

**SANTA ANA RIVER
WASTE LOAD ALLOCATION
MODEL UPDATE**

SUPPLEMENTAL REPORT

PREPARED FOR:

Santa Ana Watershed Project Authority

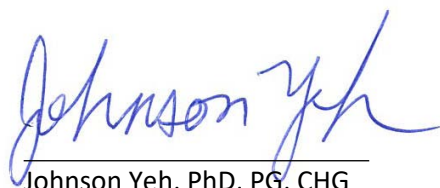
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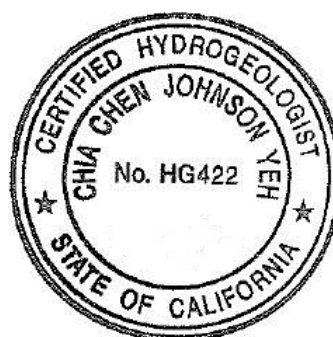
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SANTA ANA RIVER WASTE LOAD ALLOCATION MODEL UPDATE - SUPPLEMENTAL REPORT

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2	Summary of TIN Model Results for Supplemental Scenarios A-F
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|---|--|
| 4 | Summary of TDS Model Results for Scenarios A-F |
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Appendices

Ltr.	Description
<i>(Attached)</i>	
A	Updated Recycled Water Discharge Projections Provided by YVWD
B	Supplemental Predictive Scenario Results – San Timoteo Groundwater Management Zone
C	Supplemental Predictive Scenario Results – Bunker Hill-B Groundwater Management Zone
D	Supplemental Predictive Scenario Results – Colton Groundwater Management Zone
E	Retrospective Model Run Results (Water Years 2005 through 2016)

Acronyms, Abbreviations, and Initialisms

Abbrev.	Description
2017 WLAM HSPF	Waste Load Allocation Model Developed by Geoscience as part of the most recent WLAM update (Geoscience, 2020).
cfs	cubic feet per second
DP	discharge point
EMWD	Eastern Municipal Water District
EVMWD	Elsinore Valley Municipal Water District
EVWD	East Valley Water District
ft	feet
Geoscience	Geoscience Support Services, Inc.
GMZ	groundwater management zone
HSPF	Hydrological Simulation Program – Fortran
IEUA	Inland Empire Utilities Agency
in.	inches
MGD	million gallons per day
mg/L	milligrams per liter
OCWD	Orange County Water District
POTW	publicly owned treatment work
RCFCWCD	Riverside County Flood Control and Water Conservation District
Regional Board	California Regional Water Quality Control Board, Santa Ana Region
RIX	Rapid Infiltration and Extraction
RP	regional plant
RWQCP	regional water quality control plant
SAR	Santa Ana River
SARMP	Santa Ana River Mainstem Project
SAWPA	Santa Ana Watershed Project Authority

SBBA	San Bernardino Basin Area. Includes Bunker Hill and Lytle Groundwater Basins
SBVMWD	San Bernardino Valley Municipal Water District (also known as Valley District)
SNRC	Sterling Natural Resources Center
Task Force	Basin Monitoring Program Task Force
TDS	total dissolved solids
TIN	total inorganic nitrogen
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
Valley District	San Bernardino Valley Municipal Water District
WLAM	Waste Load Allocation Model
WMWD	Western Municipal Water District
WRCRWA	Western Riverside County Regional Wastewater Authority Plant
WRF	water recycling facility or water reclamation facility
WRP	water reclamation plant
WWRF	wastewater reclamation facility
WWTP	wastewater treatment plant
WY	Water Year (representing the period from October of one year to September of the next. For example, WY 2016 represents the period from October 2015 through September 2016).
YVWD	Yucaipa Valley Water District

SANTA ANA RIVER WASTE LOAD ALLOCATION MODEL UPDATE - SUPPLEMENTAL REPORT

1.0 Introduction

In 2017, the Santa Ana Watershed Project Authority (SAWPA) and Basin Monitoring Program Task Force (Task Force) retained Geoscience Support Services, Inc. (Geoscience) to update the Waste Load Allocation Model (WLAM) by developing and calibrating a watershed model using the Hydrological Simulation Program - Fortran (HSPF) computer code. Following calibration, the model – referred to as the 2017 WLAM HSPF – was used to estimate the projected total dissolved solids (TDS) and total inorganic nitrogen (TIN) concentrations of the Santa Ana River (SAR) recharge water and discharge at Prado Dam. Six predictive scenarios were conducted by varying the amount of recycled water discharge to surface water, as summarized below.

Table 1-1. Major Assumptions for WLAM Predictive Scenarios

Model Scenario	Hydrologic Period	Model Conditions	Land Use	Recycled Water Discharge to Surface Water			TDS and TIN	
				Maximum Expected Discharge	Most Likely Discharge	Minimum Expected Discharge	Permit TDS	Permit TIN
A	WY 1950 - 2016	WY 2020	2012	X			X	X
B					X		X	X
C						X	X	X
D		WY 2040	General Plan (2040)	X			X	X
E					X		X	X
F						X	X	X

This effort was conducted to satisfy monitoring and analysis requirements in the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan). Construction, calibration, and analysis of predictive scenarios for the 2017 WLAM HSPF is summarized in the SAR WLAM Update Summary Report (Geoscience, 2020).

1.1 Purpose and Scope

The WLAM scenario runs indicated that the model-predicted maximum value for volume-weighted groundwater recharge would exceed Colton Groundwater Management Zone (GMZ) water quality objectives and ambient groundwater quality for TIN under 2020 and 2040 maximum projected discharge conditions (i.e., Scenarios A and D). Following completion of the model runs and summary report (dated June 19, 2020), proposed discharge for the Sterling Natural Resources Center (SNRC) has been moved

from City Creek (tributary to the SAR) to off-channel recharge basins. Therefore, the effect of this discharge, which was previously considered in the WLAM scenarios, on surface water recharge in downgradient Colton GMZ was brought into question – particularly whether proposed SNRC discharge significantly contributed to the predicted exceedances.

A preliminary assessment of the WLAM scenario model output files indicated that very little SNRC discharge reached the main stem of the SAR and was not the only cause of the predicted exceedances in Colton GMZ. Therefore, solely removing SNRC discharge to reflect the updated operating plan would likely not cause the model-predicted maximum value for volume-weighted groundwater recharge in Colton GMZ to meet water quality objectives under Scenario A and D conditions. Much of the predicted exceedance is estimated to come from other upstream discharges; in particular, the WLAM scenarios (conservatively) assume that Yucaipa Valley Water District (YVWD) discharges from the H.N. Wochholz Water Recycling Facility (WRF) at their permitted effluent TIN limit of 6.7 mg/L.

This report provides the results of supplemental WLAM scenarios to evaluate projected TIN concentrations of groundwater recharge in San Timoteo, Bunker Hill-B, and Colton GMZs under reduced effluent limits from YVWD and without the influence of SNRC discharge in City Creek. It is meant to serve as a supplemental report to the more comprehensive WLAM Summary Report (Geoscience, 2020). As such, the discussion, figures, tables, and appendices provided in this report include references to the associated item(s) from the Summary Report that the supplementary scenario results seek to replace.

2.0 Supplemental Model Scenarios

2.1 Scenario Assumptions

The six WLAM Scenarios (see Table 1-1) were rerun to reflect the following adjustments:

- SNRC discharges were removed from City Creek, and
- The TIN permit limit for YVWD H.N. Wochholz WRF was adjusted from 6.7 mg/L (existing maximum limit) to 5.5 mg/L for all scenarios.

For the purpose of the supplemental scenarios, the WLAM was only rerun in the San Timoteo, Bunker Hill-B, and Colton GMZs, as these are the main GMZs affected by changes in SNRC and YVWD discharge assumptions. Other scenario assumptions such as hydrology, land use, discharges to surface water from other sources, TDS discharge concentrations, surface water diversions, Orange County Water District (OCWD) operations at Prado Wetlands and below Prado Dam, and rising water remained the same as those outlined in Section 5.0 of the WLAM Summary Report.

2.1.1 Recycled Water Discharge to Surface Water

Recycled discharge point locations for the supplemental WLAM scenarios are shown on Figure 3. Anticipated discharge volumes and permit concentrations for the initial 2017 WLAM HSPF scenarios were submitted by the individual Publicly Owned Treatment Works (POTWs). Completed forms were provided in Appendix F of the WLAM Summary Report. A revised form for YVWD discharges from the H.N. Wochholz WRF reflecting assumptions for the supplemental WLAM scenarios is provided here as Appendix A. Discharge assumptions for the supplemental predictive model scenarios are also summarized in attached Table 1 for all POTWs and other discharge locations. In this table, changes made for the supplemental scenarios are highlighted in orange.

2.1.1.1 Streamflow

As shown in Table 1, discharge for the SNRC has been eliminated. Discharge flow assumptions for the other facilities and discharge points, including YVWD's H.N. Wochholz WRF, remain the same in the supplemental WLAM scenarios as the discharge volumes used for the original 2017 WLAM HSPF scenarios (see Section 5.3.1.2 in the WLAM Summary Report for additional description of these flows).

2.1.1.2 TDS/TIN

YVWD currently has a split limit in their permit for the H.N. Wochholz WRF. Per the permit language and Basin Plan, a TIN value of 6.7 mg/L represents the uppermost limit when demonstrating maximum benefit. However, YVWD does not discharge above 3.6 mg/L on average, which represents the limit that would apply if maximum discharge demonstrations are not made. Initial scenario results from the 2017 WLAM HSPF indicate that the upper limit of 6.7 mg/L for TIN is problematic at the maximum flow discharge scenario (i.e., Scenarios A and D). Accordingly, YVWD agreed to look at a lower limit of TIN for the supplemental WLAM scenarios. TDS concentrations for YVWD, as well as TDS and TIN concentrations for other dischargers, remained the same as previous scenario runs since the exceedance of water quality objectives in the affected GMZs were not anticipated, even with the additional TDS concentrations

assumed for YVWD and SNRC discharge (see Section 5.4.1.1 in the WLAM Summary Report for additional description of assumed concentrations).

The reduced TIN limit for YVWD was determined through iterative model runs. The maximum 2020 flow condition (i.e., Scenario A, which represents the worst-case scenario) was assessed for various YVWD TIN limits, starting at 6.0 mg/L. The limit was then iteratively adjusted downward until an optimal TIN limit is determined that provided compliance with Colton GMZ water quality objectives. Iterative model runs were performed with the YVWD TIN limit at 6.0 mg/L, 5.6 mg/L, and 5.5 mg/L. A TIN assumption of 5.5 mg/L for YVWD discharge provided model results that met Colton GMZ objectives for the 10-year flow-weighted average. Scenarios for the remaining flow conditions (i.e., Scenarios B through F) were then completed using this optimal TIN limit of 5.5 mg/L. The results of these supplemental scenarios, using the optimal TIN limit, are presented below.

2.2 Predictive Scenario Results

The 2017 WLAM HSPF was used for the supplemental scenario runs to generate daily estimates of discharge and TIN concentrations of water recharging the GMZs along San Timoteo Creek and the SAR in Bunker Hill-B and Colton GMZs over the entire predictive scenario simulation period. These daily estimates were used to compute monthly or annual volume-weighted average concentrations. For the supplemental scenarios, flow-weighted average TIN concentrations¹ were evaluated over various time periods, including 1-year, 5-year, 10-year, 20-year, and 67-year. Each of these time periods is useful for evaluating possible compliance, depending on the planning objective. Additional discussion of these time periods is provided in Section 6.0 of the WLAM Summary Report.

The maximum 1-year, 5-year, 10-year, and 20-year flow-weighted TIN averages from the supplemental model scenario runs are summarized in attached Table 2. To be consistent with the methodology used in previous WLAM reporting (WEI, 2015), annual model-calculated values from the end of the simulation period were “rolled over” to allow long-term averages to be calculated for each year of the model simulation. This was considered appropriate since the simulated hydrology is intended to represent a range of possible hydrological conditions – not a specific sequence.

Included in Table 2 are water quality objectives, current groundwater ambient quality, and the magnitude of assimilative capacity, if any, for each GMZ and surface water body affected by POTW discharge. Bold blue values represent concentrations above the ambient but below the objective and identify conditions where a potential use of assimilative capacity may occur. Bold red values represent concentrations above basin objectives. The results of supplemental Scenarios A through F are also fully documented for the San Timoteo, Bunker Hill-B, and Colton GMZs in Appendices B, C, and D, respectively (formerly Appendices H through J in the WLAM Summary Report). These appendices include time history charts, frequency distribution plots, and tables summarizing annual results for the supplemental predictive simulations.

The supplemental predictive scenario results, along with a description of the area over which each recharge and quality were computed, are summarized in the following sections for the GMZs affected by

¹ TDS discharge assumptions were not altered for the supplementary scenario runs and remain the same as those presented in the WLAM Summary Report (Geoscience, 2020).

the change in discharge assumptions (i.e., San Timoteo, Bunker Hill-B, and Colton GMZs). 2017 WLAM HSPF scenario results for TIN in other GMZs and surface water, as well as TDS, are provided in Section 6.0 of the WLAM Summary Report.

References to “current” TIN ambient groundwater quality are based on the volume-weighted average of well samples collected in the 20-year period from 1999 through 2018, representing the most recent ambient water quality update report (Tables 3-1 and 3-2 in WSC, 2020, which was approved by the California Regional Water Quality Control Board, Santa Ana Region (Regional Board) in 2021 through Resolution No. R8-2021-0020). Ambient water quality estimates are revised triennially; the next update will be published in 2023. It should be noted that the ambient water quality is computed based on water quality from selected wells throughout the GMZ – not just those areas under direct influence from the stream segments reported here.

2.2.1 San Timoteo Groundwater Management Zone (San Timoteo Creek Reaches 2, 3, & 4)

The 2004 Basin Plan amendment established both “antidegradation” and “maximum benefit” nitrogen and TDS objectives for San Timoteo GMZ. The TIN maximum benefit objective for the San Timoteo GMZ is 5.0 mg/L. An alternative TIN antidegradation objective of 2.7 mg/L may apply should the Regional Board find that maximum benefit is not demonstrated (see Table 2-1 below). Current ambient groundwater quality is 1.5 mg/L for TIN, assuming maximum benefit objectives, creating an assimilative capacity of 3.5 mg/L for TIN. POTW discharges that may affect groundwater quality in the San Timoteo GMZ includes those from YVWD H.N. Wochholz WRF, located within the GMZ, and upgradient Beaumont Wastewater Treatment Plant (WWTP) No. 1. Annual recharge from streambed percolation and water quality was calculated for Cooper's Creek and San Timoteo Creek Reaches 2, 3, and 4 overlying the San Timoteo GMZ (Figure B-1).

Table 2-1. Supplemental Predictive Scenario Results – San Timoteo GMZ (Cooper’s Creek and San Timoteo Creek Reaches 2, 3, & 4)

Constituent	Objective	Ambient	Assimilative Capacity	Averaging Period	MAXIMUM VALUE FOR THE VOLUME-WEIGHTED RECHARGE					
					2020 Conditions			2040 Conditions		
					Scen A (Max)	Scen B (Avg)*	Scen C (Min)	Scen D (Max)	Scen E (Avg)*	Scen F (Min)
					[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]
TIN	5.0 ¹ /2.7 ²	1.5 ³	3.5 ⁴	1-year	3.75	3.73	3.72	3.41	3.36	3.11
				5-year	3.58	3.55	3.52	2.94	2.89	2.70
				10-year	3.39	3.35	3.32	2.68	2.65	2.49
				20-year	3.38	3.33	3.28	2.68	2.64	2.47
				67-year	2.85	2.79	2.72	2.22	2.18	2.02
Average Annual Streambed Recharge [acre-ft/yr]					6,473	6,386	6,337	7,945	7,872	7,716

The results shown here for the supplemental scenarios supersede the TIN results presented in Table 6-2 of the WLAM Summary Report.

Note: Bold blue values represent concentrations above ambient groundwater quality, but below the maximum benefit objective

¹ "Maximum benefit" objectives apply unless the Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state

² "Antidegradation" objectives apply when the Regional Board determines that the lowering of water quality is not of maximum benefit to the people of the state

³ 2018 estimate of ambient water quality (WSC, 2020)

⁴ Based on maximum benefit objectives

*Represents most likely discharge conditions

As shown in Table 2 and in the graphs provided in Appendix B, the TIN concentrations under supplemental Scenario A through Scenario F conditions rise above ambient groundwater concentrations, but below maximum benefit objectives. The maximum 10-year volume weighted TIN average ranges from 2.5 mg/L under Scenario F conditions to 3.4 mg/L under Scenario A conditions. The increased TIN concentrations in water recharging San Timoteo GMZ is an “authorized degradation,” provided it continues to comply with the 5.0 mg/L objective in the Basin Plan. All TIN concentrations under supplemental Scenario A through Scenario F conditions are lower than original scenario runs in the WLAM Summary Report due to the reduced TIN assumptions for YVWD.

It is important to note that the 2017 WLAM HSPF does not currently take into account the effect of upgradient landfills, like the Riverside County Badlands Landfill. This is something that may be useful to investigate in subsequent WLAM updates. In addition, YVWD is currently investigating the removal of its effluent from San Timoteo Creek (i.e., zero discharge), and plans to reassess this possibility during the next WLAM update.

2.2.2 Bunker Hill-B Groundwater Management Zone (San Timoteo Creek Reach 1 and SAR Reach 5)

The TIN objective for the Bunker Hill-B GMZ is 7.3 mg/L, (see Table 2-2 below). Current ambient groundwater quality is 5.8 mg/L for TIN, creating an assimilative capacity of 1.5 mg/L. Annual recharge from streambed percolation and water quality was calculated for San Timoteo Creek Reach 1 overlying the Bunker Hill-B GMZ and SAR Reach 5 from the northernmost boundary of Bunker Hill-B to the San Jacinto Fault (coincident with the western boundary of the GMZ; Figure C-1). Since there are no POTW outfalls in San Timoteo Creek Reach 1, the water quality of recharge from the San Timoteo Creek in this GMZ is largely affected by upstream Reaches 2 and 3 (i.e., discharges from YVWD's Henry N. Wochholz WRF and the Beaumont WWTP). In prior WLAM scenario runs, other discharges that may have affected groundwater quality in the Bunker Hill-B GMZ included those from the proposed East Valley Water District (EVWD) SNRC. This discharge has been removed from the supplemental scenario runs presented here.

Table 2-2. Supplemental Predictive Scenario Results – Bunker Hill-B GMZ (San Timoteo Creek Reach 1 and SAR Reach 5)

Constituent	Objective	Ambient	Assimilative Capacity	Averaging Period	MAXIMUM VALUE FOR THE VOLUME-WEIGHTED RECHARGE					
					2020 Conditions			2040 Conditions		
					Scen A (Max)	Scen B (Avg)*	Scen C (Min)	Scen D (Max)	Scen E (Avg)*	Scen F (Min)
					[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]
TIN	7.3	5.8 ¹	1.5	1-year	3.32	3.09	2.83	3.10	3.02	2.76
				5-year	2.84	2.56	2.34	2.57	2.49	2.24
				10-year	2.76	2.48	2.24	2.52	2.43	2.16
				20-year	2.67	2.39	2.17	2.44	2.35	2.10
				67-year	2.45	2.18	1.92	2.27	2.19	1.93
Average Annual Streambed Recharge [acre-ft/yr]					17,209	15,079	13,110	19,816	19,079	17,105

The results shown here for the supplemental scenarios supersede the TIN results presented in Table 6-3 of the WLAM Summary Report.

¹ 2018 estimate of ambient water quality (WSC, 2020)

*Represents most likely discharge conditions

As shown in Table 2 and in the graphs provided in Appendix C, the TIN concentrations under supplemental Scenario A through Scenario F conditions do not exceed the TIN objectives for Bunker Hill-B GMZ. The maximum 10-year volume-weighted TIN average ranges from 2.2 mg/L under Scenario F conditions to 2.8 mg/L under Scenario A conditions. All TIN concentrations under supplemental Scenario A through Scenario F conditions are lower than original scenario runs in the WLAM Summary Report due to the reduced TIN assumptions for YVWD. Average annual streambed recharge under supplemental Scenario A through Scenario F conditions is lower than that predicted by the original scenarios because discharge for the SNRC was eliminated in the supplemental runs.

2.2.3 Colton Groundwater Management Zone (SAR Reach 4)

The TIN objective for the Colton GMZ is 2.7 mg/L. Current ambient groundwater quality is 3.3 mg/L for TIN, meaning that no assimilative capacity exists (see Table 2-3 below). Annual recharge from streambed percolation and water quality was calculated for the SAR Reach 4 overlying the Colton GMZ (Figure D-1). Since there are no POTW discharges in the Colton GMZ, this area is primarily affected by upgradient discharges.

Table 2-3. Supplemental Predictive Scenario Results – Colton GMZ (SAR Reach 4)

Constituent	Objective	Ambient	Assimilative Capacity	Averaging Period	MAXIMUM VALUE FOR THE VOLUME-WEIGHTED RECHARGE					
					2020 Conditions			2040 Conditions		
					Scen A (Max)	Scen B (Avg)*	Scen C (Min)	Scen D (Max)	Scen E (Avg)*	Scen F (Min)
					[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]	[mg/L]
TIN	2.7	3.3 ¹	none	1-year	3.45	2.34	2.31	3.11	3.06	2.23
				5-year	2.83	1.90	1.82	2.62	2.47	1.82
				10-year	2.70	1.86	1.65	2.53	2.37	1.78
				20-year	2.63	1.76	1.57	2.50	2.36	1.69
				67-year	2.39	1.58	1.39	2.30	2.16	1.52
Average Annual Streambed Recharge [acre-ft/yr]					2,657	2,125	2,003	3,179	2,942	2,409

The results shown here for the supplemental scenarios supersede the TIN results presented in Table 6-4 of the WLAM Summary Report.

Note: Bold red values represent concentrations above the basin objective

¹ 2018 estimate of ambient water quality (WSC, 2020)

*Represents most likely discharge conditions

As shown in Table 2 and in the graphs provided in Appendix D, the TIN concentrations under supplemental Scenario A through Scenario F exceed TIN objectives under Scenario A, Scenario D, and Scenario E conditions for the maximum 1-year volume-weighted average. The 10-year volume-weighted TIN average ranges from 1.7 mg/L under Scenario C conditions to 2.7 mg/L under Scenario A conditions. All TIN concentrations under supplemental Scenario A through Scenario F conditions are lower than original scenario runs in the WLAM Summary Report due to the reduced TIN assumptions for YVWD. The 10-year volume-weighted TIN average under supplemental Scenario A through Scenario F conditions do not exceed the TIN objectives for Colton GMZ. Average annual streambed recharge under supplemental Scenario A through Scenario F conditions is lower than that predicted by the original scenarios because discharge for the SNRC was eliminated in the supplemental runs .

3.0 2017 WLAM HSPF Retrospective Model Run

The calibrated 2017 WLAM HSPF was also run using historical daily precipitation data and historical discharge data to estimate the volume and quality of recharged water for the period from WY 2005 through 2016. This run is referred to as the retrospective model run and is an indication of recharge that occurred based on reported precipitation, discharges, diversions, and model calibration to observed streamflow and water quality. Results of these runs are provided in Section 8.0 of the WLAM Summary Report and were shown in comparison to the model-calculated projections from the 2020 scenario runs (Scenarios A through C). The 2020 scenario runs were made using the same land use conditions for which the 2017 WLAM HSPF was calibrated (2012 land use), thereby making these predictive scenarios more comparable than the 2040 scenarios.

For the purpose of this supplemental report, updated TIN results for supplemental Scenarios A through C are shown in comparison to results from the retrospective model run in Table 3 and Appendix E, even though results of the retrospective model runs remain the same as those presented in the WLAM Summary Report. Discussion regarding YVWD discharges in San Timoteo GMZ in the context of the supplemental scenario runs is also provided below.

3.1.1 San Timoteo Groundwater Management Zone (San Timoteo Creek Reaches 2, 3, & 4)

The retrospective model run for recharge in San Timoteo GMZ showed the maximum 1-year volume-weighted average TIN of streambed recharge exceeded water quality objectives:

Table 3-1. Retrospective Model Run Results – San Timoteo GMZ (Cooper’s Creek and San Timoteo Creek Reaches 2, 3, & 4)

Constituent	Objective	Ambient	Assimilative Capacity	Averaging Period	MAXIMUM VALUE FOR THE VOLUME-WEIGHTED RECHARGE
	[mg/L]	[mg/L]	[mg/L]		[mg/L]
TIN	5.0 ¹ /2.7 ²	1.5 ³	3.5 ⁴	1-year	6.09
				5-year	4.09
				10-year	3.45
				12-year	3.13

The results shown here are the same as those presented in Table 8-3 of the WLAM Summary Report.

Note: Bold blue values represent concentrations above ambient groundwater quality, but below the maximum benefit objective. Bold red values represent concentrations above the basin objective.

¹ “Maximum benefit” objectives apply unless the Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state

² “Antidegradation” objectives apply when the Regional Board determines that the lowering of water quality is not of maximum benefit to the people of the state

³ 2018 estimate of ambient water quality (WSC, 2020)

⁴ Based on maximum benefit objectives

As with the predictive scenario runs, TIN exceedances of the ambient concentration for the 5-year and 10-year volume-weighted average represents “authorized degradation” in accordance with the maximum benefit demonstration previously authorized by the Regional Board.

YVWD H.N. Wochholz WRF had an average discharge of 3.6 MGD during the 12-year retrospective run period from WY 2005 through 2016, which is similar to the Scenario B most likely discharge of 3.8 MGD. Volume-weighted annual TIN concentration in streambed recharge is largely affected by TIN concentrations from YVWD discharge. Exceptionally high TIN was observed in YVWD discharge during WY 2005, 2006, and 2008 (from 2008 WLAM and SAWPA database), as shown in the following table. In other years when observed TIN concentrations for YVWD discharge are lower than permit TIN concentrations used for the predictive scenarios, model-calculated TIN concentrations in streambed recharge for the retrospective run are lower than those projected under similar discharge conditions (supplemental Scenario B). The higher TIN concentration in streambed recharge for the retrospective run during WY 2016 is due to the higher observed TIN concentrations in discharge from the upgradient Beaumont WWTP No. 1 (see Section 8.1.1 of the WLAM Summary Report).

Table 3-2. Observed TIN Concentrations for YVWD H.N. Wochholz WRP Discharge (WY 2005, 2006, and 2008)

Sample Date / Model Input Period	TIN, mg/L
Oct-04	9.6
Nov-04	6.9
Dec-04	11.8
Jan-05	14.65
Feb-05	14.08
Mar-05	13.26
Apr-05	9.65
May-05	11.35
Jun-05	12.44
Jul-05	8.45
Aug-05	9.36
Sep-05	10.33
Oct-05	8.63
Nov-05	8.63
Dec-05	8.63
Jan-06	16.85
Feb-06	16.25
Mar-06	18.88
Apr-06	15.93
May-06	17.56
Jun-06	16.38
Jul-06	15.73
Aug-06	16.98
Sep-06	19.35
1/3/2008	14.4
1/17/2008	16.3
1/30/2008	23.4
2/14/2008	23.8
2/28/2008	25.2
3/5/2008	26.7
3/13/2008	29
3/27/2008	26.3
4/3/2008	24.8
4/24/2008	27.2
5/8/2008	16
5/21/2008	19.7
6/5/2008	23
6/18/2008	13.5

Sample Date / Model Input Period	TIN, mg/L
7/2/2008	25.2
7/17/2008	26.1
7/31/2008	27
8/14/2008	8.4
8/28/2008	8.9
9/11/2008	3.5
9/25/2008	11.1

Source of monthly data prior to WY 2007: 2008 WLAM input (WEI, 2009)

Source of data after WY 2006: SAWPA database

It is important to note that while the data accurately represent historical water quality at YVWD, it is not representative of current TIN effluent concentrations. Recent 12-month volume-weighted average TIN concentrations in discharge from the H.N. Wochholz WRF, from June 2020 through May 2021, is 3.6 mg/L (see Appendix A), which is well below the assumed TIN concentration of 5.5 mg/L used for the supplemental WLAM scenarios.

4.0 Summary

Due to exceedances of WLAM model-predicted maximum values for volume-weighted TIN concentrations in streambed recharge for Colton GMZ, supplemental scenarios were run to evaluate projected TIN concentrations of groundwater recharge in San Timoteo, Bunker Hill-B, and Colton GMZs under reduced TIN effluent limits from YVWD and without the influence of SNRC discharge, which is no longer planned to occur in City Creek. An optimal TIN limit for YVWD discharge was determined through iterative model runs and was found to be 5.5 mg/L.

In general, the supplemental predictive model scenarios show:

- In the San Timoteo GMZ, TIN concentrations under supplemental Scenario A through Scenario F conditions rise above ambient groundwater concentrations, but below basin objectives, under all averaging periods. All TIN concentrations under supplemental Scenario A through Scenario F conditions are lower than original scenario runs in the WLAM Summary Report due to the reduced TIN assumptions for YVWD.
- TIN concentrations under supplemental Scenario A through Scenario F conditions do not exceed the TIN objectives or ambient for Bunker Hill-B GMZ. All TIN concentrations under supplemental Scenario A through Scenario F conditions are lower than original scenario runs in the WLAM Summary Report due to the reduced TIN assumptions for YVWD. Average annual streambed recharge under supplemental Scenario A through Scenario F conditions is also lower because discharge for the SNRC was eliminated.
- The 10-year volume-weighted TIN average under supplemental Scenario A through Scenario F conditions do not exceed the TIN objectives for Colton GMZ. Average annual streambed recharge under supplemental Scenario A through Scenario F conditions is lower than original scenario runs because discharge for the SNRC was eliminated.

The complete summary tables from the 2017 WLAM Summary Report (Geoscience, 2020), including all GMZs, wetlands, and surface water analyzed by the WLAM, are provided here for reference as Tables 4 and 5 for TDS and TIN, respectively. Table 4 (TDS) is a reproduction of Table 24 from the Summary Report – no changes were made to TDS results during the Supplemental Scenario Runs. Table 5 (TIN) includes the updated results from the Supplemental Scenarios for San Timoteo, Bunker Hill-B, and Colton GMZs.

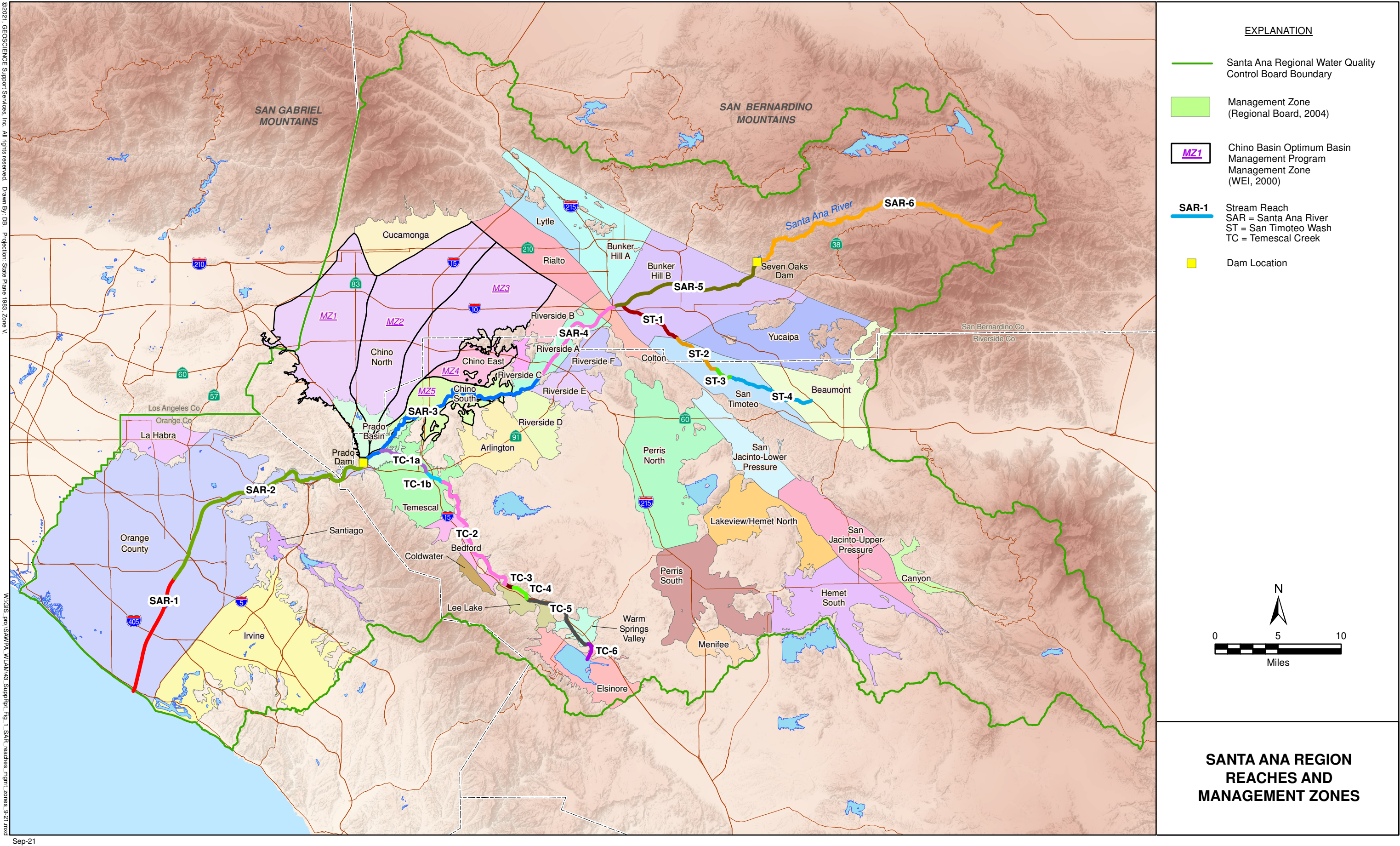
5.0 References

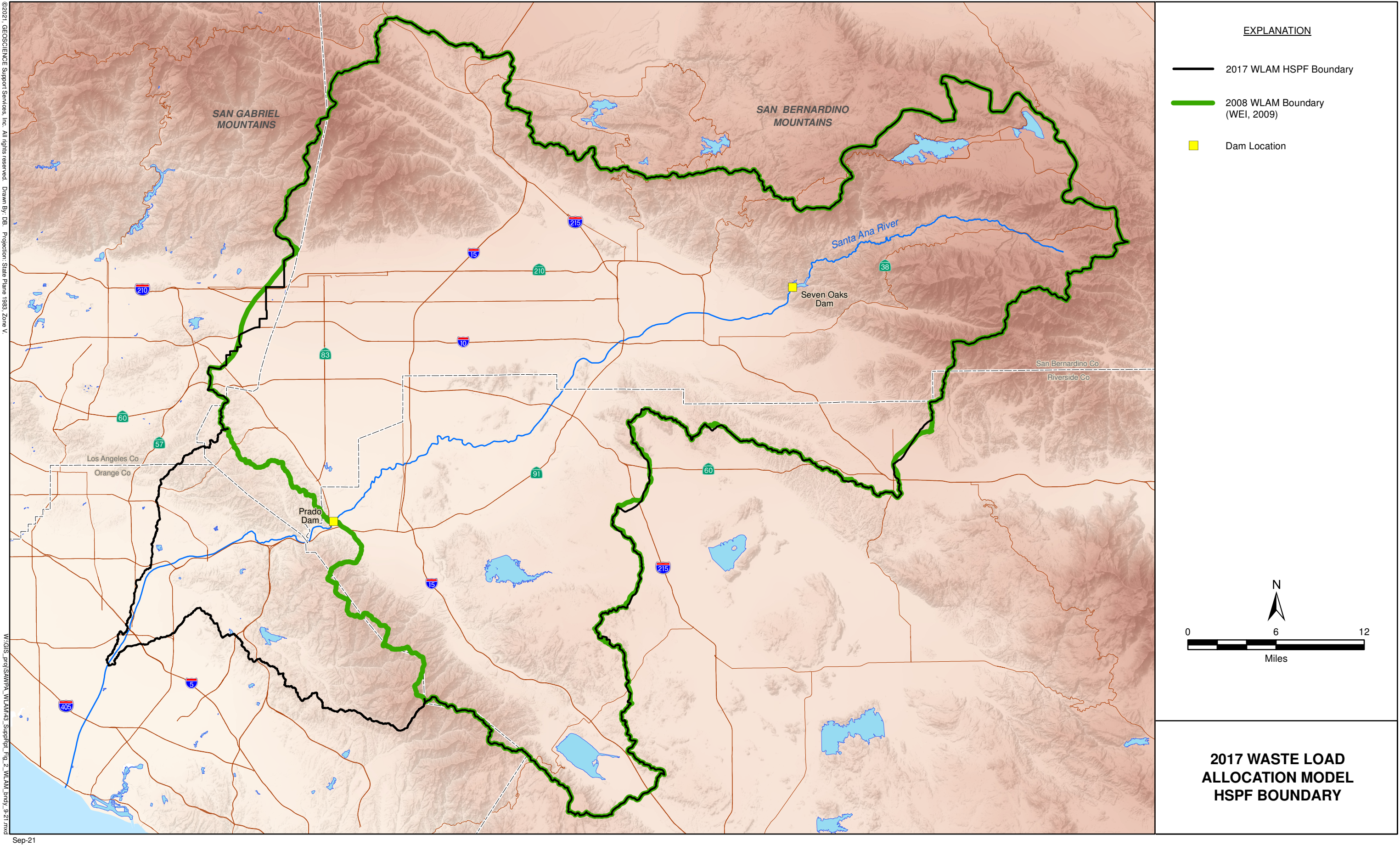
- Geoscience (Geoscience Support Services, Inc.), 2020. Santa Ana River Waste Load Allocation Model Update – Summary Report. Prepared for the Santa Ana Watershed Project Authority Basin Monitoring Program Task Force, dated June 19, 2020.
- Regional Board (California Regional Water Quality Control Board, Santa Ana Region), 2021. Consideration of Acceptance of the 2018 TDS and Nitrate-Nitrogen Ambient Water Quality Determinations for Groundwater Management Zones in the Santa Ana Region – Resolution No. R8-2021-0020. Dated March 12, 2021.
- WEI (Wildermuth Environmental, Inc.), 2009. 2008 Santa Ana River Wasteload Allocation Model Report – 2004 Basin Plan Amendment Required Monitoring and Analyses. Prepared for the Basin Monitoring Program Task Force. Dated May 2009.
- WEI, 2015. Addendum to the 2008 Santa Ana River Wasteload Allocation Model Report: Scenario 8. Dated January 5, 2015.
- WSC (Water Systems Consulting, Inc.), 2020. Recomputation of Ambient Water Quality for the Period 1999 to 2018 in the Santa Ana River Watershed. Prepared for Santa Ana Watershed Project Authority Basin Monitoring Program Task Force, dated July 8, 2020.

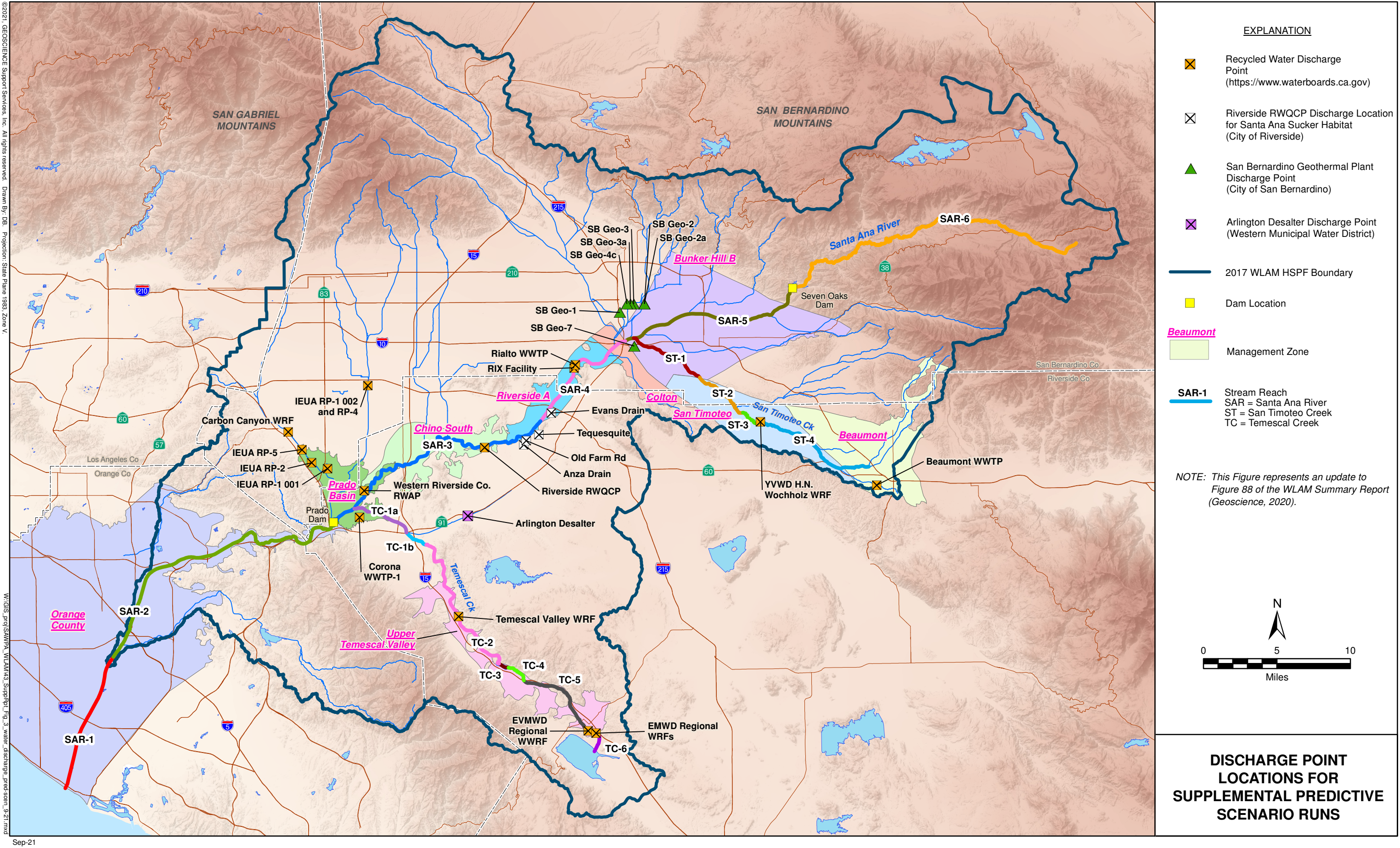
FIGURES

GEOSCIENCE

The logo graphic consists of a horizontal line with a downward-pointing curve or 'V' shape centered beneath it.







TABLES

POTW Discharge Assumptions for Supplemental Predictive Model Scenarios

Agency	Facility / Discharge Point	Current Design Capacity	2020 Design Capacity	2040 Design Capacity	Hydrologic Year	Scenario A 2012 Land Use			Scenario B 2012 Land Use			Scenario C 2012 Land Use			Scenario D General Plan (2040) Land Use			Scenario E General Plan (2040) Land Use			Scenario F General Plan (2040) Land Use		
						2020 Maximum Expected Discharge [MGD]	Permit TDS [mg/L]	Permit TIN [mg/L]	2020 Most Likely Discharge [MGD]	Permit TDS [mg/L]	Permit TIN [mg/L]	2020 Minimum Expected Discharge [MGD]	Permit TDS [mg/L]	Permit TIN [mg/L]	2040 Maximum Expected Discharge [MGD]	Permit TDS [mg/L]	Permit TIN [mg/L]	2040 Most Likely Discharge [MGD]	Permit TDS [mg/L]	Permit TIN [mg/L]	2040 Minimum Expected Discharge [MGD]	Permit TDS [mg/L]	Permit TIN [mg/L]
San Timoteo Creek																							
City of Beaumont	Beaumont Wastewater Treatment Plant (WWTP)	4	6	8	1950-2016	3.8	400 / 300 ^A	6 / 3.6 ^A	3.5	400 / 300 ^A	6 / 3.6 ^A	3.2	400 / 300 ^A	6 / 3.6 ^A	6.3	400 / 300 ^A	6 / 3.6 ^A	6.1	400 / 300 ^A	6 / 3.6 ^A	5.9	400 / 300 ^A	6 / 3.6 ^A
Yucaipa Valley Water District	H.N. Wochholz Water Recycling Facility	8	-	-	1950-2016	8.0	400	5.5 ^B	3.8	400	5.5 ^B	1.6	400	5.5 ^B	8.0	400	5.5 ^B	6.0	400	5.5 ^B	1.6	400	5.5 ^B
City Creek																							
East Valley Water District	Sterling Natural Resource Center (SNRC) ^C	0	8.0	10.0	1950-2016	0.0	500	6.0	0.0	500	6.0	0.0	500	6.0	0.0	500	6.0	0.0	500	6.0	0.0	500	6.0
East Twin and Warm Creek																							
City of San Bernardino	San Bernardino Geothermal Plant	-	-	-	1950-2016	1.0 ^D	264 ^D	0.7 ^D	1.0 ^D	264 ^D	0.7 ^D	1.0 ^D	264 ^D	0.7 ^D	1.0 ^D	264 ^D	0.7 ^D	1.0 ^D	264 ^D	0.7 ^D	1.0 ^D	264 ^D	0.7 ^D
Santa Ana River Reach 4																							
City of Rialto	Rialto WWTP	11.7	-	-	1950-2016	7.2	490	10.0	6.4	490	10.0	5.8	490	10.0	18.0	490	10.0	11.7	490	10.0	5.0	490	10.0
Colton/San Bernardino	Rapid Infiltration and Extraction (RIX) Facility	40	40	40	1950-2016	34.5	550	10.0	17.8	550	10.0	16.9	550	10.0	30.1	550	10.0	18.4	550	10.0	17.3	550	10.0
Santa Ana River Reach 3																							
City of Riverside	Riverside Regional Water Quality Control Plant (RWQCP)	46	46	46	1950-2016	33.8	650	10.0	25.0	650	10.0	18.1 ^E	650	10.0	46.0	650	10.0	22.5 ^F	650	10.0	18.1 ^E	650	10.0
City of Corona	Corona WWTP-1	11.5	-	-	1950-2016	11.5	700 ^G	10.0	4.6	700 ^G	10.0	1.5	700 ^G	10.0	15.0	700 ^G	10.0	8.5	700 ^G	10.0	1.5	700 ^G	10.0
Chino Creek / Cucamonga Creek / Prado Basin																							
Inland Empire Utilities Agency	Regional Plant (RP) 1 - DP 001	44	44	44	1950-2016	44.0	550	8.0	1.4 ^H	550	8.0	0.0	550	8.0	44.0	550	8.0	1.4 ^H	550	8.0	0.0	550	8.0
	RP 1 - DP 002 and RP 4	14	14	21	1950-2016	14.0	550	8.0	8.1 ^H	550	8.0	0.2	550	8.0	21.0	550	8.0	8.1 ^H	550	8.0	0.2	550	8.0
	RP-5	15	15	30	1950-2016	15.0	550	8.0	2.5 ^H	550	8.0	0.0	550	8.0	30.0	550	8.0	2.5 ^H	550	8.0	0.0	550	8.0
	Carbon Canyon Water Recycling Facility	12	12	12	1950-2016	12.0	550	8.0	3.2 ^H	550	8.0	0.3	550	8.0	12.0	550	8.0	3.2 ^H	550	8.0	0.3	550	8.0
Western Municipal Water District	Western Riverside County Regional Wastewater Authority Plant (WRCRWA)	14	14	14	1950-2016	12.0	625	10.0	9.0	625	10.0	7.5	625	10.0	15.3	625	10.0	12.5	625	10.0	10.5	625	10.0

POTW Discharge Assumptions for Supplemental Predictive Model Scenarios

Agency	Facility / Discharge Point	Current Design Capacity	2020 Design Capacity	2040 Design Capacity	Hydrologic Year	Scenario A 2012 Land Use			Scenario B 2012 Land Use			Scenario C 2012 Land Use			Scenario D General Plan (2040) Land Use			Scenario E General Plan (2040) Land Use			Scenario F General Plan (2040) Land Use		
						2020 Maximum Expected Discharge	Permit TDS	Permit TIN	2020 Most Likely Discharge	Permit TDS	Permit TIN	2020 Minimum Expected Discharge	Permit TDS	Permit TIN	2040 Maximum Expected Discharge	Permit TDS	Permit TIN	2040 Most Likely Discharge	Permit TDS	Permit TIN	2040 Minimum Expected Discharge	Permit TDS	Permit TIN
						[MGD]	[mg/L]	[mg/L]	[MGD]	[mg/L]	[mg/L]	[MGD]	[mg/L]	[mg/L]	[MGD]	[mg/L]	[mg/L]	[MGD]	[mg/L]	[mg/L]	[MGD]	[mg/L]	[mg/L]
Temescal Creek																							
Temescal Valley Water District	Temescal Valley WRF	1.57	-	-	1950-2016	2.3	650	10.0	1.2	650	10.0	1.0	650	10.0	2.3	650	10.0	2.3	650	10.0	1.9	650	10.0
Elsinore Valley Municipal Water District	Regional WWRF - DP001 (Temescal Wash)	8	12	-	1950-2016	8.0 ^I	700	10.0	0.5	700	10.0	0.5	700	10.0	12.0 ^I	700	10.0	0.5	700	10.0	0.5	700	10.0
Eastern Municipal Water District	EMWD Regional WRFs	69	-	-	1950-2016	0.0 / 52.5 ^J	650 ^K	10.0	0.0 / 52.5 ^L	650 ^K	10.0	0.0	650 ^K	10.0	0.0 / 52.5 ^J	650 ^K	10.0	0.0 / 52.5 ^L	650 ^K	10.0	0.0	650 ^K	10.0
Western Municipal Water District	Arlington Desalter ^M	6.9	7.25	-	1950-2016	7.25	260 ^D	4.4 ^D	6.3 ^N	260 ^D	4.4 ^D	0.0	260 ^D	4.4 ^D	7.25	260 ^D	4.4 ^D	6.3 ^N	260 ^D	4.4 ^D	0.0	260 ^D	4.4 ^D

Note: Orange highlighted cells indicate changes made to assumptions for the supplemental scenarios, compared to those presented in Table 20 of the WLAM Summary Report (Geoscience, 2020)

A. Discharge requirements on the initial 1.8 MGD of flow have higher allowable TDS and TIN concentrations (400 mg/L and 6 mg/L, respectively) than any additional flow (300 mg/L for TDS and 3.6 mg/L for TIN).

B. The reduced TIN limit for YVWD in the supplemental scenarios was determined through iterative model runs.

C. SNRC discharge was removed from City Creek (tributary of SAR) in the supplemental scenarios. Future discharge is anticipated to occur in off-channel recharge basins.

D. No discharge projection form (Appendix F in WLAM Summary Report) was provided. Discharge assumptions were based on average of last 5 years (WY 2012-2016)

E. A portion of the plant's discharge will be piped to upstream tributary locations to provide Santa Ana Sucker habitat as part of a regional project with Valley District and the Upper SAR HCP. Discharge quantities and locations are described below. Supplemental discharges to Riverside-A have not yet been permitted.

* Plant Discharge: 13.7 MGD

* Anza Drain (33.966, -117.415): 0.6 MGD

* Old Farm Rd (33.970, -117.412): 1.3 MGD

* Tequesquite (33.976, -117.397): 0.6 MGD

* Evans Drain (33.997, -117.382): 1.9 MGD

F. Anza Drain, Old Farm Rd, Tequesquite, and Evans Drain discharges are the same as in Note E. Plant discharge is 18.1 MGD.

G. A TDS concentration of 665 mg/L was applied in wetter months (December through April) while a concentration of 725 mg/L was applied in drier months (May through November). The average TDS concentration is 700 mg/L.

H. Average monthly discharge rate. Discharge was varied monthly according to IEUA/Chino Basin Watermaster projections (see Exhibit 1 in Appendix F of WLAM Summary Report)

I. EVMWD's current permit allows discharge of up to 8.0 MGD to Lake Elsinore and/or Temescal Creek. Design capacity in 2040 is anticipated to be 12 MGD. Since the maximum and minimum discharge values provide sufficient bookends for discharge conditions, no spills from Lake Elsinore were considered.

J. Discharge of 52.5 MGD was only applied in February for all years and from November through April (6 months) during the wettest half of the years (34 years of the 67-year simulation period) based on precipitation at Elsinore Station 67.

K. EMWD seeks to rerun the model at 700 mg/L TDS.

L. Discharge of 52.5 MGD was only applied in February (1 month).

M. No discharge projection form (Appendix F of WLAM Summary Report) was provided. Discharge assumptions were developed through conversations with Western. Currently, there are no planned discharges from the Arlington Desalter to the SAR. Discharge is included here based on permitted discharge and possible future operations.

N. Discharge of 6.3 MGD was only applied from November through April.

Summary of TIN Model Results for Supplemental Scenarios A - F											
Reach	Underlying Management Zone	TIN Objective (mg/L)	Ambient NO ₃ -N (mg/L)	Assimilative Capacity (mg/L)	Averaging Period	Supplemental Scenario A	Supplemental Scenario B	Supplemental Scenario C	Supplemental Scenario D	Supplemental Scenario E	Scenario F
						2020 Maximum Expected Discharge	2020 Most Likely Discharge	2020 Minimum Expected Discharge	2040 Maximum Expected Discharge	2040 Most Likely Discharge	2040 Minimum Expected Discharge
Groundwater					Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology (mg/L)						
Cooper's Creek; San Timoteo Creek - Reach 2, 3 and 4	San Timoteo	5.0 ¹ /2.7 ²	1.5 ³	3.5 ⁴	1-year	3.75	3.73	3.72	3.41	3.36	3.11
					5-year	3.58	3.55	3.52	2.94	2.89	2.70
					10-year	3.39	3.35	3.32	2.68	2.65	2.49
					20-year	3.38	3.33	3.28	2.68	2.64	2.47
San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5	Bunker Hill-B	7.3	5.8 ³	1.5	1-year	3.32	3.09	2.83	3.10	3.02	2.76
					5-year	2.84	2.56	2.34	2.57	2.49	2.24
					10-year	2.76	2.48	2.24	2.52	2.43	2.16
					20-year	2.67	2.39	2.17	2.44	2.35	2.10
Santa Ana River - Reach 4	Colton	2.7	3.3 ³	none	1-year	3.45	2.34	2.31	3.11	3.06	2.23
					5-year	2.83	1.90	1.82	2.62	2.47	1.82
					10-year	2.70	1.86	1.65	2.53	2.37	1.78
					20-year	2.63	1.76	1.57	2.50	2.36	1.69

Notes

The results shown here for the supplemental scenarios supersede the TIN results presented in Table 25 of the WLAM Summary Report (Geoscience, 2020)

Bold black values represent concentrations above ambient groundwater quality, but below objective. Bold red values represent concentrations above basin objective

¹ "Maximum benefit" objectives apply unless the Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state

² "Antidegradation" objectives apply when the Regional Board determines that the lowering of water quality is not of maximum benefit to the people of the state

³ 2018 estimate of ambient water quality (WSC, 2020)

⁴ Based on maximum benefit objectives

Summary of TIN Model Results for Supplemental Scenarios A - C and Retrospective Model Run									
Reach	Underlying Management Zone	TIN Objective (mg/L)	Ambient NO ₃ -N (mg/L)	Assimilative Capacity (mg/L)	Averaging Period	Supplemental Scenario A	Supplemental Scenario B	Supplemental Scenario C	Retrospective Model Run WY 2005 - 2016
						2020 Maximum Expected Discharge	2020 Most Likely Discharge	2020 Minimum Expected Discharge	
Groundwater					Maximum Value for the Volume-Weighted Recharge for the Simulation Period Hydrology (mg/L)				
Cooper's Creek; San Timoteo Creek - Reach 2, 3 and 4	San Timoteo	5.0 ¹ /2.7 ²	1.5 ³	3.5 ⁴	1-year	3.75	3.73	3.72	6.09
					5-year	3.58	3.55	3.52	4.09
					10-year	3.39	3.35	3.32	3.45
					20-year	3.38	3.33	3.28	na
San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5	Bunker Hill-B	7.3	5.8 ³	1.5	1-year	3.32	3.09	2.83	2.41
					5-year	2.84	2.56	2.34	2.04
					10-year	2.76	2.48	2.24	1.91
					20-year	2.67	2.39	2.17	na
Santa Ana River - Reach 4	Colton	2.7	3.3 ³	none	1-year	3.45	2.34	2.31	1.92
					5-year	2.83	1.90	1.82	1.72
					10-year	2.70	1.86	1.65	1.62
					20-year	2.63	1.76	1.57	na

Notes

The results shown here for the supplemental scenarios supersede the TIN results presented in Table 32 of the WLAM Summary Report (Geoscience, 2020)

Bold black values represent concentrations above ambient groundwater quality, but below objective. Bold red values represent concentrations above basin objective

¹ "Maximum benefit" objectives apply unless the Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state

² "Antidegradation" objectives apply when the Regional Board determines that the lowering of water quality is not of maximum benefit to the people of the state

³ 2015 estimate of ambient water quality (DBSA, 2017)

⁴ Based on maximum benefit objectives

Summary of TDS Model Results for Scenarios A - F											
Reach	Underlying Management Zone	TDS Objective (mg/L)	Ambient TDS (mg/L)	Assimilative Capacity (mg/L)	Averaging Period	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
						2020 Maximum Expected Discharge	2020 Most Likely Discharge	2020 Minimum Expected Discharge	2040 Maximum Expected Discharge	2040 Most Likely Discharge	2040 Minimum Expected Discharge
Groundwater					Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology (mg/L)						
Noble Creek; unnamed tributary to Marshall Creek below Beaumont DP 007; Cooper's Creek; San Timoteo Creek - Reach 4	Beaumont	330 ¹ /230 ²	280 ³	50 ⁴	1-year	255	257	259	228	228	228
					5-year	226	227	228	208	208	208
					10-year	218	220	221	204	204	204
					20-year	217	218	219	203	203	203
Cooper's Creek; San Timoteo Creek - Reach 2, 3 and 4	San Timoteo	400 ¹ /300 ²	420 ³	none	1-year	372	369	369	349	346	329
					5-year	356	353	353	307	304	288
					10-year	338	335	334	281	278	266
					20-year	338	335	332	280	277	266
San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5	Bunker Hill-B	330	280 ³	50	1-year	329	295	239	311	302	267
					5-year	300	261	226	277	266	230
					10-year	287	250	221	265	254	226
					20-year	277	245	216	257	247	220
Santa Ana River - Reach 4	Colton	410	490 ³	none	1-year	399	307	260	346	356	293
					5-year	340	250	221	307	300	237
					10-year	317	246	217	290	281	233
					20-year	305	237	211	282	275	225
Santa Ana River - Reach 4 ⁵	Riverside-A	560	430 ³	130	1-year	511	488	486	492	478	472
					5-year	487	454	450	467	447	433
					10-year	477	441	437	457	434	418
					20-year	472	435	431	452	428	411
Santa Ana River - Reach 3	Chino-South	680	920 ³	none	1-year	629	644	646	599	618	624
					5-year	497	506	509	461	461	464
					10-year	458	466	468	417	419	422
					20-year	457	465	466	415	418	420
Temescal Creek - Reach 2,3, 4, 5 and 6	Upper Temescal Valley ⁶	820 ⁷	750 ⁸	70	1-year	676	584	544	662	560	509
					5-year	662	537	469	645	502	445
					10-year	658	519	442	638	481	419
					20-year	654	514	430	631	472	405
Santa Ana River - Reach 2	Orange County	580	600 ³	none	1-year	603	681	734	589	684	728
					5-year	568	649	690	547	645	677
					10-year	529	609	629	510	593	607
					20-year	525	604	623	504	591	603
Wetlands					Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology (mg/L)						
Santa Ana River - Reach 3 above River Rd	Prado Basin ⁹	na	na ¹⁰	na	1-year	652	662	666	636	650	654
					5-year	637	646	649	622	635	638
					10-year	630	638	640	616	627	629
					20-year	621	629	630	607	617	619
Surface Water					Maximum Value for the Volume-Weighted Stream Concentration for the Planning Period Hydrology (mg/L)						
Santa Ana River Reach 3 Below Prado Dam	na	700	na	na ¹¹	Baseflow Average ¹²	621	733	774	618	730	761
Santa Ana River Reach 2 Below Prado Dam	na	650 ¹³	na	na ¹¹	5-year moving average of the 1-year volume-weighted average	525	485	445	521	464	416
Santa Ana River Reach 2 at Santa Ana	na	650 ¹³	na	na ¹¹	5-year moving average of the 1-year volume-weighted average	331	197	146	395	161	135

Notes

This table is a reproduction of Table 24 from the 2017 WLAM Summary Report (Geoscience, 2020). No changes were made to TDS results from the Supplemental WLAM Scenarios.

Bold black values represent concentrations above ambient groundwater quality, but below objective. Bold red values represent concentrations above basin objective

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² "Antidegradation" objectives apply when the Regional Board determines that the lowering of water quality is not of maximum benefit to the people of the state

³ 2018 estimate of ambient water quality (WSC, 2020)

⁴ Based on maximum benefit objectives

⁵ Due to rising water conditions, no streambed recharge occurs in SAR Reach 3 overlying Riverside-A GMZ.

⁶ Proposed Upper Temescal Valley GMZ includes Bedford GMZ, Lee Lake GMZ, Warm Springs Valley GMZ

⁷ Proposed TDS objective from June 2018 CEQA Scoping Meeting

⁸ Based on Salt and Nutrient Management Plan for the Upper Temescal Valley, Table 6-B (WEI, 2017)

⁹ Streambed recharge in Prado Basin Management Zone only occurs above River Rd. This recharge is assumed to be temporary and become rising water farther downstream. Prado Basin Management Zone does not have its own set of water quality objectives, although the objectives of the streams that flow into the Prado Basin Management Zone (presented in the Prado Basin Surface Water Management Zone Section of the 2016 Water Quality Control Plan (Basin Plan) for the Santa Ana River Basin, pg. 4-29) continue to apply. For the purposes of this investigation, no objectives were evaluated for Prado Basin Management Zone. Note: SAR Reach 3 TDS/TIN objectives are identified in the Basin Plan as “baseflow” objectives. According to the 1983 Basin Plan, compliance with these objectives should be assessed without the influence of stormflow events. Model-calculated maximum volume-weighted recharge concentrations for Prado Basin do not represent baseflow conditions. Baseflow Average concentrations for Reach 3, without the influence of storm events, are presented for surface water flow at the Santa Ana River Below Prado Dam.

¹⁰ No Prado Basin ambient TDS was computed after 1997

¹¹ Currently, the Regional Board does not recognize the existence of assimilative capacity for TDS in surface water

¹² SAR Reach 3 TDS/TIN objectives are identified in the Basin Plan as “baseflow” objectives. Model-calculated maximum volume-weighted stream concentrations for Reach 3 in August and September, without the influence of storm events, are used to represent baseflow conditions.

¹³ 5-year moving average

Revised Summary of TIN Model Results for Scenarios A - F											
Reach	Underlying Management Zone	TIN Objective (mg/L)	Ambient NO ₃ -N (mg/L)	Assimilative Capacity (mg/L)	Averaging Period	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
						2020 Maximum Expected Discharge	2020 Most Likely Discharge	2020 Minimum Expected Discharge	2040 Maximum Expected Discharge	2040 Most Likely Discharge	2040 Minimum Expected Discharge
Groundwater					Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology (mg/L)						
Noble Creek; unnamed tributary to Marshall Creek below Beaumont DP 007; Cooper's Creek; San Timoteo Creek - Reach 4	Beaumont	5.0 ¹ /1.5 ²	2.7 ³	2.3 ⁴	1-year	2.29	2.32	2.36	1.86	1.87	1.88
					5-year	1.88	1.90	1.92	1.60	1.61	1.61
					10-year	1.77	1.79	1.81	1.54	1.54	1.54
					20-year	1.74	1.75	1.77	1.52	1.52	1.53
Cooper's Creek; San Timoteo Creek - Reach 2, 3 and 4	San Timoteo	5.0 ¹ /2.7 ²	1.5 ³	3.5 ⁴	1-year	3.75	3.73	3.72	3.41	3.36	3.11
					5-year	3.58	3.55	3.52	2.94	2.89	2.70
					10-year	3.39	3.35	3.32	2.68	2.65	2.49
					20-year	3.38	3.33	3.28	2.68	2.64	2.47
San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5	Bunker Hill-B	7.3	5.8 ³	1.5	1-year	3.32	3.09	2.83	3.10	3.02	2.76
					5-year	2.84	2.56	2.34	2.57	2.49	2.24
					10-year	2.76	2.48	2.24	2.52	2.43	2.16
					20-year	2.67	2.39	2.17	2.44	2.35	2.10
Santa Ana River - Reach 4	Colton	2.7	3.3 ³	none	1-year	3.45	2.34	2.31	3.11	3.06	2.23
					5-year	2.83	1.90	1.82	2.62	2.47	1.82
					10-year	2.70	1.86	1.65	2.53	2.37	1.78
					20-year	2.63	1.76	1.57	2.50	2.36	1.69
Santa Ana River - Reach 4 ⁵	Riverside-A	6.2	5.7 ³	0.5	1-year	6.95	6.68	6.64	6.80	6.59	6.39
					5-year	6.60	6.16	6.10	6.42	6.09	5.79
					10-year	6.45	5.97	5.91	6.27	5.91	5.58
					20-year	6.35	5.83	5.77	6.16	5.78	5.43
Santa Ana River - Reach 3	Chino-South	5.0 ⁶	27.6 ³	none	1-year	4.47	4.45	4.42	4.35	4.27	4.25
					5-year	3.48	3.47	3.45	3.29	3.12	3.11
					10-year	3.20	3.18	3.16	2.96	2.84	2.82
					20-year	3.20	3.17	3.15	2.95	2.83	2.81
Temescal Creek - Reach 2,3, 4, 5 and 6	Upper Temescal Valley ⁷	7.9 ⁸	4.7 ⁹	3.2	1-year	7.20	6.38	5.47	7.05	6.09	5.38
					5-year	7.14	5.77	4.71	6.93	5.31	4.46
					10-year	7.08	5.57	4.41	6.82	5.05	4.16
					20-year	7.02	5.49	4.32	6.73	4.95	4.03
Santa Ana River - Reach 2	Orange County	3.4	3.0 ³	0.4	1-year	3.60	3.10	2.66	3.58	3.25	2.68
					5-year	3.41	2.97	2.49	3.34	3.06	2.52
					10-year	3.20	2.81	2.32	3.13	2.84	2.30
					20-year	3.19	2.78	2.29	3.11	2.83	2.27
Wetlands					Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology (mg/L)						
Santa Ana River - Reach 3 above River Rd	Prado Basin ¹⁰	na	na ¹¹	na	1-year	6.46	6.34	6.26	6.53	6.29	6.21
					5-year	6.30	6.18	6.09	6.38	6.13	6.05
					10-year	6.24	6.10	6.00	6.31	6.05	5.97
					20-year	6.16	6.02	5.92	6.24	5.97	5.88
Surface Water					Maximum Value for the Volume-Weighted Stream Concentration for the Planning Period Hydrology (mg/L)						
Santa Ana River Reach 3 Below Prado Dam	na	10.0	na	na ¹²	Baseflow Average ¹³	7.05	5.95	5.34	6.99	6.25	5.28
Santa Ana River Reach 2 Below Prado Dam	na	na	na	na ¹²	5-year moving average of the 1-year volume-weighted average	5.90	4.28	3.17	5.89	4.25	3.03
Santa Ana River Reach 2 at Santa Ana	na	na	na	na ¹²	5-year moving average of the 1-year volume-weighted average	2.80	1.29	0.94	3.33	1.33	1.14

Notes

This table represents a revised version of Table 25 from the 2017 WLAM Summary Report (Geoscience, 2020) and includes the results from the Supplemental WLAM Scenarios for San Timoteo, Bunker Hill-B, and Colton Groundwater Management Zones.

Bold black values represent concentrations above ambient groundwater quality, but below objective. Bold red values represent concentrations above basin objective

¹ "Maximum benefit" objectives apply unless the Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state

² "Antidegradation" objectives apply when the Regional Board determines that the lowering of water quality is not of maximum benefit to the people of the state

³ 2018 estimate of ambient water quality (WSC, 2020)

⁴ Based on maximum benefit objectives

⁵ Due to rising water conditions, no streambed recharge occurs in SAR Reach 3 overlying Riverside-A GMZ.

⁶ On August 4, 2017, the California Regional Water Quality Control Board, Santa Ana Region, adopted Resolution No. R8-2017-0036 revising the water quality objective for nitrate as nitrogen from 4.2 mg/L to 5.0 mg/L in the Chino South Groundwater Management Zone. The State Water Resource Control Board approved the amendment under Resolution No. 2018-0004 on February 6, 2018. The new objective became effective when the Office of Administrative Law approved the Basin Plan amendment on July 2, 201.

⁷ Proposed Upper Temescal Valley GMZ includes Bedford GMZ, Lee Lake GMZ, Warm Springs Valley GMZ

⁸ Proposed TIN objective from June 2018 CEQA Scoping Meeting

⁹ Based on Salt and Nutrient Management Plan for the Upper Temescal Valley, Table 6-B (WEI, 2017)

¹⁰ Streambed recharge in Prado Basin Management Zone only occurs above River Rd. This recharge is assumed to be temporary and become rising water farther downstream. Prado Basin Management Zone does not have its own set of water quality objectives, although the objectives of the streams that flow into the Prado Basin Management Zone (presented in the Prado Basin Surface Water Management Zone Section of the 2016 Water Quality Control Plan (Basin Plan) for the Santa Ana River Basin, pg. 4-29) continue to apply. For the purposes of this investigation, no objectives were evaluated for Prado Basin Management Zone. Note: SAR Reach 3 TDS/TIN objectives are identified in the Basin Plan as "baseflow" objectives. According to the 1983 Basin Plan, compliance with these objectives should be assessed without the influence of stormflow events. Model-calculated maximum volume-weighted recharge concentrations for Prado Basin do not represent baseflow conditions. Baseflow Average concentrations for Reach 3, without the influence of storm events, are presented for surface water flow at the Santa Ana River Below Prado Dam.

¹¹ No Prado Basin ambient Nitrate as Nitrogen was computed after 1997

¹² Currently, the Regional Board does not recognize the existence of assimilative capacity for nitrogen in surface water

¹³ SAR Reach 3 TDS/TIN objectives are identified in the Basin Plan as "baseflow" objectives. Model-calculated maximum volume-weighted stream concentrations for Reach 3 in August and September, without the influence of storm events, are used to represent the baseflow conditions.

APPENDIX A

Updated Recycled Water Discharge Projections Provided by YVWD



The original YVWD data request form is provided in the WLAM Summary Report in Appendix F (page F-4). Changes made for the Supplemental WLAM Scenarios (2021) are shown below in red.

Agency Name:	Yucaipa Valley Water District
POTW Plant Name	Henry N. Wochholz Regional Water Recycling Facility
Plant Design Capacity (MGD)	8.0
NPDES Permit Discharge Location:	San Timoteo Creek
Contact Person:	Ashley Gibson
Contact Phone Number:	(909) 790-3311
Contact E-mail Address:	agibson@yvwd.dst.ca.us
Current Discharge Permit No.:	CA0105619
Reg. Bd. Res. No. & Date:	R8-2015-0027

DISCHARGE to SURFACE WATER	Current	2020	2040
Maximum Expected Discharge (MGD)	3.6	8.0	8.0
Average Expected Discharge (MGD)	3.0	3.8	6.0
Minimum Expected Discharge (MGD)	1.6	1.6	1.6

RECYLED WATER for IRRIGATION or REUSE	Current	2020	2040
Maximum Expected Reuse (MGD)	2.0	3.8	6.0
Average Expected Reuse (MGD)	1.9	2.2	4.4
Minimum Expected Reuse (MGD)	0.7	1.0	3.2

RECYCLED WATER for AQUIFER RECHARGE	Current	2020	2040
Maximum Expected Recharge (MGD)	0.0	2.8	2.8
Average Expected Recharge (MGD)	0.0	2.5	2.5
Minimum Expected Recharge (MGD)	0.0	0.0	0.0

WATER QUALITY	TIN	TDS
Effluent Limit in Current Discharge Permit (mg/L)	6.7*	400*
Effluent Limit used for Supplemental WLAM Scenarios (mg/L)	5.5	-
Recent 12-mos. Volume Weighted Average (mg/L)	6.1 3.6	296 285
Est. 12 mos. Volume Weighted Average in 2040 (mg/L)	6.7 5.5	400

Updated
for period
from June
2020
through
May 2021

- 1) Current or recent annual average can be calendar 2016 or FY 2016-17 or other 12 mo. rolling average.
- 2) "MGD" = million-gallons-per-day (annualized average).
- 3) Agencies with multiple treatment facilities and outfalls may need to complete separate forms for each facility and/or discharge location.
- 4) If water quality in the recycled water earmarked for reuse is different from the water quality of the wastewater that is discharged, such differences should be described in detail.

* Note: YVWD currently has a split limit in their permit for the H.N. Wochholz WRF, where:

- TDS = 400 mg/L for up to 1.6 MGD; 300 mg/L for flows in excess of 1.6 MGD where maximum benefit is not demonstrated
- TIN = 6.7 mg/L for up to 1.6 MGD; 3.6 mg/L where maximum benefit is not demonstrated

APPENDIX B

Supplemental Predictive Scenario Results San Timoteo Groundwater Management Zone



APPENDIX B:

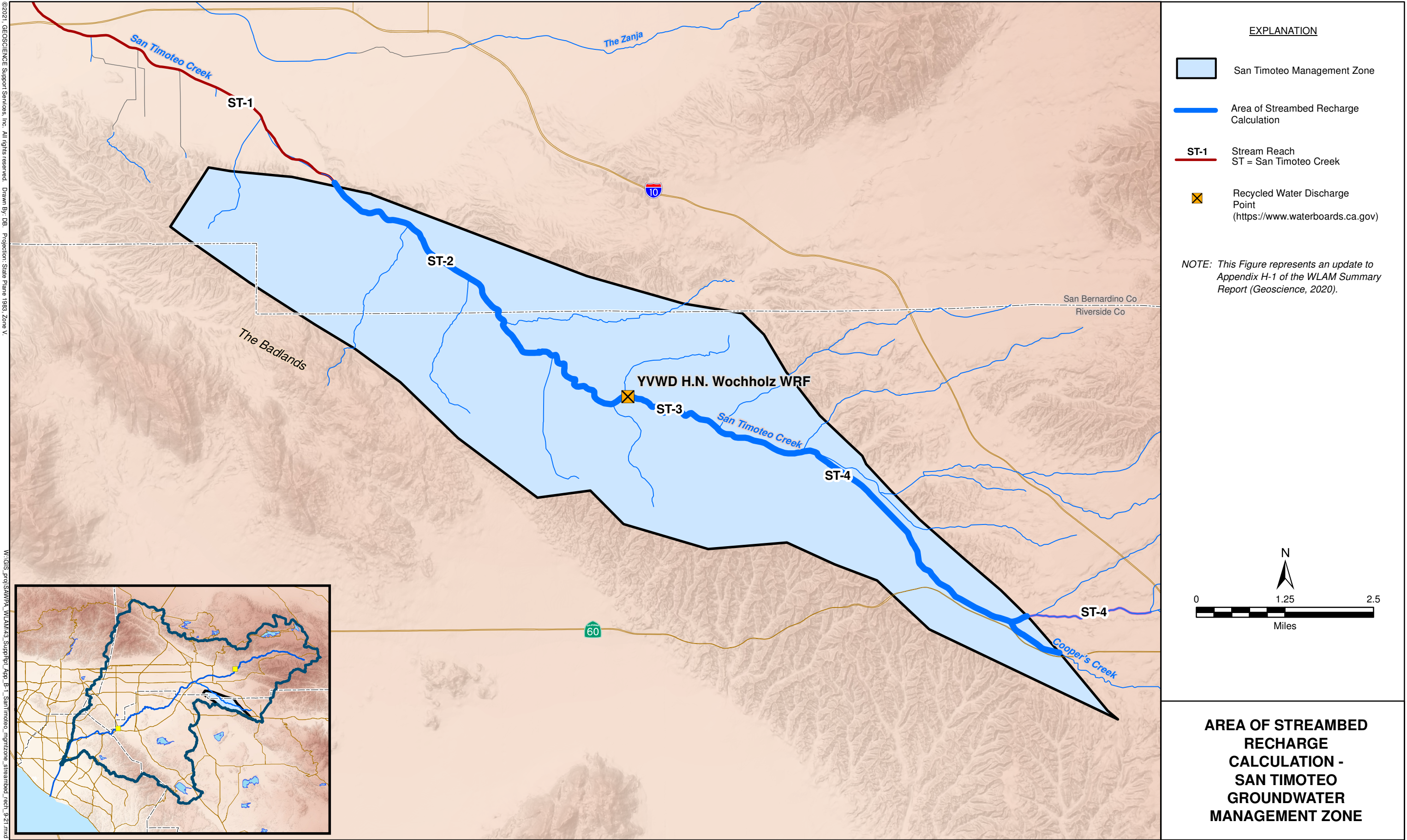
SUPPLEMENTAL PREDICTIVE SCENARIO RESULTS – SAN TIMOTEO GROUNDWATER MANAGEMENT ZONE

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Supplemental Scenario F – 2040 Minimum Expected Discharge

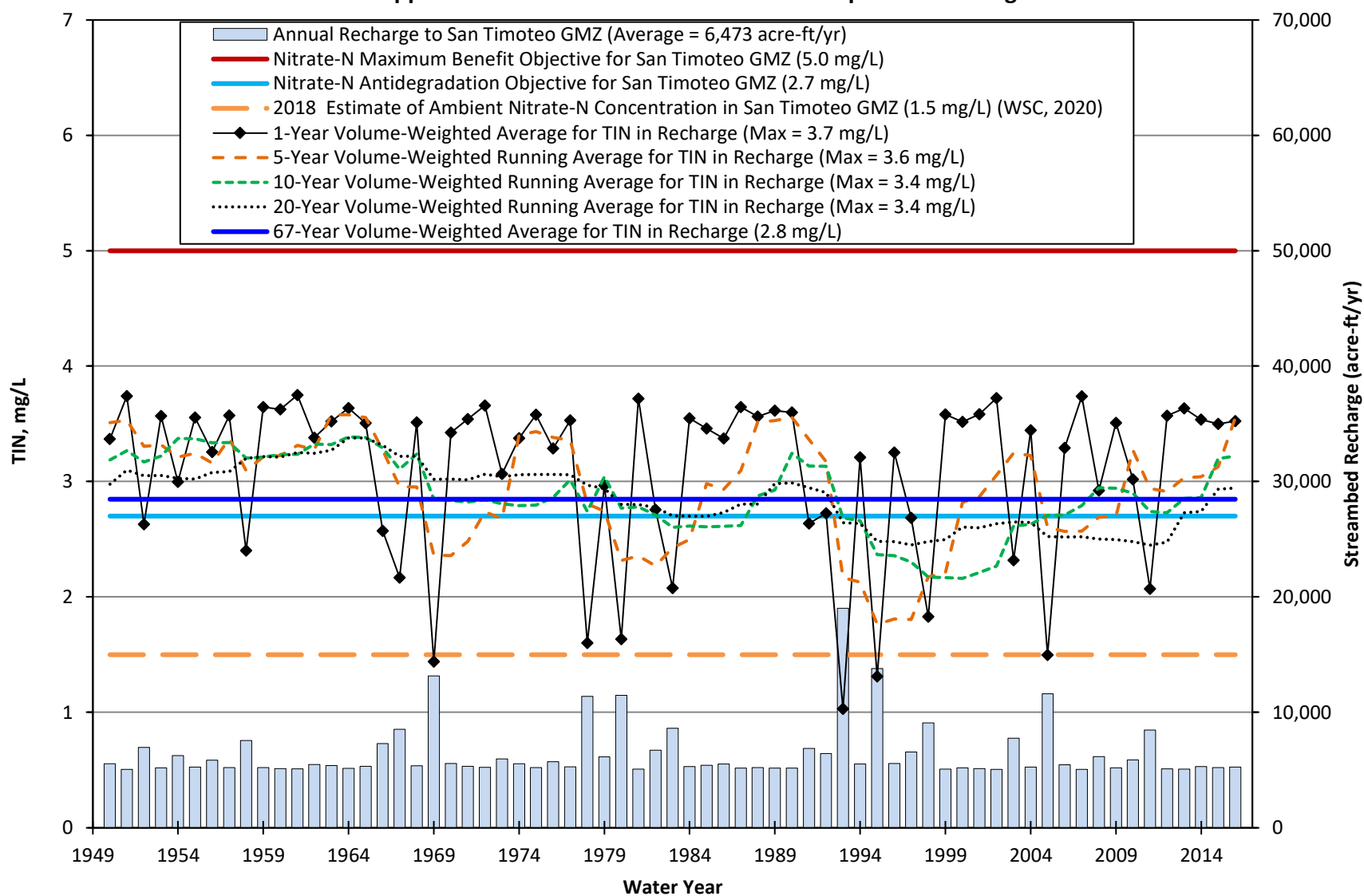
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©2021, GEOSCIENCE Support Services, Inc. All rights reserved. Drawn By: DB. Projection: State Plane 1983, Zone V. W:\GIS\proj\SAWPA_WLAM\43_Support\Map B-1_SanTimoteo_mgtzone_streambed_rech_9-21.mxd

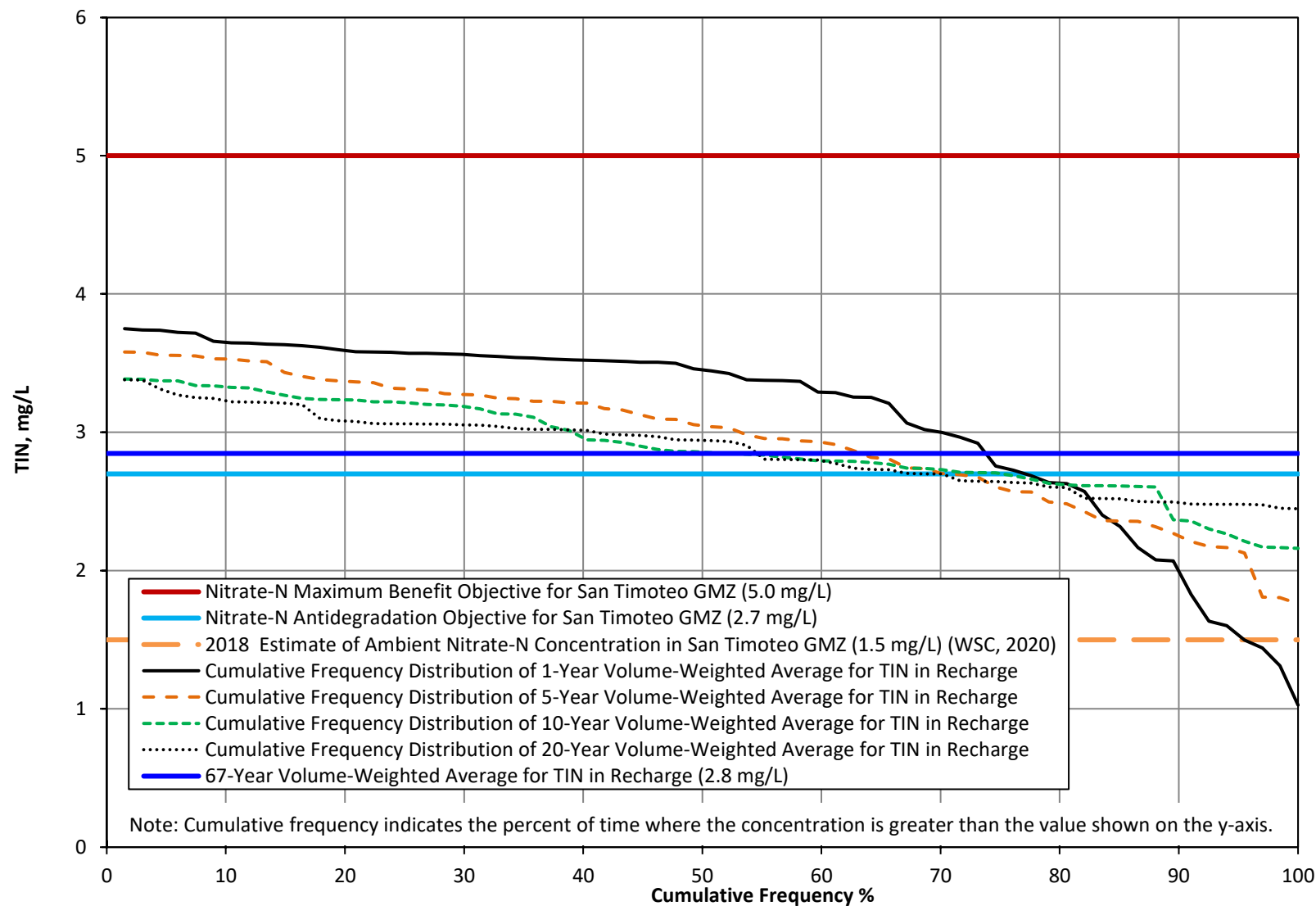
Sep-21

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge**



Note: This figure represents an update to Figure H-4 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge**



Note: This figure represents an update to Figure H-5 of the WLAM Summary Report (Geoscience, 2020)

**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

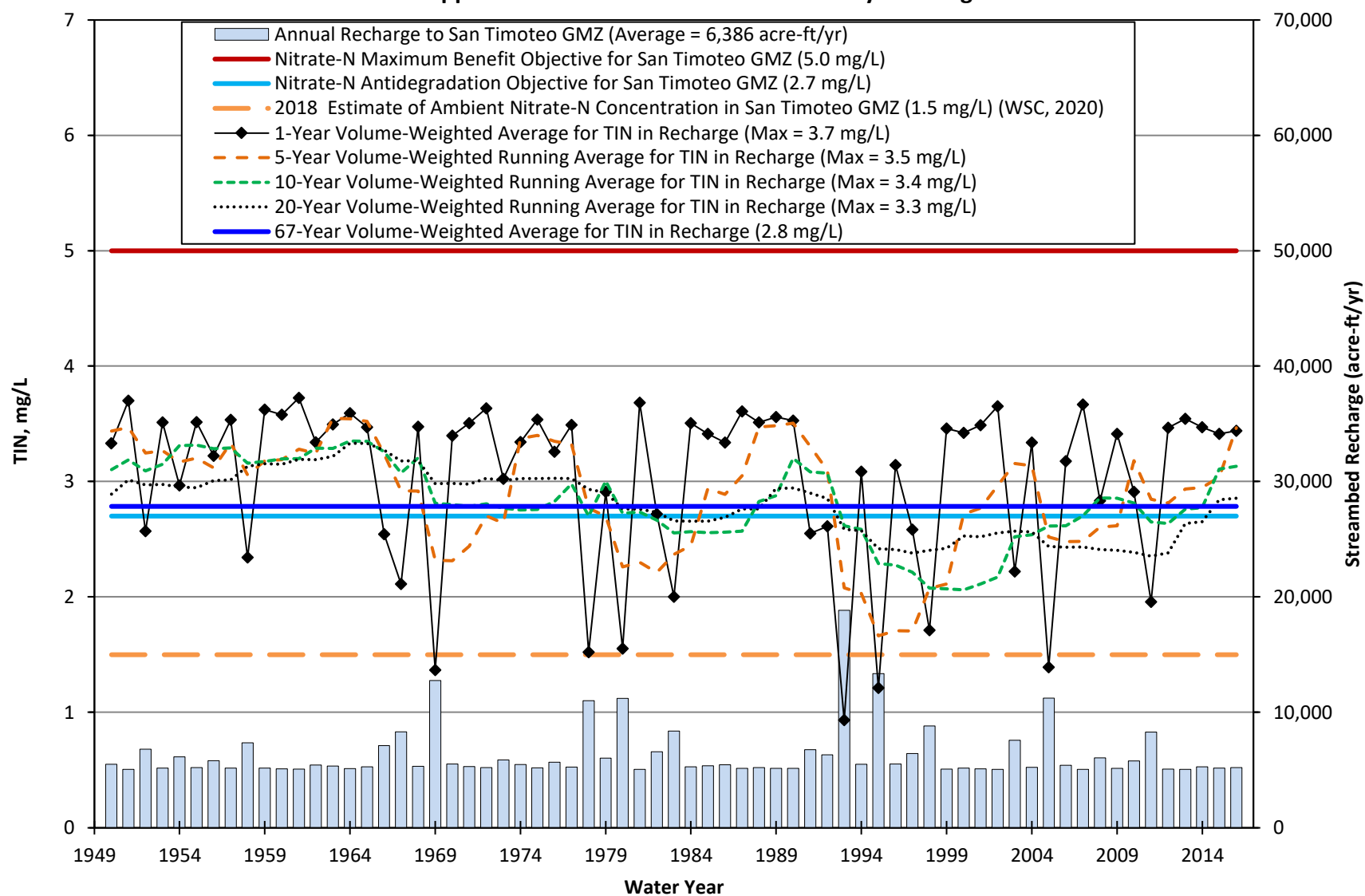
TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4
Overlying San Timoteo GMZ

Supplemental Scenario A - 2020 Maximum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	5,544	3.37	3.51	3.19	2.98
1951	5,047	3.74	3.53	3.27	3.10
1952	6,942	2.63	3.30	3.17	3.05
1953	5,181	3.57	3.32	3.22	3.05
1954	6,235	3.00	3.21	3.37	3.03
1955	5,239	3.55	3.24	3.37	3.02
1956	5,854	3.25	3.16	3.33	3.08
1957	5,213	3.57	3.37	3.34	3.08
1958	7,551	2.40	3.09	3.20	3.20
1959	5,198	3.65	3.21	3.21	3.22
1960	5,113	3.63	3.22	3.23	3.21
1961	5,085	3.75	3.31	3.24	3.25
1962	5,480	3.38	3.28	3.32	3.25
1963	5,378	3.52	3.58	3.32	3.27
1964	5,134	3.64	3.58	3.39	3.38
1965	5,316	3.51	3.55	3.38	3.38
1966	7,280	2.57	3.27	3.29	3.31
1967	8,518	2.17	2.95	3.11	3.22
1968	5,353	3.51	2.95	3.24	3.22
1969	13,137	1.44	2.36	2.85	3.02
1970	5,556	3.42	2.36	2.83	3.02
1971	5,320	3.54	2.48	2.82	3.01
1972	5,229	3.66	2.74	2.84	3.06
1973	5,965	3.07	2.68	2.81	3.04
1974	5,533	3.38	3.40	2.79	3.06
1975	5,209	3.58	3.43	2.79	3.06
1976	5,717	3.29	3.38	2.86	3.06
1977	5,281	3.53	3.36	3.01	3.06
1978	11,368	1.60	2.81	2.74	2.97
1979	6,137	2.96	2.74	3.04	2.94
1980	11,467	1.63	2.32	2.77	2.80
1981	5,080	3.72	2.36	2.78	2.80
1982	6,704	2.75	2.27	2.71	2.77
1983	8,610	2.08	2.43	2.60	2.70
1984	5,300	3.55	2.50	2.61	2.70
1985	5,395	3.46	2.98	2.61	2.70
1986	5,510	3.37	2.93	2.61	2.73
1987	5,160	3.64	3.09	2.62	2.80
1988	5,214	3.56	3.52	2.87	2.80
1989	5,159	3.61	3.53	2.93	2.98
1990	5,156	3.60	3.56	3.24	2.99
1991	6,864	2.64	3.36	3.13	2.94
1992	6,423	2.72	3.17	3.13	2.90
1993	19,019	1.03	2.17	2.68	2.64
1994	5,525	3.21	2.13	2.66	2.64
1995	13,781	1.31	1.76	2.37	2.48
1996	5,559	3.25	1.81	2.36	2.48
1997	6,545	2.69	1.80	2.30	2.45
1998	9,080	1.83	2.17	2.17	2.48
1999	5,068	3.58	2.21	2.17	2.50
2000	5,173	3.52	2.82	2.16	2.60
2001	5,110	3.58	2.87	2.21	2.60
2002	5,047	3.72	3.05	2.27	2.63
2003	7,746	2.32	3.25	2.61	2.65
2004	5,257	3.44	3.22	2.63	2.65
2005	11,610	1.50	2.60	2.71	2.52
2006	5,437	3.29	2.57	2.71	2.52
2007	5,044	3.74	2.57	2.79	2.52
2008	6,147	2.92	2.69	2.95	2.50
2009	5,174	3.51	2.70	2.94	2.50
2010	5,859	3.02	3.27	2.90	2.48
2011	8,453	2.07	2.94	2.74	2.45
2012	5,090	3.57	2.91	2.73	2.47
2013	5,062	3.63	3.03	2.85	2.73
2014	5,298	3.54	3.04	2.86	2.74
2015	5,196	3.50	3.13	3.20	2.93
2016	5,243	3.52	3.55	3.22	2.94
Maximum	19,019	3.75	3.58	3.39	3.38
Average	6,473				

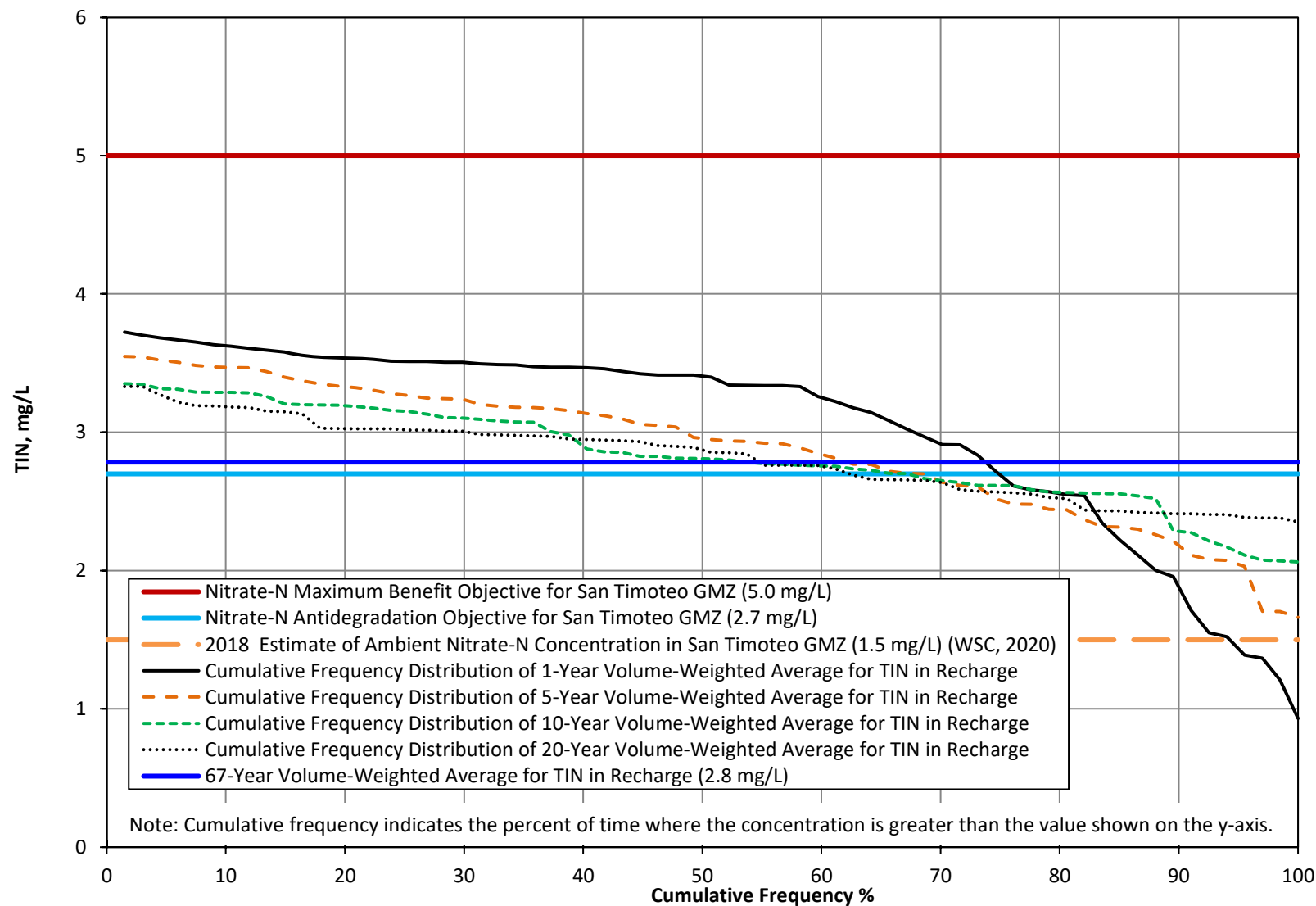
Note: This table represents an update to Table H-6 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario B - 2020 Most Likely Discharge**



Note: This figure represents an update to Figure H-9 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario B - 2020 Most Likely Discharge**



Note: This figure represents an update to Figure H-10 of the WLAM Summary Report (Geoscience, 2020)

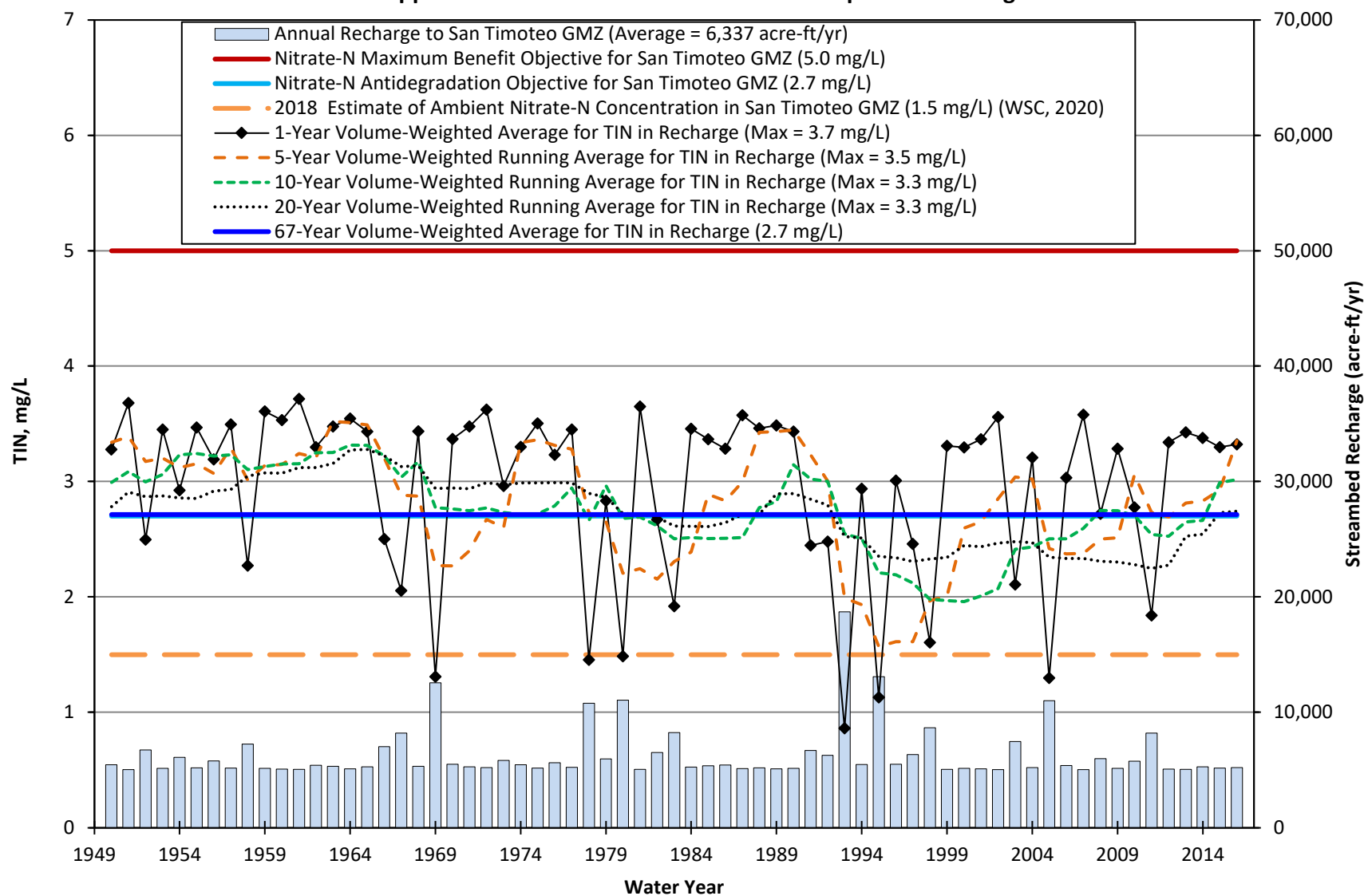
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4
Overlying San Timoteo GMZ
Supplemental Scenario B - 2020 Most Likely Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	5,487	3.33	3.44	3.10	2.89
1951	5,042	3.70	3.47	3.19	3.01
1952	6,801	2.57	3.25	3.09	2.97
1953	5,161	3.51	3.27	3.15	2.97
1954	6,136	2.97	3.17	3.31	2.95
1955	5,202	3.51	3.20	3.31	2.95
1956	5,809	3.22	3.12	3.28	3.01
1957	5,171	3.54	3.33	3.29	3.02
1958	7,351	2.34	3.06	3.16	3.13
1959	5,166	3.62	3.18	3.17	3.15
1960	5,091	3.58	3.19	3.19	3.15
1961	5,072	3.73	3.28	3.20	3.19
1962	5,429	3.34	3.24	3.29	3.19
1963	5,343	3.50	3.55	3.29	3.22
1964	5,112	3.59	3.54	3.35	3.33
1965	5,281	3.47	3.52	3.35	3.33
1966	7,114	2.54	3.24	3.26	3.27
1967	8,312	2.11	2.92	3.07	3.18
1968	5,324	3.47	2.92	3.20	3.18
1969	12,760	1.37	2.32	2.81	2.98
1970	5,510	3.40	2.31	2.80	2.98
1971	5,293	3.51	2.44	2.78	2.98
1972	5,212	3.63	2.70	2.81	3.03
1973	5,870	3.02	2.64	2.77	3.01
1974	5,481	3.34	3.37	2.75	3.02
1975	5,182	3.54	3.40	2.76	3.03
1976	5,661	3.26	3.35	2.83	3.03
1977	5,249	3.49	3.32	2.98	3.02
1978	10,992	1.52	2.77	2.70	2.93
1979	6,028	2.91	2.70	3.00	2.90
1980	11,209	1.55	2.26	2.72	2.76
1981	5,061	3.68	2.30	2.74	2.76
1982	6,572	2.72	2.21	2.66	2.73
1983	8,367	2.00	2.37	2.55	2.66
1984	5,270	3.51	2.44	2.56	2.66
1985	5,368	3.41	2.94	2.56	2.65
1986	5,450	3.34	2.89	2.56	2.69
1987	5,137	3.61	3.05	2.57	2.76
1988	5,198	3.51	3.47	2.83	2.76
1989	5,128	3.56	3.48	2.88	2.94
1990	5,139	3.53	3.51	3.20	2.94
1991	6,749	2.55	3.30	3.08	2.90
1992	6,315	2.61	3.10	3.07	2.85
1993	18,827	0.93	2.08	2.62	2.58
1994	5,488	3.08	2.03	2.58	2.57
1995	13,343	1.21	1.66	2.29	2.42
1996	5,517	3.14	1.71	2.27	2.41
1997	6,413	2.58	1.70	2.21	2.38
1998	8,811	1.71	2.07	2.08	2.40
1999	5,063	3.46	2.11	2.07	2.42
2000	5,150	3.42	2.72	2.06	2.53
2001	5,096	3.49	2.77	2.11	2.52
2002	5,043	3.65	2.96	2.17	2.55
2003	7,569	2.22	3.16	2.52	2.57
2004	5,228	3.34	3.14	2.54	2.56
2005	11,222	1.39	2.52	2.61	2.44
2006	5,397	3.18	2.48	2.61	2.43
2007	5,039	3.67	2.48	2.70	2.43
2008	6,044	2.83	2.61	2.86	2.41
2009	5,144	3.41	2.61	2.85	2.40
2010	5,791	2.91	3.18	2.81	2.38
2011	8,281	1.96	2.85	2.65	2.35
2012	5,082	3.47	2.81	2.64	2.38
2013	5,056	3.54	2.93	2.76	2.64
2014	5,279	3.47	2.95	2.77	2.65
2015	5,167	3.41	3.04	3.11	2.84
2016	5,215	3.44	3.47	3.13	2.85
Maximum	18,827	3.73	3.55	3.35	3.33
Average	6,386				

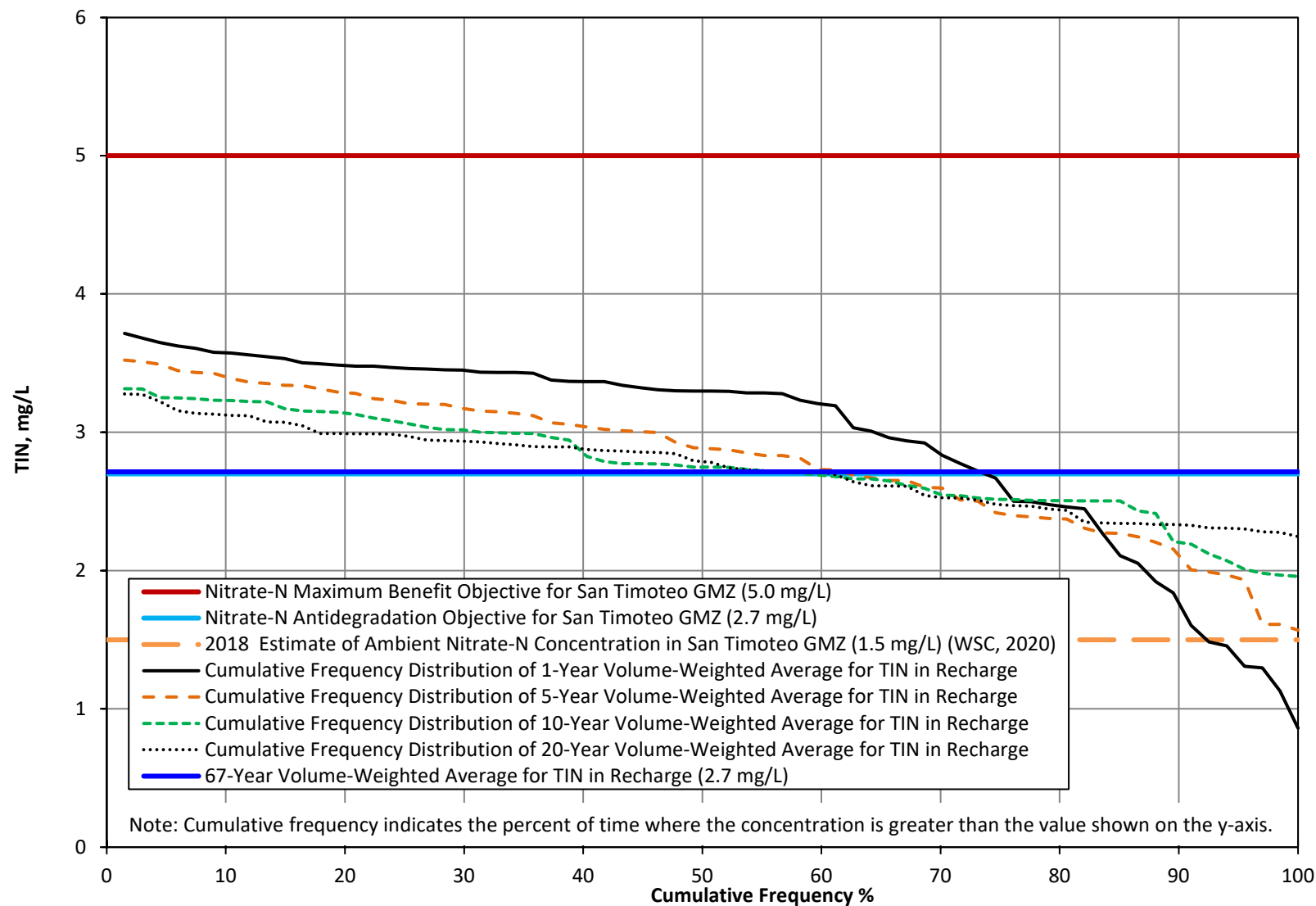
Note: This table represents an update to Table H-11 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge**



Note: This figure represents an update to Figure H-14 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge**



Note: This figure represents an update to Figure H-15 of the WLAM Summary Report (Geoscience, 2020)

**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

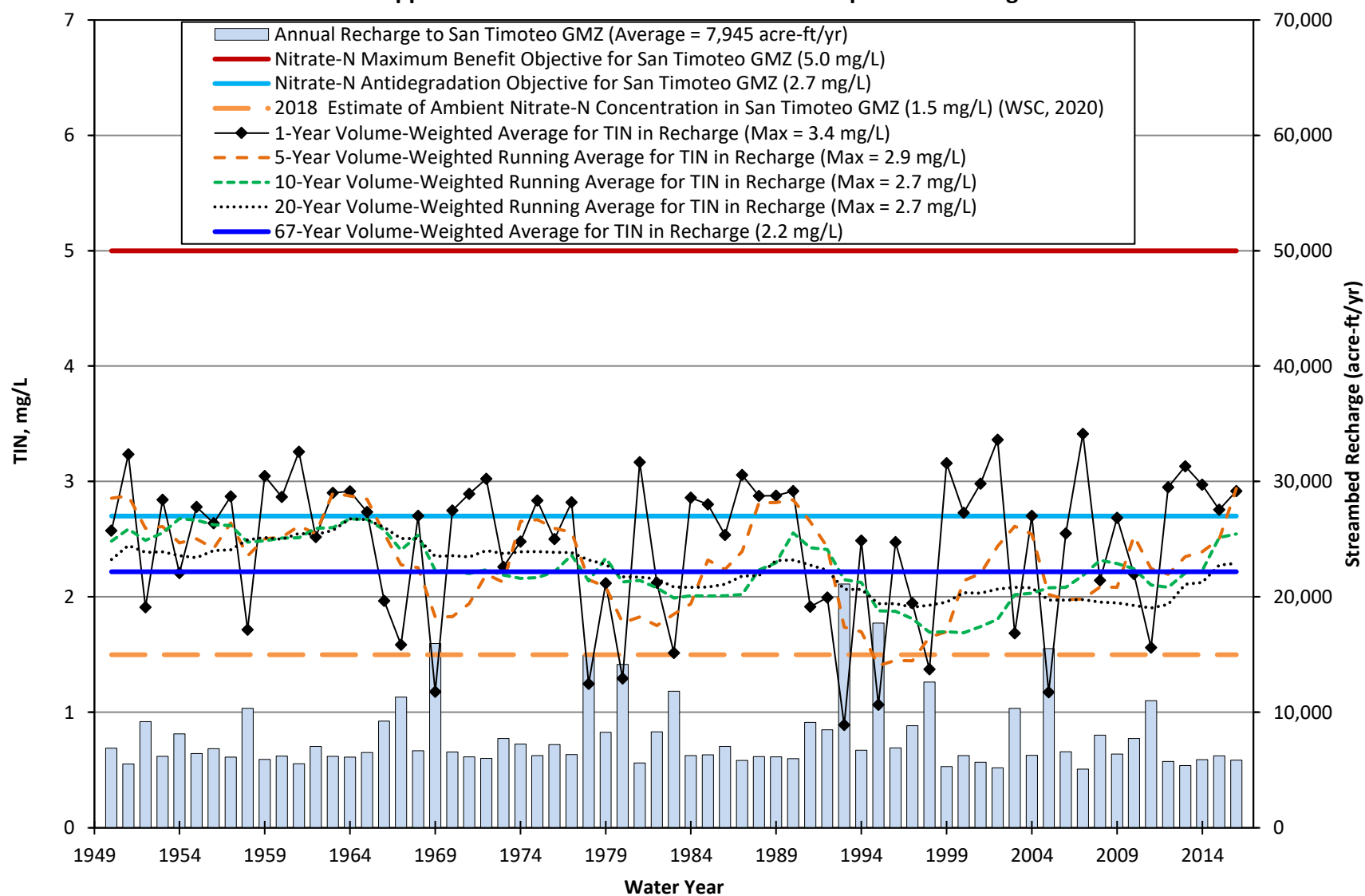
TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4
Overlying San Timoteo GMZ

Supplemental Scenario C - 2020 Minimum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	5,451	3.28	3.34	2.99	2.78
1951	5,037	3.68	3.39	3.08	2.91
1952	6,722	2.50	3.17	3.00	2.87
1953	5,148	3.45	3.20	3.06	2.88
1954	6,081	2.92	3.12	3.23	2.86
1955	5,182	3.47	3.15	3.24	2.85
1956	5,780	3.19	3.07	3.22	2.92
1957	5,150	3.49	3.29	3.23	2.93
1958	7,242	2.27	3.01	3.10	3.05
1959	5,147	3.61	3.14	3.13	3.07
1960	5,078	3.53	3.15	3.15	3.07
1961	5,059	3.72	3.24	3.15	3.12
1962	5,398	3.30	3.21	3.25	3.12
1963	5,323	3.48	3.52	3.25	3.16
1964	5,098	3.55	3.51	3.32	3.27
1965	5,261	3.43	3.49	3.31	3.28
1966	7,025	2.50	3.20	3.22	3.22
1967	8,193	2.05	2.88	3.04	3.13
1968	5,308	3.43	2.87	3.17	3.14
1969	12,549	1.31	2.27	2.77	2.94
1970	5,483	3.37	2.27	2.76	2.94
1971	5,276	3.48	2.40	2.75	2.94
1972	5,199	3.62	2.67	2.77	2.99
1973	5,819	2.96	2.60	2.73	2.97
1974	5,451	3.30	3.34	2.71	2.99
1975	5,164	3.50	3.36	2.72	2.99
1976	5,631	3.23	3.31	2.79	2.99
1977	5,230	3.45	3.28	2.94	2.99
1978	10,784	1.45	2.73	2.66	2.90
1979	5,966	2.83	2.65	2.96	2.86
1980	11,048	1.48	2.20	2.68	2.72
1981	5,049	3.65	2.24	2.69	2.72
1982	6,499	2.67	2.15	2.62	2.69
1983	8,235	1.92	2.31	2.50	2.61
1984	5,253	3.46	2.39	2.51	2.61
1985	5,350	3.36	2.89	2.51	2.61
1986	5,417	3.28	2.83	2.51	2.64
1987	5,123	3.57	3.00	2.51	2.72
1988	5,187	3.46	3.43	2.77	2.72
1989	5,104	3.49	3.43	2.83	2.89
1990	5,128	3.43	3.45	3.14	2.89
1991	6,688	2.45	3.23	3.02	2.85
1992	6,256	2.48	3.00	3.00	2.79
1993	18,712	0.86	1.99	2.54	2.52
1994	5,465	2.94	1.93	2.51	2.51
1995	13,090	1.13	1.57	2.21	2.35
1996	5,492	3.01	1.61	2.19	2.34
1997	6,341	2.46	1.61	2.12	2.31
1998	8,665	1.60	1.97	1.98	2.33
1999	5,058	3.31	2.01	1.97	2.34
2000	5,138	3.30	2.60	1.96	2.45
2001	5,087	3.37	2.65	2.01	2.44
2002	5,038	3.56	2.85	2.07	2.47
2003	7,471	2.11	3.04	2.41	2.48
2004	5,209	3.21	3.02	2.43	2.47
2005	11,010	1.30	2.42	2.50	2.34
2006	5,374	3.03	2.37	2.50	2.33
2007	5,035	3.58	2.38	2.59	2.33
2008	5,988	2.72	2.50	2.75	2.31
2009	5,128	3.29	2.51	2.75	2.30
2010	5,753	2.77	3.06	2.70	2.28
2011	8,186	1.84	2.73	2.54	2.25
2012	5,076	3.34	2.69	2.52	2.28
2013	5,050	3.43	2.81	2.65	2.53
2014	5,266	3.38	2.83	2.66	2.54
2015	5,149	3.30	2.93	2.99	2.73
2016	5,198	3.32	3.35	3.02	2.74
Maximum	18,712	3.72	3.52	3.32	3.28
Average	6,337				

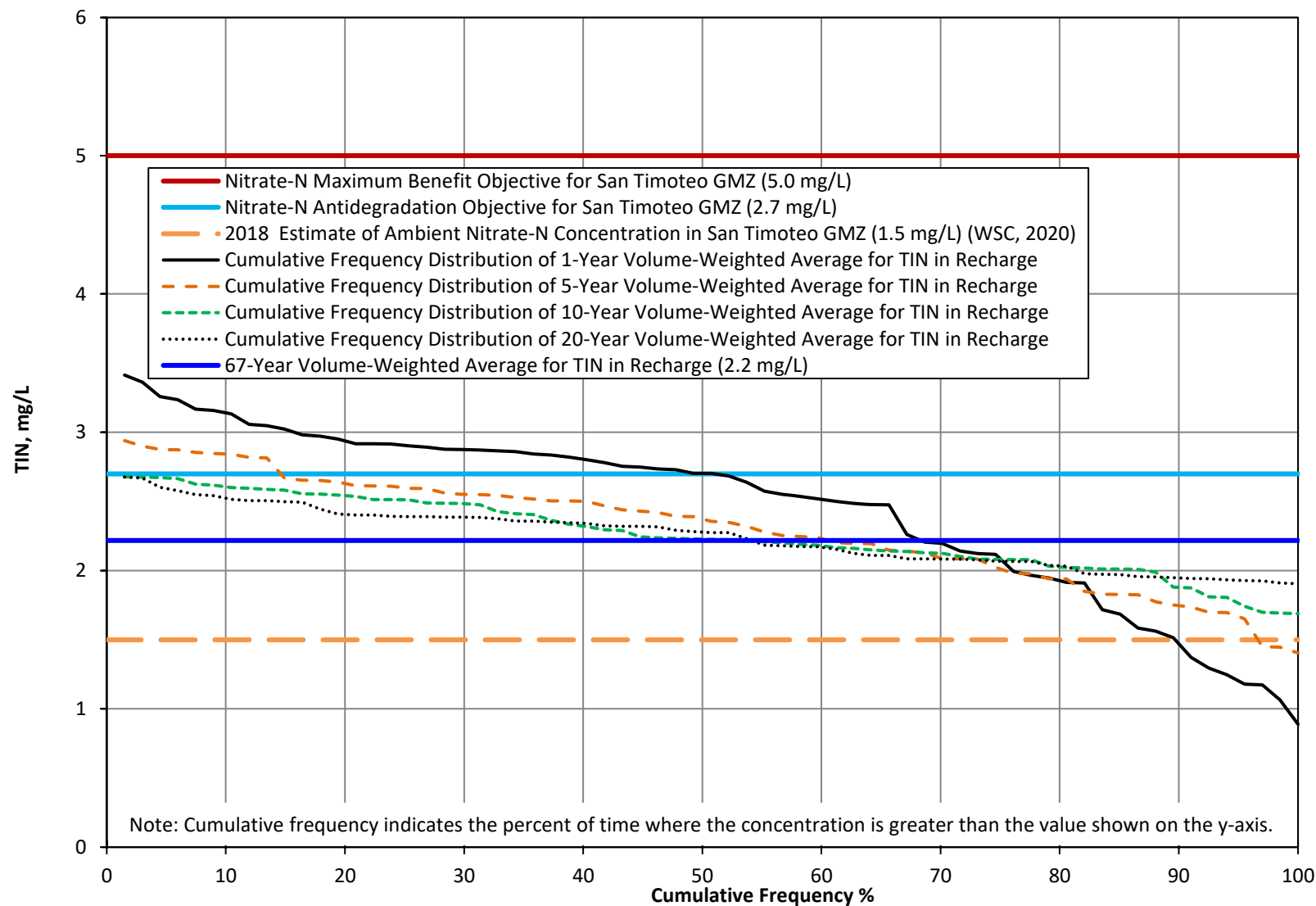
Note: This table represents an update to Table H-16 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge**



Note: This figure represents an update to Figure H-19 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge**



Note: This figure represents an update to Figure H-20 of the WLAM Summary Report (Geoscience, 2020)

**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

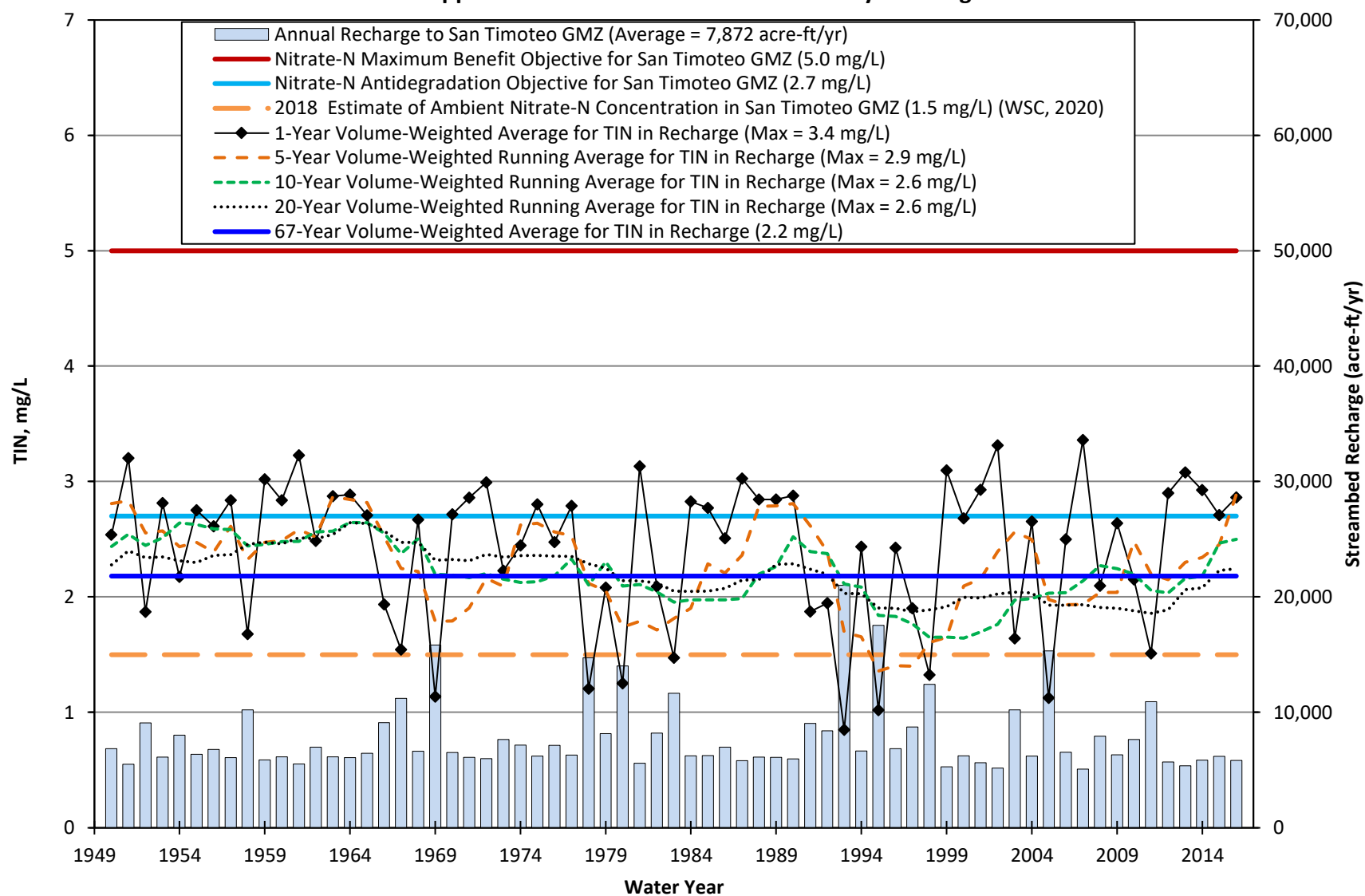
TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4
Overlying San Timoteo GMZ

Supplemental Scenario D - 2040 Maximum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	6,896	2.57	2.85	2.48	2.32
1951	5,517	3.24	2.87	2.59	2.45
1952	9,198	1.91	2.59	2.49	2.39
1953	6,175	2.84	2.61	2.55	2.39
1954	8,116	2.21	2.47	2.68	2.36
1955	6,414	2.78	2.50	2.67	2.34
1956	6,841	2.64	2.42	2.63	2.40
1957	6,118	2.87	2.64	2.62	2.41
1958	10,347	1.72	2.36	2.47	2.49
1959	5,906	3.05	2.50	2.49	2.51
1960	6,197	2.87	2.52	2.51	2.50
1961	5,536	3.26	2.61	2.51	2.55
1962	7,035	2.52	2.55	2.59	2.54
1963	6,177	2.90	2.90	2.60	2.58
1964	6,113	2.92	2.87	2.68	2.68
1965	6,505	2.74	2.85	2.67	2.67
1966	9,222	1.97	2.55	2.58	2.60
1967	11,304	1.59	2.28	2.41	2.51
1968	6,664	2.70	2.25	2.53	2.50
1969	15,963	1.18	1.83	2.23	2.35
1970	6,546	2.75	1.83	2.22	2.36
1971	6,133	2.89	1.94	2.20	2.35
1972	6,002	3.02	2.20	2.24	2.40
1973	7,733	2.26	2.13	2.19	2.38
1974	7,231	2.48	2.65	2.16	2.39
1975	6,245	2.84	2.67	2.17	2.39
1976	7,204	2.50	2.59	2.22	2.39
1977	6,340	2.82	2.56	2.36	2.38
1978	14,943	1.25	2.15	2.14	2.32
1979	8,255	2.12	2.09	2.34	2.28
1980	14,140	1.29	1.77	2.13	2.17
1981	5,599	3.17	1.83	2.14	2.17
1982	8,306	2.12	1.75	2.08	2.15
1983	11,827	1.51	1.85	1.99	2.08
1984	6,251	2.86	1.94	2.01	2.08
1985	6,305	2.80	2.32	2.01	2.08
1986	7,051	2.54	2.24	2.01	2.11
1987	5,826	3.06	2.39	2.02	2.18
1988	6,161	2.87	2.82	2.23	2.18
1989	6,132	2.88	2.82	2.30	2.32
1990	5,990	2.92	2.84	2.55	2.32
1991	9,123	1.91	2.65	2.43	2.27
1992	8,480	1.99	2.43	2.41	2.23
1993	21,108	0.89	1.74	2.15	2.07
1994	6,713	2.49	1.70	2.12	2.06
1995	17,733	1.06	1.40	1.88	1.94
1996	6,905	2.48	1.45	1.87	1.94
1997	8,835	1.95	1.45	1.81	1.91
1998	12,615	1.37	1.65	1.69	1.93
1999	5,292	3.16	1.70	1.70	1.95
2000	6,253	2.73	2.14	1.69	2.04
2001	5,662	2.98	2.20	1.74	2.03
2002	5,182	3.36	2.44	1.81	2.07
2003	10,348	1.69	2.61	2.02	2.08
2004	6,260	2.70	2.54	2.03	2.08
2005	15,524	1.17	2.02	2.08	1.97
2006	6,584	2.55	1.98	2.08	1.97
2007	5,081	3.41	1.98	2.18	1.98
2008	8,009	2.14	2.08	2.32	1.95
2009	6,377	2.68	2.08	2.29	1.95
2010	7,725	2.20	2.53	2.24	1.93
2011	11,007	1.56	2.25	2.10	1.90
2012	5,737	2.95	2.20	2.08	1.93
2013	5,389	3.13	2.35	2.21	2.11
2014	5,881	2.97	2.39	2.23	2.12
2015	6,220	2.75	2.50	2.51	2.27
2016	5,837	2.92	2.94	2.55	2.29
Maximum	21,108	3.41	2.94	2.68	2.68
Average	7,945				

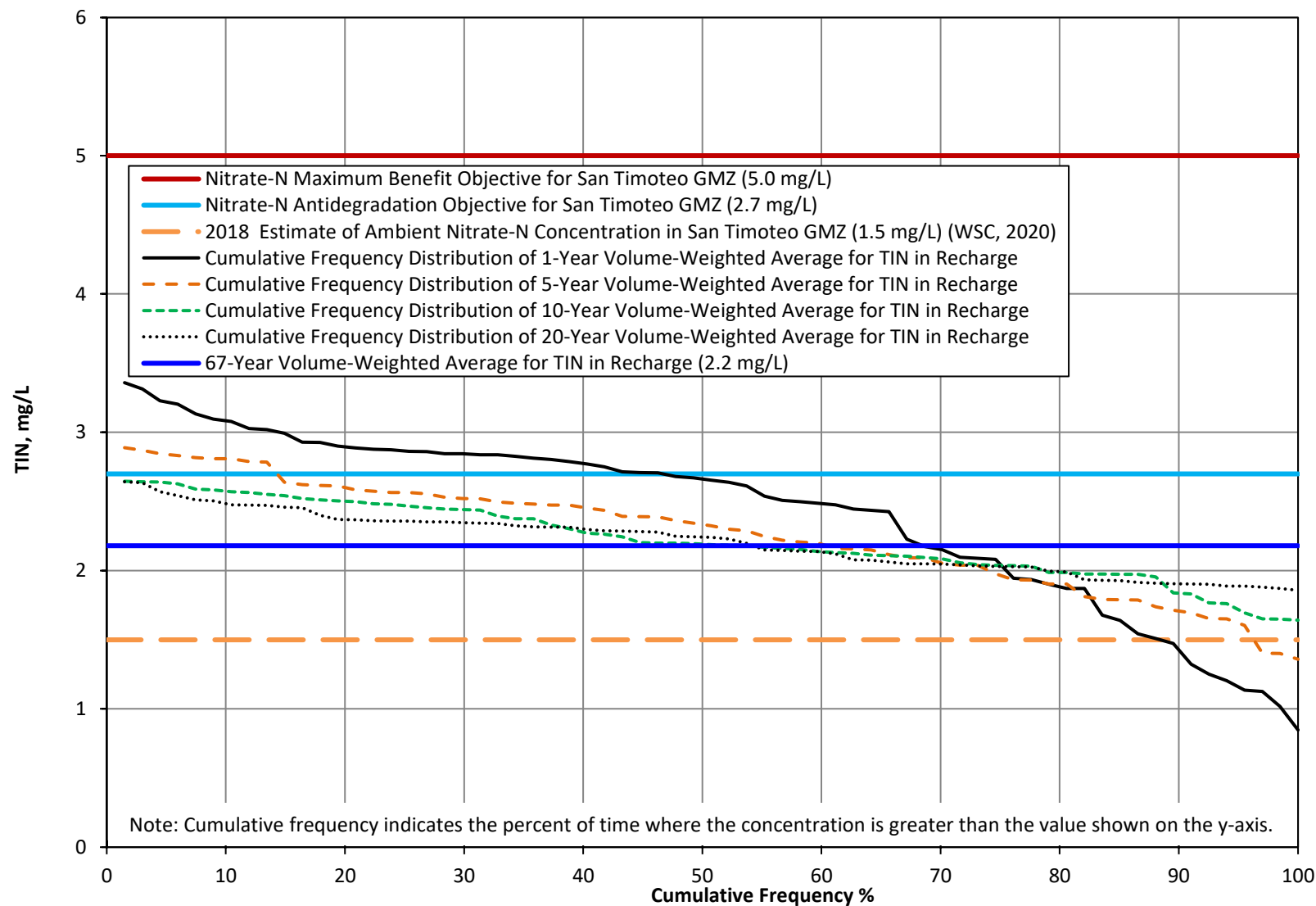
Note: This table represents an update to Table H-21 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario E - 2040 Most Likely Discharge**



Note: This figure represents an update to Figure H-24 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario E - 2040 Most Likely Discharge**



Note: This figure represents an update to Figure H-25 of the WLAM Summary Report (Geoscience, 2020)

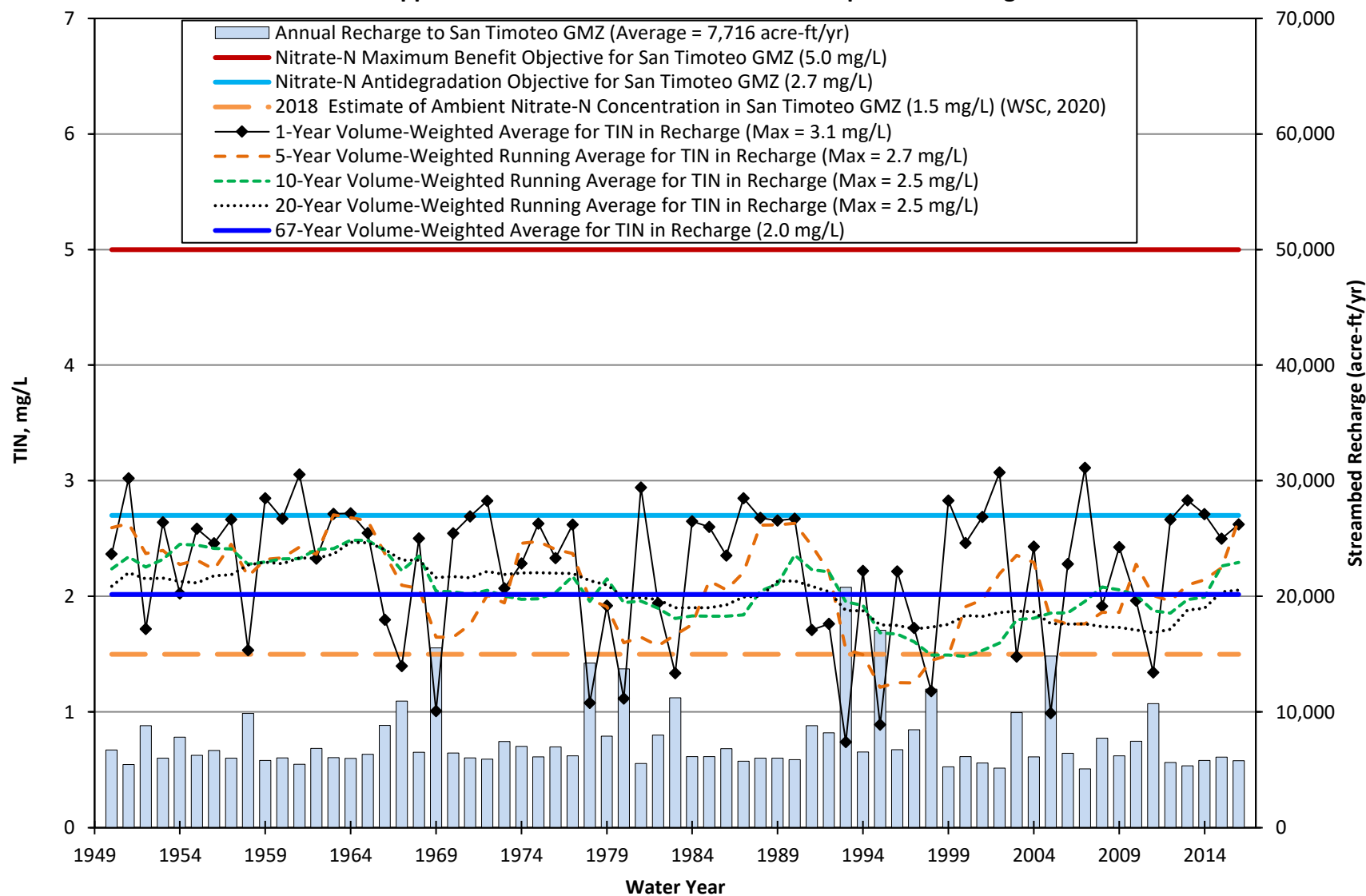
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4
Overlying San Timoteo GMZ
Supplemental Scenario E - 2040 Most Likely Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	6,834	2.54	2.81	2.44	2.28
1951	5,493	3.20	2.83	2.54	2.40
1952	9,072	1.87	2.55	2.44	2.34
1953	6,114	2.81	2.57	2.51	2.35
1954	8,019	2.17	2.44	2.64	2.31
1955	6,355	2.75	2.47	2.63	2.30
1956	6,784	2.61	2.39	2.59	2.36
1957	6,077	2.84	2.61	2.58	2.37
1958	10,195	1.68	2.32	2.44	2.45
1959	5,871	3.02	2.47	2.45	2.48
1960	6,142	2.84	2.49	2.48	2.46
1961	5,514	3.23	2.58	2.48	2.51
1962	6,975	2.49	2.52	2.56	2.50
1963	6,137	2.87	2.87	2.57	2.54
1964	6,068	2.89	2.84	2.65	2.64
1965	6,450	2.71	2.82	2.64	2.63
1966	9,101	1.93	2.52	2.55	2.57
1967	11,199	1.54	2.25	2.37	2.47
1968	6,618	2.67	2.22	2.50	2.47
1969	15,830	1.13	1.79	2.19	2.32
1970	6,510	2.71	1.79	2.19	2.32
1971	6,096	2.86	1.90	2.17	2.31
1972	5,974	2.99	2.16	2.20	2.37
1973	7,636	2.23	2.09	2.15	2.34
1974	7,162	2.45	2.62	2.12	2.36
1975	6,204	2.80	2.64	2.13	2.36
1976	7,127	2.47	2.56	2.18	2.35
1977	6,295	2.79	2.53	2.33	2.35
1978	14,720	1.20	2.12	2.10	2.29
1979	8,137	2.08	2.05	2.30	2.25
1980	14,008	1.25	1.74	2.09	2.14
1981	5,575	3.13	1.79	2.11	2.14
1982	8,203	2.09	1.71	2.04	2.12
1983	11,637	1.47	1.81	1.95	2.05
1984	6,212	2.83	1.90	1.98	2.05
1985	6,251	2.77	2.29	1.97	2.05
1986	6,976	2.51	2.21	1.97	2.07
1987	5,792	3.03	2.36	1.99	2.14
1988	6,112	2.84	2.78	2.20	2.15
1989	6,093	2.84	2.79	2.26	2.28
1990	5,950	2.88	2.81	2.52	2.29
1991	9,022	1.87	2.62	2.39	2.24
1992	8,385	1.94	2.39	2.38	2.20
1993	21,001	0.85	1.69	2.11	2.03
1994	6,650	2.44	1.65	2.08	2.03
1995	17,522	1.02	1.36	1.84	1.90
1996	6,847	2.43	1.40	1.83	1.90
1997	8,712	1.90	1.40	1.77	1.87
1998	12,409	1.32	1.60	1.65	1.89
1999	5,277	3.10	1.65	1.65	1.91
2000	6,213	2.68	2.09	1.64	2.00
2001	5,634	2.93	2.16	1.70	1.99
2002	5,169	3.31	2.39	1.76	2.03
2003	10,215	1.64	2.56	1.97	2.04
2004	6,210	2.65	2.50	1.99	2.03
2005	15,312	1.13	1.98	2.03	1.93
2006	6,531	2.50	1.93	2.04	1.93
2007	5,078	3.36	1.93	2.14	1.93
2008	7,917	2.10	2.04	2.27	1.91
2009	6,322	2.64	2.04	2.24	1.90
2010	7,637	2.15	2.48	2.20	1.88
2011	10,915	1.51	2.20	2.06	1.86
2012	5,700	2.90	2.15	2.03	1.89
2013	5,368	3.08	2.30	2.16	2.06
2014	5,856	2.93	2.34	2.18	2.08
2015	6,175	2.71	2.45	2.47	2.23
2016	5,818	2.86	2.89	2.50	2.24
Maximum	21,001	3.36	2.89	2.65	2.64
Average	7,872				

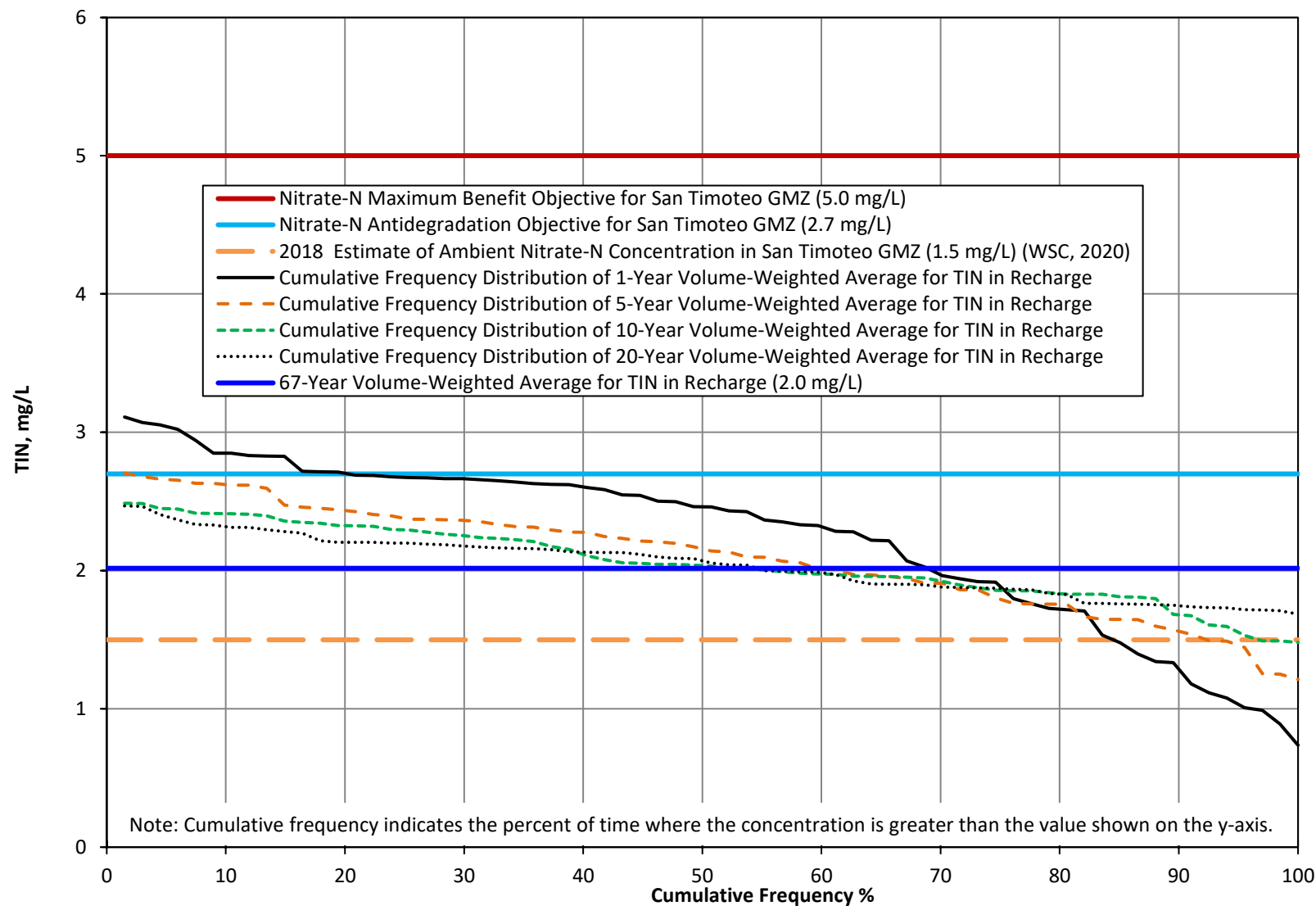
Note: This table represents an update to Table H-26 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge**



Note: This figure represents an update to Figure H-29 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge**



Note: This figure represents an update to Figure H-30 of the WLAM Summary Report (Geoscience, 2020)

**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4
Overlying San Timoteo GMZ

Supplemental Scenario F - 2040 Minimum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	6,701	2.37	2.59	2.24	2.09
1951	5,444	3.02	2.63	2.34	2.20
1952	8,809	1.72	2.37	2.25	2.15
1953	5,991	2.64	2.40	2.32	2.16
1954	7,812	2.03	2.28	2.45	2.13
1955	6,239	2.59	2.31	2.44	2.12
1956	6,664	2.46	2.23	2.41	2.18
1957	5,991	2.66	2.45	2.41	2.19
1958	9,867	1.53	2.17	2.28	2.27
1959	5,798	2.85	2.32	2.30	2.29
1960	6,030	2.67	2.33	2.32	2.28
1961	5,463	3.05	2.43	2.33	2.33
1962	6,847	2.33	2.36	2.41	2.33
1963	6,051	2.71	2.70	2.41	2.37
1964	5,974	2.72	2.68	2.49	2.47
1965	6,332	2.55	2.65	2.48	2.46
1966	8,837	1.80	2.37	2.40	2.40
1967	10,944	1.40	2.10	2.22	2.31
1968	6,520	2.50	2.07	2.35	2.31
1969	15,528	1.01	1.65	2.05	2.16
1970	6,434	2.54	1.65	2.04	2.17
1971	6,019	2.69	1.76	2.02	2.16
1972	5,916	2.83	2.01	2.05	2.21
1973	7,432	2.07	1.94	2.00	2.19
1974	7,018	2.28	2.46	1.98	2.20
1975	6,120	2.63	2.47	1.98	2.20
1976	6,967	2.33	2.40	2.03	2.20
1977	6,203	2.62	2.37	2.17	2.20
1978	14,236	1.08	1.97	1.96	2.14
1979	7,898	1.92	1.91	2.15	2.10
1980	13,726	1.12	1.60	1.95	1.99
1981	5,532	2.94	1.65	1.96	1.99
1982	7,988	1.94	1.57	1.90	1.97
1983	11,224	1.33	1.67	1.81	1.90
1984	6,130	2.65	1.76	1.83	1.90
1985	6,143	2.60	2.13	1.83	1.90
1986	6,818	2.35	2.06	1.83	1.93
1987	5,727	2.85	2.21	1.84	2.00
1988	6,009	2.68	2.62	2.05	2.00
1989	6,010	2.66	2.62	2.11	2.13
1990	5,865	2.67	2.63	2.36	2.13
1991	8,807	1.71	2.44	2.23	2.09
1992	8,186	1.76	2.21	2.21	2.04
1993	20,782	0.74	1.54	1.95	1.88
1994	6,524	2.22	1.49	1.92	1.87
1995	17,070	0.89	1.21	1.68	1.75
1996	6,727	2.22	1.25	1.67	1.75
1997	8,458	1.73	1.25	1.61	1.72
1998	11,971	1.18	1.44	1.49	1.73
1999	5,249	2.83	1.49	1.49	1.76
2000	6,129	2.46	1.91	1.48	1.84
2001	5,579	2.69	1.97	1.53	1.83
2002	5,141	3.07	2.20	1.60	1.86
2003	9,929	1.48	2.35	1.80	1.87
2004	6,110	2.43	2.29	1.81	1.86
2005	14,829	0.99	1.80	1.85	1.76
2006	6,423	2.28	1.76	1.86	1.76
2007	5,073	3.11	1.76	1.96	1.76
2008	7,733	1.92	1.86	2.08	1.74
2009	6,209	2.43	1.86	2.06	1.73
2010	7,453	1.96	2.28	2.01	1.71
2011	10,711	1.34	2.01	1.88	1.69
2012	5,629	2.66	1.96	1.85	1.71
2013	5,329	2.83	2.10	1.97	1.88
2014	5,802	2.71	2.14	1.99	1.90
2015	6,082	2.50	2.25	2.26	2.04
2016	5,779	2.62	2.66	2.29	2.05
Maximum	20,782	3.11	2.70	2.49	2.47
Average	7,716				

Note: This table represents an update to Table H-31 of the WLAM Summary Report (Geoscience, 2020)

APPENDIX C

Supplemental Predictive Scenario Results Bunker Hill-B Groundwater Management Zone



APPENDIX C:

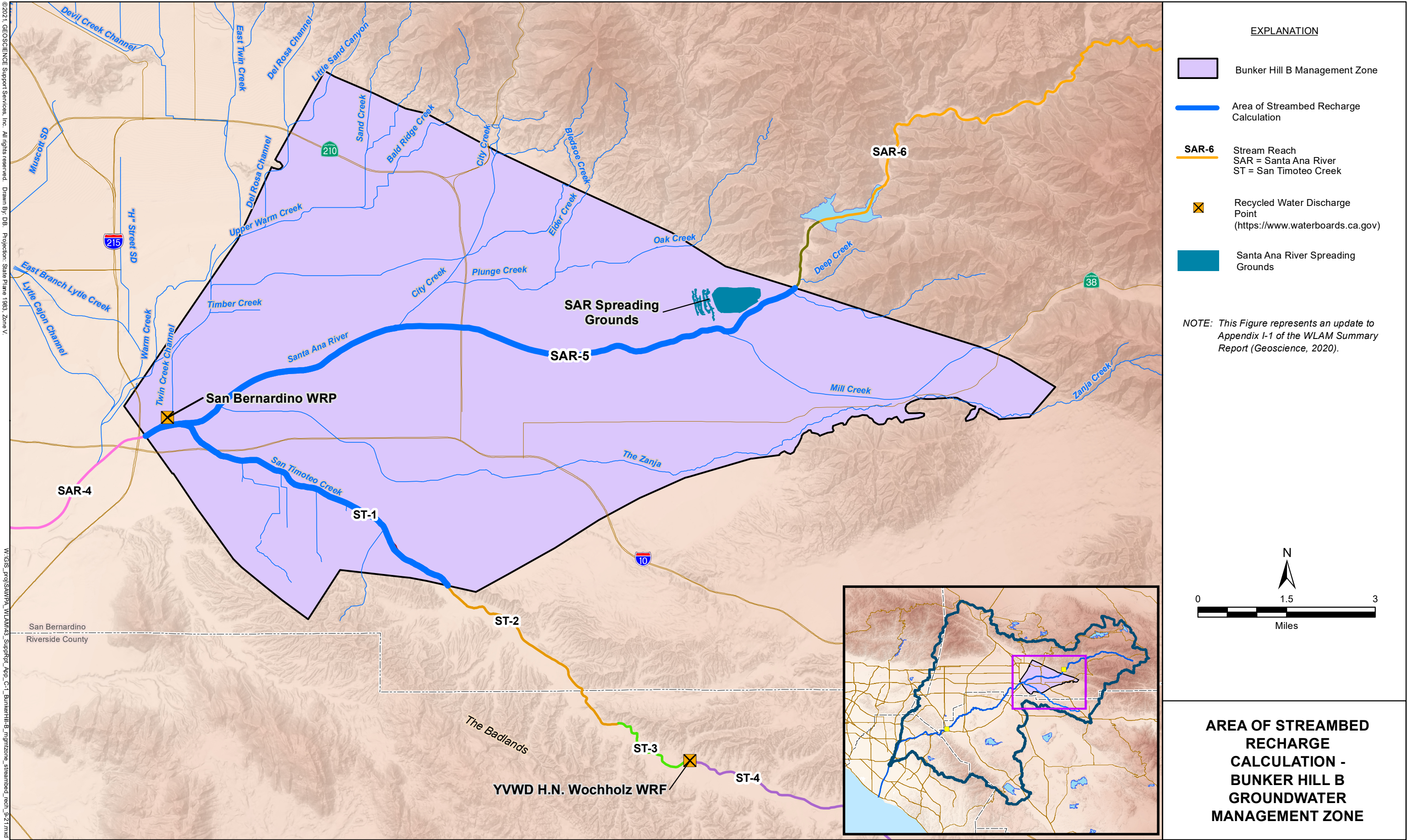
SUPPLEMENTAL PREDICTIVE SCENARIO RESULTS – BUNKER HILL-B GROUNDWATER MANAGEMENT ZONE

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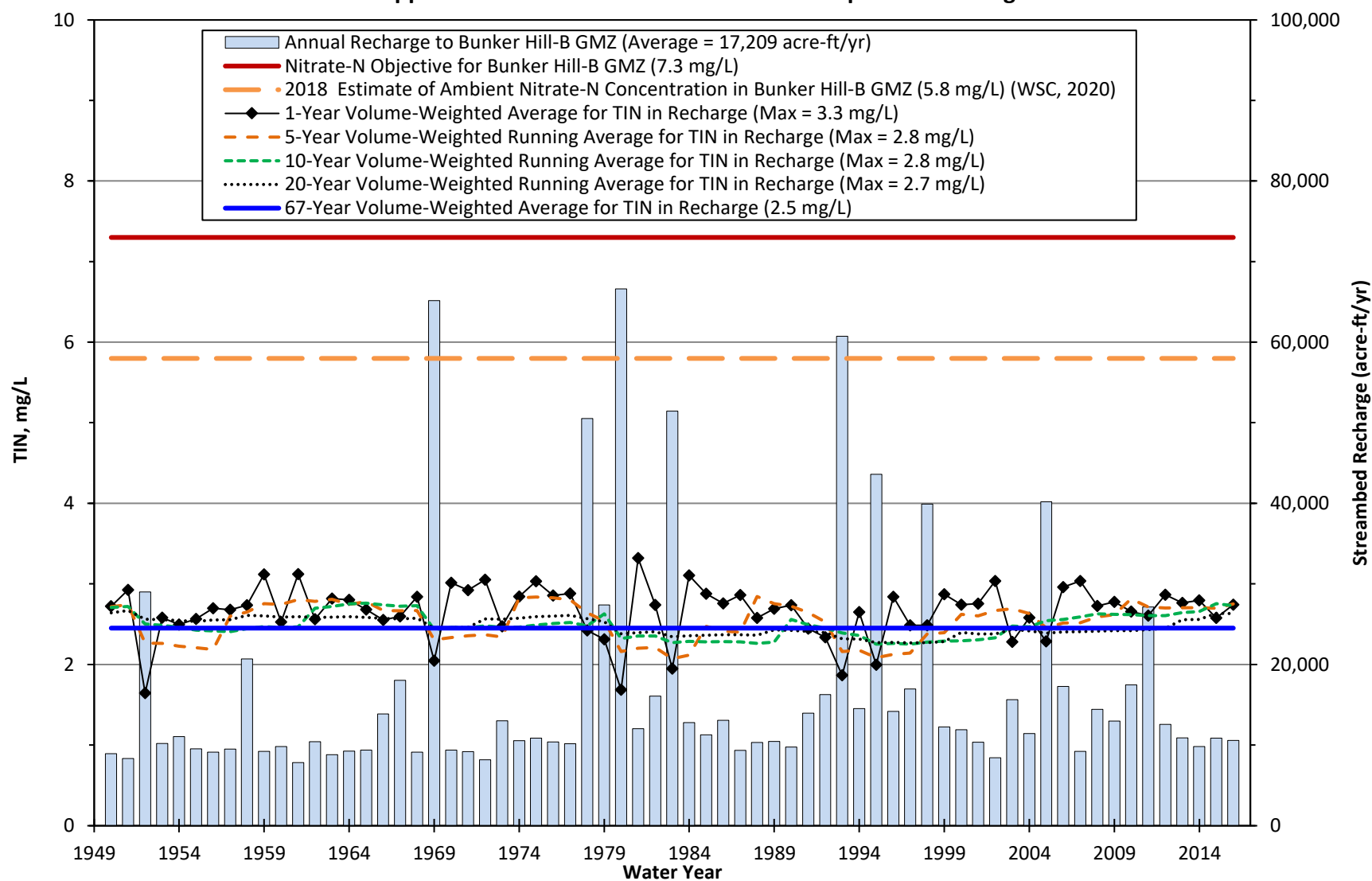
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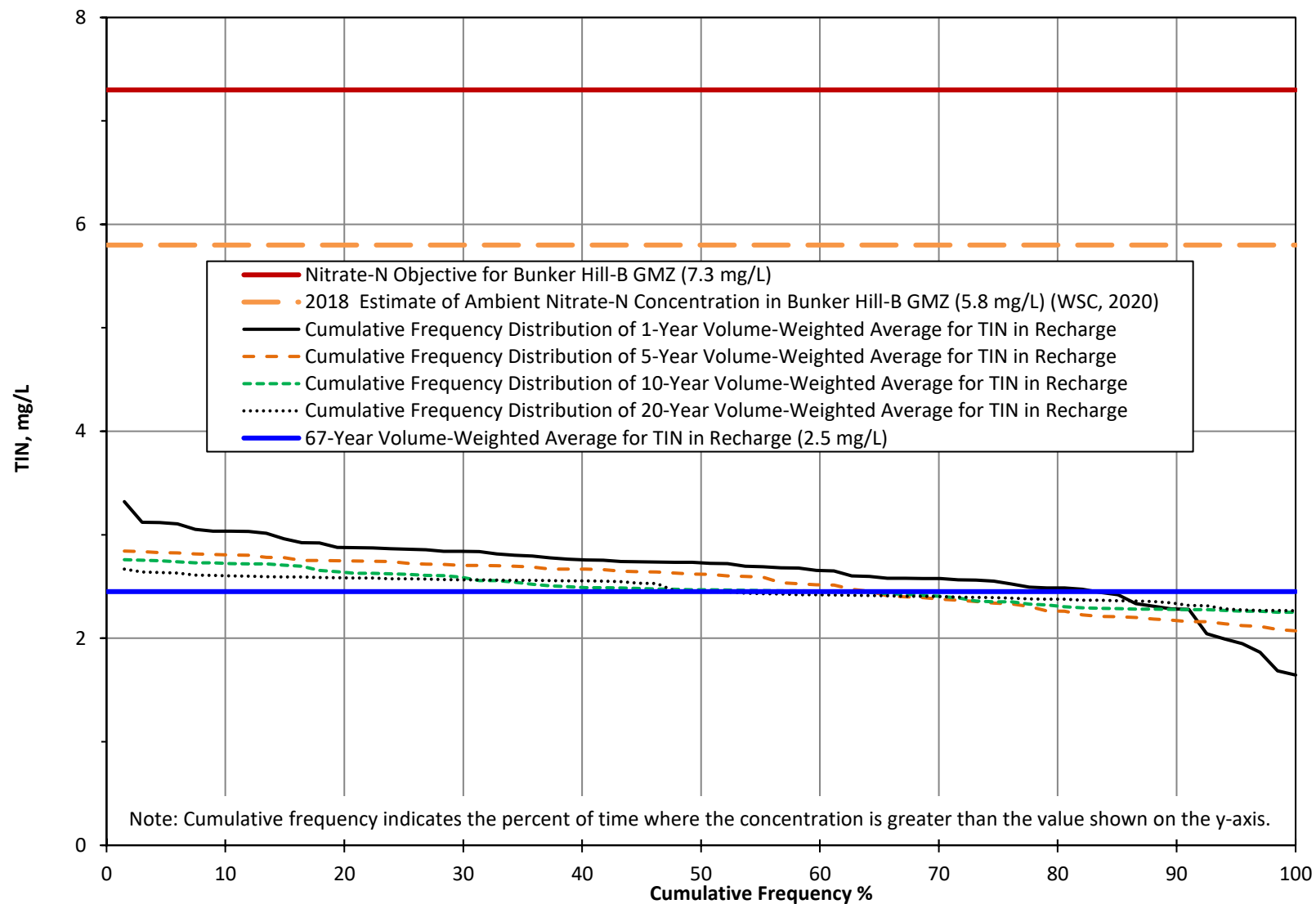
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**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge**



Note: This figure represents an update to Figure I-4 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge**



Note: This figure represents an update to Figure I-5 of the WLAM Summary Report (Geoscience, 2020)

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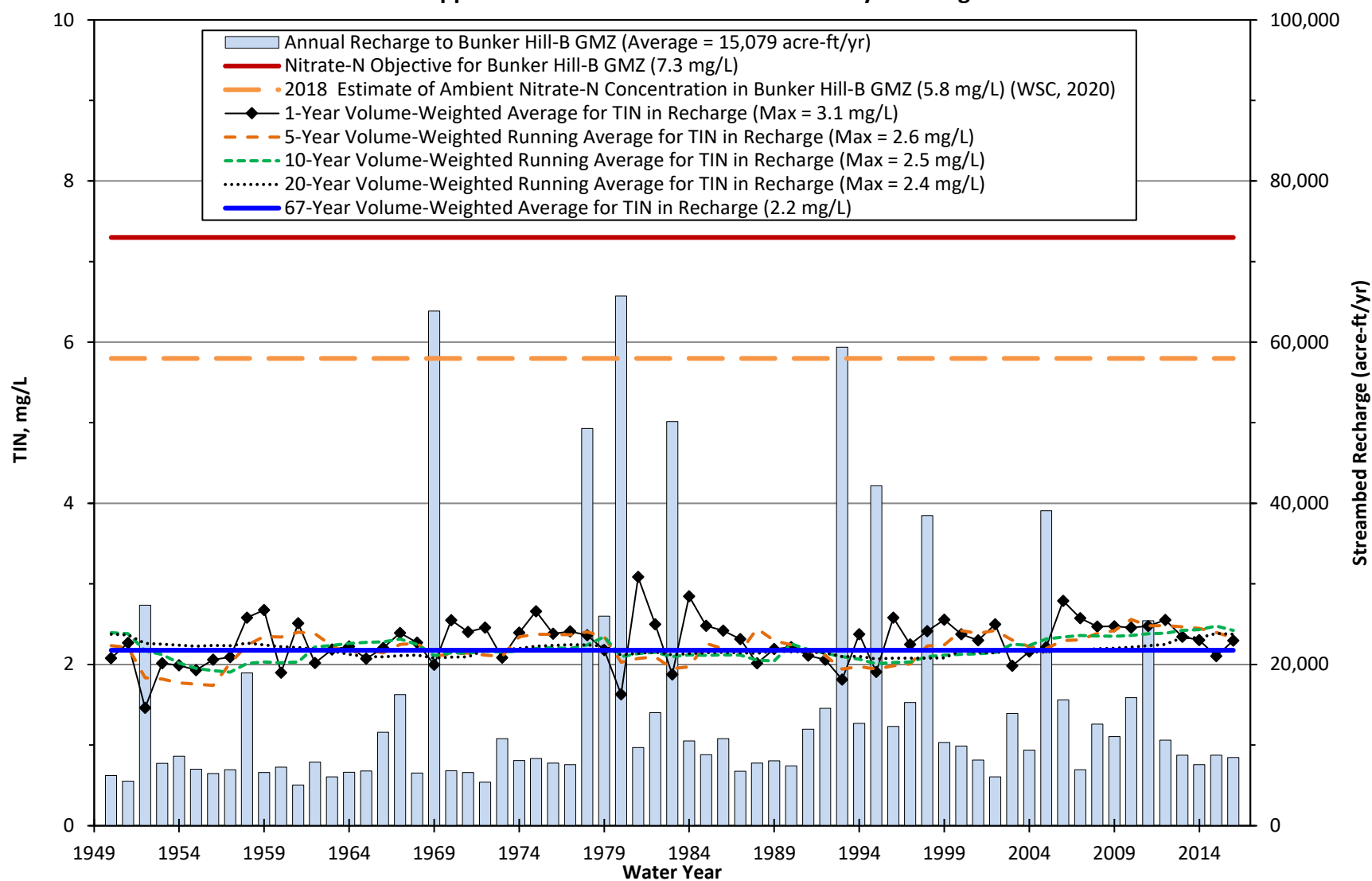
TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5
Overlying Bunker Hill-B GMZ

Supplemental Scenario A - 2020 Maximum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	8,933	2.72	2.72	2.71	2.64
1951	8,326	2.92	2.74	2.72	2.67
1952	28,999	1.65	2.26	2.50	2.56
1953	10,197	2.58	2.26	2.49	2.56
1954	11,042	2.49	2.23	2.46	2.55
1955	9,537	2.56	2.21	2.43	2.53
1956	9,099	2.70	2.19	2.42	2.55
1957	9,490	2.68	2.60	2.41	2.55
1958	20,695	2.73	2.65	2.44	2.61
1959	9,214	3.12	2.75	2.47	2.60
1960	9,814	2.53	2.75	2.46	2.59
1961	7,821	3.12	2.80	2.47	2.59
1962	10,397	2.56	2.78	2.70	2.58
1963	8,803	2.82	2.81	2.72	2.59
1964	9,222	2.80	2.75	2.75	2.59
1965	9,360	2.68	2.78	2.76	2.58
1966	13,849	2.55	2.67	2.74	2.57
1967	18,027	2.60	2.66	2.72	2.56
1968	9,106	2.84	2.67	2.73	2.57
1969	65,140	2.05	2.31	2.43	2.45
1970	9,370	3.01	2.33	2.46	2.46
1971	9,173	2.92	2.35	2.45	2.46
1972	8,158	3.05	2.37	2.48	2.57
1973	12,988	2.47	2.34	2.46	2.56
1974	10,546	2.84	2.83	2.46	2.57
1975	10,839	3.03	2.84	2.49	2.59
1976	10,362	2.86	2.83	2.51	2.60
1977	10,155	2.88	2.80	2.52	2.61
1978	50,528	2.42	2.64	2.48	2.57
1979	27,394	2.31	2.54	2.63	2.53
1980	66,624	1.68	2.16	2.32	2.38
1981	12,013	3.32	2.20	2.35	2.40
1982	16,068	2.74	2.21	2.35	2.40
1983	51,449	1.95	2.07	2.27	2.34
1984	12,771	3.10	2.11	2.29	2.35
1985	11,250	2.88	2.47	2.28	2.36
1986	13,063	2.76	2.41	2.28	2.37
1987	9,346	2.86	2.40	2.28	2.37
1988	10,325	2.58	2.84	2.26	2.36
1989	10,451	2.69	2.75	2.28	2.43
1990	9,746	2.74	2.72	2.56	2.42
1991	13,945	2.44	2.64	2.49	2.41
1992	16,259	2.34	2.53	2.45	2.39
1993	60,745	1.87	2.16	2.39	2.32
1994	14,523	2.65	2.17	2.36	2.32
1995	43,599	1.99	2.09	2.25	2.27
1996	14,183	2.84	2.12	2.26	2.27
1997	16,962	2.49	2.14	2.25	2.27
1998	39,893	2.49	2.38	2.28	2.27
1999	12,227	2.87	2.39	2.29	2.28
2000	11,898	2.74	2.62	2.29	2.40
2001	10,332	2.75	2.60	2.30	2.38
2002	8,402	3.03	2.67	2.33	2.38
2003	15,617	2.28	2.69	2.47	2.44
2004	11,429	2.58	2.63	2.47	2.42
2005	40,191	2.28	2.45	2.54	2.39
2006	17,259	2.96	2.51	2.56	2.40
2007	9,197	3.04	2.52	2.59	2.41
2008	14,406	2.73	2.59	2.63	2.41
2009	12,979	2.78	2.62	2.62	2.42
2010	17,469	2.66	2.81	2.62	2.42
2011	27,132	2.60	2.71	2.61	2.43
2012	12,567	2.86	2.70	2.60	2.45
2013	10,867	2.76	2.70	2.64	2.56
2014	9,793	2.79	2.70	2.66	2.56
2015	10,855	2.58	2.70	2.76	2.64
2016	10,580	2.74	2.75	2.73	2.63
Maximum	66,624	3.32	2.84	2.76	2.67
Average	17,209				

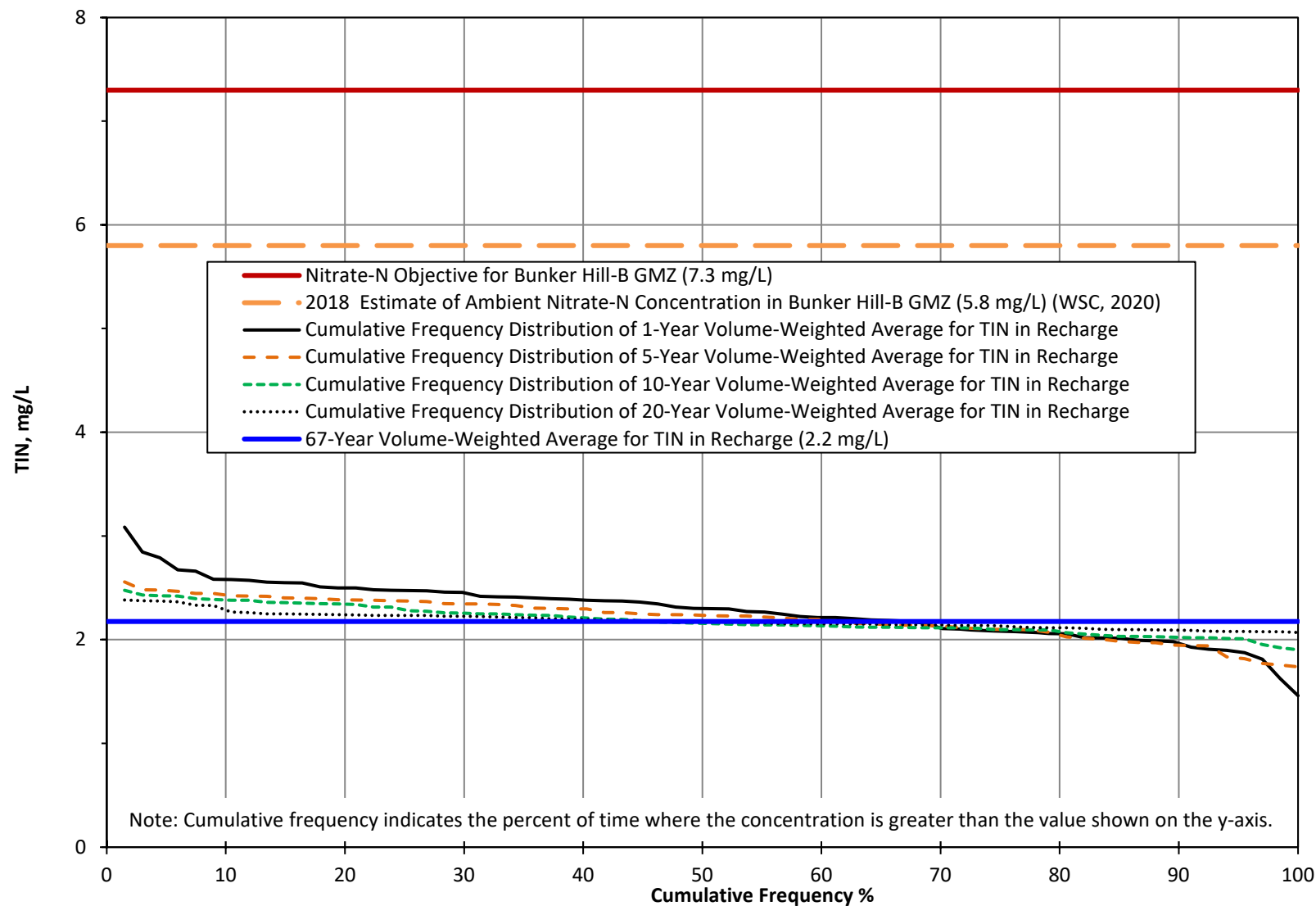
Note: This table represents an update to Table I-6 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario B - 2020 Most Likely Discharge**



Note: This figure represents an update to Figure I-9 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario B - 2020 Most Likely Discharge**



Note: This figure represents an update to Figure I-10 of the WLAM Summary Report (Geoscience, 2020)

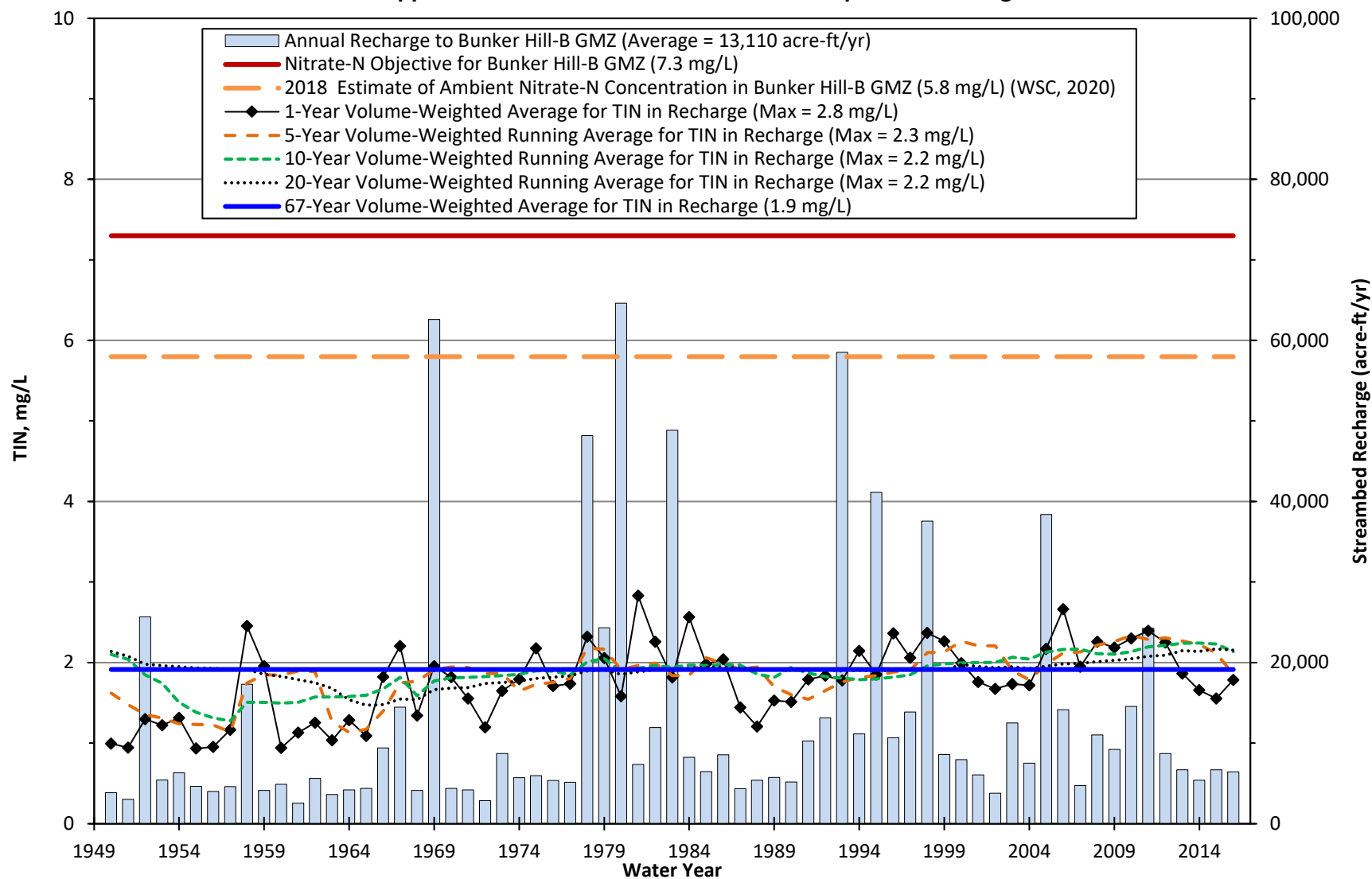
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TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5
Overlying Bunker Hill-B GMZ
Supplemental Scenario B - 2020 Most Likely Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	6,211	2.08	2.23	2.40	2.37
1951	5,494	2.27	2.21	2.38	2.37
1952	27,356	1.46	1.83	2.17	2.26
1953	7,720	2.02	1.82	2.12	2.25
1954	8,602	1.99	1.77	2.02	2.24
1955	6,991	1.93	1.76	1.95	2.22
1956	6,446	2.06	1.74	1.92	2.23
1957	6,934	2.09	2.01	1.90	2.23
1958	18,948	2.58	2.24	2.01	2.27
1959	6,590	2.67	2.35	2.03	2.24
1960	7,234	1.90	2.34	2.02	2.22
1961	5,027	2.51	2.40	2.03	2.21
1962	7,892	2.02	2.38	2.22	2.19
1963	6,057	2.18	2.23	2.23	2.17
1964	6,601	2.22	2.14	2.26	2.12
1965	6,768	2.07	2.18	2.27	2.10
1966	11,577	2.20	2.14	2.28	2.09
1967	16,239	2.39	2.25	2.31	2.11
1968	6,534	2.27	2.26	2.25	2.12
1969	63,855	1.99	2.10	2.11	2.08
1970	6,802	2.55	2.13	2.14	2.09
1971	6,594	2.40	2.14	2.14	2.09
1972	5,391	2.46	2.12	2.16	2.18
1973	10,797	2.08	2.10	2.15	2.18
1974	8,058	2.39	2.34	2.17	2.20
1975	8,316	2.66	2.38	2.20	2.22
1976	7,761	2.38	2.37	2.21	2.23
1977	7,554	2.41	2.37	2.20	2.25
1978	49,300	2.36	2.40	2.24	2.24
1979	25,991	2.18	2.34	2.34	2.23
1980	65,725	1.63	2.03	2.10	2.12
1981	9,674	3.09	2.07	2.13	2.14
1982	14,001	2.50	2.09	2.15	2.15
1983	50,136	1.88	1.95	2.10	2.12
1984	10,510	2.85	1.97	2.12	2.14
1985	8,793	2.48	2.26	2.11	2.14
1986	10,780	2.42	2.19	2.12	2.15
1987	6,732	2.31	2.16	2.12	2.14
1988	7,754	2.01	2.45	2.05	2.14
1989	8,027	2.19	2.30	2.04	2.17
1990	7,402	2.21	2.24	2.26	2.16
1991	11,955	2.11	2.16	2.18	2.15
1992	14,536	2.06	2.11	2.14	2.15
1993	59,377	1.81	1.94	2.10	2.10
1994	12,690	2.37	1.97	2.07	2.10
1995	42,170	1.91	1.94	2.01	2.07
1996	12,309	2.58	1.98	2.02	2.08
1997	15,262	2.25	2.00	2.03	2.08
1998	38,482	2.41	2.23	2.10	2.08
1999	10,311	2.56	2.24	2.12	2.08
2000	9,865	2.37	2.42	2.12	2.17
2001	8,140	2.30	2.38	2.13	2.15
2002	6,048	2.50	2.42	2.15	2.14
2003	13,912	1.98	2.30	2.25	2.18
2004	9,370	2.16	2.22	2.24	2.16
2005	39,092	2.21	2.20	2.31	2.15
2006	15,594	2.79	2.30	2.34	2.17
2007	6,929	2.57	2.30	2.36	2.18
2008	12,597	2.47	2.38	2.35	2.19
2009	11,042	2.47	2.42	2.35	2.20
2010	15,880	2.46	2.56	2.36	2.21
2011	25,426	2.48	2.48	2.38	2.23
2012	10,601	2.55	2.48	2.39	2.25
2013	8,747	2.34	2.47	2.42	2.33
2014	7,566	2.30	2.45	2.43	2.33
2015	8,734	2.10	2.40	2.48	2.39
2016	8,458	2.30	2.33	2.42	2.37
Maximum	65,725	3.09	2.56	2.48	2.39
Average	15,079				

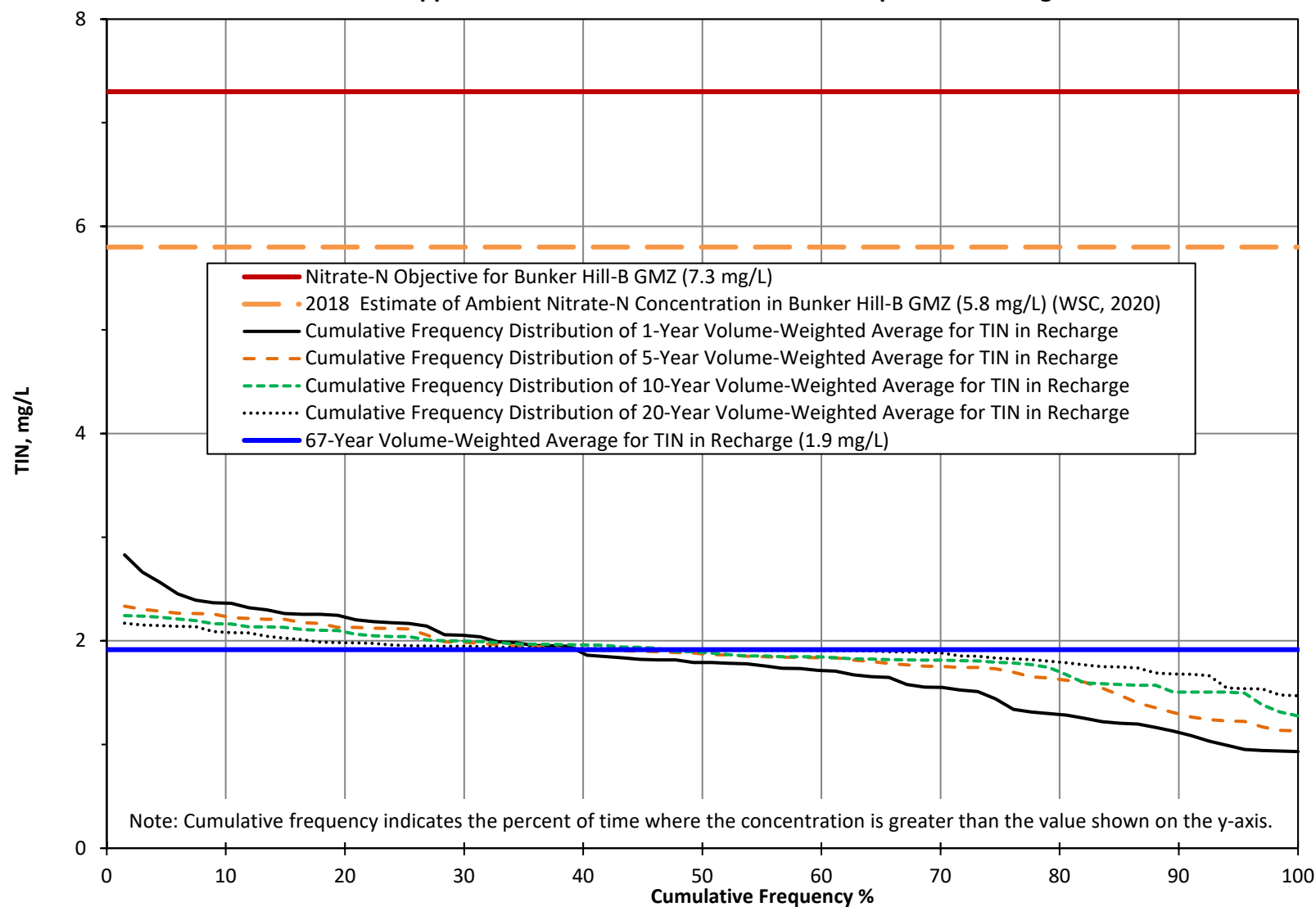
Note: This table represents an update to Table I-11 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge**



Note: This figure represents an update to Figure I-14 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge**



Note: This figure represents an update to Figure I-15 of the WLAM Summary Report (Geoscience, 2020)

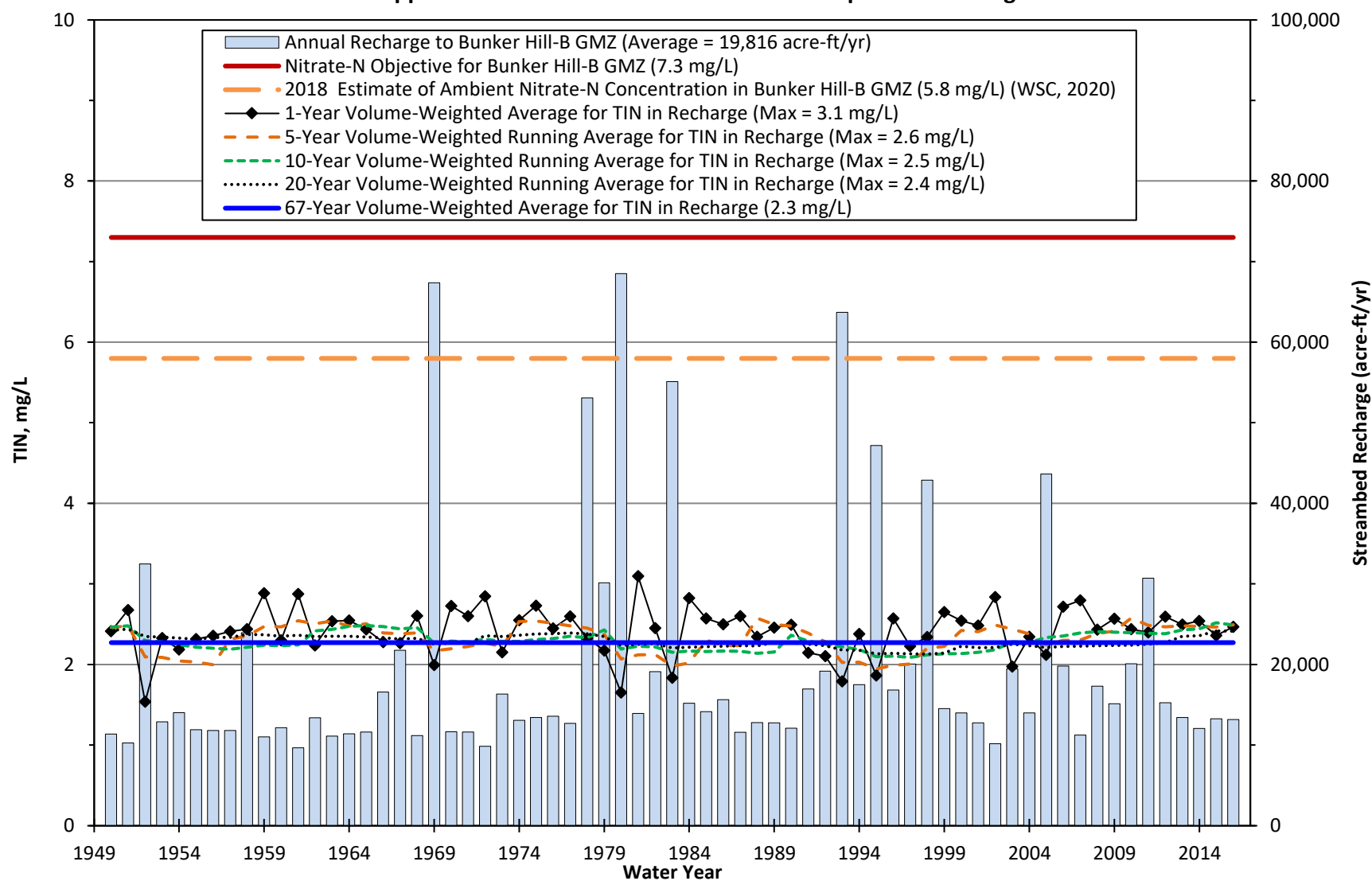
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5
Overlying Bunker Hill-B GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	3,817	0.99	1.62	2.10	2.14
1951	3,010	0.94	1.48	2.04	2.08
1952	25,666	1.30	1.35	1.85	1.98
1953	5,408	1.22	1.31	1.74	1.96
1954	6,300	1.31	1.24	1.51	1.95
1955	4,623	0.93	1.23	1.38	1.93
1956	3,994	0.95	1.22	1.31	1.92
1957	4,578	1.17	1.14	1.28	1.92
1958	17,304	2.45	1.74	1.51	1.91
1959	4,122	1.96	1.85	1.51	1.85
1960	4,867	0.94	1.84	1.50	1.83
1961	2,531	1.13	1.89	1.51	1.79
1962	5,589	1.25	1.89	1.57	1.75
1963	3,609	1.03	1.27	1.57	1.68
1964	4,187	1.28	1.13	1.58	1.54
1965	4,375	1.09	1.17	1.59	1.47
1966	9,411	1.82	1.40	1.67	1.48
1967	14,453	2.20	1.74	1.81	1.55
1968	4,121	1.34	1.77	1.59	1.54
1969	62,599	1.95	1.91	1.77	1.66
1970	4,359	1.82	1.94	1.81	1.68
1971	4,180	1.55	1.94	1.81	1.69
1972	2,850	1.20	1.86	1.83	1.74
1973	8,694	1.65	1.87	1.84	1.75
1974	5,694	1.79	1.64	1.85	1.77
1975	5,948	2.18	1.73	1.90	1.80
1976	5,354	1.71	1.75	1.89	1.82
1977	5,135	1.74	1.80	1.85	1.83
1978	48,189	2.32	2.18	2.01	1.89
1979	24,326	2.06	2.17	2.05	1.91
1980	64,604	1.58	1.91	1.88	1.85
1981	7,333	2.83	1.96	1.93	1.88
1982	11,915	2.26	1.99	1.96	1.91
1983	48,830	1.82	1.84	1.94	1.91
1984	8,229	2.57	1.84	1.97	1.93
1985	6,453	1.98	2.06	1.96	1.94
1986	8,532	2.04	1.99	1.97	1.95
1987	4,324	1.44	1.91	1.97	1.93
1988	5,377	1.20	1.94	1.86	1.92
1989	5,741	1.53	1.70	1.82	1.91
1990	5,171	1.51	1.60	1.94	1.90
1991	10,236	1.79	1.54	1.87	1.91
1992	13,114	1.84	1.65	1.82	1.91
1993	58,508	1.78	1.76	1.81	1.89
1994	11,122	2.14	1.81	1.79	1.90
1995	41,142	1.85	1.84	1.79	1.89
1996	10,657	2.36	1.88	1.82	1.91
1997	13,848	2.06	1.90	1.85	1.92
1998	37,544	2.37	2.12	1.96	1.91
1999	8,584	2.26	2.13	1.98	1.91
2000	7,930	1.99	2.26	1.99	1.98
2001	6,052	1.76	2.21	2.00	1.95
2002	3,764	1.67	2.21	2.00	1.94
2003	12,487	1.73	1.90	2.07	1.95
2004	7,485	1.72	1.78	2.04	1.92
2005	38,385	2.17	1.98	2.13	1.95
2006	14,137	2.66	2.12	2.16	1.98
2007	4,709	1.95	2.13	2.17	1.99
2008	11,021	2.26	2.22	2.11	2.01
2009	9,207	2.19	2.26	2.10	2.03
2010	14,534	2.30	2.34	2.13	2.05
2011	24,244	2.39	2.29	2.20	2.08
2012	8,691	2.25	2.30	2.21	2.09
2013	6,683	1.86	2.27	2.24	2.15
2014	5,372	1.66	2.22	2.24	2.14
2015	6,686	1.55	2.11	2.23	2.17
2016	6,409	1.78	1.85	2.14	2.15
Maximum	64,604	2.83	2.34	2.24	2.17
Average	13,110				

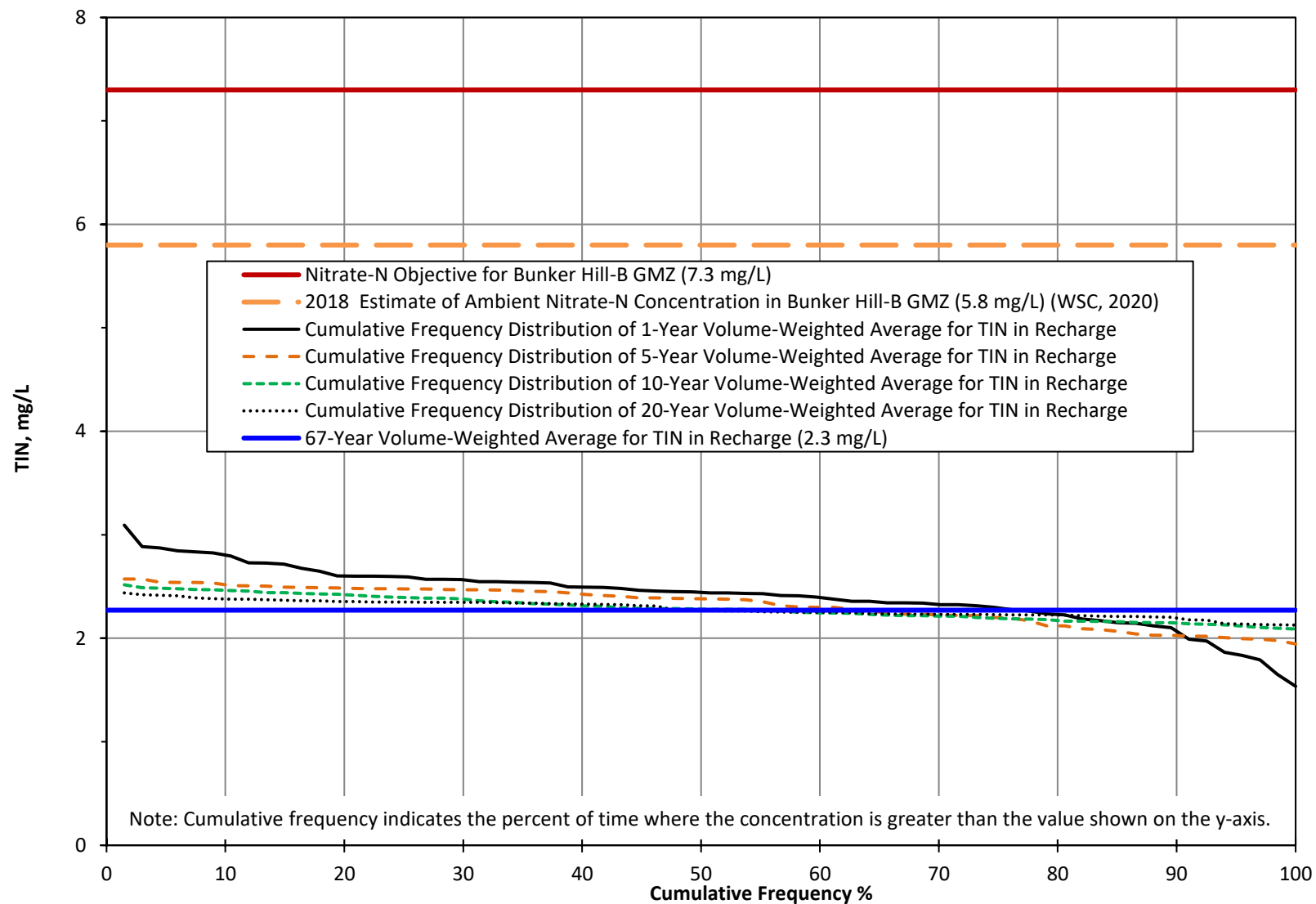
Note: This table represents an update to Table I-16 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge**



Note: This figure represents an update to Figure I-19 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge**



Note: This figure represents an update to Figure I-20 of the WLAM Summary Report (Geoscience, 2020)

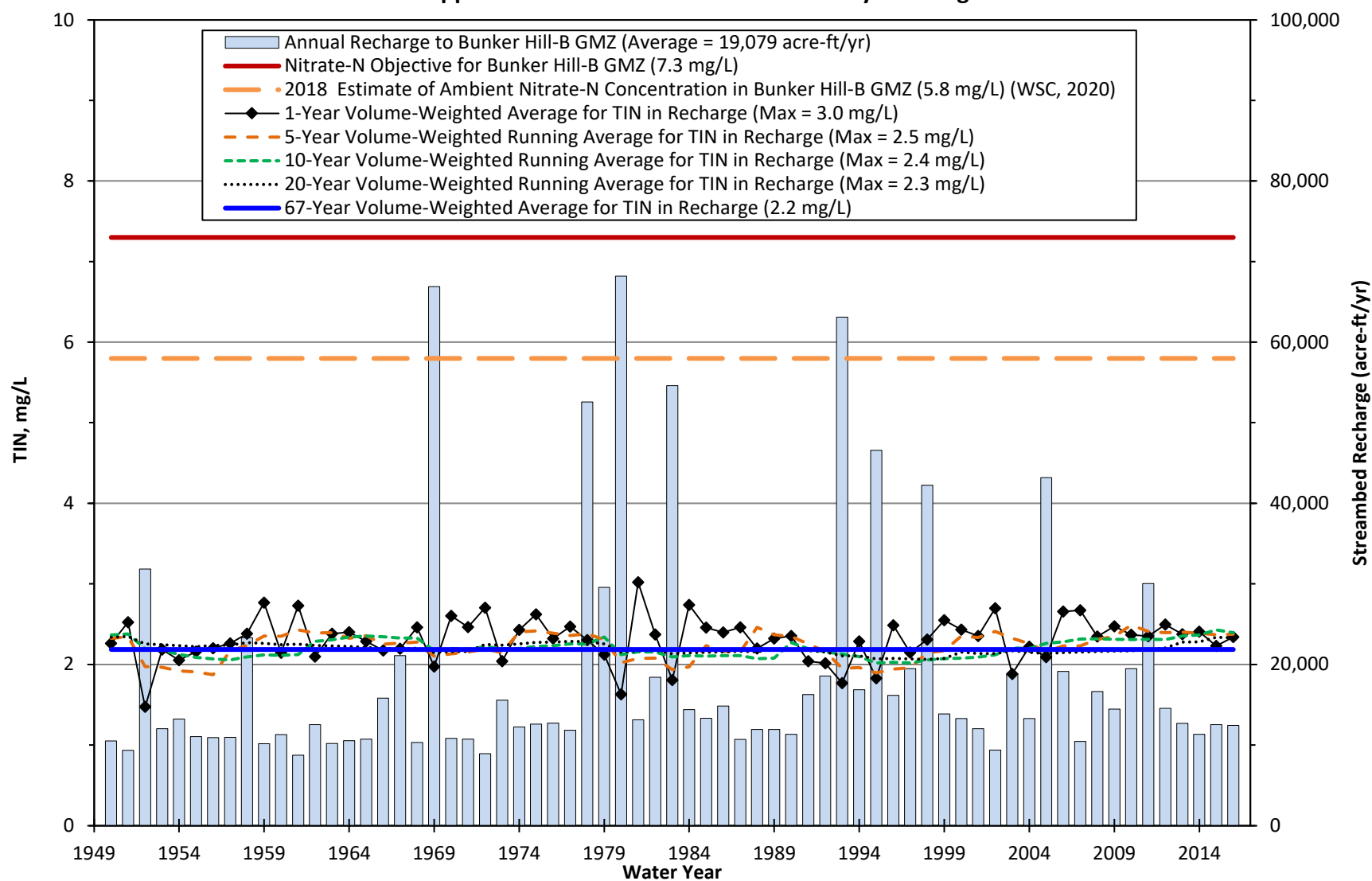
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5
Overlying Bunker Hill-B GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	11,351	2.41	2.45	2.46	2.42
1951	10,244	2.68	2.48	2.48	2.44
1952	32,468	1.54	2.09	2.29	2.35
1953	12,865	2.33	2.09	2.28	2.34
1954	14,023	2.18	2.04	2.25	2.33
1955	11,885	2.31	2.03	2.21	2.31
1956	11,801	2.36	2.00	2.20	2.33
1957	11,810	2.41	2.31	2.19	2.34
1958	23,934	2.44	2.35	2.21	2.37
1959	11,014	2.89	2.47	2.24	2.37
1960	12,150	2.30	2.47	2.23	2.35
1961	9,651	2.87	2.54	2.24	2.36
1962	13,375	2.24	2.51	2.42	2.35
1963	11,099	2.54	2.54	2.43	2.35
1964	11,400	2.55	2.48	2.47	2.35
1965	11,607	2.43	2.50	2.48	2.34
1966	16,555	2.28	2.39	2.47	2.33
1967	21,757	2.27	2.38	2.44	2.32
1968	11,178	2.60	2.39	2.46	2.32
1969	67,383	1.99	2.17	2.26	2.25
1970	11,654	2.73	2.19	2.29	2.26
1971	11,597	2.60	2.22	2.28	2.26
1972	9,831	2.85	2.27	2.31	2.36
1973	16,311	2.15	2.22	2.29	2.35
1974	13,065	2.55	2.53	2.29	2.36
1975	13,421	2.73	2.54	2.31	2.38
1976	13,563	2.45	2.51	2.32	2.38
1977	12,691	2.60	2.48	2.35	2.39
1978	53,087	2.32	2.45	2.33	2.38
1979	30,124	2.17	2.37	2.43	2.34
1980	68,507	1.65	2.07	2.19	2.23
1981	13,921	3.10	2.12	2.22	2.25
1982	19,112	2.45	2.12	2.22	2.26
1983	55,110	1.83	1.98	2.15	2.20
1984	15,190	2.82	2.02	2.17	2.21
1985	14,122	2.57	2.30	2.16	2.22
1986	15,613	2.50	2.23	2.16	2.23
1987	11,577	2.60	2.23	2.16	2.23
1988	12,785	2.34	2.57	2.14	2.23
1989	12,736	2.46	2.49	2.15	2.27
1990	12,096	2.49	2.48	2.36	2.27
1991	16,941	2.14	2.39	2.29	2.25
1992	19,174	2.10	2.28	2.25	2.23
1993	63,714	1.79	2.02	2.22	2.18
1994	17,474	2.38	2.03	2.19	2.17
1995	47,175	1.86	1.95	2.10	2.13
1996	16,809	2.57	1.99	2.10	2.14
1997	20,063	2.23	2.01	2.09	2.13
1998	42,871	2.34	2.20	2.12	2.13
1999	14,532	2.65	2.22	2.13	2.14
2000	13,987	2.54	2.42	2.14	2.23
2001	12,734	2.48	2.41	2.15	2.21
2002	10,146	2.84	2.49	2.18	2.21
2003	19,437	1.97	2.44	2.28	2.25
2004	13,985	2.34	2.38	2.27	2.23
2005	43,631	2.12	2.24	2.34	2.21
2006	19,781	2.72	2.30	2.35	2.22
2007	11,214	2.80	2.30	2.39	2.23
2008	17,283	2.43	2.38	2.41	2.23
2009	15,126	2.57	2.41	2.40	2.24
2010	20,084	2.44	2.57	2.39	2.24
2011	30,713	2.40	2.49	2.39	2.25
2012	15,251	2.59	2.47	2.38	2.27
2013	13,404	2.49	2.48	2.43	2.35
2014	12,061	2.54	2.47	2.44	2.35
2015	13,240	2.36	2.46	2.52	2.42
2016	13,171	2.46	2.49	2.49	2.41
Maximum	68,507	3.10	2.57	2.52	2.44
Average	19,816				

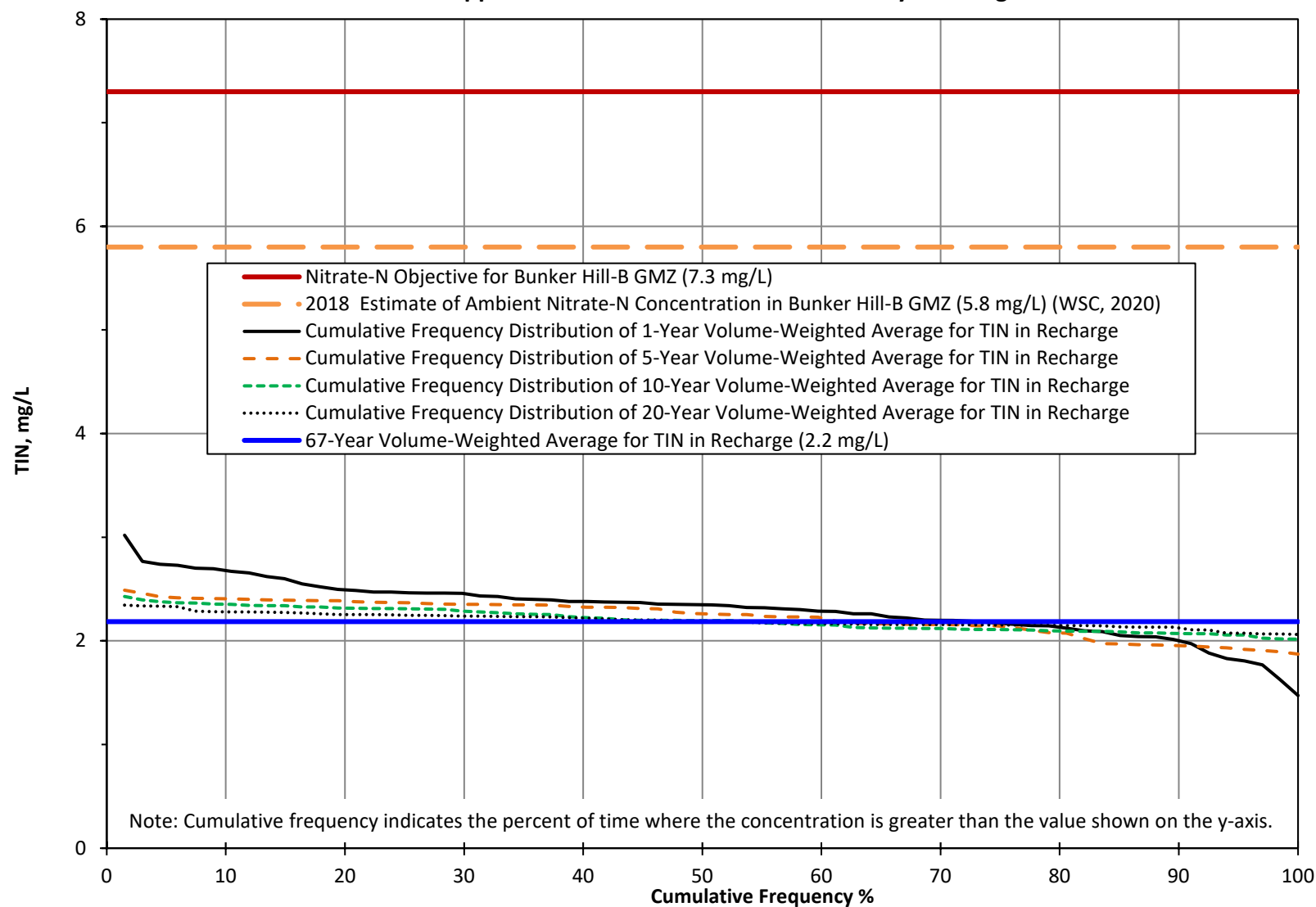
Note: This table represents an update to Table I-21 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario E - 2040 Most Likely Discharge**



Note: This figure represents an update to Figure I-24 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario E - 2040 Most Likely Discharge**



Note: This figure represents an update to Figure I-25 of the WLAM Summary Report (Geoscience, 2020)

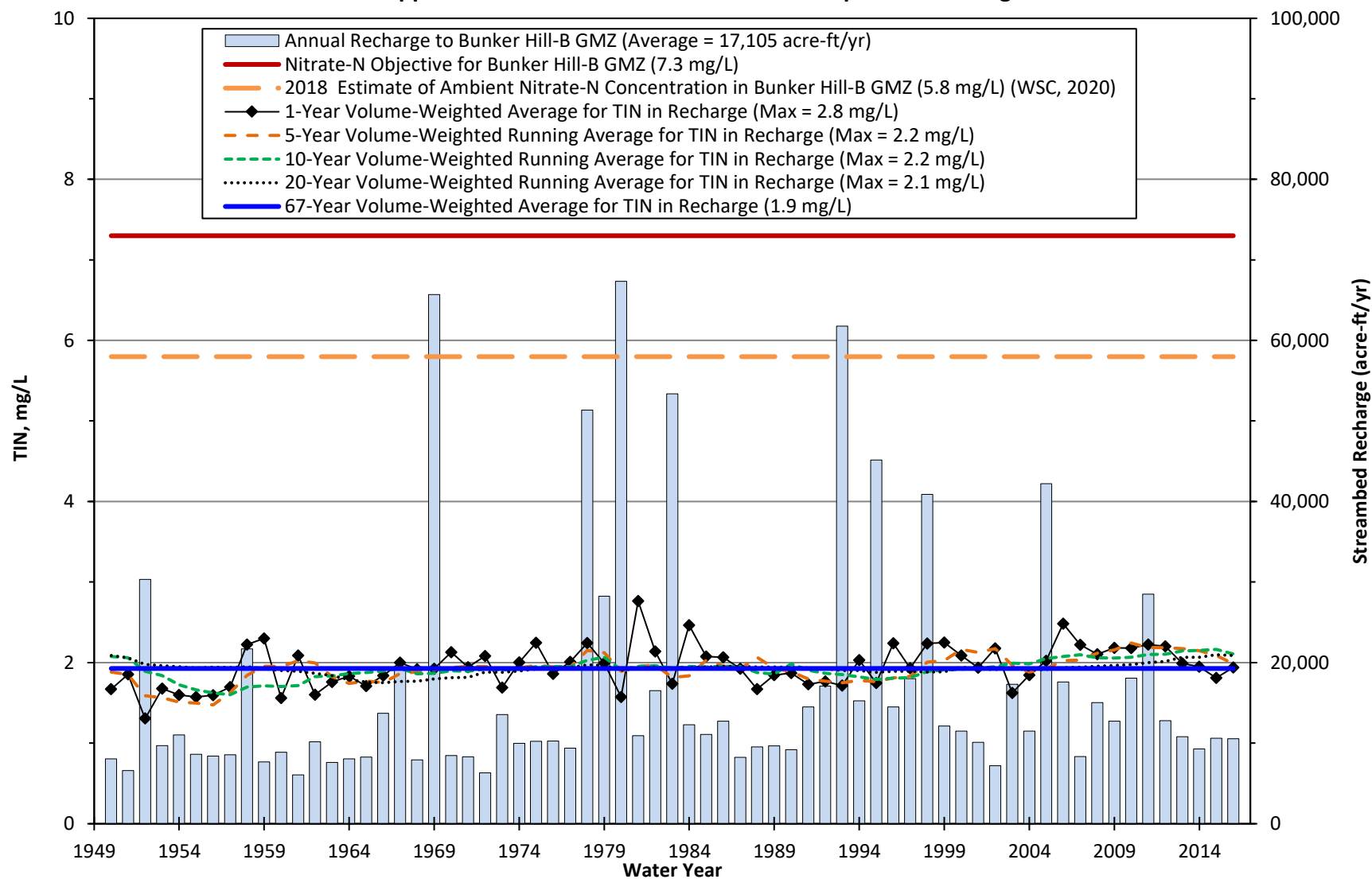
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5
Overlying Bunker Hill-B GMZ
Supplemental Scenario E - 2040 Most Likely Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	10,504	2.26	2.32	2.37	2.34
1951	9,317	2.52	2.34	2.38	2.35
1952	31,853	1.47	1.97	2.20	2.25
1953	12,019	2.18	1.96	2.17	2.25
1954	13,227	2.05	1.92	2.12	2.23
1955	11,024	2.16	1.91	2.09	2.22
1956	10,914	2.20	1.87	2.07	2.24
1957	10,955	2.26	2.17	2.06	2.24
1958	23,288	2.38	2.24	2.09	2.27
1959	10,140	2.77	2.35	2.12	2.26
1960	11,292	2.14	2.35	2.11	2.24
1961	8,731	2.73	2.43	2.12	2.25
1962	12,533	2.10	2.39	2.29	2.23
1963	10,200	2.38	2.39	2.30	2.23
1964	10,527	2.40	2.32	2.34	2.22
1965	10,733	2.29	2.36	2.35	2.21
1966	15,798	2.17	2.25	2.34	2.20
1967	21,106	2.20	2.26	2.33	2.19
1968	10,318	2.46	2.28	2.33	2.20
1969	66,892	1.97	2.10	2.17	2.15
1970	10,809	2.60	2.13	2.20	2.16
1971	10,732	2.46	2.15	2.19	2.16
1972	8,923	2.70	2.19	2.22	2.25
1973	15,563	2.04	2.15	2.20	2.24
1974	12,244	2.43	2.40	2.20	2.25
1975	12,581	2.62	2.41	2.22	2.27
1976	12,703	2.32	2.39	2.23	2.28
1977	11,827	2.47	2.36	2.25	2.29
1978	52,564	2.30	2.38	2.26	2.28
1979	29,566	2.12	2.31	2.34	2.25
1980	68,182	1.63	2.02	2.12	2.15
1981	13,111	3.02	2.07	2.16	2.17
1982	18,410	2.37	2.08	2.15	2.18
1983	54,593	1.81	1.93	2.09	2.13
1984	14,400	2.74	1.97	2.11	2.14
1985	13,317	2.46	2.23	2.10	2.15
1986	14,841	2.40	2.16	2.11	2.16
1987	10,702	2.46	2.16	2.11	2.16
1988	11,927	2.20	2.46	2.07	2.16
1989	11,922	2.32	2.37	2.08	2.19
1990	11,315	2.35	2.35	2.27	2.19
1991	16,268	2.04	2.25	2.20	2.17
1992	18,575	2.01	2.16	2.16	2.15
1993	63,093	1.77	1.95	2.13	2.11
1994	16,840	2.29	1.96	2.10	2.10
1995	46,554	1.83	1.90	2.02	2.07
1996	16,147	2.49	1.94	2.03	2.07
1997	19,469	2.15	1.96	2.02	2.07
1998	42,231	2.31	2.15	2.06	2.06
1999	13,844	2.55	2.17	2.07	2.07
2000	13,294	2.43	2.35	2.08	2.15
2001	12,004	2.35	2.33	2.09	2.13
2002	9,362	2.70	2.41	2.12	2.14
2003	18,834	1.88	2.33	2.20	2.17
2004	13,280	2.22	2.26	2.20	2.15
2005	43,183	2.09	2.16	2.26	2.13
2006	19,142	2.65	2.23	2.28	2.15
2007	10,437	2.67	2.23	2.31	2.15
2008	16,645	2.35	2.31	2.32	2.16
2009	14,458	2.47	2.35	2.31	2.17
2010	19,492	2.37	2.49	2.31	2.17
2011	30,045	2.35	2.41	2.31	2.19
2012	14,554	2.50	2.39	2.31	2.20
2013	12,681	2.38	2.40	2.35	2.28
2014	11,313	2.41	2.39	2.37	2.28
2015	12,517	2.23	2.37	2.43	2.34
2016	12,445	2.34	2.37	2.39	2.33
Maximum	68,182	3.02	2.49	2.43	2.35
Average	19,079				

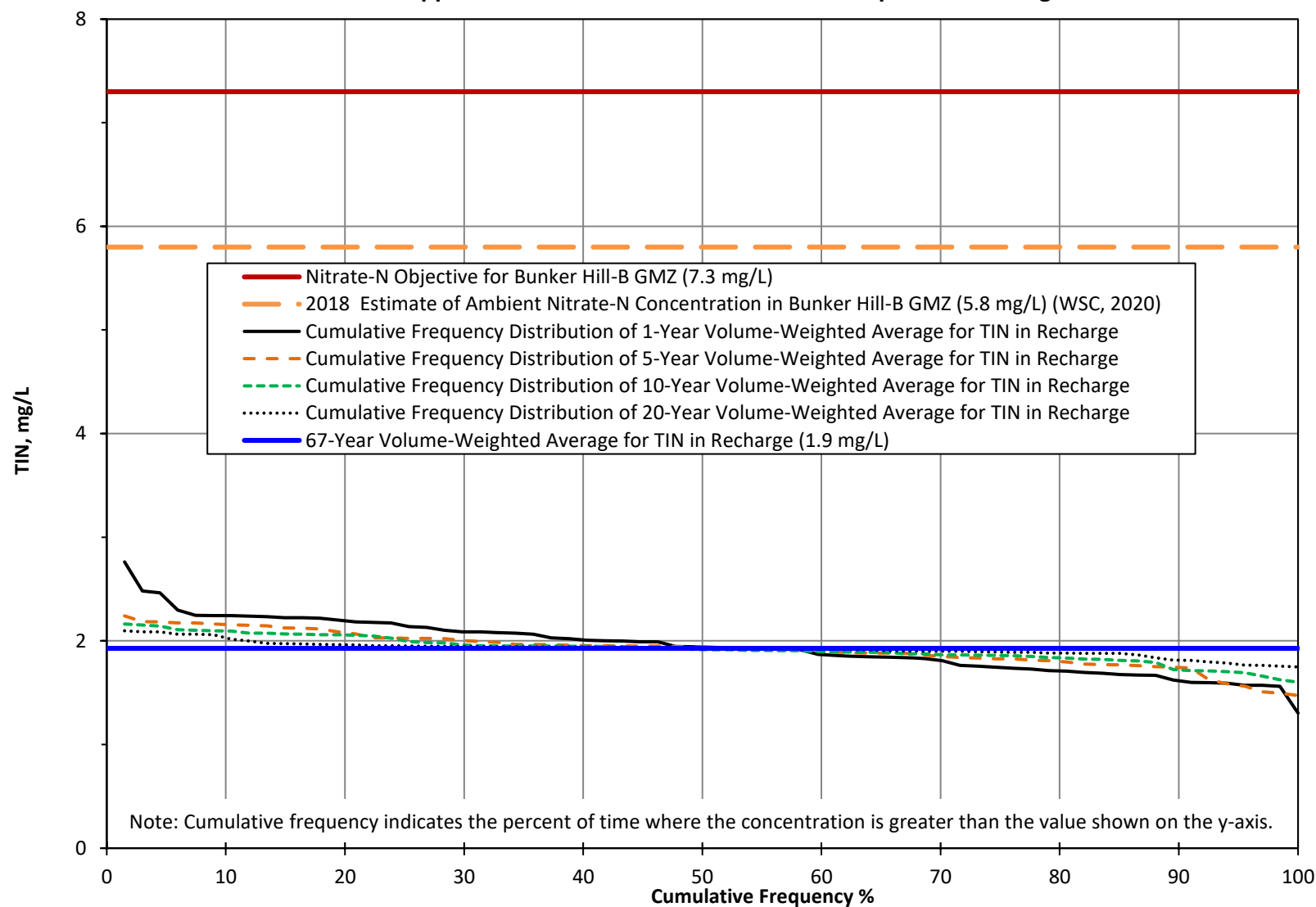
Note: This table represents an update to Table I-26 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge**



Note: This figure represents an update to Figure I-29 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge**



Note: This figure represents an update to Figure I-30 of the WLAM Summary Report (Geoscience, 2020)

**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5
Overlying Bunker Hill-B GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	8,039	1.67	1.88	2.07	2.09
1951	6,570	1.85	1.85	2.06	2.06
1952	30,326	1.31	1.59	1.89	1.97
1953	9,674	1.68	1.56	1.84	1.96
1954	11,009	1.60	1.51	1.72	1.95
1955	8,615	1.57	1.50	1.66	1.93
1956	8,396	1.59	1.47	1.62	1.94
1957	8,541	1.70	1.63	1.60	1.94
1958	21,689	2.22	1.84	1.69	1.95
1959	7,649	2.30	1.95	1.71	1.92
1960	8,868	1.56	1.95	1.70	1.90
1961	6,043	2.09	2.02	1.71	1.89
1962	10,164	1.60	1.99	1.83	1.86
1963	7,603	1.76	1.83	1.83	1.84
1964	8,042	1.83	1.74	1.86	1.79
1965	8,267	1.71	1.77	1.87	1.76
1966	13,705	1.84	1.75	1.89	1.75
1967	19,451	2.00	1.86	1.93	1.76
1968	7,898	1.92	1.88	1.86	1.77
1969	65,686	1.92	1.91	1.86	1.80
1970	8,436	2.13	1.94	1.90	1.81
1971	8,296	1.94	1.95	1.89	1.81
1972	6,293	2.08	1.95	1.92	1.88
1973	13,549	1.69	1.92	1.91	1.88
1974	9,956	2.00	1.93	1.92	1.90
1975	10,210	2.24	1.96	1.95	1.92
1976	10,245	1.86	1.95	1.95	1.93
1977	9,364	2.01	1.94	1.95	1.94
1978	51,356	2.24	2.15	2.03	1.97
1979	28,247	1.99	2.12	2.07	1.97
1980	67,343	1.57	1.89	1.91	1.90
1981	10,899	2.76	1.95	1.95	1.93
1982	16,521	2.14	1.97	1.96	1.94
1983	53,364	1.73	1.82	1.93	1.92
1984	12,284	2.46	1.83	1.95	1.94
1985	11,077	2.07	2.03	1.94	1.95
1986	12,728	2.06	1.96	1.95	1.95
1987	8,221	1.92	1.92	1.95	1.95
1988	9,518	1.67	2.07	1.87	1.94
1989	9,656	1.84	1.93	1.86	1.95
1990	9,181	1.87	1.88	1.98	1.94
1991	14,492	1.73	1.80	1.90	1.93
1992	17,062	1.76	1.77	1.86	1.92
1993	61,761	1.71	1.75	1.85	1.90
1994	15,245	2.03	1.78	1.82	1.90
1995	45,154	1.74	1.76	1.79	1.88
1996	14,486	2.24	1.81	1.81	1.89
1997	17,989	1.93	1.83	1.81	1.89
1998	40,876	2.23	2.00	1.89	1.88
1999	12,100	2.25	2.02	1.91	1.88
2000	11,483	2.09	2.16	1.92	1.94
2001	10,090	1.93	2.13	1.93	1.92
2002	7,181	2.17	2.17	1.95	1.91
2003	17,304	1.62	1.97	1.99	1.93
2004	11,475	1.84	1.88	1.98	1.91
2005	42,208	2.02	1.92	2.05	1.91
2006	17,595	2.48	2.02	2.07	1.93
2007	8,325	2.22	2.03	2.10	1.94
2008	15,029	2.10	2.12	2.06	1.95
2009	12,715	2.18	2.16	2.05	1.96
2010	18,046	2.18	2.24	2.07	1.97
2011	28,494	2.22	2.18	2.10	2.00
2012	12,782	2.20	2.18	2.10	2.02
2013	10,776	1.99	2.17	2.14	2.06
2014	9,270	1.95	2.15	2.15	2.06
2015	10,594	1.81	2.09	2.16	2.10
2016	10,538	1.94	1.99	2.11	2.09
Maximum	67,343	2.76	2.24	2.16	2.10
Average	17,105				

Note: This table represents an update to Table I-31 of the WLAM Summary Report (Geoscience, 2020)

APPENDIX D

Predictive Scenario Results Colton Groundwater Management Zone



APPENDIX D:

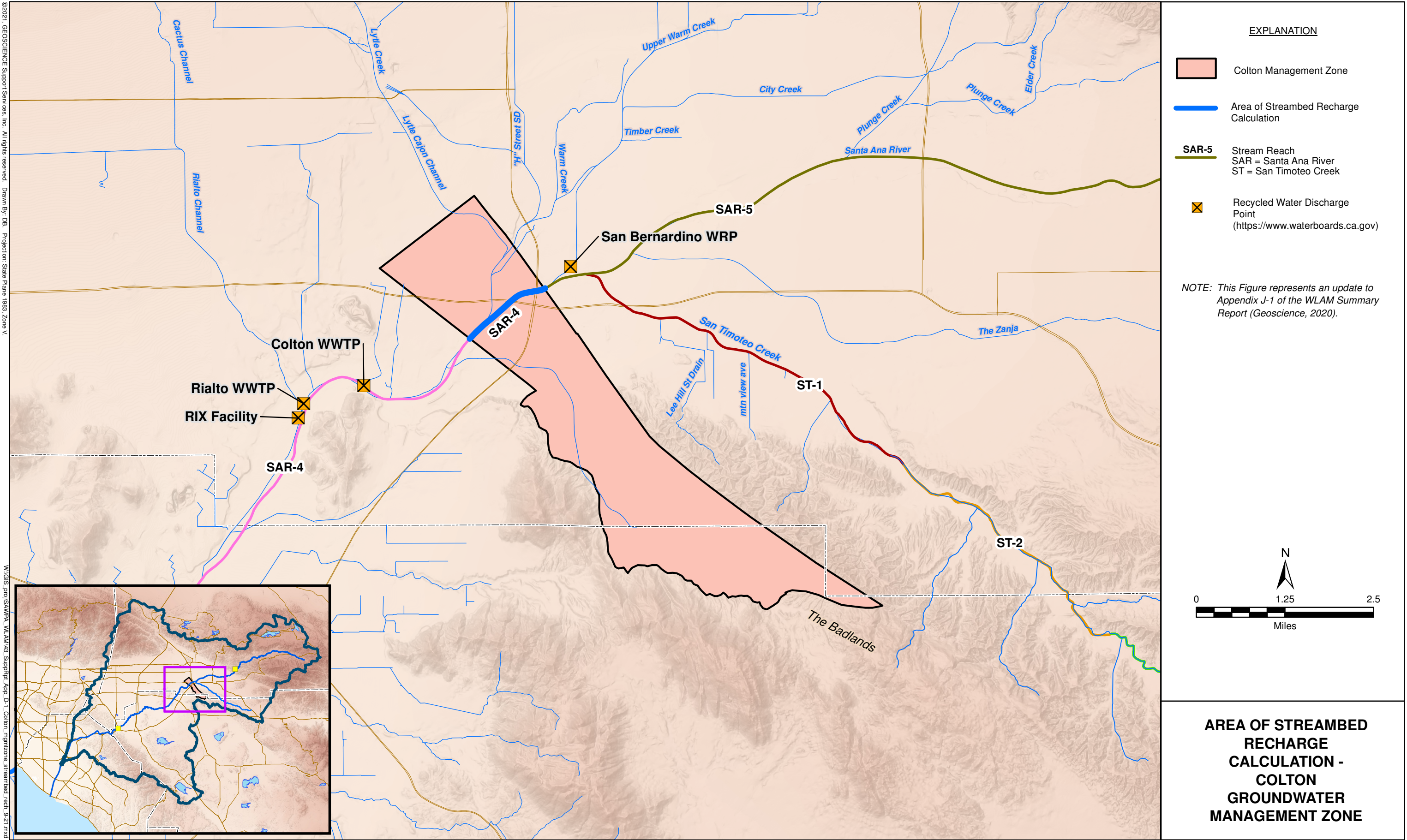
SUPPLEMENTAL PREDICTIVE SCENARIO RESULTS – COLTON GROUNDWATER MANAGEMENT ZONE

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Supplemental Scenario F – 2040 Minimum Expected Discharge

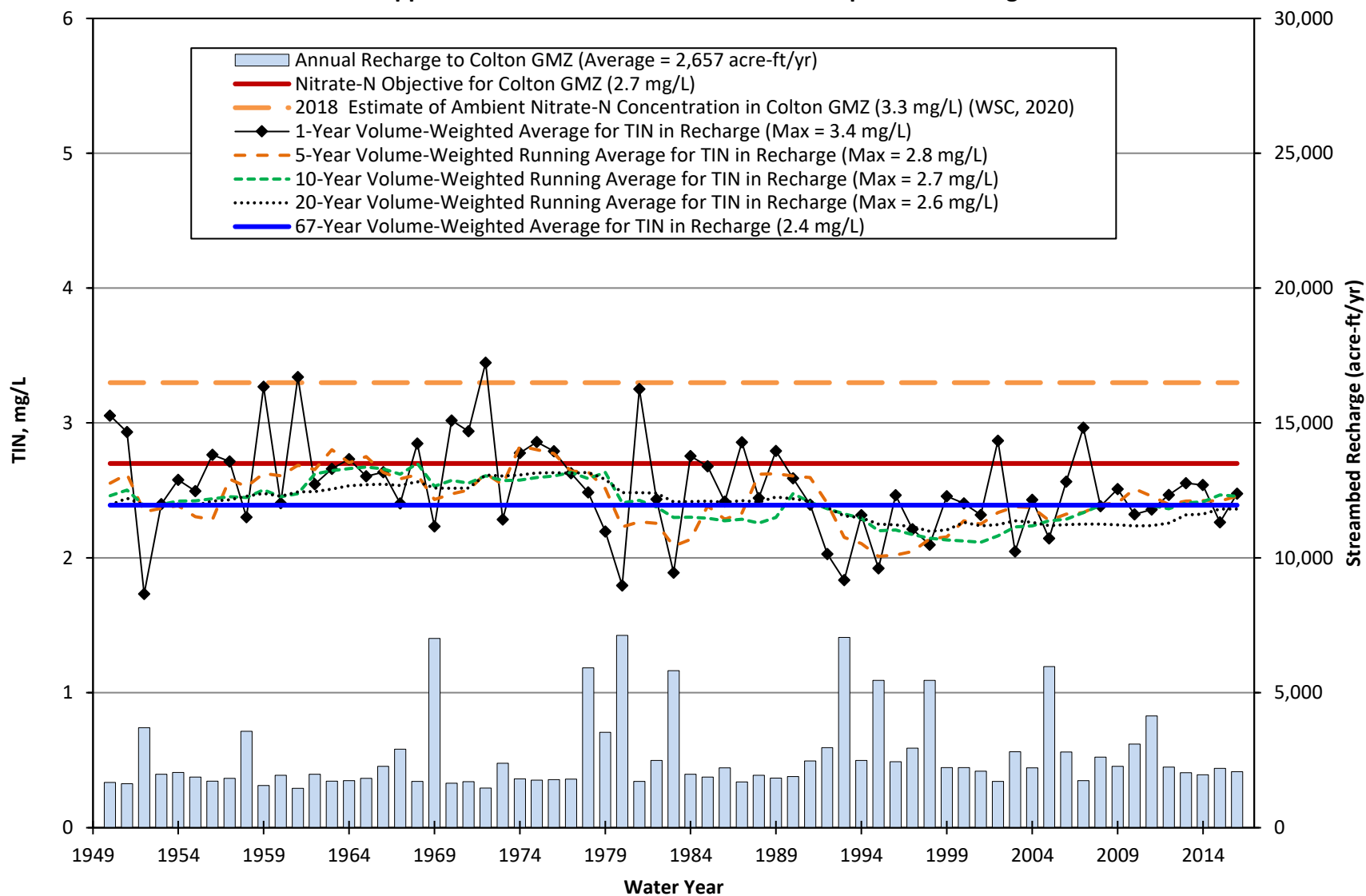
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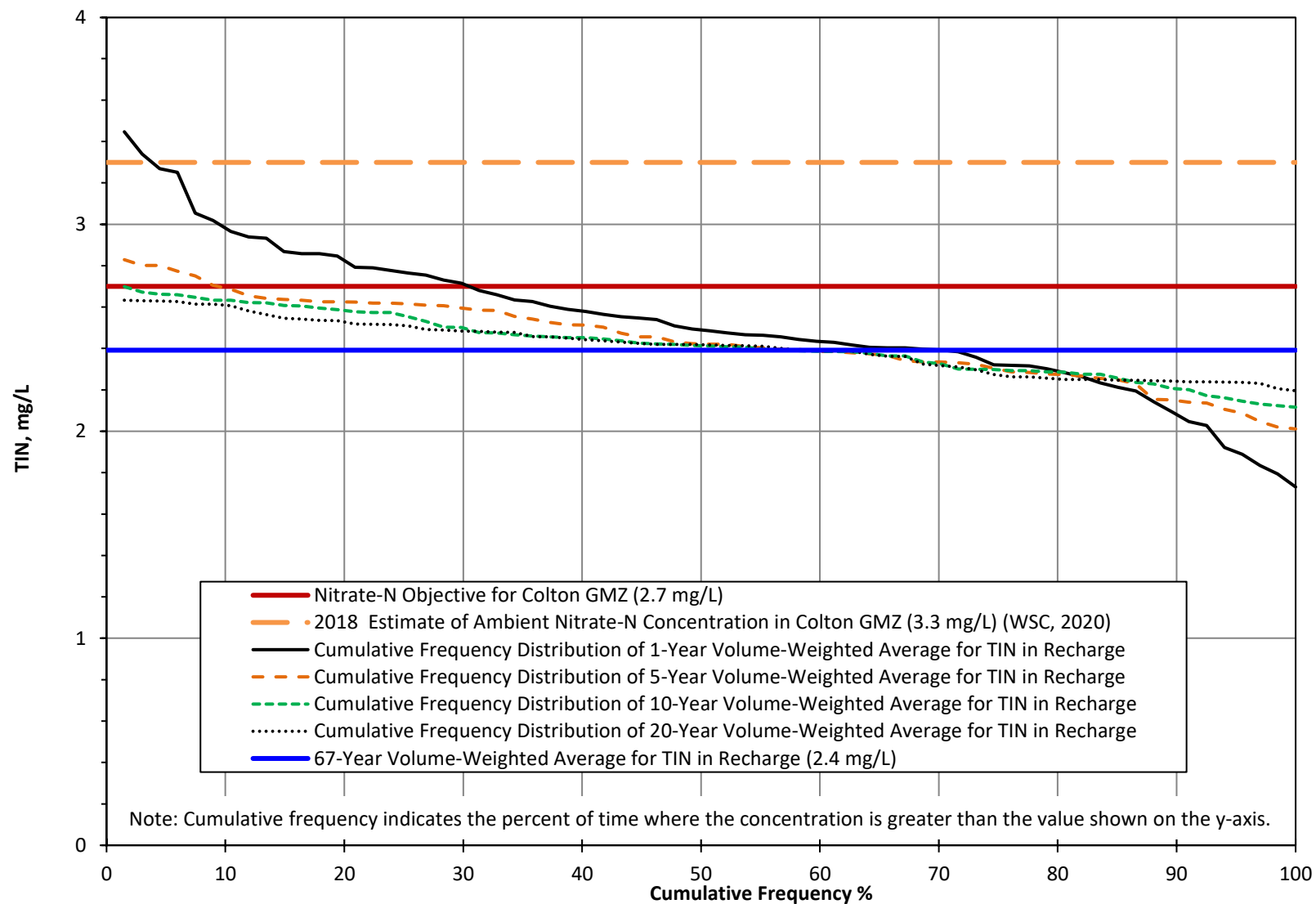
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**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge**



Note: This figure represents an update to Figure J-4 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge**



Note: This figure represents an update to Figure J-5 of the WLAM Summary Report (Geoscience, 2020)

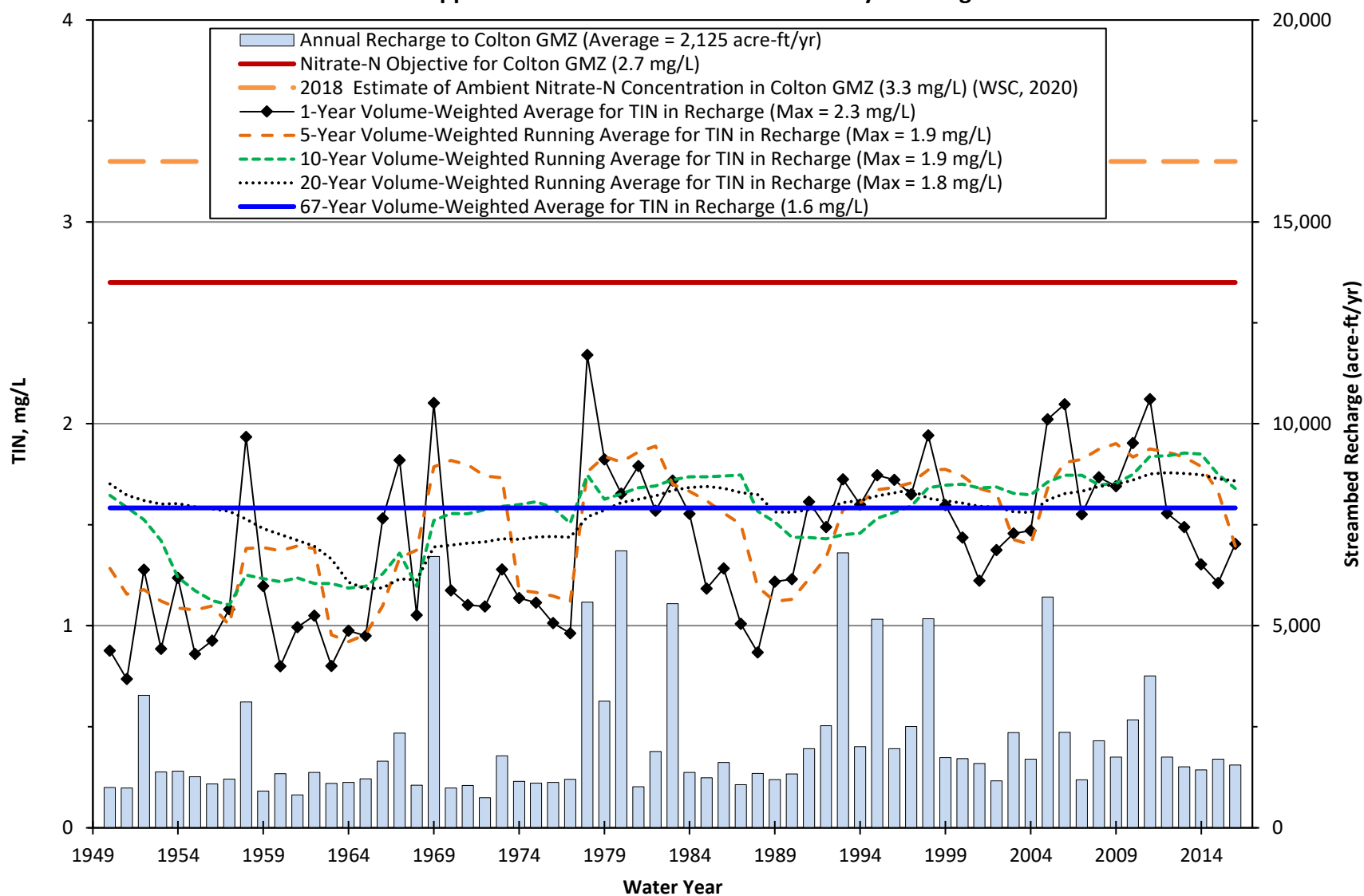
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario A - 2020 Maximum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	1,667	3.05	2.55	2.46	2.39
1951	1,626	2.93	2.62	2.50	2.44
1952	3,700	1.73	2.34	2.39	2.39
1953	1,973	2.40	2.37	2.40	2.39
1954	2,039	2.58	2.39	2.42	2.40
1955	1,869	2.49	2.30	2.42	2.39
1956	1,722	2.76	2.28	2.44	2.42
1957	1,825	2.71	2.58	2.45	2.43
1958	3,567	2.30	2.53	2.45	2.46
1959	1,562	3.27	2.63	2.50	2.48
1960	1,936	2.41	2.61	2.45	2.46
1961	1,453	3.34	2.69	2.48	2.49
1962	1,970	2.55	2.65	2.62	2.49
1963	1,714	2.66	2.80	2.65	2.51
1964	1,740	2.73	2.70	2.66	2.53
1965	1,821	2.60	2.75	2.67	2.54
1966	2,270	2.63	2.63	2.66	2.55
1967	2,900	2.40	2.58	2.62	2.54
1968	1,712	2.85	2.62	2.70	2.56
1969	7,013	2.23	2.43	2.53	2.52
1970	1,643	3.02	2.47	2.57	2.52
1971	1,695	2.94	2.50	2.55	2.52
1972	1,462	3.45	2.63	2.61	2.61
1973	2,385	2.28	2.54	2.57	2.61
1974	1,802	2.78	2.83	2.58	2.61
1975	1,754	2.86	2.80	2.59	2.63
1976	1,773	2.79	2.77	2.61	2.63
1977	1,793	2.63	2.64	2.63	2.63
1978	5,921	2.49	2.64	2.59	2.63
1979	3,532	2.19	2.51	2.63	2.58
1980	7,125	1.79	2.23	2.41	2.48
1981	1,712	3.25	2.27	2.43	2.48
1982	2,486	2.43	2.26	2.38	2.48
1983	5,820	1.89	2.09	2.30	2.41
1984	1,978	2.75	2.14	2.30	2.42
1985	1,872	2.68	2.38	2.29	2.42
1986	2,214	2.42	2.29	2.28	2.41
1987	1,690	2.86	2.33	2.29	2.42
1988	1,938	2.44	2.62	2.26	2.41
1989	1,832	2.79	2.62	2.30	2.45
1990	1,891	2.59	2.61	2.48	2.44
1991	2,464	2.39	2.60	2.41	2.42
1992	2,965	2.03	2.40	2.36	2.37
1993	7,049	1.83	2.15	2.33	2.31
1994	2,484	2.32	2.11	2.29	2.30
1995	5,453	1.92	2.01	2.20	2.25
1996	2,442	2.46	2.02	2.21	2.24
1997	2,938	2.21	2.05	2.17	2.23
1998	5,452	2.10	2.14	2.15	2.20
1999	2,217	2.46	2.15	2.13	2.21
2000	2,225	2.40	2.27	2.12	2.26
2001	2,089	2.32	2.25	2.12	2.24
2002	1,713	2.87	2.33	2.16	2.25
2003	2,807	2.05	2.38	2.23	2.27
2004	2,213	2.43	2.37	2.24	2.26
2005	5,963	2.14	2.28	2.28	2.24
2006	2,799	2.56	2.32	2.29	2.25
2007	1,741	2.97	2.33	2.33	2.25
2008	2,614	2.38	2.40	2.39	2.25
2009	2,266	2.51	2.41	2.39	2.24
2010	3,089	2.32	2.51	2.38	2.24
2011	4,132	2.36	2.46	2.39	2.24
2012	2,240	2.47	2.40	2.36	2.26
2013	2,030	2.55	2.42	2.41	2.32
2014	1,957	2.54	2.42	2.42	2.32
2015	2,189	2.26	2.42	2.47	2.36
2016	2,068	2.47	2.46	2.46	2.36
Maximum	7,125	3.45	2.83	2.70	2.63
Average	2,657				

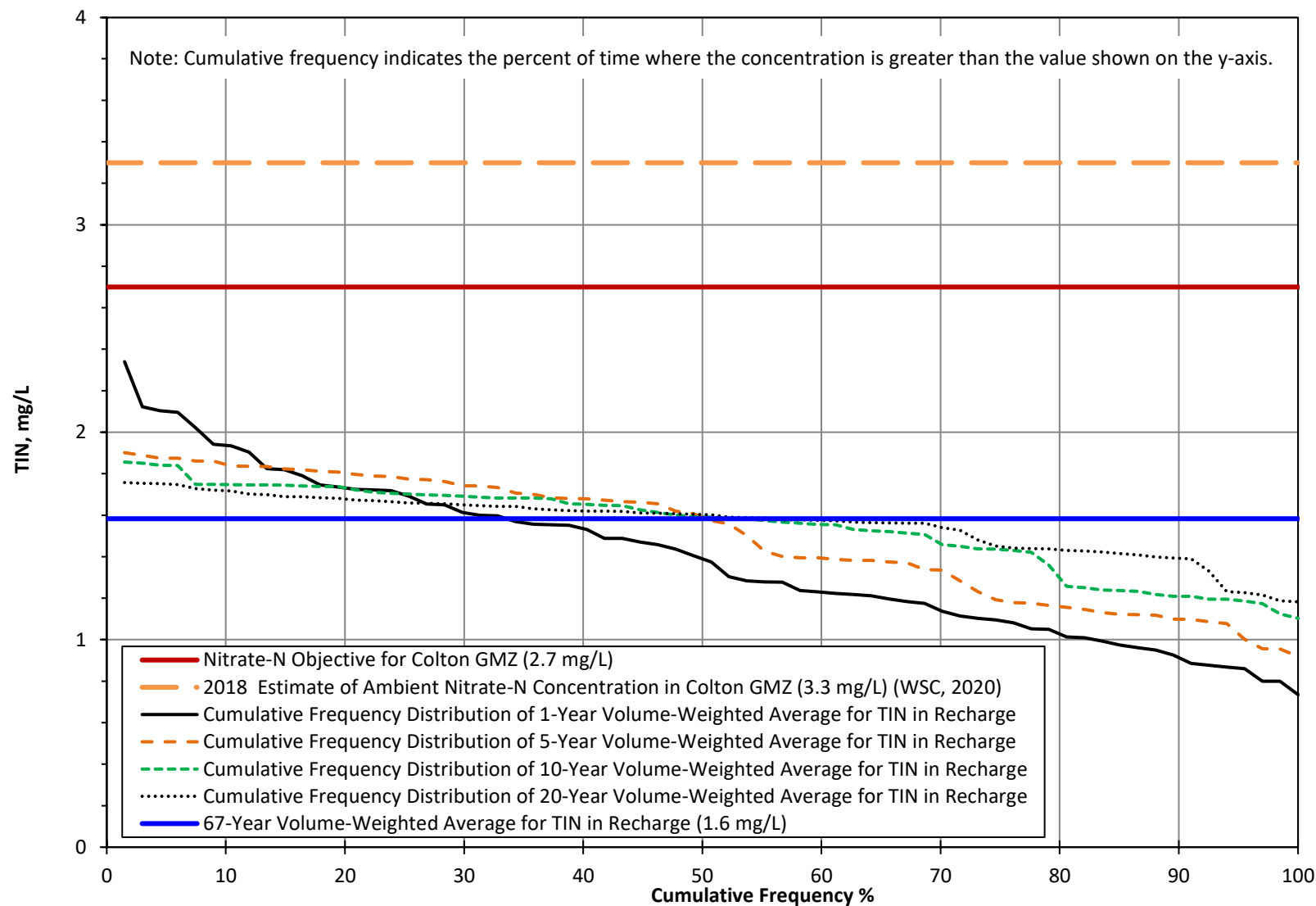
Note: This table represents an update to Table J-6 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario B - 2020 Most Likely Discharge**



Note: This figure represents an update to Figure J-9 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario B - 2020 Most Likely Discharge**



Note: This figure represents an update to Figure J-10 of the WLAM Summary Report (Geoscience, 2020)

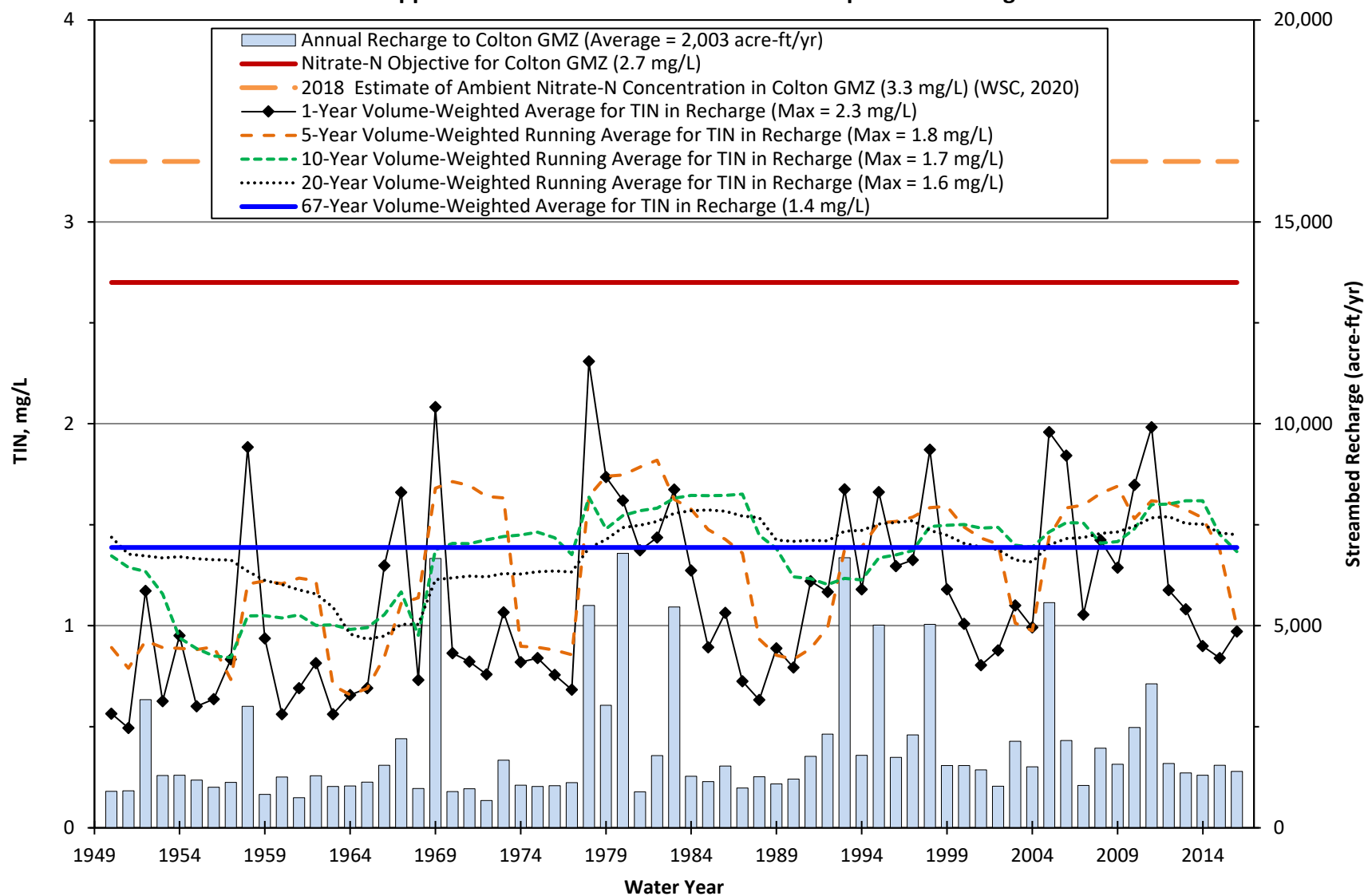
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario B - 2020 Most Likely Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	991	0.88	1.28	1.65	1.70
1951	983	0.74	1.16	1.59	1.65
1952	3,274	1.28	1.18	1.52	1.62
1953	1,378	0.89	1.12	1.42	1.60
1954	1,397	1.24	1.09	1.24	1.60
1955	1,261	0.86	1.08	1.17	1.59
1956	1,082	0.93	1.10	1.12	1.58
1957	1,204	1.08	1.00	1.10	1.57
1958	3,114	1.93	1.38	1.25	1.53
1959	903	1.20	1.39	1.23	1.48
1960	1,338	0.80	1.37	1.22	1.45
1961	812	0.99	1.39	1.24	1.42
1962	1,365	1.05	1.38	1.21	1.39
1963	1,097	0.80	0.96	1.21	1.33
1964	1,119	0.97	0.92	1.19	1.22
1965	1,210	0.95	0.96	1.20	1.18
1966	1,647	1.53	1.10	1.26	1.19
1967	2,342	1.82	1.34	1.36	1.23
1968	1,053	1.05	1.37	1.20	1.23
1969	6,715	2.10	1.79	1.52	1.39
1970	979	1.17	1.82	1.56	1.40
1971	1,043	1.10	1.80	1.55	1.41
1972	744	1.10	1.74	1.57	1.41
1973	1,777	1.28	1.73	1.59	1.43
1974	1,145	1.14	1.18	1.60	1.43
1975	1,104	1.11	1.16	1.61	1.44
1976	1,121	1.01	1.15	1.58	1.44
1977	1,199	0.96	1.12	1.51	1.44
1978	5,587	2.34	1.76	1.75	1.54
1979	3,133	1.82	1.84	1.63	1.57
1980	6,852	1.65	1.81	1.65	1.61
1981	1,011	1.79	1.86	1.68	1.63
1982	1,888	1.57	1.89	1.69	1.64
1983	5,545	1.72	1.70	1.72	1.67
1984	1,368	1.55	1.67	1.74	1.68
1985	1,233	1.18	1.62	1.74	1.69
1986	1,613	1.28	1.56	1.74	1.68
1987	1,063	1.01	1.50	1.75	1.66
1988	1,342	0.87	1.19	1.57	1.65
1989	1,187	1.22	1.12	1.51	1.56
1990	1,329	1.23	1.13	1.44	1.56
1991	1,953	1.61	1.23	1.44	1.57
1992	2,523	1.49	1.34	1.43	1.58
1993	6,801	1.73	1.57	1.45	1.61
1994	2,006	1.60	1.61	1.46	1.62
1995	5,158	1.75	1.67	1.53	1.64
1996	1,956	1.72	1.68	1.56	1.66
1997	2,507	1.65	1.71	1.59	1.67
1998	5,172	1.94	1.77	1.68	1.63
1999	1,733	1.60	1.77	1.70	1.62
2000	1,709	1.44	1.74	1.70	1.61
2001	1,588	1.22	1.68	1.68	1.59
2002	1,159	1.37	1.66	1.69	1.59
2003	2,351	1.46	1.43	1.66	1.56
2004	1,699	1.47	1.40	1.65	1.56
2005	5,708	2.02	1.68	1.71	1.62
2006	2,357	2.10	1.81	1.75	1.65
2007	1,182	1.55	1.82	1.75	1.67
2008	2,151	1.74	1.87	1.70	1.69
2009	1,748	1.69	1.90	1.71	1.70
2010	2,667	1.90	1.84	1.75	1.72
2011	3,756	2.12	1.88	1.84	1.75
2012	1,748	1.56	1.86	1.84	1.76
2013	1,504	1.49	1.84	1.86	1.75
2014	1,431	1.30	1.79	1.85	1.75
2015	1,694	1.21	1.66	1.75	1.73
2016	1,550	1.40	1.39	1.68	1.72
Maximum	6,852	2.34	1.90	1.86	1.76
Average	2,125				

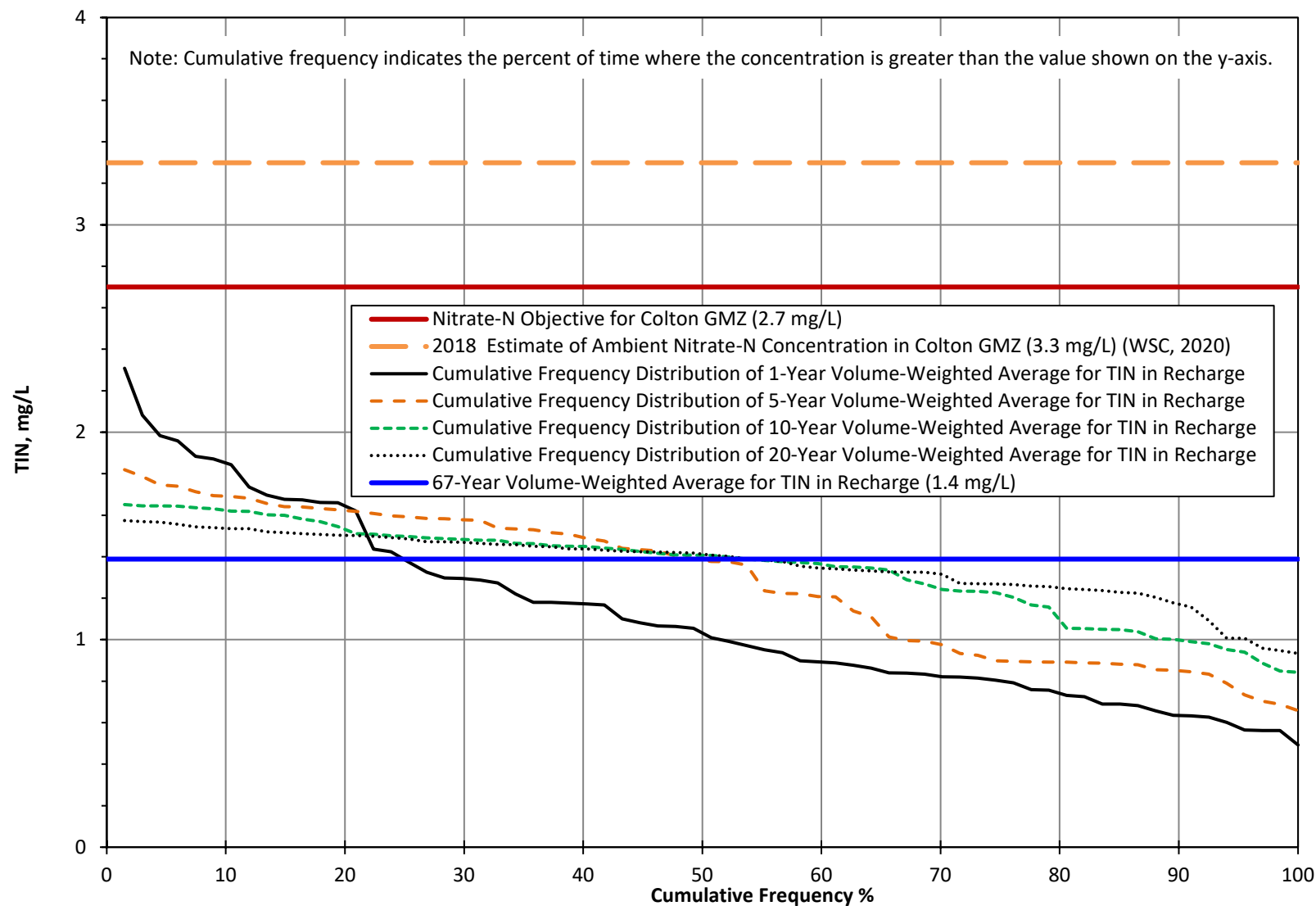
Note: This table represents an update to Table J-11 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge**



Note: This figure represents an update to Figure J-14 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge**



Note: This figure represents an update to Figure J-15 of the WLAM Summary Report (Geoscience, 2020)

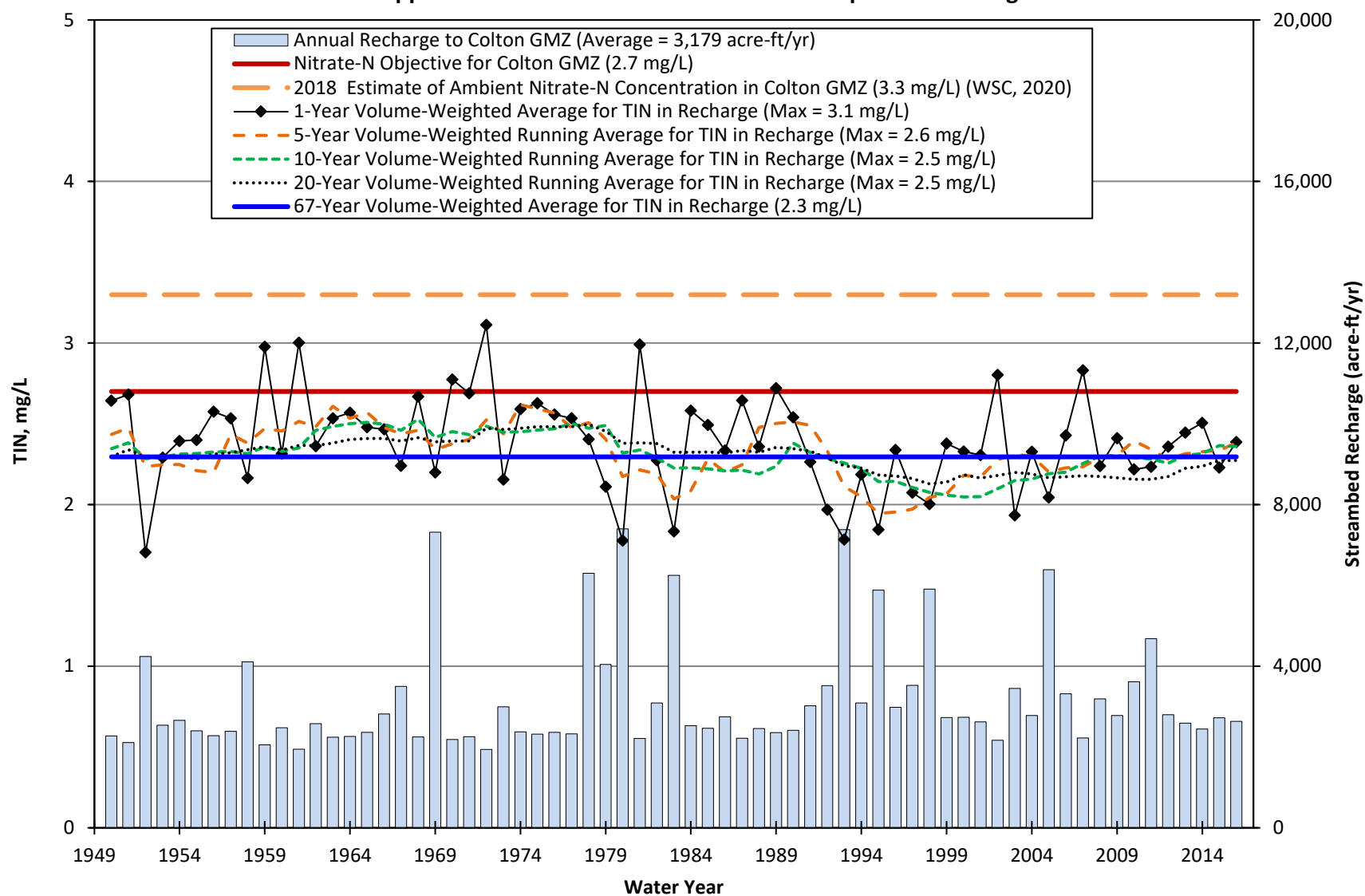
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario C - 2020 Minimum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	900	0.56	0.89	1.35	1.44
1951	910	0.49	0.79	1.29	1.35
1952	3,170	1.17	0.92	1.27	1.35
1953	1,291	0.63	0.89	1.16	1.34
1954	1,300	0.95	0.89	0.94	1.34
1955	1,178	0.60	0.88	0.89	1.33
1956	1,001	0.64	0.90	0.85	1.33
1957	1,123	0.83	0.73	0.84	1.32
1958	3,001	1.88	1.21	1.05	1.27
1959	824	0.94	1.22	1.05	1.22
1960	1,256	0.56	1.21	1.04	1.20
1961	744	0.69	1.24	1.05	1.18
1962	1,283	0.81	1.22	1.00	1.16
1963	1,021	0.56	0.70	1.00	1.09
1964	1,031	0.66	0.66	0.98	0.96
1965	1,128	0.69	0.69	0.99	0.93
1966	1,542	1.30	0.85	1.05	0.95
1967	2,202	1.66	1.11	1.17	1.01
1968	967	0.73	1.14	0.95	1.01
1969	6,662	2.08	1.68	1.38	1.23
1970	890	0.86	1.71	1.41	1.24
1971	961	0.82	1.69	1.41	1.25
1972	671	0.76	1.64	1.43	1.24
1973	1,667	1.07	1.63	1.44	1.26
1974	1,053	0.82	0.90	1.45	1.26
1975	1,021	0.84	0.89	1.46	1.27
1976	1,040	0.76	0.88	1.44	1.27
1977	1,117	0.68	0.86	1.35	1.27
1978	5,504	2.31	1.64	1.64	1.38
1979	3,028	1.74	1.74	1.48	1.43
1980	6,793	1.62	1.75	1.55	1.49
1981	886	1.37	1.79	1.57	1.50
1982	1,785	1.44	1.82	1.58	1.52
1983	5,465	1.67	1.63	1.63	1.56
1984	1,271	1.27	1.58	1.65	1.57
1985	1,142	0.89	1.48	1.64	1.57
1986	1,524	1.06	1.43	1.65	1.57
1987	980	0.73	1.36	1.65	1.54
1988	1,260	0.63	0.93	1.45	1.54
1989	1,081	0.89	0.85	1.38	1.42
1990	1,202	0.79	0.83	1.24	1.42
1991	1,765	1.22	0.89	1.23	1.42
1992	2,313	1.17	0.99	1.20	1.42
1993	6,682	1.68	1.38	1.23	1.47
1994	1,788	1.18	1.39	1.23	1.47
1995	5,017	1.66	1.51	1.34	1.50
1996	1,738	1.30	1.52	1.35	1.51
1997	2,298	1.33	1.54	1.37	1.52
1998	5,033	1.87	1.58	1.49	1.47
1999	1,540	1.18	1.59	1.50	1.45
2000	1,537	1.01	1.49	1.50	1.41
2001	1,431	0.80	1.43	1.48	1.39
2002	1,026	0.88	1.40	1.49	1.38
2003	2,137	1.10	1.01	1.40	1.32
2004	1,508	0.99	0.98	1.39	1.31
2005	5,568	1.96	1.44	1.46	1.40
2006	2,154	1.84	1.58	1.51	1.43
2007	1,046	1.06	1.60	1.51	1.44
2008	1,965	1.42	1.66	1.41	1.46
2009	1,566	1.29	1.69	1.42	1.46
2010	2,478	1.70	1.53	1.48	1.49
2011	3,561	1.98	1.62	1.60	1.53
2012	1,587	1.18	1.61	1.60	1.54
2013	1,354	1.08	1.58	1.62	1.51
2014	1,295	0.90	1.53	1.62	1.50
2015	1,546	0.84	1.38	1.45	1.46
2016	1,391	0.97	1.00	1.37	1.45
Maximum	6,793	2.31	1.82	1.65	1.57
Average	2,003				

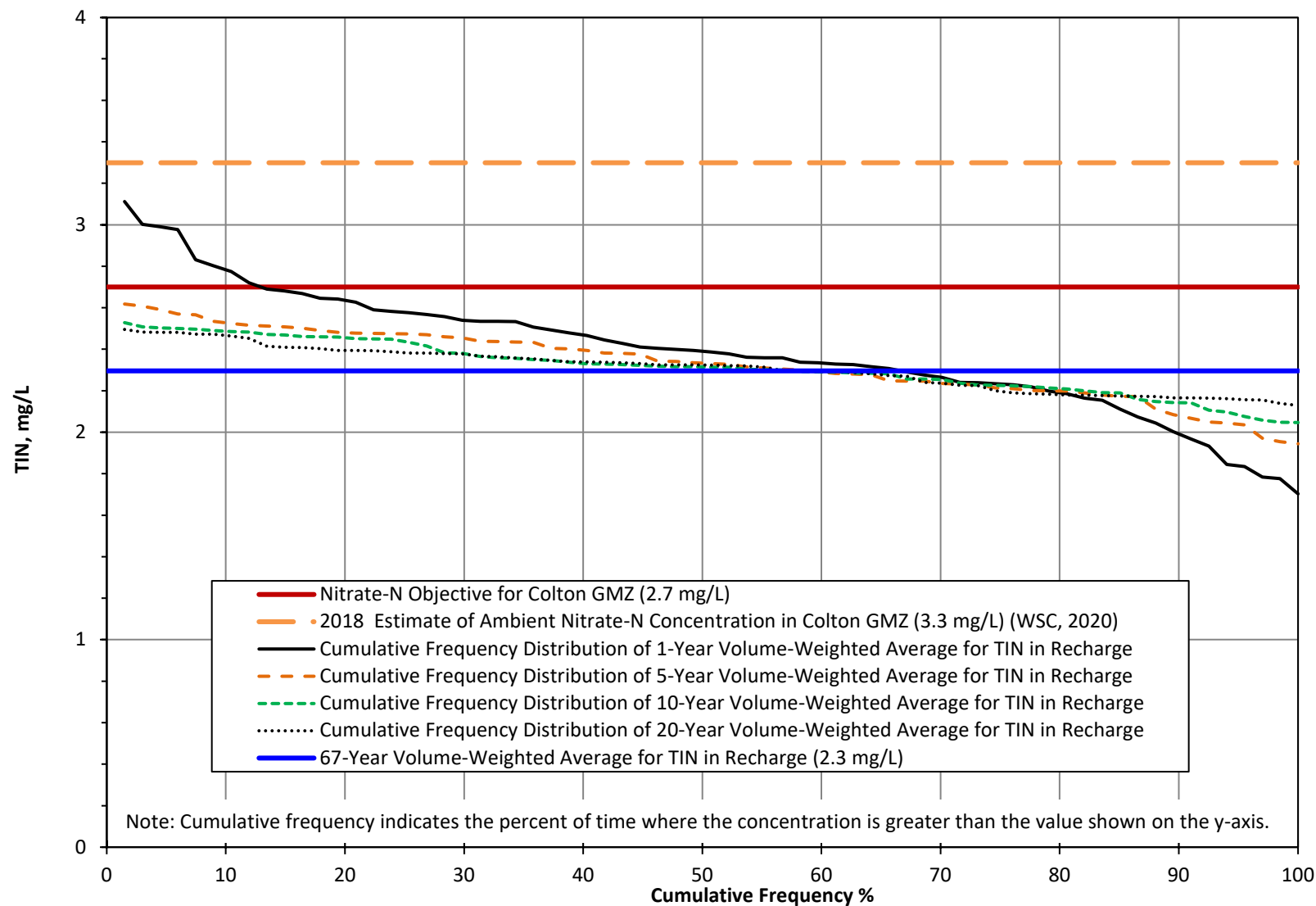
Note: This table represents an update to Table J-16 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge**



Note: This figure represents an update to Figure J-19 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge**



Note: This figure represents an update to Figure J-20 of the WLAM Summary Report (Geoscience, 2020)

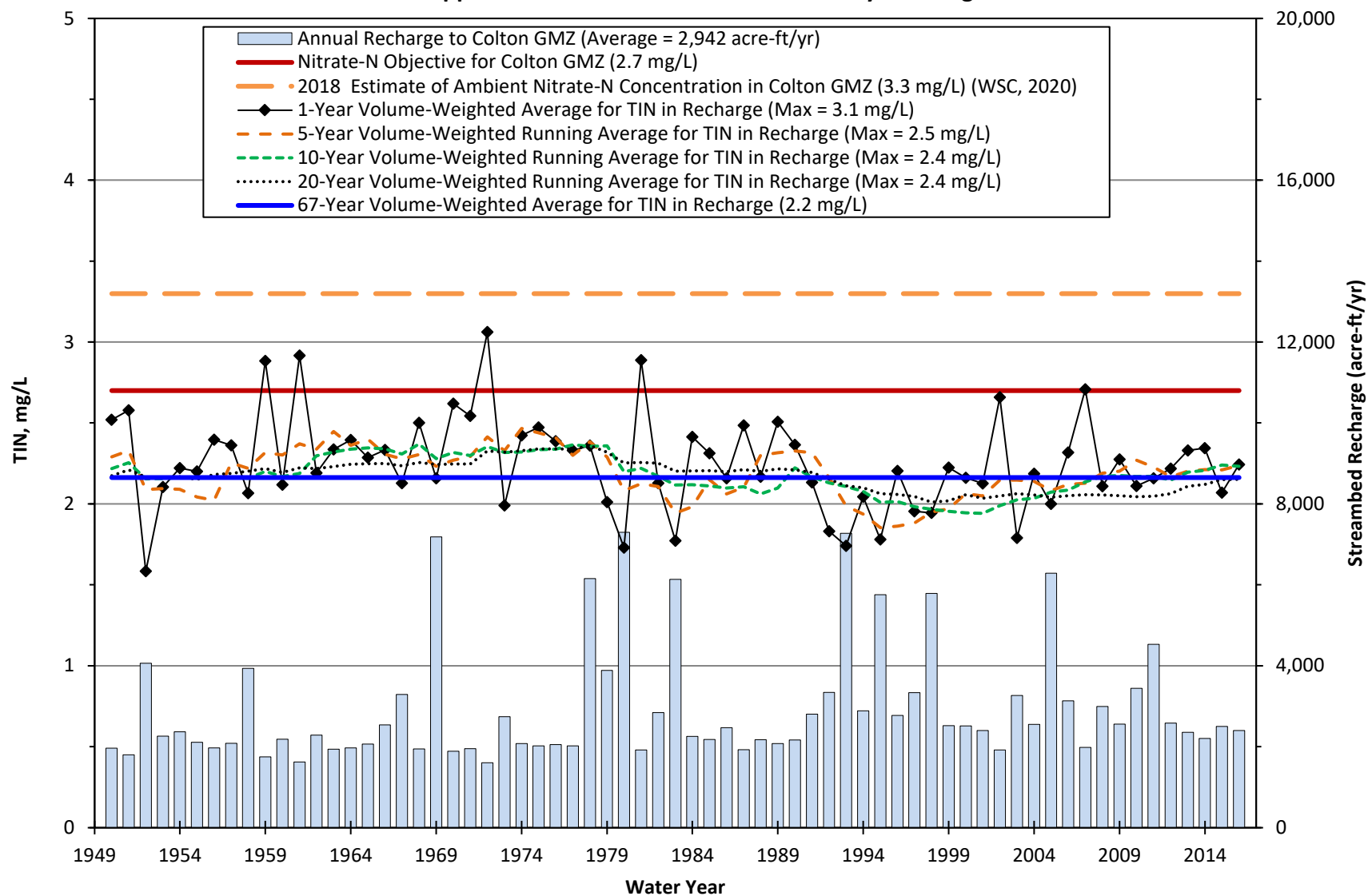
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario D - 2040 Maximum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	2,274	2.64	2.43	2.35	2.30
1951	2,104	2.68	2.47	2.38	2.34
1952	4,236	1.70	2.23	2.28	2.29
1953	2,538	2.29	2.25	2.29	2.29
1954	2,656	2.39	2.25	2.31	2.30
1955	2,398	2.40	2.21	2.32	2.28
1956	2,275	2.58	2.20	2.33	2.31
1957	2,382	2.53	2.43	2.33	2.32
1958	4,106	2.16	2.38	2.31	2.34
1959	2,050	2.98	2.47	2.36	2.36
1960	2,475	2.32	2.45	2.33	2.34
1961	1,941	3.00	2.52	2.35	2.37
1962	2,574	2.36	2.48	2.46	2.36
1963	2,241	2.53	2.61	2.48	2.38
1964	2,259	2.57	2.53	2.50	2.40
1965	2,357	2.48	2.57	2.51	2.41
1966	2,817	2.47	2.48	2.50	2.41
1967	3,494	2.24	2.44	2.46	2.39
1968	2,245	2.67	2.46	2.53	2.41
1969	7,317	2.20	2.34	2.42	2.39
1970	2,183	2.77	2.38	2.45	2.39
1971	2,249	2.69	2.40	2.43	2.39
1972	1,938	3.11	2.52	2.48	2.47
1973	2,995	2.15	2.44	2.45	2.46
1974	2,372	2.59	2.62	2.45	2.47
1975	2,317	2.63	2.59	2.46	2.48
1976	2,360	2.56	2.57	2.47	2.48
1977	2,320	2.53	2.47	2.50	2.48
1978	6,301	2.40	2.51	2.47	2.50
1979	4,039	2.11	2.40	2.49	2.45
1980	7,397	1.78	2.17	2.32	2.38
1981	2,210	2.99	2.21	2.34	2.38
1982	3,087	2.28	2.19	2.29	2.38
1983	6,245	1.83	2.03	2.23	2.32
1984	2,522	2.58	2.08	2.23	2.32
1985	2,460	2.49	2.28	2.22	2.33
1986	2,742	2.33	2.20	2.21	2.32
1987	2,217	2.65	2.25	2.21	2.33
1988	2,457	2.36	2.48	2.19	2.32
1989	2,351	2.72	2.50	2.24	2.35
1990	2,412	2.54	2.51	2.38	2.35
1991	3,019	2.26	2.49	2.32	2.33
1992	3,518	1.97	2.33	2.29	2.29
1993	7,382	1.78	2.11	2.26	2.24
1994	3,084	2.19	2.05	2.22	2.23
1995	5,883	1.85	1.95	2.14	2.18
1996	2,977	2.34	1.95	2.14	2.18
1997	3,520	2.07	1.97	2.11	2.16
1998	5,905	2.00	2.04	2.08	2.13
1999	2,727	2.38	2.07	2.06	2.14
2000	2,732	2.33	2.18	2.05	2.19
2001	2,620	2.31	2.17	2.05	2.16
2002	2,164	2.80	2.28	2.10	2.18
2003	3,445	1.93	2.31	2.15	2.20
2004	2,777	2.33	2.30	2.16	2.19
2005	6,386	2.04	2.20	2.19	2.17
2006	3,315	2.43	2.23	2.20	2.17
2007	2,222	2.83	2.23	2.25	2.18
2008	3,190	2.24	2.29	2.30	2.17
2009	2,774	2.41	2.30	2.30	2.17
2010	3,613	2.22	2.39	2.29	2.16
2011	4,682	2.23	2.34	2.28	2.16
2012	2,794	2.36	2.28	2.26	2.17
2013	2,584	2.44	2.31	2.30	2.22
2014	2,441	2.51	2.33	2.32	2.24
2015	2,721	2.23	2.34	2.36	2.27
2016	2,629	2.39	2.38	2.36	2.27
Maximum	7,397	3.11	2.62	2.53	2.50
Average	3,179				

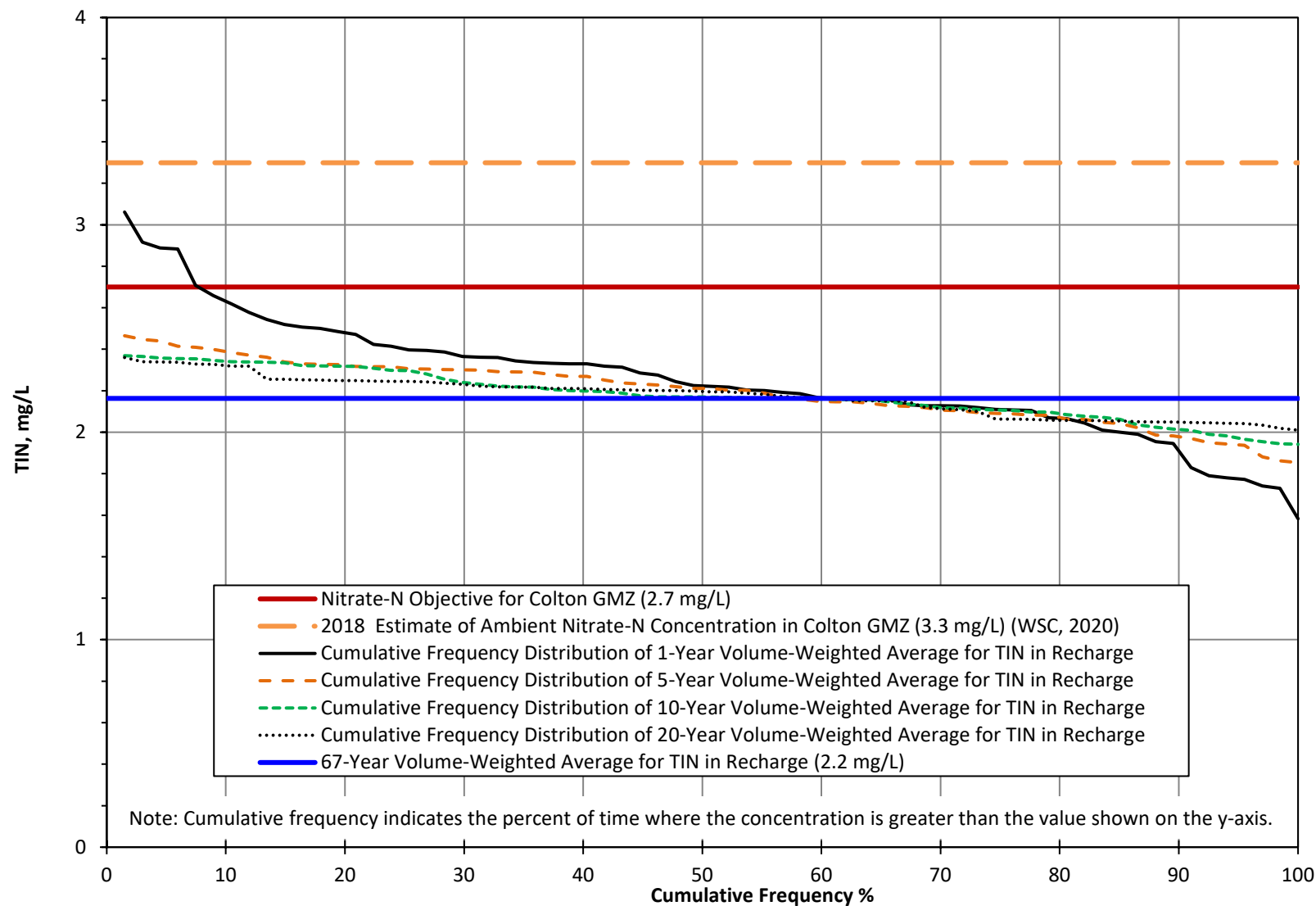
Note: This table represents an update to Table J-21 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario E - 2040 Most Likely Discharge**



Note: This figure represents an update to Figure J-24 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario E - 2040 Most Likely Discharge**



Note: This figure represents an update to Figure J-25 of the WLAM Summary Report (Geoscience, 2020)

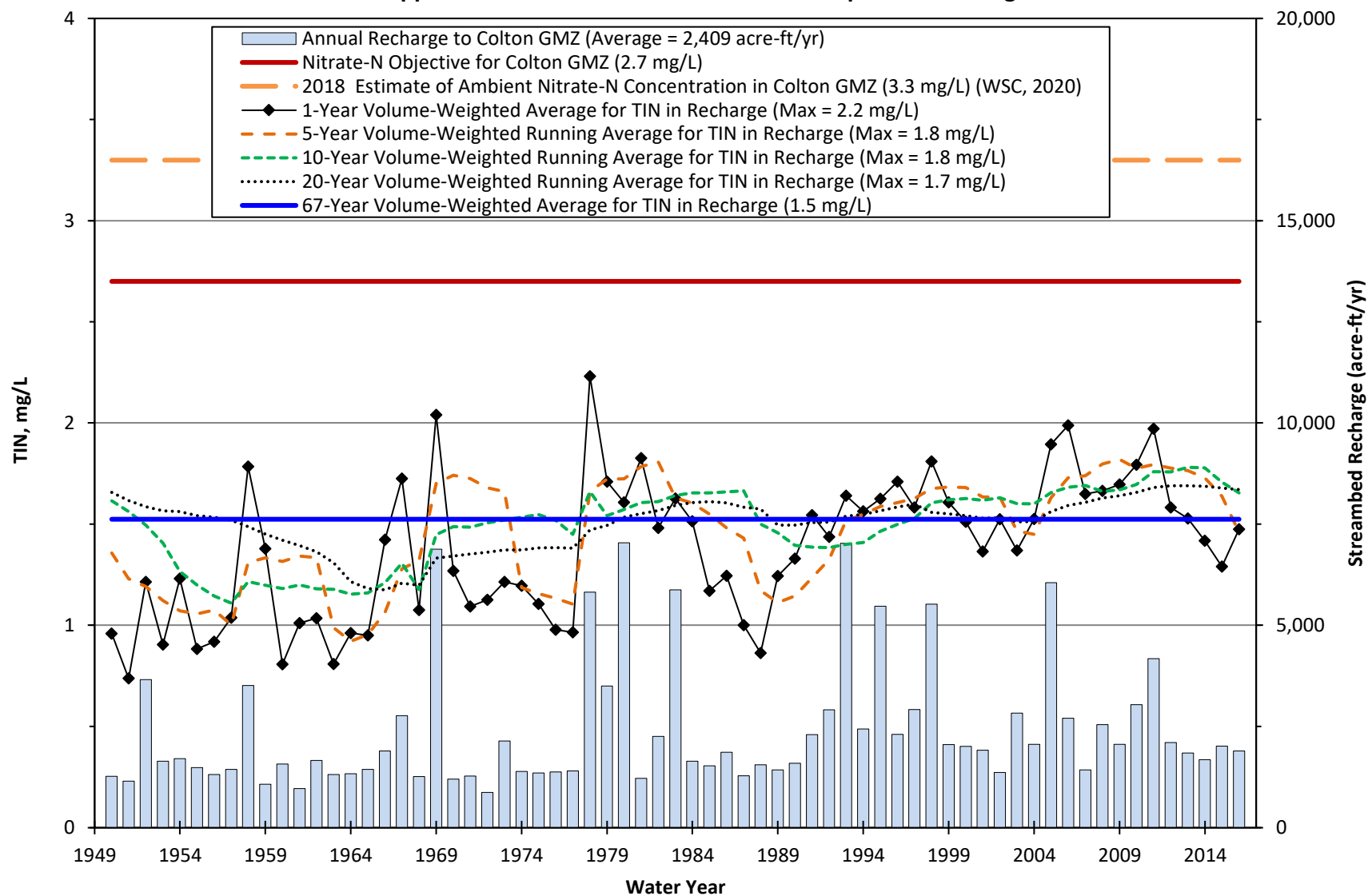
**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario E - 2040 Most Likely Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	1,963	2.52	2.29	2.22	2.17
1951	1,796	2.58	2.33	2.25	2.21
1952	4,063	1.58	2.09	2.15	2.17
1953	2,256	2.10	2.10	2.16	2.16
1954	2,368	2.22	2.09	2.16	2.17
1955	2,109	2.20	2.04	2.16	2.15
1956	1,969	2.40	2.02	2.16	2.18
1957	2,080	2.36	2.25	2.16	2.19
1958	3,934	2.07	2.22	2.16	2.20
1959	1,744	2.88	2.32	2.20	2.22
1960	2,184	2.12	2.30	2.17	2.19
1961	1,620	2.92	2.37	2.19	2.22
1962	2,284	2.19	2.34	2.30	2.22
1963	1,936	2.34	2.45	2.32	2.23
1964	1,964	2.39	2.36	2.34	2.24
1965	2,063	2.29	2.40	2.35	2.25
1966	2,535	2.33	2.31	2.34	2.25
1967	3,291	2.13	2.28	2.31	2.24
1968	1,942	2.50	2.31	2.37	2.26
1969	7,182	2.16	2.23	2.28	2.24
1970	1,886	2.62	2.27	2.32	2.25
1971	1,948	2.54	2.29	2.30	2.25
1972	1,601	3.06	2.41	2.35	2.33
1973	2,740	1.99	2.33	2.32	2.32
1974	2,074	2.42	2.47	2.32	2.33
1975	2,018	2.47	2.44	2.33	2.34
1976	2,052	2.39	2.41	2.34	2.34
1977	2,021	2.33	2.30	2.36	2.34
1978	6,153	2.36	2.38	2.36	2.36
1979	3,882	2.01	2.29	2.36	2.32
1980	7,297	1.73	2.08	2.20	2.25
1981	1,920	2.89	2.12	2.22	2.26
1982	2,841	2.13	2.11	2.17	2.25
1983	6,133	1.77	1.94	2.12	2.20
1984	2,252	2.41	1.98	2.12	2.20
1985	2,175	2.31	2.15	2.11	2.21
1986	2,468	2.16	2.06	2.10	2.20
1987	1,921	2.49	2.10	2.11	2.21
1988	2,168	2.17	2.30	2.06	2.20
1989	2,077	2.51	2.32	2.10	2.22
1990	2,162	2.36	2.33	2.22	2.21
1991	2,803	2.13	2.32	2.17	2.19
1992	3,339	1.83	2.16	2.13	2.15
1993	7,271	1.74	1.99	2.11	2.11
1994	2,887	2.04	1.94	2.08	2.10
1995	5,756	1.78	1.85	2.01	2.06
1996	2,771	2.20	1.86	2.01	2.06
1997	3,335	1.95	1.88	1.98	2.05
1998	5,785	1.95	1.95	1.97	2.01
1999	2,518	2.22	1.97	1.95	2.02
2000	2,511	2.16	2.06	1.94	2.06
2001	2,396	2.13	2.05	1.94	2.03
2002	1,916	2.66	2.15	1.99	2.05
2003	3,262	1.79	2.15	2.02	2.06
2004	2,552	2.19	2.14	2.04	2.05
2005	6,283	2.00	2.08	2.07	2.04
2006	3,130	2.32	2.12	2.08	2.05
2007	1,979	2.71	2.13	2.14	2.06
2008	2,995	2.11	2.19	2.17	2.06
2009	2,556	2.28	2.20	2.18	2.05
2010	3,439	2.11	2.27	2.17	2.04
2011	4,528	2.16	2.23	2.17	2.05
2012	2,579	2.22	2.17	2.15	2.06
2013	2,354	2.33	2.20	2.20	2.11
2014	2,202	2.34	2.21	2.21	2.12
2015	2,497	2.07	2.21	2.24	2.15
2016	2,400	2.24	2.24	2.23	2.15
Maximum	7,297	3.06	2.47	2.37	2.36
Average	2,942				

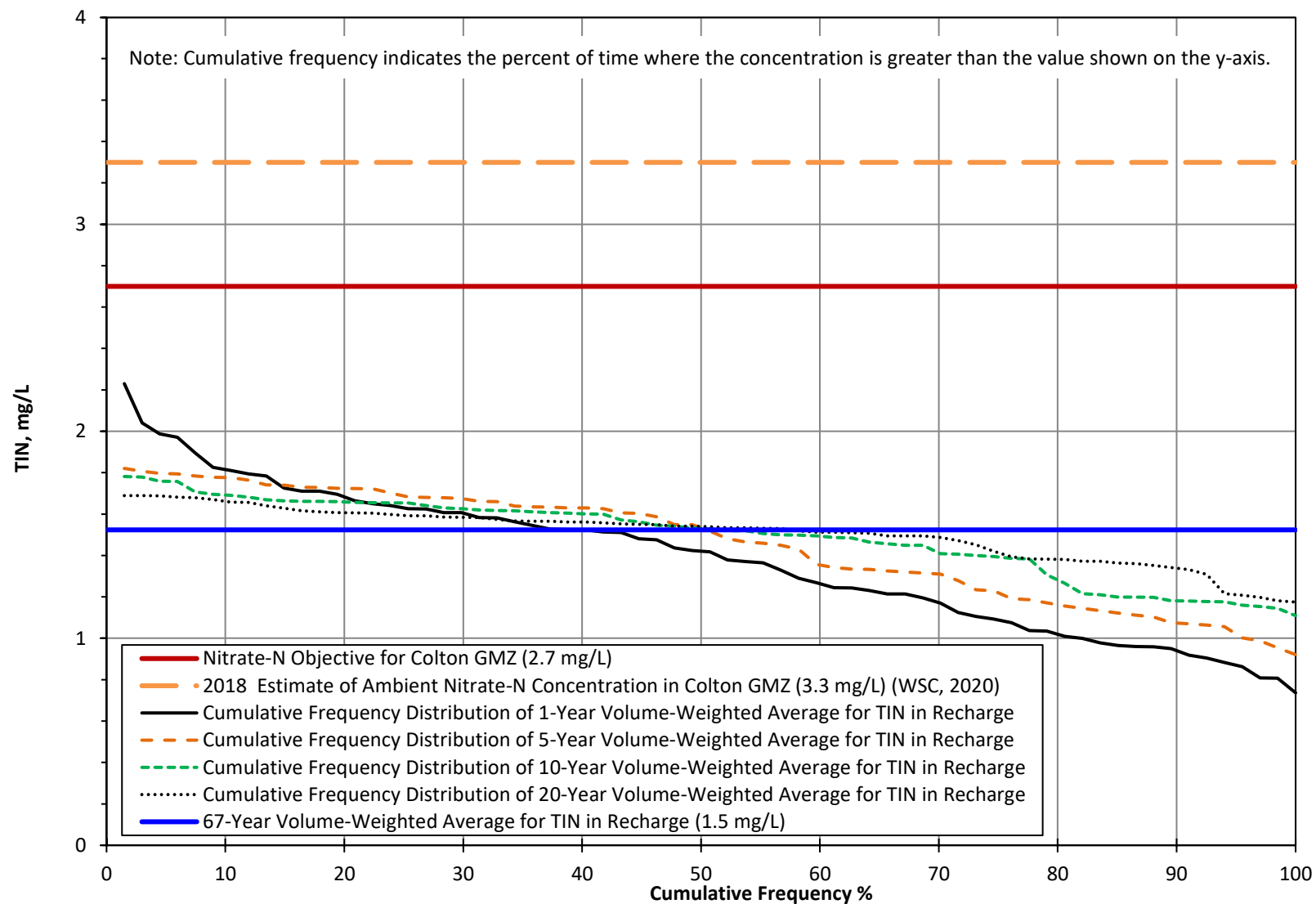
Note: This table represents an update to Table J-26 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge**



Note: This figure represents an update to Figure J-29 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Cumulative Frequency Distribution of Volume-Weighted TIN Concentration
of Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge**



Note: This figure represents an update to Figure J-30 of the WLAM Summary Report (Geoscience, 2020)

**Santa Ana River Waste Load Allocation Model Update -
Supplemental Report**

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Supplemental Scenario F - 2040 Minimum Expected Discharge

Water Year	Streambed Percolation (ac-ft)	Volume-Weighted Running Average (mg/L)			
		TIN			
		1 Year	5 Year	10 Year	20 Year
1950	1,264	0.96	1.36	1.62	1.66
1951	1,143	0.74	1.23	1.56	1.62
1952	3,657	1.21	1.19	1.49	1.59
1953	1,641	0.90	1.12	1.41	1.57
1954	1,705	1.23	1.07	1.27	1.56
1955	1,478	0.88	1.06	1.20	1.54
1956	1,311	0.92	1.08	1.14	1.53
1957	1,434	1.04	1.00	1.11	1.52
1958	3,513	1.78	1.31	1.22	1.49
1959	1,069	1.38	1.33	1.20	1.45
1960	1,568	0.81	1.32	1.18	1.42
1961	964	1.01	1.34	1.20	1.39
1962	1,656	1.03	1.33	1.18	1.36
1963	1,310	0.81	0.99	1.18	1.31
1964	1,327	0.96	0.92	1.15	1.22
1965	1,433	0.95	0.95	1.16	1.18
1966	1,891	1.42	1.06	1.21	1.18
1967	2,763	1.73	1.28	1.31	1.21
1968	1,258	1.07	1.32	1.18	1.20
1969	6,879	2.04	1.70	1.45	1.33
1970	1,199	1.27	1.74	1.49	1.34
1971	1,275	1.09	1.72	1.48	1.35
1972	864	1.12	1.68	1.51	1.36
1973	2,135	1.21	1.66	1.52	1.37
1974	1,388	1.19	1.19	1.53	1.37
1975	1,348	1.11	1.16	1.55	1.38
1976	1,376	0.98	1.13	1.52	1.38
1977	1,398	0.97	1.10	1.45	1.38
1978	5,818	2.23	1.66	1.66	1.47
1979	3,499	1.71	1.72	1.54	1.49
1980	7,035	1.61	1.72	1.57	1.53
1981	1,217	1.83	1.78	1.61	1.55
1982	2,251	1.48	1.81	1.61	1.57
1983	5,872	1.63	1.63	1.64	1.59
1984	1,638	1.51	1.60	1.65	1.61
1985	1,527	1.17	1.55	1.65	1.61
1986	1,857	1.24	1.48	1.66	1.61
1987	1,275	1.00	1.43	1.66	1.58
1988	1,551	0.86	1.17	1.50	1.57
1989	1,422	1.24	1.11	1.46	1.49
1990	1,591	1.33	1.14	1.39	1.49
1991	2,295	1.54	1.23	1.39	1.51
1992	2,912	1.44	1.33	1.38	1.51
1993	7,027	1.64	1.52	1.40	1.54
1994	2,437	1.56	1.55	1.41	1.55
1995	5,471	1.63	1.59	1.46	1.57
1996	2,300	1.71	1.61	1.50	1.58
1997	2,913	1.58	1.63	1.53	1.60
1998	5,519	1.81	1.68	1.60	1.56
1999	2,050	1.61	1.68	1.62	1.55
2000	2,008	1.51	1.68	1.63	1.54
2001	1,911	1.36	1.63	1.62	1.53
2002	1,359	1.52	1.63	1.63	1.53
2003	2,826	1.37	1.47	1.60	1.51
2004	2,055	1.53	1.45	1.60	1.51
2005	6,049	1.89	1.63	1.66	1.56
2006	2,702	1.99	1.73	1.68	1.59
2007	1,426	1.65	1.74	1.69	1.61
2008	2,546	1.66	1.80	1.66	1.63
2009	2,056	1.70	1.82	1.67	1.64
2010	3,033	1.79	1.78	1.70	1.66
2011	4,171	1.97	1.79	1.76	1.68
2012	2,099	1.58	1.78	1.76	1.69
2013	1,841	1.53	1.76	1.78	1.69
2014	1,679	1.42	1.73	1.78	1.69
2015	2,009	1.29	1.64	1.71	1.68
2016	1,890	1.48	1.46	1.65	1.67
Maximum	7,035	2.23	1.82	1.78	1.69
Average	2,409				

Note: This table represents an update to Table J-31 of the WLAM Summary Report (Geoscience, 2020)

APPENDIX E

Retrospective Model Run Results (Water Years 2005 through 2016)



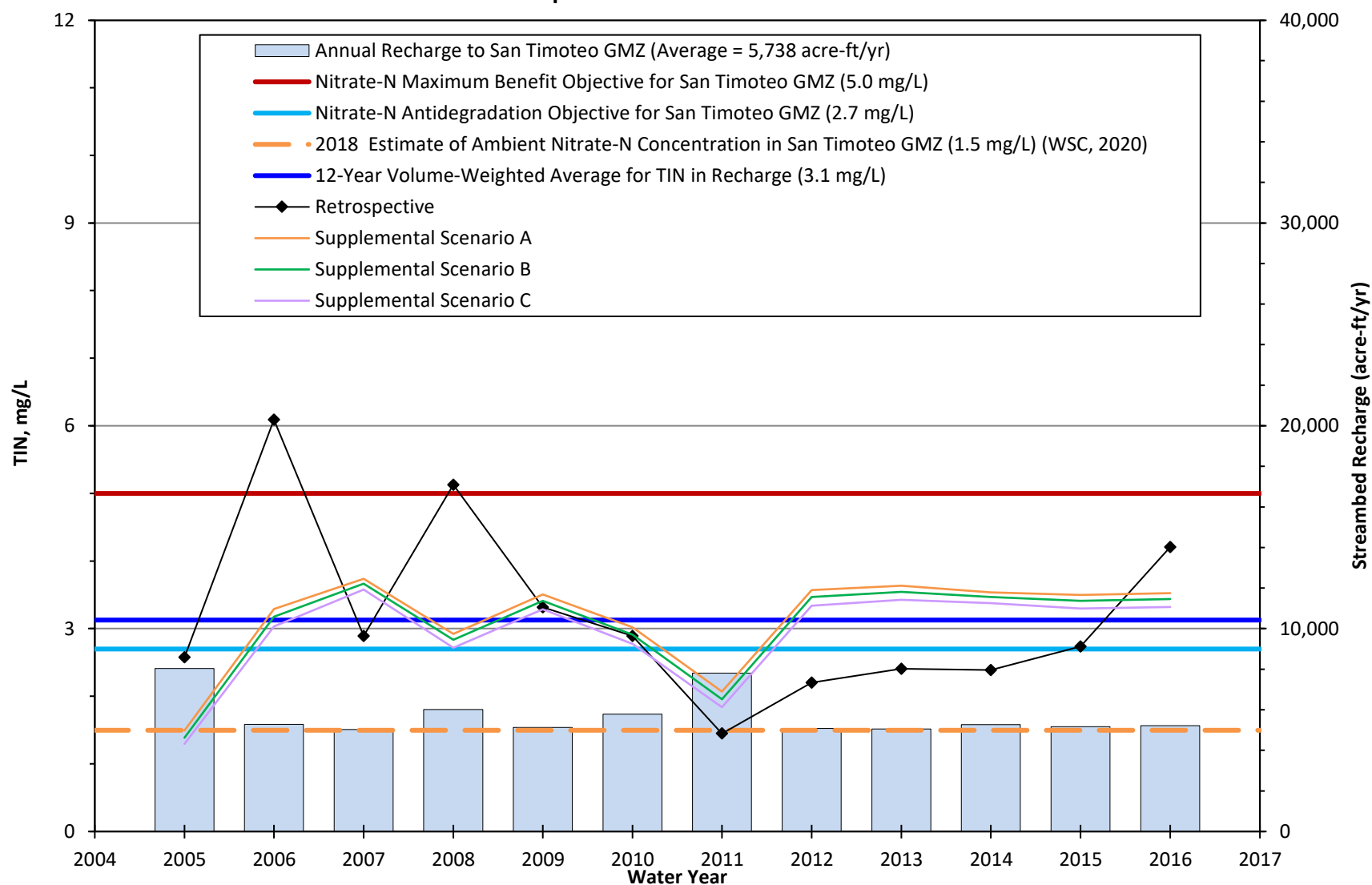
APPENDIX E:

RETROSPECTIVE MODEL RUN RESULTS (WATER YEARS 2005 THROUGH 2016)

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<u>San Timoteo Creek – Reach 1 and Santa Ana River – Reach 5 Overlying Bunker Hill-B GMZ</u>	
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<u>Santa Ana River – Reach 4 Overlying Colton GMZ</u>	
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**Estimated Annual Streambed Recharge and 1-Year Volume-Weighted TIN Concentration
of Cooper's Creek and San Timoteo Creek - Reach 2, 3 and 4 Overlying San Timoteo GMZ
Retrospective Model Run WY 2005 - 2016**



Note: This figure represents an update to Figure S-17 of the WLAM Summary Report (Geoscience, 2020)

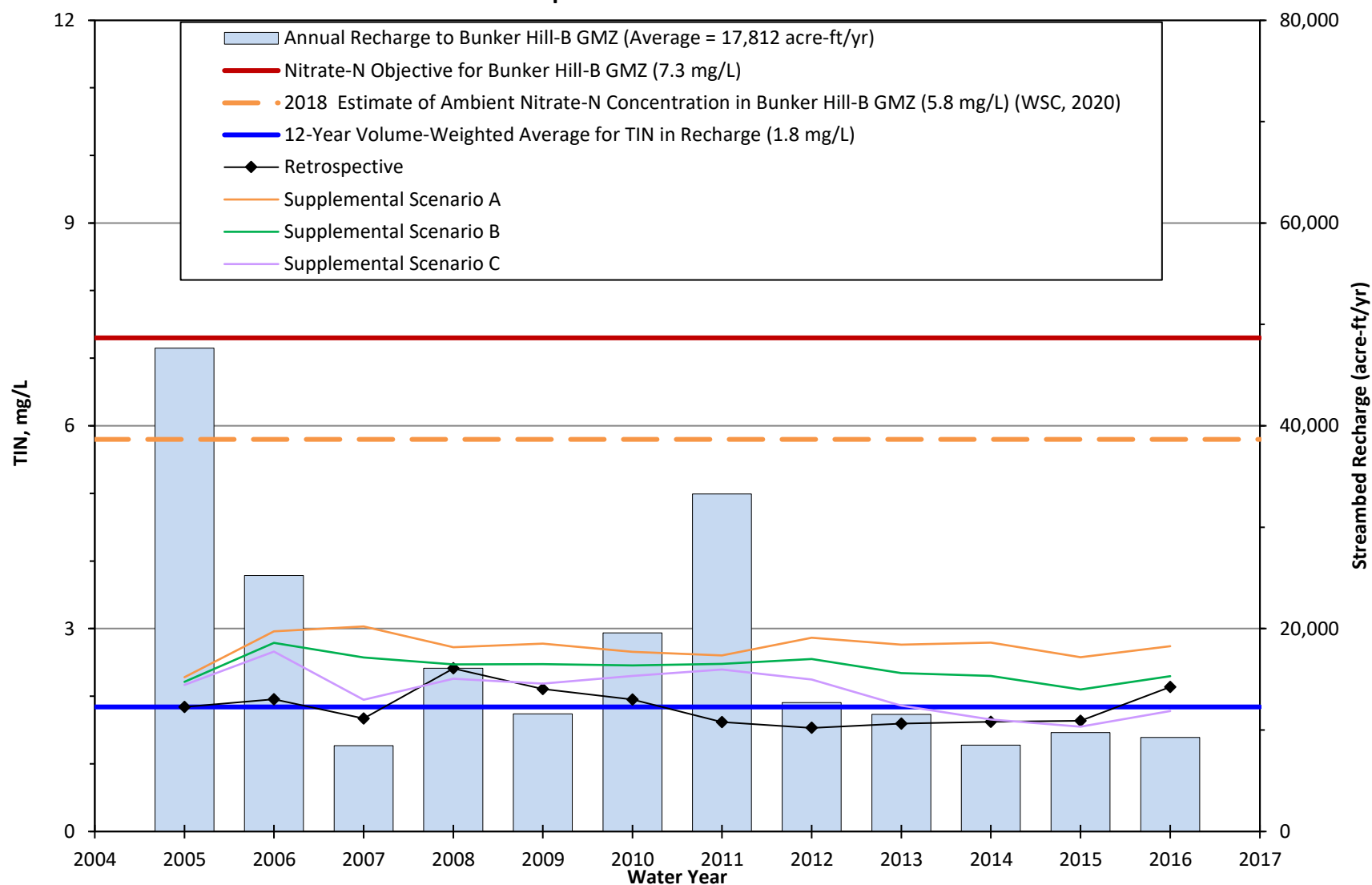
TIN of Streambed Recharge to Cooper's Creek and San Timoteo Creek - Reach 2, 3 and
4 Overlying San Timoteo GMZ
Retrospective Model Run WY 2005 - 2016

Water Year	Streambed Percolation (ac-ft)	1-Year Volume-Weighted Running Average (mg/L)			
		TIN			
		Retrospective	Supplemental Scenario A	Supplemental Scenario B	Supplemental Scenario C
2005	8,034	2.58	1.50	1.39	1.30
2006	5,283	6.09	3.29	3.18	3.03
2007	5,025	2.89	3.74	3.67	3.58
2008	6,010	5.13	2.92	2.83	2.72
2009	5,133	3.32	3.51	3.41	3.29
2010	5,782	2.89	3.02	2.91	2.77
2011	7,804	1.45	2.07	1.96	1.84
2012	5,074	2.20	3.57	3.47	3.34
2013	5,049	2.41	3.63	3.54	3.43
2014	5,274	2.39	3.54	3.47	3.38
2015	5,164	2.74	3.50	3.41	3.30
2016	5,217	4.21	3.52	3.44	3.32
Maximum	8,034	6.09	3.74	3.67	3.58
Average¹	5,738	3.13			

¹ 12-Year Volume-Weighted Average is calculated for TIN.

Note: This table represents an update to Table S-18 of the WLAM Summary Report (Geoscience, 2020)

**Estimated Annual Streambed Recharge and 1-Year Volume-Weighted TIN Concentration
of San Timoteo Creek - Reach 1 and Santa Ana River - Reach 5 Overlying Bunker Hill-B GMZ
Retrospective Model Run WY 2005 - 2016**



Note: This figure represents an update to Figure S-20 of the WLAM Summary Report (Geoscience, 2020)

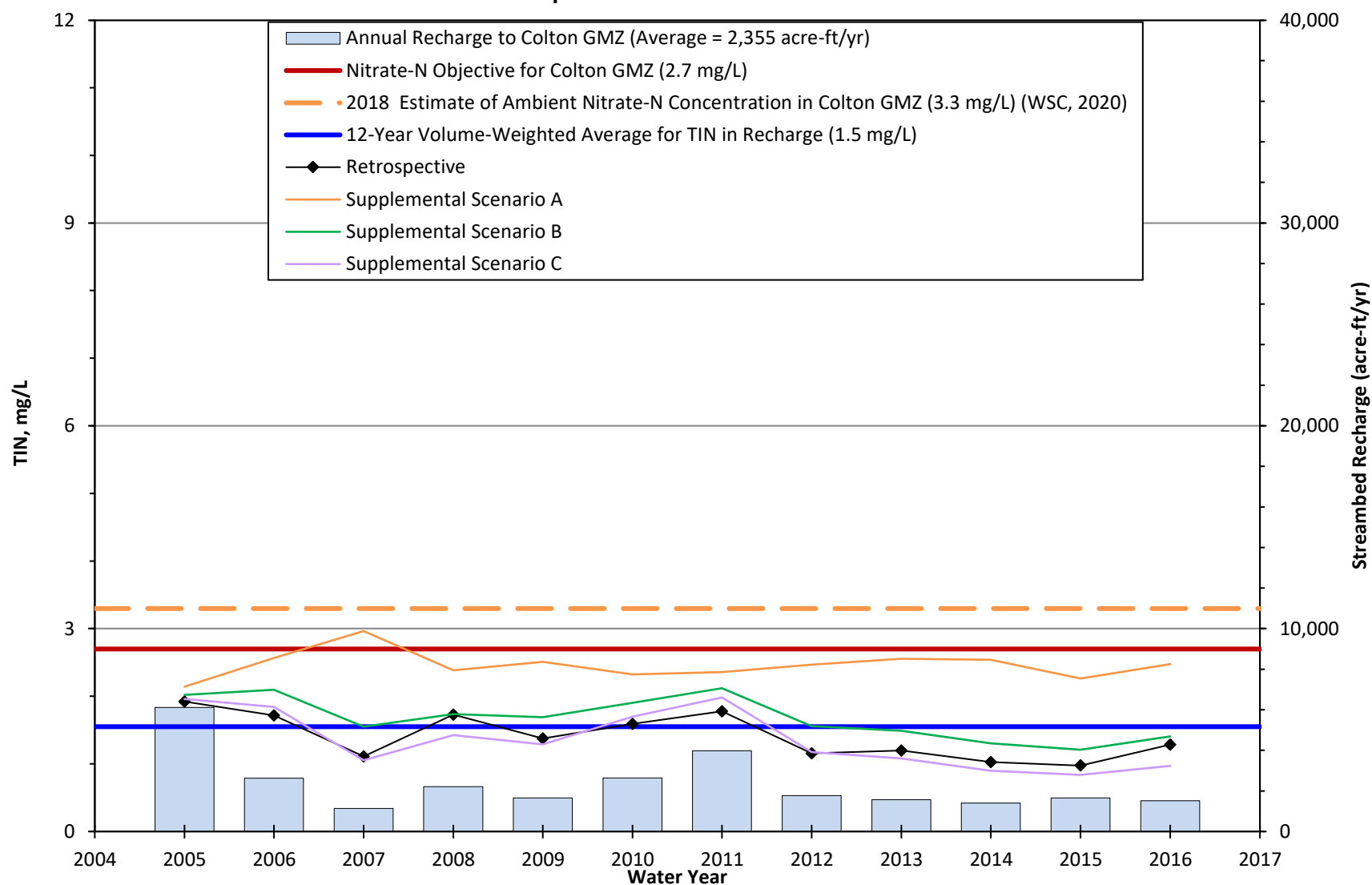
TIN of Streambed Recharge to San Timoteo Creek - Reach 1 and Santa Ana River -
Reach 5 Overlying Bunker Hill-B GMZ
Retrospective Model Run WY 2005 - 2016

Water Year	Streambed Percolation (ac-ft)	1-Year Volume-Weighted Running Average (mg/L)			
		TIN			
		Retrospective	Supplemental Scenario A	Supplemental Scenario B	Supplemental Scenario C
2005	47,663	1.84	2.28	2.21	2.17
2006	25,247	1.95	2.96	2.79	2.66
2007	8,471	1.67	3.04	2.57	1.95
2008	16,099	2.41	2.73	2.47	2.26
2009	11,608	2.11	2.78	2.47	2.19
2010	19,576	1.95	2.66	2.46	2.30
2011	33,282	1.62	2.60	2.48	2.39
2012	12,701	1.53	2.86	2.55	2.25
2013	11,548	1.59	2.76	2.34	1.86
2014	8,527	1.62	2.79	2.30	1.66
2015	9,758	1.64	2.58	2.10	1.55
2016	9,265	2.14	2.74	2.30	1.78
Maximum	47,663	2.41	3.04	2.79	2.66
Average¹	17,812	1.84			

¹ 12-Year Volume-Weighted Average is calculated for TIN.

Note: This table represents an update to Table S-21 of the WLAM Summary Report (Geoscience, 2020)

Estimated Annual Streambed Recharge and 1-Year Volume-Weighted TIN Concentration of Santa Ana River - Reach 4 Overlying Colton GMZ Retrospective Model Run WY 2005 - 2016



Note: This figure represents an update to Figure S-23 of the WLAM Summary Report (Geoscience, 2020)

TIN of Streambed Recharge to Santa Ana River - Reach 4 Overlying Colton GMZ
Retrospective Model Run WY 2005 - 2016

Water Year	Streambed Percolation (ac-ft)	1-Year Volume-Weighted Running Average (mg/L)			
		TIN			
		Retrospective	Supplemental Scenario A	Supplemental Scenario B	Supplemental Scenario C
2005	6,112	1.92	2.14	2.02	1.96
2006	2,623	1.72	2.56	2.10	1.84
2007	1,132	1.11	2.97	1.55	1.06
2008	2,214	1.73	2.38	1.74	1.42
2009	1,657	1.38	2.51	1.69	1.29
2010	2,639	1.59	2.32	1.90	1.70
2011	3,977	1.78	2.36	2.12	1.98
2012	1,769	1.16	2.47	1.56	1.18
2013	1,560	1.20	2.55	1.49	1.08
2014	1,402	1.03	2.54	1.30	0.90
2015	1,656	0.98	2.26	1.21	0.84
2016	1,518	1.28	2.47	1.40	0.97
Maximum	6,112	1.92	2.97	2.12	1.98
Average¹	2,355	1.55			

¹ 12-Year Volume-Weighted Average is calculated for TIN.

Note: This table represents an update to Table S-24 of the WLAM Summary Report (Geoscience, 2020)

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