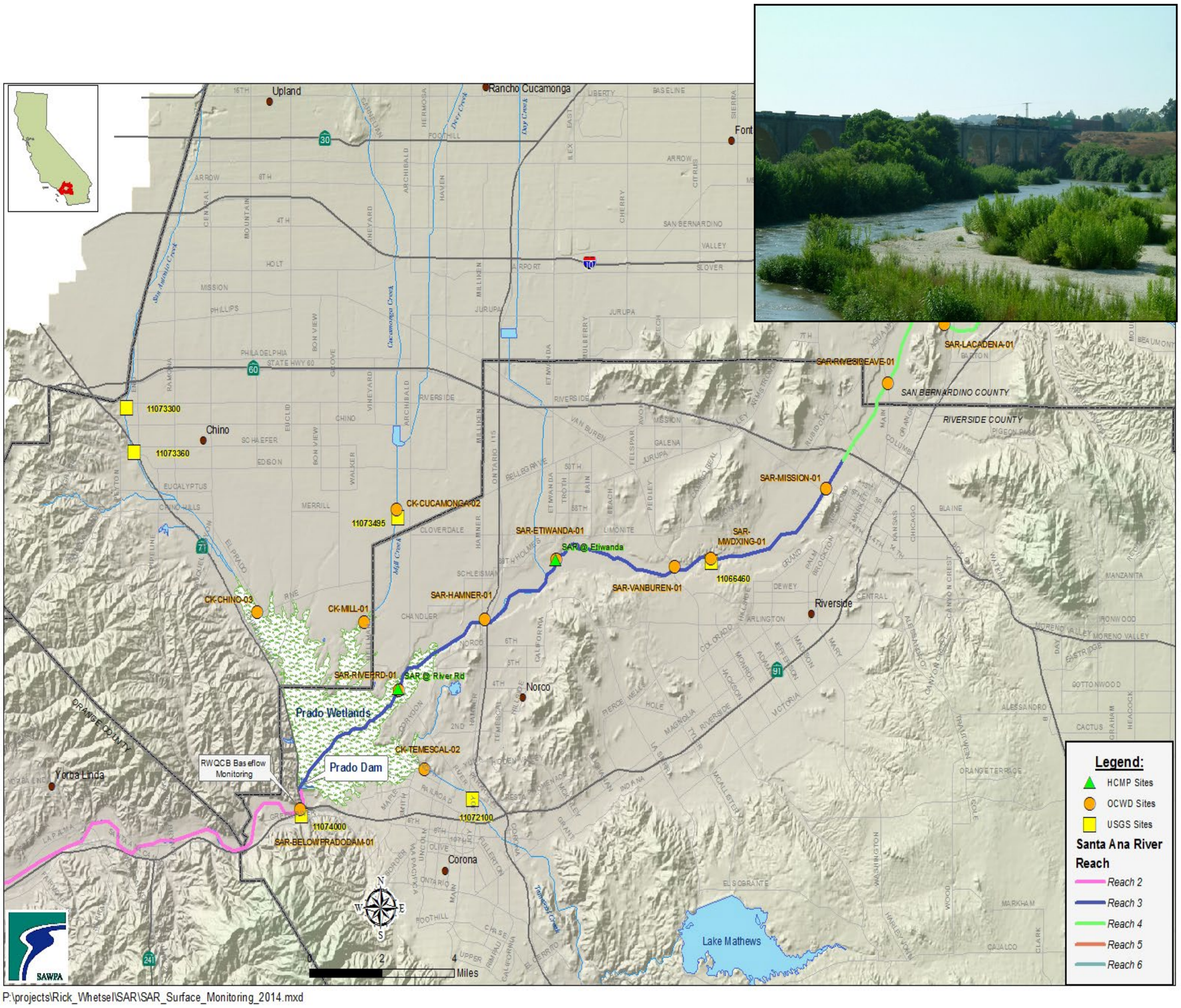
2023 Annual Report

of Santa Ana River Water Quality

Final Report



Prepared by:

SANTA ANA WATERSHED PROJECT AUTHORITY

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Acronym and Abbreviations List

AFY	acre-feet per year
COD	chemical oxygen demand
EC	electrical conductivity
HCMP	Hydraulic Control Monitoring Program
mg/L	milligrams per liter
umhos/cm	micromhos per centimeter
MWD	Metropolitan Water District of Southern California
NTU	nephelometric turbidity units
OCWD	Orange County Water District
RIX	Regional Tertiary Treatment Rapid Infiltration and Extraction Facility
RWQCB	Regional Water Quality Control Board, Santa Ana Region
SAR	Santa Ana River
SAWPA	Santa Ana Watershed Project Authority
TDS	total dissolved solids
TIN	total inorganic nitrogen
TN	total nitrogen
USGS	United States Geological Survey

1 Introduction

In 1996, the Nitrogen and Total Dissolved Solids (N/TDS) Task Force was formed to conduct scientific investigations regarding the then existing nitrogen and TDS water quality objectives of the 1995 Water Quality Control Plan for the Santa Ana River (SAR) Basin (Region 8). This Task Force, administered by the Santa Ana Watershed Project Authority (SAWPA) was comprised of 22 water supply and wastewater agencies. The work performed by the Task Force was broken out into several phases. In 2003, the Final Technical Memorandum was completed, which reported the results of this scientific investigation, *The TIN/TDS Study – Phase 2B of the Santa Ana Watershed Wasteload Allocation Investigation*.

As a result of this work (referenced above), the Santa Ana Regional Water Quality Control Board (Regional Board) amended the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan). The Basin Plan Amendment (hereafter the 2004 Basin Plan Amendment) was adopted by the Regional Board in January 2004, approved by the State Water Resources Control Board in September 2004, and approved by the Office of Administrative Law in December 2004.

In December 2021, the Regional Board amended the Basin Plan to revise and update limited components of the total dissolved solids (TDS) and nitrogen management program. These updates were approved by the Office of Administrative Law on July 27, 2023. These amendments resulted in the Task Force updating the Surface Water Quality Ambient Monitoring Program, which will be reflected in the future 2024 Annual Report for the SAR.

Pursuant to the 2004 Basin Plan Amendment (and maintained in the 2021 amendments), certain participants in the N/TDS Task Force are required to conduct the following investigations:

- Re-computation of Ambient Water Quality over a 20-year period; and
- Preparation of an Annual Report of Santa Ana River Water Quality.

This report fulfills the second requirement listed above – *Preparation of an Annual Report of Santa Ana River Water Quality*[1]. Contained within this report are water quality data required to implement the surface water quality monitoring program necessary to determine compliance with the nitrogen and TDS objectives for Reaches 2, 3, 4 and 5 of the SAR and, thereby, the effectiveness of the wasteload allocations.

In Chapter 4 of the Basin Plan, the base flow TDS and total nitrogen objectives for Reach 3 of the SAR are specified. For Reach 2, a TDS objective based on a five-year, volume-weighted, moving average of the annual TDS concentration is also defined. The use of this moving average allows the effects of wet and dry years to be integrated over the five-year period and reflects the long-term quality of water recharged by Orange County Water District (OCWD) downstream of Prado Dam.

The Basin Plan specifies a monitoring program to determine compliance with the Reach 3 base flow objectives at Prado Dam (see Chapter 4 of the Basin Plan), whereas base flow is defined by the Basin Plan to be when the influence of storm flows and nontributary flows are at a minimum, which typically occurs during August and September. Regional Board staff currently conducts this monitoring program on an annual basis. The measurement of base flow quality, rather than the quality of flows in Reach 2, has long been used to indicate the effects of recharge of SAR flows on Orange County groundwater. The efficacy of this approach was evaluated as part of the 2004 Basin Plan Amendment for the TDS/nitrogen management plan in the Basin Plan. As discussed in the 2004 Basin Plan Amendment, Reach 3 base flow objectives are

[1] The 2023 Annual Report was prepared in accordance with the Santa Ana River Water Quality Work Plan approved by the Regional Board in Res. No. R8-2005-0063.

considered protective of the Orange County Groundwater Basin and the existing monitoring program designed to measure compliance is sufficient.

In addition to the base flow sampling program and the surface water quality monitoring commitments associated with certain agencies' "maximum benefit" programs, the comprehensive monitoring program implemented by the Task Force members must include an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4, and 5 of the SAR. Compliance with the Reach 2 TDS objective can be determined by the evaluation of data collected by OCWD, the United States Geological Survey (USGS), and others. Compliance with Basin Plan objectives for Reach 4 and 5 of the SAR can be determined in the same manner.

A description of the data collected for this report is discussed in Section 2. Section 3 presents the analysis of the surface water quality monitoring data collected. Results are presented by Reach of the SAR. Section 4 provides Conclusions and Recommendations of the report. Section 5 presents the Response to Comments. The complete set of 2023 surface water quality data is included as Appendix B, available on the SAWPA website.

2 Data Collection

Water quality and discharge data used to prepare the 2023 Annual Report of Santa Ana River Water Quality, were collected from a number of regional efforts to monitor surface water quality along the SAR and its tributaries, including in-stream gauges employed by USGS, shown in Figure 2-1.

A detailed description of each of these monitoring efforts, representing the 2023 calendar year, are as follows:

Regional Board staff typically conducts annual water quality monitoring of base flow in the SAR exiting Reach 3, below Prado Dam. Monitoring typically extends over a five-week period during the months of August and September and is used to determine compliance with Reach 3 base flow objectives. In 2023; however, several rainfall events occurred in August (10, 16, 20, and 21) and September (1, 2, and 10) that introduced significant volumes of storm flow runoff into the SAR impacting base flow. In light of these storms, base flow monitoring was conducted in during September and October. This monitoring consisted of five sampling events between September 12 through October 10, 2023, as shown in Table 3-3. The complete set of 2023 base flow water quality data collected exiting Reach 3 below Prado Dam by the Regional Board is included in Appendix B, which is available on the SAWPA website.

Additionally, OCWD conducts a monitoring program for the SAR to assess the quality of the SAR water recharged into the Orange County Groundwater Basin. OCWD collects monthly and quarterly samples from the SAR at Imperial Highway in Anaheim and other locations along the SAR below Prado Dam and its tributaries. During the months of August and September, monitoring is performed with a greater sampling frequency to capture base flow conditions within the Watershed. At sites above Prado Dam, OCWD collects samples from a single monitoring event in August. These data are typically used in this report to evaluate water quality for Reaches 2, 3, 4, and 5 of the SAR during low flow conditions. In 2023, however, this single monitoring event took place on August 22, 2023, one day following a significant rainfall event. Accordingly, this data is not reflective of base flow conditions and is therefore excluded in the summary analysis of baseflow. A second sample collected on September 19, 2023, at their *SAR River Road* site. was included in the summary analysis. OCWD monitoring locations used in this report are presented in Table 2-1. In later tables and figures, OCWD stations are referred to by the name of the reach. The complete set of 2023 SAR water quality data collected by OCWD and used in this report is included in Appendix B, available on the SAWPA website.

Table 2-1. OCWD's Santa Ana River Water Quality Monitoring Locations

Station ID	Station Name	Tributary	X Coordinate	Y Coordinate
8105	SAR-BELOWDAM-01[2]	Santa Ana River Reach 2	- 117.644996	33.883665
24782	SAR-BELOWDAM-02[3]	Santa Ana River Reach 2	-117.641669	33.88683
8096	SAR-RIVERRD-01	Santa Ana River Reach 3	- 117.666485	33.948989
8111	SAR-HAMNER-01	Santa Ana River Reach 3	- 117.556597	33.947337
9672	SAR-ETIWANDA-01	Santa Ana River Reach 3	- 117.522230	33.967365
8112	SAR-VANBUREN-01	Santa Ana River Reach 3	- 117.465465	33.965049
8113	SAR-MWDXING-01[1]	Santa Ana River Reach 3	- 117.448032	33.968027
8114	SAR-MISSION-01	Santa Ana River Reach 4	- 117.392523	33.991576
8115	SAR-RIVERSIDEAVE-01	Santa Ana River Reach 4	- 117.362809	34.026480
8116	SAR-LACADENA-01	Santa Ana River Reach 4	- 117.335710	34.046335
8117	SAR-WATERMAN-01	Santa Ana River Reach 5	- 117.276721	34.071365

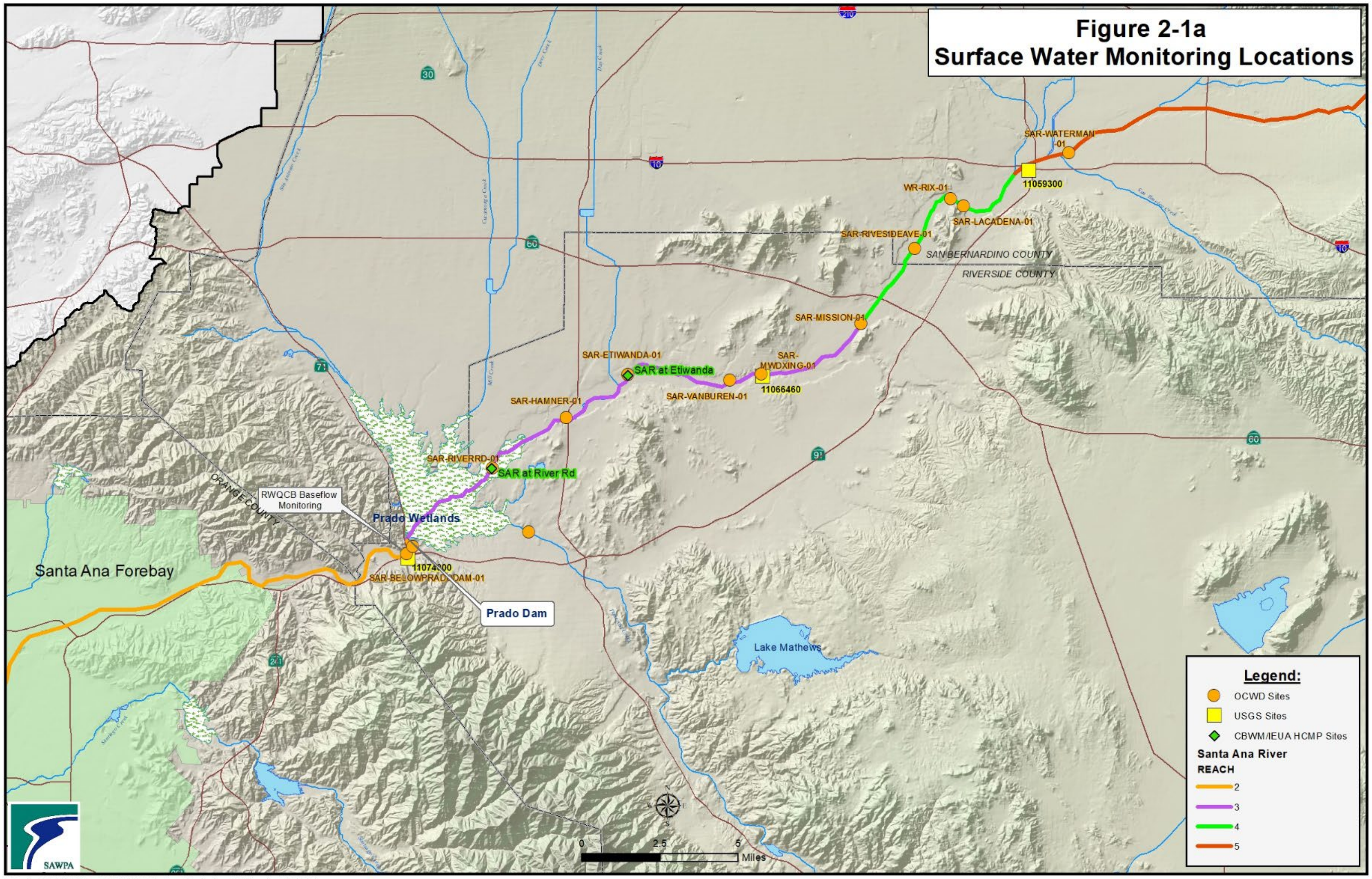
[1]*No data reported for this site in 2023.*
[2]*Site inaccessible due to major construction from June through December 2023.*
[3]*Site replaced SAR-BELOWDAM-01 during major construction from June through December 2023.*

The Chino Basin Hydraulic Control Monitoring Program (HCMP) is conducted jointly by the Chino Basin Water Master (CBWM) and Inland Empire Utilities Agency (IEUA) as part of their Maximum Benefit monitoring commitment. Water quality data collected through this program is used in this report to evaluate compliance with Basin Plan objectives for Reaches 2 and 3 of the SAR. Through 2012, the HCMP program collected bi-monthly samples from locations along the SAR (both above and below Prado Dam) and its tributaries. In 2013, the HCMP requirements were reduced to quarterly monitoring at two locations, which are presented in Table 2-3. The complete set of 2016 water quality data collected through the HCMP is included in Appendix C on the enclosed CD.

Table 2-2. Chino Basin Hydraulic Control Monitoring Program (HCMP) Monitoring Sites

Station ID	Site Name	Tributary	X Coordinate	Y Coordinate
1207120	SAR at River Rd	SAR Reach 3	- 117.59810654289	33.9236262794
1207118	SAR at Etiwanda	SAR Reach 3	- 117.52258200702	33.96704204502

Figure 2-1. Surface Water Monitoring Locations



The USGS maintains three active gauging stations to monitor flow and water quality along the SAR. Long-term stream flow and water quality data are available for gauging stations 11074000, located at *Below Prado Dam*, and 11066460, located at *MWD Crossing*. Additionally, stream flow data is available for gauging station 11059300, located at *SAR at E St near San Bernardino*. The list of USGS gauging stations used in this report is presented in Table 2-2. The complete set of 2023 flow and water quality data available from these USGS gauging stations is included in Appendix B, available on the SAWPA website.

Table 2-3. USGS Stream Gauge Stations

USGS ID	Station Name	2023 Flow (AFY)	Tributary	X Coordinate	Y Coordinate
11074000	SAR Below Prado Dam	303,607	SAR Reach 2	- 117.644446	33.881583
11066460	SAR at MWD Crossing	111,037	SAR Reach 3	- 117.447501	33.966858
11059300	SAR at E St near San Bernardino	68,992	SAR Reach 5	- 117.299444	34.065000

3 Analysis of Monitoring Data

3.1 *Santa Ana River Reach 2*

Table 4-1 of the Basin Plan specifies a TDS objective (650 milligrams per liter (mg/L)) for Reach 2 of the Santa Ana River. The determination of compliance with the TDS objective for Reach 2 is made by using the mean of the five most recent flow-weighted annual averages as reported by the SAR Watermaster, shown in Table 3-1. In years of normal rainfall, most of the total flow of the river is percolated in the Santa Ana Forebay (see Figure 2-1), and directly affects the quality of the groundwater. For that reason, compliance with the TDS water quality objective for Reach 2 is based on the five-year moving average, which is estimated by computing the arithmetic average of the five most recent annual estimates of flow-weighted TDS for total flow at Below Prado (from the 2022-23 Annual SAR Watermaster Report[2]). Use of this moving average allows the effects of wet and dry years to be smoothed out over the five-year period.

Table 3-1. Yearly Volume-Weighted Moving Average TDS at Below Prado Dam (SAR Watermaster Report)

Water Year Ending[A]	Yearly Flow-weighted TDS (mg/L)
2019	401
2020	468
2021	609
2022	499
2023	354
5 Year Average	466

Note: [A] Santa Ana River Watermaster data reported for FY 2022-23 water year

Alternative Method to Determine Compliance with TDS Objective for Reach 2

In addition to the method prescribed in the Basin Plan, as presented in Table 3-1, the Task Force employs an alternative method to determine compliance with the TDS objective for Reach 2 of the Santa Ana River. This alternative method was first employed in 2005 when the Task Force began preparing the Annual Reports of Santa Ana River Water Quality. This method computes compliance with the TDS objective in Reach 2 as a five-year average based on the 60-month volume-weighted[3] dataset. This alternative method was the sole method to demonstrate compliance through the first four reports (2005 through 2008). While this method was technically correct, the Task Force became concerned that it might not be legally correct. Additional review of the Basin Plan text indicated that the volume-weighted five-

[2] Determination of flow-weighted TDS for total flow at Below Prado for Water Year 2022-23 is based on records from a continuous monitoring device operated by the USGS for EC of the river flow below Prado Dam. This record is supplemented by grab samples for EC collected by the USGS and analyzed for TDS. Using the daily EC data, flow-weighted average daily concentrations for TDS are calculated using the following best fit correlation equation:

TDS = EC x 0.6068 (where the units of TDS and EC are mg/L and umhos/cm, respectively)

[3]

$$5-Year\ Moving\ Average\ TDS\ (mg/L) = \frac{\left(\sum_{n=first\ month\ of\ 1st\ year}^{last\ month\ of\ 5th\ year} Monthly\ Flow\right) x \left(\sum_{n=first\ month\ of\ 1st\ year}^{last\ month\ of\ 5th\ year} Volume\ Weighted\ Monthy\ Average\ TDS\right)}{\left(\sum_{n=first\ month\ of\ 1st\ year}^{last\ month\ of\ 5th\ year} Monthly\ Flow\right)}$$

year average should be computed as the arithmetic mean of the five discrete volume-weighted values for each of the five years (as presented in Table 3-1).

While it is true that the 60-month volume-weighted averaging approach implemented by the Task Force more accurately estimates the long-term volume weighted average TDS concentration in Reach 2, the approach, as prescribed in the Basin Plan provides a better estimate of the long-term volume-weighted average of TDS concentrations in the river flow that percolates through the streambed into the underlying groundwater basin. In very wet years, the volume-weighted average TDS concentration is much lower, but some of this high-quality water flows out to the Pacific Ocean rather than percolating to groundwater. By assuming the same volume of water percolates every year, the method specified by the Basin Plan tends to slightly overestimate the TDS concentrations entering the Orange County groundwater basin, whereas the 60-month volume-weighted averaging approach tends to slightly underestimate the TDS concentration.

Beginning with the 2009 Annual Report, the Task Force started applying and reporting both methods and results. The Task Force has continued with this approach because it provides the context for a better understanding of the data. It also helps illustrate how small changes in the assumptions and procedures used to perform the calculations can lead to consequential changes in the subsequent compliance determinations. Regardless of which method is used, the resulting five-year, volume-weighted average has never exceeded the Basin Plan objective of 650 mg/L for the period shown.

Computation of the 60-month Volume-weighted Average TDS Concentration

During the 2023 calendar year, 53 samples were collected for TDS at *Below Prado Dam*. These included grab samples collected by the USGS, OCWD, and the Regional Board. From the results of these samples, electrical conductivity (EC) and TDS were graphically plotted. A linear regression of TDS versus EC yielded the following equation:

$$TDS = (EC \times 0.5817) - 25.9910$$

The coefficient of determination (R^2) of the linear regression was 0.97, which indicates a strong correlation between TDS and EC; that is, about 97 percent of the variability in TDS is explained by this equation. Using the above equation and daily EC data from a continuous monitoring device operated by USGS, daily TDS values were calculated for 2023 data. Daily stream flow values at *Below Prado Dam* were multiplied by the computed TDS values and summed for each month. This total was divided by the total monthly flow to yield a volume-weighted average for each month. These results are shown in Table 3-2. The 60-month volume-weighted moving average for the period January 2019 through December 2023 was 453 mg/L. This represents a decrease of 35 mg/L from last year's 60-month volume-weighted moving average TDS of 488 mg/L.

Figure 3-1 compares the Reach 2 Basin Plan Objective for TDS to a time history for TDS observations for 2003 to the present at *Below Prado Dam* depicted as the mean TDS concentration of five annual flow-weighted averages, and the flow-weighted, 60-month moving average[4] TDS concentration.

4

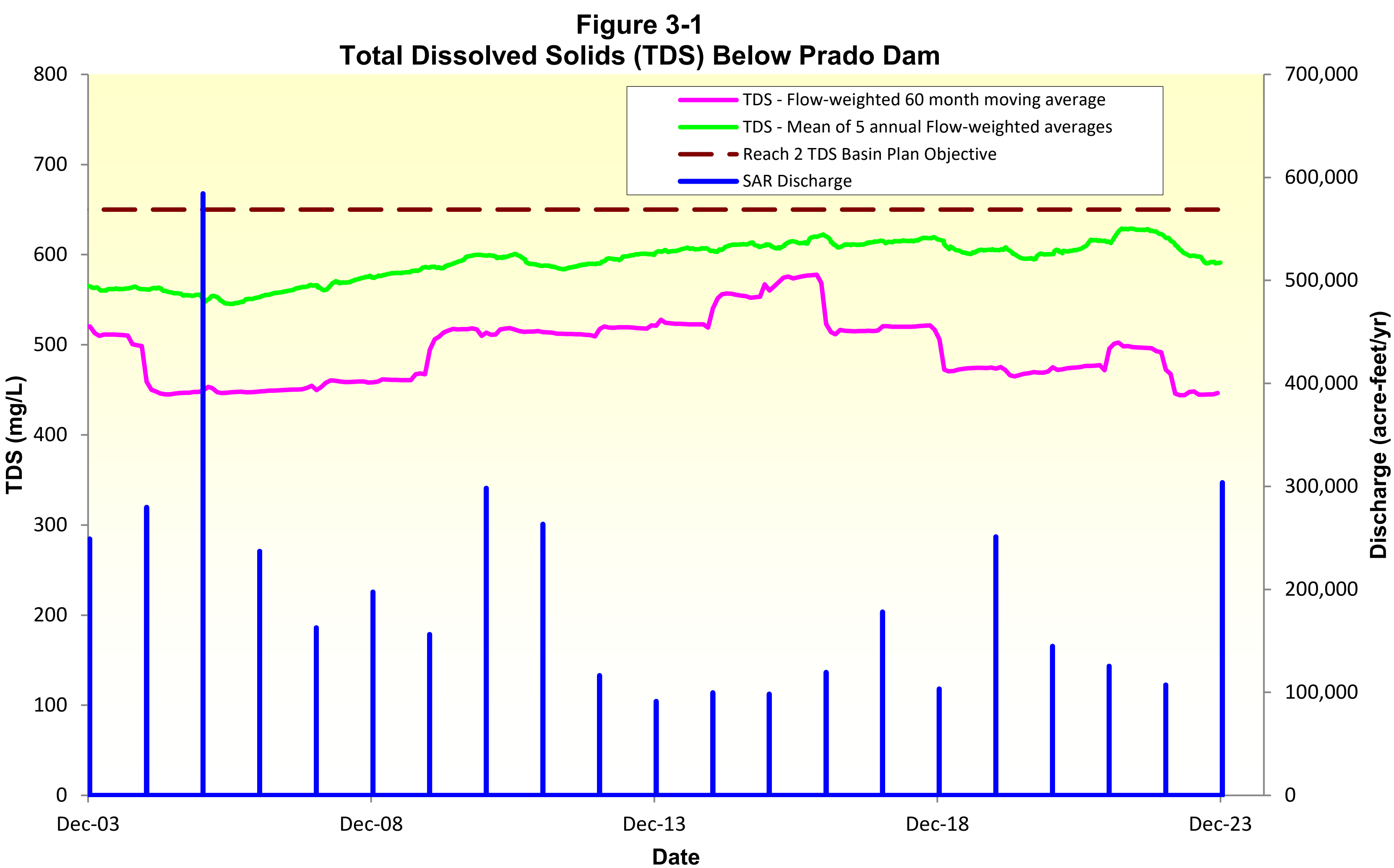
$$Volume\ Weighted\ Monthy\ Average\ TDS\ (mg/L) = \sum_{n=first\ day\ of\ month}^{last\ day\ of\ month} \frac{Daily\ TDS\ Sample\ \left(\frac{mg}{L}\right) x\ Daily\ Flow\ (cfs)}{\sum_{n=first\ day\ of\ month}^{last\ day\ of\ month} Daily\ Flow\ (cfs)}$$

Table 3-2. Monthly Volume-Weighted Moving Average TDS at Below Prado Dam (2023 OCWD, USGS and Regional Board at Below Prado Dam)

Month	Monthly Flow (cfs-days)	Monthly Volume Weighted TDS (mg/L)	Monthly Flow X TDS
Jan-19	14,494	323	4,680,018
Feb-19	44,004	248	10,896,992
Mar-19	15,464	403	6,227,282
Apr 19 **	11,236	531	5,963,072
May-19	11,137	566	6,298,555
Jun-19 **	3,572	680	2,428,738
Jul-19	2,927	661	1,934,719
Aug-19	2,484	672	1,668,363
Sep-19	2,601	685	1,780,391
Oct-19	2,517	674	1,696,256
Nov-19 **	3,468	591	2,049,773
Dec-19	12,047	341	4,111,578
Jan-20	11,716	499	5,846,560
Feb-20	4,400	701	3,086,465
Mar-20	7,376	411	3,032,135
Apr-20	15,982	371	5,926,254
May-20	8,432	489	4,120,666
Jun-20	6,364	615	3,911,894
Jul-20	1,408	729	1,026,766
Aug-20	2,142	694	1,487,298
Sep-20	2,282	688	1,570,905
Oct-20	2,400	698	1,673,975
Nov-20	3,723	653	2,429,466
Dec-20	3,138	680	2,133,983
Jan-21	4,872	568	2,764,882
Feb-21	6,681	423	2,826,040
Mar-21	7,499	534	4,004,962
Apr-21	5,736	657	3,770,455
May-21	3,220	675	2,172,964
Jun-21	2,481	673	1,668,541
Jul-21 **	1,419	687	974,212
Aug-21 **	1,916	678	1,298,803
Sep-21	2,328	689	1,604,558
Oct-21	2,821	670	1,891,328
Nov-21	3,104	682	2,115,825
Dec-21	18,111	291	5,266,752
Jan-22	13,198	433	5,714,329
Feb-22	3,902	694	2,707,979
Mar-22	4,158	636	2,645,333
Apr-22	3,961	651	2,577,507
May-22	2,702	684	1,847,520
Jun-22	2,458	650	1,598,610
Jul-22 **	1,570	696	1,092,528
Aug-22	1,357	751	1,018,981
Sep-22	2,172	662	1,438,527
Oct-22	2,782	679	1,889,132
Nov-22	8,452	419	3,540,976
Dec-22	7,192	515	3,706,454
Jan-23	26,775	220	5,883,539
Feb-23	11,908	368	4,376,427
Mar-23 **	13,192	290	3,831,609
Apr-23 **	1,992	443	881,568
May-23 **	1,213	500	606,321
Jun-23 **	4,319	714	3,085,208
Jul-23 **	2,339	692	1,618,809
Aug-23 **	5,735	299	1,716,304
Sep-23	7,267	531	3,856,259
Oct-23 **	3,139	676	2,121,127
Nov-23	4,390	603	2,647,033
Dec-23	5,954	562	3,344,185
Total	**397,628**		**180,087,692**
60 - Month Volume Weighted Average: 453mg/L			

Note: ** ***Denotes monthly results missing EC readings due to instrumentation issues with USGS equipment only available EC data was used.***

Figure 3-1. Total Dissolved Solids (TDS) Below Prado Dam



Notes:
TDS Weighted = Monthly flow weighted TDS calculated from EC. Data prior to October 2003 from Watermaster; October 2003 to December 2004 from WeInc, 2005 to 2022 from SAWPA.

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3.2 *Santa Ana River Reach 3*

3.2.1 Below Prado Dam

To determine whether water quality objectives for base flow in Reach 3 are being met, the Regional Board typically collects a series of grab and composite samples at *Below Prado Dam* during August and September when the influence of storm flows and non-tributary flows is at a minimum. These include conditions where there were no non-tributary flows and usually no water impounded behind Prado Dam, the volumes of storm flows, rising water, and nonpoint sources discharges tend to be low, and the major component of base flow is municipal wastewater. Water quality objectives specified for Reach 3 of the SAR by the Basin Plan include TDS, hardness, sodium, chloride, Total Nitrogen (TN), sulfate, Chemical Oxygen Demand (COD), and boron. In 2023, however, several rainfall events occurred in August (10, 16, 20 and 21) and September (1, 2 and 10) that introduced significant volumes of stormwater runoff into the Santa Ana River impacting base flow. In light of these events, base flow monitoring was conducted during September and October to better reflect actual base flow conditions.. This monitoring consisted of five sampling events, as presented in Table 3-3.

**Table 3-3. Results for 2023
Annual Base Flow Monitoring Program for the
Santa Ana River at Below Prado Dam (Regional Board Data Only)**

Parameter	Units	Basin Plan Objectives SAR Reach 3	9/12/2023[4]	9/19/2023	9/26/2023	10/3/2023	10/10/2023
Ammonia-Nitrogen	mg/L	**X[1]**	0.2	0.09	0.06	0.08	0.06
Bicarbonate (as CaCO3)	mg/L		260	250	250	230	250
Boron (dis)[3]	mg/L	**0.75**	0.34	0.35	0.33	0.34	0.34
Calcium (dis)	mg/L		95	85	84	82	93
Carbonate (as CaCO3)	mg/L		<5	<5	<5	<5	<5
Chemical Oxygen Demand	mg/L	**30**	21	16	28	14	21
Chloride	mg/L	**140**	140	160	150	130	150
Electrical Conductivity (field)	umhos/		1170	1171	1150	1074	1176
Hydroxide (as CaCO3)	mg/L		<5	<5	<5	<5	<5
Magnesium (dis)	mg/L		22	21	19	19	22
Nitrate-Nitrogen	mg/L		4	4.9	4.7	4.7	6
Nitrite-Nitrogen	mg/L		0.019	0.022	0.015	0.013	0.017
Organic Nitrogen	mg/L		0.3	0.8	0.6	0.9	0.6
Potassium (dis)	mg/L		13	13	13	13	13
Sodium (dis)[3]	mg/L	**110**	120	110	110	110	120
Sulfate	mg/L	**150**	120	120	120	100	120
Total Alkalinity (as CaCO3)	mg/L		260	250	250	230	250
Total Dissolved Solids	mg/L	**700**	680	690	670	620	670
Total Hardness (as CaCO3) (dis)[3]	mg/L	**350**	330	300	290	290	320
Total Inorganic Nitrogen (calc)	mg/L	**10[2]**	4.2	5.0	4.8	4.8	6.1
Total Kjeldahl Nitrogen	mg/L		0.5	0.9	0.7	1.0	0.7
Total Nitrogen	mg/L		4.5	5.9	5.4	5.7	6.8
Total Organic Carbon	mg/L		5.5	4.4	4.3	5	4.2
Dissolved Organic Carbon	mg/L		5.1	4.3	4.2	4.7	4
Turbidity	NTU		260	83	70	120	52
Turbidity (field)	NTU		400	120	87	160	70

Notes: *All nitrogen species filtered*
na not available
X[1] *Santa Ana River Basin Plan specifies an un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*
X[2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*
X[3] *Dissolved fraction results presented, but Basin Plan reports based upon the Total fraction.*
X[4] *Sample collected within 4 days of a measured rainfall event.*

A summary of all base flow monitoring data collected by the USGS, OCWD, and the Regional Board at *Below Prado Dam* during 2023 along with Basin Plan objectives for base flow conditions for SAR Reach 3 water quality are presented in Table 3-4a. This includes four of five monitoring events conducted by the Regional Board for their annual water quality monitoring of base flow in the SAR during September and October of 2023. OCWD conducted six base flow monitoring events at *Below Prado Dam* in August, September, and October in 2023. However, as the nitrogen species data collected by OCWD was not filtered, it is presented, but was not used to evaluate the water quality objective because the Basin Plan currently states that the water quality objective is based on a filtered sample of Total Inorganic Nitrogen. The USGS conducted monthly base flow sampling at *Below Prado Dam* in August, September, and October 2023. Table 3-4a presents the results of this monitoring.

Table 3-4a. Summary of August, September, and October Base Flow Water Quality Observations for the Santa Ana River at Below Prado Dam (2023 OCWD, USGS and Regional Board at Below Prado Dam)

Constituent	Units	Basin Plan Objectives SAR Reach 3	Base Flow Average	# of Samples
Ammonia-Nitrogen (filtered)	mg/L		0.07	4
Ammonia-Nitrogen (unfiltered)	mg/L	**X[1]**	<0.1	6
Bicarbonate (as CaCO3) (filtered)	mg/L		229	3
Bicarbonate (as CaCO3) (unfiltered)	mg/L		232	10
Boron (total)	mg/L	**0.75**	0.30	6
Boron (dis)[3]	mg/L		0.34	4
Calcium (total)	mg/L		74	6
Calcium (dis)[3]	mg/L		86	4
Carbonate (as CaCO3)	mg/L		<5	13
Chemical Oxygen Demand (filtered)	mg/L		12	3
Chemical Oxygen Demand (unfiltered)	mg/L	**30**	16	7
Chloride	mg/L	**140**	126	13
Electrical Conductivity	umhos/cm		988	13
Electrical Conductivity (field)	umhos/cm		1098	10
Fluoride	mg/L		0.41	6
Hydroxide (as CaCO3)	mg/L		<5	10
Magnesium	mg/L		17	6
Magnesium (dis)	mg/L		20	4
Nitrate-Nitrogen (filtered)	mg/L		5.1	4
Nitrate-Nitrogen (unfiltered)	mg/L		3.1	6
Nitrite-Nitrogen (filtered)	mg/L		0.017	4
Nitrite-Nitrogen (unfiltered)	mg/L		0.028	6
Organic Nitrogen (filtered)	mg/L		0.73	4
Organic Nitrogen (unfiltered)	mg/L		0.5	6
Potassium	mg/L		12.5	6
Potassium (dis)	mg/L		13.0	4
Sodium	mg/L	**110**	85	6
Sodium (dis)[3]	mg/L		113	4
Sulfate	mg/L	**150**	101	13
Total Alkalinity (as CaCO3)	mg/L		223	13
Total Dissolved Solids	mg/L	**700**	625	17
Total Hardness (as CaCO3)	mg/L	**350**	254	6
Total Hardness (as CaCO3) (dis)[3]	mg/L		300	4
Total Inorganic Nitrogen (calculated filtered)	mg/L	**10[2]**	5.2	4
Total Inorganic Nitrogen (calc unfiltered)	mg/L		3.1	6
Total Nitrogen (calculated filtered)	mg/L		6.0	4
Total Nitrogen (calculated unfiltered)	mg/L		3.7	6
Total Kjeldahl Nitrogen (filtered)	mg/L		0.83	4
Total Kjeldahl Nitrogen (unfiltered)	mg/L		0.54	6
Total Organic Carbon	mg/L		5.8	13
Dissolved Organic Carbon	mg/L		4.3	4
Turbidity	NTU		60	12
Turbidity (field)	NTU		109	4

Notes: Table summarizes base flow monitoring data collected by USGS, OCWD and the Regional Board at Below Prado Dam during 2023

na not available

X[1] *Santa Ana River Basin Plan specifies an un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*

X [2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*
X [3] *Dissolved fraction results presented, but Basin Plan reports based upon the Total fraction.*

In addition to the August, September, and October analysis of base flow data, an additional analysis of data that is considered to be reflective of base flow conditions was conducted to provide an alternative characterization of Santa Ana River base flow. The alternative approach for calculating base flow is being considered as a potential future Basin Plan Amendment. This analysis included base flow monitoring data collected by OCWD, USGS, and Regional Board at *Below Prado Dam* during 2023 that met the following criteria:

i) monitoring data collected between April 1 and October 31;
ii) no precipitation events or imported water discharge within four days prior to sampling, and
iii) the water level elevation of the conservation pool behind Prado Dam is at or below the level that the Army Corps of Engineers (ACOE) considers empty (472 ft-above mean sea level).

the results of this analysis of monitoring data are presented below in Table 3-4b.

Table 3-4b. Summary of Annual Base Flow Water Quality Observations for the Santa Ana River at Below Prado Dam (2023 OCWD, USGS and Regional Board at Below Prado Dam)

Constituent	Units	Basin Plan Objectives SAR Reach 3	Base Flow Average	# of Samples
Total Dissolved Solids	mg/L	**700**	689	19
Total Inorganic Nitrogen (calculated filtered)	mg/L	**10[2]**	4.7	5
Total Inorganic Nitrogen (calc unfiltered)	mg/L		3.4	6
Total Nitrogen (calculated filtered)	mg/L		5.4	5
Total Nitrogen (calculated unfiltered)	mg/L		3.9	6

Notes: Table summarizes base flow monitoring data collected by OCWD, USGS, and the Regional Board at Below Prado Dam during 2023
X [2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*

The USGS also maintains a gauging station, 11074000, located on the SAR below Prado Dam, shown in Figure 2-1. In 2023, this station recorded flows totaling 303,607 AFY.

A long time-history of water quality data has been collected by USGS along with data collected by OCWD, Regional Board base flow monitoring program, and by CBWM/IEUA at *Below Prado Dam* and *MWD Crossing*. These data were plotted for each constituent that has a Basin Plan objective for January 2003 through to current and are included in Appendix A, to show the longer-term trends in base flow data as non-volume-weighted five-year moving averages.

3.2.2 Santa Ana River Mainstem between Riverside Narrows and Prado Wetlands

Monitoring of Reach 3, above Prado Dam is performed by OCWD for their SAR Water Quality Monitoring Program, the CBWM/IEUA through the HCMP, and the USGS as part of their National Water Quality Program. OCWD typically monitors the following locations: *MWD Crossing, Van Buren Blvd., Etiwanda Avenue, Hamner Road, and River Road*, CBWM/IEUA at *Etiwanda Avenue, and River Road*, and USGS at *MWD Crossing*, as shown in Figure 2-1.

OCWD conducted two monitoring events in SAR Reach 3, above Prado dam in 2023. This included a single monitoring event for each of the available locations on August 22, 2023 and a second monitoring event conducted only at the *River Road* site on September 19, 2023. However, as the August 22, 2023, monitoring event occurred one day following a significant rainfall event, only the September 19, 2023, data is reflective of base flow conditions and included in the data summary. Additionally, since the nitrogen species data collected by OCWD was not filtered, these data were presented in the summary table, but not used to evaluate if the water quality objective for TIN was exceeded. The CBWM/IEUA conducts monitoring on a quarterly basis, but only the October 17th data met the criteria to be used in analysis, and the USGS collects only electrical conductivity and TDS at their *Santa Ana River at MWD Crossing site*. Table 3-5a presents a summary of the results of these monitoring efforts for the months of August, September, and October under base flow conditions.

An assessment of base flow conditions, represented by water quality data collected in August, September, and October of 2023, showed no exceedances of water quality objectives specified in the Basin Plan.

The USGS maintains a gauging station, 11066460, located along Reach 3 of the SAR at the MWD Crossing, shown in Figure 2-1. In 2023, this station recorded flows totaling 111,037 AFY.

Table 3-5a. Summary of August, September, and October Base Flow Water Quality Observations for the Santa Ana River Reach 3 (2023 Between Riverside Narrows and Prado Wetlands)

Constituent	Units	Basin Plan Objectives SAR Reach 3	Base Flow Average	# of Samples
Ammonia-Nitrogen (unfiltered)	mg/L	**X1**	<0.1	3
Bicarbonate (as CaCO3)	mg/L		205	3
Boron (total)	mg/L		0.37	2
Carbonate (as CaCO3)	mg/L		<5	3
Calcium	mg/L		81	3
Chemical Oxygen Demand (filtered)	mg/L		na	na
Chemical Oxygen Demand (unfiltered)	mg/L	**30**	na	na
Chloride	mg/L	**140**	115	3
Electrical Conductivity	umhos/cm		911	7
Electrical Conductivity (field)	umhos/cm		878	5
Hydroxide (as CaCO3)	mg/L		<5	3
Magnesium	mg/L		16	3
Nitrate-Nitrogen (unfiltered)	mg/L		5.4	3
Nitrite-Nitrogen (unfiltered)	mg/L		<0.4	3
Organic Nitrogen (unfiltered)	mg/L		0.2	1
Potassium	mg/L		16	3
Sodium	mg/L		106	3
Sulfate	mg/L	**150**	95	3
Total Alkalinity (as CaCO3)	mg/L		210	3
Total Dissolved Solids	mg/L	**700**	556	7
Total Hardness (as CaCO3)	mg/L		270	3
Total Inorganic Nitrogen (calculated unfiltered)	mg/L	**10[2]**	6.0	3
Total Kjeldahl Nitrogen (unfiltered)	mg/L		<1	3
Total Nitrogen (unfiltered)	mg/L		6.4	3
Total Organic Carbon	mg/L		3.4	3
Turbidity	NTU		17	3

Note: Table presents average concentration data
X[1] Santa Ana River Basin Plan specifies an un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.
- Site SAR River Road includes data collected by OCWD at "SAR-RIVERRD-01"
- Site SAR Hamner includes only data collected by OCWD at "SAR-HAMNER-01"
- Site SAR Etiwanda includes data collected by OCWD at "SAR-ETIWANDA-01"
- Site SAR Van Buren includes only data collected by OCWD at "SAR-VANBUREN-01"
- Site SAR MWD includes data collected by USGS at "Santa Ana River at MWD Crossing" and OCWD at "SAR-MWD Crossing-01"
X[2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*

A summary analysis of the 2023 base flow monitoring data for Reach 3 above Prado Dam using the alternative assessment approach described above in Section 3.2.1, is presented in Table 3-5b. These data also showed no exceedances of water quality objectives specified in the Basin Plan.

Table 3-5b. Summary of Alternative Analysis Approach Base Flow Water Quality Observations for the Santa Ana River Reach 3 (2023 Between Riverside Narrows and Prado Wetlands)

Constituent	Units	Basin Plan Objectives SAR Reach 3	Base Flow Average	# of Samples
Total Dissolved Solids	mg/L	**700**	580	11
Total Inorganic Nitrogen (calculated	mg/L	**10[2]**	5.7	5
Total Nitrogen (calculated unfiltered)	mg/L		6.1	5

Note: Table presents average concentration data
- Site SAR River Road includes data collected by OCWD at "SAR-RIVERRD-01"
- Site SAR Etiwanda includes data collected by OCWD at "SAR-ETIWANDA-01"
- Site SAR MWD includes data collected by USGS at "Santa Ana River at MWD Crossing" and OCWD at "SAR-MWD Crossing-01"
X[2] *Santa Ana River Basin Plan specifies that Total Nitrogen Samples are to be filtered.*

3.3 *Santa Ana River Reach 4*

The Basin Plan has specified water quality objectives for SAR Reach 4 for TDS, TIN, and COD. Along SAR Reach 4, OCWD monitors sites, *SAR-MISSION-01*, *SAR-RIVERSIDEAVE-01, and SAR-LACADENA-01*, shown in Figure 2-1.

In 2023, the *SAR-RIVERSIDEAVE-01, SAR-MISSION-01, and SAR-LACADENA-01* sites were monitored by OCWD on August 22, 2023; however, as these data were collected only one day following a significant rainfall event, and not considered reflective of base flow conditions. An assessment of this data showed an exceedance of the water quality objective for COD specified in the Basin Plan. Table 3-6 presents a summary of the results of this monitoring.

Table 3-6. Summary of Water Quality Observations for Santa Ana River Reach 4

Constituent	Units	Basin Plan Objective SAR Reach 4	SAR Reach 4 Average	# of Samples
Ammonia-Nitrogen (unfiltered)	mg/L	**X[1]**	<0.1	3
Bicarbonate (as CaCO3)	mg/L		130	3
Carbonate (as CaCO3)	mg/L		<1	3
Chemical Oxygen Demand (filtered)	mg/L		24	3
Chemical Oxygen Demand (unfiltered)	mg/L	**30**	32	3
Chloride	mg/L		28	3
Electrical Conductivity	umhos/c		405	3
Electrical Conductivity (field)	umhos/c		405	3
Hydroxide (as CaCO3)	mg/L		<1	3
Nitrate-Nitrogen (unfiltered)	mg/L		1.4	3
Nitrite-Nitrogen (unfiltered)	mg/L		0.058	3
Organic Nitrogen (unfiltered)	mg/L		0.43	3
Sulfate	mg/L		32	3
Total Alkalinity (as CaCO3)	mg/L		130	3
Total Dissolved Solids	mg/L	**550**	414	3
Total Inorganic Nitrogen (calc unfiltered)	mg/L	**10**	1.5	3
Total Kjeldahl Nitrogen (unfiltered)	mg/L		0.47	3
Total Nitrogen (unfiltered)	mg/L		1.9	3
Total Organic Carbon	mg/L		11	3
Turbidity	NTU		3,933	3

Note: Table presents average concentration data
X[1] *Santa Ana River Basin Plan specifies un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the Middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.*
- Site SAR Mission Avenue includes data collected by OCWD at " SAR-MISSION-01"
- Site SAR Riverside Avenue includes only data collected by OCWD at " SAR-RIVERSIDEAVE-01"
- Site SAR La Cadena Drive includes only data collected by OCWD at " SAR-LACADENA-01"

3.4 *Santa Ana River Reach 5*

The Basin Plan has specified water quality objectives for the SAR Reach 5 for TDS, hardness, sodium, chloride, TIN, sulfate, and COD. Along the SAR Reach 5, OCWD monitors a single site, *SAR-WATERMAN-01*, shown in Figure 2-1.

In 2023, the *SAR- WATERMAN -01 site was monitored by OCWD* on August 22, 2023; however, as these data were collected only one day following a significant rainfall event, and not considered reflective of base flow conditions. An assessment of this data showed an exceedance of the water quality objective for COD specified in the Basin Plan. Table 3-7 presents a summary of the results of this monitoring.

Table 3-7. Summary of Water Quality Observations for Santa Ana River Reach 5

Constituent	Units	Basin Plan Objective SAR Reach 5	SAR Reach 5 Average	# of Samples
Ammonia-Nitrogen (unfiltered)	mg/L		<0.1	1
Bicarbonate (as CaCO3)	mg/L		123	1
Carbonate (as CaCO3)	mg/L		<1	1
Chemical Oxygen Demand (filtered)	mg/L		30	1
Chemical Oxygen Demand (unfiltered)	mg/L	**15**	55	1
Chloride	mg/L	**75**	5	1
Electrical Conductivity	umhos/c		250	1
Electrical Conductivity (field)	umhos/c		175	1
Hydroxide (as CaCO3)	mg/L		<1	1
Nitrate-Nitrogen (unfiltered)	mg/L		0.17	1
Nitrite-Nitrogen (unfiltered)	mg/L		0.009	1
Organic Nitrogen (unfiltered)	mg/L		0.5	1
Sodium	mg/L	**75**	na	na
Sulfate	mg/L	**60**	18	1
Total Alkalinity (as CaCO3)	mg/L		123	1
Total Dissolved Solids	mg/L	**550**	530	1
Total Hardness	mg/L	**240**	na	na
Total Inorganic Nitrogen (calc unfiltered)	mg/L	**8**	0.2	1
Total Kjeldahl Nitrogen (unfiltered)	mg/L		0.5	1
Total Nitrogen (unfiltered)	mg/L		0.7	1
Total Organic Carbon	mg/L		15	1
Turbidity	NTU		3,900	1

Note:Table presents average concentration data

X1 Santa Ana River Basin Plan specifies un-ionized ammonia objectives for WARM designated surface water bodies including site specific objectives for the Santa Ana River and certain tributaries including the Middle Santa Ana River, Chino Creek, Mill Creek (Prado Area), Temescal Creek, and San Timoteo Creek. Site specific objectives must be computed based upon temperature and pH.

- Site SAR Waterman Avenue includes data collected by OCWD at " SAR-WATERMAN-01"

The USGS maintains a gauging station, 11059300, located along the SAR at E Street near San Bernardino, shown in Figure 2-1. In 2023, this station recorded flows totaling 68,992 AFY.

4 Conclusions and Recommendations

4.1 Conclusions

In 2015, the Basin Monitoring Program Task Force commissioned an investigation to determine the cause for the steady increase in the average TDS concentrations measured during the summer base flow conditions since about 2005. The study found that average TDS concentrations were increasing because the POTWs, while still meeting their discharge obligations were discharging less volume of treated wastewater to the

Santa Ana River system.[5] Additionally, the watershed is in a long term dry period[7], which makes the interpretation of trend data more difficult, as shown in Figure 4-1. During the late summer months of August and September, the combined volume-weighted average TDS concentration for the nine municipal effluents that eventually converge at Prado Dam ranges between 535-570 mg/L.[6] High quality (low TDS) municipal effluent tends to dilute low quality (high TDS) discharges from other sources (e.g. dry weather urban runoff, rising groundwater, etc.) that also contribute flows to Reach 3. In the period from 2005 to 2014, POTWs reduced the total volume of treated wastewater discharged to Reach 3 of the Santa Ana River (and its major tributaries) by 45%; from 145 million gallons per day (mgd) down to 79 mgd. Additional modeling revealed that, if the total volume of municipal effluent discharge had remained unchanged, average TDS concentrations at Prado Dam would also have remained stable. The reduction in wastewater flows, and the subsequent loss of dilution, also appears to be a correlation to the long-term rising trend in the average concentration of various individual salt ions (i.e. chloride, sodium, and sulfate) during base flow conditions.

In 2022, a follow-up investigation was conducted to extend the analysis to cover the years 2015 to 2021. The 2022 study showed the average TDS concentration of base flow sampled at *Below Prado Dam* in August and September exceed the Reach 3 TDS objective in each 2017, 2018, 2019, and 2020, which corresponded with years of lower total POTW discharge (about 4,600 to 4,800 million gallons). The results and observations of this investigation are consistent with those in the POTW TDS Investigation 1[6], which indicated that 2004 to 2014 volume-weighted TDS concentration of the total POTW discharge in August and September were relatively low (about 560 mg/L) and remained below the Reach 3 TDS objective of 700 mg/L. The findings of these POTW TDS investigations continue to support previous estimations that the observed August and September increases of the TDS concentration in Reach 3, may be correlated with a decrease in POTW discharges of relatively low TDS concentration. And there are likely other gains and losses of discharge and mass that occur in Reach 3 and Reach 4 (e.g., rising groundwater, streambed recharge, evapotranspiration, dry-weather runoff, etc.) that contribute to the periodically increasing TDS concentration of baseflow in Reach 3 during August and September.[7]

In 2023, the five-year running average TDS concentration, for samples collected immediately below Prado Dam, continued to comply with the water quality objectives established for Reach 2 of the Santa Ana River and the underlying Orange Country Groundwater Management Zone (650 mg/L and 580 mg/, respectively). The average TDS concentration of the 17 samples collected at the same location in August, September, and October of 2023 were in compliance with the water quality objective established for Reach 3 during baseflow conditions (625 mg/L vs. 700 mg/L, respectively).

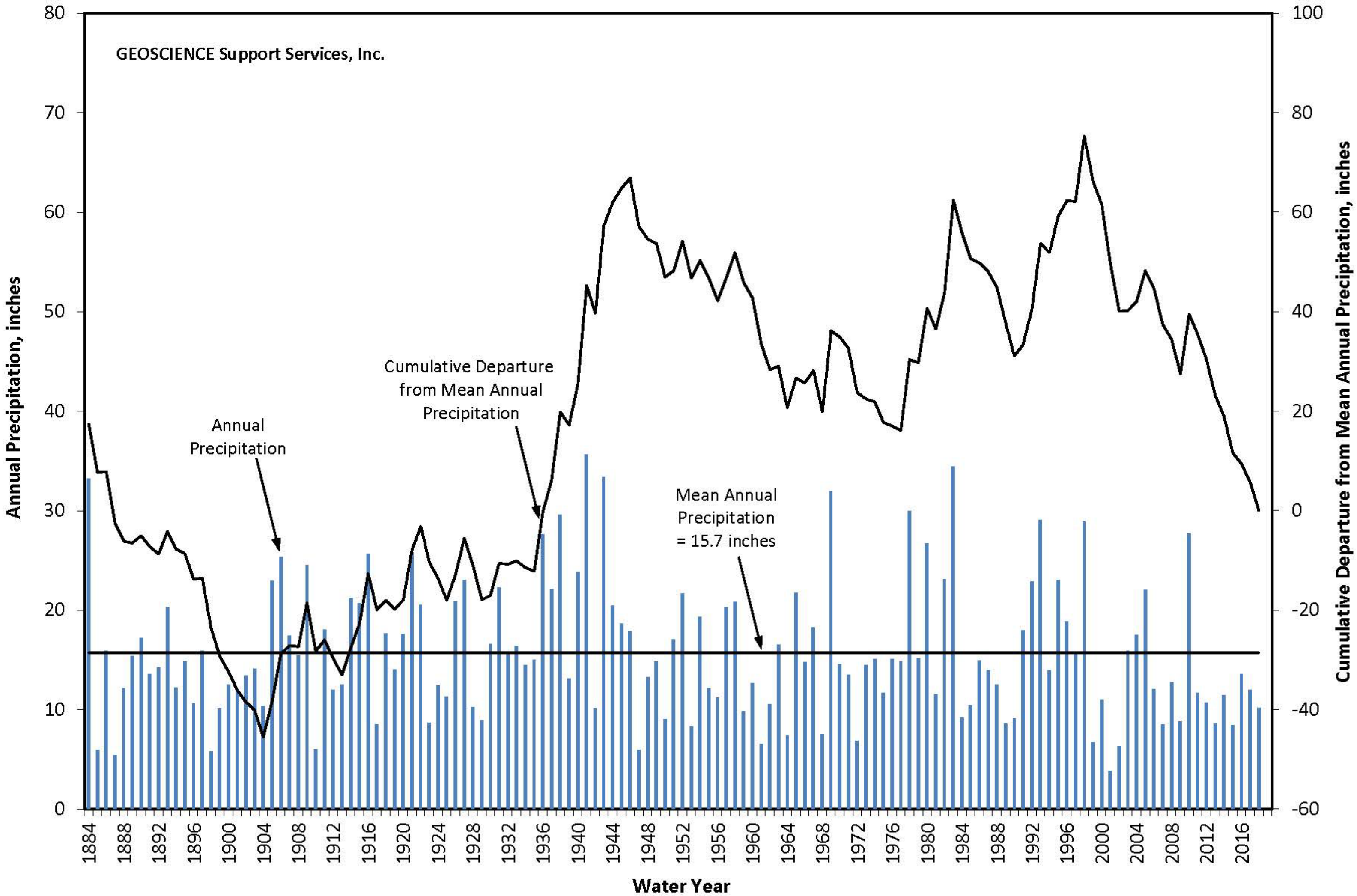
In 2023, the average base flow concentration of Total Nitrogen at *Below Prado Dam* was 6.0 mg/L, well below the water quality objective established for Reach 3. Long-term water quality monitoring data confirms that average nitrogen concentrations are continuing to slowly decline over time (see Figure 3-2). This is the result of discharging less volume of treated wastewater into the river system because the average nitrogen concentration in municipal effluent ranges from 8-10 mg/L as well as de-nitrification (N loss) processes through the uptake of nitrogen by plants in Prado wetlands and along the Santa Ana River.

[5] Wildermuth Environmental, Inc. Investigation and Characterization of the Cause(s) of Recent Exceedances of the TDS Concentration Objective for Reach 3 of the Santa Ana River. Feb. 11, 2015.

[6] Wildermuth Environmental, Inc. Volume-Weighted TDS Concentration of POTW Discharges above Prado Dam during August-September. June 15, 2015.

[7] West Yost Technical Memorandum. 2015 to 2021 Volume-Weighted TDS Concentration of POTW Discharges above Prado Dam during August and September. October 11, 2022.

Figure 4-1. Cumulative Departure from Mean Annual Precipitation San Bernardino County Hospital Station (1884-2018)



In addition, some of the observed trend toward lower average nitrogen concentrations are likely due to the operation of OCWD's treatment wetlands immediately above Prado Dam.

Base flow samples collected for Reach 3 of the Santa Ana River mainstem between Riverside Narrows and Prado Wetlands. The average TDS concentration of these samples was 556 mg/L and the average TIN concentration was 6.0 mg/L. Both values were in compliance with the water quality objective for Reach 3 of the river.

Water quality samples were collected for Reach 4 of the Santa Ana River mainstem. The average TDS concentration of these samples was 414 mg/L and the average TIN concentration was 1.5 mg/L. Both values were in compliance with the water quality objective for Reach 4 of the river.

A water quality sample was collected for Reach 5 of the Santa Ana River mainstem. The TDS concentration of this sample was 530 mg/L and the TIN concentration was 0.2 mg/L. Both values were in compliance with the water quality objective for Reach 5 of the river.

4.2 Recommendations

The Task Force has now been implementing the approved monitoring plan for more than fifteen years. Through the implementation of the existing monitoring plan, some issues have been identified regarding the most appropriate way to collect, analyze, interpret, and report the resulting data. To address these issues, the Task Force identified some recommendations in Basin Plan Amendments, which were adopted by the Regional Board in December of 2022 and approved by the State Water Resources Control Board in May of 2022. The relevant recommendations that were adopted into the most recent Basin Plan Amendment are as follows:

1) The monitoring plan should be reviewed to ensure that we are collecting all data necessary to assess compliance with relevant water quality objectives and the overall effectiveness of the newly approved wasteload allocation model (WLAM), which was completed in June 2020. The Basin Plan was amended to require stakeholders to submit an update to the 2005 monitoring plan to the Regional Water Board by August of 2022 for Regional Board review and approval. For surface water, the update to the 2005 monitoring plan should consider if the monitoring program should be expanded to include the major tributaries to the Santa Ana River (e.g. Chino Cr., Mill-Cucamonga Cr., Temescal Cr., Hole Lake Cr., San Timoteo Cr., etc.).

2) As part of the 2005 monitoring plan update discussed in paragraph 1 above, the update should include a list of parameters to be analyzed, sites to be sampled, and the sampling schedule. A Quality Assurance Project Plan (QAPP) should also be prepared to support the monitoring program. It should also be decided if monitoring data collected should be uploaded to CEDEN or other state database.

3) Additional future Basin Plan amendments should consider revisions to include a clear definition of what constitutes "base flow" with respect to the water quality objectives for Reach 3 that is consistent with the Annual Report and the updated Wasteload Allocation Model. For example, should data influenced by summer precipitation in August and September be included? Can we use data from other months to characterize base flow conditions provided that no recent precipitation has occurred? Should data influenced by State Water Project transfers be excluded?

4) In order to assure more consistent application of water quality standards, the Basin Plan should be amended to clarify that filtered samples should be used to evaluate all surface water TIN objectives.

This approach would be consistent with the approach used for evaluating compliance with TIN objectives in Reach 3.

5) The application of existing WQOs for various salt ions may no longer be necessary. Most were established based on very limited sampling data collected in the early 1980's. All were intended to represent antidegradation targets - not use impairment thresholds. The Basin Monitoring Task Force continues to recommend that the Basin Plan be amended in the future to properly clarify application of the existing WQOs for individual salt ions (chloride, sodium, sulfate, etc.) that references and integrates prior Regional Board decisions that pertain to application of the WQOs.

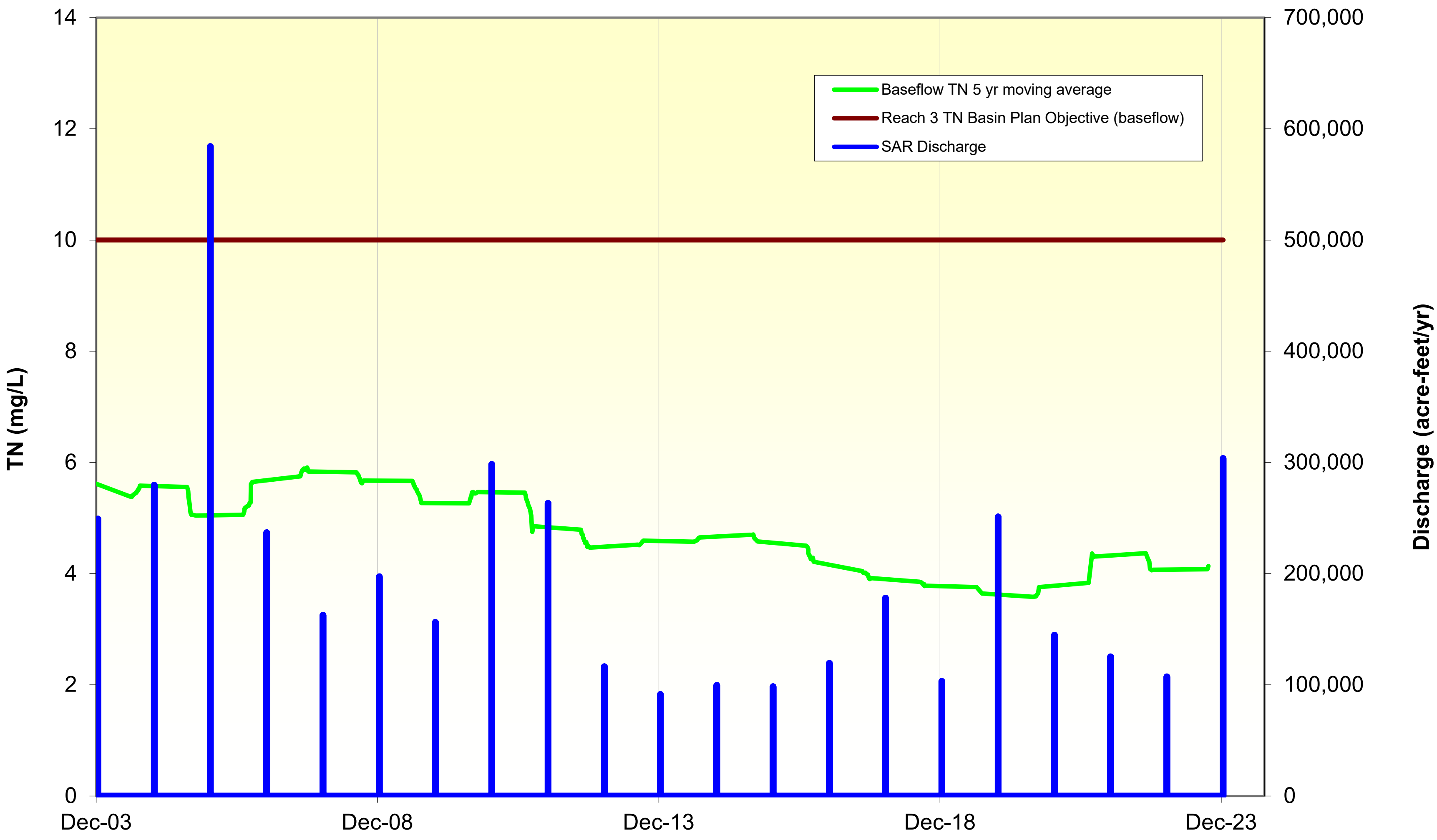
   In March of 2023, the Task Force submitted a proposed update to the 2005 Santa Ana River Water Quality Work Plan, *2022 Santa Ana River Total Dissolved Solids (TDS) and Total Inorganic Nitrogen (TIN) Monitoring Workplan,* in response to Basin Plan amendments adopted by the Santa Ana Water Board in December of 2021. The 2022 Work Plan proposes an updated surface water monitoring program to assess current compliance with TDS and TIN objectives for the Santa Ana River Reaches 2, 3, 4, and 5. Once the 2022 Workplan is approved by the Santa Ana Water Board and implemented by the Task Force, which is estimated to begin with monitoring year 2024, this Annual Report will also be modified accordingly.

5 Response to Comments

No comments were provided.

Appendix A
Water Quality Trends at Below Prado Dam and MWD Crossing 2002 to Current

Figure A-1. Total Nitrogen (TN) Below Prado Dam



Notes:
Baseflow = TN samples from RWQCB, USGS, HCMP, OCWD for August and September..

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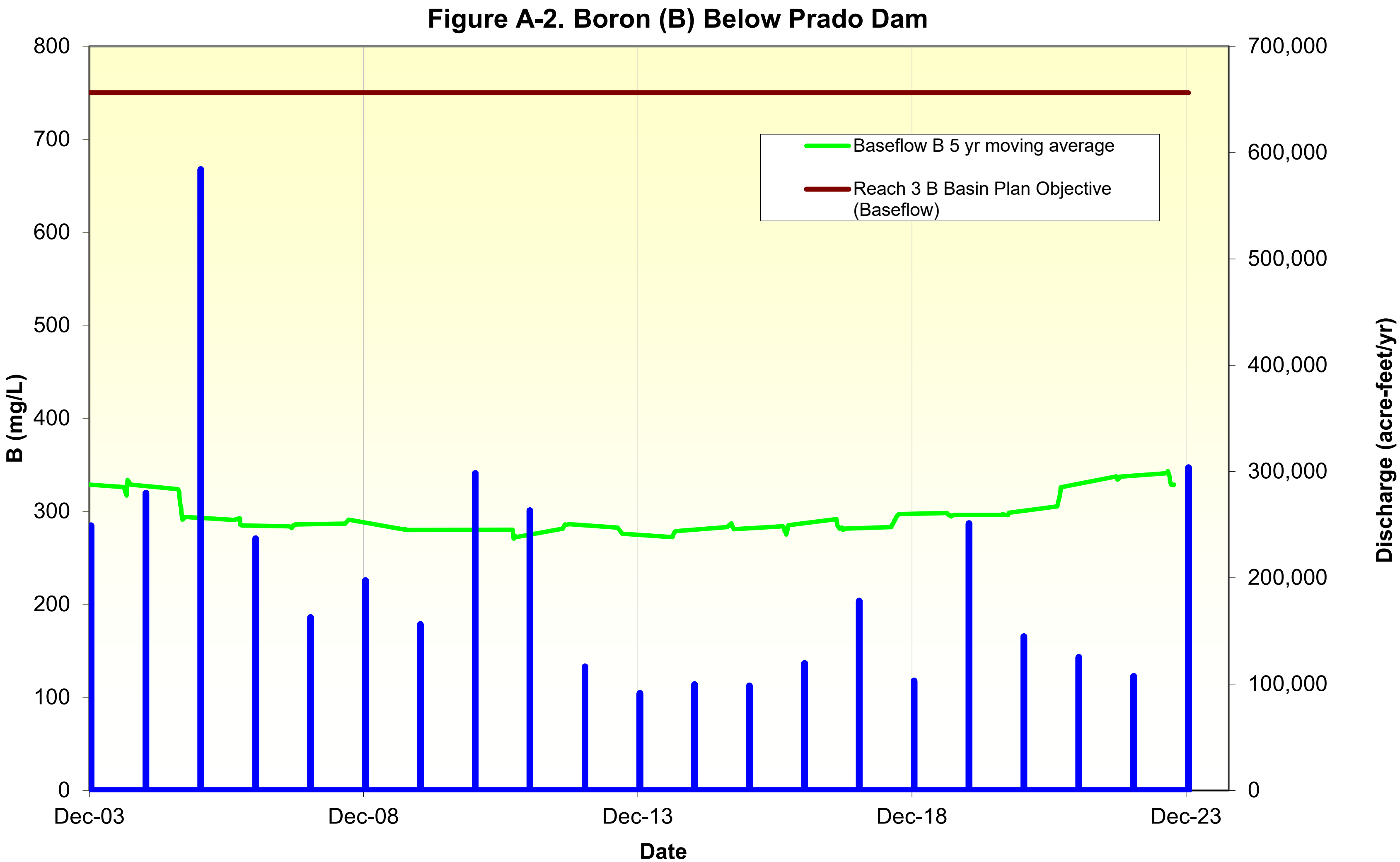

Notes:
Baseflow = B samples from RWQCB, USGS, HCMP, OCWD for August and September.
Samples from RWQCB for 2021 were not used because of higher than normal detection limits.

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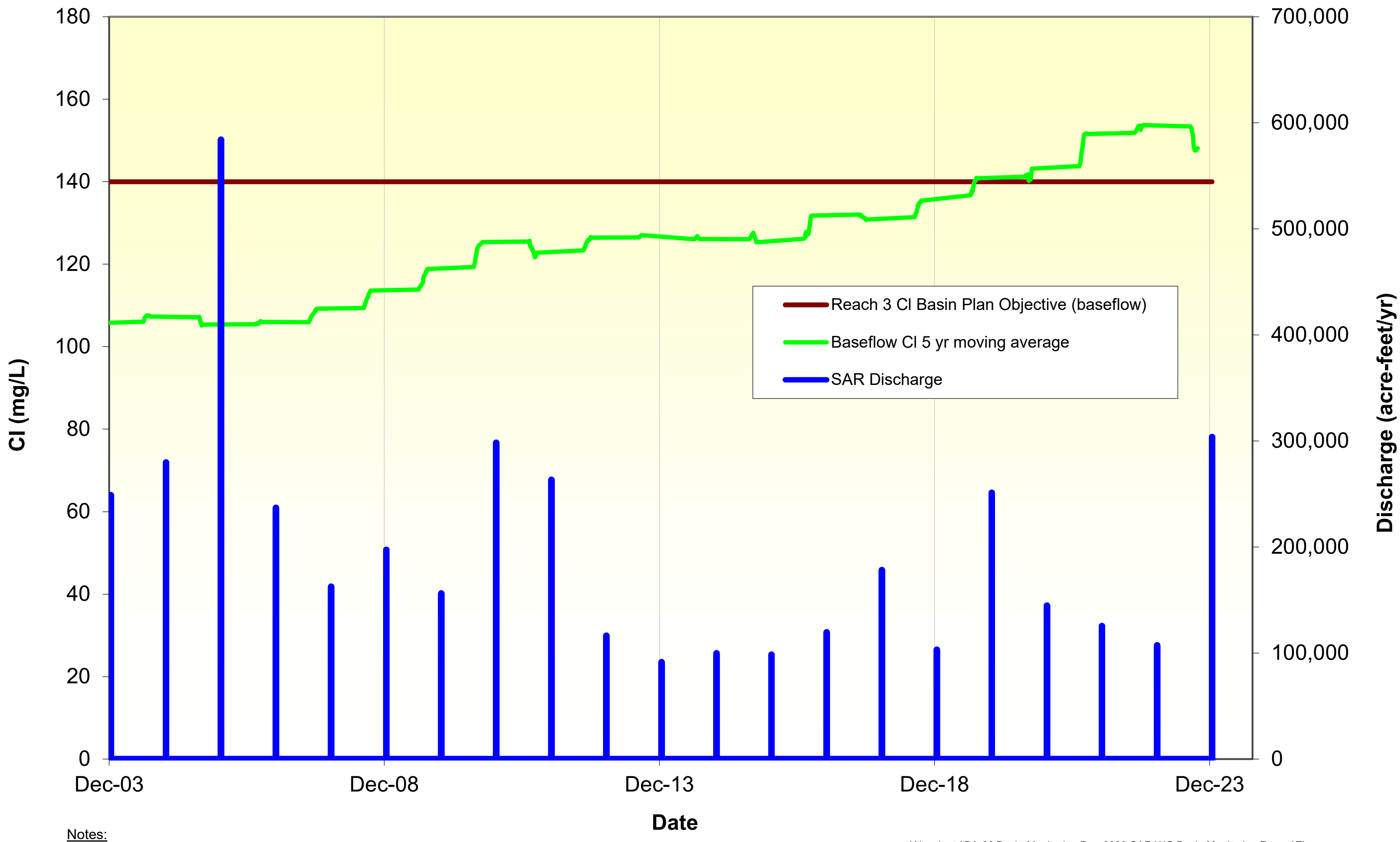
Figure A-3. Chloride (Cl) Below Prado Dam



Notes:
Baseflow = Cl samples from RWQCB, USGS, HCMP, OCWD for August and September

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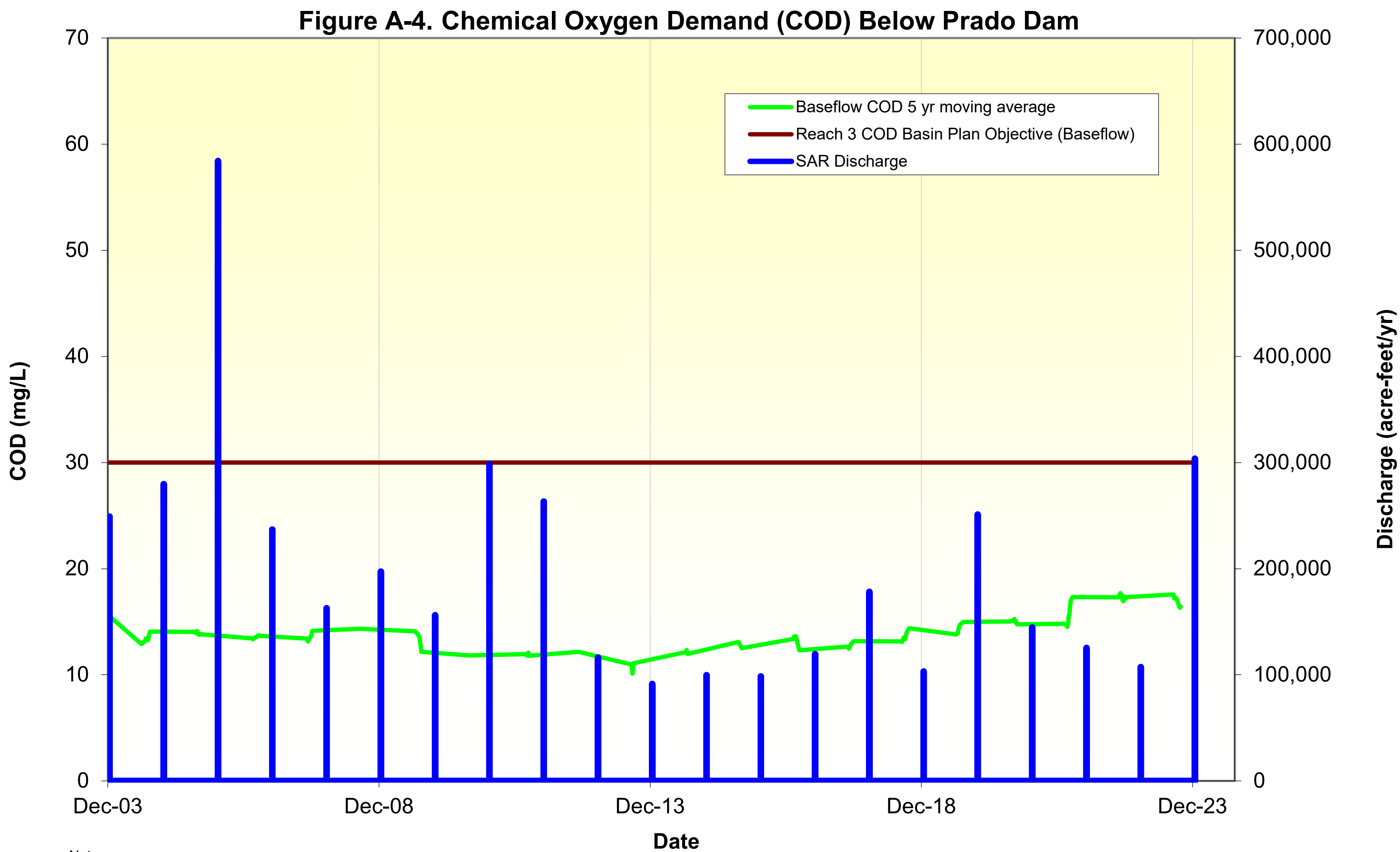

Notes:
Baseflow = COD samples from RWQCB, USGS, HCMP, OCWD for August and September

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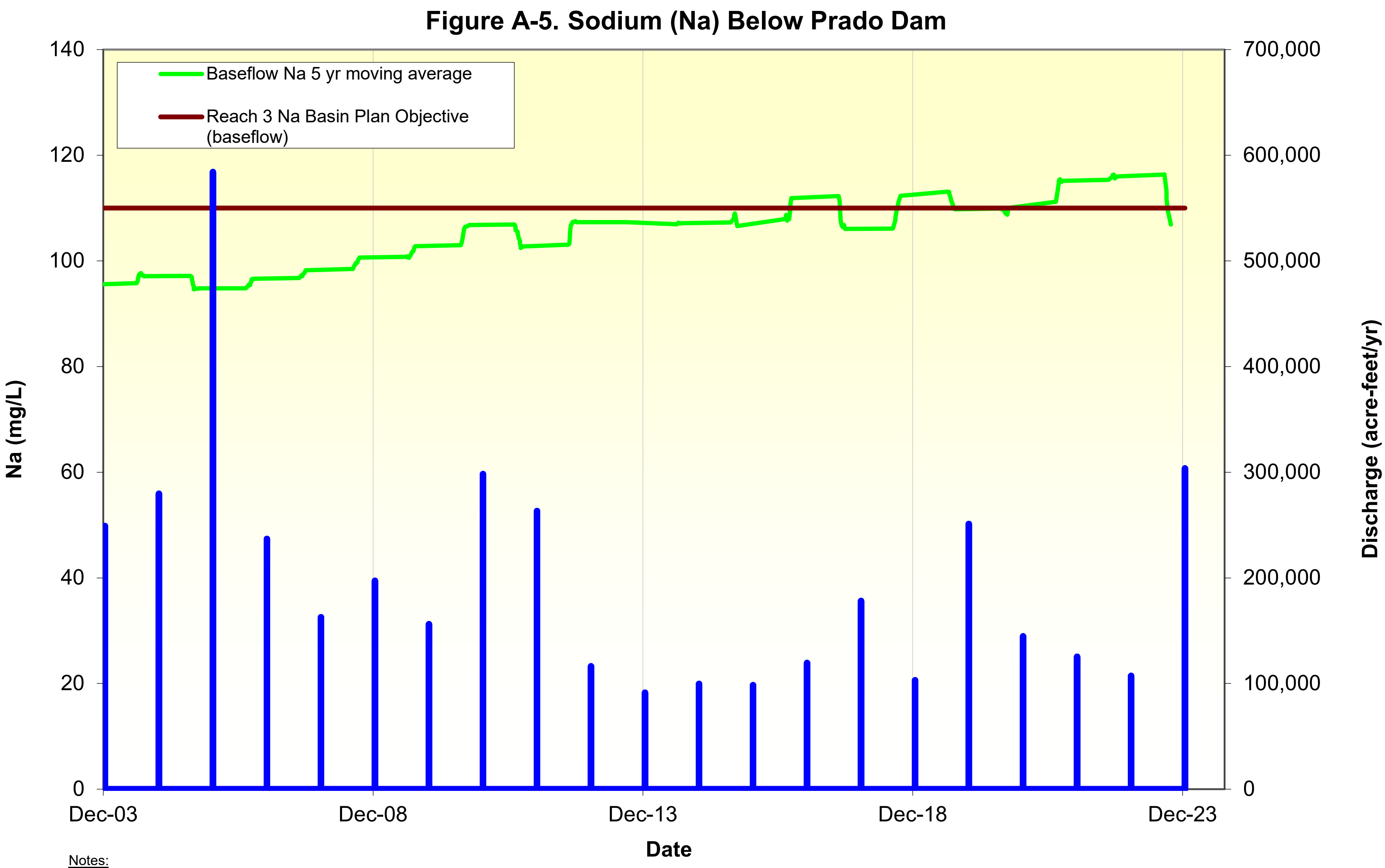

Notes:
Baseflow = Na samples from RWQCB, USGS, HCMP, OCWD for August and September.

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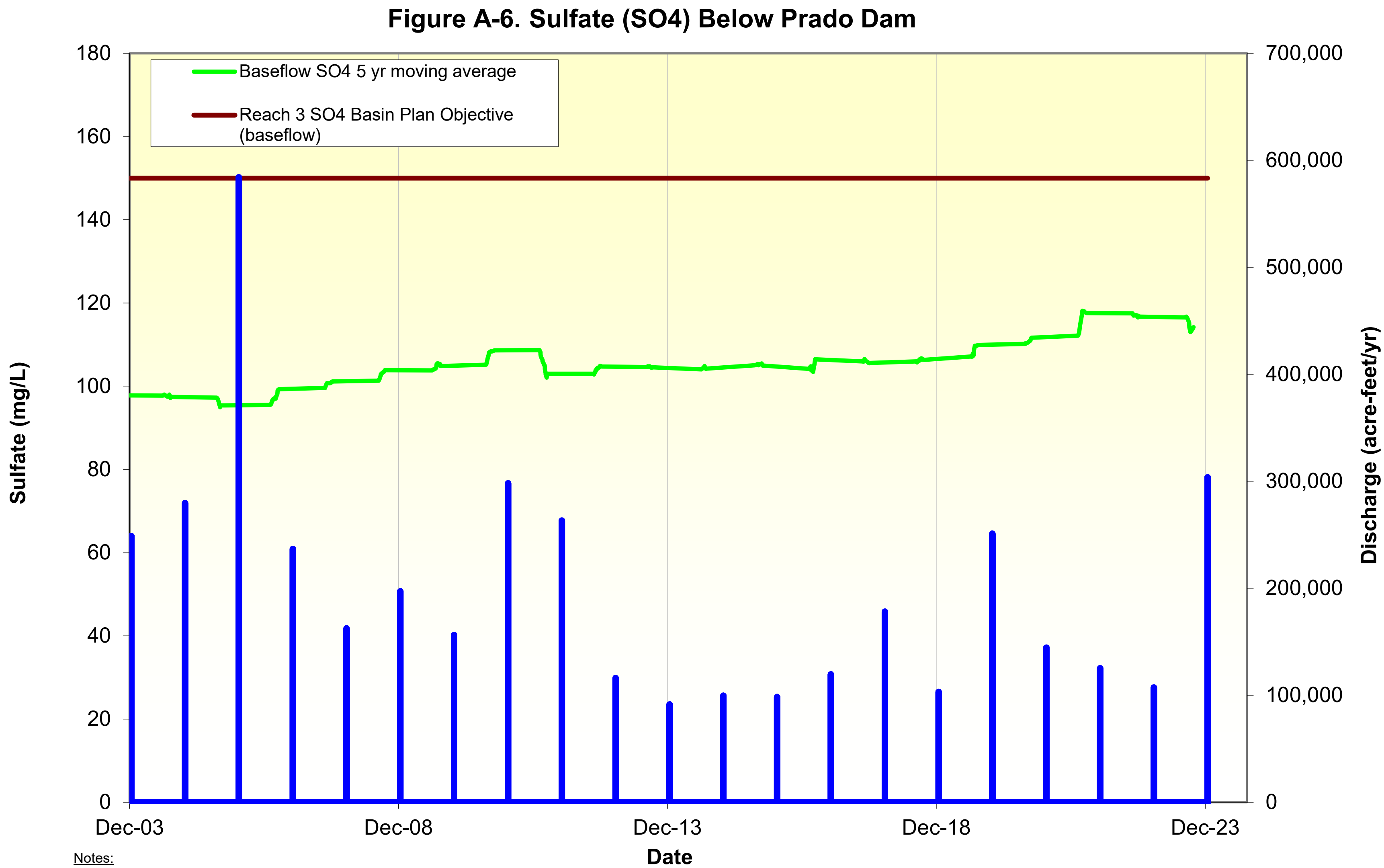

Notes:
Baseflow = SO4 samples from RWQCB, USGS, HCMP, OCWD for August and September.

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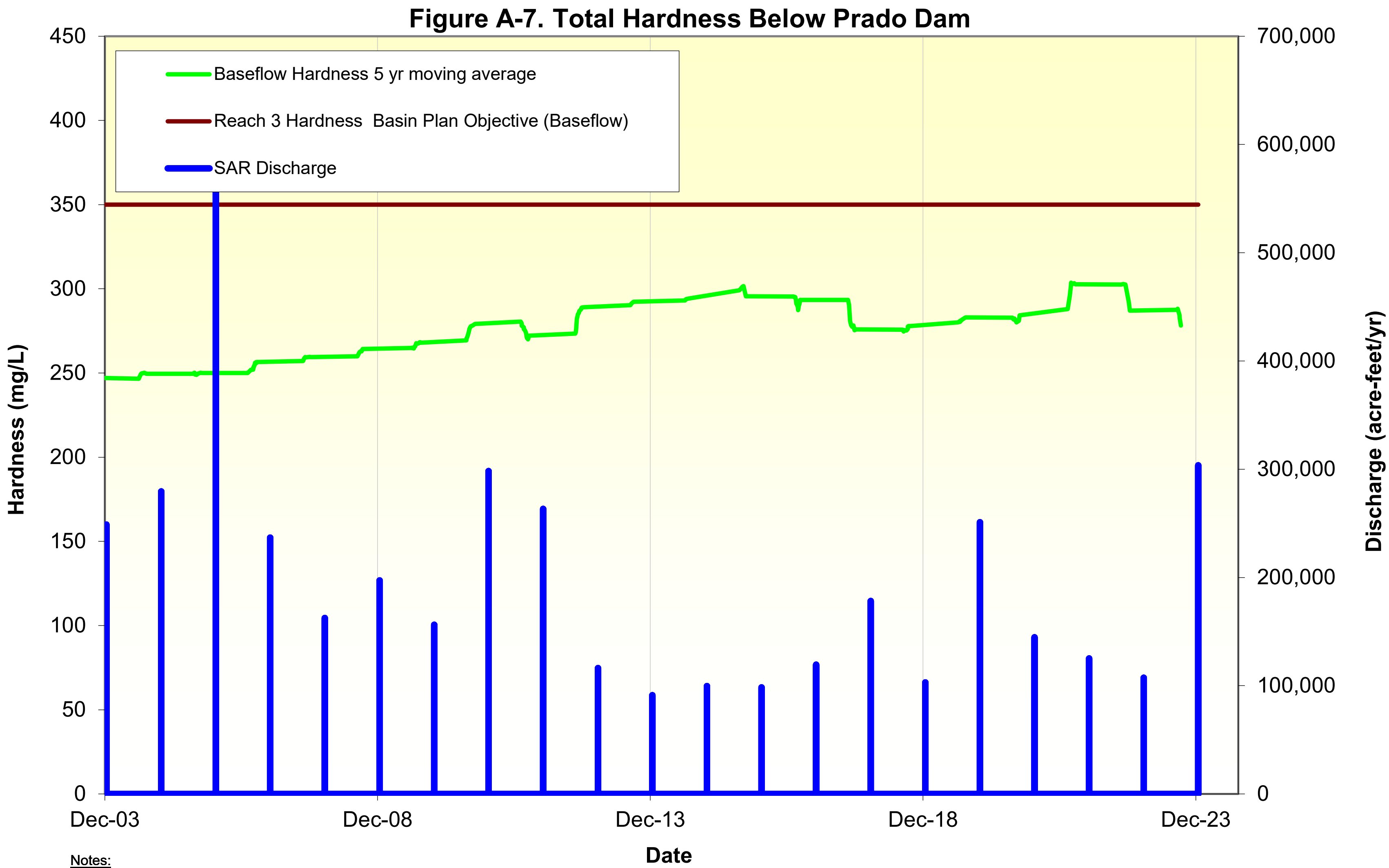

Notes:
Baseflow = Hardness samples from RWQCB, USGS, HCMP, OCWD for August and September.

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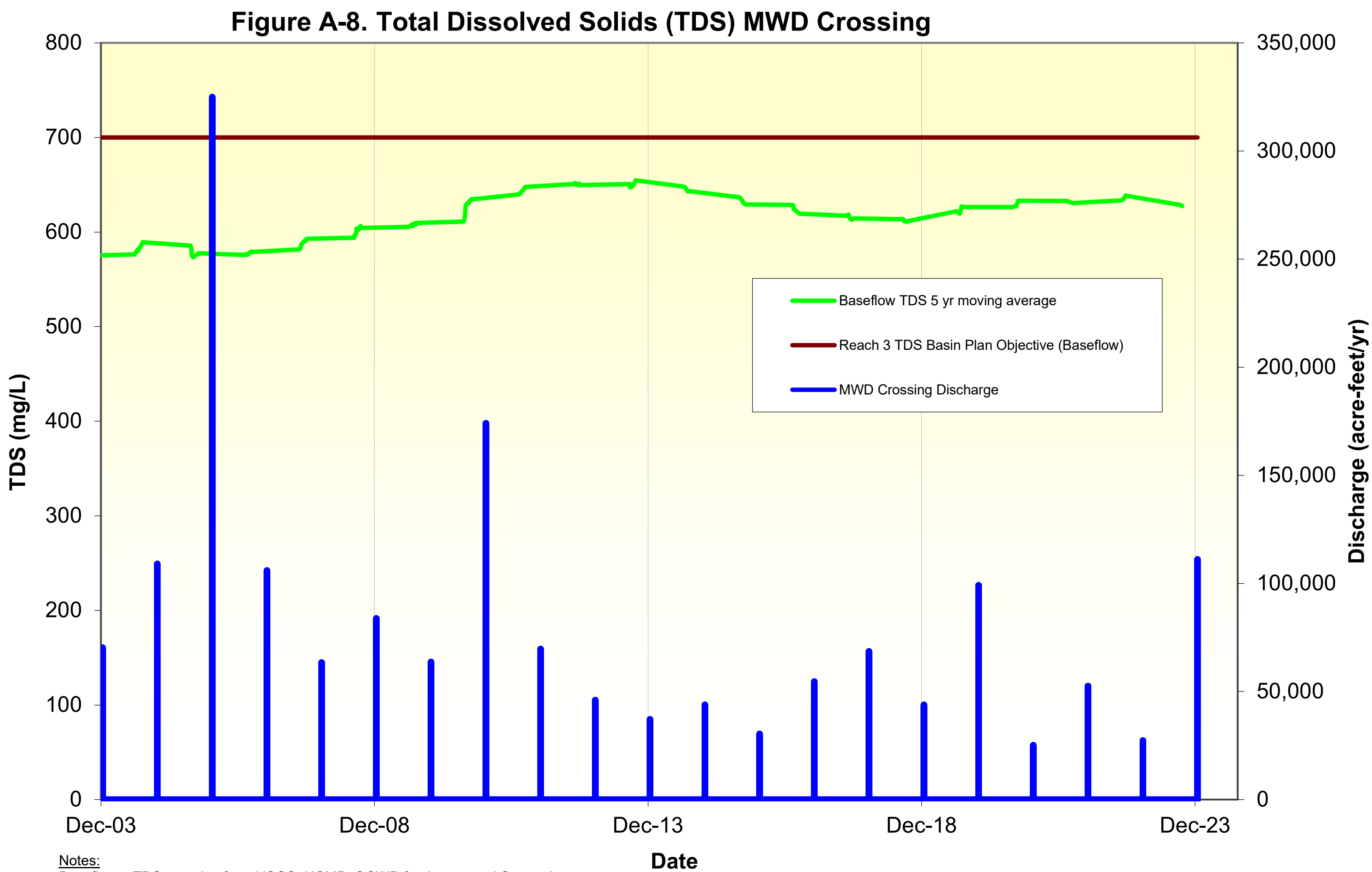

Notes:
Baseflow = TDS samples from USGS, HCMP, OCWD for August and September

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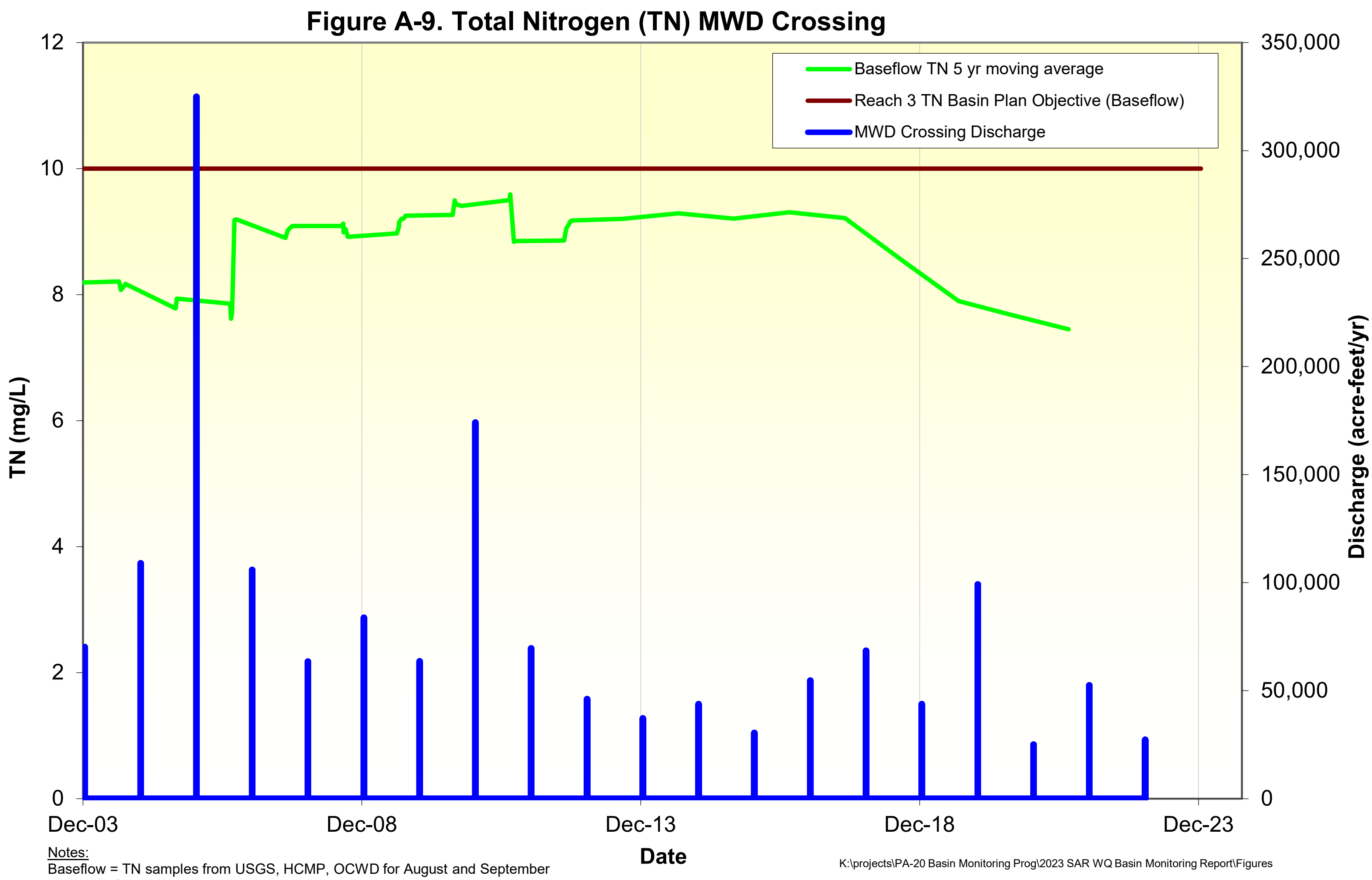

Notes:
Baseflow = TN samples from USGS, HCMP, OCWD for August and September
No Water Quality data submitted 2022 and 2023

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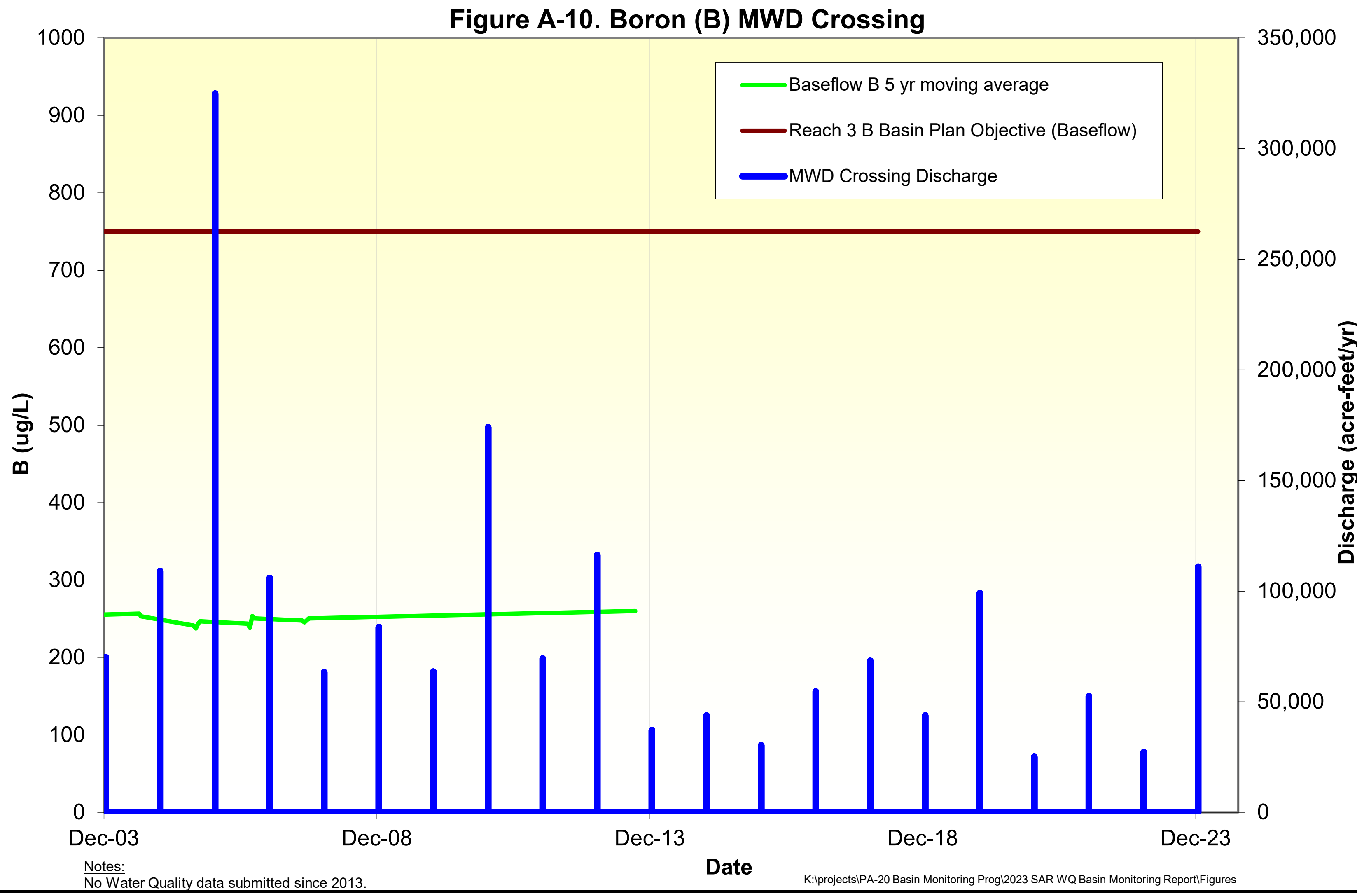
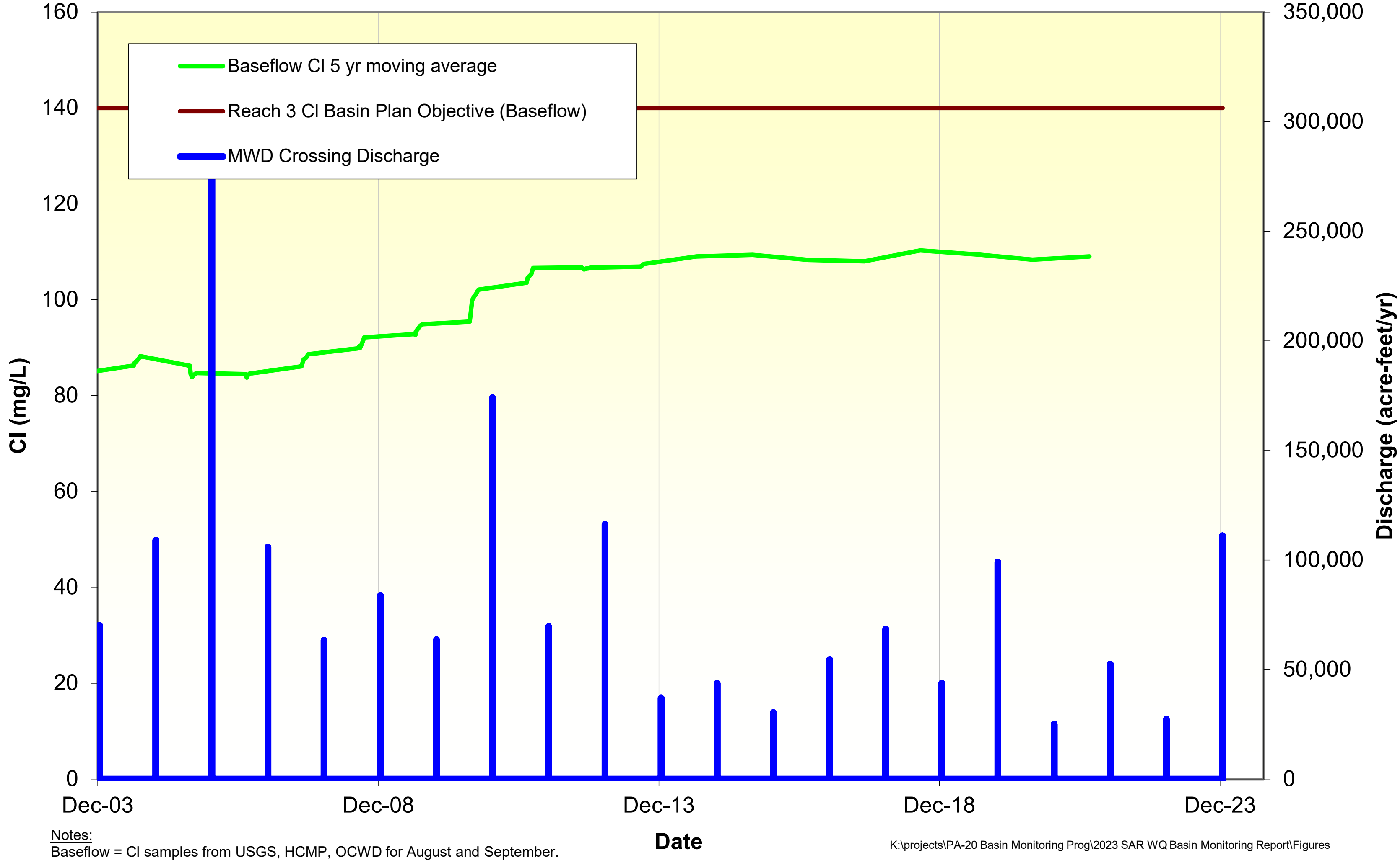


Notes:
No Water Quality data submitted since 2013.

Figure A-11. Chloride (Cl) MWD Crossing



Notes:
Baseflow = Cl samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted 2022, 2023

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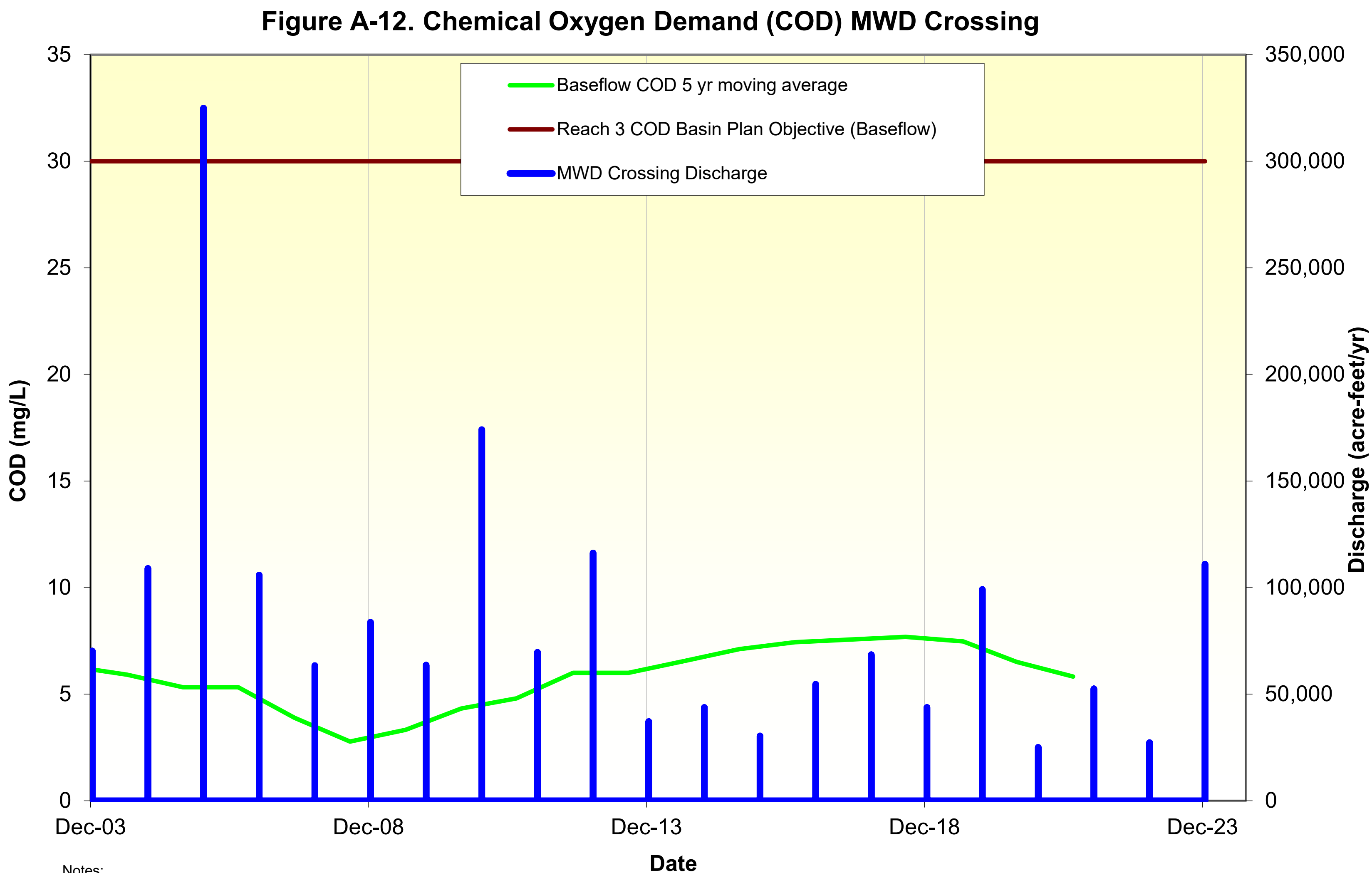

Notes:
Baseflow = COD samples from USGS, HCMP, OCWD for August and September.
No Water Quality submitted 2022, 2023

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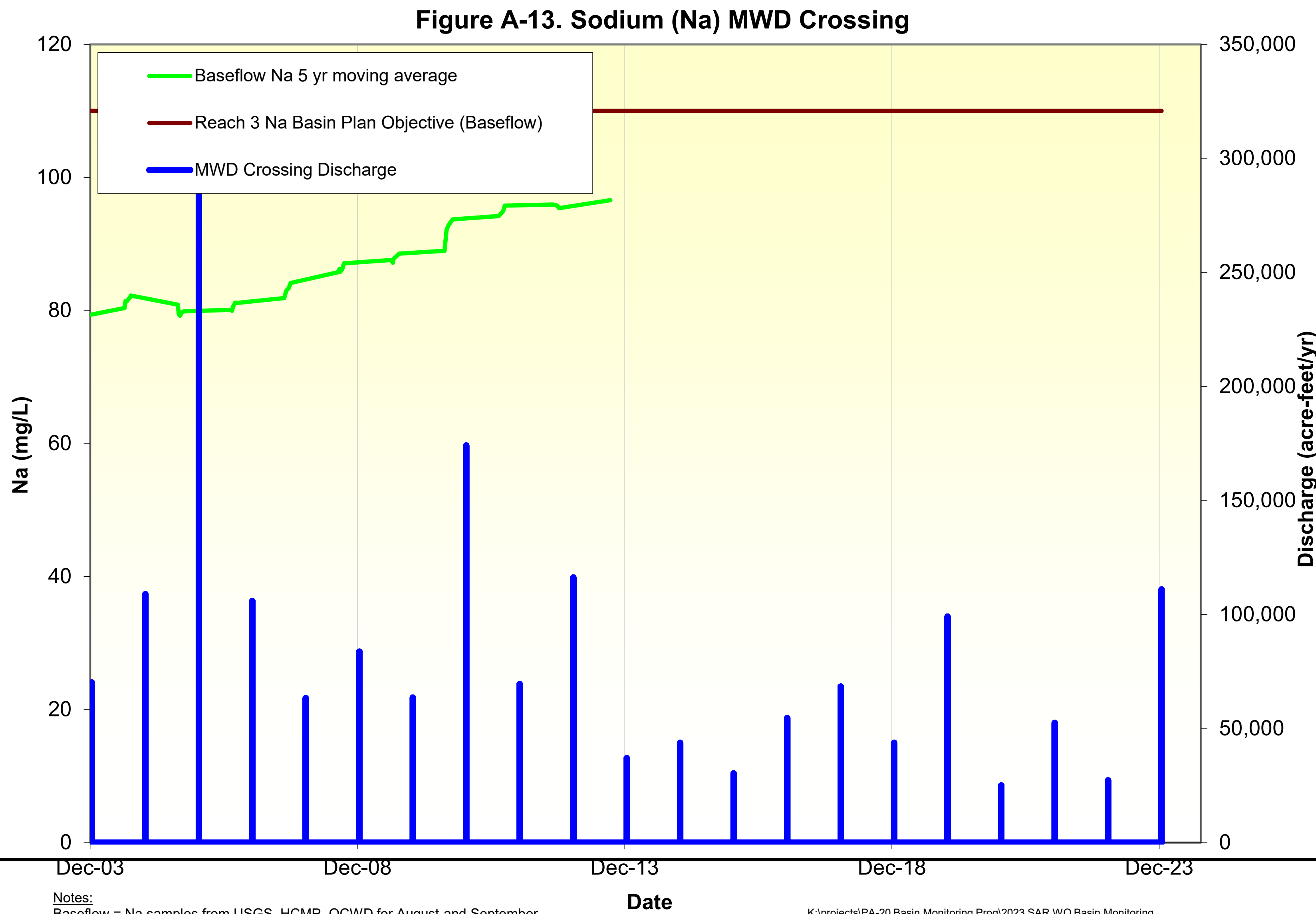

Notes:
Baseflow = Na samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted for Sodium since 2013.

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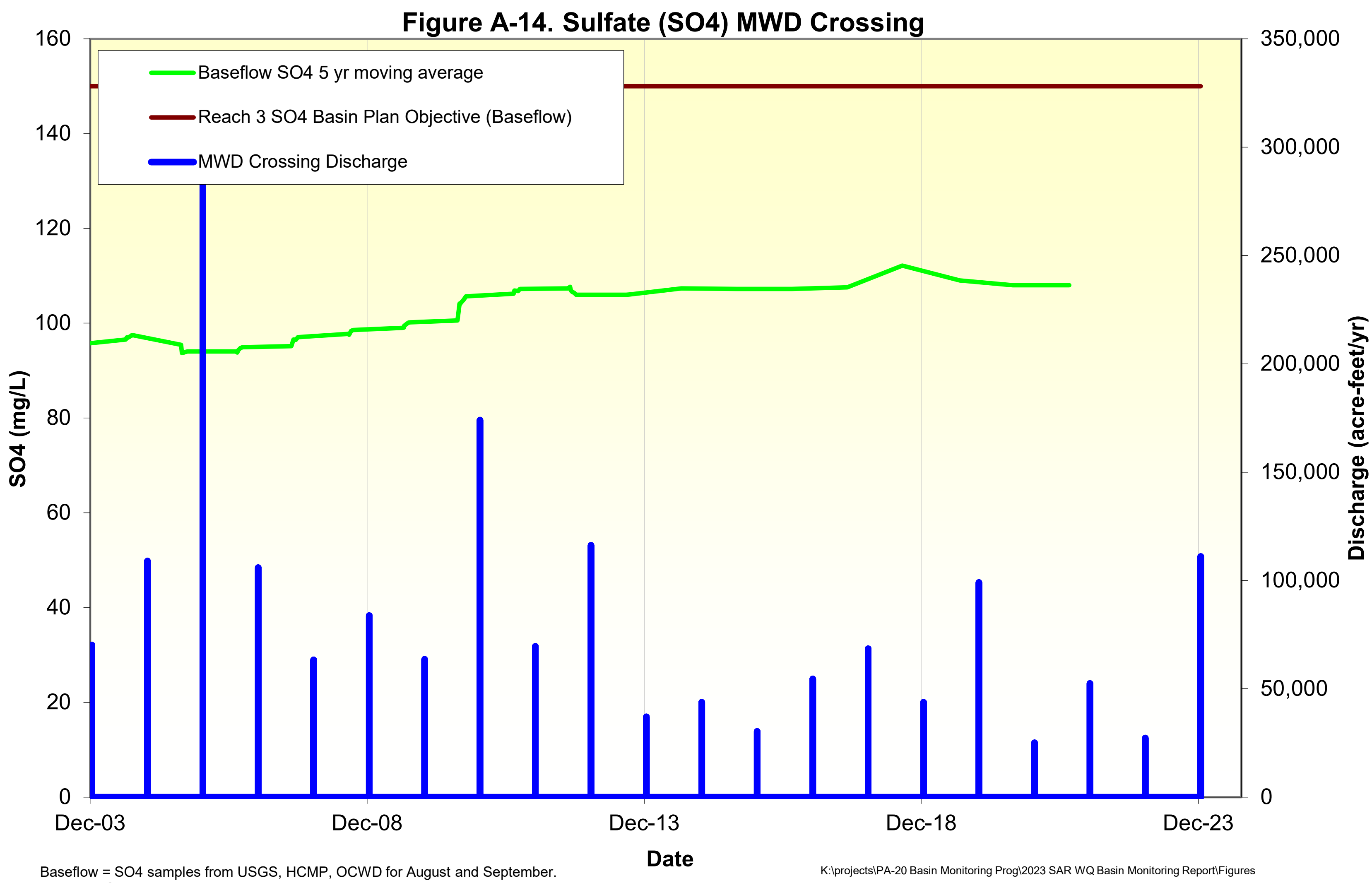

Baseflow = SO4 samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted 2022, 2023

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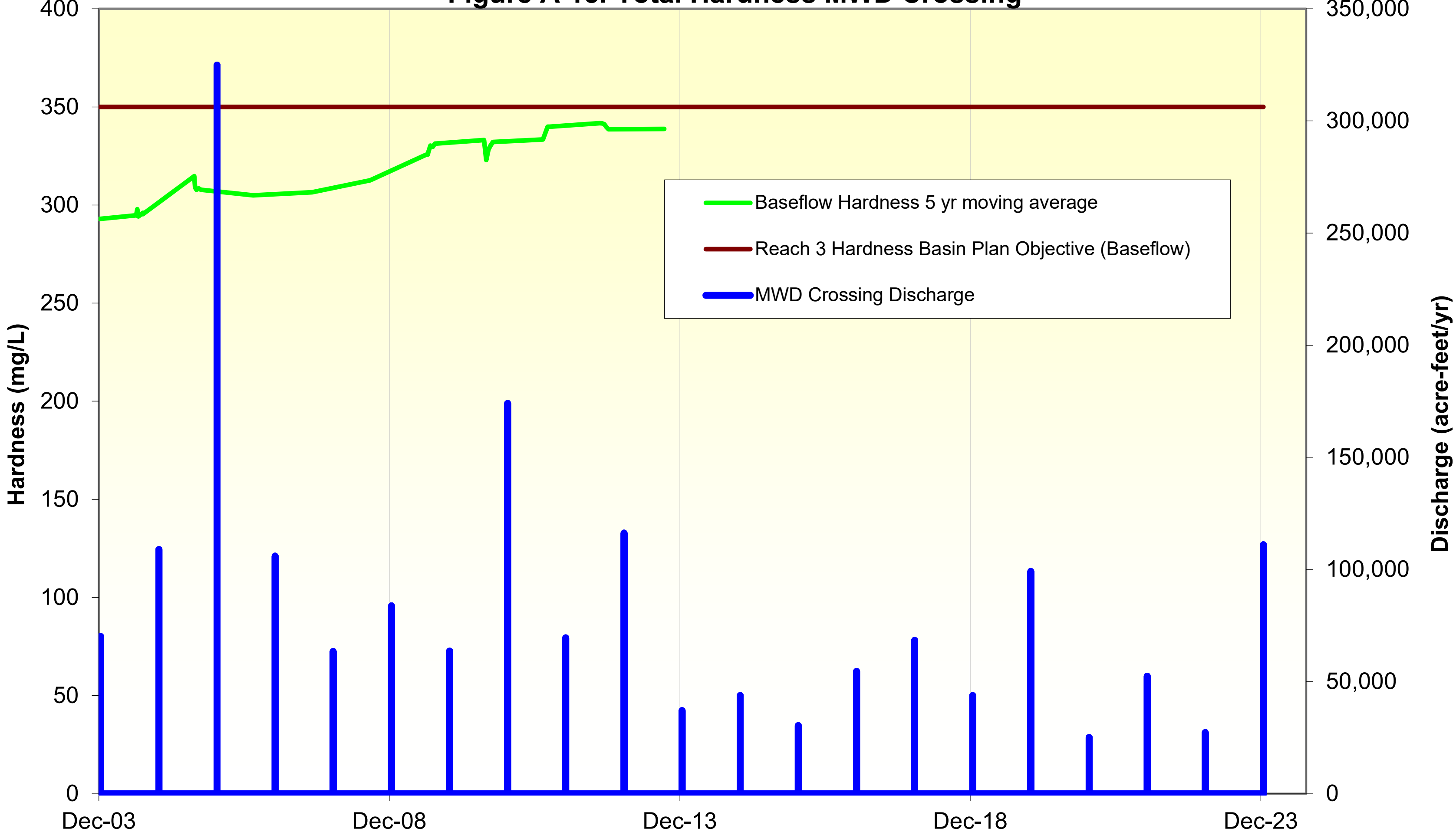
Figure A-15. Total Hardness MWD Crossing



Notes:
Baseflow = Hardness samples from USGS, HCMP, OCWD for August and September.
No Water Quality data submitted for Hardness since 2013.

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Appendix B
All 2023 Water Quality and Flow Data
(Available on the SAWPA Website)