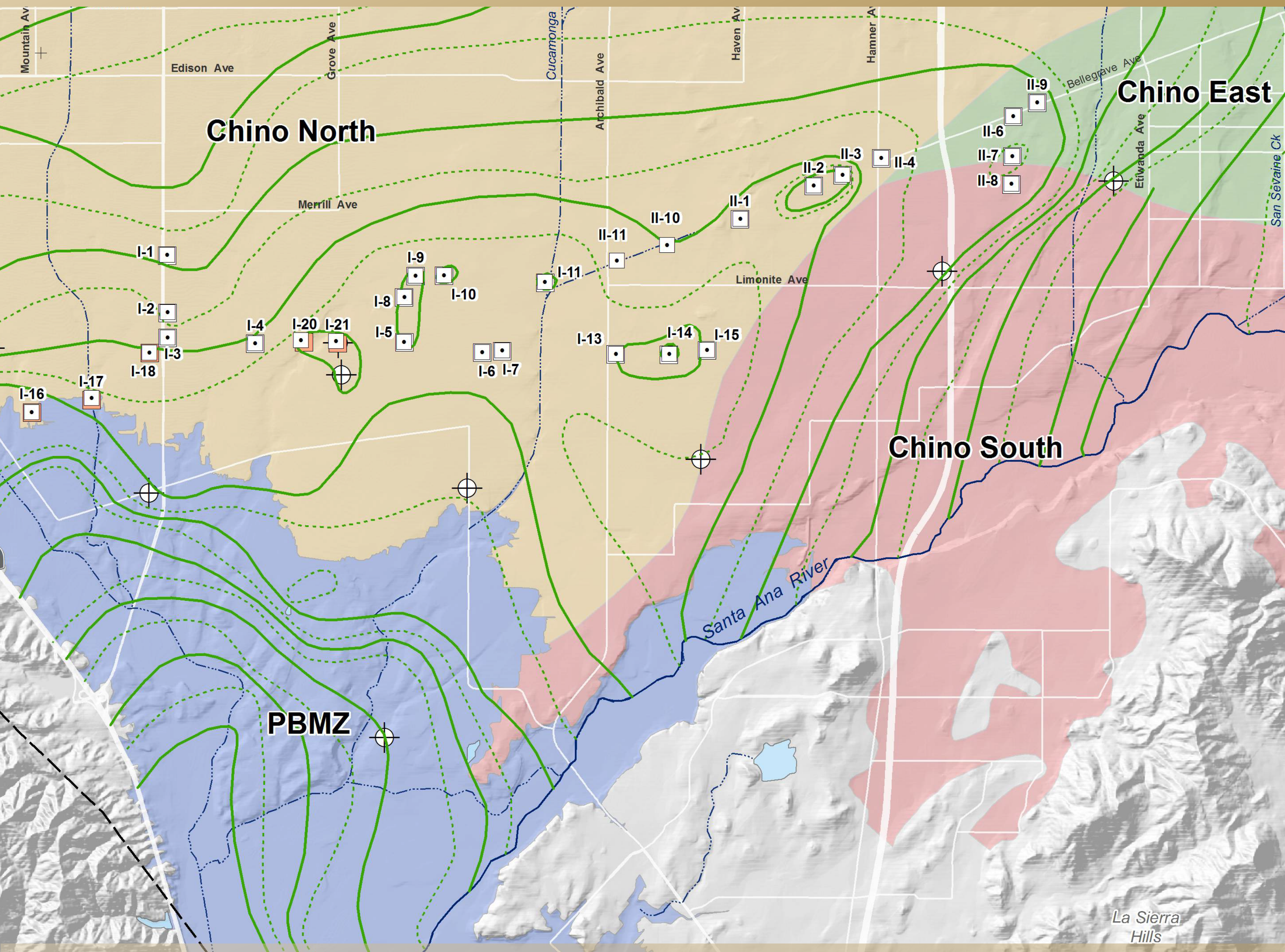
Optimum Basin Management Program
Chino Basin Maximum Benefit Annual Report
2018



prepared for

Chino Basin Watermaster and Inland Empire Utilities Agency

April 2019

WEI

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April 15, 2019

Regional Water Quality Control Board, Santa Ana Region
Attention: Ms. Hope Smythe
3737 Main Street, Suite 500
Riverside, California 92501-3348

Subject: Transmittal of the Chino Basin 2018 Maximum Benefit Annual Report

Dear Ms. Smythe,

The Chino Basin Watermaster (Watermaster) and Inland Empire Utilities Agency (IEUA) hereby submit the Chino Basin Maximum Benefit Annual Report for 2018. This Annual Report is in partial fulfillment of the maximum benefit commitments made by Watermaster and the IEUA as discussed in Resolution No. R8-2004-0001 and its attachment: *Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate an Updated Total Dissolved Solids (TDS) and Nitrogen Management Plan for the Santa Ana Region Including Revised Groundwater Subbasin Boundaries, Revised TDS and Nitrate-Nitrogen Quality Objectives for Groundwater, Revised TDS and Nitrogen Wasteload Allocations, and Revised Reach Designations, TDS and Nitrogen Objectives and Beneficial Uses for Specific Surface Waters.* Table 5-8a in the attachment to the Resolution identifies the Chino Basin Maximum Benefit Commitments which are specific projects and requirements that must be implemented to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. This Annual Report describes the status of compliance with each commitment and the work performed during 2018.

If you have any questions, please do not hesitate to call.

Sincerely,

<u>Chino Basin Watermaster</u>

Peter Kavounas, P.E.
General Manager

<u>Inland Empire Utilities Agency</u>

Sylvie Lee, P.E.
Manager of Planning &
Environmental Resources

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Acronyms, Abbreviations, and Initialisms

afy	acre-feet per year
Basin Plan	Water Quality Control Plan for the Santa Ana River Basin
CCWF	Chino Creek Well Field
CDA	Chino Basin Desalter Authority
Chino-North	Chino-North Groundwater Management Zone
DTSC	California Department of Toxic Substance Control
ET	evapotranspiration
GMZ	Groundwater Management Zone
GWQMP	Groundwater Quality Monitoring Program
HCMP	Hydraulic Control Monitoring Program
IEUA	Inland Empire Utilities Agency
Judgment	OCWD vs. City of Chino et al., Case No. 117628, County of Riverside
MCL	Maximum contaminant level
mgd	million gallons per day
mgl	milligrams per liter
MS	Microsoft
NAWQA	National Water Quality Assessment
OBMP	Optimum Basin Management Program
OCWD	Orange County Water District
PBHSP	Prado Basin Habitat Sustainability Program
PBMZ	Prado Basin Management Zone
Regional Board	Regional Water Quality Control Board, Santa Ana Region
SAR	Santa Ana River
SARWC	Santa Ana River Water Company
SARWM	Santa Ana River Watermaster
SOB	State of the Basin
SWP	State Water Project
TCS	trichloroethene
TDS	total dissolved solids
TIN	total inorganic nitrogen
USGS	United States Geological Survey
VOC	volatile organic compound
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.

Section 1 – Introduction

This 2018 Maximum Benefit Annual Report was prepared by the Chino Basin Watermaster (Watermaster) and the Inland Empire Utilities Agency (IEUA) pursuant to their maximum-benefit commitments, as described in the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) (California Regional Water Quality Control Board, Santa Ana Region [Regional Board], 2008).

This introductory section provides background on: the Chino Basin Optimum Basin Management Program (OBMP) and Implementation Plan; the Regional Board's recognition of the Chino Basin OBMP Implementation Plan; the establishment of alternative, maximum-benefit groundwater-quality objectives for the Chino Basin; and the commitments made by Watermaster and the IEUA when the Regional Board granted them access to the assimilative capacity created by the application of the maximum-benefit objectives for regulatory purposes. This Annual Report describes the status of compliance with each commitment and the work performed during calendar year 2018.

1.1 Investigations of the Relationship between Groundwater Production and Santa Ana River Discharge

Figure 1-1 is a map of the Chino Basin. Groundwater generally flows from the forebay regions in the north and east toward the Prado Basin, where rising groundwater becomes surface water in the Santa Ana River and its tributaries. Recent and past studies have provided insight into the influence of groundwater pumping in the southern end of the Chino Basin on the Safe Yield of the Basin and the ability of pumping in this part of the Basin to control the discharge of rising groundwater to the Prado Basin and Santa Ana River. Several studies, as discussed below, quantify the impacts of the groundwater desalters in the southern Chino Basin on groundwater discharge to the Prado Basin and the Santa Ana River.

Desalter well fields were first described in *Nitrogen and TDS Studies, Upper Santa Ana Watershed* (James M. Montgomery, Consulting Engineers, Inc., 1991). This study matched desalter production to meet future potable demands in the lower Chino Basin through 2015. Well fields were sited to maximize the interception of rising groundwater discharge from the north and to induce streambed percolation in the Santa Ana River. The decrease in rising groundwater and increase in streambed infiltration were projected to account for 45 to 65 percent of total desalter pumping.

A design study for the Chino Basin Desalter well fields provided estimates of the volume of rising groundwater discharge intercepted by desalter production (Wildermuth, 1993). This study used a detailed model of the lower Chino Basin (a rectangular grid with 400-foot by 400-foot cells, covering the southern Chino Basin) to evaluate the hydraulic impacts of desalter production on rising groundwater discharge and groundwater levels at nearby wells. This study showed the relationship of intercepting rising groundwater discharge to well field locations and capacity. The fraction of total desalter well pumping composed of decreased rising groundwater discharge and increased streambed infiltration was estimated to range from 40 to 50 percent.

A subsequent analysis, consistent with the OBMP Implementation Plan and the Peace II Agreement, projected the increase in streambed infiltration to be about 20 percent of desalter pumping due to Watermaster's basin re-operation plan alone (Wildermuth Environmental, Inc. [WEI], 2009d). This projection resulted from evaluating the Peace II project description through 2060 with the 2007 Chino Basin Model using then current and projected groundwater pumping at the Chino Desalter wells.

In 2011, the Chino Basin Watermaster initiated the process to recalculate safe yield, which included an update and recalibration of its groundwater model. The 2013 Chino Basin Model was used to conduct a detailed investigation of the state of hydraulic control of rising groundwater discharge from the north, including an estimation of the historical amounts of rising groundwater discharge to the Santa Ana River and Santa Ana River recharge and for the period 1961 through 2011, and to project the same through 2050 (WEI, 2015c). The New Yield[1] from Santa Ana River recharge as estimated by the 2013 Chino Basin Model is 61 percent of desalter well production in fiscal year 2011 and levels off to about 49 percent of total future desalter well pumping through fiscal year 2030. This new yield induced by pumping at the desalter wells and reoperation is consistent with the planning estimates described in the previous studies.

These studies demonstrate that the yield of the Chino Basin is enhanced by increasing groundwater pumping in the southern portion of the Basin. These studies also indicated that the Chino Basin Desalter program and a slight permanent decrease in basin storage authorized in the Peace II agreement and approved by the Court will (i) capture groundwater flowing south from the forebay regions of the Chino Basin and (ii) reduce the outflow of high-salinity groundwater to the Santa Ana River, thereby providing greater protection of downstream beneficial uses.

1.2 The OBMP and the 2004 Basin Plan Amendment

The Chino Basin OBMP (WEI, 1999) was developed by Watermaster and the parties to the 1978 Chino Basin Judgment (Chino Basin Municipal Water District *v.* City of Chino et al.) pursuant to a February 19, 1998 court ruling. The OBMP maps a strategy that provides for the enhanced yield of the Chino Basin and reliable water supplies for development that is expected to occur within the Basin. The goals of the OBMP are: to enhance basin water supplies, to protect and enhance water quality, to enhance the management of the Basin, and to equitably finance the OBMP. The OBMP Implementation Plan is the court-ordered governing document for achieving the goals defined in the OBMP. The OBMP Implementation Plan is a comprehensive, long-range water management plan for the Chino Basin and includes the use of recycled water for direct reuse and artificial recharge. It also includes the capture of increased quantities of high quality storm water, the recharge of imported water when total dissolved solids (TDS) concentrations are low, improving the water supply by desalting poor-quality

[1] New Yield as defined in the Peace Agreement "means proven increases in yield in quantities greater than historical amounts from sources of supply including, but not limited to, […] operations of the Desalters […] and other management activities implemented and operational after June 1, 2000." The net Santa Ana River recharge in fiscal year 2000 is the baseline from which to measure New Yield from Santa Ana River recharge in all subsequent years.

groundwater, supporting regulatory efforts to improve water quality in the Basin, and the implementation of management activities that will result in the reduced outflow of high-TDS/high-nitrate groundwater to the Santa Ana River and the Orange County Basin, thus ensuring the protection of downstream beneficial uses and water quality (WEI, 1999).

The 1995 Basin Plan contained restrictions on the use of recycled water for irrigation and groundwater recharge. In particular, it contained TDS objectives ranging from 220 to 330 milligrams per liter (mgl) over a significant portion of the Basin. The ambient TDS concentrations in these areas exceeded the objectives, which meant that no assimilative capacity existed for the Basin. Therefore, the use of the IEUA's recycled water (which had a TDS concentration of about 490 mgl at the time) for irrigation and groundwater recharge—one of the key elements of the OBMP Implementation Plan—would require mitigation even though recycled water reuse would not materially impact future TDS concentrations or impair the beneficial uses of Chino Basin groundwater.

In 1995, in part because of these considerations, the Regional Board initiated a collaborative study with 22 water supply and wastewater agencies, including Watermaster and the IEUA, to devise a new TDS and nitrogen management plan for the Santa Ana Watershed. This study culminated in the Regional Board's adoption of a Basin Plan amendment in January 2004 (Regional Board, 2004). This amendment included revised groundwater subbasin boundaries, termed "groundwater management zones" (GMZs), revised TDS and nitrate-nitrogen objectives for groundwater, revised TDS and nitrogen wasteload allocations, revised surface water reach designations, and revised TDS and nitrogen objectives and beneficial uses for specific surface waters. The technical work supporting the 2004 Basin Plan amendment was directed by the TIN/TDS Task Force and is summarized in *TIN/TDS Phase 2A: Tasks 1 through 5, TIN/TDS Study of the Santa Ana Watershed* (WEI, 2000).

The new TDS and nitrate-nitrogen objectives for the GMZs in the Santa Ana Watershed Basin were established to ensure that water quality is maintained pursuant to the State's antidegradation policy (State Board Resolution No. 68-16). These objectives were termed "antidegradation" objectives. Figure 1-1 shows the antidegradation objectives for the five Chino Basin GMZs[2]: Chino-1, Chino-2, Chino-3, Chino-East, and Chino-South. Note that the antidegradation TDS objectives for Chino-1, Chino-2, and Chino-3 are low (250 to 280 mgl) and would restrict recycled water reuse and artificial recharge, as well as the recharge of imported water when its TDS concentration is above the objectives, without mitigation. Figure 1-2 shows the percent of time that the TDS concentration of State Water Project (SWP) water at Silverwood Lake[3] has been less than or equal to the TDS antidegradation objectives for these three GMZs based on the observed TDS concentrations from 1980 through 2018, a period of 39 years. The TDS concentrations of SWP water were less than the antidegradation objectives in the Chino-1, -2, and -3 GMZs about 67, 52, and 58 percent of the time, respectively.

To address this issue, Watermaster and the IEUA proposed, and the Regional Board accepted, alternative and less stringent "maximum-benefit" objectives for a new GMZ, the Chino-North

[2] Note that the Prado Basin Management Zone is regulated by the Regional Board as a surface water management zone and does not have groundwater objectives assigned.

[3] Silverwood Lake in the San Bernardino Mountains is a reservoir on the east branch of the SWP that supplies the IEUA region with SWP water deliveries from the Metropolitan Water District of Southern California (MWD) via Devil Canyon Power Plant Afterbay and the Upper Feeder Pipeline.

GMZ (Chino-North), that combined Chino-1, Chino-2 and Chino-3 into one single management unit, as shown in Figure 1-1. All of the recharge activities that would occur as part of the OBMP Implementation Plan are within Chino-North. The TDS and nitrate-nitrogen maximum-benefit objectives established for Chino-North are 420 and 5 mgl, respectively. The maximum-benefit TDS objective was higher than the then-current ambient TDS[4] concentration of 300 mgl, thus creating 120 mgl of assimilative capacity for TDS and allowing for recycled water reuse and recharge, and imported water recharge, without mitigation. Under the maximum benefit program, the TDS concentration of SWP water is projected be less than the objective of 420 mgl 99 percent of the time, as shown in Figure 1-2.

The maximum-benefit objectives were established based on demonstrations by Watermaster and the IEUA that the antidegradation requirements were satisfied. First, they demonstrated that beneficial uses would continue to be protected. Second, they showed that water quality consistent with maximum benefit to the people of the State of California would be maintained. Other factors—such as economics, the need to use recycled water, and the need to develop housing in the area—were also taken into account in establishing the maximum-benefit objectives.

1.3 Maximum Benefit Implementation Plan for Salt Management: Maximum-Benefit Commitments

The application of the maximum-benefit objectives is contingent upon the implementation of specific projects and programs by Watermaster and the IEUA. These projects and programs, termed the "Chino Basin maximum-benefit commitments," are described in the Maximum Benefit Implementation Plan for Salt Management in Chapter 5 of the Basin Plan and listed in Table 5-8a therein (Regional Board, 2008). These commitments include:

1. The implementation of a surface-water monitoring program.
2. The implementation of a groundwater monitoring program.
3. The expansion of the Chino-I Desalter to 10 million gallons per day (mgd) and the construction of the Chino-II Desalter with a design capacity of 10 mgd.
4. The additional expansion of desalter capacity (20 mgd) pursuant to the OBMP and the Peace Agreement (tied to the IEUA's agency-wide effluent concentration).
5. The completion of the recharge facilities included in the Chino Basin Facilities Improvement Program.
6. The management of recycled water quality to ensure that the agency-wide, 12-month running average wastewater effluent quality does not exceed 550 mgl and 8 mgl for TDS and total inorganic nitrogen (TIN), respectively.
7. The management of basin-wide, volume-weighted TDS and nitrogen concentrations in artificial recharge to less than or equal to the maximum-benefit objectives.

[4] The current ambient TDS of the Chino-North GMZ, for the period of 1996 to 2015, is 360 mgl (Daniel B. Stephens & Associates, Inc., 2017).

8. The achievement and maintenance of the "hydraulic control" of groundwater outflow from the Chino Basin, specifically from Chino-North, to protect Santa Ana River water quality and downstream beneficial uses.
9. The determination of ambient TDS and nitrate-nitrogen concentrations of Chino Basin groundwater every three years.

If these maximum-benefit commitments are not met, the antidegradation objectives would apply for regulatory purposes. The application of the antidegradation objectives would result in no assimilative capacity for TDS and nitrate-nitrogen in the Chino-1, Chino-2, and Chino-3 GMZs, and the Regional Board would require mitigation for both recycled water and imported SWP water discharges to Chino-North that exceed the antidegradation objectives. Furthermore, the Regional Board would require that Watermaster and the IEUA mitigate the effects of discharges of recycled and imported SWP water that took place in excess of the antidegradation objectives under the maximum benefit objectives retroactively to January 2004. The mitigation for past discharges would be required to be completed within a ten-year period following the Regional Board's finding that the maximum-benefit commitments were not met.

1.4 Purpose and Report Organization

This report describes the status of compliance with the maximum-benefit commitments listed above and is organized as follows:

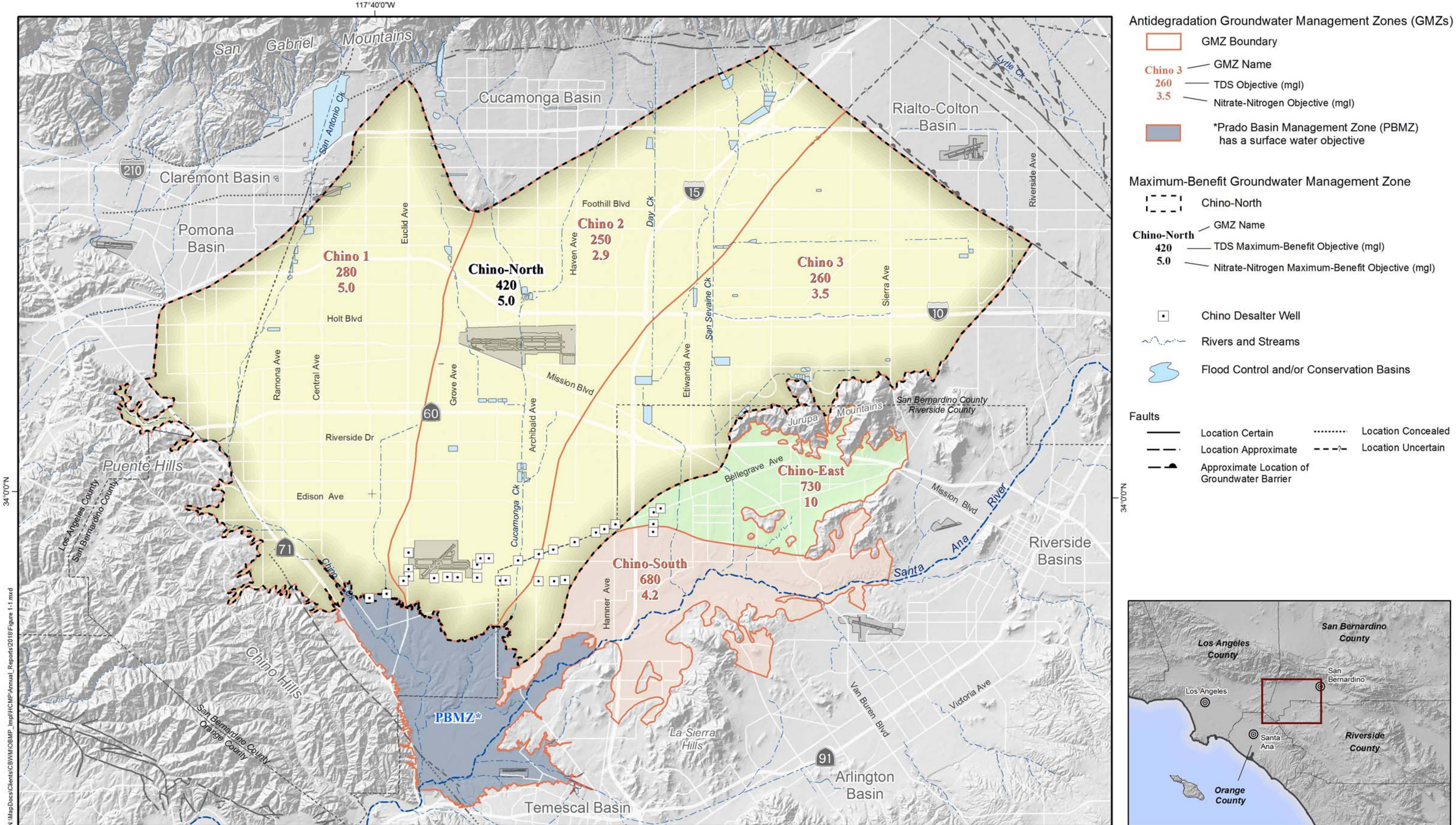
Section 1 – Introduction: This section provides context and background regarding the development of the maximum-benefit objectives and the associated maximum-benefit commitments for the Chino Basin.

Section 2 – Maximum-Benefit Commitment Compliance: This section describes the status of compliance with each of the maximum-benefit commitments.

Section 3 – Data Collected in 2018: This section describes the data collected in 2018 as part of the maximum benefit monitoring program.

Section 4 – The Influence of Rising Groundwater on the Santa Ana River: This section characterizes the influence of rising groundwater on the flow and quality of the Santa Ana River between the Riverside Narrows and Prado Dam.

Section 5 – References: This section provides the references consulted in performing the analyses described herein and in writing this report.



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File: Figure 1-1

0 1 2 3 4 Miles

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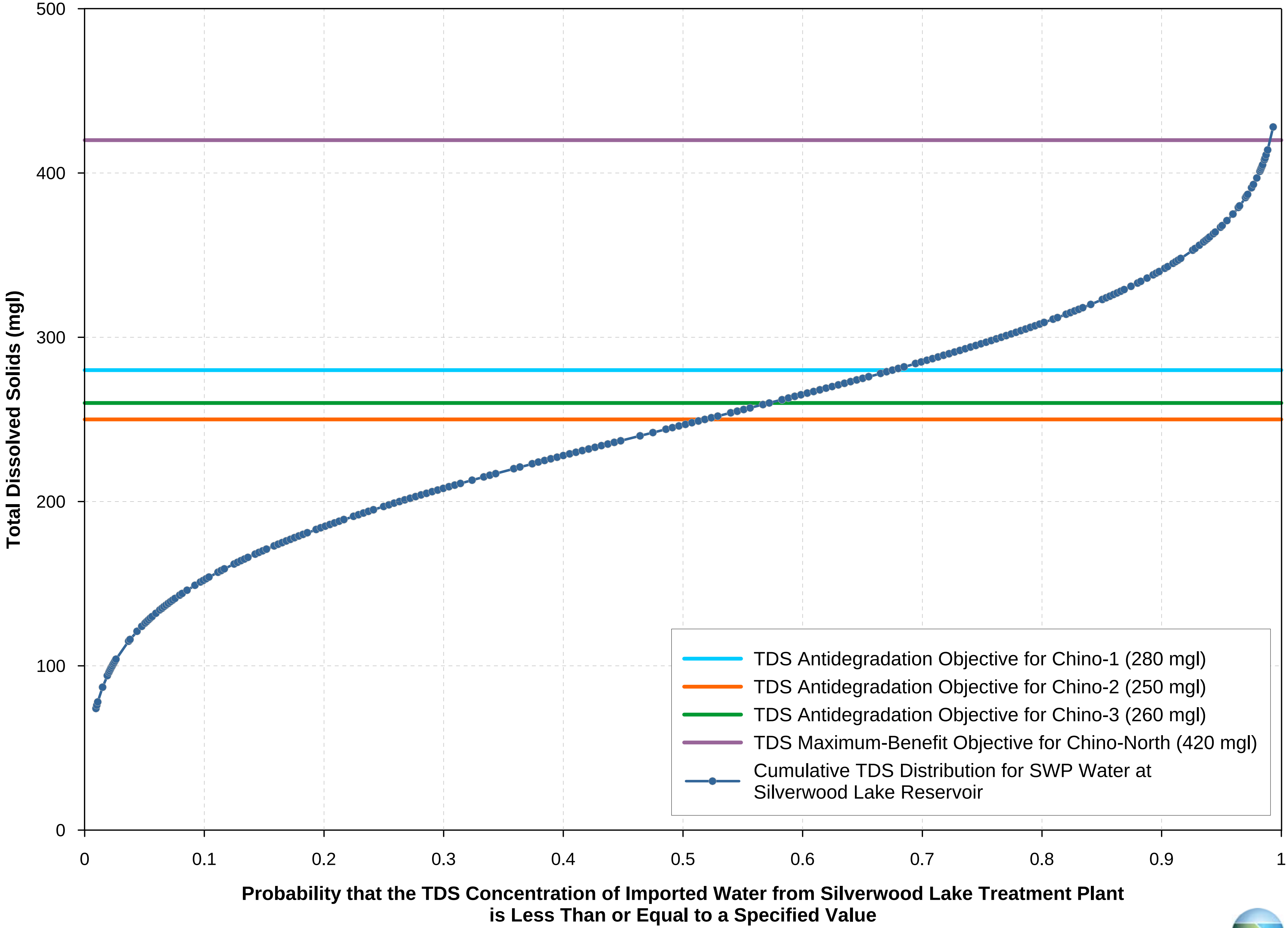
2018 Maximum Benefit Annual Report

Chino Basin Management Zones

Antidegradation & Maximum-Benefit Objectives for TDS and Nitrate-Nitrogen

Figure 1-1

Figure 1-2
Historical TDS Concentration in State Water Project (SWP) Water at Silverwood Lake Reservoir



Section 2 – Maximum-Benefit Commitment Compliance

Table 2-1 lists the status of compliance for each of the nine maximum-benefit commitments outlined in the Maximum Benefit Implementation Plan for Salt Management in Chapter 5 of the Basin Plan (Regional Board, 2008) as of December 31, 2018. A discussion of ongoing activities related to compliance with the commitments is provided below. For this discussion, the commitments are grouped together by four main topics covering: hydraulic control, Chino Basin Desalters, recycled water recharge, and the recomputation of ambient groundwater quality.

2.1 Hydraulic Control

The Regional Board requires that Watermaster and the IEUA achieve and maintain "hydraulic control" of groundwater outflow from Chino-North (Commitment number 8). The Basin Plan defines hydraulic control as: "[…] eliminating groundwater discharge from the Chino Basin to the Santa Ana River, or controlling the discharge to *de minimis* levels […]." In practice, Watermaster and the IEUA use a more measurable definition of hydraulic control: eliminating groundwater discharge from Chino-North to the Prado Basin Management Zone (PBMZ) or controlling the discharge to *de minimis* levels. In a letter from the Regional Board to Watermaster and the IEUA, dated October 12, 2011, the Regional Board defined the *de minimis* discharge of groundwater from Chino-North to the PBMZ as less than 1,000 afy. (Regional Board, 2011).

2.1.1 Hydraulic Control Monitoring Program

The surface-water and groundwater monitoring programs (Commitments number 1 and number 2) were required, in part[5], to collect the data necessary to determine the state of hydraulic control and were thus referred to collectively as the Hydraulic Control Monitoring Program (HCMP). In May 2004, Watermaster and the IEUA submitted a surface-water and groundwater monitoring program work plan to the Regional Board entitled: *Final Hydraulic Control Monitoring Program Work Plan for the Optimum Basin Management Program* (Work Plan [WEI, 2004b]). The Regional Board adopted Resolution R8-2005-0064, approving this Work Plan, and required Watermaster and the IEUA to implement the HCMP. The concept of using multiple lines of evidence was included in the initial design of the HCMP because it was not clear at that time whether one line of evidence would clearly demonstrate hydraulic control. These multiple lines of evidence are summarized as follows:

- Collect and analyze groundwater-elevation data to determine the direction of groundwater flow in the southern part of the Chino Basin and whether pumping at the Chino Desalter well fields is completely capturing all groundwater that would otherwise discharge out of Chino-North and into the PBMZ.
- Collect and analyze the chemistry of basin-wide groundwater and the Santa Ana River to (i) track the migration, or lack thereof, of the South Archibald volatile organic compound (VOC) plume beyond the Chino Desalter well fields, and (ii)

[5] The groundwater monitoring program also supports the recomputation of ambient water quality, as well as a number of Watermaster's OBMP activities.

identify the source of groundwater in the area of the Chino Basin between the Santa Ana River and the Chino Desalter well fields.

- Collect and analyze surface-water quality data and surface-water discharge measurements to determine if groundwater from the Chino Basin is rising as surface water and contributing to flow in the Santa Ana River or if the River is recharging the Basin.
- Use Watermaster's numerical groundwater-flow model to corroborate the results and interpretations of the first three lines of evidence.

Watermaster and the IEUA executed this surface-water and groundwater-monitoring program per the 2004 Basin Plan Amendment and Work Plan from 2004 through 2011 (WEI, 2007b; 2008b; 2009a; 2010; 2011a; and 2012b), and concluded that (i) hydraulic control had been achieved to the east of Chino-I Desalter Well 5, (ii) hydraulic control had not been achieved to the west of Chino-I Desalter Well 5, and (iii) the impact of rising groundwater discharge from Chino-North on surface-water quality in the Santa Ana River at Prado Dam has been *de minimis*. Watermaster and the IEUA also concluded that the data collected as part of the surface-water monitoring program were not necessary to determine the state of hydraulic control, and began the process of modifying the surface-water and groundwater-monitoring program and commitments accordingly. In 2010, the Chino Basin Desalter Authority[6] (CDA) began construction of the Chino Creek Well Field (CCWF), which was designed to achieve hydraulic control to the west of Chino-I Desalter Well 5 (see also: Section 2.1.3 and Figure 2-1).

On February 10, 2012, the Regional Board adopted an amendment to the Basin Plan to remove all references to specific monitoring locations and sampling frequencies for the groundwater and surface-water monitoring programs and, in their place, required that Watermaster and the IEUA submit (i) an updated surface-water monitoring program by February 25, 2012 and (ii) a revised groundwater monitoring program and schedule for achieving hydraulic control by December 31, 2013. Pursuant to (i), Watermaster and the IEUA submitted the *2012 Hydraulic Control Monitoring Program Work Plan* (2012 Work Plan) to the Regional Board on February 25, 2012 (WEI, 2012a). The 2012 Work Plan was adopted by the Regional Board on March 16, 2012 (Regional Board, 2012).[7] Pursuant to (ii), Watermaster and the IEUA submitted the *2014 Maximum Benefit Monitoring Work Plan* (2014 Work Plan) to the Regional Board on December 23, 2013 (WEI, 2013c).[8] The 2014 Work Plan was approved by the Regional Board on April 25, 2014 (Regional Board, 2014b).

Each year, the data collected pursuant to the 2014 Work Plan is summarized and included in the Chino Basin Maximum Benefit Annual Report (see Section 3 of this report).

[6] www.chinodesalter.org

[7] The Basin Plan amendment was approved by the Office of Administrative Law on December 6, 2012, and at that time, the revised surface-water monitoring program (2012 Work Plan) was implemented.

[8] The name was changed from the Hydraulic Control Monitoring Program Work Plan to the Maximum Benefit Monitoring Program Work Plan to clarify that the 2014 Work Plan (and its predecessor) contains the monitoring and data collection strategy for complying with both the maximum-benefit monitoring directives of demonstrating hydraulic control and computing ambient water quality.

2.1.2 Hydraulic Control Monitoring Program Objectives and Methods

Based on the results to date, the ongoing questions to be answered by the HCMP are:

1. Will hydraulic control of groundwater from Chino-North be maintained east of Chino-I Desalter Well 5?
2. Will the CCWF reduce groundwater discharge from Chino-North to the PBMZ past the desalter well field west of Chino-I Desalter Well 5 to the *de minimis* threshold of 1,000 afy or less?
3. Will the impact of groundwater discharge from Chino-North to the PBMZ that becomes rising groundwater on the surface-water quality in the Santa Ana River remain *de minimis*?

Watermaster and the IEUA use the following methods to answer these questions:

Method to Address Question 1. The groundwater monitoring program (groundwater level and quality) and periodic modeling will continue to be used to define the capture zone created by the Chino Desalter well field east of Chino-I Desalter Well 5. These methods will be sufficient to demonstrate hydraulic control in this area in the future.

Watermaster prepares a State of the Basin (SOB) Report every two years (WEI, 2002; 2005; 2007c; 2009c; 2011c; 2013b, 2015b, and 2017). The SOB Report includes a spring groundwater-elevation contour map of the southern portion of Chino Basin, showing the capture zone of the Chino Desalter well field, and a characterization of the state of hydraulic control based on the groundwater-elevation contours. The most up-to-date hydraulic control findings in the SOB Report will be referenced each year in the Chino Basin Maximum Benefit Annual Report (see Section 2.1.3 of this report).

Watermaster recalibrates and runs its groundwater-flow model at least every five years to assess the physical impacts of the implementation of the OBMP and Peace II Agreement, the state of hydraulic control, the balance of recharge and discharge, the cumulative impact of water rights transfers among the parties, and to recalculate safe yield. The most up-to-date modeling assessment of the then-current and projected state of hydraulic control will be referenced each year in the Maximum Benefit Annual Report (see Section 2.1.3 of this report).

Method to Address Question 2. The 2013 Chino Basin Model estimated that the amount of groundwater discharge from Chino-North to the PBMZ in the absence of the CCWF has been about 2,400 afy (WEI, 2014a). The model was used to estimate the discharge once the CCWF wells are in operation. The results indicated that with planned production at the CCWF (1,529 afy), the groundwater discharge would decrease to about 900 afy by 2016, which is less than the *de minimis* threshold.

At least every five years, historical production and groundwater-level data for the CCWF and other wells will be used to recalibrate the Chino Basin Model. The model will be used to calculate annual groundwater discharge past the CCWF since the start of CCWF operations and to estimate future groundwater discharge past the CCWF based on projected groundwater pumping in the Basin. The most up-to-date modeling assessment of the then-current and projected groundwater discharge past the CCWF will be referenced each year in the Maximum Benefit Annual Report (see Section 2.1.3 of this report).

Method to Address Question 3. The HCMP has shown that the historical and current impacts of groundwater discharge from Chino-North to the PBMZ that becomes rising groundwater on the surface-water quality of the Santa Ana River at Prado Dam is *de minimis*. Groundwater modeling shows that pumping at the CCWF will further decrease the volume of groundwater discharge from Chino-North that becomes rising groundwater in the PBMZ and thereby further reduces the impact on the water quality of the Santa Ana River.

Table 2-2 shows a mass-balance analysis of the estimated impact on the annual discharge and discharge-weighted TDS concentration of the Santa Ana River at Prado Dam resulting from groundwater discharge from Chino-North to the PBMZ through the CCWF area for two hydraulic control scenarios: 1) achievement of hydraulic control to the *de minimis* threshold (<1,000 afy) of Chino-North discharge to the PBMZ and 2) hydraulic control at full containment, meaning zero Chino-North discharge to the PBMZ. For each hydraulic control scenario, Table 2-2 shows:

- the annual discharge of the Santa Ana River at Prado Dam and its associated TDS concentration without CCWF operation (historical reported values [SARWM, 2016]); values are the same for both scenarios,
- the volume and TDS concentration of groundwater produced by the CCWF,
- the estimated annual discharge and associated TDS of the Santa Ana River at Prado Dam had the CCWF been in operation,
- the estimated change in TDS concentration of the Santa Ana River at Prado Dam had the CCWF been in operation, and
- the estimated increase in the TDS concentration of the Santa Ana River at Prado Dam due to partial containment by the CCWF (e.g. the change in TDS concentration attributable to Scenario 2 minus the change in TDS concentration attributable to Scenario 1).

The mass-balance analysis in Table 2-2 demonstrates that operation of the CCWF reduces the TDS concentration of the Santa Ana River at Prado Dam by two to seven mgl (average of one-percent decrease) for the *de minimis* threshold scenario, and by three to eleven mgl (average of one and a half percent decrease) for the complete hydraulic control scenario. In addition, operating to full containment instead of the *de minimis* threshold only improves the TDS concentration of the Santa Ana River at Prado Dam by one to four mgl, which is less than one percent of the TDS concentration at Prado Dam. Overall, the estimated impact of rising groundwater from Chino-North on the TDS concentration of the Santa Ana River at Prado Dam without CCWF operation is small, and from a mass-balance perspective is increasing the TDS concentration of the River by about one and a half percent. The operation of the CCWF to the *de minimis* threshold (Scenario 1) will reduce this impact.

Continued analysis of Santa Ana River flow and quality at Below Prado Dam will help determine the nature of the impact of groundwater discharge from Chino-North that becomes rising groundwater in the PBMZ. The impact of groundwater discharge from Chino-North to the PBMZ on Reach 2 of the Santa Ana River will be characterized each year in the Chino Basin Maximum Benefit Annual Report (see Section 4 of this report).

2.1.3 Current Status of Hydraulic Control

Watermaster and the IEUA have demonstrated in previous Annual Reports (WEI, 2007b; 2008b; 2009a; 2010; 2011a; 2012b; 2013a; 2014b; 2015a; and 2016) that complete hydraulic control has been achieved at and east of Chino-I Desalter Well 5. For the area west of Chino-I Desalter Well 5 the CCWF is intended to achieve hydraulic control to *de minimis* levels (<1,000 afy) based on modeling results (WEI, 2014a). In February 2016, the CCWF commenced full-scale operation with production at wells I-16, I-17, I-20, and I-21 and, by definition, hydraulic control was determined to have been achieved in this area. In 2018, the CCWF wells produced a total of about 1,420 af. Production at the CCWF has decreased as a result of the new maximum contaminant level (MCL) for 1,2,3-TCP, which resulted in the CDA temporarily shutting down operation of CCWF Well I-17. In 2019, Watermaster will use its groundwater model to assess the volume of groundwater discharge from Chino-North to the PBMZ under actual 2018 pumping conditions in the area.

Figure 2-1 shows the most current characterization of the state of hydraulic control based on groundwater-elevation contours for spring 2016 from the 2016 SOB Report (WEI, 2017)[9]. The spring 2016 groundwater-elevation contours show that, compared to prior years, the regional depression in groundwater elevation around the desalter wells has expanded west to Chino-I Desalter Well 20, demonstrating complete hydraulic containment of all Chino-North groundwater by the desalter wells in this area.

2.1.4 Future Projection of Hydraulic Control

In a letter dated January 23, 2014, the Regional Board required that Watermaster and the IEUA submit a plan detailing how hydraulic control will be sustained in the future as agricultural pumping in the southern region of Chino-North continues to decrease, and how the Chino Basin Desalters will achieve the required total groundwater production level of 40,000 afy. Watermaster and the IEUA coordinated with the CDA to develop a plan to achieve 40,000 afy of desalter well pumping and submitted a final plan to the Regional Board on June 30, 2015 (Watermaster & IEUA, 2015). The plan includes the construction and operation of three new wells (II-10, II-11, and II-12) for the Chino-II Desalter. Two of the three new wells began operation in the second half of 2018 and the operation of all three is anticipated to begin in 2021 (refer to Figure 2-3 and Section 2.2 of this Report for more details).

Planning projections for future groundwater pumping and recharge were updated in 2017 as part of the Watermaster's Storage Framework investigation (WEI, 2019a). The updated planning information includes an updated projection of the land use transitions from agricultural to urban land uses, pumping projections, replenishment obligation projections and recharge projections. Three baseline planning scenarios were developed from the updated planning projections to bracket future groundwater pumping and recharge. The groundwater and surface water responses in the Chino Basin to these new baseline planning scenarios were

[9] Updated groundwater elevation contours for spring 2018 will be prepared for the 2018 SOB Report which is due to the be published in June 2019.

evaluated with Watermaster's 2017 Chino Basin groundwater model[10]. All three baseline scenarios assume that the Chino Basin Desalter well fields produce 40,000 afy and the continuation of reoperation through 2030. Baseline scenario 1A represents the pumpers' best estimates of how future water supplies would be used to meet demands. This scenario was chosen to assess the future state of hydraulic control in this demonstration because it is the planning baseline scenario for the storage programs evaluated for the Storage Framework investigation and because it is projected to attain the weakest state of hydraulic control among all the baseline scenarios. Hydraulic control is projected to be attained and maintained indefinitely in all three baseline scenarios. Figures 2-2a, 2-2b, and 2-2c show the model-projected state of hydraulic control in 2020, 2025, and 2030, respectively. These figures include groundwater-elevation contours and arrows that depict groundwater-flow direction and show full hydraulic containment of Chino-North groundwater at and east of Chino-I Desalter Well 20 in 2020, and 2030. The groundwater-flow direction indicates that groundwater will continue to flow past the CCWF, west of well I-20. Table 2-3 shows the model-projected groundwater discharge through the CCWF from 2018 to 2050 for Scenario 1A. The model-projected groundwater discharge through the CCWF will decrease to around 830 afy by 2030 and 730 afy by 2050.

In 2019, Watermaster will be completing its five-year update and recalibration of the Chino Basin Model to recalculate Safe Yield of the Chino Basin. As part of the 2020 Safe Yield recalculation, the future state of hydraulic control will be assessed based on planning projections as of 2019.

2.2 Chino Basin Desalters

The operation of the Chino Basin Desalters is fundamental to the maximum benefit requirement of achieving hydraulic control to protect the water quality of the Santa Ana River, as well as maximizing the yield of the Chino Basin and minimizing the loss of stored water. The first Chino Basin Desalter, Chino-I, began operation in late 2000 and had an original design capacity of 8 mgd. Commitment number 3 requires the expansion of Chino-I Desalter and the construction of Chino-II Desalter. Prior to the recharge of recycled water in the Chino Basin, the Chino-I Desalter was expanded to a capacity of 14 mgd, and a contract was awarded for the construction of the Chino-II Desalter. The Chino-II Desalter came online in June 2006 and has a capacity of 15 mgd. Commitment number 4 requires the submittal of plans to construct additional wells and facilities in addition to those described in Commitment number 3. As articulated in the OBMP Implementation Plan, the Peace Agreement, and the 2007 Peace II Agreement, Watermaster and IEUA are required to expand desalter well pumping to about 40,000 afy.

The most recently completed expansion is the construction and operation of the CCWF wells. The five CCWF wells (I-16, I-17, I-18, I-20, and I-21) were constructed between September

[10] The 2017 Chino Basin model is an updated version of the 2013 model. Updates include the extension of the historical hydrology through June 30, 2017 and minor updates to stream system in Prado Basin. The 2017 model was documented in the Storage Framework investigation published in Fall 2018 and updated in January 2019 (WEI, 2019). The model will be substantively recalibrated in fiscal year 2019.

2011 and May 2012[11] in the southwestern portion of the Chino Basin (see Figure 2-3). Pumping at CCWF wells I-16 and I-17 commenced in mid-2014. Pumping at CCWF wells I-20 and I-21 commenced in February 2016. The combined pumping capacity of these four wells is about 1,529 afy. Due to the presence of VOCs the CDA does not have plans to produce at well I-18 for the Chino-I Desalter system. And, as previously noted, well I-17 is temporarily offline due to the detection of 1,2,3-TCP at levels that exceed the new MCL[12].

The final expansion plan to achieve the 40,000 afy of production is to construct and operate three new wells for the Chino-II Desalter, wells II-10, II-11, and II-12, the locations for which are shown in Figure 2-3[13]. Due to the proximity of these wells to the South Archibald trichloroethene (TCE) plume, the CDA is collaborating with identified parties to integrate these wells into a remedial solution to address groundwater cleanup while maintaining hydraulic control[14]. The plan and schedule to construct the final three wells was submitted to the Regional Board on June 30, 2015 (Watermaster & IEUA, 2015). The plan includes the construction of a dedicated pipeline to convey groundwater produced from these wells to the Desalter II treatment facility that will remove VOCs via air stripping.

The construction of wells II-10 and II-11 was completed in September 2015. In 2018, equipping of these wells was completed and pumping initiated in July 2018 and September 2018 at wells II-11 and II-10 respectively. The land acquisition process for Well II-12, and construction of the dedicated raw water pipeline to deliver the water from the three new wells to the Chino-II Desalter are underway. The construction of Well II-12 is expected to begin in 2019 and pumping at all three wells is anticipated to begin by 2021.

Figure 2-3 shows the location of the existing and planned Chino Basin Desalter wells and total annual pumping at the CDA wells since 2000. In 2018, the total pumping by the Chino Basin Desalter wells was 29,997 af. Over the last 19 years, the Chino Basin Desalters have treated about 425,730 af of high-TDS/nitrate water, or an average of about 22,400 afy. Figure 2-3 also shows the time series of the cumulative salt exports of TDS and nitrate from pumping and treatment at the Chino Desalter facilities. From fiscal year 2001 to fiscal year 2018, the desalter wells have exported about 262,010 tons of TDS and 15,600 tons of nitrate from the Chino Basin.

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[11] Proposed CCWF Well I-19 was not constructed because the projected pumping estimates during borehole testing were too low to warrant construction.

[12] Chino-I Desalter wells I-1, I-2 and I-3 were also taken out of service in 2018 due to the detection of 1,2,3-TCP at levels that exceed the new MCL.

[13] Note that the location of Well II-12 is approximate.

[14] In June 2013, the CDA entered into a Memorandum of Understanding with CDA Sponsor Agencies (Western Municipal Water District, City of Ontario, and Jurupa Community Service District), the IEUA, and City of Upland, regarding the South Archibald TCE Plume cleanup. The CDA is working with this group, and the "Airport Parties" (former industrial companies on the Ontario Airport property and the United States Army and Air Force) to find a mutually agreeable and beneficial solution to mitigate the TCE contamination.

2.3 Recycled Water Recharge and Quality

The recharge of recycled water, imported water, and storm water is an integral part of the OBMP Implementation Plan, and is necessary to maximize the use of the water resources of the Chino Basin. The IEUA, Watermaster, Chino Basin Water Conservation District, and San Bernardino County Flood Control District are partners in the implementation of the Chino Basin Recycled Water Groundwater Recharge Program. The IEUA manages the recharge program and performs recycled water recharge operations pursuant to Regional Board Orders R8-2007-0039 and R8-2009-0057. As required by these orders, the IEUA and Watermaster submit quarterly and annual reports to the Regional Board on Chino Basin recycled water recharge activities. Figure 2-4 is a map of existing recharge facilities in the Chino Basin, and Table 2-4 summarizes total annual recharge by water type from July 2005 (commencement of recycled water recharge activities) through 2018. Since 2005, about 162,000 af of imported water, 135,000 af of storm water, and 114,000 af of recycled water have been recharged to the Chino Basin.

Commitment number 7 requires that the use of recycled water for artificial recharge be limited to the amount that can be blended on a volume-weighted basis with other sources of recharge to achieve five-year running-average concentrations of no more than the maximum-benefit objectives (420 mgl for TDS and 5 mgl for nitrate-nitrogen). Recycled water recharge began in July 2005; thus, the first five-year period for which the metric was computed was July 2005 through June 2010. The metric is computed on a monthly basis. Table 2-5 summarizes the five-year running-average volume-weighted TDS and nitrate-nitrogen concentrations of the combined recharge sources. The monthly recharge and water-quality data used to compute the five-year running-average TDS and nitrate-nitrogen metrics are plotted in Figures 2-5a and 2-5b, respectively. A table of the monthly data used to compute these metrics has been included as Appendix A to this report.

The five-year running-average, volume-weighted, TDS and nitrate-nitrogen concentrations have not exceeded the maximum-benefit objectives for TDS or nitrate-nitrogen. Since June 2010, the five-year running average, volume-weighted, TDS and nitrate-nitrogen concentrations have increased: TDS increased from about 203 mgl in 2010 to about 281 mgl in 2018 and nitrate-nitrogen increased from 1.1 mgl to about 2.0 mgl.

During 2016, the rate of increase of the metric values rose significantly. Prior to 2016, the TDS concentration metric was increasing monotonically at a rate of about 1.3 mgl per month and the increase was primarily driven by the increasing proportion of recycled water recharge relative to imported and storm waters. Between May and September 2016, that rate increased to about 12 mgl per month, reflecting the loss of the last significant period of imported water recharge (May and September of 2011) from the 5-year period used for metric calculation. The TDS concentration metric began to decrease and stabilize due to imported water recharge that occurred from October 2016 through January 2018. A similar trend was observed for the nitrate-nitrogen concentration metric, as shown in Figure 2-5b. These observations demonstrate the importance of imported water recharge to complying with the long-term TDS metric contained in the maximum benefit commitments.

As described in the Basin Plan, the IEUA wastewater effluent TDS and TIN permit limits are an important component of the maximum-benefit demonstration and provide a controlling point for the management of TDS and nitrate quality in the Chino Basin. The TDS and TIN permit limits for the IEUA agency-wide effluent (a volume-weighted average for all IEUA wastewater treatment facilities) are 550 mgl and 8 mgl, respectively, based on a 12-month running average. Commitment number 6 requires that the IEUA submit a plan and schedule to the Regional Board for the implementation of measures to ensure that the 12-month running-average of the IEUA agency-wide effluent concentration does not exceed these permit limits when either the 12-month running-average IEUA agency-wide effluent TDS concentration exceeds 545 mgl for three consecutive months, or the TIN concentration exceeds 8 mgl in any one month. The plan must be submitted within 60 days of a finding that one of these trigger limits has been exceeded. The plan and schedule must be implemented upon Regional Board approval. The 12-month running-average IEUA agency-wide effluent water quality is reported by the IEUA in the Groundwater Recharge Program Quarterly Monitoring Reports.

Table 2-6 and Figure 2-6 show the monthly and 12-month running-average IEUA agency-wide effluent TDS and TIN concentrations for 2005 through 2018. Since the initiation of recycled water recharge in July 2005, the 12-month running average IEUA agency-wide TDS and TIN concentrations have never exceeded the triggers and have ranged between 456 and 534 mgl and 4.9 and 7.8 mgl[15], respectively. During 2018, the 12-month running average IEUA agency-wide TDS and TIN concentrations ranged between 456 and 487 mgl and 4.9 and 6.0 mgl, respectively.

During 2015, a historical-high 12-month running-average IEUA agency-wide effluent TDS concentration of 534 mgl was calculated for three consecutive months: June, July and August. This 12-month running-average IEUA agency-wide effluent TDS concentration of 534 mgl was only 11 mgl below the trigger in Commitment number 6 to prepare a plan and schedule to ensure that the 12-month running-average IEUA agency-wide wastewater effluent TDS concentration does not exceed the permit limit of 550 mgl. The TDS concentration of the effluent is influenced by the volume and TDS concentration of the water supplies served tributary to the IEUA treatment plants. To demonstrate this Figure 2-7 shows the monthly and 12-month running-average IEUA agency-wide effluent TDS concentration, plotted with: the monthly TDS concentrations of SWP water from Silverwood Lake[16]; the monthly volume-weighted TDS concentrations of the combined water supplies served in the area tributary to the IEUA's treatment plants (including SWP water); the volume of water supply served in the area tributary to IEUA's treatment plants that is SWP water, and the volume of water supply served in the area tributary to IEUA's treatment plants that is from local sources (groundwater and surface water). From 2012 through early 2016, the SWP water seasonal-high TDS concentrations continuously increased due to state-wide drought conditions that began in 2012. This increase correlates to the increase of the monthly combined water supply TDS concentration, and the monthly and 12-month running-average IEUA agency-wide effluent TDS concentrations. The increase in the TDS concentration of the combined monthly water supply is less than the increase in monthly SWP water TDS concentrations because it includes local water supplies with lower-TDS concentrations. In 2015, the proportion of the total water

[15] The Agency-wide 12-month running average TIN limit in the NPDES permit was decreased from 10 mgl to 8 mgl, effective July 8, 2006. This decreased limit was anticipated; therefore, secondary treatment at all facilities was optimized to attain lower TIN. The 12-Month Running Average TIN has not been above the limit of 8 mgl since the recycled water recharge program began in July 2005.

[16] Source of imported SWP water to IEUA agencies.

supply that is SWP water decreased, reducing the effect of the increasing TDS concentration of the SWP water on the volume-weighted TDS concentration of the total water supply. In 2016 and 2017, the TDS concentration of SWP water decreased due to wet-winter conditions in northern California. This also increased the availability of the SWP water supply. The increased use of lower-TDS concentration SWP water in 2016 and 2017 resulted in a decreasing trend of the 12-month running-average IEUA agency-wide effluent TDS concentration throughout 2017.

The relationships of the TDS concentrations plotted in Figure 2-7 indicate that the increase in the TDS concentration of SWP water during the drought contributed in part to the increase in the TDS concentration of the IEUA agency-wide effluent. The increasing trend in the TDS concentration of the effluent is not solely explained by the TDS concentrations plotted in Figure 2-7, and there are likely other factors contributing to the increase as suggested by the difference in the magnitude of increase between the monthly water supply TDS concentrations (about 70 mgl) and the monthly IEUA agency-wide effluent TDS concentrations (about 120 mgl) from 2012 to early 2016. Another likely cause of the increase in the effluent TDS concentration is the incorporation of the water conservation practices required by the State of California during the drought. Water conservation practices in 2015 and 2016 are evident in the time history of the volume of total water supply plotted in Figure 2-7. These trends suggest that drought conditions have a meaningful impact on the TDS concentration of water supply and recycled water and that future droughts similar to the 2012 to 2016 period could lead to short term exceedances of the 12-month running-average IEUA agency-wide effluent TDS. For this reason, Watermaster and the IEUA have petitioned the Regional Board to modify the TDS compliance metric for recycled water to a longer-term averaging period. The Regional Board agreed that an evaluation of the compliance metric is warranted and directed Watermaster and the IEUA to develop a technical scope of work to support the adoption of a longer-term averaging period. The scope of work was submitted to the Regional Board in 2017 and includes the following tasks:

- develop numerical modeling tools (R4, Hydrus 2D, MODFLOW, MT3D) to evaluate the projected future TDS and nitrate concentrations of the Chino Basin,
- define a baseline (status-quo) scenario and evaluate it with the new modeling tools
- define up to three alternative salinity management planning scenarios and evaluate them with the new modeling tools to compare the projected TDS and nitrate concentrations against the baseline scenario,
- use the results to develop a draft regulatory compliance strategy that includes a longer-term average period for recycled water TDS concentrations,
- collaborate with the Regional Board to review and finalize the regulatory strategy, and
- support the Regional Board in the preparation of a Basin Plan amendment upon approval of the regulatory strategy.

Watermaster and the IEUA began implementing the scope of work in July 2017 and are on schedule to complete the draft regulatory compliance strategy by July 2019.

2.4 Ambient Groundwater Quality

Commitment number 9 requires that Watermaster and the IEUA recompute the ambient TDS and nitrate concentrations for the Chino Basin and Cucamonga GMZs every three years, beginning in July 2005. The method used to compute ambient TDS and nitrate concentrations was consistent with the method used by the TIN/TDS Task Force to determine the antidegradation objectives for the GMZs of the Santa Ana River Watershed. The most recent recomputation, covering the 20-year period from 1996 to 2015, was completed by the Basin Monitoring Program Task Force in September 2017 (Daniel B. Stephens & Associates, Inc., 2017). Table 2-7 shows the results of the current and all historical ambient TDS and nitrate-nitrogen concentration determinations. As of 2015, the ambient TDS concentration of Chino-North is 360 mgl and thus, there remains 60 mgl of assimilative capacity. The ambient TDS concentration has been increasing at a rate of about 10 mgl per three-year period since 2003. The ambient nitrate-nitrogen concentration of Chino-North is 10.3 mgl and there is no assimilative capacity as has been the case since the adoption of the maximum benefit objectives. The ambient nitrate-nitrogen concentration has been increasing at a rate of about 0.4 mgl per three-year period since 2003. The next recomputation, covering the 20-year period from 1999 to 2018, is due to be completed by June 2020.

Table 2-1
Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date – as soon as possible, but no later than	Status of Compliance
1. Surface Water Monitoring Program[1] a. Submit draft Monitoring Program to Regional Board b. Implement Monitoring Program c. Submit Draft Revised Monitoring Program to Regional Board d. Implement Revised Monitoring Program e. Submit Draft Revised Monitoring Program(s) (subsequent to that required in "c", above) to Regional Board f. Implement Revised Monitoring Program(s) g. Annual data report submittal	a. January 23, 2005 b. Within 30 days from the date of Regional Board approval of the monitoring plan c. 15 days from 2012 Basin Plan Amendment (BPA) approval d. Upon Regional Board approval e. Upon notification of the need to do so from the Regional Board Executive Officer and in accordance with the schedule prescribed by the Executive Officer f. Upon Regional Board approval g. April 15th	a. Draft work plan submitted to the Regional Board on January 23, 2005 b. Monitoring plan initiated prior to Regional Board approval c. Draft work plan submitted to the Regional Board on February 16, 2012, six days after 2012 BPA approval d. Revised monitoring program began in December 2012 after the BPA was approved by the Office of Administrative Law on December 6, 2012 e. No revisions requested by the Regional Board f. n/a g. All annual reports submitted by April 15 of each year since 2006
2. Groundwater Monitoring Program[1] a. Submit Draft Monitoring Program to Regional Board b. Implement Monitoring Program c. Plan and schedule for demonstrating hydraulic control	a. January 23, 2005 b. Within 30 days from the date of Regional Board approval of the monitoring plan c. By December 31, 2013	a. Draft monitoring plan submitted to Regional Board on January 23, 2005 b. Monitoring program initiated prior to Regional Board approval c. Plan and schedule for demonstrating hydraulic control submitted in the 2014 Work Plan to the Regional Board on December 23, 2013

[1] The commitments related to surface water and groundwater monitoring were revised by a Basin Plan amendment approved by the Regional Board on February 10, 2012. The commitments and status of compliance shown in this table reflect the amended commitments for surface water and groundwater monitoring.

Table 2-1
Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date – as soon as possible, but no later than	Status of Compliance
d. Implement hydraulic control demonstration e. Submit Draft Revised Monitoring Program(s) (subsequent to that required in “a”, above) to Regional Board f. Implement revised monitoring plans (s) g. Annual data report submittal	d. Upon Regional Board approval e. Upon notification of the need to do so from the Regional Board Executive Officer and in accordance with the schedule prescribed by the Executive Officer f. Upon Regional Board approval g. April 15th	d. Hydraulic control demonstration reported in all annual reports e. No revisions requested by Regional Board f. n/a g. All annual reports submitted by April 15 of each year
3. Chino Desalters a. Chino-I Desalter expansion to 10 mgd b. Chino-II Desalter construction to 10 mgd capacity	a. Prior to the recharge of recycled water b. Recharge of recycled water allowed once award of contract and notice to proceed issued for construction of desalter treatment plant	a. Chino-I Desalter expansion to about 14 mgd was completed in April 2005 and operation began in October 2005; recycled water recharge began in July 2005. b. Contract for Chino-II Desalter awarded in early 2005; construction was completed to a capacity of 15 mgd, and the facility went online in June 2006.
4. Submittal of future desalters plan and schedule	October 1, 2005 Implement plan and schedule upon Regional Board approval	Several plans for desalter expansion have been submitted to the Regional Board since 2005. The capacity of the constructed desalter wells in 2015 was about 30 mgd. Watermaster and the IEUA submitted a plan to the Regional Board on June 30, 2015 to construct three additional wells to achieve the ultimate capacity of 36 mgd, per the Peace and Peace II Agreements. The first two wells are constructed and began operating in 2018. The construction of the the third well is anticipated to begin in 2019.

Table 2-1
Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date – as soon as possible, but no later than	Status of Compliance
5. Recharge facilities (17) built and in operation	June 30, 2005	Watermaster and the IEUA partnered with the San Bernardino County Flood Control District and the Chino Basin Water Conservation District for completion of the Chino Basin Facilities Improvement Program to construct and/or improve eighteen recharge sites. There are currently 17 basins in the Chino Basin Groundwater Recharge Program.
6. Submittal of IEUA wastewater quality improvement plan and schedule	60 days after agency-wide, 12-month running average effluent TDS quality equals or exceeds 545 mgl for 3 consecutive months, or after agency-wide, 12-month running average TIN equals or exceeds 8 mgl in any month Implement plan and schedule upon approval by Regional Board	These threshold events have not occurred; therefore, a wastewater quality improvement plan has not been submitted (See Table 2-5 and Figures 2-6 and 2-7 of this report).
7. Recycled water will be blended with other recharge sources such that the volume-weighted, 5-year running average TDS and nitrate-nitrogen concentrations of recharge are equal to or less than the maximum benefit water quality objectives. a. Submit a report that documents the location, amount of recharge, and TDS and nitrogen quality of storm water recharge before the OBMP recharge improvements were constructed and what is projected to occur after the recharge improvements are completed.	Compliance must be achieved by the end of the 5th year after initiation of recycled water recharge operations. a. Prior to initiation of recycled water recharge	a. No documentation of water quality data or quantity for storm water prior to OBMP initiation exists. Storm water has been monitored for flow, TDS, and nitrogen since 2005.

Table 2-1
Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date – as soon as possible, but no later than	Status of Compliance
b. Submit documentation of the amount and TDS and nitrogen quality of all sources of recharge and recharge locations. For storm water recharge used for blending, submit documentation that the recharge is the result of OBMP enhanced recharge facilities.	b. Annually, by April 15th, after initiation of construction of basins/other facilities to support enhanced storm water recharge	b. The volume-weighted, 5-year running average TDS and nitrate-nitrogen concentrations of Chino Basin recharge are less than the maximum-benefit water quality objectives (See Table 2-5, and Figures 2-5a and 2-5b of this report).
8. Hydraulic Control Failure a. Plan and schedule to correct loss of hydraulic control b. Achievement and maintenance of hydraulic control c. Mitigation plan for temporary failure to achieve/maintain hydraulic control	a. 60 days from Regional Board finding that hydraulic control is not being maintained b. In accordance with plan and schedule approved by the Regional Board c. By January 23, 2005	a. No mitigation plan and schedule for the loss of hydraulic control has been requested. b. Hydraulic control has been achieved to the east of Chino-I Desalter Well 20. Groundwater model estimates published in 2015 indicate that production at the CCWF will achieve hydraulic control in the west to *de minimis* levels (<1,000 afy of groundwater flow past the CCWF well field to the PBMZ). Full production at the CCWF was achieved in 2016. Watermaster and the IEUA submitted a plan on June 30, 2015 to the Regional Board to construct three additional wells to achieve the ultimate Desalter capacity of 40,000 afy. Construction of two wells is completed and they began operating in 2018. Construction of the third well is anticipated to begin in 2019.

Table 2-1
Status of Compliance with the Chino Basin Maximum-Benefit Commitments

Description of Commitment	Compliance Date – as soon as possible, but no later than	Status of Compliance
		c. Plan submitted to the Regional Board on March 3, 2005. No mitigation action has been triggered.
9. Ambient groundwater quality determination	July 1, 2005 and every three years thereafter	Watermaster and the IEUA have participated in the regional triennial ambient water quality determination as requested by SAWPA. Watermaster and the IEUA provide their fair share of funds and substantial groundwater data for this effort.

Table 2-2
Estimated Impacts on the Annual Discharge and Annual Discharge-Weighted Total Dissolved Solids (TDS) Concentration of the Santa Ana River at Prado Dam for Two Scenarios of Hydraulic Control

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
						= (3) - (5)	=[(3)*(4) - (5)*(6)]/(7)	= (8) - (4)	= (9)/(4)*100		= (11)/(4)*100
Hydraulic Control Scenario	**Water Year**	**Santa Ana River (SAR) at Prado Dam without CCWF in Operation[1]**		**CCWF Production**		**SAR at Prado Dam with CCWF in Operation[3]**		**Change in SAR at Prado Dam TDS Due to CCWF Operation**		**Difference in TDS of SAR at Prado Dam Due to Partial Containment at CCWF[4]**	**Percentage of the SAR at Prado Dam TDS that is the Difference in TDS Due to Non-Full Containment at CCWF**
		Discharge (afy)	**TDS (mgl)**	**Production (afy)**	**TDS[2] (mgl)**	**Discharge (afy)**	**TDS (mgl)**	**TDS (mgl)**	**TDS %**	**TDS (mgl)**	**TDS %**
Hydraulic Control at de minimis Threshold [5]	2009/2010	243,776	443	1,529	966	242,247	440	-3	-0.7	**2**	**0.4**
	2010/2011	324,892	528	1,529	966	323,363	526	-2	-0.4	**1**	**0.2**
	2011/2012	121,123	597	1,529	966	119,594	592	-5	-0.8	**3**	**0.5**
	2012/2013	100,003	621	1,529	966	98,474	616	-5	-0.9	**3**	**0.5**
	2013/2014	86,486	582	1,529	966	84,957	575	-7	-1.2	**4**	**0.7**
	2014/2015	107,600	522	1,529	966	106,071	516	-6	-1.2	**4**	**0.7**
Hydraulic Control at Full Containment[6]	2009/2010	243,776	443	2,405	966	241,371	438	-5	-1.2	-	-
	2010/2011	324,892	528	2,405	966	322,487	525	-3	-0.6	-	-
	2011/2012	121,123	597	2,405	966	118,718	590	-7	-1.3	-	-
	2012/2013	100,003	621	2,405	966	97,598	612	-9	-1.4	-	-
	2013/2014	86,486	582	2,405	966	84,081	571	-11	-1.9	-	-
	2014/2015	107,600	522	2,405	966	105,195	512	-10	-1.9	-	-

[1] Annual discharge and TDS concentration as estimated and reported by the Santa Ana River Watermaster

[2] Based on the volume-weighted average of measured TDS concentration at each CCWF well

[3] Annual discharge and TDS concentration for various levels of CCWF production

[4] Relative to the comparable water year and hydraulic control at full containment scenario

[5] In this scenario, groundwater discharge from the Chino-North is about 900 afy in the CCWF area, with production at CCWF wells I-16, I-17, I-20, and I-21

[6] In this scenario, there is full hydraulic containment of groundwater from the Chino-North through the CCWF area; in other words, discharge from Chino-North is 0 afy

Table 2-3

Model-Projected Groundwater Discharge Past the Chino Creek Well Field (CCWF) - Scenario 1A - Fiscal Year 2018 to 2050

Fiscal Year	Projected Flow through the CCWF (afy)
2018	916
2019	891
2020	859
2021	851
2022	844
2023	840
2024	836
2025	832
2026	829
2027	827
2028	827
2029	828
2030	830
2031	818
2032	825
2033	830
2034	832
2035	830
2036	827
2037	823
2038	818
2039	813
2040	806
2041	801
2042	797
2043	791
2044	783
2045	774
2046	765
2047	757
2048	748
2049	739
2050	731

Note: Values are based off of projected data used in Scenario 1A from Chino Basin Watermaster Storage Framework Investigation Report published in October 2018 and amended in January 2019.

Table 2-4

Annual Groundwater Recharge at Chino Basin Facilities - 2005 to 2018

Calendar Year	Imported water (af)	Storm water (af)	Recycled Water (af)	Total (af)
2005	22,015	16,334	868	39,217
2006	47,426	11,852	2,699	61,977
2007	3,948	6,074	1,622	11,644
2008	0	10,568	2,781	13,349
2009	20	8,220	4,516	12,756
2010	4,980	19,390	8,304	32,674
2011	32,913	10,762	6,914	50,589
2012	0	9,372	7,823	17,195
2013	0	3,429	14,394	17,823
2014	795	8,166	10,997	19,958
2015	0	6,769	12,056	18,825
2016	4,261	9,812	14,310	28,383
2017	39,581	7,824	14,481	61,885
2018	5,989	6,754	12,510	25,253
Total	**161,928**	**135,326**	**114,275**	**411,529**

Table 2-5

Monthly Calculation of the Five-Year, Volume-Weighted, Total Dissolved Solids (TDS) and Nitrate-Nitrogen Concentrations of Recharge Water Sources to the Chino Basin [1]

Five-Year Period	TDS (mgl)	Nitrate-N (mgl)
July 2005 - June 2010	203	1.1
Aug 2005 - July 2010	205	1.1
Sept 2005 - Aug 2010	207	1.1
Oct 2005 - Sept 2010	208	1.1
Nov 2005 - Oct 2010	210	1.1
Dec 2005 - Nov 2010	211	1.2
Jan 2006 - Dec 2010	213	1.1
Feb 2006 - Jan 2011	212	1.2
March 2006 - Feb 2011	214	1.2
April 2006 - March 2011	216	1.2
May 2006 - April 2011	221	1.3
June 2006 - May 2011	222	1.3
July 2006 - June 2011	222	1.3
Aug 2005 - July 2011	218	1.2
Sept 2006 - Aug 2011	215	1.2
Oct 2006 - Sept 2011	213	1.2
Nov 2006 - Oct 2011	217	1.3
Dec 2006 - Nov 2011	220	1.3
Jan 2007 - Dec 2011	218	1.4
Feb 2007 - Jan 2012	218	1.4
March 2007 - Feb 2012	218	1.4
April 2007 - March 2012	216	1.4
May 2007 - April 2012	215	1.4
June 2007 - May 2012	217	1.4
July 2007 - June 2012	220	1.4
Aug 2007 - July 2012	221	1.4
Sept 2007 - Aug 2012	221	1.4
Oct 2007 - Sept 2012	222	1.4
Nov 2007 - Oct 2012	222	1.4
Dec 2007 - Nov 2012	223	1.4
Jan 2008 - Dec 2012	224	1.5
Feb 2008 - Jan 2013	231	1.6
March 2008 - Feb 2013	233	1.6
April 2008 - March 2013	235	1.6
May 2008 - April 2013	236	1.6
June 2008 - May 2013	237	1.6
July 2008 - June 2013	239	1.7
Aug 2008 - July 2013	240	1.7
Sept 2008 - Aug 2013	241	1.7
Oct 2008 - Sept 2013	243	1.7
Nov 2008 - Oct 2013	245	1.7
Dec 2008 - Nov 2013	247	1.7
Jan 2009 - Dec 2013	251	1.8

Table 2-5

Monthly Calculation of the Five-Year, Volume-Weighted, Total Dissolved Solids (TDS) and Nitrate-Nitrogen Concentrations of Recharge Water Sources to the Chino Basin [1]

Five-Year Period	TDS (mgl)	Nitrate-N (mgl)
Feb 2009 - Jan 2014	253	1.8
March 2009 - Feb 2014	257	1.8
April 2009 - March 2014	259	1.9
May 2009 - April 2014	261	1.9
June 2009 - May 2014	263	1.9
July 2009 - June 2014	264	1.9
Aug 2009 - July 2014	265	1.9
Sept 2009 - Aug 2014	266	1.9
Oct 2009 - Sept 2014	268	1.9
Nov 2009 - Oct 2014	269	1.9
Dec 2009 - Nov 2014	269	1.9
Jan 2010 - Dec 2014	266	1.9
Feb 2010 - Jan 2015	273	2.0
March 2010 - Feb 2015	279	2.0
April 2010 - March 2015	280	2.0
May 2010 - April 2015	283	2.0
June 2010 - May 2015	283	2.1
July 2010 - June 2015	285	2.1
Aug 2010 - July 2015	286	2.1
Sept 2010 - Aug 2015	286	2.1
Oct 2010 - Sept 2015	287	2.1
Nov 2010 - Oct 2015	287	2.1
Dec 2010 - Nov 2015	289	2.1
Jan 2011 - Dec 2015	291	2.2
Feb 2011 - Jan 2016	288	2.2
March 2011 - Feb 2016	290	2.2
April 2011 - March 2016	292	2.2
May 2011 - April 2016	293	2.2
June 2011 - May 2016	300	2.3
July 2011 - June 2016	310	2.4
Aug 2011 - July 2016	323	2.6
Sept 2011 - Aug 2016	338	2.8
Oct 2011 - Sept 2016	354	3.0
Nov 2011 - Oct 2016	349	2.9
Dec 2011 - Nov 2016	352	2.9
Jan 2012 - Dec 2016	345	2.8
Feb 2012 - Jan 2017	336	2.7
March 2012 - Feb 2017	334	2.7
April 2012 - March 2017	340	2.8
May 2012 - April 2017	342	2.8
June 2012 - May 2017	342	2.8
July 2012 - June 2017	328	2.6
Aug 2012 - July 2017	314	2.5

Table 2-5

Monthly Calculation of the Five-Year, Volume-Weighted, Total Dissolved Solids (TDS) and Nitrate-Nitrogen Concentrations of Recharge Water Sources to the Chino Basin [1]

Five-Year Period	TDS (mgl)	Nitrate-N (mgl)
Sept 2012 - Aug 2017	302	2.4
Oct 2012 - Sept 2017	298	2.3
Nov 2012 - Oct 2017	292	2.3
Dec 2012 - Nov 2017	290	2.3
Jan 2013 - Dec 2017	289	2.2
Feb 2013 - Jan 2018	287	2.1
March 2013 - Feb 2018	287	2.1
April 2013 - March 2018	283	2.1
May 2013 - April 2018	283	2.1
June 2013 - May 2018	283	2.1
July 2013 - June 2018	283	2.1
Aug 2013 - July 2018	284	2.1
Sept 2013 - Aug 2018	284	2.1
Oct 2013 - Sept 2018	284	2.1
Nov 2013 - Oct 2018	283	2.1
Dec 2013 - Nov 2018	282	2.0
Jan 2014 - Dec 2018	281	2.0

1 - See Appendix A for more details.

Table 2-6

Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent
Total Inorganic Nitrogen (TIN) and Total Dissolved Solids (TDS) Concentrations - 2005 to 2018

Month	TIN (mgl)		TDS (mgl)	
	Monthly	12-Month Running Average [1]	Monthly	12-Month Running Average
Jan-05	7.3	8.4	492	486
Feb-05	8.4	8.4	496	487
Mar-05	7.5	8.4	516	488
Apr-05	6.9	8.2	534	491
May-05	6.7	8.0	513	492
Jun-05	7.0	8.0	507	492
Jul-05	5.4	7.8	466	492
Aug-05	5.9	7.7	452	490
Sep-05	5.4	7.4	469	491
Oct-05	5.5	7.1	468	491
Nov-05	5.5	6.7	467	490
Dec-05	8.4	6.7	481	488
Jan-06	9.9	6.9	491	488
Feb-06	9.0	6.9	467	486
Mar-06	8.8	7.1	471	482
Apr-06	7.8	7.1	464	476
May-06	8.3	7.2	454	471
Jun-06	6.5	7.2	466	468
Jul-06	6.8	7.3	472	469
Aug-06	5.9	7.3	475	470
Sep-06	6.5	7.4	465	470
Oct-06	6.4	7.6	457	469
Nov-06	6.9	7.6	456	468
Dec-06	7.1	7.5	470	467
Jan-07	7.7	7.3	488	467
Feb-07	6.2	7.1	481	468
Mar-07	6.7	6.9	490	470
Apr-07	5.6	6.7	491	472
May-07	5.6	6.5	489	475
Jun-07	6.0	6.5	495	477
Jul-07	5.1	6.3	492	479
Aug-07	5.2	6.3	478	479
Sep-07	5.9	6.2	478	480
Oct-07	6.0	6.2	517	485
Nov-07	7.6	6.2	514	490
Dec-07	7.4	6.3	522	495
Jan-08	6.8	6.2	511	481
Feb-08	6.4	6.2	492	483
Mar-08	6.6	6.2	515	484
Apr-08	6.7	6.3	519	487
May-08	7.2	6.4	502	489
Jun-08	6.8	6.5	490	490

Table 2-6

Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent Total Inorganic Nitrogen (TIN) and Total Dissolved Solids (TDS) Concentrations - 2005 to 2018

Month	TIN (mgl)		TDS (mgl)	
	Monthly	12-Month Running Average [1]	Monthly	12-Month Running Average
Jul-08	6.1	6.6	499	491
Aug-08	5.8	6.6	514	492
Sep-08	8.3	6.8	510	494
Oct-08	7.0	6.9	503	496
Nov-08	5.7	6.7	496	498
Dec-08	6.3	6.7	494	504
Jan-09	6.5	6.6	497	503
Feb-09	7.8	6.7	463	500
Mar-09	6.9	6.8	496	499
Apr-09	6.6	6.8	509	498
May-09	5.8	6.6	501	498
Jun-09	5.4	6.5	505	499
Jul-09	5.0	6.4	512	499
Aug-09	4.5	6.3	499	497
Sep-09	4.0	6.0	498	497
Oct-09	4.6	5.8	500	497
Nov-09	4.8	5.7	489	497
Dec-09	5.5	5.6	494	497
Jan-10	5.7	5.6	493	496
Feb-10	6.2	5.4	489	498
Mar-10	6.4	5.4	482	497
Apr-10	5.7	5.3	473	494
May-10	5.2	5.3	471	492
Jun-10	5.0	5.2	478	490
Jul-10	5.1	5.2	477	487
Aug-10	4.6	5.2	477	485
Sep-10	3.7	5.2	476	483
Oct-10	5.5	5.3	478	481
Nov-10	5.7	5.3	479	481
Dec-10	5.0	5.3	472	479
Jan-11	6.4	5.4	474	477
Feb-11	6.9	5.4	455	474
Mar-11	6.4	5.4	468	473
Apr-11	6.5	5.5	460	472
May-11	6.0	5.6	462	471
Jun-11	5.7	5.6	464	470
Jul-11	4.3	5.5	454	468
Aug-11	4.4	5.5	457	467
Sep-11	5.8	5.7	457	465
Oct-11	5.2	5.7	457	463
Nov-11	5.9	5.7	453	461
Dec-11	6.3	5.8	454	460

Table 2-6

Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent
Total Inorganic Nitrogen (TIN) and Total Dissolved Solids (TDS) Concentrations - 2005 to 2018

Month	TIN (mgl)		TDS (mgl)	
	Monthly	12-Month Running Average [1]	Monthly	12-Month Running Average
Jan-12	6.4	5.8	465	459
Feb-12	6.7	5.8	476	461
Mar-12	6.7	5.8	497	463
Apr-12	7.4	5.9	496	466
May-12	6.4	5.9	493	469
Jun-12	5.8	5.9	482	470
Jul-12	5.4	6.0	477	472
Aug-12	4.8	6.1	463	473
Sep-12	5.1	6.0	472	474
Oct-12	4.9	6.0	486	476
Nov-12	6.1	6.0	485	479
Dec-12	6.0	6.0	492	482
Jan-13	6.1	5.9	495	484
Feb-13	6.8	5.9	490	486
Mar-13	6.1	5.9	493	485
Apr-13	6.4	5.8	501	486
May-13	6.4	5.8	503	487
Jun-13	5.8	5.8	502	488
Jul-13	5.6	5.8	496	490
Aug-13	6.9	6.0	496	493
Sep-13	7.3	6.2	499	495
Oct-13	7.4	6.4	496	496
Nov-13	6.7	6.4	507	497
Dec-13	7.6	6.6	511	499
Jan-14	5.9	6.6	510	500
Feb-14	6.1	6.5	509	502
Mar-14	5.5	6.5	497	502
Apr-14	5.2	6.4	517	504
May-14	5.2	6.3	524	505
Jun-14	4.4	6.1	506	506
Jul-14	3.5	6.0	494	505
Aug-14	3.5	5.7	508	506
Sep-14	4.1	5.4	524	508
Oct-14	4.9	5.2	541	512
Nov-14	5.9	5.1	571	518
Dec-14	6.2	5.0	565	522
Jan-15	7.9	5.2	546	525
Feb-15	7.4	5.3	560	529
Mar-15	6.2	5.4	528	532
Apr-15	5.2	5.4	531	533
May-15	6.1	5.4	520	533
Jun-15	4.6	5.4	515	534

Table 2-6

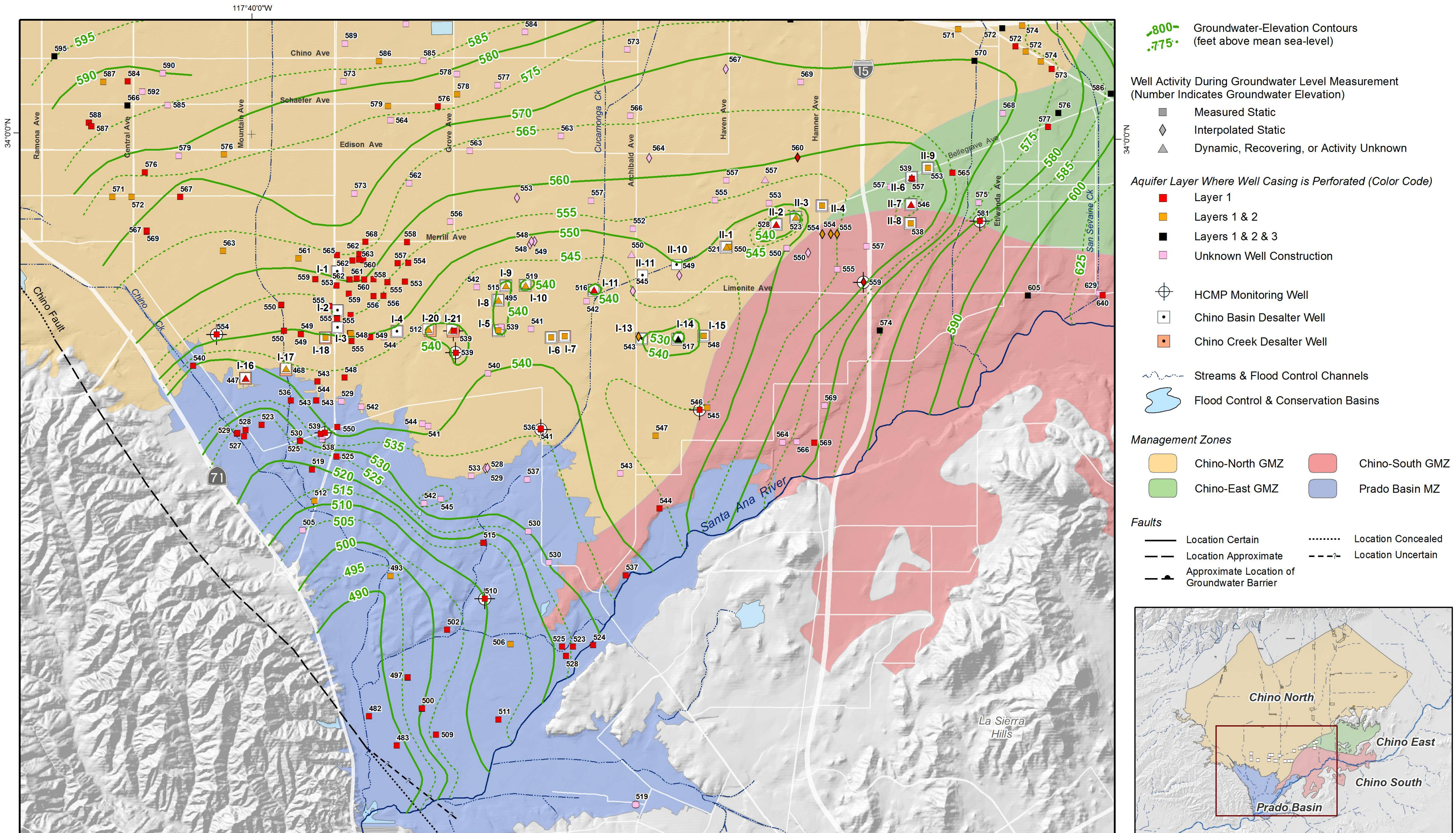
Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent Total Inorganic Nitrogen (TIN) and Total Dissolved Solids (TDS) Concentrations - 2005 to 2018

Month	TIN (mgl)		TDS (mgl)	
	Monthly	12-Month Running Average [1]	Monthly	12-Month Running Average
Jul-15	5.2	5.6	500	534
Aug-15	4.7	5.7	503	534
Sep-15	4.8	5.7	508	532
Oct-15	5.2	5.8	506	529
Nov-15	5.4	5.7	505	524
Dec-15	6.2	5.7	503	519
Jan-16	7.3	5.7	504	515
Feb-16	6.5	5.6	495	510
Mar-16	5.9	5.6	521	509
Apr-16	5.8	5.6	514	508
May-16	5.7	5.6	514	507
Jun-16	5.3	5.7	519	508
Jul-16	6.2	5.7	514	509
Aug-16	6.5	5.9	502	509
Sep-16	6.4	6.0	492	507
Oct-16	5.8	6.1	491	506
Nov-16	5.5	6.1	489	505
Dec-16	5.8	6.0	495	504
Jan-17	6.5	6.0	495	504
Feb-17	6.7	6.0	489	503
Mar-17	5.3	5.9	469	499
Apr-17	5.8	6.0	468	495
May-17	5.7	6.0	464	491
Jun-17	5.5	6.0	461	486
Jul-17	6.8	6.0	447	480
Aug-17	6.0	6.0	446	476
Sep-17	5.7	5.9	440	471
Oct-17	6.1	6.0	428	466
Nov-17	6.5	6.0	455	463
Dec-17	6.8	6.0	444	459
Jan-18	5.3	6.0	464	456
Feb-18	5.3	5.9	488	456
Mar-18	4.4	5.8	504	459
Apr-18	5.0	5.8	485	460
May-18	4.8	5.7	495	463
Jun-18	4.7	5.6	490	465
Jul-18	4.6	5.4	484	468
Aug-18	4.3	5.3	478	471
Sep-18	5.2	5.3	467	473
Oct-18	4.7	5.1	496	479
Nov-18	5.9	5.1	505	483
Dec-18	5.0	4.9	487	487

1- The Agency-wide 12-month running average TIN limit in the NPDES permit was decreased from 10 mg/L to 8 mg/L, effective July 8, 2006. This decreased limit was anticipated; therefore, secondary treatment at all facilities was optimized to attain lower TIN. The 12-Month Running Average TIN has not been above the limit of 8 mg/L since the recycled water recharge program began in July 2005.

Table 2-7
Water Quality Objectives and Ambient Water Quality Determinations for the Chino Basin and Cucamonga Groundwater Management Zones

Groundwater Management Zone	Water Quality Objectives mgl				Ambient Water Quality Determination mgl											
	Antidegradation		Maximum Benefit		1997		2003		2006		2009		2012		2015	
	TDS	NO_3-N	TDS	NO_3-N	TDS	NO_3-N	TDS	NO_3-N	TDS	NO_3-N	TDS	NO_3-N	TDS	NO_3-N	TDS	NO_3-N
Chino Basin Maximum-Benefit Groundwater Management Zone																
Chino-North	--	--	420	5	300	7.4	320	8.7	340	9.7	340	9.5	350	10	360	10.3
Chino Basin Antidegradation Groundwater Management Zones																
Chino 1	280	5	--	--	310	8.4	330	8.9	340	9.3	340	9.1	350	10	350	10.5
Chino 2	250	2.9	--	--	300	7.2	340	9.5	360	10.7	360	10.3	380	10.7	380	10.9
Chino 3	260	3.5	--	--	280	6.3	280	6.8	310	8.2	320	8.4	320	8.5	320	8.9
Chino-South	680	4.2	--	--	720	8.8	790	15.3	940	25.7	980	26.8	990	28	940	27.8
Chino-East	730	10	--	--	760	29.1	620	9.6	650	12.7	770	15.7	770	21	840	22
Cucamonga	210	2.4	380	5	260	4.4	250	4.3	250	4.0	250	4.1	260	4.1	260	4.3



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Author: NWS

Date: 4/11/2019

Document Name: Figure 2-1_HC_Spring16

0 1 2 Miles

0 1 2 3 Kilometers

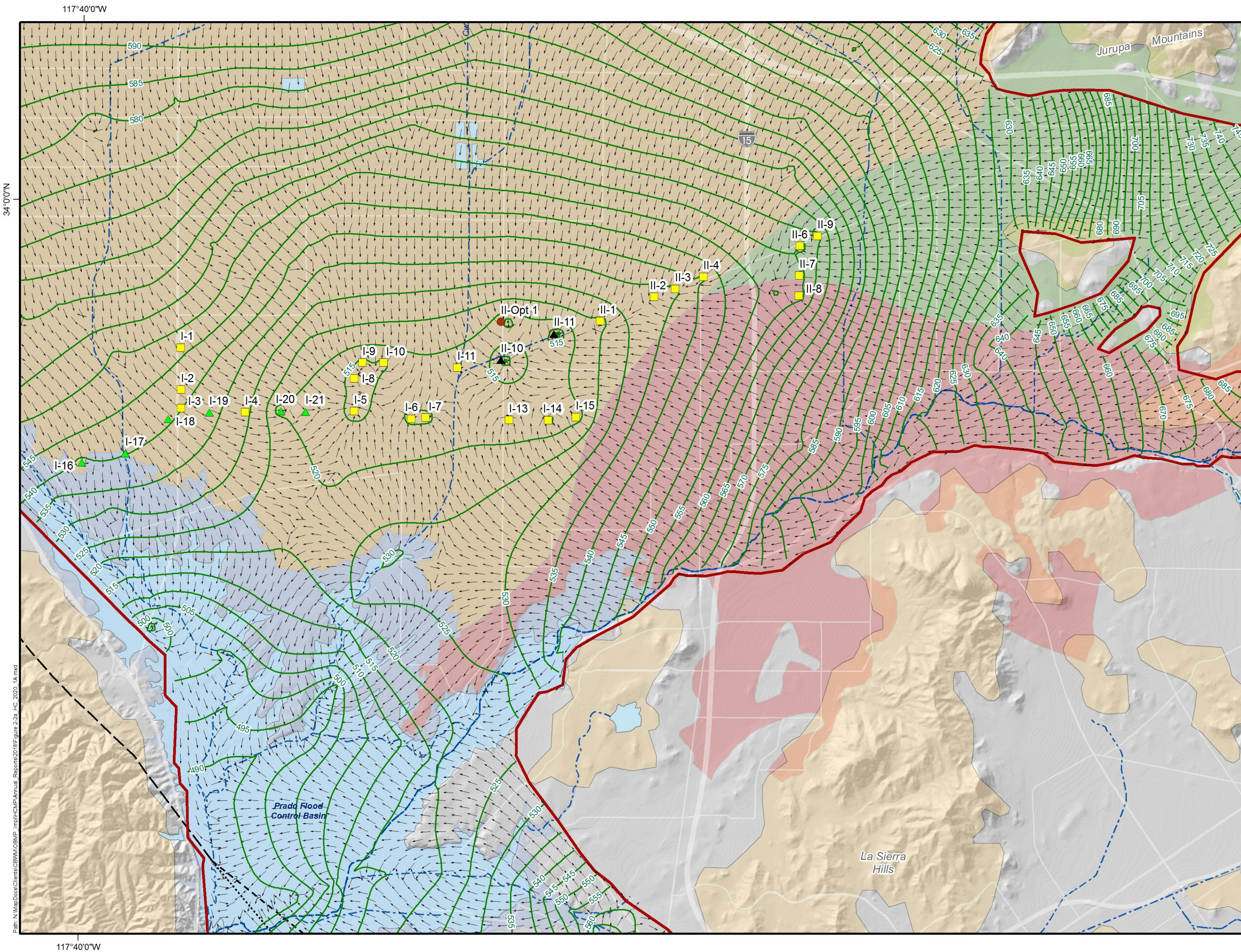
(Exhibit 4-8 from the 2016 Chino Basin State of the Basin Report - June 2017)

2018 Maximum Benefit Annual Report

State of Hydraulic Control in Spring 2016

Shallow Aquifer System

Figure 2-1



2020 Groundwater Flow Vectors Model Layer 1 - Scenario 1A*

2020 Groundwater Elevation Contours (Scenario 1A*) *(feet above mean sea-level)*

Chino Desalter Well

Chino Creek Well Field Well

Future Chino II Desalter Well (assumed operation in 2018)

Optional Location of a Future Chino II Desalter Well (assumed operational in 2019)

Groundwater Flow Model Boundary

Flood Control and/or Conservation Basins

Streams & Flood Control Channels

Management Zones

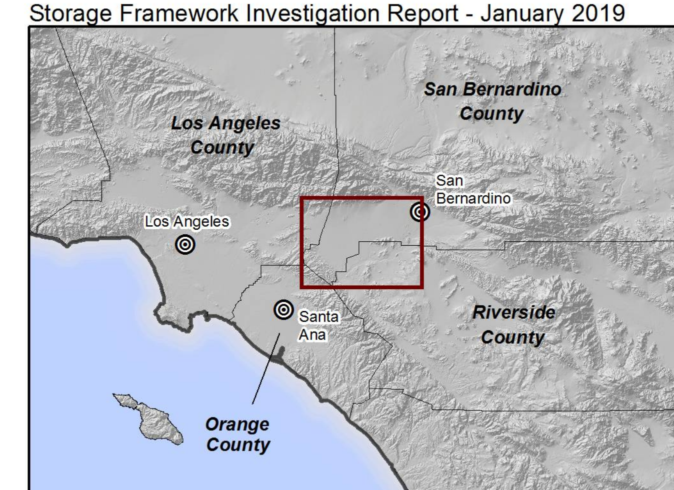
Chino-North GMZ

Chino-East GMZ

Chino-South GMZ

Prado Basin MZ

*Scenario 1A from Chino Basin Watermaster's Storage Framework Investigation Report - January 2019



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Date: 3/29/2019

0 1 2 **Miles**

0 0.5 1 1.5 **Kilometers**

2018 Maximum Benefit Annual Report

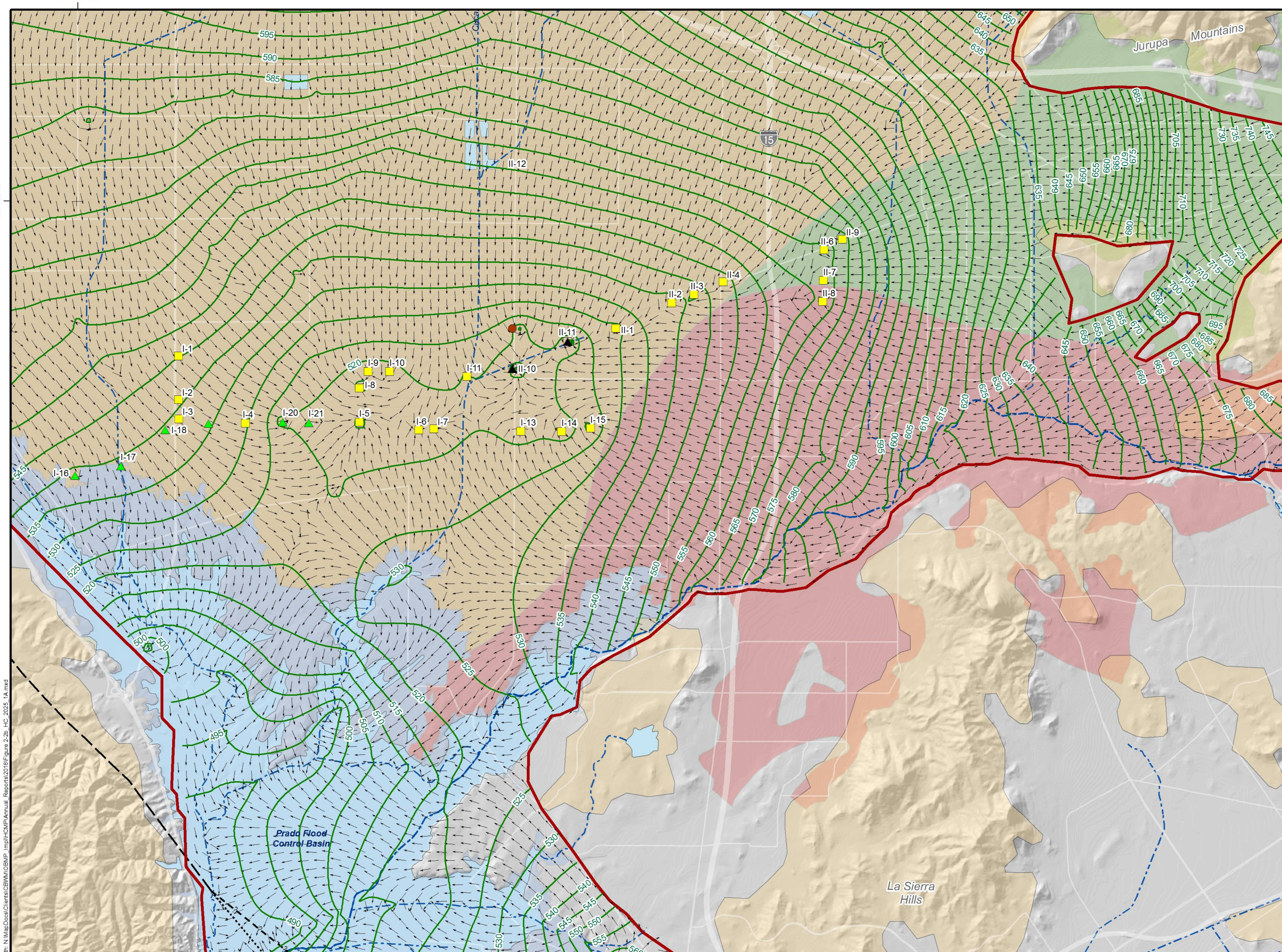
State of Hydraulic Control in 2020

*Scenario 1A**

Figure 2-2a

117°40'0"W

34°0'0"N



117°40'0"W

34°0'0"N

2025 Groundwater Flow Vectors Model Layer 1 - Scenario 1A*

2025 Groundwater Elevation Contours (Scenario 1A*) *(feet above mean sea-level)*

Chino Desalter Well

Chino Creek Well Field Well

Future Chino II Desalter Well (assumed operational in 2018)

Optional Location for a Future Chino II Desalter Well (assumed operational in 2019)

Groundwater Flow Model Boundary

Flood Control and/or Conservation Basins

Streams & Flood Control Channels

Management Zones

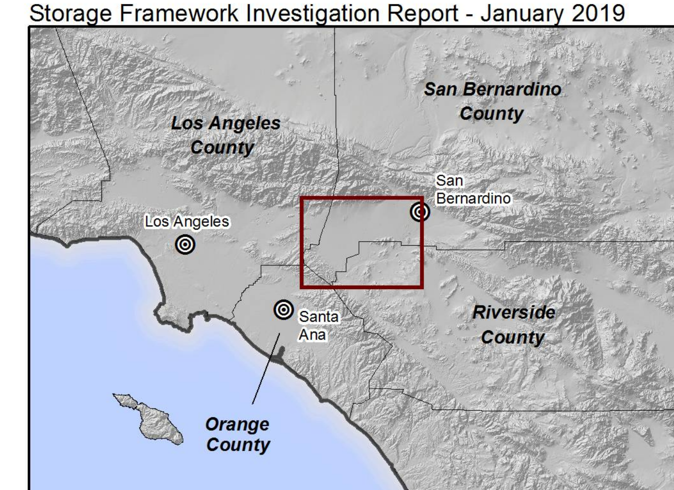
Chino-North GMZ

Chino-South GMZ

Chino-East GMZ

Prado Basin MZ

*Scenario 1A from Chino Basin Watermaster's Storage Framework Investigation Report - January 2019



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0 1 2 Miles

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2018 Maximum Benefit Annual Report

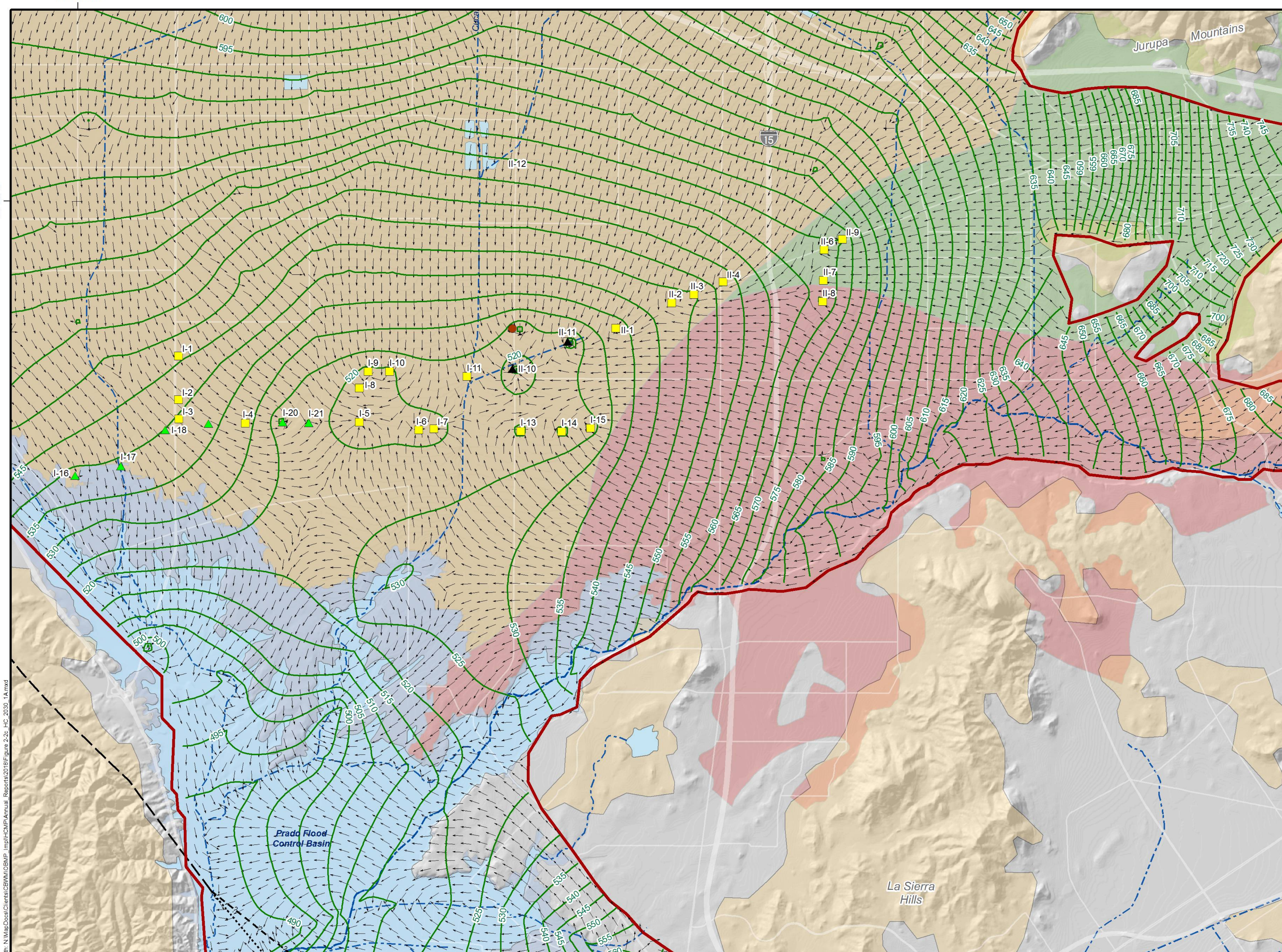
State of Hydraulic Control in 2025

*Scenario 1A**

Figure 2-2b

117°40'0"W

34°0'0"N



34°0'0"N

117°40'0"W

2030 Groundwater Flow Vectors
Model Layer 1 - Scenario 1A*

2030 Groundwater Elevation Contours (Scenario 1A*)
(feet above mean sea-level)

Chino Desalter Well

Chino Creek Well Field Well

Future Chino II Desalter Well
(assumed operational in 2018)

Optional Location for a Future Chino II Desalter Well
(assumed operational in 2019)

Groundwater Flow Model Boundary

Flood Control and/or Conservation Basins

Streams & Flood Control Channels

Management Zones

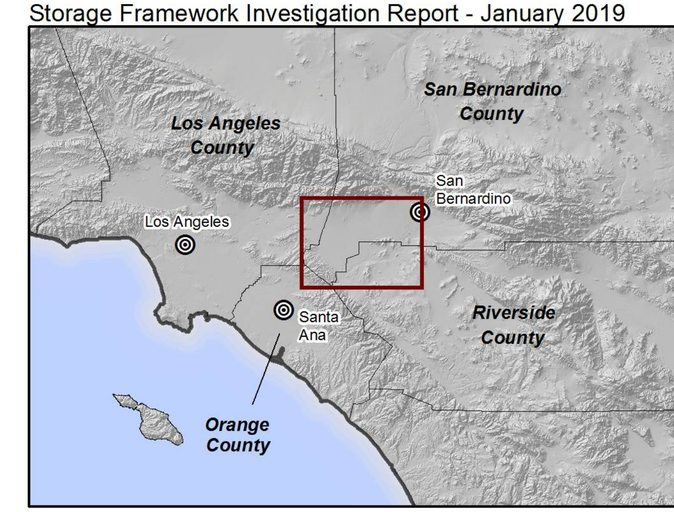
Chino-North GMZ

Chino-South GMZ

Chino-East GMZ

Prado Basin MZ

*Scenario 1A from Chino Basin Watermaster's
Storage Framework Investigation Report - January 2019



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0 1 2 Miles

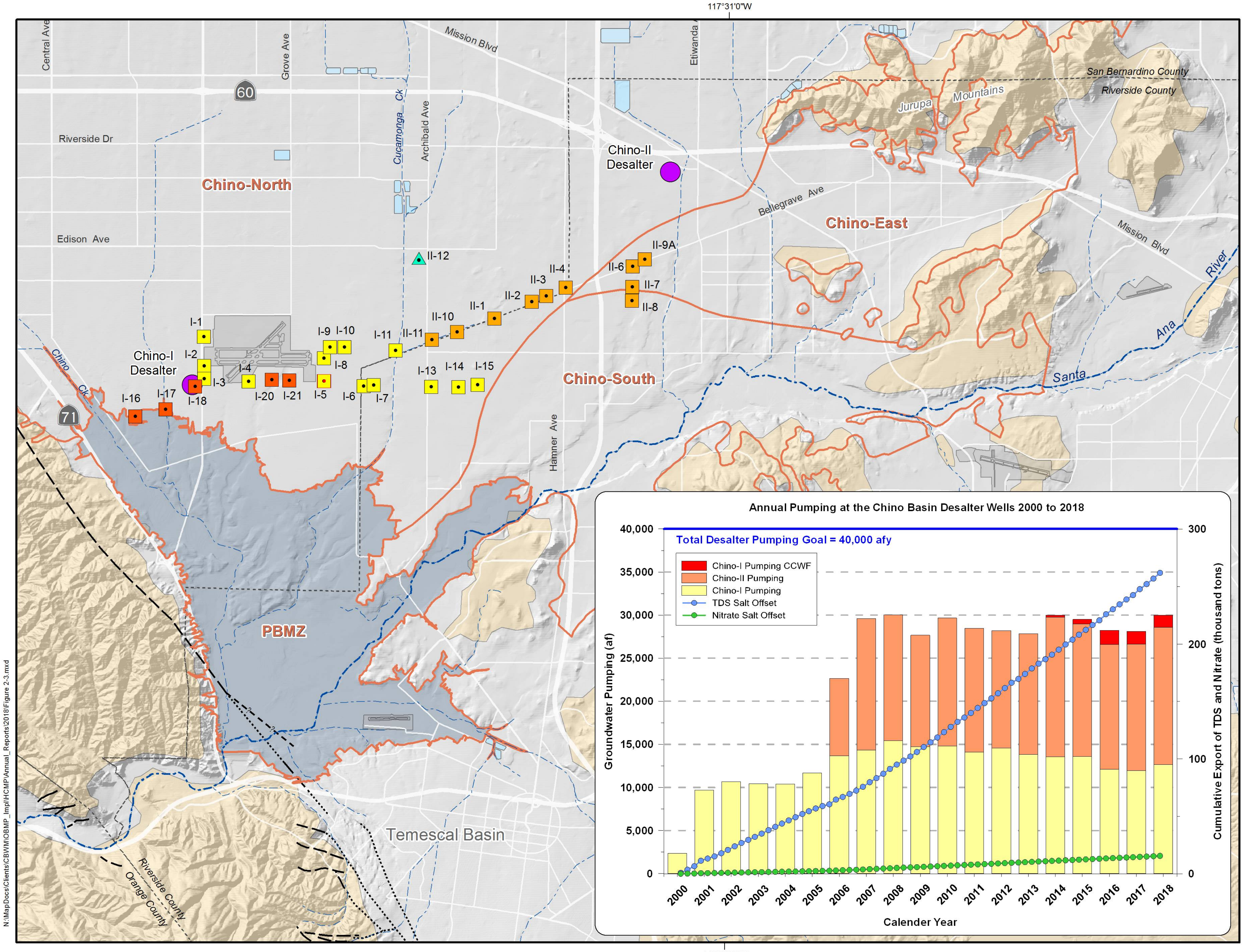
0 0.5 1 1.5 Kilometers

2018 Maximum Benefit
Annual Report

State of Hydraulic Control in 2030

*Scenario 1A**

Figure 2-2c



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Chino Basin Desalter Wells

Existing Wells

- Chino-I Desalter Well
- Chino-I Desalter Well 5
- Chino-I CCWF Well
- Chino-II Desalter Well

Expansion Wells

- Optional Location for a Future Chino II Desalter Well
- Desalter Treatment Facility
- Groundwater Management Zone Boundaries
- Prado Basin Management Zone (PBMZ)
- Rivers and Streams
- Flood Control and/or Conservation Basins

Geology

Water-Bearing Sediments

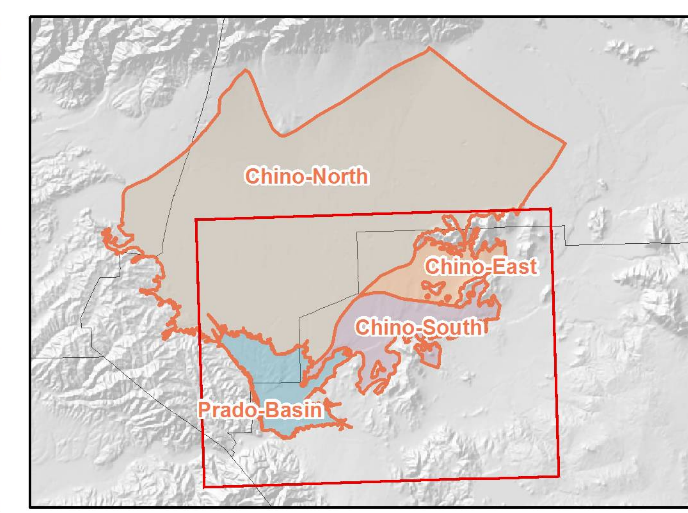
- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Approximate Location of Groundwater Barrier
- Location Concealed
- Location Uncertain



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File: Figure 2-3

0 1 2 3 4 Miles

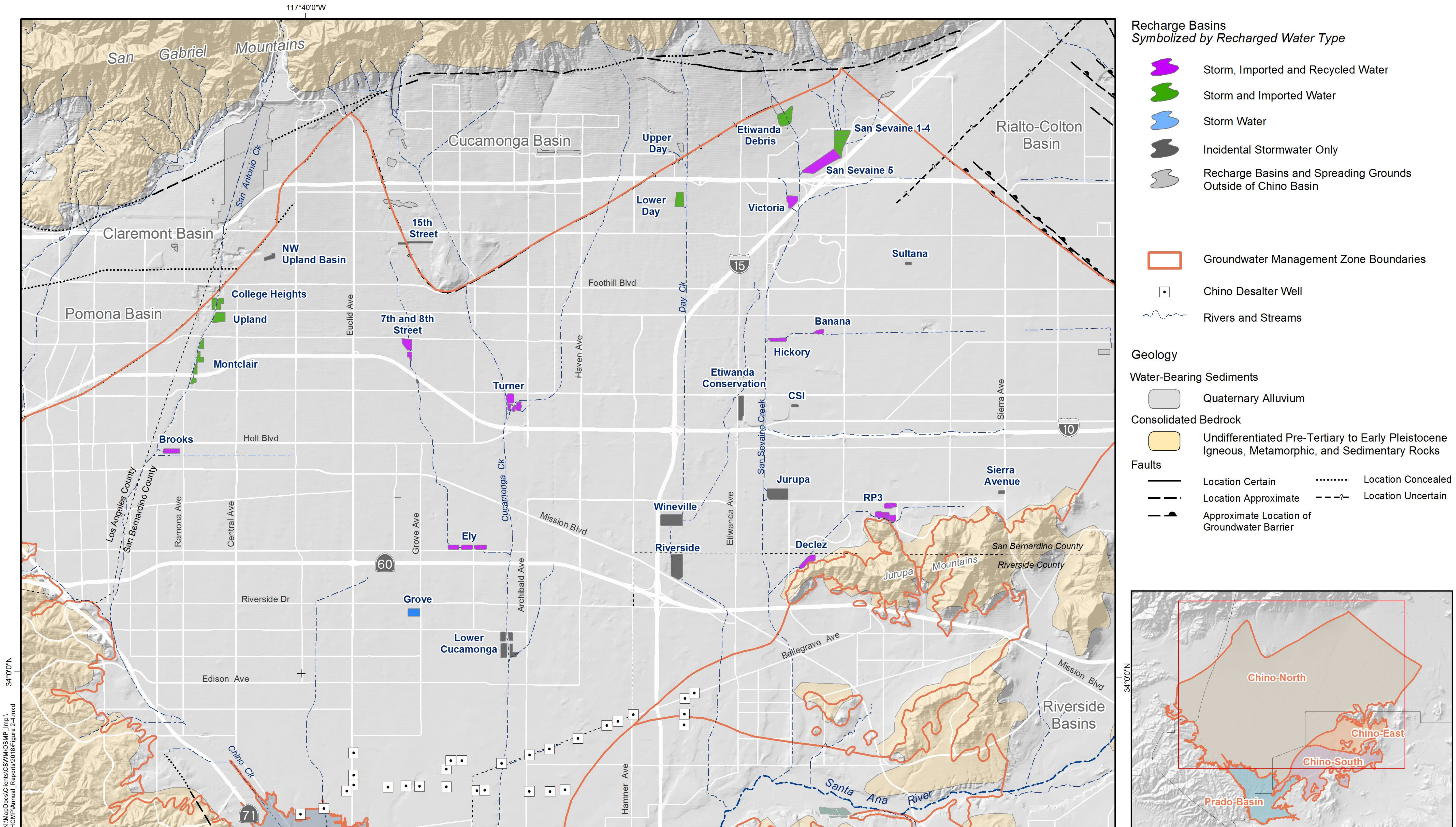
0 2 4 6 Kilometers

2018 Maximum Benefit Annual Report

Chino Basin Desalter Wells

Annual Pumping 2000 to 2018

Figure 2-3



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2018 Maximum Benefit Annual Report

Chino Basin Recharge Basins

Existing Facilities by Recharge Type as of 2018

Figure 2-4

Figure 2-5a
Volume and Total Dissolved Solids (TDS) Concentrations of Recharge Water Sources in the Chino Basin - 2005 to 2018

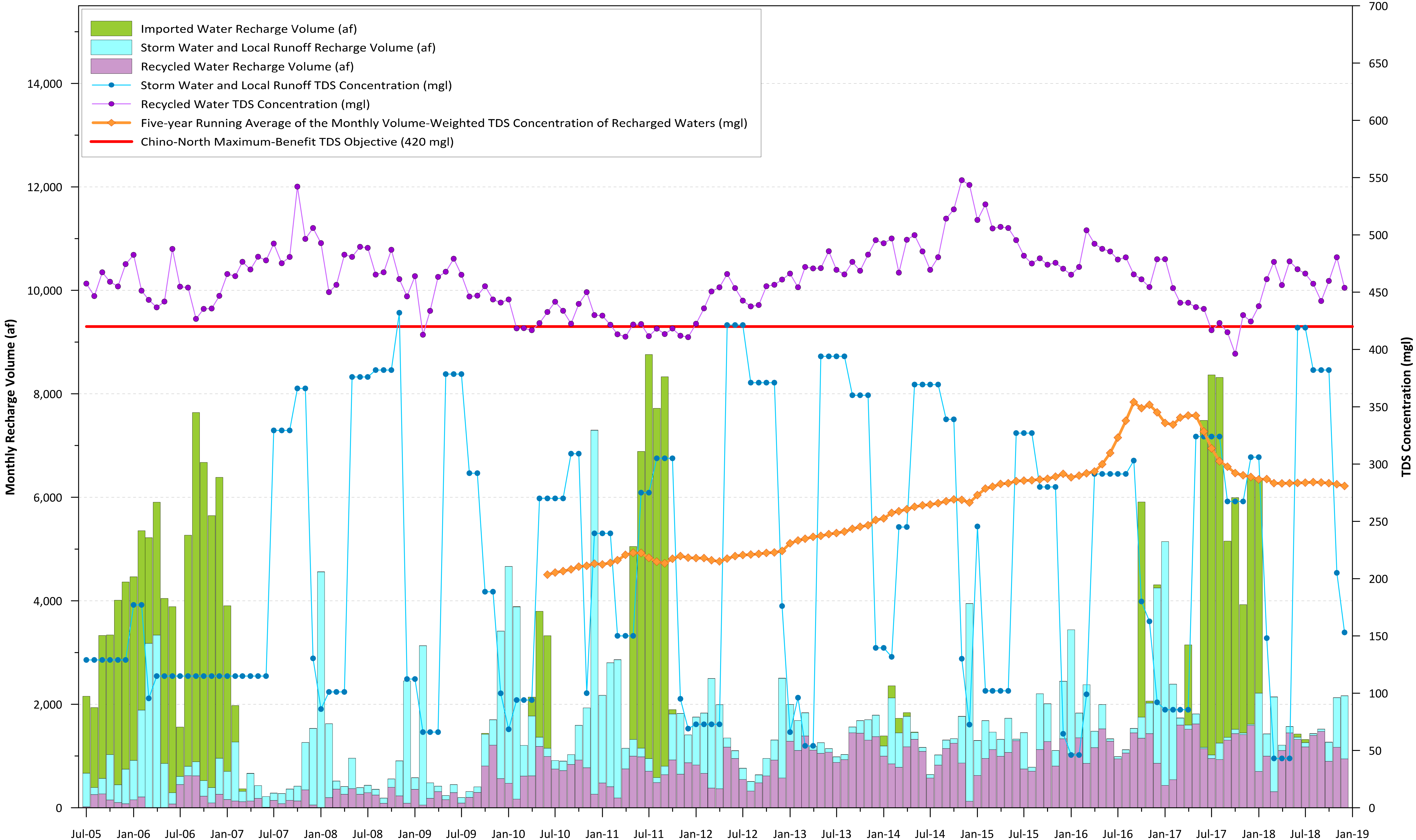


Figure 2-5b
Volume and Nitrate-Nitrogen Concentrations of Recharge Water Sources in the Chino Basin - 2005 to 2018

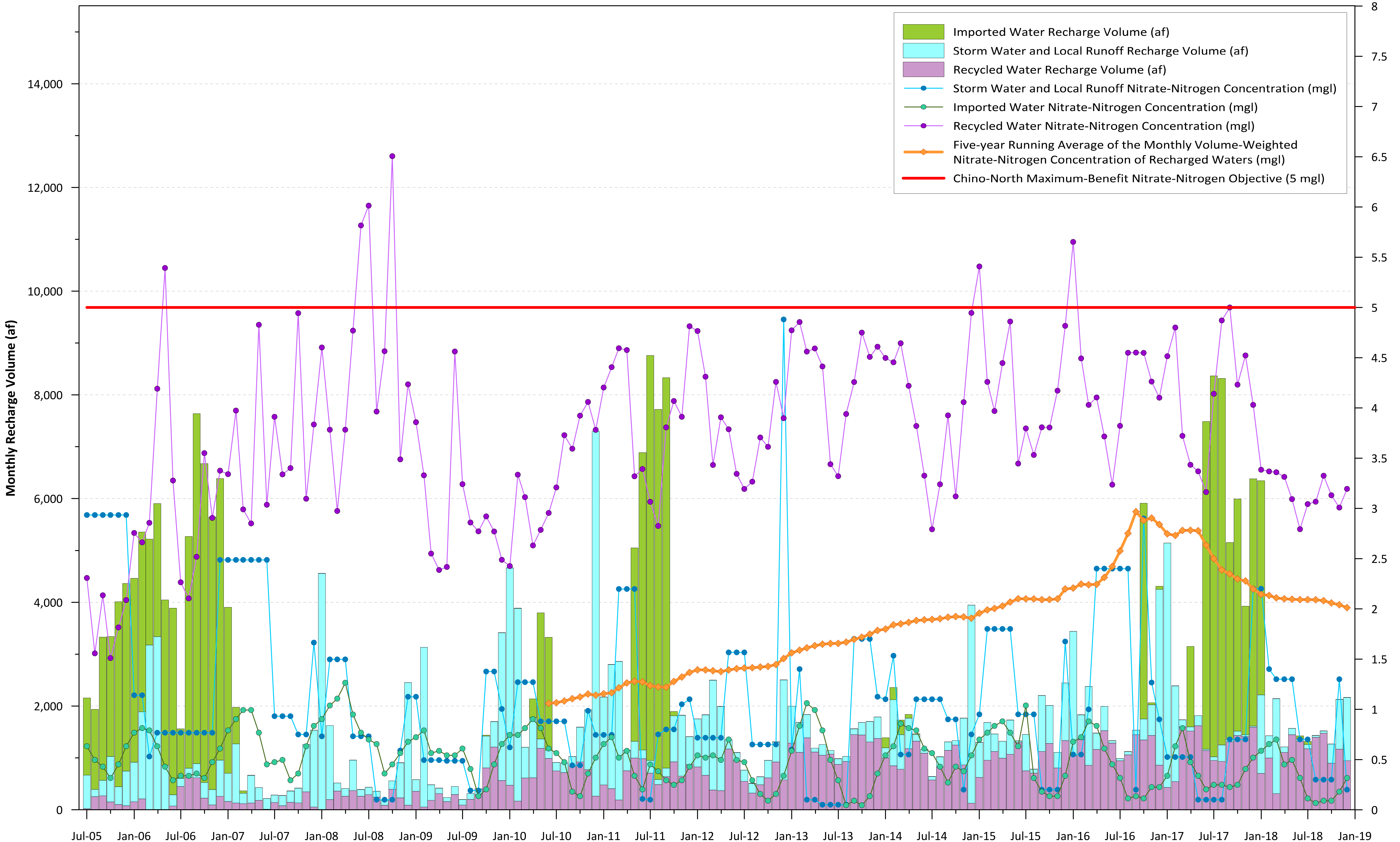


Figure 2-6
Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent
Total Dissolved Solids (TDS) and Total Inorganic Nitrogen (TIN) Concentrations - 2005 to 2018

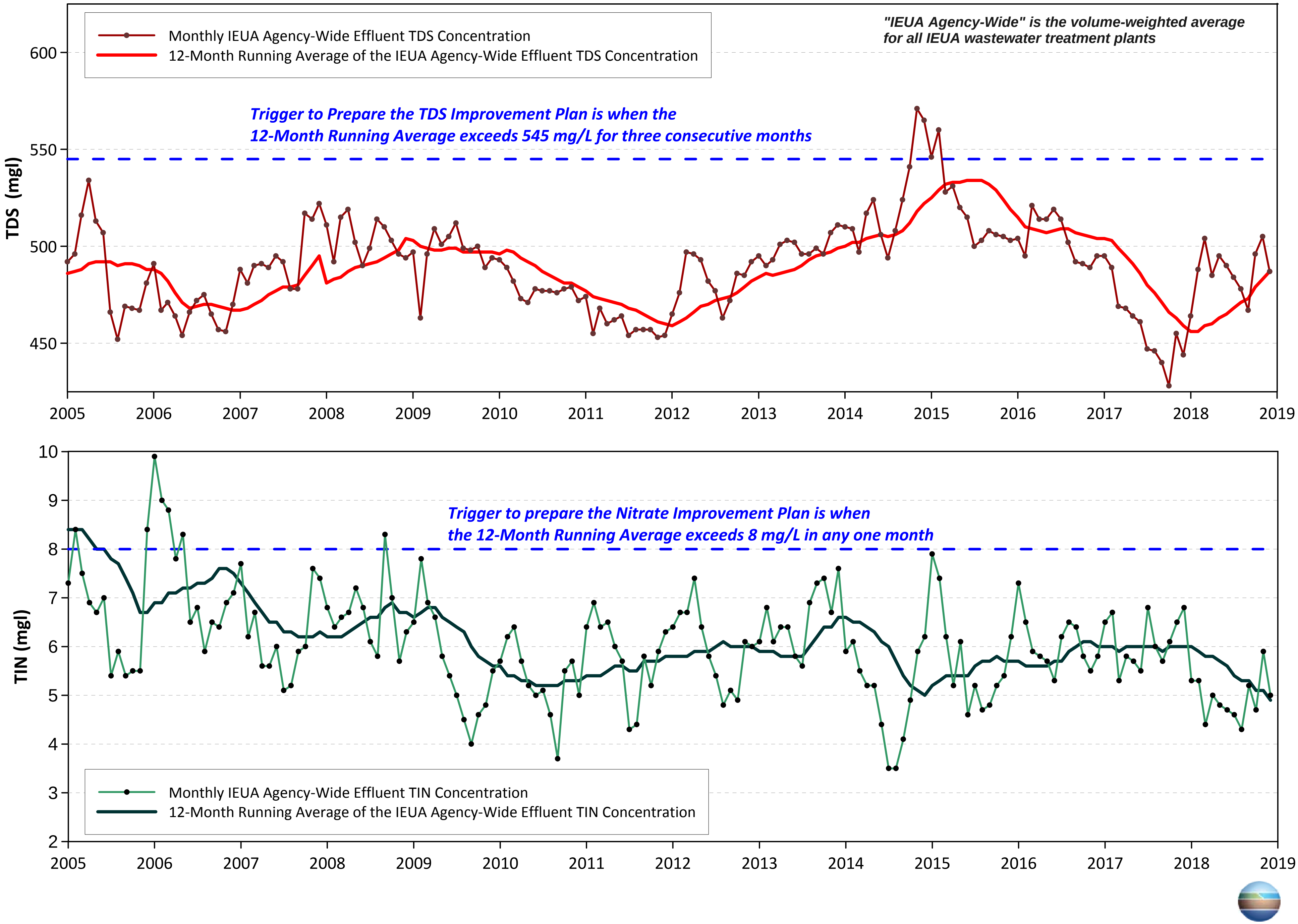
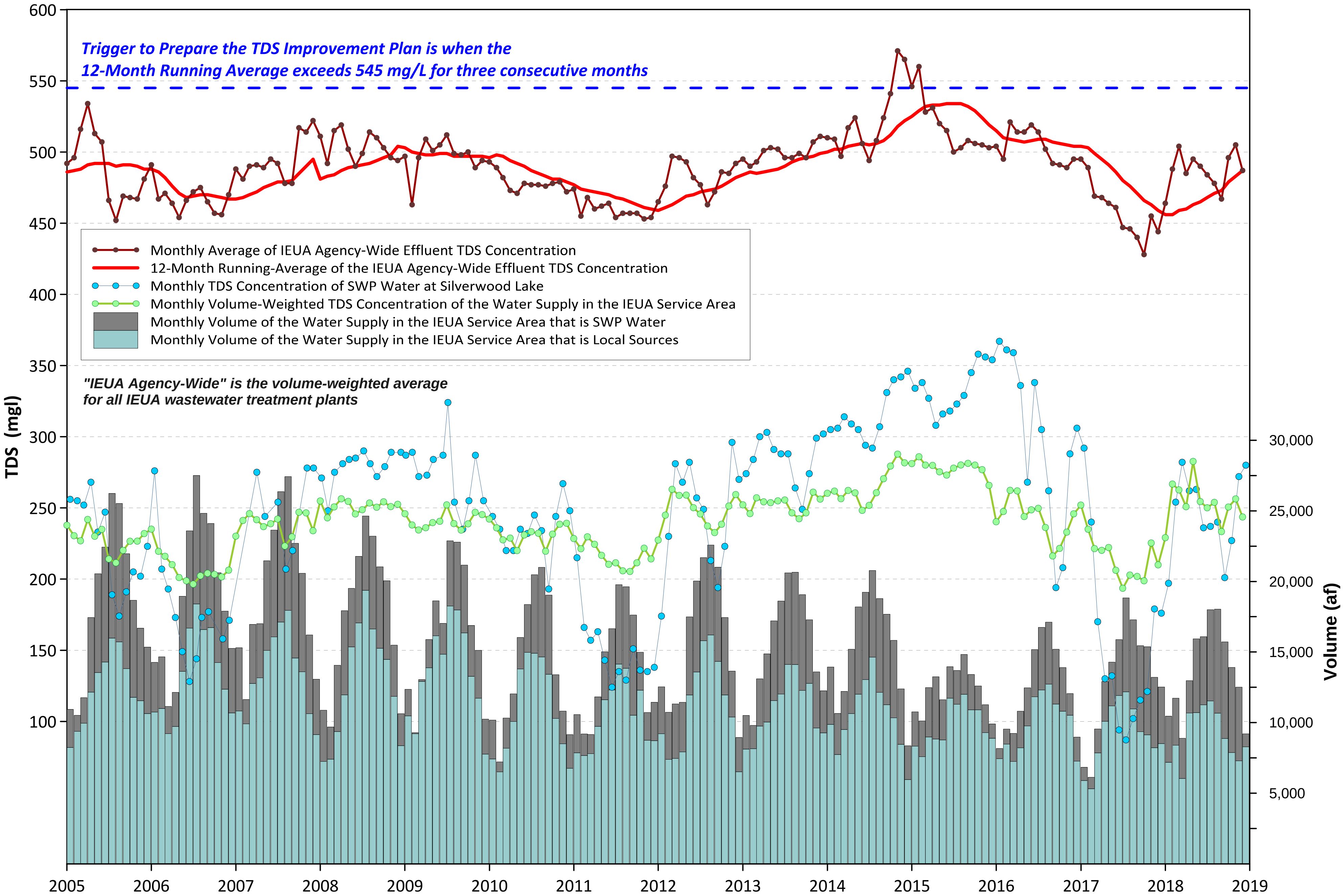


Figure 2-7
Monthly and 12-Month Running Average of the IEUA Agency-Wide Effluent Total Dissolved Solids (TDS) Concentrations, versus Monthly TDS Concentrations of the State Water Project (SWP) Water and the Monthly IEUA Volume-Weighted Water Supply - 2005 to 2018



Section 3 – Data Collected in 2018

Groundwater and surface-water data collected for the Maximum-Benefit Monitoring Program pursuant to the 2014 Work Plan are used for both maximum-benefit monitoring directives of demonstrating hydraulic control and computing ambient water quality every three years. The data collected in 2018 for the Maximum-Benefit Monitoring Program include groundwater elevation, groundwater quality, and surface-water quality. The 2018 data collection efforts are described below.

3.1 Groundwater Monitoring Program

Watermaster's Groundwater Monitoring Program consists of two main components: a groundwater-level monitoring program and a groundwater-quality monitoring program. These monitoring programs were designed and implemented to support the OBMP Implementation Plan and the other regulatory requirements of Watermaster and the IEUA. Watermaster's Groundwater Monitoring Program is summarized below with specific reference to the monitoring requirements of the maximum-benefit commitments.

3.1.1 Groundwater-Level Monitoring Program

Figure 3-1 shows the locations of the wells that are included in Watermaster's groundwater-level monitoring program. In total there are about 1,300 wells in the groundwater-level monitoring program. The groundwater-level monitoring program supports many Watermaster management functions, including: the periodic assessment of Safe Yield, groundwater model development and recalibration, cumulative impacts of transfers, balance of recharge and discharge, subsidence management, material physical injury assessments, estimation of storage change, other scientific demonstrations required for groundwater management; and many regulatory requirements such as demonstration of hydraulic control and the triennial ambient water quality recomputation. The wells within the southern portion of the Basin were selected for inclusion in the monitoring program to assist in Watermaster's analyses of hydraulic control, land subsidence, and desalter impacts to private well owners, and riparian vegetation in the PBMZ. The density of groundwater-level monitoring near the desalter well fields is greater than in outlying areas because hydraulic gradients are expected to be steeper near the desalter well fields, and these data are needed to assess the state of hydraulic control.

Figure 3-1 shows the wells where groundwater-level data were collected in 2018, symbolized by measurement frequency. At about 1,050 of these wells, water levels are measured by well owners, including municipal water agencies, the California Department of Toxic Substance Control (DTSC), the County of San Bernardino, and various consulting firms on behalf of their clients. The measurement frequency by municipal water agencies is typically about once per month, and Watermaster compiles the data quarterly. The measurement frequency by other well owners varies, and Watermaster compiles these data twice per year. The remaining approximately 250 wells shown in Figure 3-1 are mainly privately-owned wells or dedicated monitoring wells that are primarily located in the southern portion of the Chino Basin. Watermaster staff measures water levels at these wells using manual methods once per month or with pressure transducers with on-board data loggers that record water levels once every 15 minutes. All water-level data are reviewed by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE[SM]. All water-level data collected in 2018 are contained in the Microsoft (MS) Access database that has been included with this report as Appendix B. The well location information for private wells with water-level data is excluded from the database in this report for confidentiality reasons.

3.1.2 Groundwater-Quality Monitoring Program

Figure 3-2 shows the locations of the wells that are included in Watermaster's groundwater – quality monitoring program. In total there are about 600 wells in the groundwater-quality monitoring program. Watermaster obtains groundwater-quality data, in part, to comply with two maximum-benefit commitments: the triennial ambient water quality recomputation and the analysis of hydraulic control. These data are also used for Watermaster's biennial SOB report, to support ground-water modeling, to characterize non-point source contamination and plumes associated with point-source discharges, and to characterize present trends in groundwater quality.

Figure 3-2 shows the wells where groundwater-quality data were collected in 2018. At about 518 of these wells, water-quality samples were collected by well owners, including municipal water agencies, the DTSC, the County of San Bernardino, and various private companies and consulting firms. The sampling frequency and constituents tested vary by well and owner. These water quality data are compiled by Watermaster twice per year. The remaining approximately 100 wells shown in Figure 3-2 are privately owned agricultural wells or dedicated monitoring wells that were sampled by Watermaster for various purposes. All groundwater samples collected by Watermaster are tested for the analytes listed in Table 3-1. VOCs are sampled only at wells within or adjacent to known contamination plumes.

During 2018, Watermaster performed the following groundwater-quality sampling:

- Annual and triennial samples were collected for the Key Well Groundwater Quality Monitoring Program (GWQMP). The Key Well GWQMP consists of a network of about 85 private wells predominantly in the southern portion of the Chino Basin and 11 monitoring wells, which include two multi-nested MZ-3 monitoring wells (six well casings), and two multi-nested former Kaiser Steel monitoring wells (five well casings). About nine of the private wells are sampled every year; the remaining private wells are sampled every three years. Watermaster is constantly evaluating and revising the private wells in the Key Well GWQMP as wells are abandoned or destroyed due to urban development. During 2018, 27 private wells and eleven monitoring wells were sampled from August through October 2018.

- Annual samples were collected from the nine multi-nested HCMP monitoring wells (21 well casings) in the southern portion of Chino Basin in August 2018.

- Quarterly samples were collected at four shallow monitoring wells along the Santa Ana River, which consist of two former United States Geological Survey (USGS) National Water Quality Assessment (NAWQA) Program wells (Archibald 1 and Archibald 2) and two Santa Ana River Water Company (SARWC) wells (Wells 9 and 11). Samples were collected in January, April, July, and October 2018.

- Quarterly samples were collected at the nine multi-nested Prado Basin Habitat Sustainability Program (PBHSP) monitoring wells (18 well casings) in March and June 2018, and quarterly samples were collected at the two multi-nested PBHSP monitoring wells (4 casings) in September and December 2018.

All groundwater-quality data were reviewed by Watermaster staff and uploaded to a centralized database management system that can be accessed online through HydroDaVE^{SM}. All publicly available water-quality data collected in 2018 are contained in the MS Access database included with this report as Appendix B. Groundwater-quality data collected at private wells in the Basin are excluded from the database in this report for confidentiality reasons.

3.2 Surface-Water Quality Monitoring Program

Watermaster collects quarterly surface-water quality samples from two sites along the Santa Ana River: *SAR at Etiwanda* and *SAR at River Road*. Figure 3-2 shows the locations of these sites. Surface-water quality data are used to characterize surface water and groundwater interactions along the Santa Ana River.

The surface water samples are collected on the same day as the quarterly groundwater-quality samples at the near-river NAWQA and SARWC wells. Samples were collected in January, April, July, and October 2018. Surface-water quality samples are tested for the analytes listed in Table 3-2. All surface-water quality data are reviewed by Watermaster and uploaded to a centralized database management system that can be accessed online through HydroDaVE^{SM}. All surface-water quality data collected in 2018 are contained in the MS Access database included with this report as Appendix B.

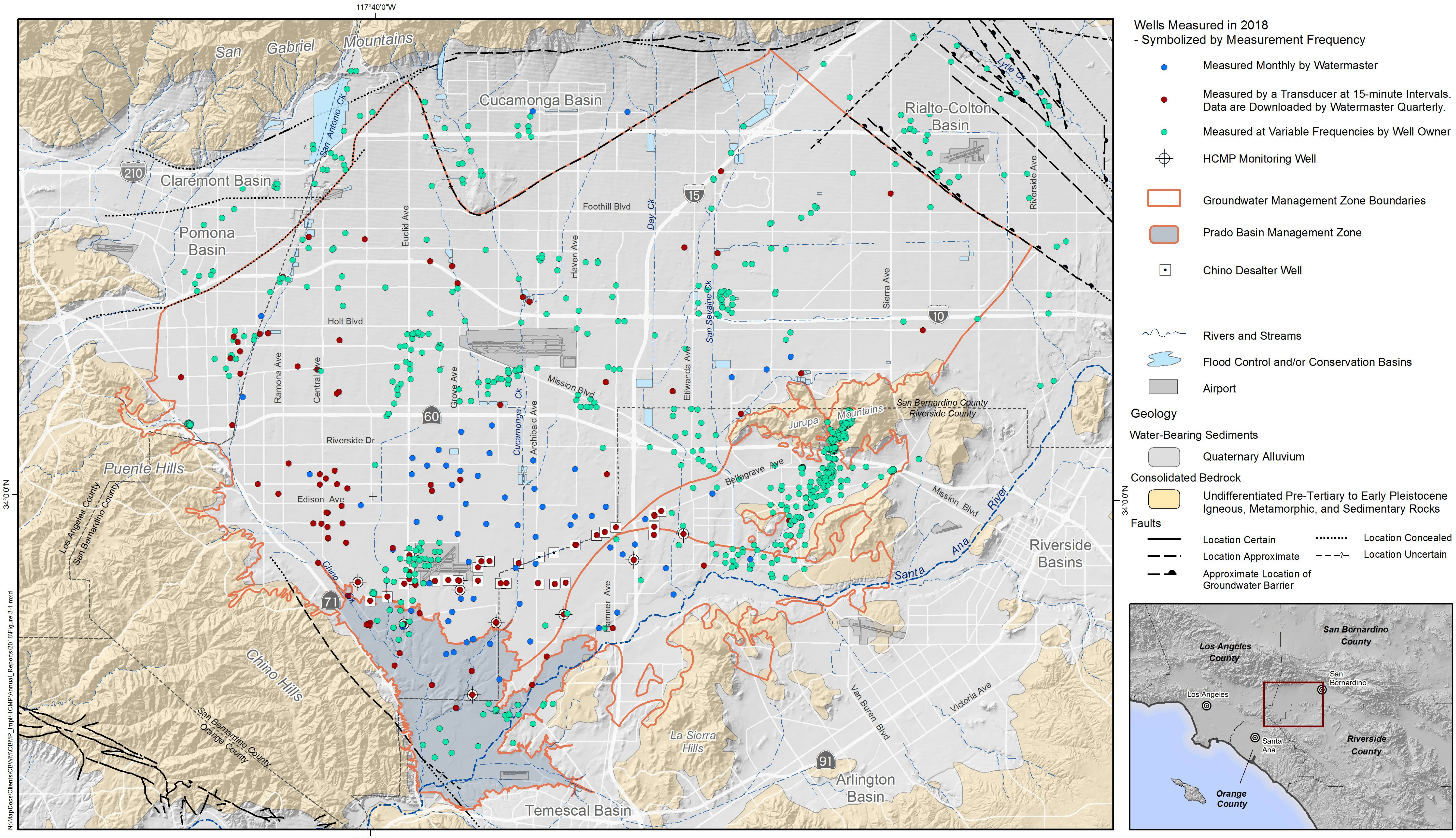
Table 3-1
Analyte List for the Groundwater-Quality Monitoring Program

Analyte	Laboratory Analysis Method
Major cations: Ca, Mg, K, Si, Na	EPA 200.7
Major anions: Cl, SO_4, NO_2, NO_3	EPA 300.0
Total Hardness	SM 2340B
Total Alkalinity (incl. Carbonate, Bicarbonate, Hydroxide)	SM 2320B
Ammonia Nitrogen	EPA 350.1
Arsenic	EPA 200.8
Boron	EPA 200.7
Chromium, Total	EPA 200.8
Hexavalent Chromium	EPA 218.6
Fluoride	SM 4500F-C
Perchlorate	EPA 314.0
pH	SM2330B/SM 4500-HB
Specific Conductance	SM 2510B
Total Dissolved Solids	EPA 160.1/SM 2540C
Total Kjeldahl Nitrogen (TKN)	EPA 351.2
Organic Nitrogen	EPA 351.2
Total Organic Carbon	SM5310C/E415.3
Turbidity	EPA 180.1
VOCs[1]	EPA 524.2
1,2,3 -Trichloropropane (Low Detection)	CASRL 524M-TCP

[1] Only at wells within or near known VOC plumes (Chino Airport, South Archibald, Pomona, GE Flatiron, GE Testcell, Former Crown Coach Facility, Alger Manufacturing Inc., Chino Institution for Men, Milliken Landfill, Stringfellow)

Table 3-2
Analyte List for the Surface-Water Quality Monitoring Program

Analytes	Laboratory Analysis Method
Major cations: K, Na, Ca, Mg	EPA 200.7
Major anions: Cl, SO_4, NO_2, NO_3	EPA 300.0
Total Hardness	SM 2340B
Total Alkalinity (incl. Carbonate, Bicarbonate, Hydroxide)	SM 2320B
Boron	EPA 200.7
Ammonia-Nitrogen	EPA 350.1
pH	SM 4500-HB
Specific Conductance	SM 2510B
Total Dissolved Solids	E160.1/SM2540C
Total Kjeldahl Nitrogen (TKN)	EPA 351.2
Organic Nitrogen	EPA 351.2
Turbidity	EPA 180.1
Total Organic Carbon	SM5310C/E415.3



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File: Figure 3-1

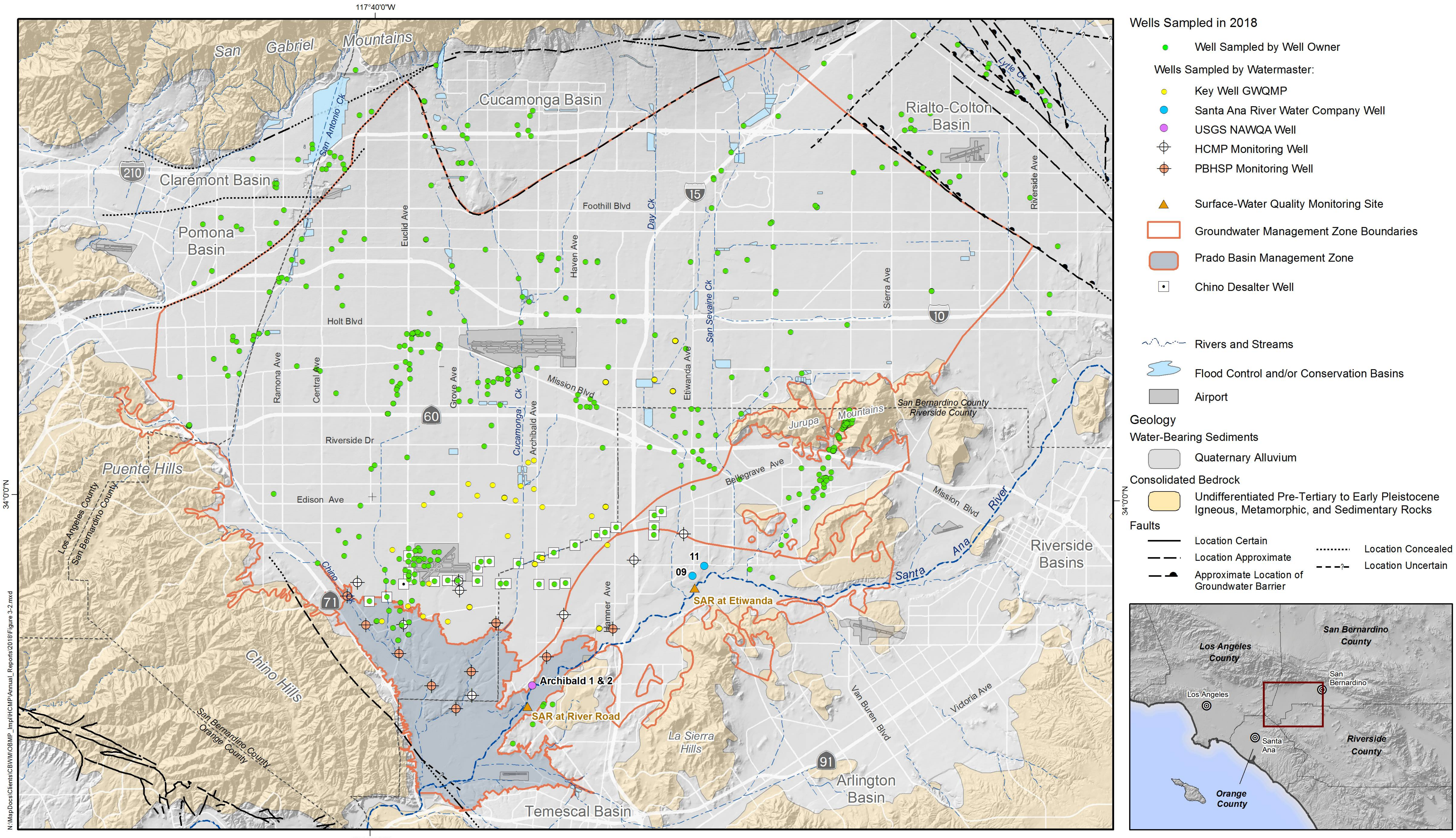
0 1 2 3 4 Miles
0 2 4 6 Kilometers

Chino Basin Watermaster — Partners in Basin Management

2018 Maximum Benefit Annual Report

Groundwater-Level Monitoring Program
Wells Monitored in 2018

Figure 3-1



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File: Figure 3-2

Chino Basin Watermaster — Partners in Basin Management

2018 Maximum Benefit Annual Report

Groundwater and Surface-Water Quality Monitoring Program

Sites Sampled in 2018

Figure 3-2

Section 4 - The Influence of Rising Groundwater on the Santa Ana River

This section characterizes the influence of rising groundwater on the flow and quality of the Santa Ana River between the Riverside Narrows and Prado Dam. Rising groundwater from the Chino Basin to the Santa Ana River consists of groundwater from Chino-North that flows past the CCWF well field and unpumped groundwater south of and outside the influence of the Chino Desalter well fields[17].

4.1 Surface-Water Discharge Accounting

Annual estimates of the recharge and discharge components that are computational results from Watermaster's Chino Basin groundwater model were used to evaluate the annual net contribution of rising groundwater to the Santa Ana River between Riverside Narrows and Prado Dam. The purpose of this analysis is to estimate the magnitude of net rising groundwater in the Santa Ana River. Net rising groundwater is the combined losses and gains in flow due to rising groundwater, streambed infiltration, and evapotranspiration (ET). Achieving hydraulic control should decrease net rising groundwater.

Table 4-1 show the water budget table from the Watermaster's groundwater model update in 2018 with historical hydrology through September 2018 to simulate the annual change in storage for water year 2018 required for the Sustainable Groundwater Management Act (SGMA) (WEI, 2019b). The water budget table lists the annual recharge and discharge components for the Chino Basin input to, or computed by, the model for water year 1970 to 2018. Column 5 is *Streambed Infiltration from the Santa Ana River* and is the annual estimate of streambed infiltration in the Santa Ana River and lower reaches of Chino Creek and Mill Creek downstream of the Riverside Narrows. Column 15 is *Groundwater Discharge to Streams* which is the annual estimate of Chino-North groundwater discharge to the Santa Ana River, Chino Creek, and Mill Creek. The net rising groundwater from to the Santa Ana River between Riverside Narrows and Prado Dam is calculated in Column 18 as the difference between groundwater discharge to Santa Anta River and streambed infiltration from Santa Ana River (Column 15 – Column 5). The time history of this net rising groundwater calculation is shown graphically in in Figure 4-1. With one exception, the net rising groundwater estimate is negative over the last 48 years. Negative values for net rising groundwater indicate that the volume of rising groundwater in this reach of the Santa Ana River is less than the combined volume of losses from the river due to streambed infiltration. Net rising groundwater decreased (larger negative values) as the Chino-I and Chino-II Desalters ramped up production in the southern Chino Basin starting in water year 2005. These observations are consistent with the conclusion from the monitoring data that the achievement of hydraulic control is occurring.

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[17] See groundwater flow vectors in Figures 2-2a, 2-2b, and 2-2c.

4.2 Surface-Water Quality at Prado Dam

Rising groundwater from the Chino Basin to the Santa Ana River consists of groundwater from Chino-North that flows past the CCWF well field and unpumped groundwater south of and outside the influence of the Chino Desalter well fields[18]. Groundwater discharge from Chino-North to the PBMZ is either pumped by wells, consumed by riparian vegetation in the PBMZ or becomes rising groundwater and contributes to the Santa Ana River discharge at Prado Dam. Calibration of the 2008 Wasteload Allocation Model (1994-2006) estimated that rising groundwater in the PBMZ had an average TDS concentration of about 850 mgl (WEI, 2009b). This estimate is consistent with a TDS mass-balance characterization of the Santa Ana River (WEI, 2015d) and recent sampling at monitoring wells in the PBMZ.

The Santa Ana River Watermaster's (SARWM) annual analysis of the volume and TDS concentration of the Santa Ana River is used to demonstrate the impact of rising groundwater outflow on the TDS concentration of the Santa Ana River at Prado Dam. The SARWM has compiled annual reports pursuant to the 1969 stipulated judgment[19] that contain estimates of significant discharges to the Santa Ana River, estimates of the storm flow discharge and base flow discharge of the River each water year, as well as the volume-weighted TDS concentration of discharge at the Riverside Narrows and at Prado Dam (see SARWM, 2019). Figure 4-2 is a time-history chart of the annual discharge components in the Santa Ana River at Prado Dam and the associated annual volume-weighted TDS concentration as reported by the SARWM. The base flow discharge is represented by two bars: (i) the SARWM estimate of base flow discharge at Prado Dam minus the rising groundwater from the Chino Basin component, (ii) and the total rising groundwater discharge from the Chino Basin to the Santa Ana River estimated with the Watermaster's 2018 groundwater model update — the sum of these two terms equal the SARWM estimate of base flow discharge at Prado Dam. Figure 4-2 also shows the five-year moving average of the annual flow-weighted TDS concentration of the Santa Ana River at Prado Dam, which is the metric the Regional Board uses to determine compliance with the Basin Plan TDS concentration objective of 650 mgl for Reach 2 of the Santa Ana River (Reach 2 TDS metric) (Regional Board, 2008). Note that:

- Since about 1980, the annual estimates of the rising groundwater discharge from the Chino Basin to the Santa Ana River, which ranged from about 14,300 to 25,100 afy, have been a small percentage of the total annual flow at Prado Dam, ranging from about three percent during wet years to about 20 percent during dry years.
- From 2005 to 2015, the model-estimated groundwater discharge from Chino-North to the PBMZ, was about 2,400 afy without CCWF operation, representing a small fraction of the total rising groundwater from Chino Basin to the Santa Ana River: it represents about 13 percent of the rising groundwater

[18] See groundwater flow vectors in Figures 2-2a, 2-2b, and 2-2c of this report.

[19] The Santa Ana River was adjudicated in the 1960s, and a stipulated judgment was filed in 1969 (OCWD v. City of Chino et al., Case No. 117628, County of Orange). Since the Judgment was filed, the SARWM has compiled annual reports

discharge from the Chino Basin to the Santa Ana River, and about two percent of the total flow in the Santa Ana River at Prado Dam.

- In 2016, the CCWF commenced full production, meaning that the estimated groundwater discharge from Chino-North to the PBMZ was reduced to *de minimis* levels (less than 1,000 afy). The model projected groundwater discharge past the CCWF ranges from about 900 to 700 afy through 2050.[20] This represents about four percent of the total rising groundwater discharge to the Santa Ana River from the Chino Basin, and less than one percent of the total flow in the Santa Ana River at Prado Dam.
- Since about 1980, the Reach 2 TDS metric has ranged between 481 and 603 mgl and has not exceeded the TDS objective of 650 mg/L—even during extended dry periods when storm water dilution of the Santa Ana River is relatively little (e.g. water years 1984 through 1992, 1999 through 2004, and 2012 through 2016).
- The Reach 2 TDS metric increased continuously from water year 2006 to water year 2016, which coincides with a dry climatic period and a steady decrease in the volume of base flow discharge. The decrease in baseflow is mostly attributable to the decrease in low-TDS wastewater discharges to the Santa Ana River.
- In water year 2018, the Reach 2 TDS metric decreased to 539 mgl.

These observations suggest that the rising groundwater discharge from the Chino Basin to the Santa Ana River has had a *de minimis* impact on the flow and TDS concentration of the Santa Ana River since about 1980 and has never contributed to an exceedance of the TDS objective for Reach 2. The groundwater discharge from the Chino-North to the PBMZ that becomes rising groundwater discharge in the Santa Ana River has historically been small compared to total discharge in the Santa Ana River, and has decreased due to operation of the CCWF. Based on the trends observed since 2005, the Reach 2 TDS metric will likely continue to increase as the other conditions that affect the flow and quality of the Santa Ana River change over time, such as continued reduction of wastewater effluent discharges to the River, and/or an increase in the duration and frequency of dry periods due to climate change. Given that wastewater effluent discharges are projected to decline further, the maintenance of hydraulic control of Chino-North will become increasingly important to protecting downstream beneficial uses.

[20] See Table 2-3 of this report for modeling projections of groundwater discharge from the Chino-North to the PBMZ past the CCWF based on historical data.

Table 4-1
Water Budget for Chino Basin by Water Year
(af)

End of Water Year	Recharge										Discharge							Net Rising Groundwater Contribution to Surface Discharge	Recharge minus Discharge
	Subsurface Boundary Inflow from:			Streambed Infiltration from:		Water Recharged in Basins from:			Deep Infiltration of Precipitation and Applied Water[2]	Subtotal Recharge	Pumping:			Evapo-Transpiration	Groundwater Discharge to Streams[3]	Subsurface Discharge to Temescal Basin	Subtotal Discharge		
	Chino Hills, Six Basins, Cucamonga Basin and Rialto Basin	Bloomington Divide	Temescal Basin	Santa Ana River Tributaries	Santa Ana River[1]	Storm Water	Recycled Water	Imported Water, including ASR Injection			Chino Basin Desalter	Appropriative and Overlying Non-Ag Pools	Overlying Agricultural Pool Production						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18) = (15) - (5)	(19) = (10) - (17)
1970	16,585	8,156	3,272	9,011	26,386	2,855	17,540	0	111,107	194,912	0	59,685	139,306	13,382	18,263	1,748	232,383	-8,123	-37,471
1971	16,180	8,365	3,500	11,305	27,441	2,831	8,287	0	111,259	189,168	0	61,466	136,691	14,013	18,187	1,627	231,983	-9,255	-42,816
1972	16,056	8,672	3,260	6,180	27,373	1,868	5,319	0	111,974	180,701	0	60,636	140,045	14,515	16,929	1,485	233,609	-10,444	-52,908
1973	16,640	8,194	3,636	20,985	28,015	5,779	4,464	0	114,766	202,479	0	58,400	112,707	15,436	18,368	2,221	207,132	-9,646	-4,653
1974	16,696	8,656	3,592	11,009	29,250	3,500	2,664	0	108,496	183,862	0	67,016	128,812	15,933	16,836	1,993	230,589	-12,414	-46,727
1975	16,108	8,941	3,963	12,858	31,362	3,836	2,823	0	107,897	187,790	0	75,547	118,773	16,410	16,671	2,442	229,842	-14,692	-42,052
1976	15,492	9,144	3,841	7,776	35,007	2,777	3,007	0	107,611	184,654	0	75,137	119,048	16,552	14,757	2,249	227,745	-20,249	-43,090
1977	15,715	9,257	4,103	8,336	33,459	3,950	3,126	0	115,656	193,602	0	63,914	120,424	16,840	17,323	2,523	221,023	-16,136	-27,422
1978	16,847	9,247	4,917	24,643	35,637	10,351	3,174	13,916	117,182	235,913	0	64,771	120,481	17,110	18,007	3,684	224,052	-17,630	11,861
1979	17,450	9,507	5,836	15,134	29,323	6,493	3,122	32,138	111,379	230,382	0	65,008	118,629	16,571	17,428	2,263	219,899	-11,895	10,483
1980	17,905	11,355	5,704	20,620	33,039	10,380	3,312	9,310	109,289	220,914	0	69,503	104,634	16,603	15,286	1,618	207,644	-17,753	13,270
1981	17,834	11,588	5,823	7,193	30,796	2,970	3,554	23,636	107,346	210,740	0	72,927	119,335	16,134	14,146	1,308	223,850	-16,650	-13,110
1982	18,275	11,948	6,026	11,573	33,377	5,755	3,800	18,437	116,278	225,469	0	68,404	90,598	16,894	17,327	2,214	195,437	-16,050	30,032
1983	19,156	12,216	6,724	19,175	34,323	12,270	3,917	33,953	118,219	259,951	0	67,259	88,419	17,542	20,383	2,625	196,228	-13,940	63,723
1984	19,882	13,743	7,298	7,446	23,852	4,492	0	17,381	118,351	212,445	0	74,726	108,423	16,790	20,417	1,002	221,358	-3,435	-8,913
1985	21,364	12,349	7,438	5,992	28,669	3,895	0	16,298	111,798	207,802	0	79,626	94,161	16,782	18,381	1,428	210,378	-10,287	-2,576
1986	22,381	11,881	7,605	6,467	36,538	6,003	0	19,155	112,352	222,383	0	83,822	111,696	17,198	18,247	2,009	232,972	-18,290	-10,589
1987	21,810	11,397	7,529	2,559	27,799	2,864	0	19,279	112,948	206,185	0	88,675	95,018	16,875	17,783	1,200	219,550	-10,017	-13,365
1988	21,503	10,967	7,415	2,866	32,720	5,065	0	2,494	111,794	194,823	0	94,222	90,159	17,114	17,993	1,938	221,426	-14,727	-26,603
1989	20,811	11,031	6,722	1,437	29,895	3,944	0	7,407	111,583	192,830	0	97,218	89,173	16,797	17,305	1,599	222,094	-12,590	-29,264
1990	19,920	11,210	6,455	427	30,284	2,799	0	503	111,420	183,017	0	98,914	83,350	16,738	16,058	1,218	216,277	-14,226	-33,260
1991	20,221	11,700	6,410	725	28,620	4,031	0	3,104	115,853	190,664	0	88,986	77,043	16,664	15,435	1,369	199,497	-13,184	-8,834
1992	21,289	12,094	5,957	1,032	32,079	6,095	0	7,228	117,853	203,628	0	102,664	77,782	16,805	16,526	1,769	215,546	-15,553	-11,918
1993	21,602	12,232	5,415	2,260	36,583	11,537	0	13,181	114,438	217,248	0	88,040	76,197	17,065	15,708	2,645	199,655	-20,875	17,594
1994	21,781	12,325	5,266	656	34,306	3,148	0	22,343	110,808	210,632	0	93,564	67,616	17,048	16,242	1,814	196,285	-18,064	14,347
1995	20,428	12,256	4,840	1,555	35,139	8,241	0	3,804	110,072	196,335	0	98,173	60,518	17,386	16,855	2,607	195,540	-18,284	795
1996	21,110	12,339	4,878	710	31,921	4,261	0	82	106,099	181,401	0	109,609	65,359	17,373	17,104	1,510	210,955	-14,817	-29,554
1997	22,783	12,370	5,024	1,033	30,924	5,960	0	17	111,442	189,553	0	112,998	61,503	17,679	19,656	2,471	214,307	-11,268	-24,755
1998	24,405	12,455	5,575	1,633	30,463	10,112	0	14,106	109,101	207,850	0	104,141	40,896	18,125	21,027	3,423	187,612	-9,436	20,238
1999	22,188	12,691	6,105	522	25,109	2,437	87	13	107,576	176,729	0	118,738	41,792	18,180	22,306	2,372	203,387	-2,803	-26,658
2000	22,348	13,139	6,780	506	24,600	3,505	772	1,009	108,442	181,102	523	133,086	43,465	18,353	23,224	2,936	221,588	-1,376	-40,486
2001	21,201	13,041	7,590	635	24,011	4,552	367	6,522	106,375	184,294	9,470	120,396	35,518	18,499	25,124	3,350	212,356	1,113	-28,062
2002	23,199	13,824	8,107	197	25,204	1,806	298	8,253	103,593	184,482	10,173	129,760	40,402	18,447	24,232	3,352	226,366	-972	-41,884
2003	22,152	13,978	8,122	865	25,440	8,441	186	4,747	107,061	190,992	10,322	123,471	34,246	18,674	25,048	3,864	215,625	-393	-24,633
2004	26,375	13,750	7,843	537	25,260	5,197	185	11,146	106,132	196,424	10,480	128,548	38,068	18,547	24,944	3,824	224,410	-316	-27,986
2005	22,252	11,759	6,232	5,981	26,685	20,051	569	15,349	104,917	213,795	10,595	112,943	31,694	18,742	23,868	4,477	202,319	-2,816	11,476
2006	19,499	12,862	5,770	1,816	29,647	13,327	2,472	40,087	95,367	220,848	19,819	113,553	27,005	18,420	18,582	3,218	200,597	-11,066	20,251
2007	20,727	13,145	5,653	83	28,621	4,990	1,682	20,786	92,418	188,105	28,529	123,695	28,817	17,983	16,760	1,991	217,774	-11,861	-29,669
2008	22,102	13,140	5,669	1,530	32,255	10,787	2,623	0	94,255	182,362	30,116	127,696	24,601	18,083	16,761	2,886	220,143	-15,495	-37,781
2009	23,318	13,213	6,418	845	31,405	8,015	2,672	0	94,931	180,817	28,456	137,345	23,940	18,158	17,580	2,833	228,312	-13,825	-47,494
2010	24,431	13,344	6,996	1,959	31,725	15,356	8,729	5,001	94,240	201,782	28,964	108,983	21,142	18,333	18,163	3,053	198,638	-13,563	3,143
2011	22,885	13,299	7,303	3,380	32,513	18,155	7,615	31,943	91,792	228,885	28,941	94,413	19,983	18,290	18,062	2,766	182,454	-14,451	46,431
2012	22,047	12,474	5,871	455	36,428	9,974	8,226	661	89,705	185,843	28,230	108,501	22,655	17,806	15,682	3,217	196,091	-20,746	-10,248
2013	21,149	11,886	4,896	245	36,497	5,388	12,495	0	89,075	181,631	27,380	111,748	23,916	17,580	14,418	3,075	198,116	-22,079	-16,485
2014	19,768	11,633	4,460	248	36,824	4,713	13,016	778	89,048	180,487	29,626	118,849	20,566	17,654	15,164	3,435	205,294	-21,660	-24,807
2015	18,750	11,552	4,729	514	38,259	9,435	10,876	0	88,221	182,336	29,877	99,971	17,147	17,977	16,388	4,230	185,591	-21,871	-3,255
2016	18,533	11,725	4,559	95	33,193	7,573	14,086	0	90,536	180,300	28,249	101,031	16,850	17,775	17,025	2,726	183,655	-16,167	-3,356
2017	18,165	11,570	5,358	1,490	33,418	12,017	13,688	31,195	98,176	225,076	28,351	91,988	17,176	18,040	18,756	3,093	177,404	-14,661	47,672
2018	17,928	11,005	4,611	2,186	31,628	8,060	13,900	18,147	93,471	200,935	29,191	96,301	16,031	17,669	17,041	2,277	178,509	-14,587	22,426

Source: Water Budget from the 2018 Chino Basin Groundwater Model Update for the calculation of a change in storage for the SGMA water year 2018 reporting.
1. Streambed infiltration from Santa Ana River includes infiltration at Santa Ana River below Riverside Narrows and at lower reaches of Chino and Mill Creeks.
2. Recharge terms that are the results of calibrated surface water models or estimated via other analytical methods.
3. Groundwater discharge to streams includes groundwater from Chino North discharge to Santa Ana River and Chino and Mill Creeks.

(Red Text) Indicates negative values.

Figure 4-1
Net Annual Rising Groundwater Contribution to Surface Discharge in Santa Ana River between Riverside Narrows and Prado Dam, 2000 to 2018

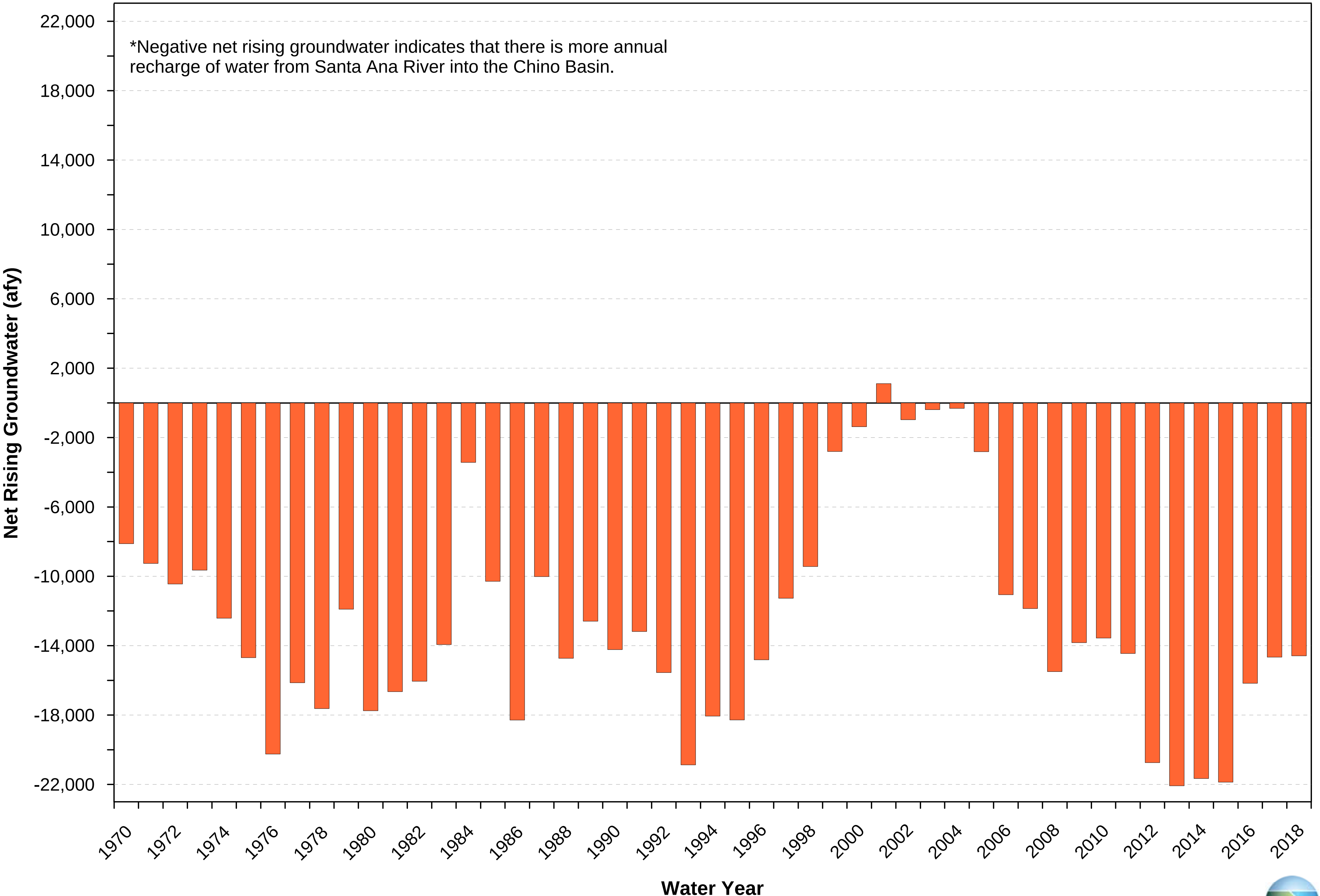
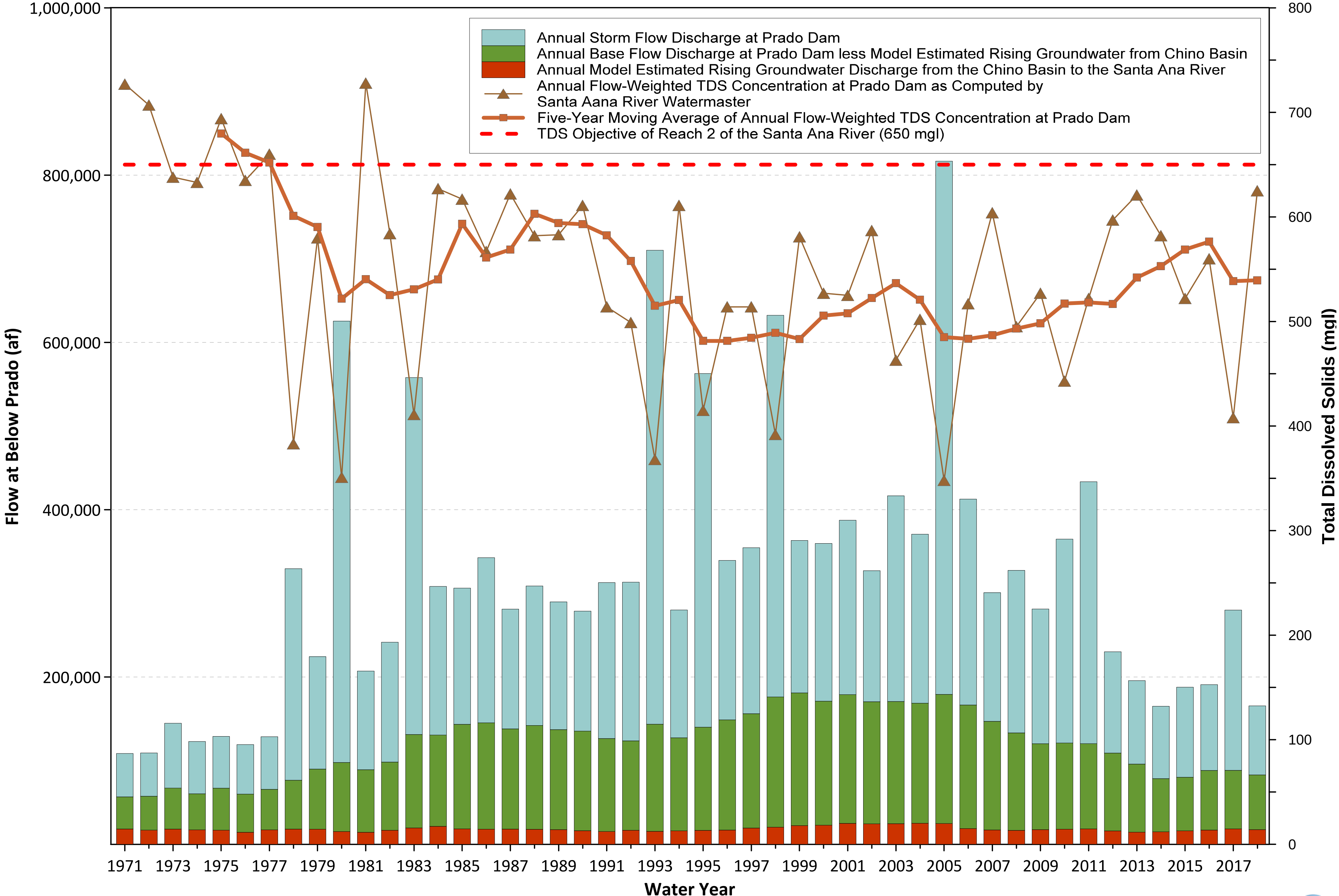


Figure 4-2
TDS and Components of Discharge of the Santa Ana River at Prado Dam - 1971 to 2018



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Appendices

Appendix A

IEUA Five-Year Volume-Weighted TDS and TIN Computation

Appendix A: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	Σ (Vol x TDS)	5-yr Avg	SW/LR (Mean)	IW	RW*	Σ (Vol x TDS)	5-yr Avg
Jul-05	647	1,488	20	2,155	129	189	458	373806		2.9	0.6	2.3	2885	
Aug-05	137	1,545	254	1,936	129	174	447	399909		2.9	0.5	1.6	1564	
Sep-05	299	2,763	268	3,329	129	191	467	691278		2.9	0.4	2.1	2634	
Oct-05	876	2,313	150	3,340	129	205	459	656175		2.9	0.3	1.5	3529	
Nov-05	344	3,567	100	4,010	129	202	455	810393		2.9	0.5	1.8	2800	
Dec-05	669	3,617	77	4,362	129	223	475	929286		2.9	0.6	2.1	4408	
Jan-06	762	3,548	154	4,463	177	276	483	1188208		1.1	0.8	2.8	4015	
Feb-06	1,679	3,467	209	5,355	177	207	451	1109014		1.1	0.8	2.7	5287	
Mar-06	3,177	2,043	0	5,219	95	193	443	697408		0.5	0.8	2.9	3297	
Apr-06	3,337	2,568	0	5,905	115	173	437	827652		0.8	0.6	4.2	4182	
May-06	857	3,190	0	4,046	115	149	442	573690		0.8	0.4	5.4	2025	
Jun-06	216	3,597	73	3,886	115	128	488	520838		0.8	0.3	3.3	1460	
Jul-06	156	956	449	1,561	115	144	455	359551		0.8	0.3	2.3	1459	
Aug-06	182	4,467	619	5,269	115	173	454	1074838		0.8	0.3	2.1	2955	
Sep-06	273	6,749	616	7,638	115	177	427	1488730		0.8	0.4	2.5	4197	
Oct-06	300	6,150	224	6,675	115	170	435	1177526		0.8	0.3	3.6	2969	
Nov-06	296	5,257	93	5,646	115	158	436	905165		0.8	0.5	2.9	2989	
Dec-06	697	5,429	260	6,386	115	271	447	1667416		2.5	0.6	3.4	5918	
Jan-07	543	3,201	160	3,904	115	247	466	927308		2.5	0.8	3.3	4413	
Feb-07	1,140	706	130	1,976	115	301	464	403809		2.5	0.9	4.0	3989	
Mar-07	200	48	117	365	115	295	477	93031		2.5	1.0	3.0	895	
Apr-07	532	4	130	666	115	275	470	123292		2.5	1.0	2.8	1698	
May-07	245	0	182	427	115	244	481	115621		2.5	0.8	4.8	1487	
Jun-07	206	0	10	216	115	249	478	28445		2.5	0.5	3.0	543	
Jul-07	141	0	141	282	329	254	492	115864		0.9	0.5	3.9	683	
Aug-07	197	0	78	275	329	207	475	101948		0.9	0.5	3.3	444	
Sep-07	218	0	143	361	329	220	481	140613		0.9	0.3	3.4	690	
Oct-07	285	0	132	417	366	272	542	175777		0.7	0.4	4.9	865	
Nov-07	915	0	346	1,261	366	278	497	506679		0.7	0.6	3.1	1757	
Dec-07	1,481	0	53	1,534	130	278	506	219871		1.7	0.8	3.8	2667	
Jan-08	4,558	0	1	4,559	86	271	493	392987		0.7	0.9	4.6	3337	
Feb-08	1,427	0	196	1,623	101	248	450	232422		1.5	1.0	3.8	2878	
Mar-08	155	0	360	515	101	275	456	179969		1.5	1.1	3.0	1303	
Apr-08	150	0	260	410	101	281	483	140669		1.5	1.3	3.8	1208	
May-08	588	0	369	957	376	284	481	398503		0.7	0.9	4.8	2190	
Jun-08	128	0	261	389	376	285	490	175914		0.7	0.8	5.8	1612	
Jul-08	142	0	291	433	376	290	489	195594		0.7	0.7	6.0	1854	
Aug-08	111	0	245	356	382	281	465	156409		<0.1	0.7	4.0	982	
Sep-08	99	0	86	185	382	272	467	78001		<0.1	0.4	4.6	402	
Oct-08	161	0	395	556	382	279	487	253867		<0.1	0.5	6.5	2586	
Nov-08	677	0	229	906	432	289	461	398131		0.6	0.6	3.5	1198	
Dec-08	2,363	0	88	2,451	112	289	446	304660		1.1	0.7	4.2	3031	
Jan-09	224	0	356	580	112	287	464	190341		1.1	0.7	3.9	1625	
Feb-09	3,080	0	52	3,132	66	289	413	224746		0.5	0.8	3.3	1698	
Mar-09	299	0	182	481	66	272	434	98661		0.5	0.6	2.6	612	
Apr-09	106	0	311	417	66	273	463	151093		0.5	0.6	2.4	795	
May-09	79	0	156	235	379	284	468	102878		0.5	0.5	2.4	416	
Jun-09	153	0	293	446	379	287	479	198306		0.5	0.5	4.6	1411	
Jul-09	107	0	90	197	379	324	465	82368		0.5	0.6	3.2	344	
Aug-09	113	0	200	313	292	254	446	122229		0.2	0.4	2.9	594	
Sep-09	108	0	296	404	292	235	447	163848		0.2	0.1	2.8	841	
Oct-09	614	17	807	1,438	189	255	455	487420		1.4	0.2	2.9	3205	
Nov-09	489	3	1,210	1,702	189	287	444	629794		1.4	0.5	2.8	4026	
Dec-09	2,851	0	563	3,414	100	255	441	532946		1.0	0.7	2.5	4262	

Appendix A: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	Σ (Vol x TDS)	5-yr Avg	SW/LR (Mean)	IW	RW*	Σ (Vol x TDS)	5-yr Avg
Jan-10	4,190	0	473	4,663	68	244	444	496489		0.6	0.7	2.4	3751	
Feb-10	3,715	6	167	3,888	94	235	418	420493		1.3	0.7	3.3	5281	
Mar-10	593	0	612	1,205	94	220	419	311908		1.3	0.8	3.1	2658	
Apr-10	1,156	365	617	2,138	94	220	417	446130		1.3	0.9	2.6	3421	
May-10	179	2,433	1,185	3,797	270	235	423	1121340		0.9	0.8	2.8	5436	
Jun-10	159	2,176	990	3,325	270	232	433	976102	203	0.9	0.6	3.0	4391	1.1
Jul-10	164	0	748	912	270	245	442	374597	205	0.9	0.6	3.2	2544	1.1
Aug-10	183	0	718	901	270	234	434	360817	207	0.9	0.5	3.7	2838	1.1
Sep-10	190	0	836	1,026	309	193	423	411920	208	0.4	0.2	3.6	3088	1.1
Oct-10	670	0	923	1,593	309	244	440	612919	210	0.4	0.1	3.9	3917	1.1
Nov-10	1,156	0	773	1,929	100	267	450	463450	211	1.0	0.4	4.1	4277	1.2
Dec-10	7,036	0	262	7,298	240	248	430	1797782	213	0.7	0.5	3.8	6238	1.1
Jan-11	1,695	0	478	2,173	240	215	430	611254	212	0.7	0.7	4.2	3273	1.2
Feb-11	2,395	0	407	2,802	240	166	422	745176	214	0.7	0.7	4.4	3579	1.2
Mar-11	2,673	0	188	2,861	150	157	413	478632	216	2.2	0.5	4.6	6738	1.2
Apr-11	399	0	751	1,150	150	163	411	368605	221	2.2	0.6	4.6	4313	1.3
May-11	323	3,729	997	5,049	150	143	422	1002210	222	2.2	0.3	3.3	5282	1.3
Jun-11	167	5,736	984	6,887	275	124	422	1172590	222	0.1	0.2	3.4	4521	1.3
Jul-11	244	7,810	706	8,760	275	135	412	1412035	218	0.1	0.5	3.1	5715	1.2
Aug-11	97	7,138	486	7,721	305	129	418	1153623	215	0.8	0.4	2.8	4185	1.2
Sep-11	163	7,529	639	8,331	305	151	413	1450791	213	0.8	0.3	3.8	4772	1.2
Oct-11	888	83	924	1,895	305	136	418	668564	217	0.8	0.2	4.1	4490	1.3
Nov-11	1,174	0	648	1,822	95	135	412	378506	220	1.1	0.3	3.9	3767	1.3
Dec-11	538	0	870	1,408	69	138	411	394455	218	1.1	0.4	4.8	4779	1.4
Jan-12	926	0	826	1,752	73	174	422	416352	218	0.7	0.5	4.8	4600	1.4
Feb-12	1,166	0	664	1,830	73	230	436	374306	218	0.7	0.5	4.3	3698	1.4
Mar-12	2,117	0	381	2,498	73	281	451	325796	216	0.7	0.5	3.4	2825	1.4
Apr-12	1,625	0	367	1,992	73	268	454	285010	215	0.7	0.5	3.9	2598	1.4
May-12	177	0	1,171	1,348	421	282	466	620049	217	1.6	0.7	3.8	4712	1.4
Jun-12	151	0	952	1,103	421	257	454	495353	220	1.6	0.5	3.3	3420	1.4
Jul-12	216	0	547	763	421	249	443	333110	221	1.6	0.5	3.2	2085	1.4
Aug-12	186	0	322	508	371	213	438	209899	221	0.7	0.3	3.3	1173	1.4
Sep-12	154	0	481	635	371	194	439	268173	222	0.7	0.2	3.7	1883	1.4
Oct-12	338	0	615	953	371	223	455	405346	222	0.7	0.1	3.6	2441	1.4
Nov-12	388	0	921	1,309	371	296	456	564333	223	0.7	0.2	4.3	4175	1.4
Dec-12	1928	0	576	2,504	176	270	461	604864	224	4.9	0.3	3.9	11654	1.5
Jan-13	713	0	1,284	1,997	66	274	466	645687	231	0.6	0.6	4.8	6556	1.6
Feb-13	579	0	1,107	1,686	96	284	454	558439	233	1.4	0.8	4.9	6185	1.6
Mar-13	449	0	1,387	1,836	54	300	472	678910	235	0.1	1.1	4.6	6370	1.6
Apr-13	75	0	1,113	1,188	54	303	471	527969	236	0.1	1.0	4.6	5117	1.6
May-13	204	0	1,052	1,256	394	291	471	575868	237	0.1	0.8	4.4	4652	1.6
Jun-13	68	0	1,074	1,142	394	288	486	548488	239	0.1	0.5	3.4	3698	1.7
Jul-13	108	0	876	984	394	288	469	453794	240	0.1	0.3	3.3	2914	1.7
Aug-13	98	0	930	1,028	394	264	466	471527	241	0.1	0.0	3.9	3669	1.7
Sep-13	112.1	0	1449	1,561	360	249	476	730660	243	1.7	0.1	4.3	6359	1.7
Oct-13	242	0	1441	1,683	360	274	469	762469	245	1.7	0.0	4.7	7255	1.7
Nov-13	394	0	1307	1,701	360	299	483	772794	247	1.7	0.1	4.5	6561	1.7
Dec-13	414	0	1374	1,788	140	302	495	738433	251	1.1	0.4	4.6	6798	1.8

Appendix A: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	Σ (Vol x TDS)	5-yr Avg	SW/LR (Mean)	IW	RW*	Σ (Vol x TDS)	5-yr Avg
Jan-14	196	195	997	1,388	140	305	493	578128	253	1.1	0.5	4.5	4805	1.8
Feb-14	1,274	235	848	2,357	132	306	497	661107	257	1.5	0.6	4.5	5879	1.8
Mar-14	665	282	782	1,729	245	314	467	616698	259	0.6	0.9	4.6	4239	1.9
Apr-14	589	72	1,177	1,838	245	309	496	749989	261	0.6	0.8	4.2	5349	1.9
May-14	131	11	1,322	1,464	369	305	500	712383	263	1.1	0.8	3.8	5203	1.9
Jun-14	76	0	1,090	1,166	369	294	486	557325	264	1.1	0.6	3.3	3708	1.9
Jul-14	67	0	574	641	369	292	470	294238	265	1.1	0.6	2.8	1676	1.9
Aug-14	195	0	825	1,020	369	307	481	468433	266	1.1	0.4	3.2	2887	1.9
Sep-14	163	0	1145	1,308	339	331	514	643986	268	0.9	0.3	3.9	4641	1.9
Oct-14	87	0	1247	1,334	339	340	522	680739	269	0.9	0.4	3.1	3968	1.9
Nov-14	903	0	864	1,767	130	342	548	590670	269	0.2	0.4	4.1	3686	1.9
Dec-14	3820	0	126	3,946	73	346	544	345444	266	0.8	0.5	4.9	3488	1.9
Jan-15	676	0	623	1,299	246	334	513	485557	273	1.0	0.7	5.4	4011	2.0
Feb-15	729	0	954	1,683	102	338	527	576798	279	1.8	0.8	4.3	5375	2.0
Mar-15	339	0	1,123	1,462	102	327	506	602367	280	1.8	0.8	4.0	5067	2.0
Apr-15	327	0	994	1,321	102	308	507	537312	283	1.8	0.9	4.4	5008	2.0
May-15	660	0	1,069	1,729	102	316	506	608234	283	1.8	0.8	4.9	6383	2.1
Jun-15	30	0	1,296	1,326	327	318	495	651848	285	1.0	0.6	3.4	4494	2.1
Jul-15	702	0	750	1,452	327	323	482	590867	286	1.0	1.0	3.8	3514	2.1
Aug-15	79	0	705	784	327	329	475	360708	286	1.0	0.3	3.5	2565	2.1
Sep-15	1,078	0	1,125	2,203	280	345	480	841340	287	0.2	0.2	3.8	4498	2.1
Oct-15	732	0	1,278	2,010	280	358	474	810732	287	0.2	0.1	3.8	5009	2.1
Nov-15	300	0	806	1,106	280	356	476	467334	289	0.2	0.1	4.2	3422	2.1
Dec-15	1,112	0	1,333	2,445	65	354	470	698826	291	1.7	0.3	4.8	8283	2.2
Jan-16	2,398	0	1,042	3,440	46	367	465	595099	288	0.6	0.7	5.7	7209	2.2
Feb-16	478	0	1,352	1,830	46	361	472	660132	290	0.6	0.7	4.5	6337	2.2
Mar-16	1,519	0	858	2,377	99	359	504	582813	292	1.0	0.9	4.0	4977	2.2
Apr-16	317	0	1,162	1,479	291	336	492	664347	293	2.4	0.8	4.1	5529	2.2
May-16	468	0	1,525	1,993	291	268	488	880267	300	2.4	0.6	3.7	6789	2.3
Jun-16	45	0	1,286	1,331	291	338	486	637463	310	2.4	0.5	3.2	4269	2.4
Jul-16	43	0	944	987	291	305	479	464231	323	2.4	0.3	3.8	3711	2.6
Aug-16	64	0	1,057	1,121	291	262	480	526390	338	2.4	0.1	4.5	4961	2.8
Sep-16	87	0	1,447	1,534	303	194	466	699940	354	0.2	0.1	4.6	6602	3.0
Oct-16	405	4160	1,345	5,910	180	208	461	1558536	349	2.9	0.1	4.5	7761	2.9
Nov-16	591	40	1,432	2,063	163	288	454	758363	352	1.3	0.2	4.3	6861	2.9
Dec-16	3,389	60	860	4,309	92	306	479	741934	345	0.9	0.2	4.1	6591	2.8
Jan-17	4712	0	431	5,143	86	292	479	609244	336	0.5	0.3	4.5	4419	2.7
Feb-17	1846	0	542	2,388	86	240	454	403660	334	0.5	0.6	4.8	3571	2.7
Mar-17	136	0	1598	1,734	86	170	441	715947	340	0.5	0.8	3.7	6018	2.8
Apr-17	81	1551	1517	3,149	86	130	441	877108	342	0.5	0.5	3.4	5987	2.8
May-17	194	0	1620	1,814	324	132	437	770616	342	<0.1	0.3	3.4	5477	2.8
Jun-17	26	6319	1141	7,486	324	94	435	1099173	328	<0.1	0.2	3.2	4895	2.6
Jul-17	68	7346	952	8,366	324	87	417	1057919	314	<0.1	0.2	4.1	5772	2.5
Aug-17	317	7068	932	8,317	324	102	423	1217994	302	<0.1	0.2	4.9	6326	2.4
Sep-17	53	3794	1307	5,154	267	115	415	992861	298	0.7	0.2	5.0	7428	2.3
Oct-17	83	4477	1433	5,993	267	121	396	1131570	292	0.7	0.2	4.2	7231	2.3
Nov-17	32	2480	1413	3,926	267	179	430	1060282	290	0.7	0.4	4.5	7422	2.3
Dec-17	23	4768	1591	6,381	306	176	424	1521360	289	2.2	0.5	4.0	8937	2.2

Appendix A: TDS and NO_3-N Data Table

	Volume (acre-feet)				TDS (mg/L)					NO_3-N (mg/L)				
Month	SW/LR	IW	RW	Total	SW/LR (Mean)	IW	RW	Σ (Vol x TDS)	5-yr Avg	SW/LR (Mean)	IW	RW*	Σ (Vol x TDS)	5-yr Avg
Jan-18	1514	4130	700.8	6,344	306	197	438	1583606	287	2.2	0.6	3.4	8126	2.1
Feb-18	428	0	997.8	1,426	148	254	461	523722	287	1.4	0.7	3.4	3960	2.1
Mar-18	1832	0	309.6	2,142	43	282	476	226292	283	1.3	0.7	3.4	3422	2.1
Apr-18	105	0	1105.4	1,210	43	262	456	508798	283	1.3	0.5	3.3	3799	2.1
May-18	122	0	1447	1,569	43	282	477	695296	283	1.3	0.5	3.1	4632	2.1
Jun-18	42	62	1321.4	1,425	419	236	470	653092	283	0.7	0.3	2.8	3739	2.1
Jul-18	82	60	1176	1,318	419	237	466	596863	284	0.7	0.1	3.0	3642	2.1
Aug-18	36	0	1397	1,432	382	240	457	652387	284	0.3	0.1	3.1	4293	2.1
Sep-18	43	0	1477	1,520	382	201	442	669458	284	0.3	0.1	3.3	4923	2.1
Oct-18	369	0	898	1,267	382	227	460	553690	283	0.3	0.1	3.1	2921	2.1
Nov-18	959	0	1168	2,128	205	272	480	757967	282	1.3	0.2	3.0	4761	2.0
Dec-18	1219	0	945	2,164	153	280	454	615408	281	0.2	0.3	3.2	3263	2.0

SW/LR (Mean): Stormwater / Local Runoff (Mean) is a monthly average value of all SW/LR data collected during the month. For months without data available, previous month's data is carried dowr

IW: Imported Water based on monthly Table D data received from the Metropolitan Water District

RW: Recycled Water based on a monthly average of all available RP-1 & RP-4 effluent data and RP-1/RP-4 RW Blend at NRG Turnout data

* 25% nitrogen loss coefficient has been applied to calculate recycled water nitrate-nitrogen quality per Basin Plan Amendment

Maximum Benefit Water Quality Objectives in Chino North Management Zone for TDS is 420 mg/L and nitrate-nitrogen is 5 mg/L, based on a 5-year running average

Appendix B

Database