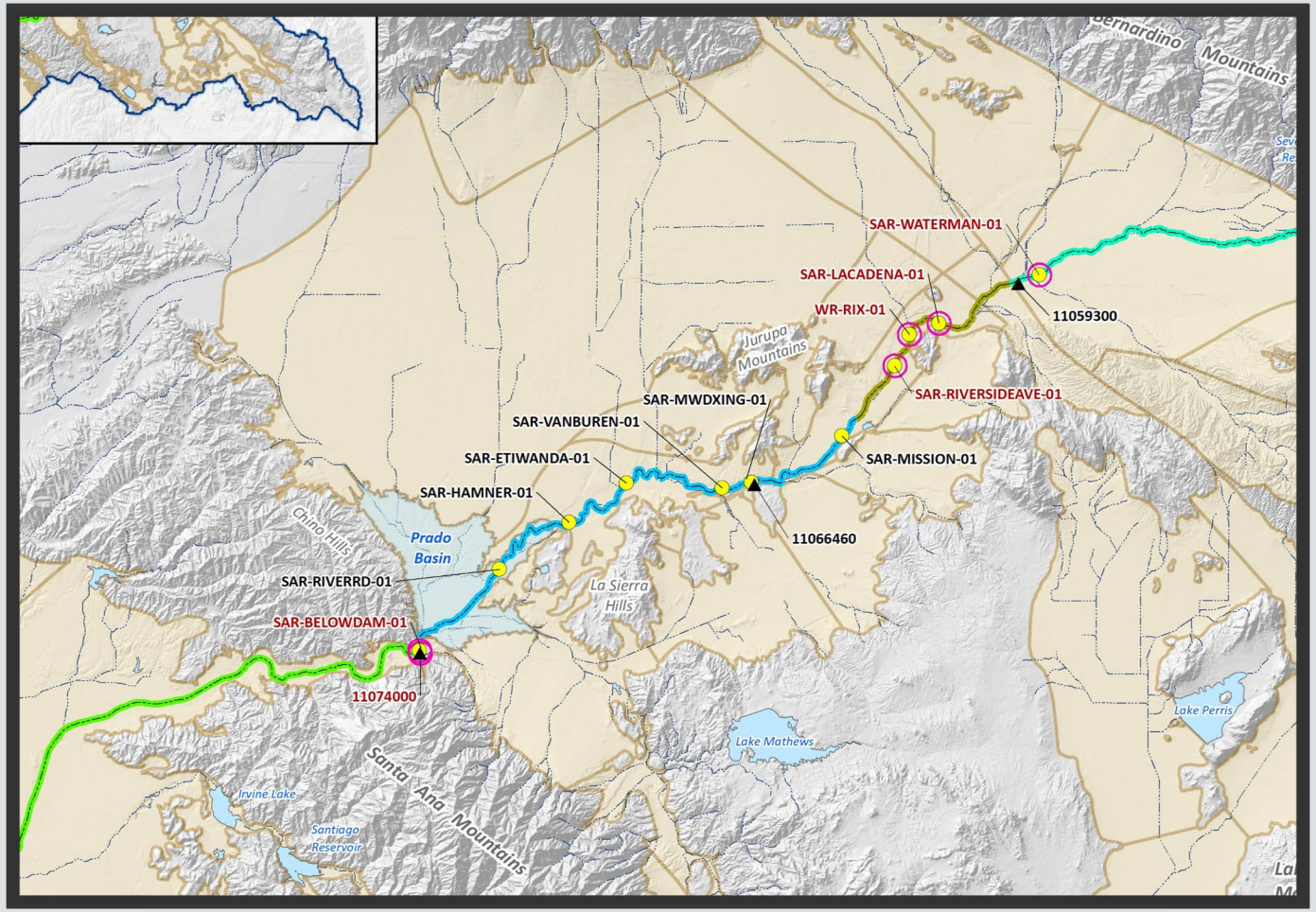
Basin Planning Priorities Task 1 Workshop – Surface Water Monitoring Requirements and Goals for the Santa Ana River Watershed, Part 1

January 27, 2022

WEST YOST

Water. Engineered.

Task 1 – Prepare Updated Surface Water Monitoring Program for TDS/N for Santa Ana Reaches 2, 3, 4, and 5



Approach - end point in mind → Questions that need to be answered by the surface water monitoring:

- Compliance with objectives
- Collect sufficient data for input/calibration of WLAM

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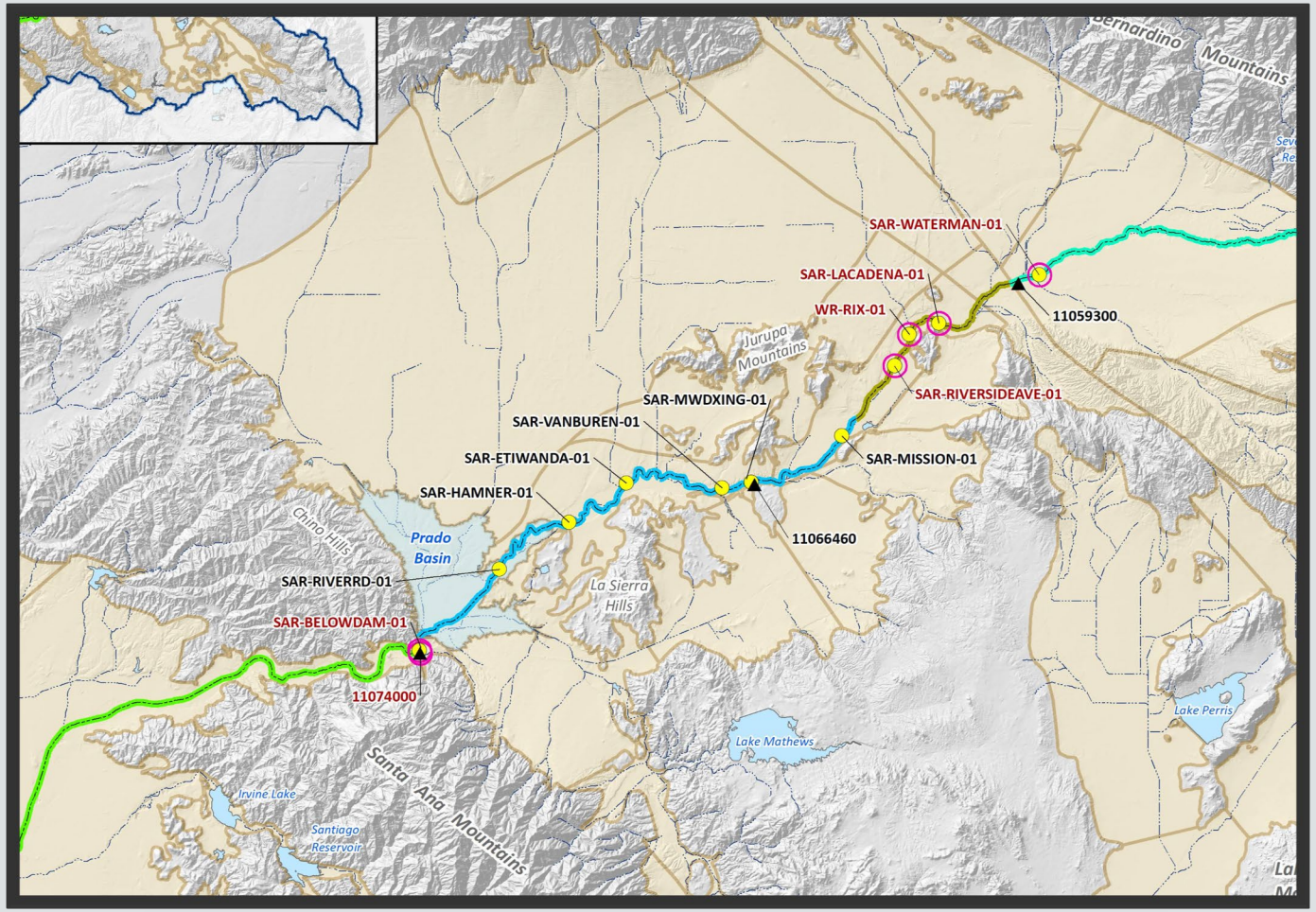

For each Reach, review:

- SW Objectives
- Metrics for compliance
- Data used
- What is metric protecting
- Data gaps? Uncertainty ?

Feedback on questions related to the monitoring program

Table 1 . Basin Plan Surface Water TDS and TIN Objectives for the Santa Ana River Reaches 2, 3, 4, and 5 and Metrics, Data, and Methods Used to Assess Compliance

Reach	Objective (mgl)		Assessment of Compliance as Specified in the Basin Plan		Assessment of Compliance with Basin Plan Objectives Conducted by the Task Force in the SAWPA Annual Report of Santa Ana River Water Quality	
	TDS	TIN(a)	Compliance Metric	Monitoring Data		
Reach 2	650	--	The "five-year moving average of the annual TDS content of **total flow**"	The SARWM calculates the volume-weighted TDS of total flow annually for the water year - using continuous monitoring of flow and EC, and grab samples by the USGS at Below Prado Dam. "The SARWM's annual determination of **total flow** quality will be used to determine compliance..."	The annual report utilizes two methods to evaluate compliance:	
					1) Based on Basin Plan	1) Average of the last five years of SARWM's annual determination of the flow-weighted TDS at Below Prado Dam for total flow
					2) Alternative	2) 60-month flow-weighted moving average of the TDS concentration of the total flow at Below Prado Dam. This is calculated using continuous monitoring of flow and EC by the USGS, and grab samples by the USGS and others (OCWD, Regional Board, CBWM/IEUA) at Below Prado Dam
Reach 3	700	10(b)	"... grab and composite samples when the influence of storm flows and nontributary flows is at a minimum. This typically occurs during August and September" - Table 4-1 indicates "**Base Flow**"	Regional Board collects grab samples in August and September at Below Prado Dam. "Results can be compared to the continuous monitoring by the USGS and data from other sources"	The annual report utilizes three methods to assess compliance:	
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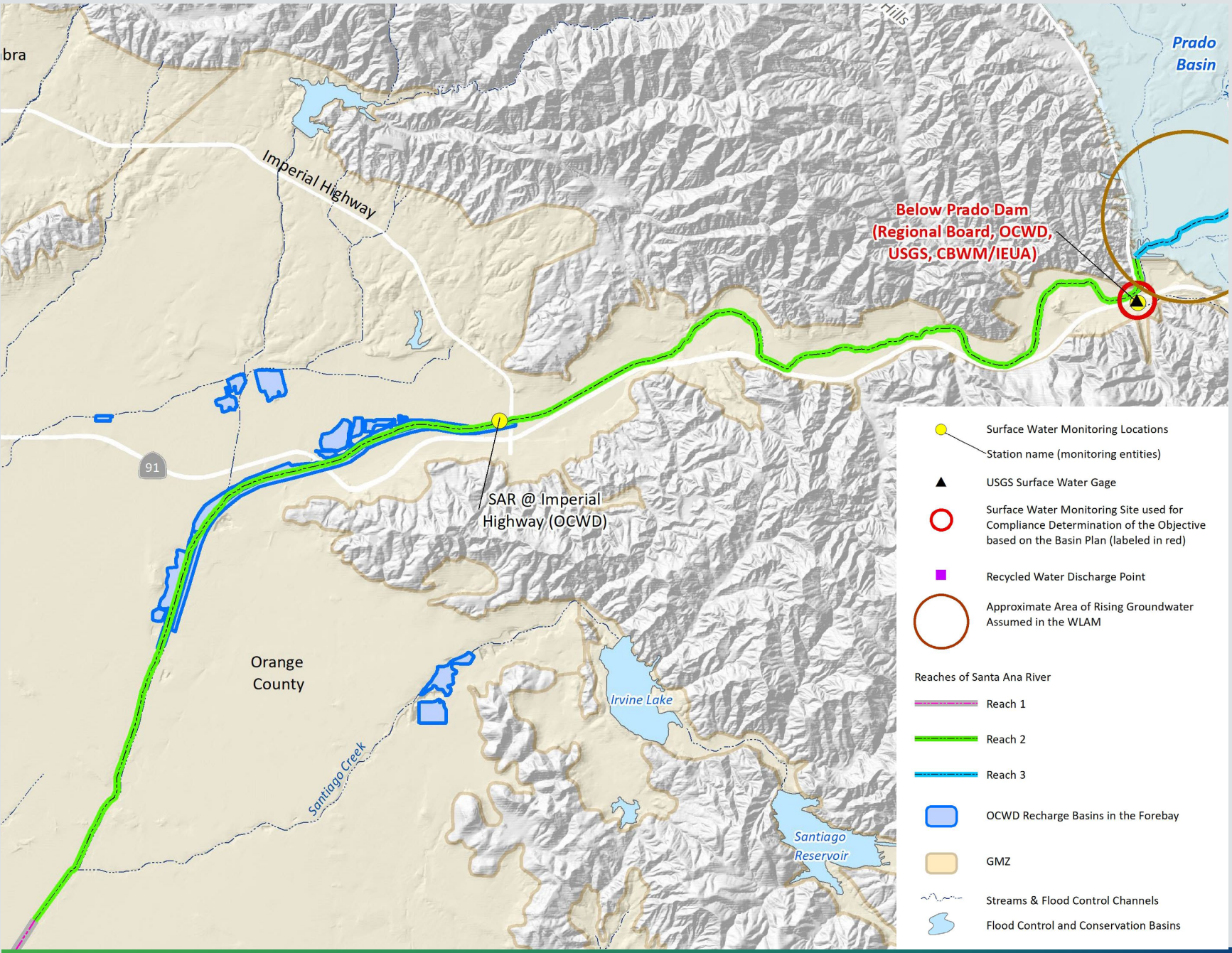
Reach 4	550	10	Undefined	Undefined	Grab sample of **base flow** in August at WR-RIX-01, SAR-RiversideAve-01, SAR-Lacadena-01.	
Reach 5	300	5	Undefined	Undefined	Grab sample of **base flow** in August at SAR-Waterman-01.	



Reach 2

Surface Water Objectives:

TDS = 650 mgl TIN = n/a

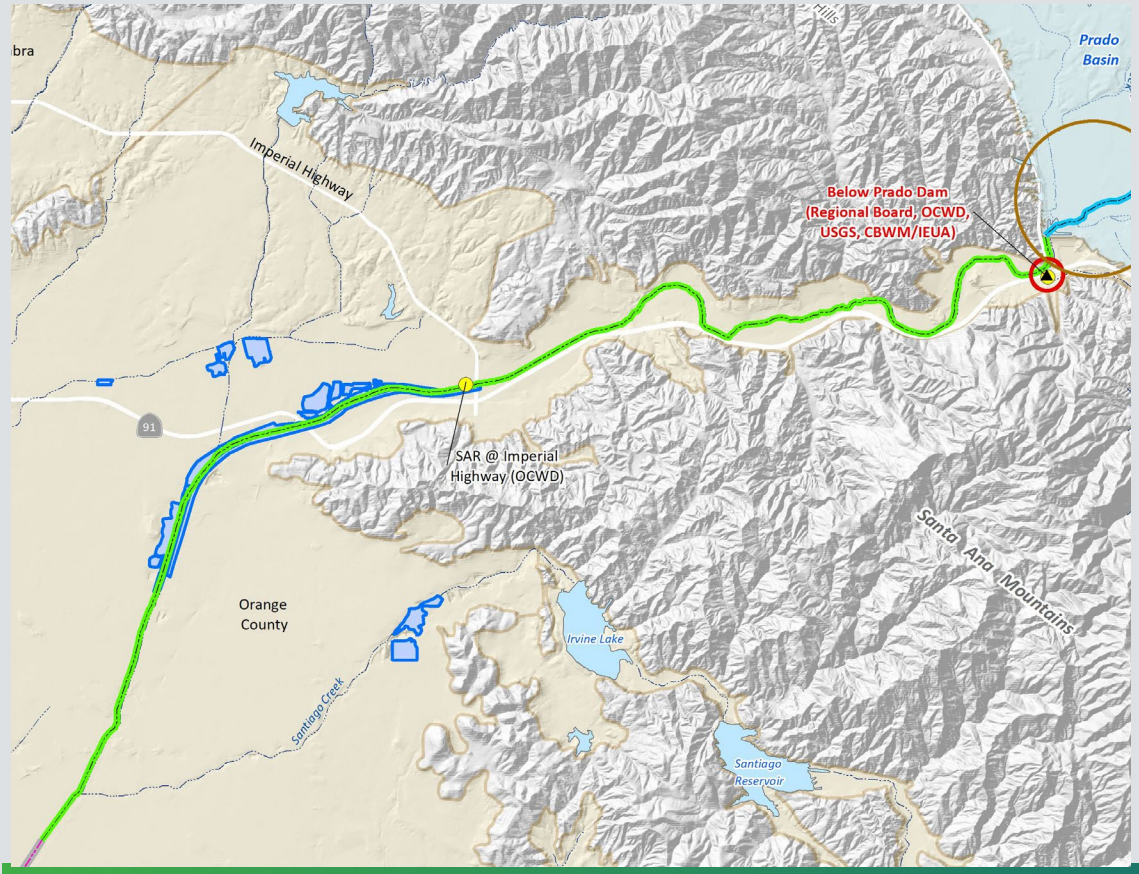
Basin Plan Metric/Data:

Compliance for "*Reach 2 will be based on the five-year moving average of the annual TDS content of total flow.*"

"*The Watermaster's* [SARWM] *annual determination of total flow quality [at Prado] will be used to determine compliance with the total flow objective…*"

Reach 2 - What does the Surface Water Objective Protect?

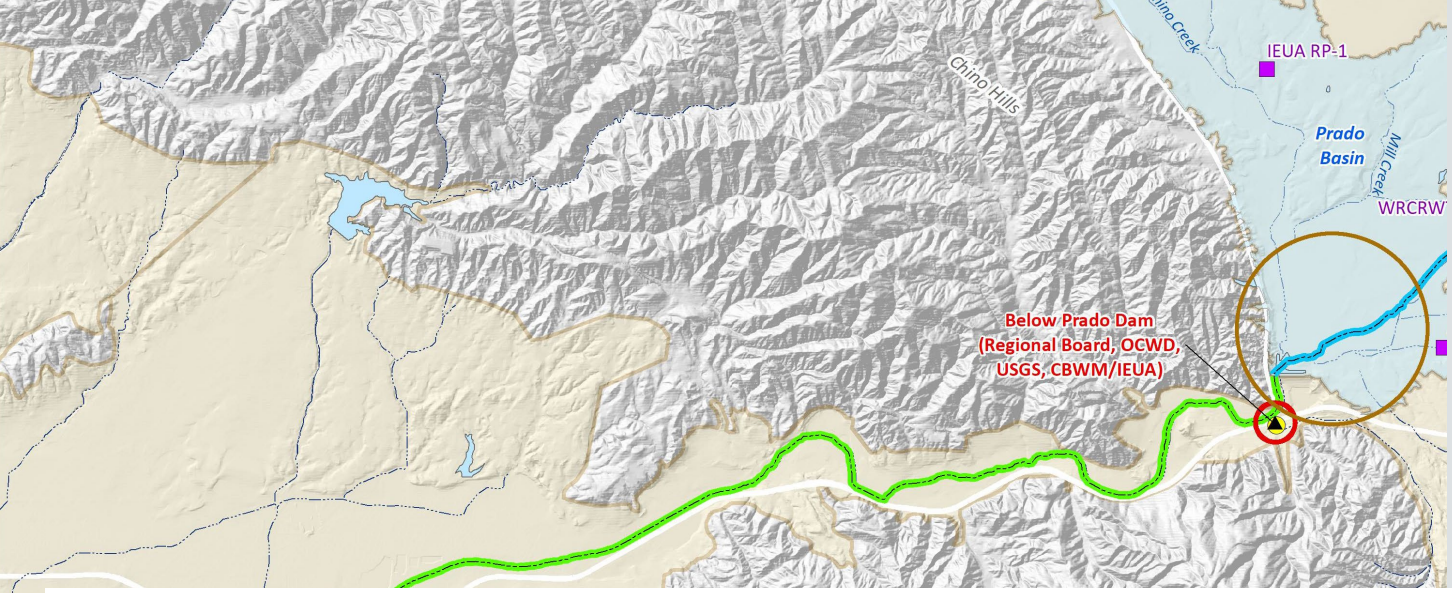
- **Protective of** recharge in Orange County GMZ



Basin Plan , Page 4-28:

"In years of normal rainfall, most of the total flow of the river is percolated in the Santa Ana Forebay, and directly affects the quality of the groundwater. For that reason, compliance with the TDS water quality objective for Reach 2 will be based on the five-year moving average of the annual TDS content of total flow."

Question to be answered by the surface water monitoring data to compare to the Reach 2 objective: What is the flow-weighted quality of the Santa Ana River at Prado Dam



Assessment of Compliance with Surface Water Objective in Reach 2

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Five-year average of the SARWM Annual TDS for Total Flow (Basin Plan Method)

SARWM Annual Calculation of Volume-Weighted TDS for Total Flow:

WATER QUALITY SAMPLES BELOW PRADO
WATER YEAR 2018-19

Date	TDS (mg/L)	EC (um/cm)	TDS/EC Ratio
10/9/2018	679	1120	0.6063
10/12/2018	672	1130	0.5947
10/24/2018	713	1180	0.6042
11/14/2018	706	1190	0.5933
11/14/2018	719	1180	0.6093
11/27/2018	654	1120	0.5839
12/7/2018		423	0.0000
12/19/2018	434	742	0.5849
12/19/2018	417	703	0.5932
1/30/2019	285	478	0.5962
1/30/2019	284	480	0.5917
1/31/2019	285	488	0.5840
2/7/2019	264	454	0.5815
2/12/2019	288	490	0.5878
2/26/2019	396	655	0.6046
2/28/2019	450	745	0.6040
3/4/2019	305	530	0.5755
3/14/2019	486	807	0.6022
3/19/2019	469	812	0.5776
3/25/2019	536	895	0.5989
4/1/2019	472	809	0.5834

Average TDS/EC Ratio = 0.5978

SUMMARY OF FLOW-WEIGHTED TDS BELOW PRADO DAM
WATER YEAR 2018-19

October 2018

Day	Prado Outflow (cfs)	Daily Mean EC (microsiemens/cm)	Computed TDS (1)	Outflow X TDS
1	84	1,130	676	56,716
2	83	1,100	658	54,746
3	81	1,110	664	53,518
4	100	1,090	652	65,200
5	91	1,070	640	58,112
6	80	1,100	658	52,443
7	77	1,130	676	52,187
8	81	1,140		55,229
23	169	1,170		118,131
24	164	1,200	717	117,588
25	150		693	103,950
26	118		676	79,768
27	110		681	74,910
28	109	1,140	681	74,229
29		1,100	658	75,670
30		1,090	652	74,980
31		1,090	652	72,372
	3,529			2,252,132

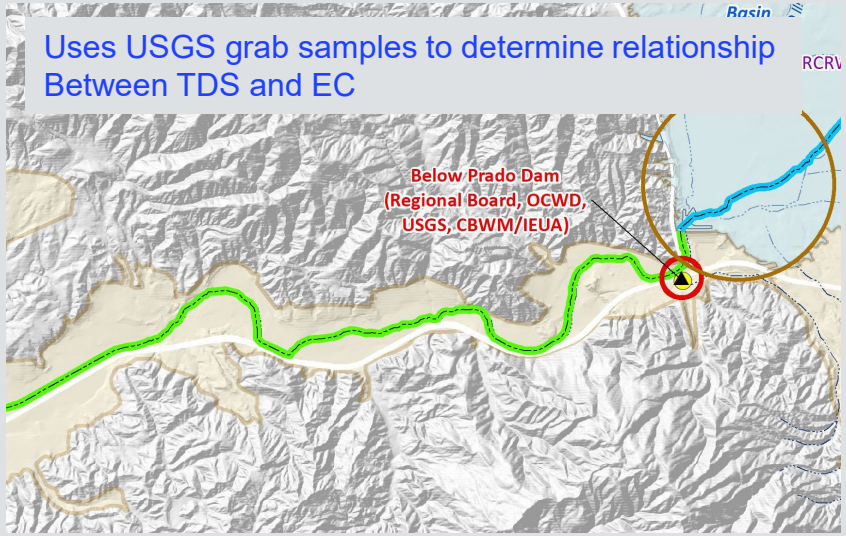
Monthly Flow-weighted TDS = 638 mg/L

(1) TDS = EC x 0.5978

Relationship used to calculate daily TDS from EC

WY 2019 Annual Flow-weighted TDS = 401 mgl

Uses USGS grab samples to determine relationship Between TDS and EC



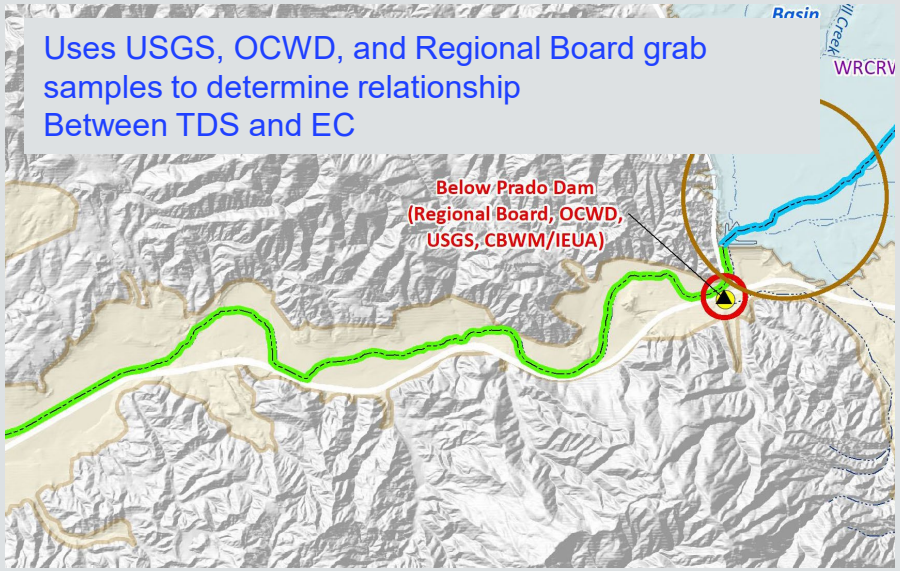
Five-Year Avg of SARWM Annual TDS in SAWPA 2019 Annual Report, Table 3-1:

Water Year Ending[A]	Yearly Flow-weighted TDS (mg/L)
2015	522
2016	560[B]
2017	408
2018	625
2019	401
5 Year Average	503

Note: [A] Santa Ana River Watermaster data reported for FY 2018-19 water year
[B] FY 2015-16 water year data adjusted from 541 mg/L to remove the influence of non-tributary water transfer flow from OC59.

2019 5-Year Avg of Flow-weighted TDS = 503 mgl

60-Month Volume-Weighted TDS for Total Flow (Alternative Method)



Graphically plot USGS, OCWD, and Regional Board samples for the year → linear regression of TDS versus EC yielded the following equation (in 2019):

$$TDS = (EC \times 0.6028) + 1.7288$$
$$R^2 = 0.95$$

60-month Volume-Weighted Avg in SAWPA 2019 Annual Report:

Table 3-2. Monthly Volume-Weighted Moving Average TDS at Below Prado Dam (2019 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-15[1]	8,443	558	4,713,608
Feb-15[1]	4,181	548	2,292,593
Mar-15	5,971	611	3,647,810
Apr-15	3,055	705	2,153,348
May-15	3,917	649	2,540,633
Jun-15[1]	2,031	658	1,335,858
Jul-15[1]	3,114	553	1,722,216
Nov-18	3,311	630	2,084,681
Dec-18	11,799	453	5,350,226
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[2]	11,236	531	5,963,072
May-19	11,137	566	6,298,555
Jun-19[2]	3,572	680	2,428,738
Jul-19		661	1,934,719
Aug-19		672	1,668,363
	2,601	685	1,780,391
	2,517	674	1,696,256
Nov-19[2]	3,468	591	2,049,773
Dec-19	12,047	341	4,111,578
Total	**369,679**		**174,909,232**
	60 - Month Volume Weighted Average		**473 mg/L**

Note: [1]Denotes monthly results with missing EC readings due to instrumentation issues with USGS equipment
Monthly Flow weighte
[2]Denotes monthly result
ilable EC data was

Relationship used to calculate daily TDS from EC for 2019

2019 60-month Flow-weighted TDS = 473 mgl

Reach 2 Compliance – Basin Plan Method versus Alternative Method

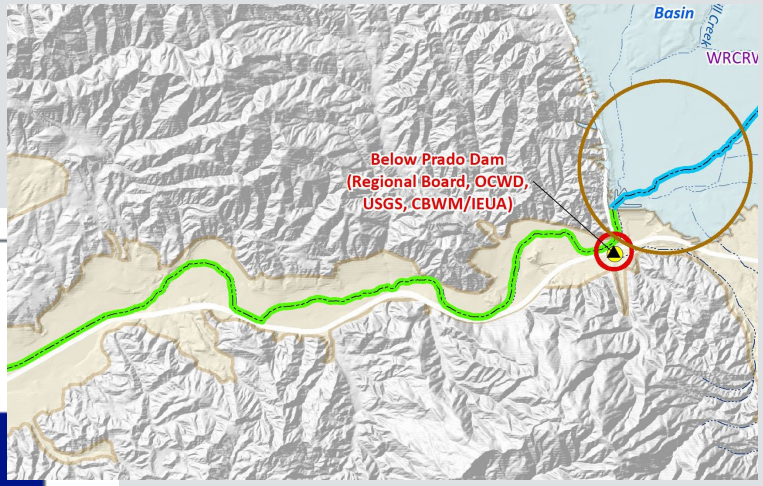


Table 2. Difference between the Two Methods used to Calculate the Five-year Volume-Weighted TDS Concentration at Below Prado Dam for Reach 2

Method	Year Type	Source of Grab Sample Data Used to Calculate a TDS and EC Relationship	Type of Calculation used to Determine Relationship between TDS and EC, to calculate a daily TDS	Calculation Type
Described in the Basin Plan	Water Year	USGS	Average Ratio	Arithmetic Mean of five different annual volume-weighted averages
Alternative	Calendar Year	USGS, OCWD, Regional Board	Linear Regression Model	Five-year (60-month) volume-weighted average

→ 2019 = 503 mgl

→ 2019 = 473 mgl

Reach 2

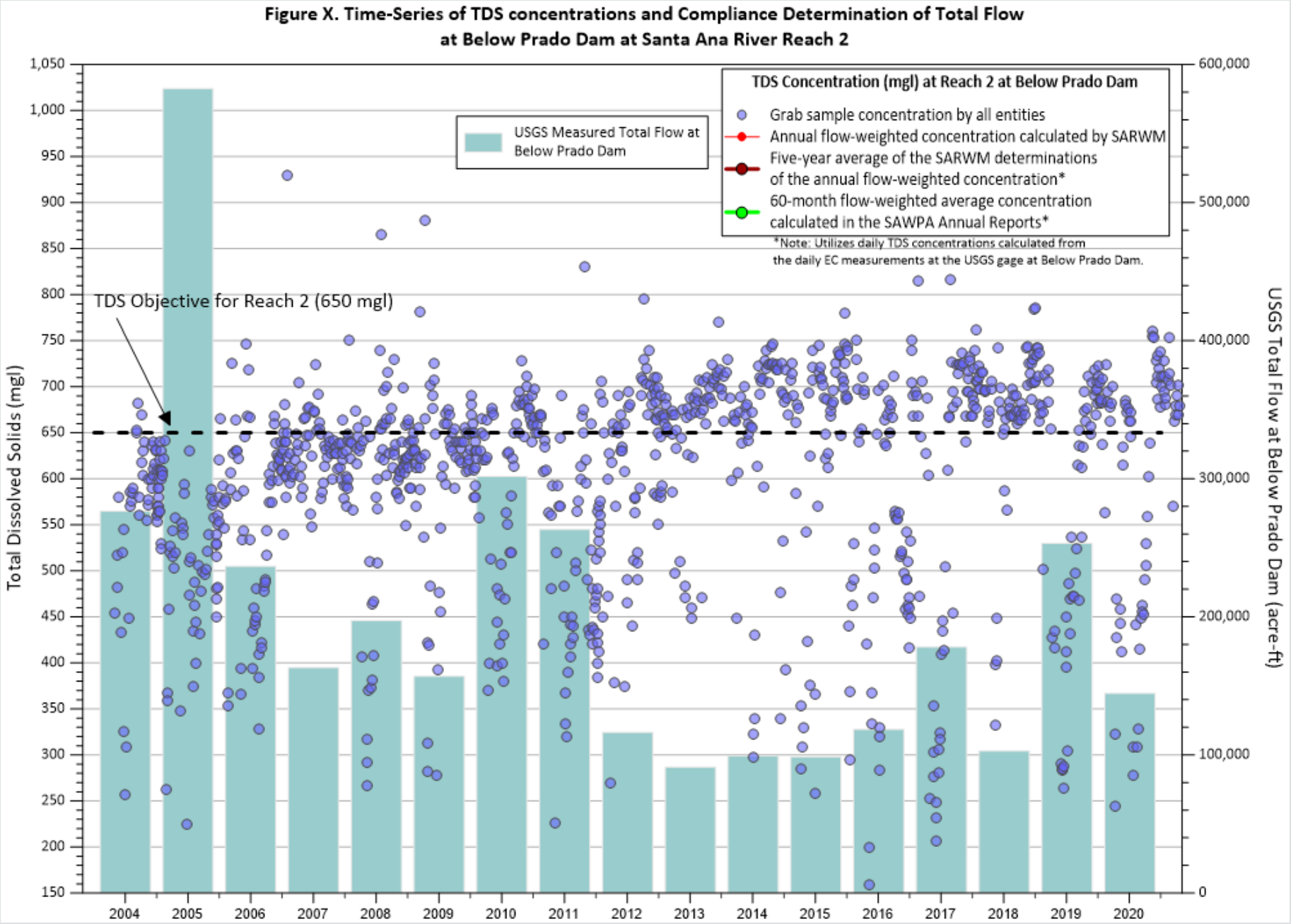


Figure X. Time-Series of TDS concentrations and Compliance Determination of Total Flow at Below Prado Dam at Santa Ana River Reach 2
TDS Concentration (mgl) at Reach 2 at Below Prado Dam
Grab sample concentration by all entities
Annual flow-weighted concentration calculated by SARWM
Five-year average of the SARWM determinations of the annual flow-weighted concentration*
60-month flow-weighted average concentration calculated in the SAWPA Annual Reports*
*Note: Utilizes daily TDS concentrations calculated from the daily EC measurements at the USGS gage at Below Prado Dam.
USGS Measured Total Flow at Below Prado Dam
TDS Objective for Reach 2 (650 mgl)
Total Dissolved Solids (mgl)
USGS Total Flow at Below Prado Dam (acre-ft)
1,050
1,000
950
900
850
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750
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300
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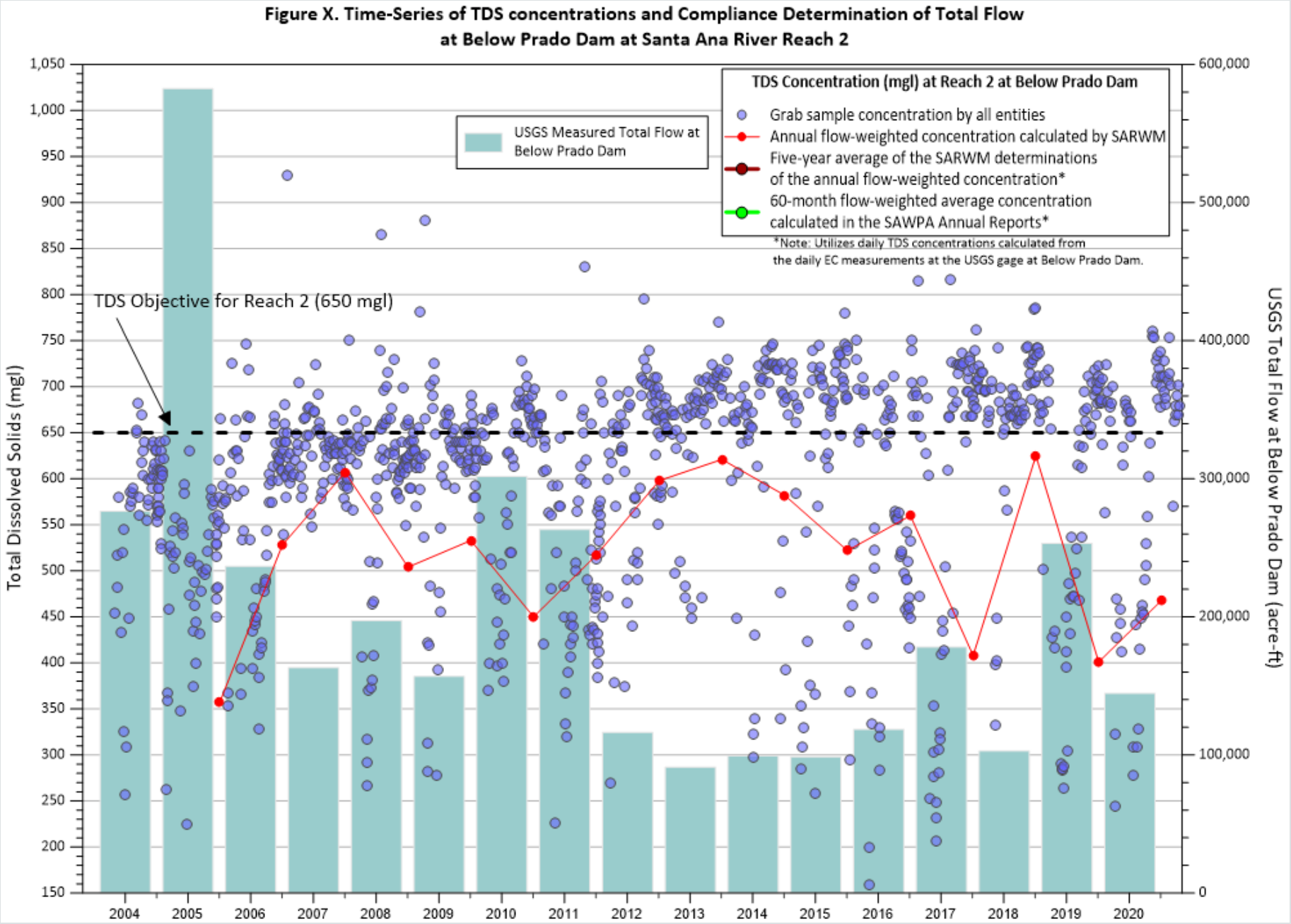
Reach 2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*Note: Utilizes daily TDS concentrations calculated from the daily EC measurements at the USGS gage at Below Prado Dam.
USGS Measured Total Flow at Below Prado Dam
TDS Objective for Reach 2 (650 mgl)
Total Dissolved Solids (mgl)
USGS Total Flow at Below Prado Dam (acre-ft)
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
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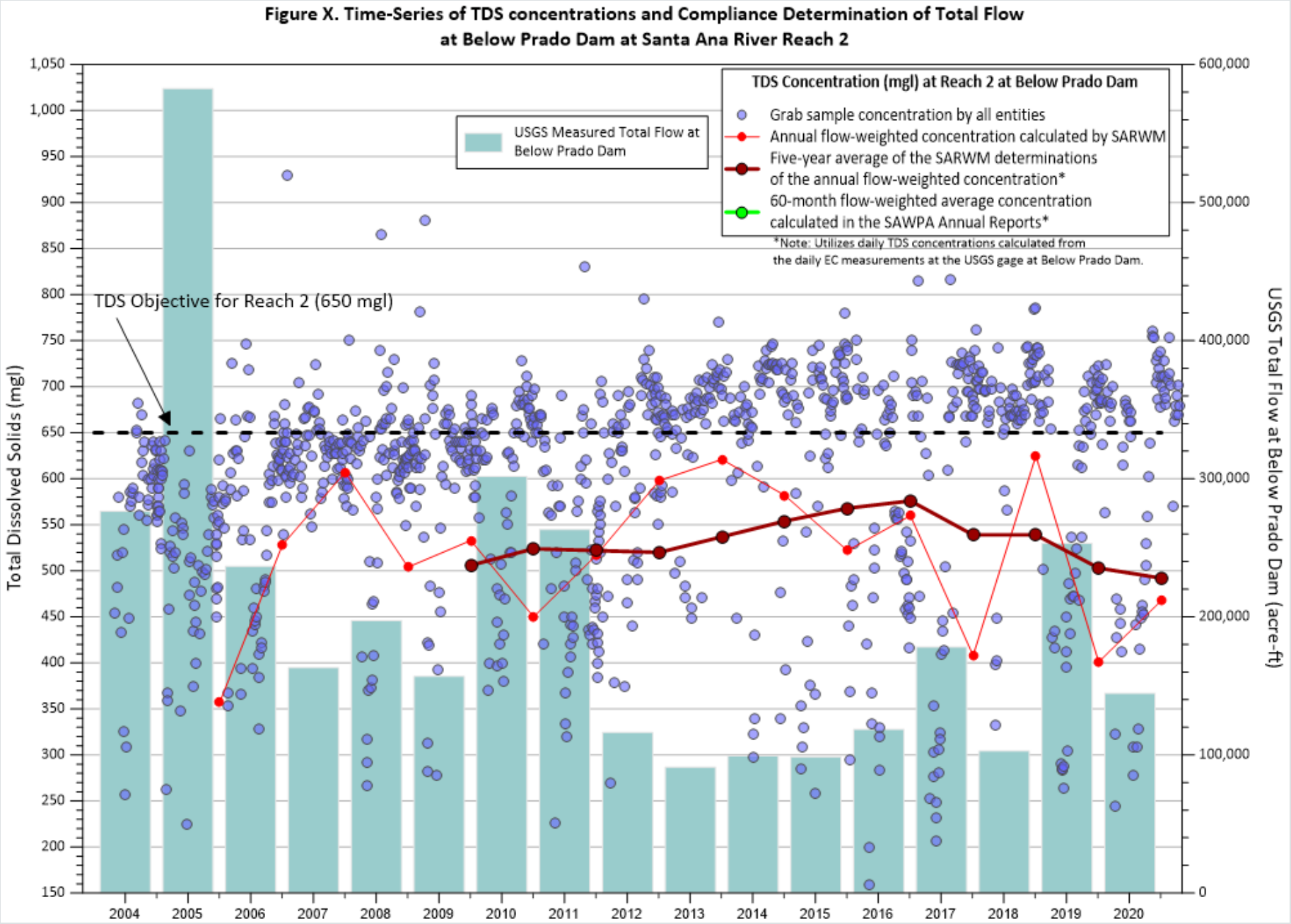
Reach 2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USGS Measured Total Flow at Below Prado Dam
TDS Objective for Reach 2 (650 mgl)
Total Dissolved Solids (mgl)
USGS Total Flow at Below Prado Dam (acre-ft)
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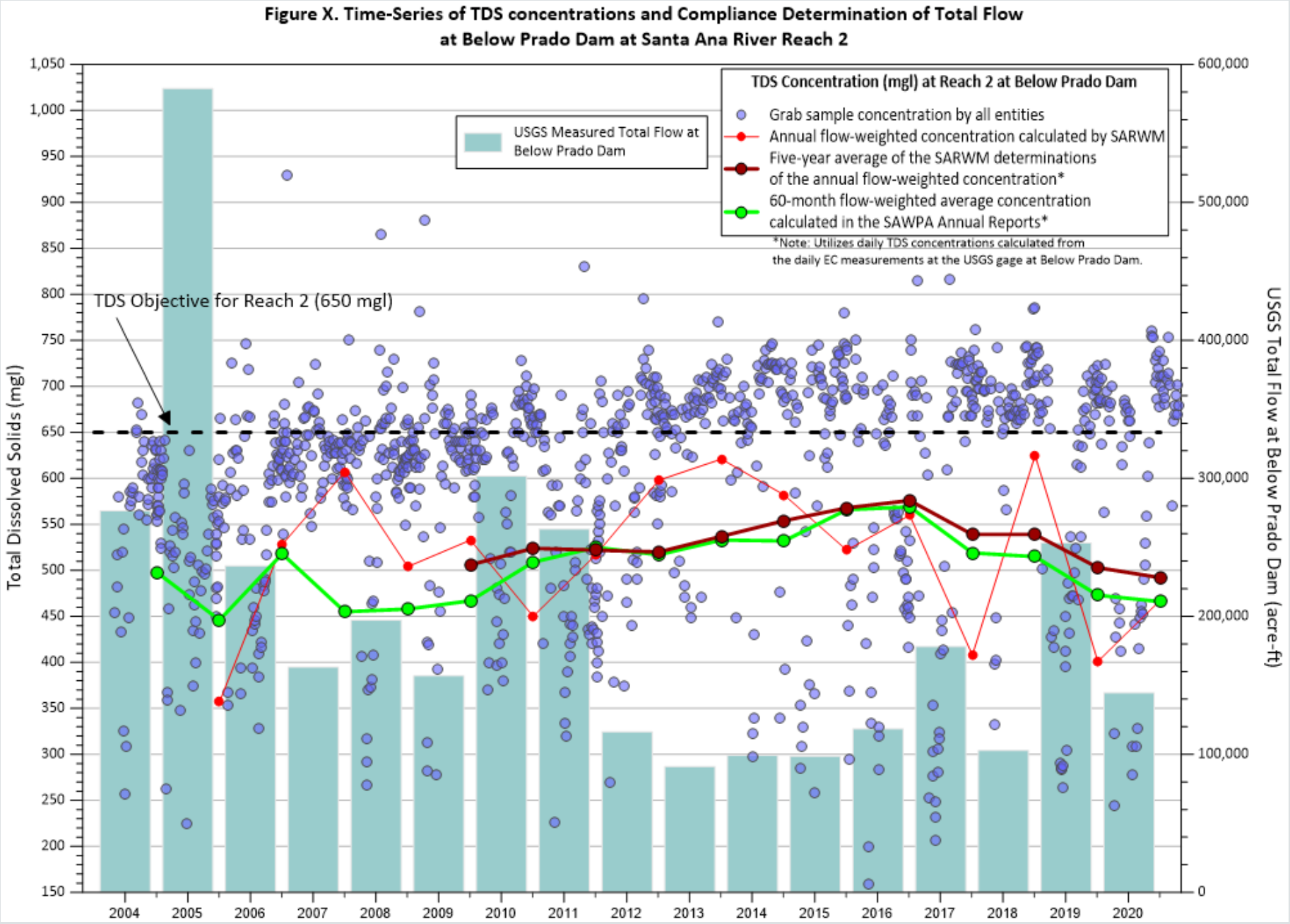
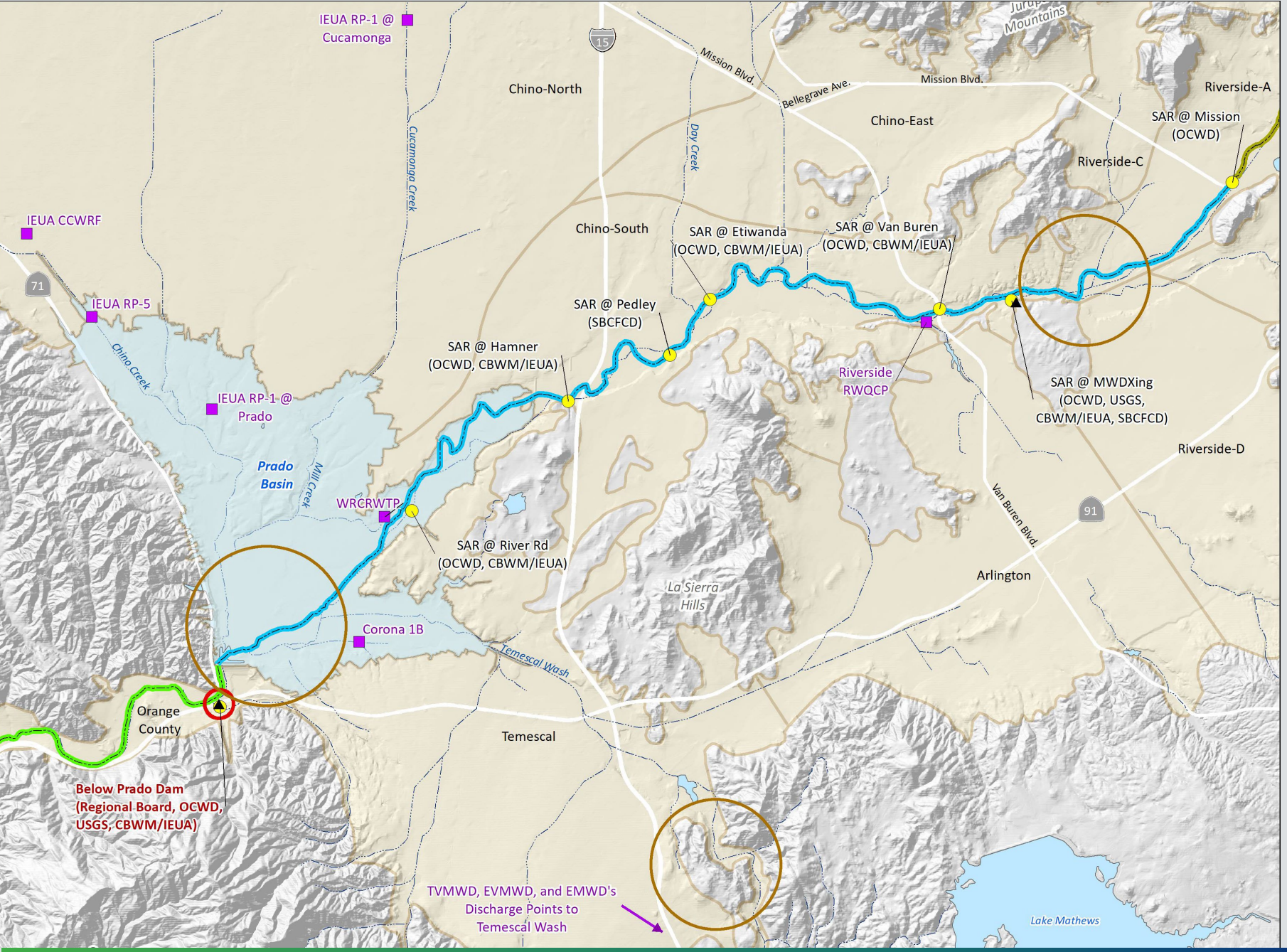


Reach 2 Questions

- **Is the data collected enough to competently assess compliance with Reach 2 TDS objective?**
- **Do you see any gaps in the data to understand the quality in Reach 2 ?**

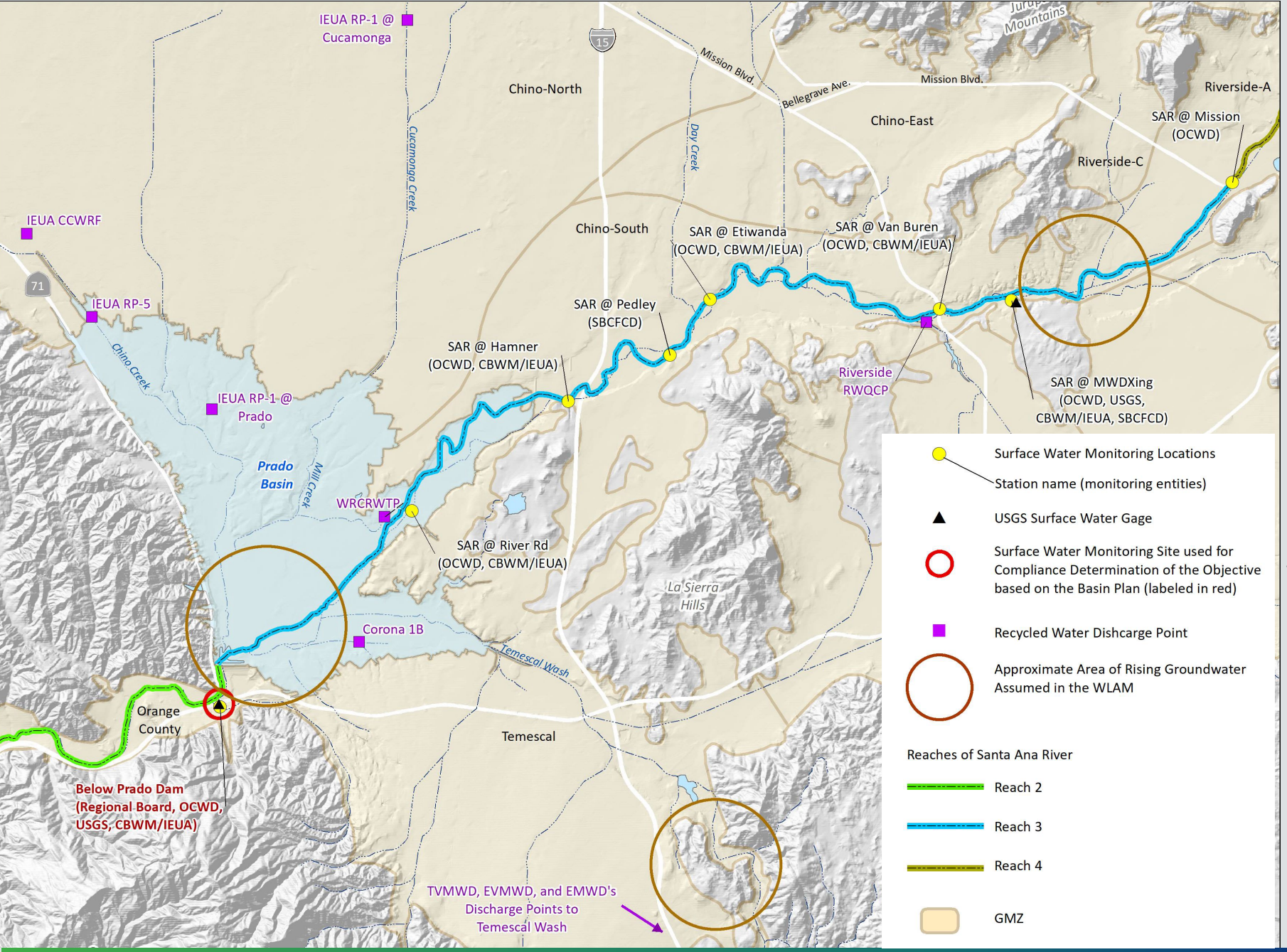
Reach 3



- Surface Water Monitoring Locations
  - Station name (monitoring entities)
- USGS Surface Water Gage
- Surface Water Monitoring Site used for Compliance Determination of the Objective based on the Basin Plan (labeled in red)
- Recycled Water Dischcarge Point
- Approximate Area of Rising Groundwater Assumed in the WLAM

Reaches of Santa Ana River

- Reach 2
- Reach 3
- Reach 4
- GMZ



Reach 3

Surface Water Objectives:

TDS = 700 mgl TIN = 10 mgl *

- Total nitrogen, filtered sample

Basin Plan Metric/Data:

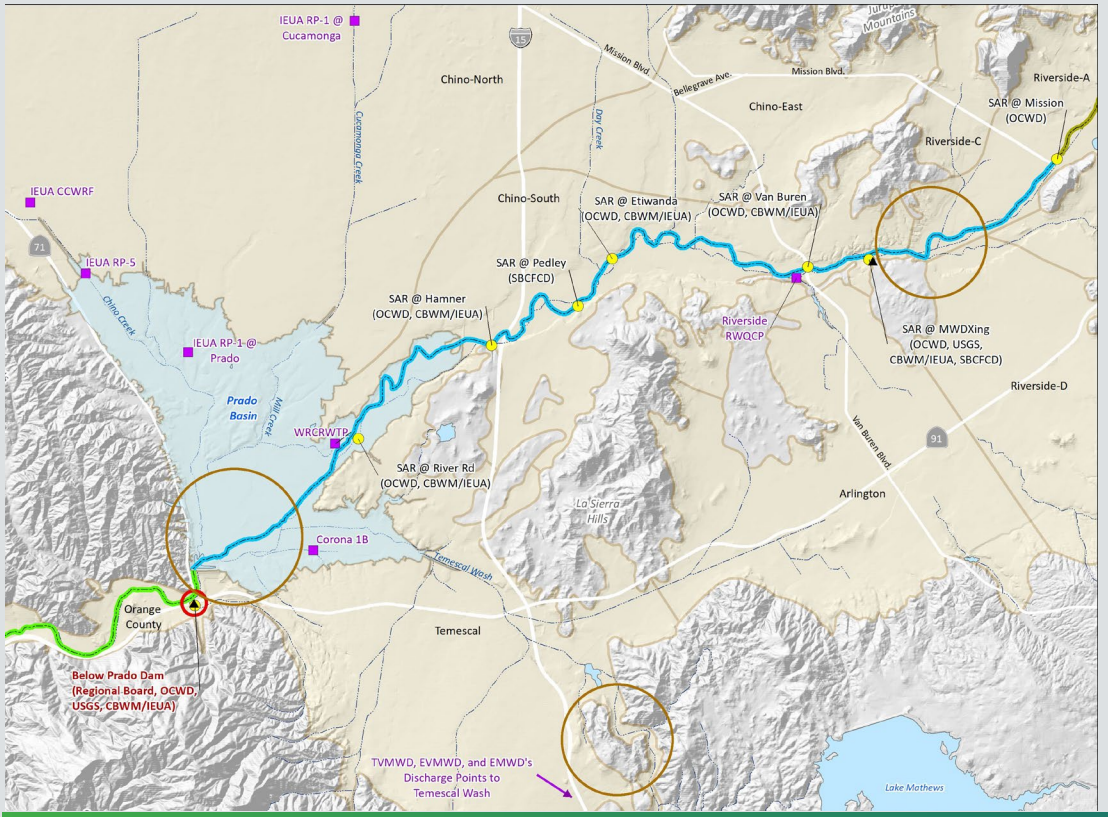
"Regional Board will collect a series of *grab and composite samples when the influence of storm flows and nontributary flows is at a minimum [baseflow]*. This typically occurs during August and September"*

"Results can be compared to the continuous monitoring by the USGS and data from other sources"

*Baseflow in Basin Plan = POTW discharge, rising groundwater, and dry weather runoff

Reach 3 - What does the Surface Water Objective Protect?

- **Protective of** beneficial uses in Orange County GMZ

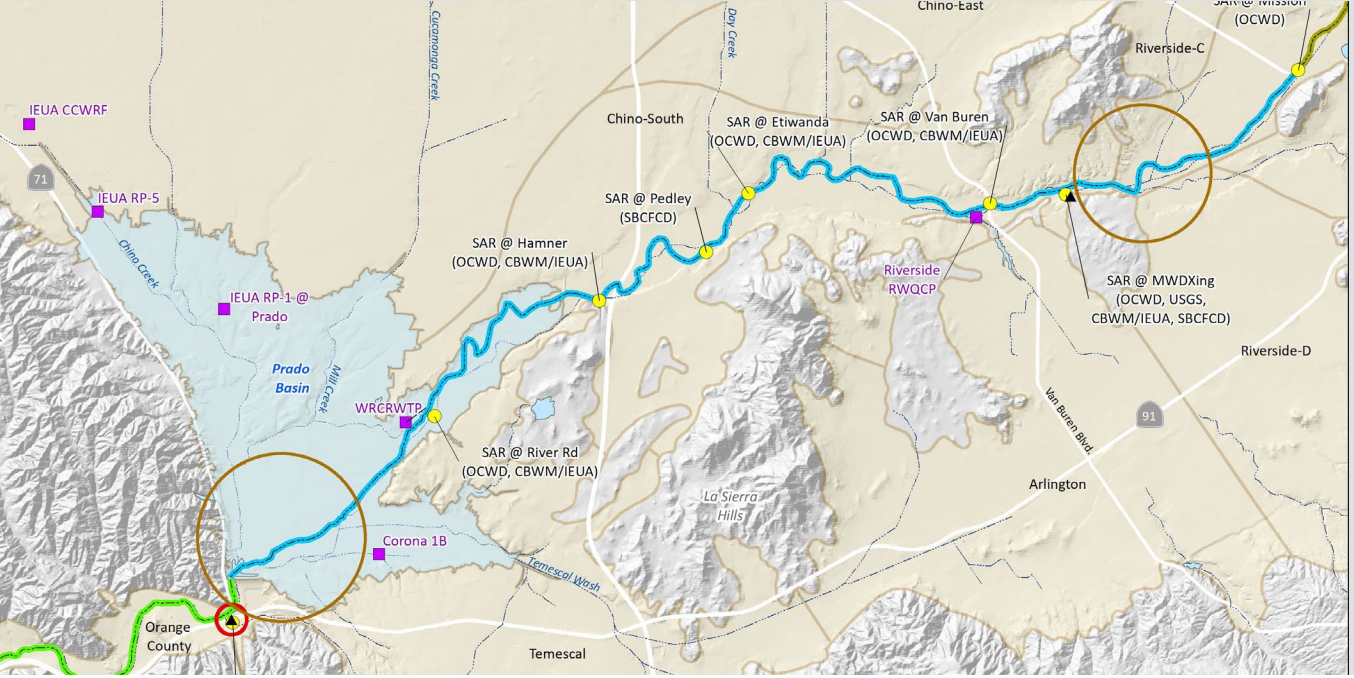


Basin Plan , Page 5-15:

"Baseflow generally provides 70% or more of the water recharged in the Orange County GMZ. In wet years…. (40%)… Therefore, to protect Orange County groundwater, it is essential to control the quality of the baseflow. To do so, baseflow TDS and nitrogen objectives are specified in this Plan for Reach 3 of the River."

Question to be answered by the surface water monitoring data to compare to the objective:

What is the quality of the baseflow in Reach 3, flowing into Reach 2?



Assessment of Compliance with Surface Water Objective in Reach 3

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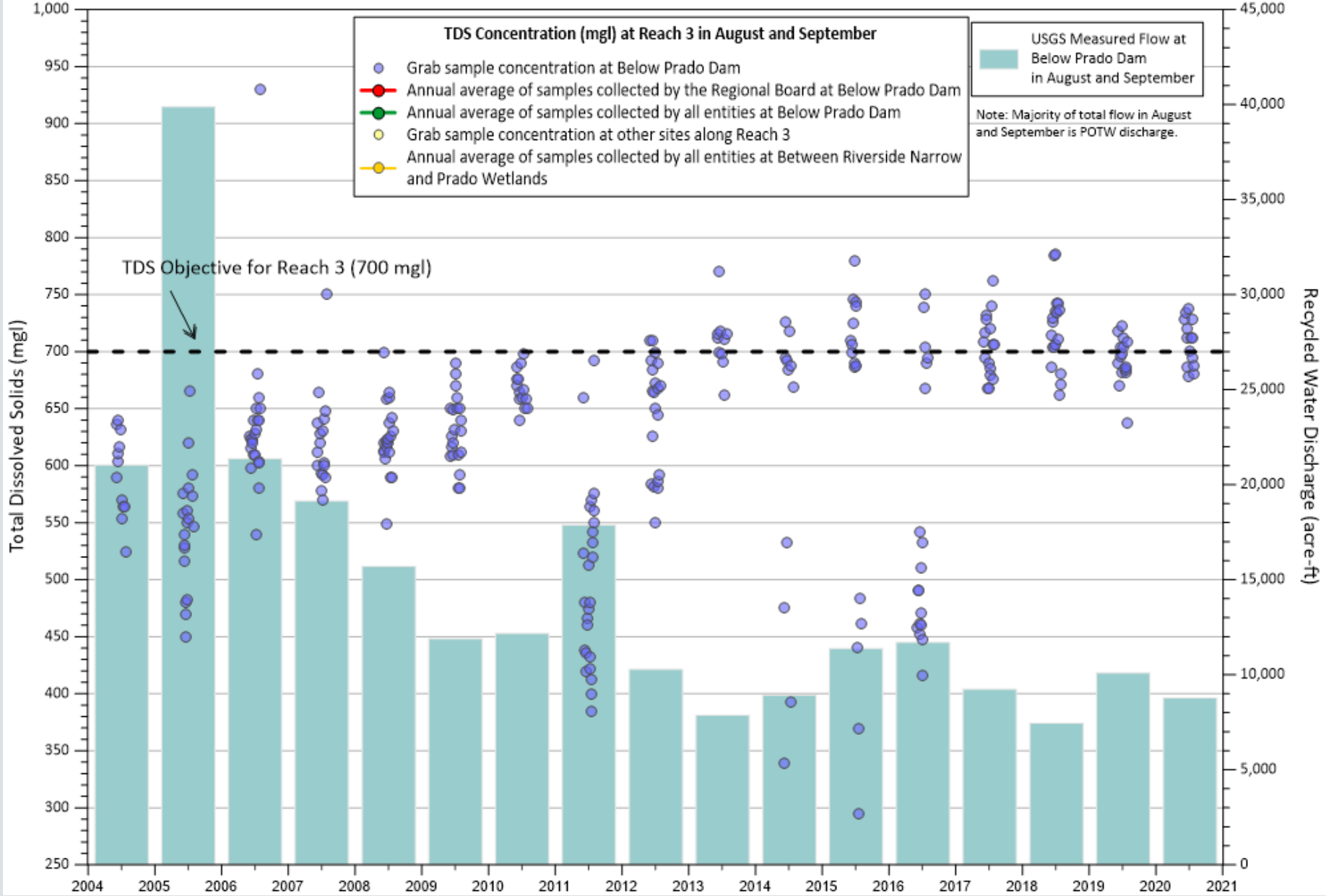

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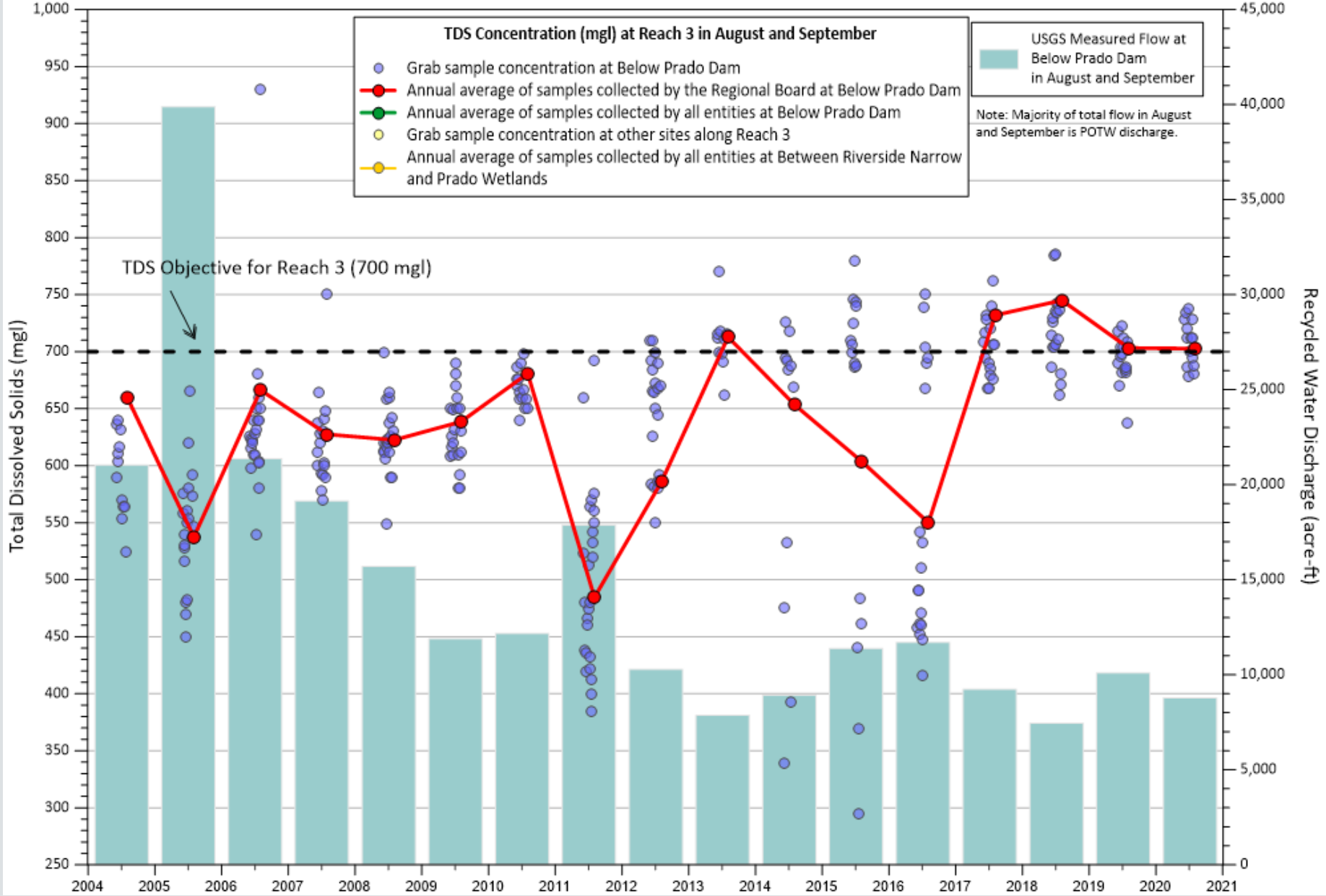

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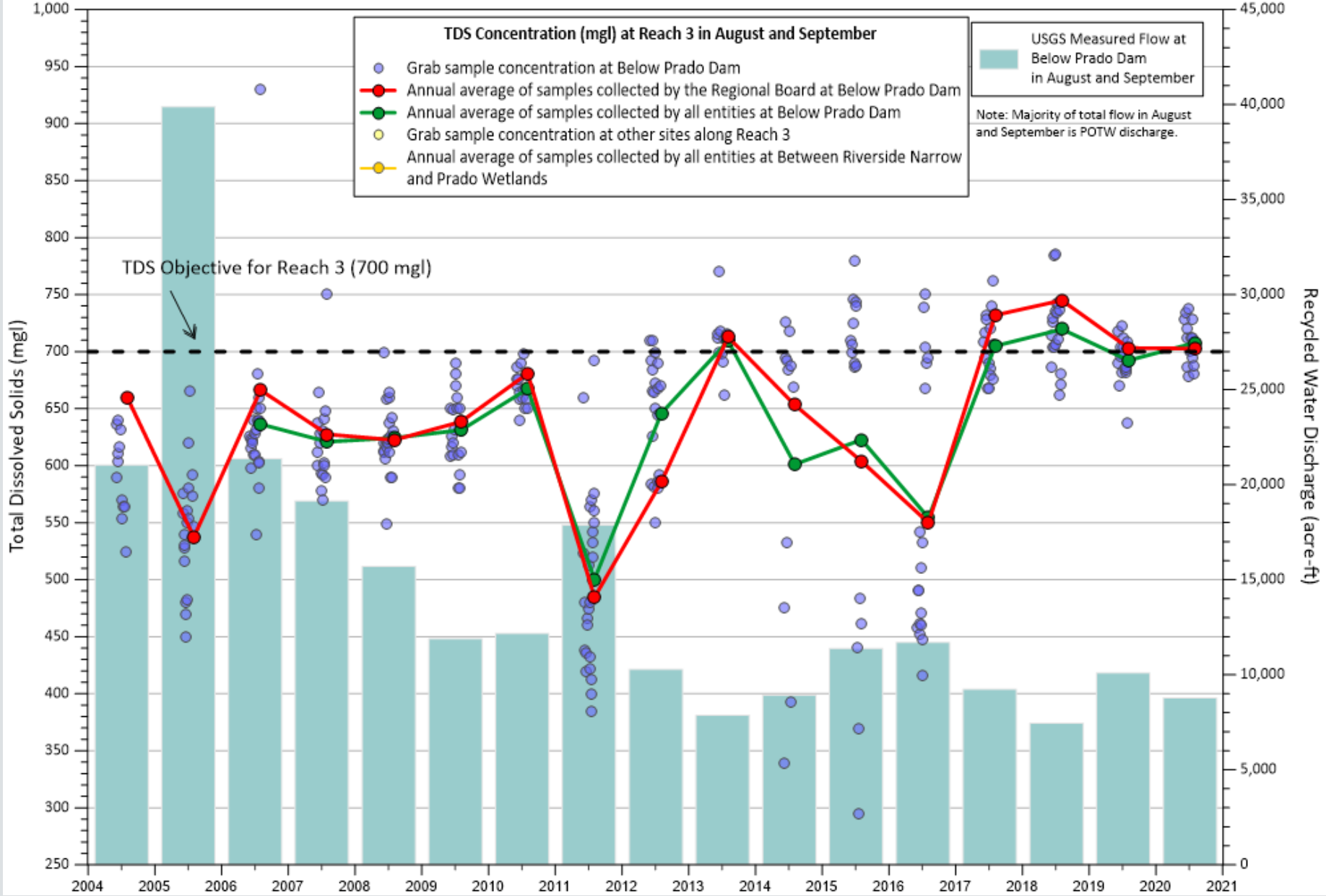

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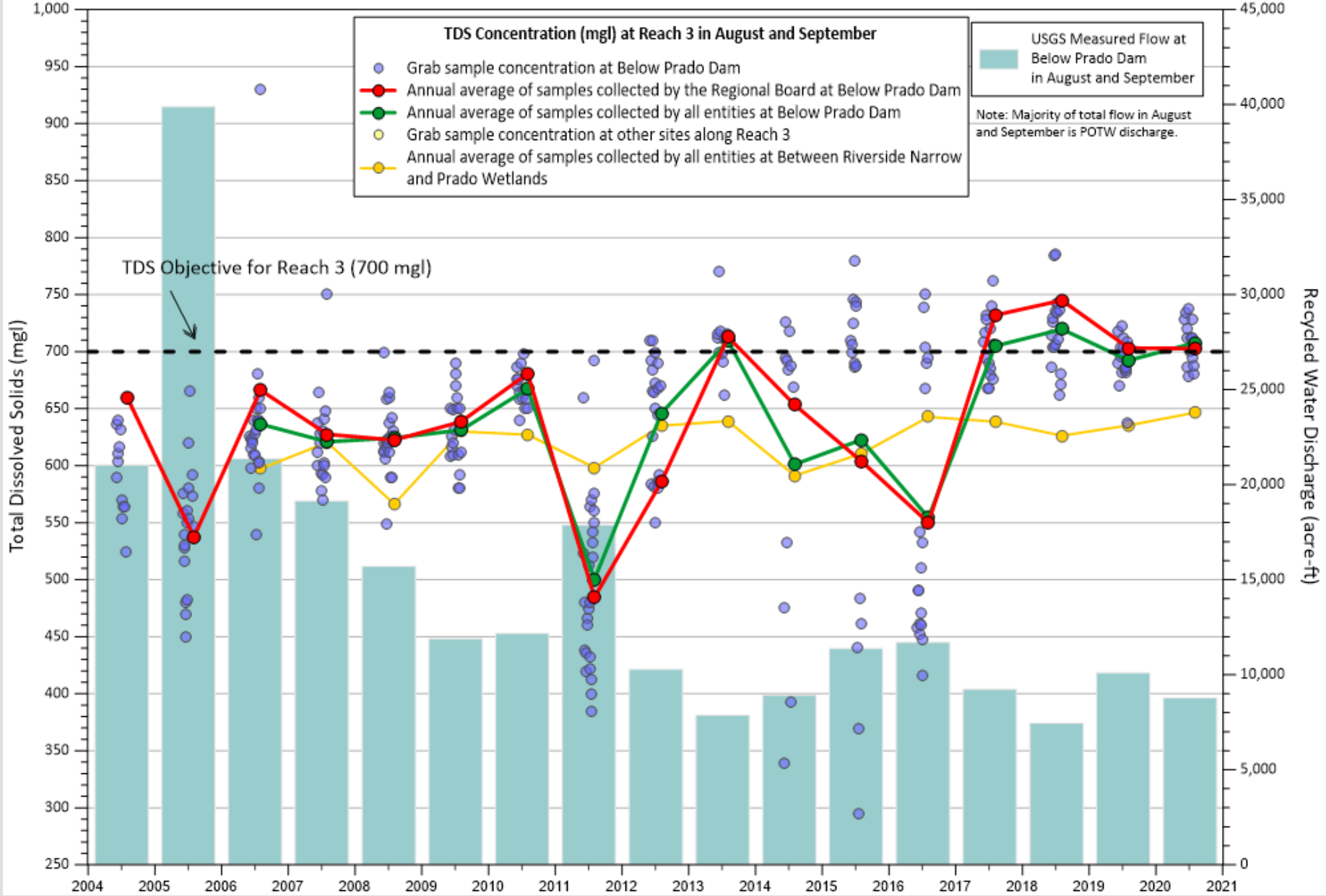

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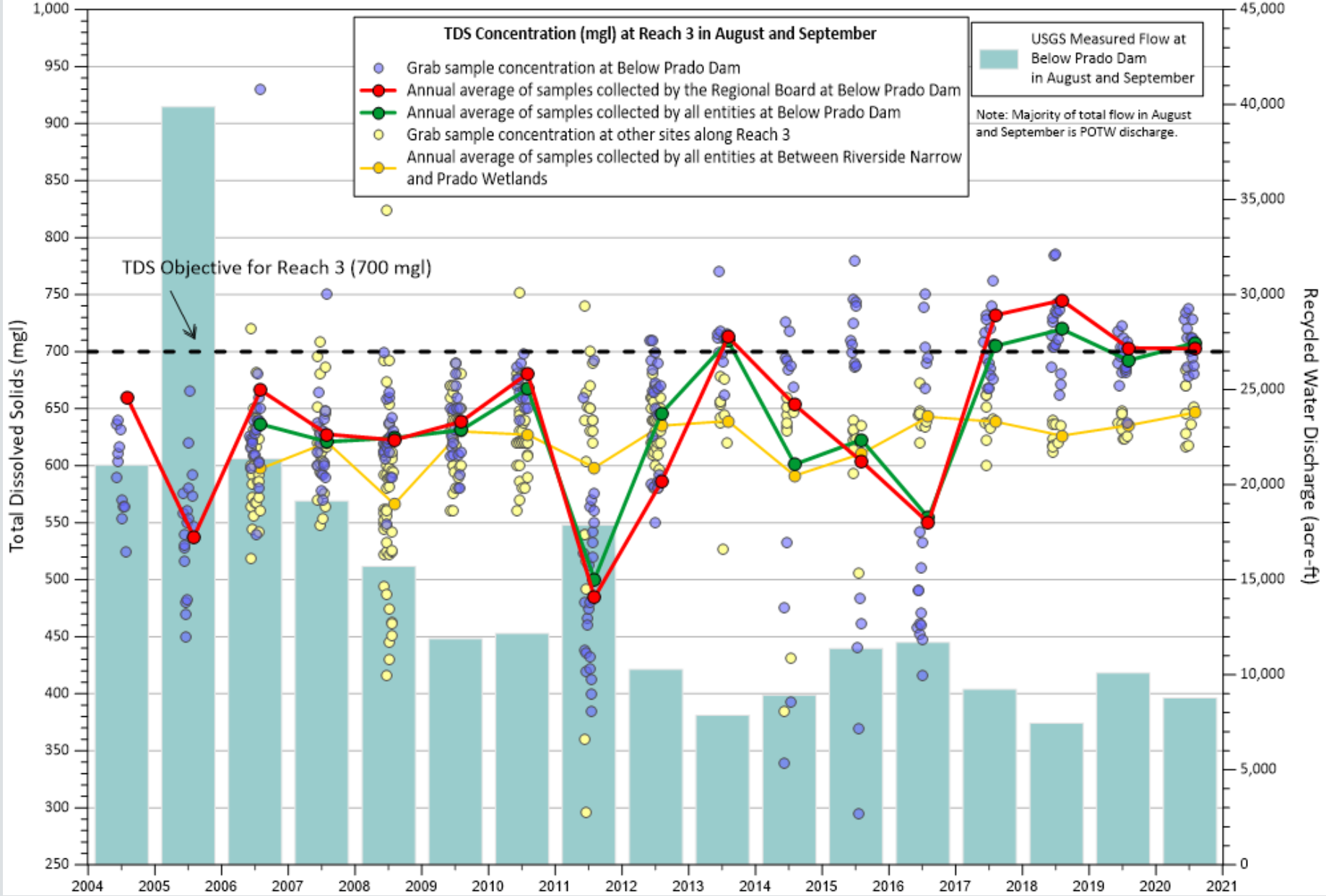


Figure X. Time-Series of TN concentrations and Compliance Determination of Base Flow at Below Prado Dam in August and September at the Santa Ana River Reach 3

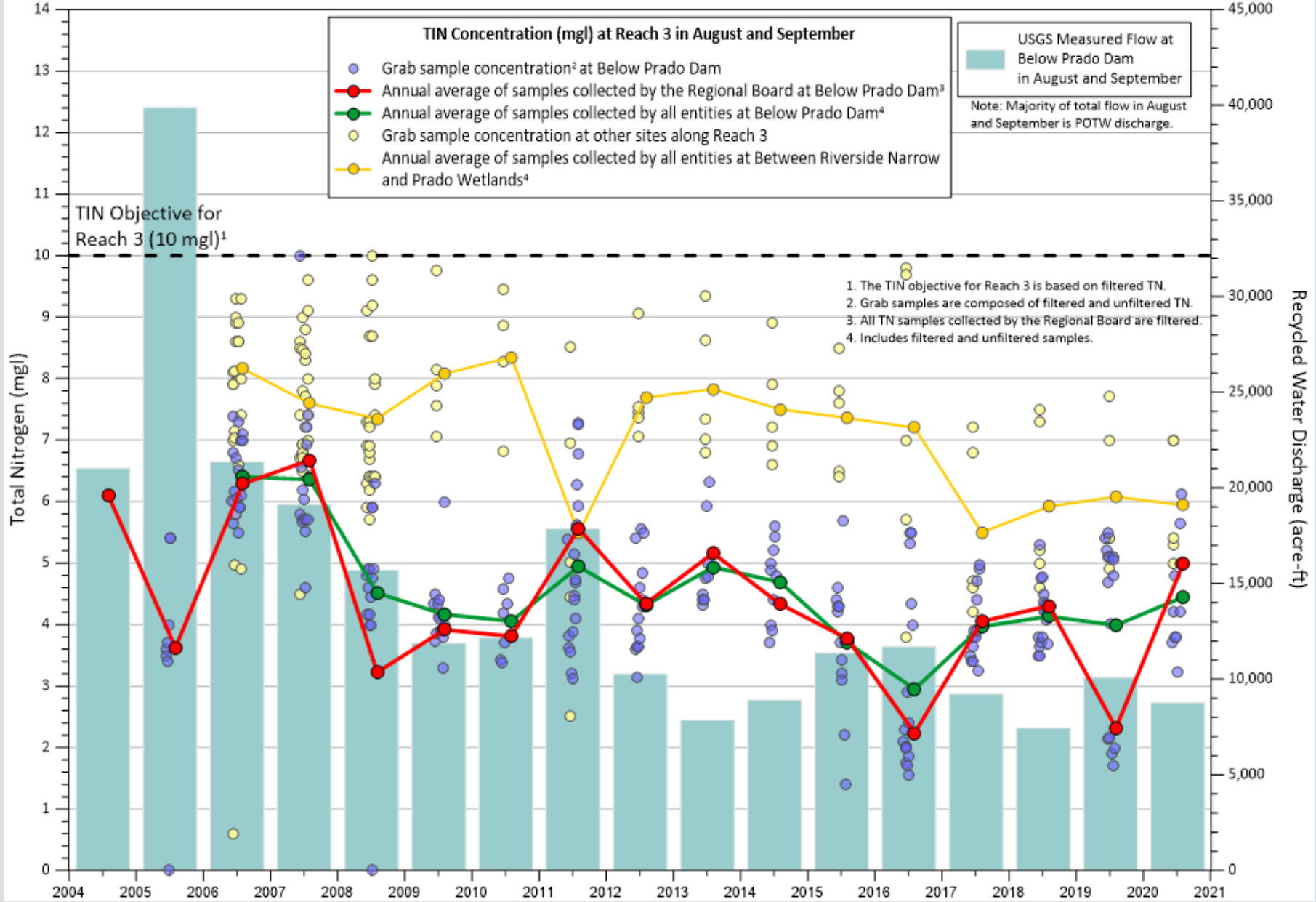
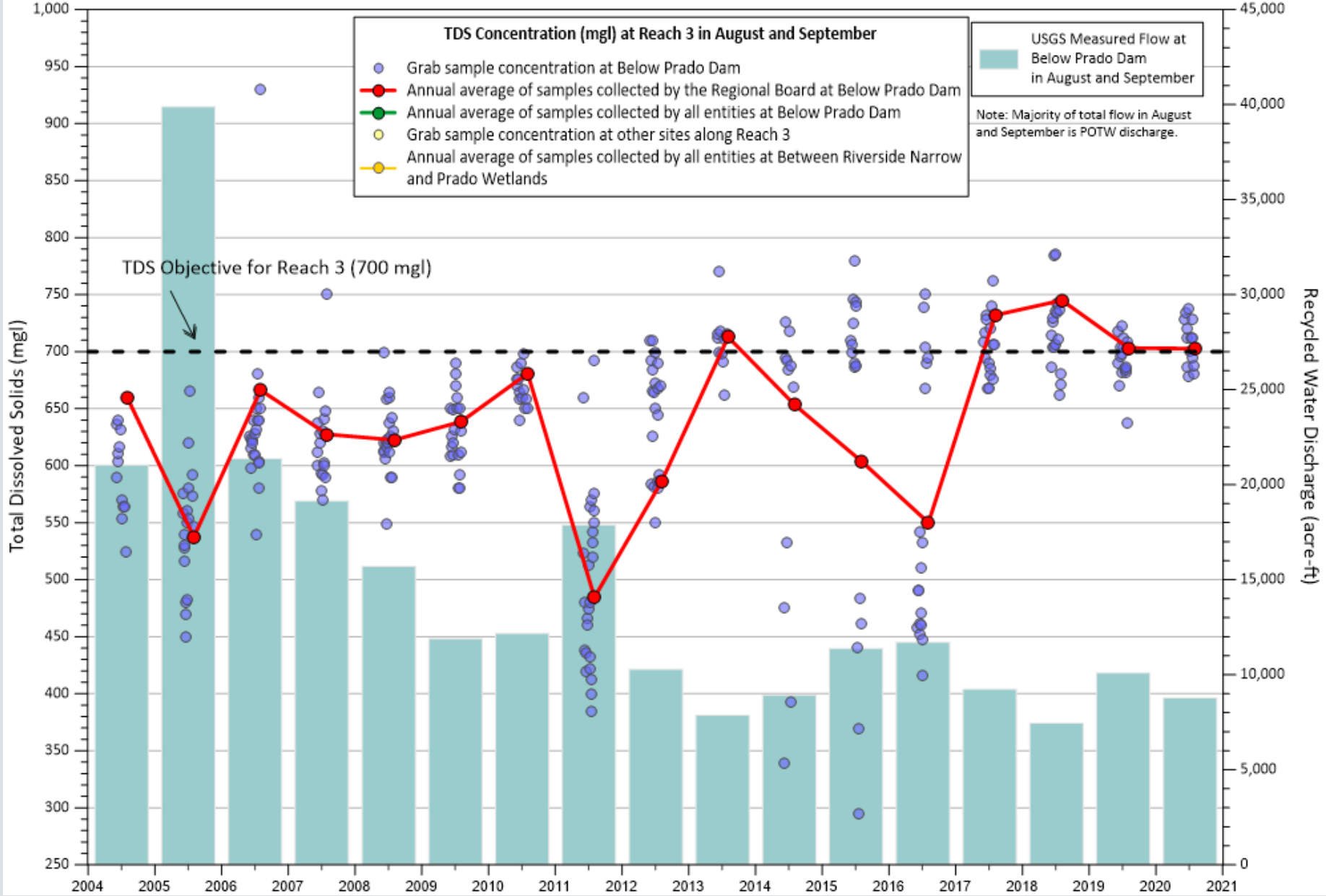
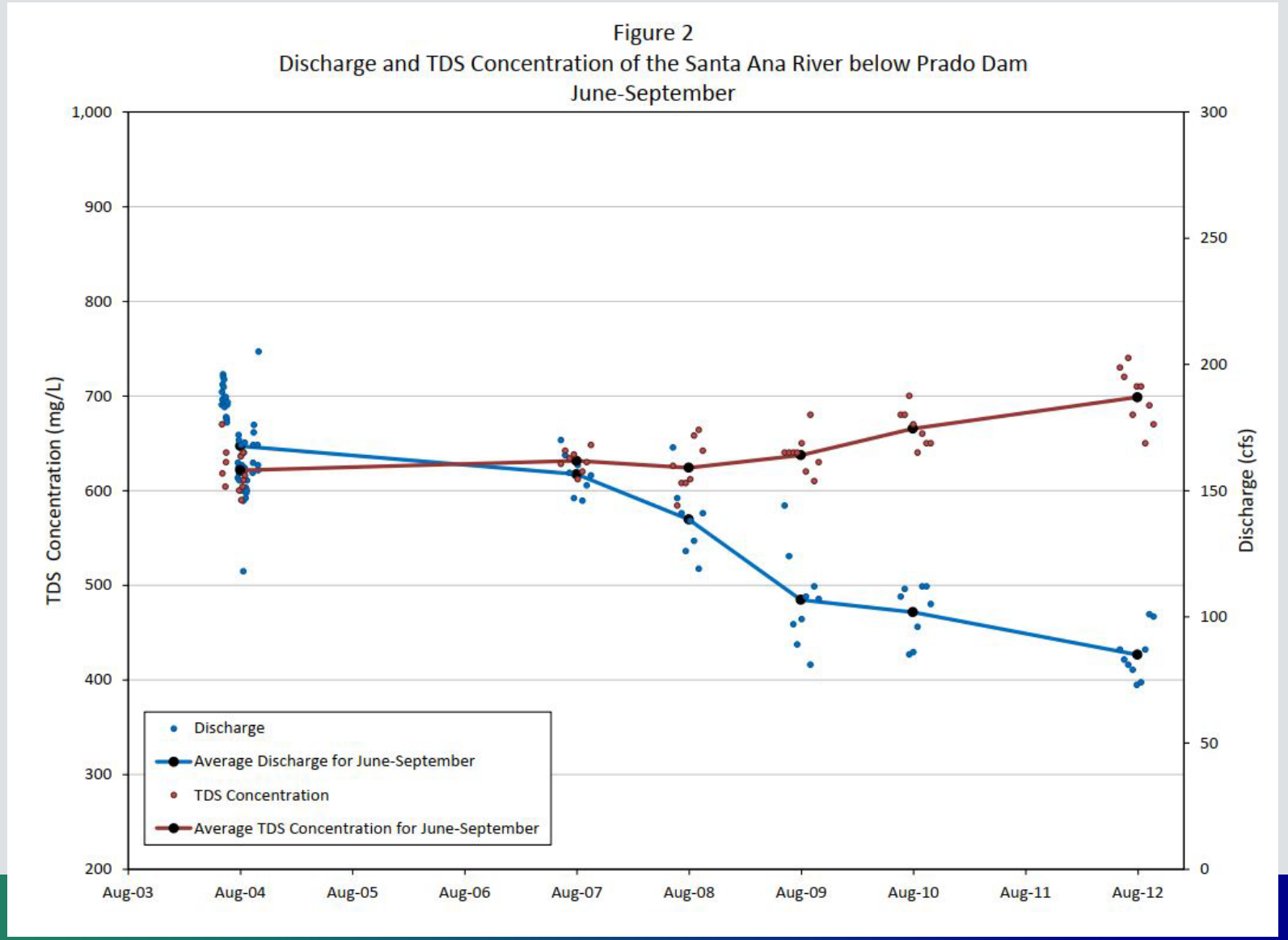


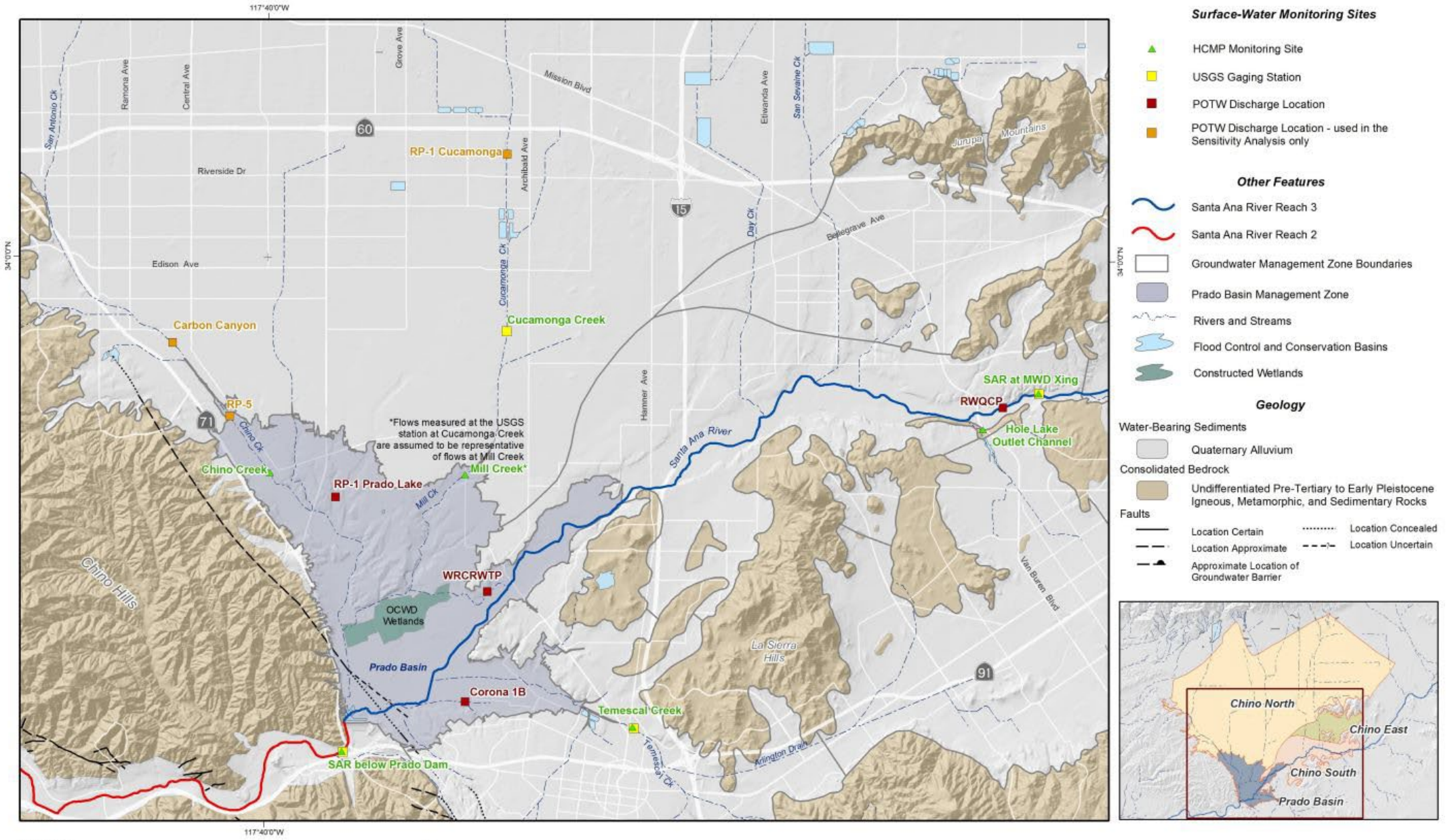
Figure X. Time-Series of TDS concentrations and Compliance Determination of Base Flow at Below Prado Dam in August and September at the Santa Ana River Reach 3



Study of TDS Exceedances in Reach 3 (WEI, 2015)

- **What are the causes of recent exceedances of the Reach 3 TDS objective?**
- Summertime discharge decreased and TDS increased since 2004
- Developed mass balance to attribute flow and TDS to components of flow in Reach 3 (summer 2004, 2007-2010, 2012)
- Calculated Residual term incorporating unmeasured inflows/outflows (e.g., rising water, streambed recharge)





Surface-Water Monitoring Sites

- HCMP Monitoring Site
- USGS Gaging Station
- POTW Discharge Location
- POTW Discharge Location - used in the Sensitivity Analysis only

Other Features

- Santa Ana River Reach 3
- Santa Ana River Reach 2
- Groundwater Management Zone Boundaries
- Prado Basin Management Zone
- Rivers and Streams
- Flood Control and Conservation Basins
- Constructed Wetlands

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

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

Faults

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

Prepared by:

WEI
Wildermuth Environmental, Inc.

Author: JMS
Date: 20141203
File: Figure 3.mxd

0 1 2 3 4 Miles
0 2 4 6 Kilometers

Investigation and Characterization of the Causes of Recent Exceedances of the TDS Concentration Objective for Reach 3 of the Santa Ana River

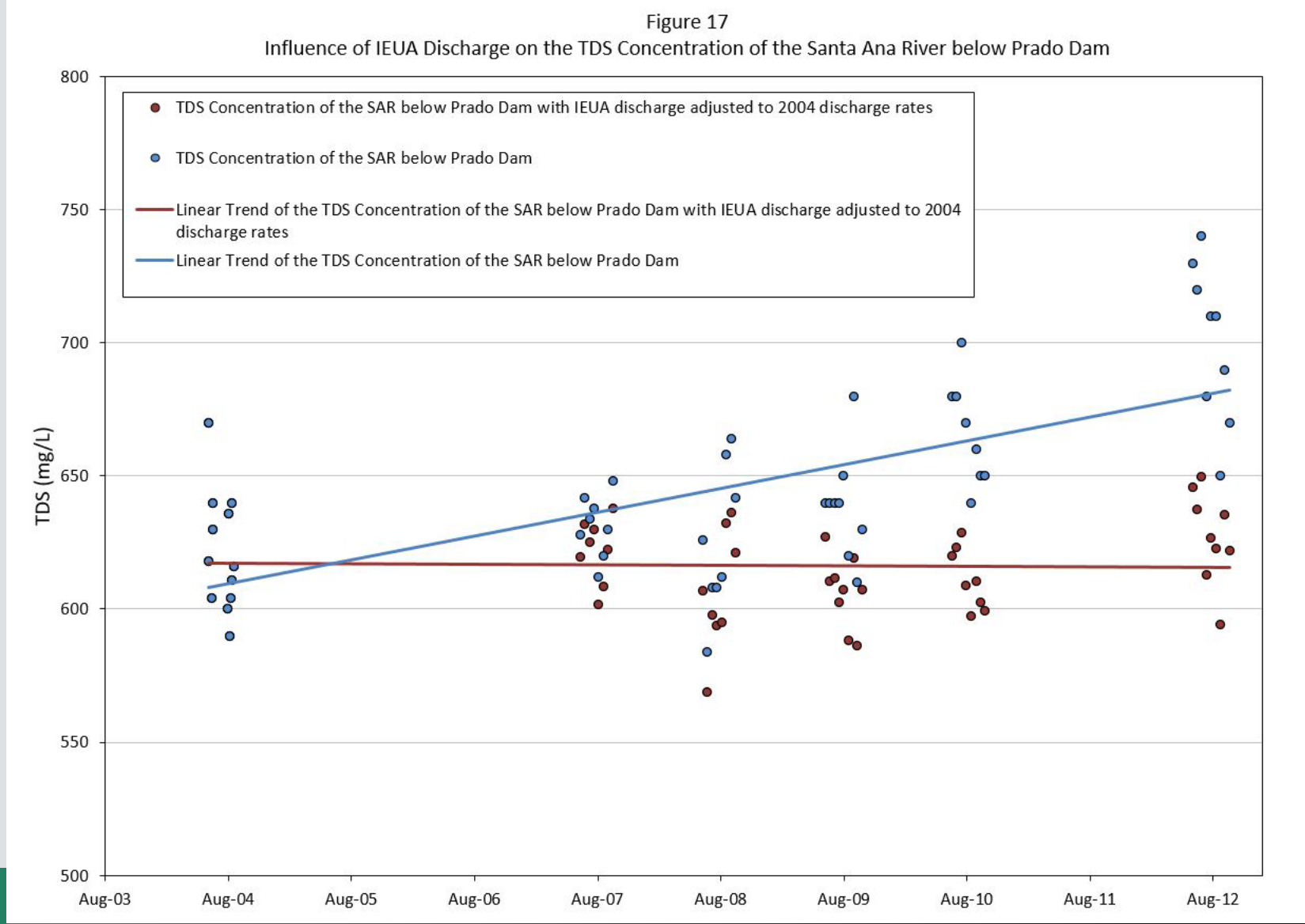
SAWPA

Surface-Water Monitoring Sites within the Study Area

Figure 3

Study of TDS Exceedances in Reach 3 (WEI, 2015)

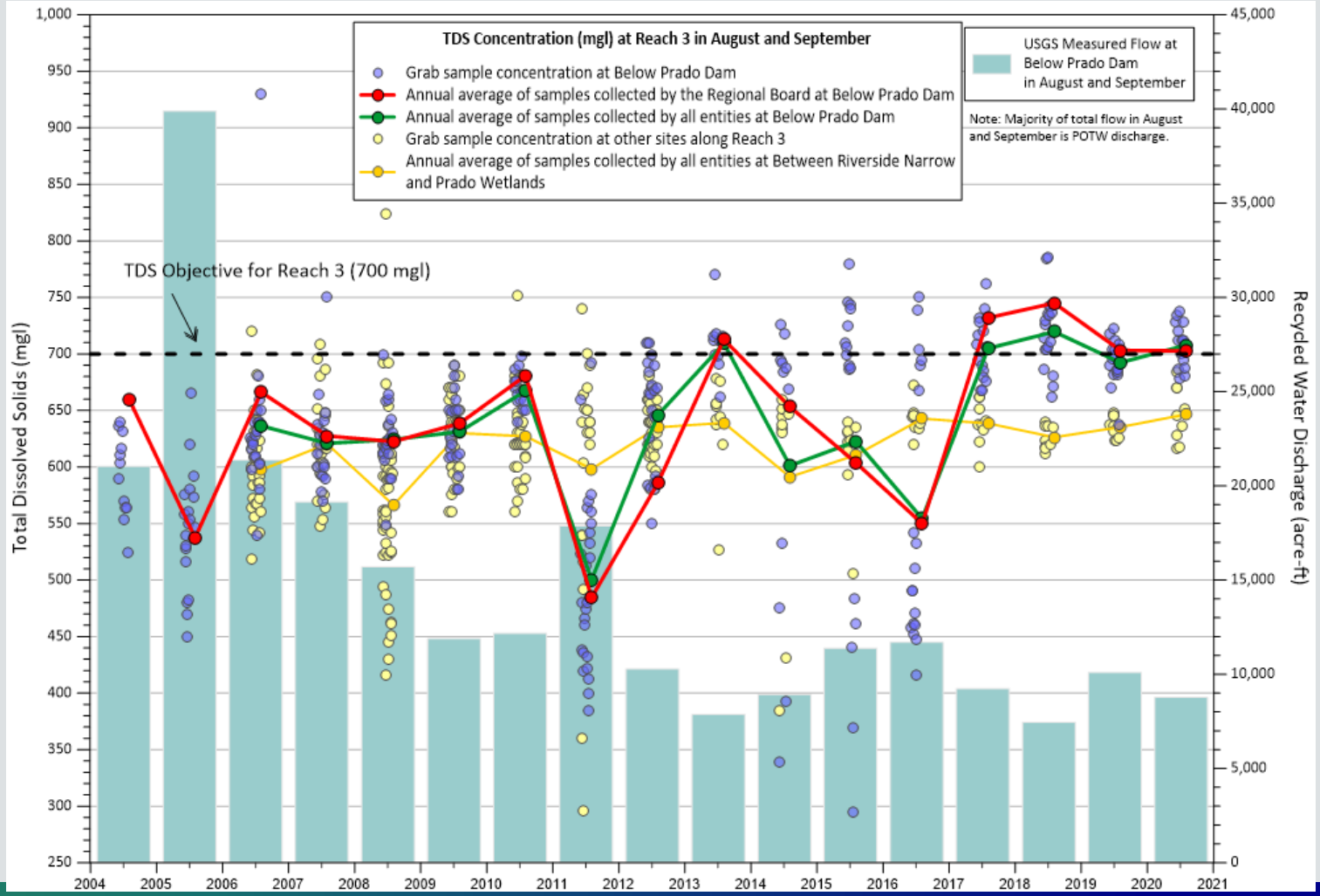
- Performed sensitivity analysis, reconstructed TDS and flow of the SAR below Prado Dam by increasing IEUA discharges to match 2004 rates
- Concluded that IEUA discharges are diluting the TDS in the SAR below Prado Dam
- Recommended further investigation of Residual to understand causes of exceedances



Reach 3 – Questions on the Monitoring for Compliance of SW Objectives

If our goal in assessing compliance with the Reach 3 objective is to ensure protection of Orange County GMZ during baseflow conditions,…

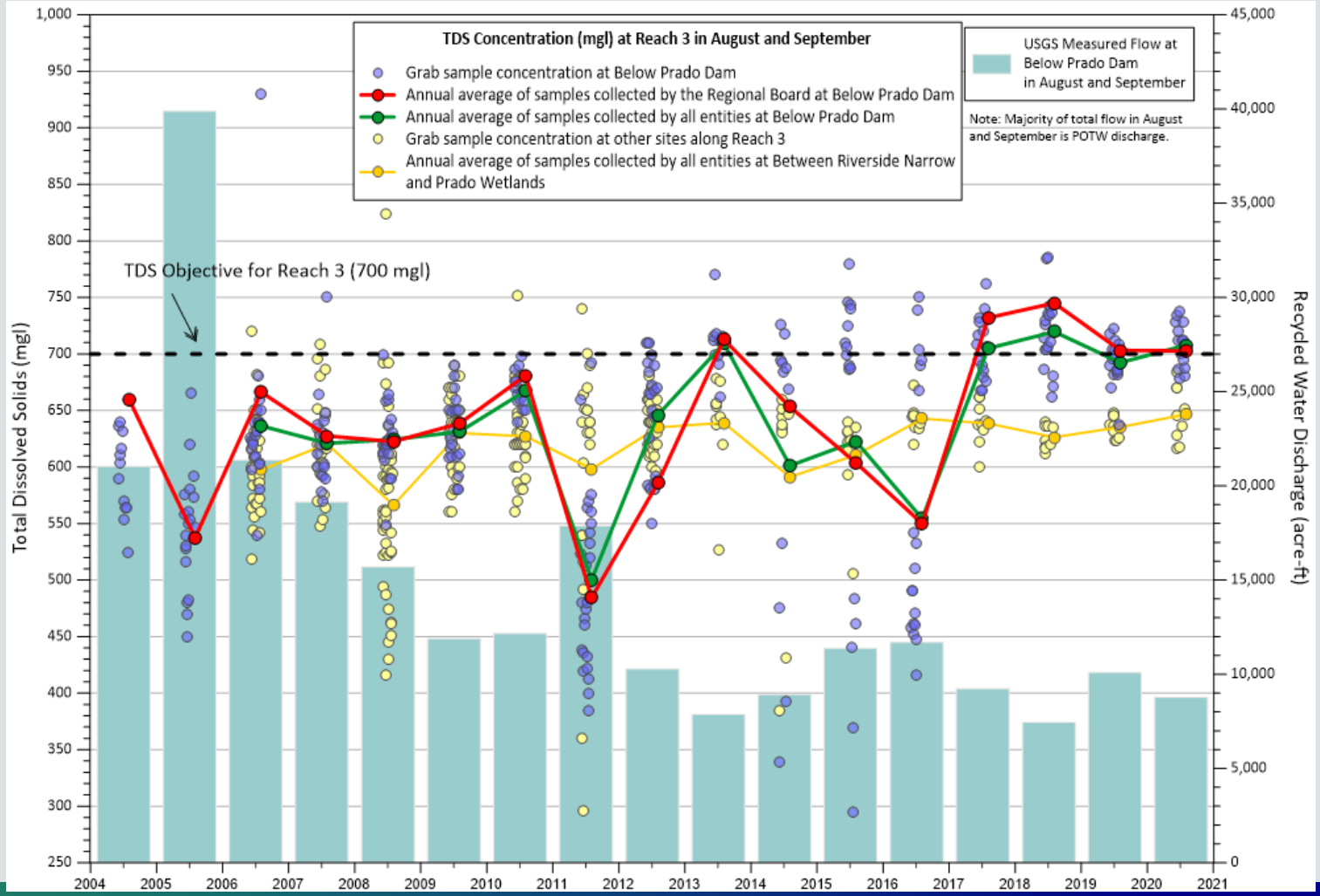
- **Is the data collected enough to competently assess compliance with Reach 3 objectives?**
- **Do we have enough data to understand the drivers of the observed trends in TDS and nitrate?**
  - Should sampling be done more than the months of August and September?
  - Should there be use of the continuous USGS measurements (as mentioned in the Basin Plan)?



Reach 3 – Questions on the Monitoring for Compliance of SW Objectives

If our goal in assessing compliance with the Reach 3 objective is to ensure protection of Orange County GMZ during baseflow conditions,…

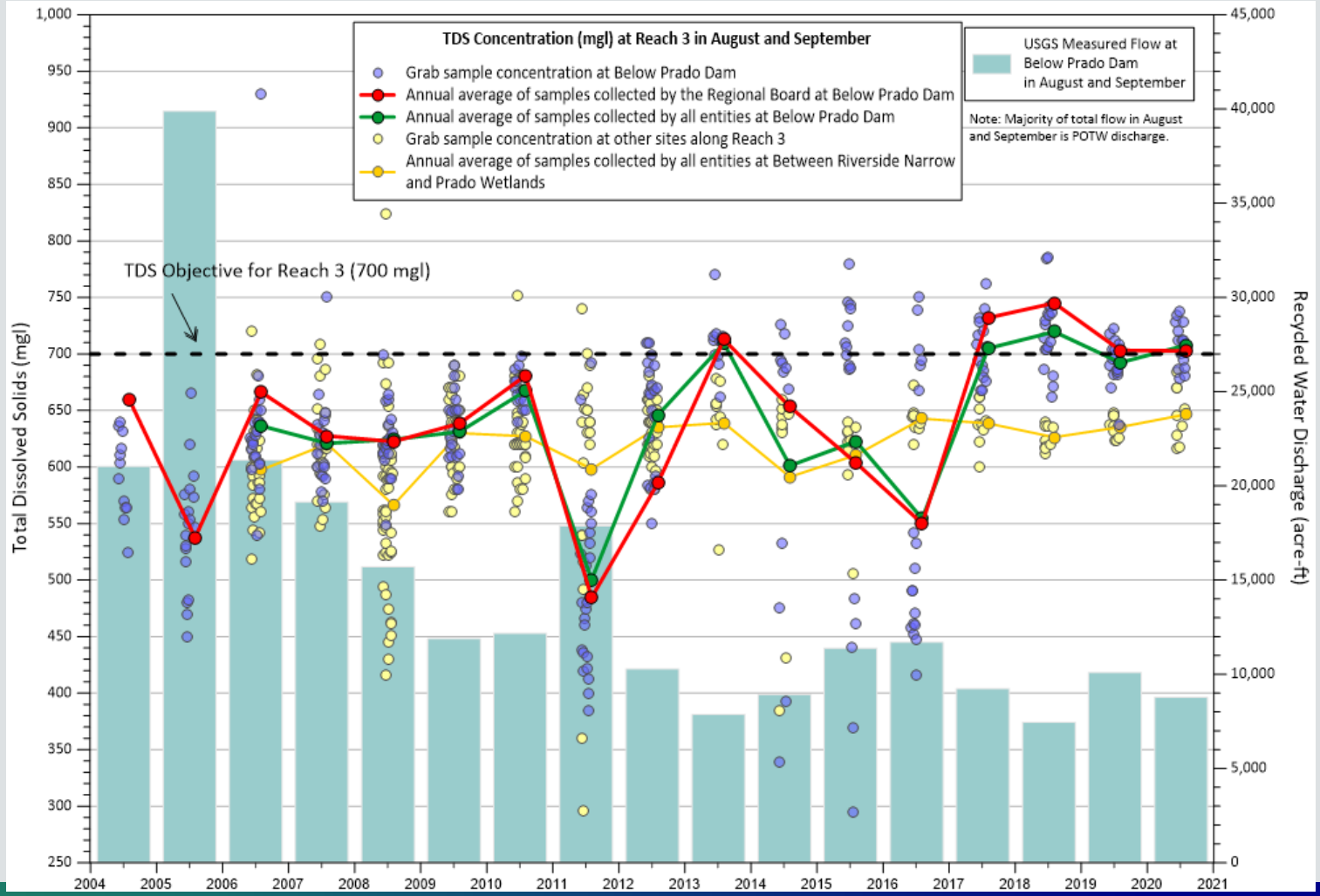
- **Is the data collected enough to competently assess compliance with Reach 3 objectives?**
- **Do we have enough data to understand the drivers of the observed trends in TDS and nitrate?**
  - Should data influenced by summer precipitation or imported water transfers in August and September be included?
  - Should sampling be done at locations other than just below Prado Dam?



Reach 3 – Questions on the Monitoring for Compliance of SW Objectives

If our goal in assessing compliance with the Reach 3 objective is to ensure protection of Orange County GMZ during baseflow conditions,…

- **Is the data collected enough to competently assess compliance with Reach 3 objectives?**
- **Do we have enough data to understand the drivers of the observed trends in TDS and nitrate?**
  - Should there be further characterization of rising groundwater along Reach 3 (quality/location)?
    - For example: What percentage of baseflow is rising groundwater in August and September?



Next Steps

- **Continue feedback on questions through February 2022.**
  - Send to Veva Weamer vweamer@westyost.com

- **February 2022 Workshop #2 –** Reaches 4 and 5, review of modeling tools

- **Late March/Early April 2022 -** Prepared Draft Technical Memorandum Surface Water Monitoring Requirements and Goals for the Santa Ana River Watershed

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WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

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