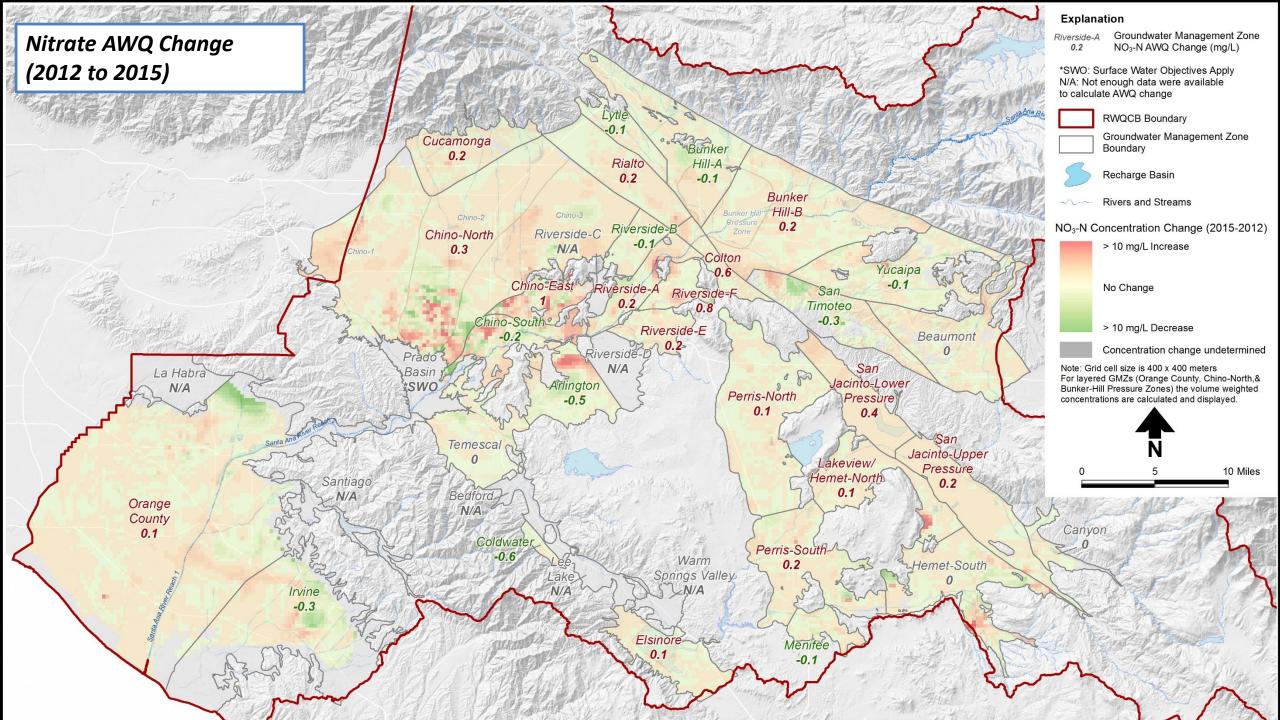
- = the volume-weighted current ambient concentration in a GMZ
- = the current ambient concentration of groundwater in the ith grid cell
- V_i = the volume of groundwater in the ith grid cell
 - = number of grid cells

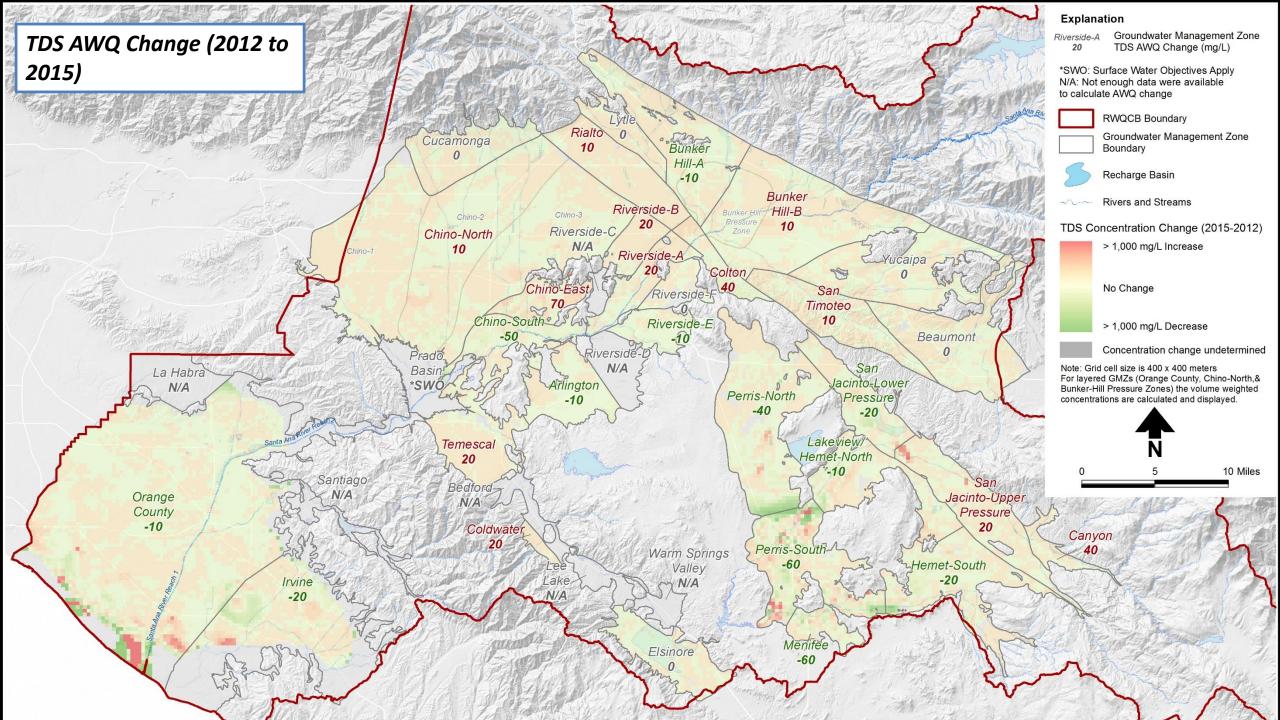


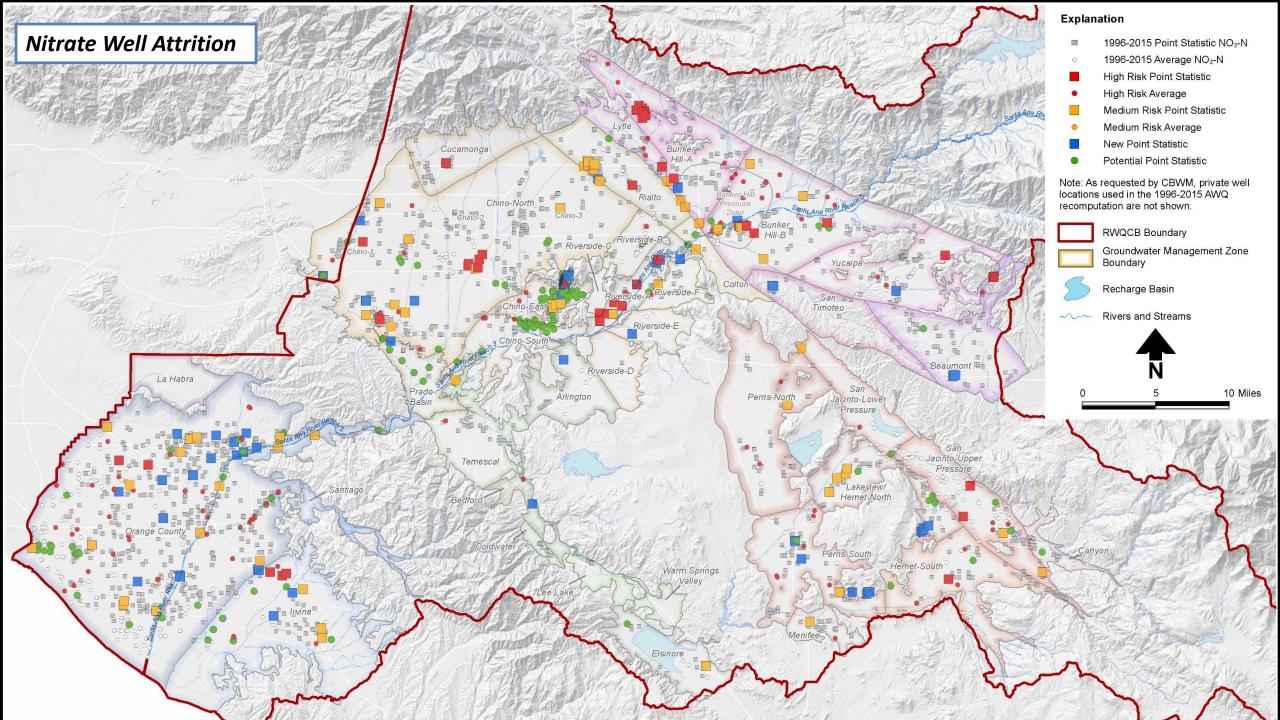


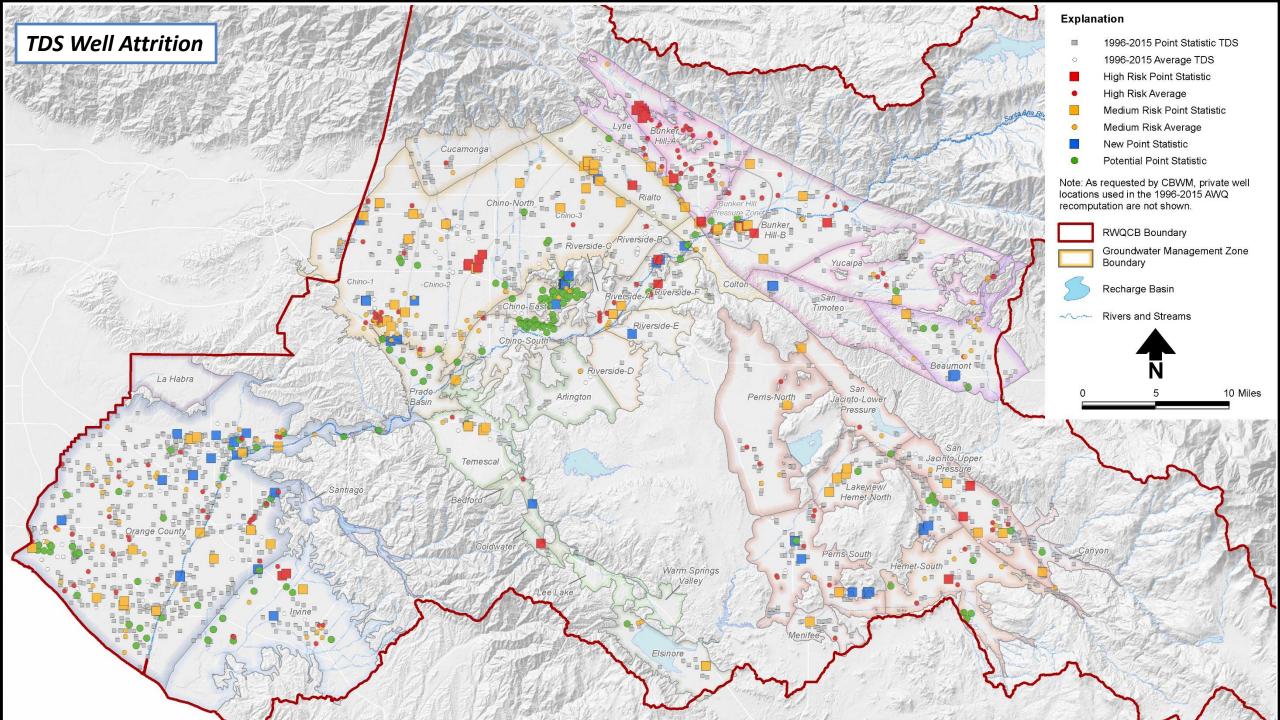












Interpretive Tools

- Atlas Style Map Package
 - Cover Page
 - Basin Analytics (area, volume, point statistics, mass)
 - AWQ Trend Charts
 - Key Interpretive Wells
 - Well Attrition
 - Well Addition

	nt Contents:				6347	Well ID	Wel Name	NO, N Imp/U	NC	Dy-N	TDS (mg/L		DS tod
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	N Concentration and Contour				Chine East	1209856	11.6	24.7		Trend	509		Trend
B6-3 TDS	Concentration and Contour Ma	ap .		The second second and the second s	Crino-East	1307150	CTP-TW1	25.9		ficied	997	Dece	varing
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	Concentration Change (2015-2	012)			Chaodouth		ICSE OC ISIN COURTY I			SIGNA .	.731		Trend
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	Basin Analytics	Chino-East	Chino-South		Chiko South	1207997	HOMP \$/2	2.2	No	ticed.	221		Trend
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				and the second se			ets for more details	See Attachy	rrent 35-4 a	erc 65-5	for NO ₂ -N	and TDS w	ell
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g 11	133	(ing		AWQ recomputation period (1999-2018).	Chine Bast	1208855	LC 48		2 0.0	1400		2 2	1.12
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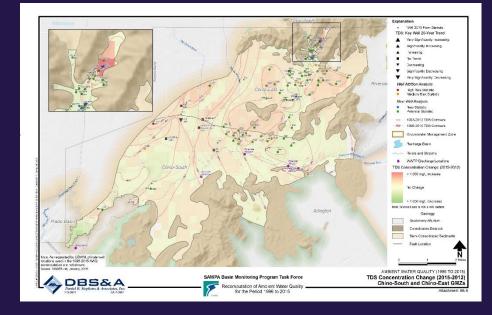


Interpretive Tools

- Atlas Style Map Package
 - Maps
 - Groundwater Elevation Contours Fall 2015
 - N03-N Concentration and Contour Map
 - TDS Concentration and Contour Map
 - NO3-N Concentration Change (2015-2012) Map
 - TDS Change Concentration (2015-2012) Map
 - Charts

Daniel B. Stephens & Associates, Inc.

• Key Well Analysis Charts

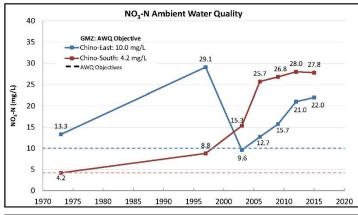


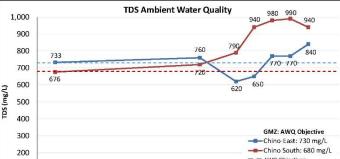
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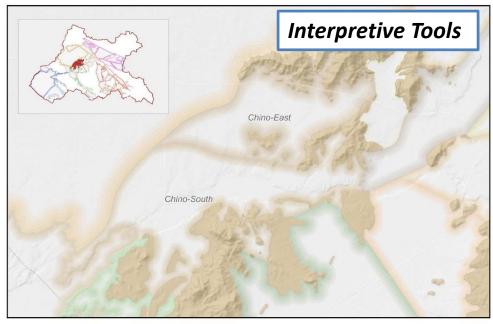
- **B6-1 Groundwater Storage and Elevation Contours Fall 2015**
- B6-2 NO₃-N Concentration and Contour Map
- **B6-3 TDS Concentration and Contour Map**
- B6-4 NO₃-N Concentration Change (2015-2012)
- B6-5 TDS Concentration Change (2015-2012)
- **B6-6 Key Well Analysis Charts**

	Basin Analytics	Chino-East	Chino-South
	GMZ Area (acres)	7,950	13,100
Basin	Volume of storage (acre-ft)	80,100	187,000
	Wells per GMZ	499	178
	Statistics per GMZ	271	51
NO ₃ -N	Total Mass (tons)	2,400	7,060
	1996-2015 AWQ	22	27.8
	Wells per GMZ	205	125
	Statistics per GMZ	29	25
TDS	Total Mass (tons)	91,500	239,000
	1996-2015 AWQ	840	940

Table 1 - Basin Analytics







Nitrate as Nitrogen (Nitrate or NO₃-N)

Chino South

The nitrate objective for Chino South is 4.2 mg/L. The ambient nitrate concentration decreased from 28.0 mg/L in 2012 to 27.8 mg/L in 2015, and there is no assimilative capacity. One out of the five key wells in Chino South GMZ have an increasing trend in nitrate concentrations, three key wells show a decreasing trend, and the other one shows no trend in the nitrate concentrations. Seven of the total 178 wells with nitrate values in Chino South will not be eligible for the next AWQ recomputation if the well is not sampled prior to 2018. No new wells with statistics were added to the 1996 to 2015 AWQ recomputation and nineteen wells that were sampled between 2014 and 2015 will be eligible to have statistics determined, if the wells are sampled again in the next AWQ recomputation period (1999-2018).

Chino East

The nitrate objective for Chino East is 10.0 mg/L. The ambient nitrate concentration increased from 21.0 mg/L in 2012 to 22.0 mg/ L in 2015, and there is no assimilative capacity. Two out of the five key wells in Chino East GMZ have a decreasing trend in nitrate concentrations, while the other three shows no trends in the nitrate concentrations. Thirteen of the total 499 wells with nitrate values in Chino East will not be eligible for the next AWQ recomputation if the well is not sampled prior to 2018. Forty-two new wells with statistics were added to the 1996 to 2015 AWQ recomputation and sixty-nine wells that were sampled between 2014 and 2015 will be eligible to have statistics determined, if the wells are sampled again in the next AWQ recomputation period (1999 -2018).

Total Dissolved Solids (TDS)

Chino South

The TDS objective for Chino South is 680 mg/L. The ambient TDS concentration decreased from 990 mg/L in 2012 to 940 mg/L in 2015, and there is no assimilative capacity. Two out of the five key interpretive wells in Chino South GMZ show a decreasing trend while the other three show no trends in TDS concentrations. Five of the total 125 wells with TDS values in Chino South will not be eligible for the next AWQ recomputation if not sampled prior to 2018. No new wells with statistics were added to the 1996 to 2015 AWQ recomputation, and nineteen wells that were sampled between 2014 and 2015 will be eligible to have statistics determined, if the wells are sampled again in the next AWQ recomputation period (1999-2018).

GMZ	Well ID	Well Name	NO₃-N (mg/L)	NO₃-N Trend	TDS (mg/L)	TDS Trend
Chino-East	1003583	03A	21.5	No Trend		
Chino-East	1206966	II-6	24.7	No Trend	609	No Trend
Chino-East	1207150	CTP-TW1	25.9	No Trend	977	Decreasing
Chino-East	1207986	HCMP-9/1	12.2	Decreasing	734	Decreasing
Chino-East	1207998	HCMP-9/2	0.2	Decreasing	178	No Trend
Chino-South	1003624	JCSD 01 (Sky Country #1)	10.0	Increasing	731	No Trend
Chino-South	1003663	9	1.5	Decreasing	601	No Trend
Chino-South	1206968	II-8	15.7	Decreasing*	800	Decreasing*
Chino-South	1207985	HCMP-8/1	61.9	Decreasing	1,354	Decreasing
Chino-South	1207997	HCMP-8/2	3.3	No Trend	225	No Trend

Table 2 - Key Interpretive Wells

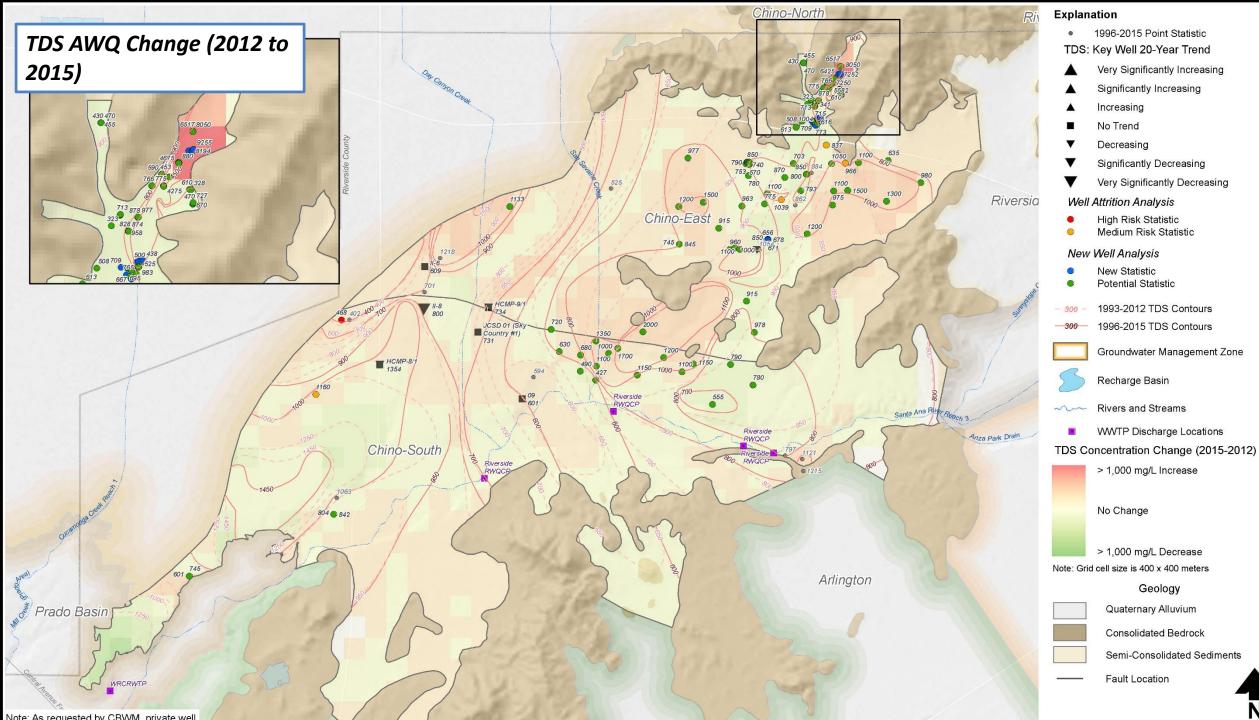
Mann-Kendall trend analyses on the annualized average concentrations for wells that have been identified as key interpretive wells was used to determine the significance of the trends in well concentrations. See Key Well Analysis Charts for more details. See Attachment B6-4 and B6-5 for NO₃-N and TDS well locations, respectively.

	Well Info	ormation	NO ₃ -N Well Attrition				TDS Well Attrition			
GMZ	Well ID	Well Name	Risk	Years1	Value ²	Method	Risk	Years1	Value ²	Method
Chino-East	1003513	JCSD 05	High	1	8.8	Ave				
Chino-East	1003582	03	High	2	20.6	Ave				
Chino-East	1207144	AGA4875	High	1	4.4	Ave				
Chino-East	1207145	AGA4915	High	2	5.0	Ave				
Chino-East	1207146	AGA4930	Medium	3	5.9	Stat				
Chino-East	1207147	AGA5040	High	2	7.0	Ave				
Chino-East	1207181	FC-249A3	Medium	2	8.6	Ave	Medium	2	966	Ave
Chino-East	1207202	FC-5A3	Medium	1	5.7	Ave	Medium	1	837	Ave
Chino-East	1207241	LEM-4A	Medium	1	5.2	Ave				
Chino-East	1207264	PED5029	High	3	9.3	Stat				
Chino-East	1207265	PED5071	Medium	2	9.4	Ave				
Chino-East	1207266	PYR3851	Medium	2	2.2	Ave	100			
Chino-East	1207270	PYR4352	Medium	1	0.0	Ave				
Chino-East	1207272	STN4800	Medium	3	5.8	Stat				
Chino-East	1207393	60TH8792	Medium	1	4.5	Ave				
Chino-East	1207407	PED4931	Medium	3	4.5	Stat				
Chino-East	1207408	PED5106	Medium	3	23.3	Stat				
Chino-East	1207409	PED5151	Medium	1	5.2	Ave				
Chino-East	1207410	PED5261	High	1	36.1	Ave				
Chino-East	1207411	PED5424	Medium	1	7.2	Ave				_
Chino-East	1207412	STN4992	Medium	1	5.2	Ave				
Chino-East	1208835	LC-4B	High	2	0.0	Ave				
Chino-East	1208836	OW-62D	High	1	4.8	Ave				
Chino-East	1208837	OW-63D	High	1	4.6	Ave				
Chino-East	1208877	FC-738A2		10	15.8	Stat	Medium	2	1,039	Ave
Chino-East	1208895	LE-109A	Medium	1	5.3	Ave				
Chino-East	1208902	OW-63A	Medium	2	5.9	Ave				
Chino-East	1208903	OW-64A	Medium	1	3.8	Ave				
Chino-East	1208904	OW-65A	Medium	2	4.1	Ave				
Chino-South	1003611	NOR 09	High	1	0.1	Ave	High	1	468	Ave
Chino-South	1003612	NOR 10	High	1	10.6	Ave				
Chino-South	1003630	07	High	2	12.1	Ave				
Chino-South	1202703	6OH	Medium	1	84.9	Ave	Medium	1	1,160	Ave
Chino-South	1207394	60TH9709	Medium	1	5.9	Ave				
chino-South	1207398	60TH9957	Medium	1	9.5	Ave				
Chino-South	1207399	60TH9989	Medium	1	8.1	Ave				
Chino-South	1207402	APP6111	Medium	1	3.2	Ave				

¹ number of years with samples ² final value used to contour well concentrations -- not applicable

Table 3 - Well Attrition Analysis

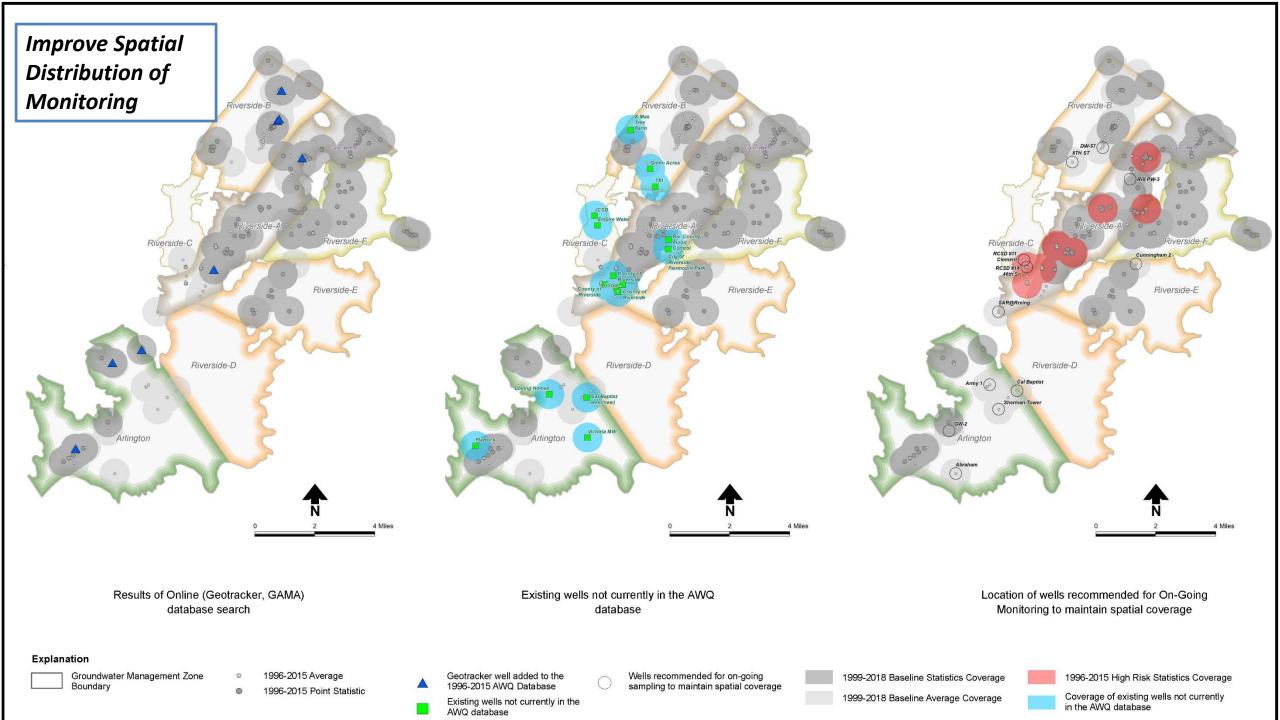
The well locations above have been identified as locations likely to be lost in future AWQ recomputation studies. High Risk wells will be lost during the 1999-2018 study period if not sampled before 2018. Medium Risk wells will be lost during the 2002-2021 study period if not sampled before 2021. See Attachment B6-4 and B6-5 for NO₃-N and TDS well locations, respectively. As requested by Chino Basin Water Master, private well locations used in the 1996-2015 AWQ recomputation are not shown.



Improve Spatial Distribution of Monitoring

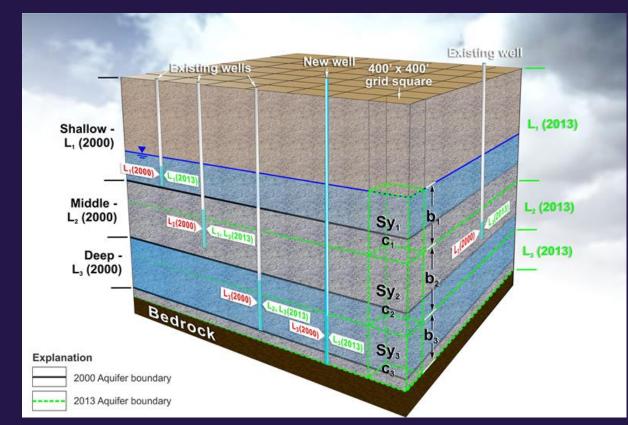
- Riverside A, Riverside B, and Arlington GMZ's
 - Included new data from online datasets (GeoTracker, GAMA, etc..)
 - Identified potential wells that were not previously listed in the AWQ database
 - Compiled a list of wells to be monitored based on key areas



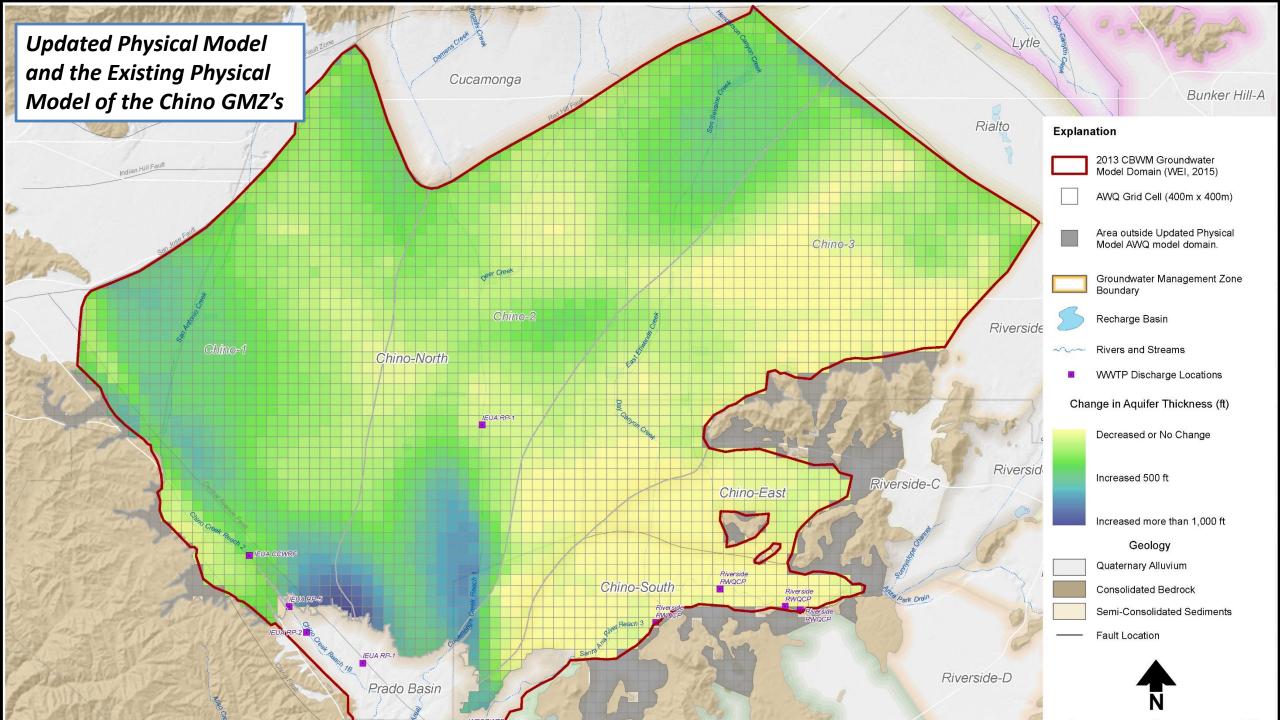


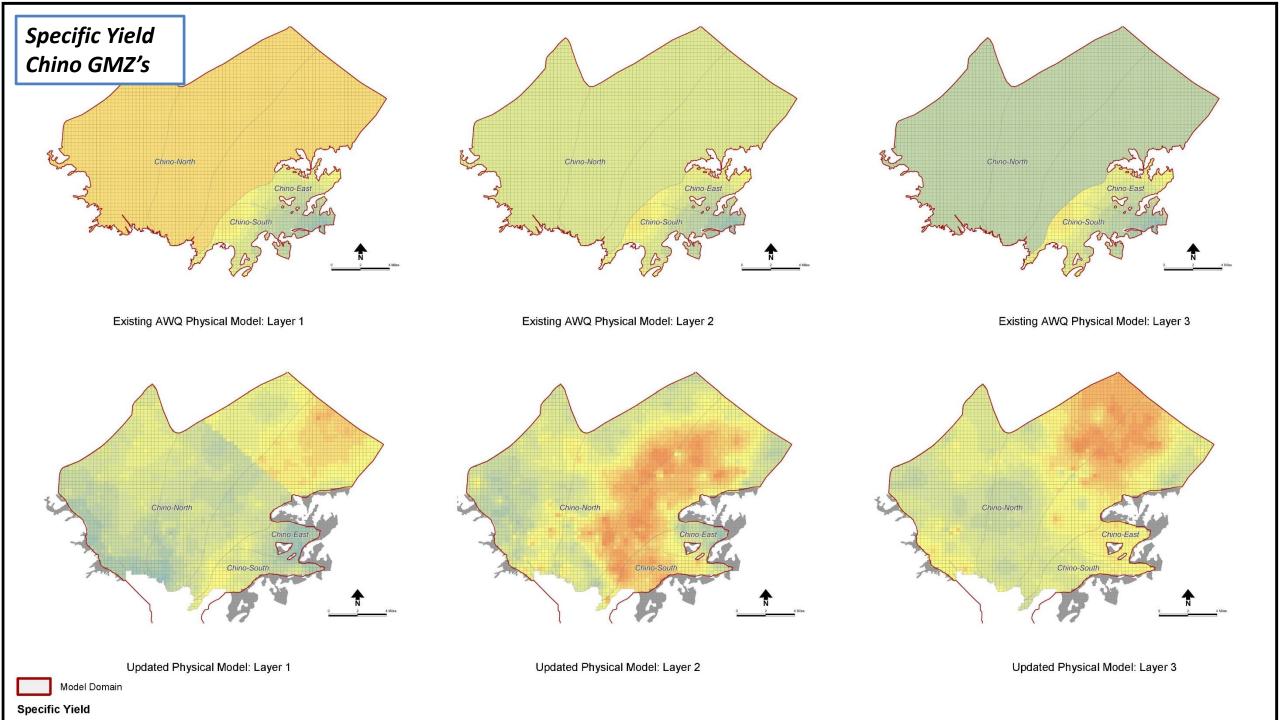
Update Physical Model of the GMZ's

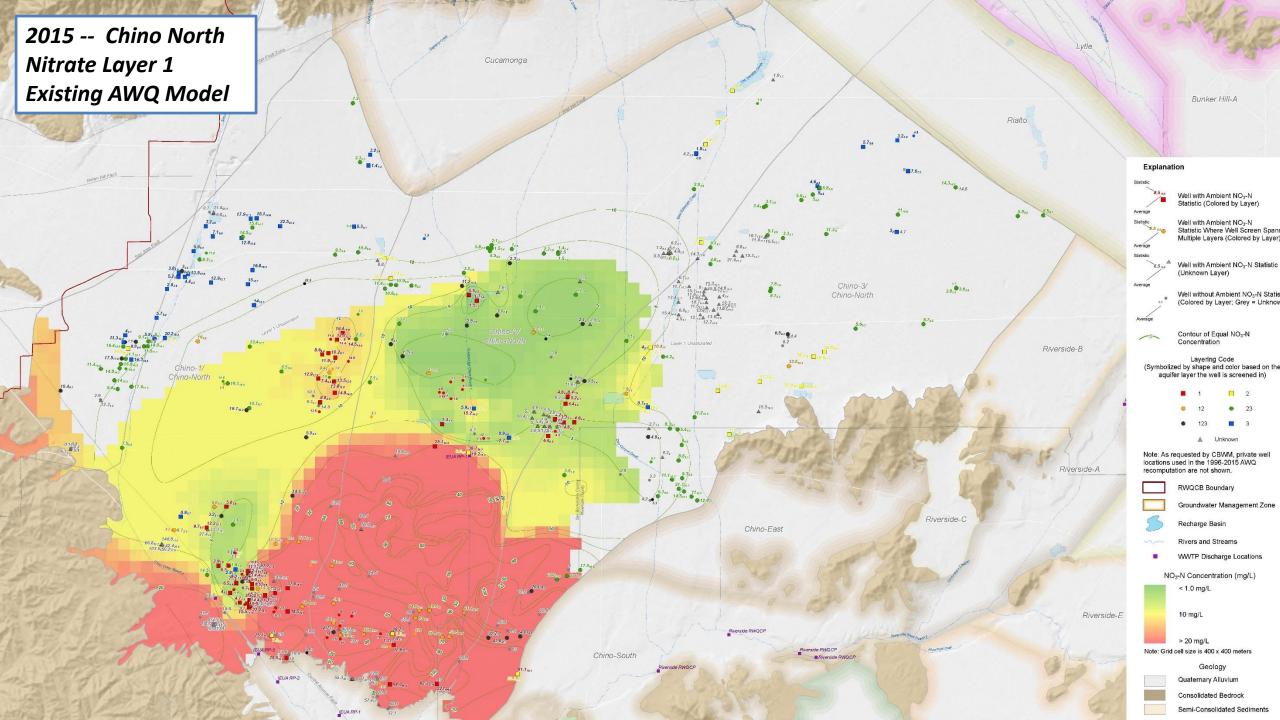
- Chino GMZ's Pilot Study (Task 1b)
 - Model Domain
 - Aquifer Thickness
 - Specific Yield
 - Layering

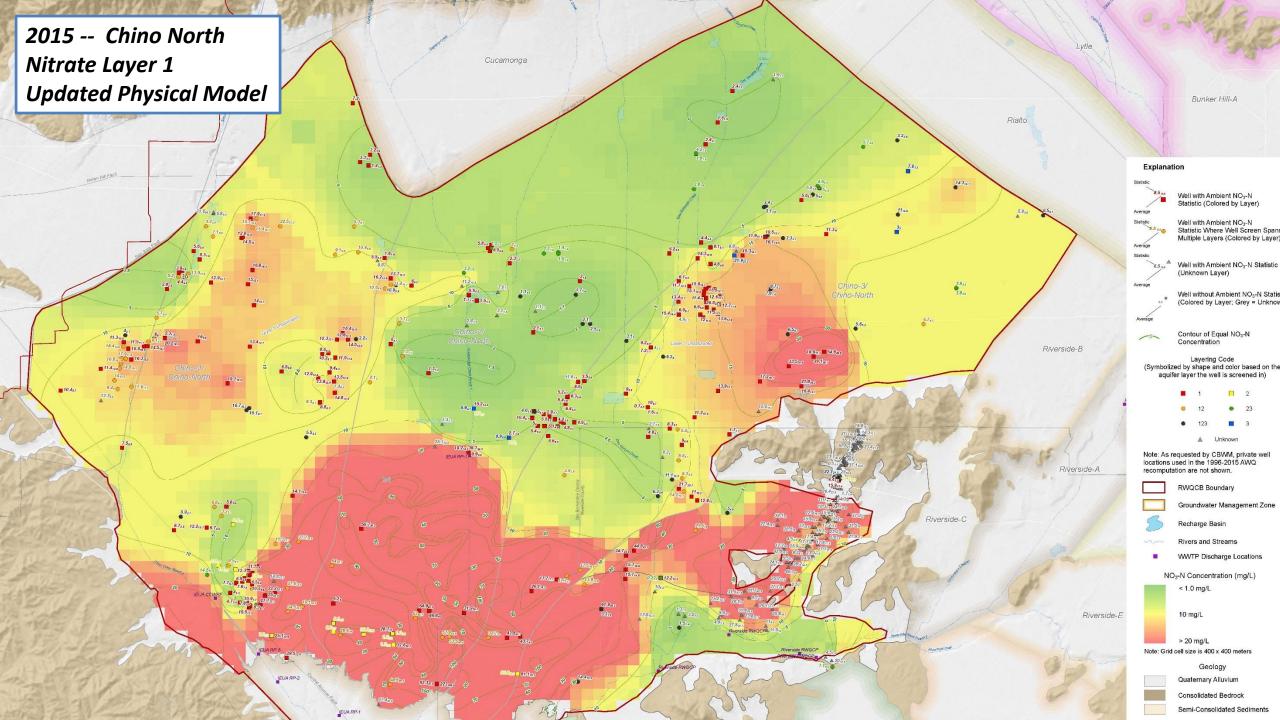








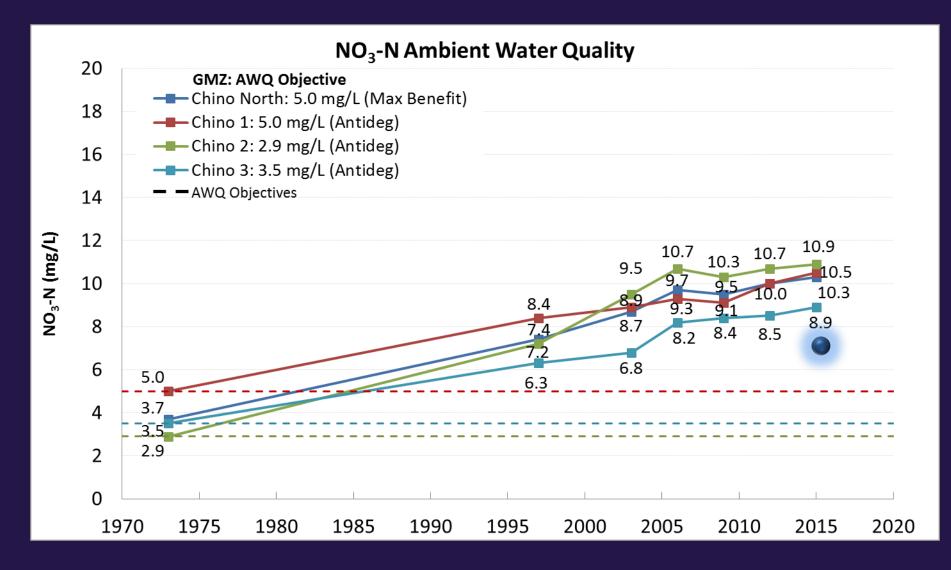




Results of the Chino MZ's Pilot Study (Task 1b)

Management Zone	Existing A	WQ Physi	cal Model	Update	d Physical	Model	Changes from Existing to Updated Physical Model			
	NO3-N	TDS	Volume	NO3-N TDS (mg/L) Volume		NO3-N	TDS (mg/L)	Volume		
	(mg/L)	(mg/L)	(acre-ft)	(mg/L)		(acre-ft)	(mg/L)		(acre-ft)	
Chino-1	10.5	350	2,100,000	8.4	300	3,130,000	2.1	50	1,030,000	
Chino-2	10.9	380	2,500,000	5.2	280	3,690,000	5.7	100	1,190,000	
Chino-3	8.9	320	1,270,000	8.1	310	2,320,000	0.8	10	1,050,000	
Chino-North	10.3	360	5,870,000	7.0	290	9,140,000	3.3	70	3,270,000	
Chino-South	27.8	940	190,000	34.7	970	160,000	-6.9	-30	-30,000	
Chino-East	22.0	840	80,000	22.7	830	60,000	-0.7	10	-20,000	

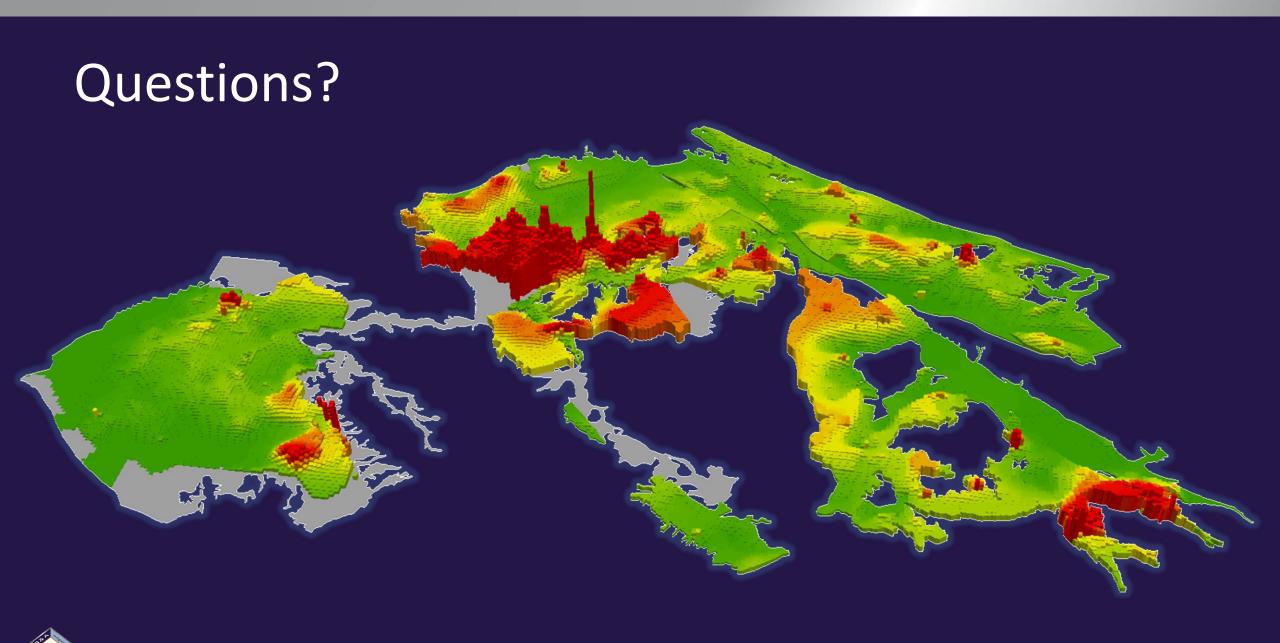




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Summary of Ambient Water Quality

- The ambient water quality recomputation is a powerful tool to assist the stakeholders in managing the water resources in the Santa Ana Watershed:
 - aids the Regional Board in identifying TDS and nitrate trends
 - the assessment of assimilative capacity is critical in permitting projects, such as groundwater replenishment reuse projects
 - assists the stakeholders in identifying areas of potential concern
 - supports Santa Ana River wasteload allocation and discharge permits
 - collaboration of stakeholders and Regional Board



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