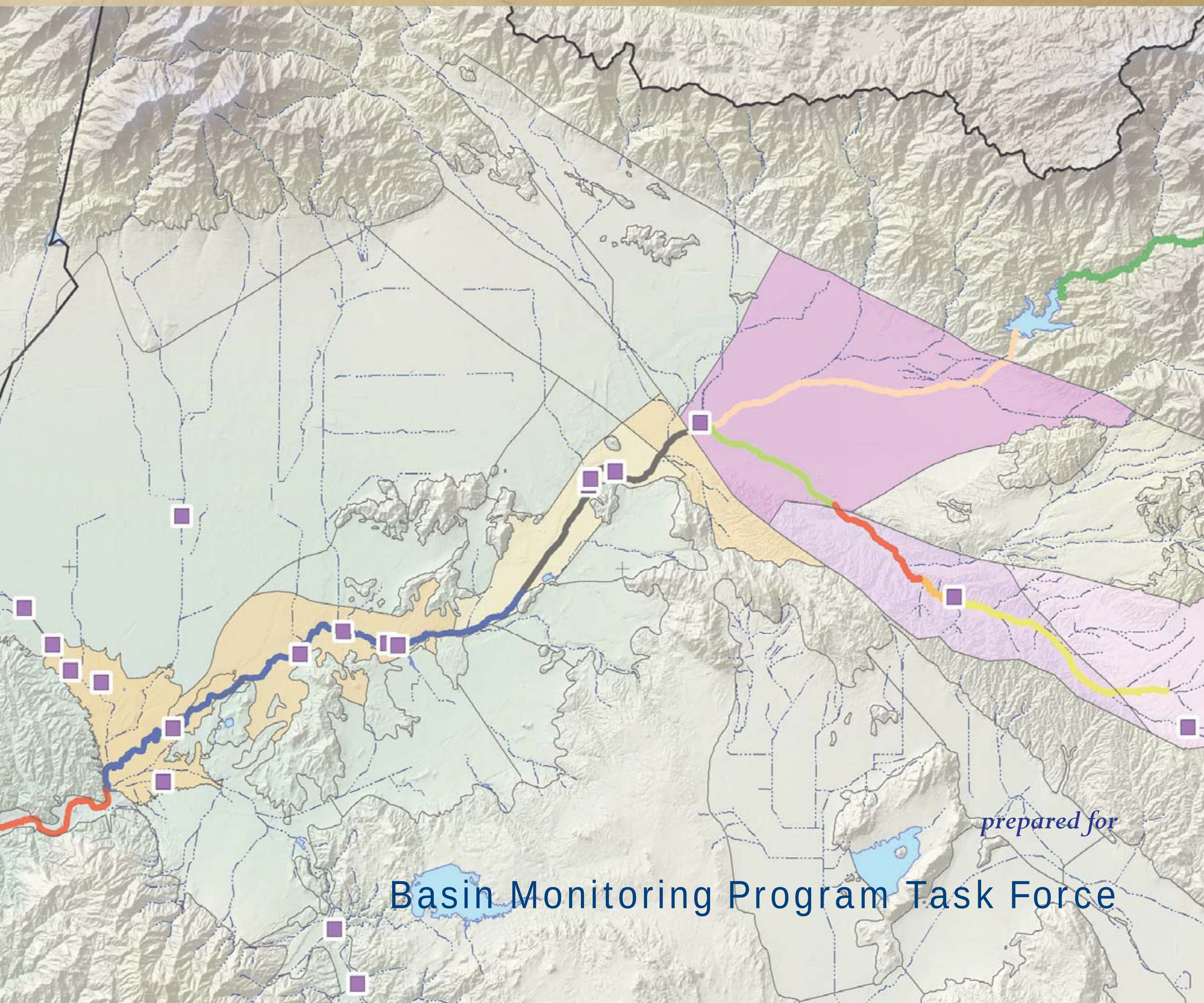
2004 Basin Plan Amendment Required Monitoring and Analyses

2008 Santa Ana River Wasteload Allocation Model Report

Final Report



prepared for

Basin Monitoring Program Task Force

May 2009

WILDERMUTH™
ENVIRONMENTAL INC.

May 13, 2009

Santa Ana Watershed Project Authority
Attention: Mr. Mark Norton
11615 Sterling Avenue
Riverside, CA 92503

Subject: Final Report - 2008 Santa Ana River Wasteload Allocation Model Report

Dear Task Force Members:

Wildermuth Environmental, Inc. (WEI) is proud to submit the *2008 Santa Ana River Wasteload Allocation Model Report* to the Basin Monitoring Program Task Force in fulfillment of our agreement (Task Order: WILD374-02). This report summarizes our efforts to update, calibrate, and apply the Wasteload Allocation Model to estimate projected TDS and Nitrate-N concentrations of the Santa Ana River recharge water and discharge at Prado Dam in accordance with the 2004 Basin Plan Amendment. The report has been vetted through the Task Force and all their comments have been included and responded to.

We have enjoyed the opportunity to work on this important project, and the staff at WEI would like to express their appreciation to all members of the Task Force for their contributions. We look forward to working with the Task Force to include the findings of this important work in the upcoming Basin Plan amendment.

Very truly yours,

Mark J. Wildermuth, PE

Chairman
Wildermuth Environmental, Inc.

Thomas D. McCarthy, PE, PG

Associate Engineer
Wildermuth Environmental, Inc.

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Principal Engineer
Wildermuth Environmental, Inc.

2004 BASIN PLAN AMENDMENT
REQUIRED MONITORING AND ANALYSES

2008 SANTA ANA RIVER WASTELOAD ALLOCATION MODEL REPORT

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Prepared for

Basin Monitoring Program Task Force

Prepared by

Wildermuth Environmental, Inc.

May 2009

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Acronyms, Abbreviations, and Initialisms

AMC	Antecedent Moisture Condition
CBFIP	Chino Basin Facilities Improvements Program
CBWCD	Chino Basin Water Conservation District
CN	Curve Number
CWA	Clean Water Act
DEM	digital elevation model
EMWD	Eastern Municipal Water District
EVMWD	Elsinore Valley Municipal Water District
HSAs	hydrologic simulation areas
IEUA	Inland Empire Utilities Agency
JCSD	Jurupa Community Services District
MWDSC	Metropolitan Water District of Southern California
NSE	Nash-Sutcliffe Efficiency coefficient
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
POTWs	Publicly-Owned Treatment Works
RCFCWCD	Riverside County Flood Control and Water Conservation District
RMSE	Root Mean Square Error
SAWPA	Santa Ana Watershed Project Authority
SBCFCD	San Bernardino County Flood Control District
SBVMWD	San Bernardino Valley Municipal Water District
SBVWCD	San Bernardino Valley Water Conservation District
SCAG	Southern California Association of Governments
SCS	Soil Conservation Service
SWMM	Storm Water Management Model
SWRCB	State Water Resource Control Board
TDS	total dissolved solids
TIN	total inorganic nitrogen
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WEI	Wildermuth Environmental, Inc.

Acronyms, Abbreviations, and Initialisms (Continued)

WLAM	Wasteload Allocation Model
WMWD	Western Municipal Water District
YVWD	Yucaipa Valley Water District

1.1 Introduction

Under California Water Code Section 13240 et seq., each Regional Water Quality Control Board must formulate and adopt a water quality control plan (Basin Plan) for all areas within its respective region. Each Basin Plan must include:

- Beneficial uses, which are to be protected;
- Water quality objectives, which protect these uses; and
- An implementation plan to achieve those objectives.

Beneficial uses are the uses to which surface water and groundwater are or may be put, including water contact recreation; municipal, agricultural, and industrial supply; and the preservation of fish and other aquatic wildlife.

Water Code Section 13050 defines water quality objectives as "the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area." At a minimum, a Regional Board must consider the following factors in establishing water quality objectives:

"(a) Past, present and probable future beneficial uses of water.

(b) Environmental characteristics of the hydrographic unit under consideration, including the quality of the water available thereto.

(c) Water quality conditions that could reasonably be achieved through coordinated control of all factors which affect water quality in the area.

(d) Economic considerations

(e) The need for developing housing within the region.

(f) The need to develop and use recycled water" (Section 13241).

In addition, the existing quality of water for which the objectives are being established must be considered. Both federal and state antidegradation policies require that existing high quality waters be protected unless lowering that quality:

- Is necessary to accommodate important economic or social development
- Is consistent with the maximum benefit to the people of the sate
- Will not unreasonably affect actual or potential beneficial uses

The implementation plan required in each Basin Plan includes the control of waste discharges by the Regional Board through waste discharge requirements and/or the prescription of waste discharge prohibitions. Implementation plans must also include recommendations for actions that are not under the Regional Board's statutory authority but can be undertaken by other public or private entities. Actions may include, but are not limited to, the construction and operation of desalters, well fields designed to intercept poor quality groundwater, and groundwater recharge programs.

The Water Code states that Basin Plans must be periodically reviewed and revised. The

Federal Clean Water Act (CWA) specifies that water quality standards (beneficial uses and water quality objectives) must be reviewed at least once every three years. Basin Plan revisions may include changes to beneficial uses, water quality objectives, and implementation plans. However, state and federal policies and regulations place stringent limits on the Regional Board's discretion in making these changes:

- Beneficial Uses. For surface water, the CWA (Section 101 [a][2]) establishes the national "fishable/swimmable" goal, which states that, wherever attainable, water quality that "provides for recreation in and on the water" must be achieved. Where the Regional Board does not designate "fishable/swimmable" uses, a use attainability analysis must be performed to demonstrate that these uses are not attainable based on physical, chemical, biological, or economic factors (40 CFR 131.10[j]). These waters must be reviewed at least once every three years to determine whether conditions have changed such that "fishable/swimmable" uses should be designated. For surface waters, existing beneficial uses (as of 1975) may not be removed but must be maintained and protected (40CFR 131.10 [j][2]). The Water Code prohibits the removal of beneficial uses solely on economic grounds (Section 13241).
- Water Quality Objectives. The reduction of water quality (establishment of less stringent water quality objectives) requires a demonstration that the change is necessary to accommodate important economic or social development and is consistent with maximum benefit to the people of the state and that actual and potential beneficial uses will not be unreasonably affected. If less stringent water quality objectives are proposed on the basis that prior technical errors or insufficient information led to the development of inappropriate water quality objectives, there must be a finding that the new objectives are theoretical rather than an actual reduction of water quality. Regardless, the level of water quality necessary to protect existing beneficial uses must be maintained.
- Implementation Plans. Changes to implementation plans are appropriate and necessary as conditions in a region change and as the understanding of water quality problems and issues improves. However, the intent of an implementation plan, to meet water quality objectives, must remain unchanged.

The 1975, 1983, 1995, and 2004 Basin Plans have wasteload allocations for discharges to the Santa Ana River. Under the CWA, violations of water quality objectives must be addressed by calculating the maximum wasteloads that can be discharged to achieve and maintain compliance. The Santa Ana River Watershed Basin Plan, in its entirety, contains a wasteload allocation for the watershed through its water supply and wastewater management plans. The wasteload allocation for the Santa Ana River was developed with the Wasteload Allocation Model (WLAM). The WLAM simulates the fate and transport processes for total dissolved solids (TDS) and total inorganic nitrogen (TIN). TIN consists of the sum of ammonia, nitrite, and nitrate, expressed as nitrogen. The wasteload allocations in the 2004 Basin Plan Amendment were based on future (2010) projections of TDS and TIN. The 2008 version of the WLAM was used in this investigation to update the wasteload allocation for an upcoming basin plan amendment in either 2009 or 2010.

1.2 Summary of Prior Work

In 1995, the TIN/TDS Task Force was formed to provide oversight, supervision, funding, and approval of a study to evaluate the impacts of TIN and TDS on water resources in the Santa Ana Watershed. Members of the TIN/TDS Task Force include:

- Chino Basin Water Conservation District (CBWCD)
- Chino Basin Watermaster
- City of Colton
- City of Corona
- City of Redlands
- City of Rialto
- City of Riverside
- City of San Bernardino
- Eastern Municipal Water District (EMWD)
- Elsinore Valley Municipal Water District (EVMWD)
- Inland Empire Utilities Agency (IEUA)
- Jurupa Community Services District (JCSD)
- Metropolitan Water District of Southern California (MWDSC)
- Orange County Sanitation District (OCSD)
- Orange County Water District (OCWD)
- Regional Water Quality Control Board, Santa Ana Region (Regional Board) – Advisory Member
- Riverside-Highland Water Company
- San Bernardino Valley Municipal Water District (SBVMWD)
- San Bernardino Valley Water Conservation District (SBVWCD)
- Santa Ana Watershed Project Authority (SAWPA) – Advisory Member
- US Geological Survey (USGS) – Advisory Member
- West San Bernardino County Water District
- Yucaipa Valley Water District (YVWD)

Wildermuth Environmental, Inc. (WEI) was retained by the TIN/TDS Task Force, through a contract administered by SAWPA, to conduct scientific and engineering investigations for the TIN/TDS Study (Task Order 1998-W020-1616-03). This work is a follow up of the previous modeling conducted in 2003 to determine the wasteload allocation for the Santa Ana River. The 2003 modeling work was used to prepare the 2004 Basin Plan Amendment (Regional Board, 2004).

1.3 The Wasteload Allocation Approach

The boundary of the study area is the Santa Ana River drainage area to Prado Dam and excludes the drainage area tributary to Lake Elsinore. This study area is the minimum area necessary to estimate discharge and the associated TDS and TIN concentrations for the reaches identified in the Basin Plan. The reaches that were included in the study are Santa Ana Reaches 3 and 4 and San Timoteo Reaches 1 through 4. All Santa Ana River reaches and groundwater management zones are shown in Figure 1-1. Figure 1-2 shows the Santa Ana River reaches included in this study, discharge locations, groundwater management zones, and their associated TDS and TIN objectives. The management zones that could be influenced by the wasteload allocation include the Beaumont management zone (San Timoteo Creek Reach 4), the San Timoteo management zone (San Timoteo Creek Reaches 2 through 4), the Bunker Hill B management zone(Santa Ana River Reach 5), the Colton management zone (Santa Ana River Reach 4), the Riverside A management zone (Santa Ana River Reach 4), the Chino South management zone (Santa Ana River Reach 3), and the Orange County management zone (Santa Ana Reach 2).

In the Santa Ana River Watershed, publicly owned treatment works (POTWs) discharge to the Santa Ana River, its tributaries, or to ponds. Discharges to the river commingle with other surface discharges that consist of runoff, rising groundwater, and other POTW discharges. Seepage occurs in the streambed, reducing surface discharges and introducing POTW discharges to groundwater; and in some reaches, rising groundwater contributes to surface discharge in the river. POTW discharges to ponds discharge directly to groundwater and were therefore not included in this investigation.

Runoff from precipitation discharges across the land surface and either percolates into the ground or discharges to stream channels where it commingles with other runoff, rising groundwater, and discharges from POTWs. Runoff water contains TDS and TIN from precipitation and from *wash off* from the land surface. The *wash off* load is dependent on soils, land use, time since last significant precipitation, and non-point source management practices. Seepage in the streambed reduces surface discharge and introduces runoff to groundwater.

The characterization of TDS and TIN loads by source needs to account for climatic and seasonal variability. POTWs discharge year-round at fairly constant rates. Nonpoint sources discharge seasonally and can vary dramatically from year to year due to precipitation. Runoff, percolation of runoff, and associated TDS and TIN loading processes are sensitive to time scales and climate. The approach developed for this wasteload allocation consists of estimating the current and proposed surface water metrics based on:

- TDS and TIN concentrations that are based on an estimate of current and future levels of POTW discharges to the River
- The expectancy of nonpoint source contributions from nonpoint loading processes for several years of daily precipitation data with constant land use and water management practices

1.4 Scope of Work

The scope work developed by WEI, approved by the Task Force, and executed for the wasteload allocation consists of the following tasks:

Task 1 - Develop Calibration Hydrology and Related Data. The precipitation, stream discharge, and water quality time histories developed during last investigation were updated. Other data—such as operational information for reservoirs, new flood control or other related facilities, and new land use and drainage area information—were also collected and extended through 2007.

Task 2 - Calibrate WLAM. The data collected in Task 1 that pertain to calibration were integrated into data files used in the WLAM. This task included getting the model running (debugging) and verifying the input data. Several runs were completed to ensure that the data were correctly entered. Upon completion of QA/QC simulations, the surface water discharge model was calibrated first for the 1995 to 2006 period. At the conclusion of the hydraulic calibration, TDS and TIN were calibrated. Modeling results from the calibration period were compared to observed values for the Santa Ana River at Riverside Narrows, below Prado Dam, and other appropriate locations in the study area.

Task 3 - Develop Future Planning Scenarios for the Santa Ana River Operation. Requests for projected recycled water production, reuse, discharges to the Santa Ana River and its tributaries, and expected quality were made to each POTW. The data were reviewed, and a daily discharge schedule was developed for the 50-year planning period. Based on the discharge information provided and feedback from the Task Force, planning scenarios were developed and circulated for review.

Task 4 - Evaluate Wasteload Allocation for Selected Planning Scenarios. In this task, the updated WLAM was converted to simulate each planning scenario. Upon completion of the simulations, the results of each modeling scenario were summarized.

Task 5 - Prepare Report. A draft report was be prepared and submitted to the Task Force for review and comment.

1.5 Report Organization

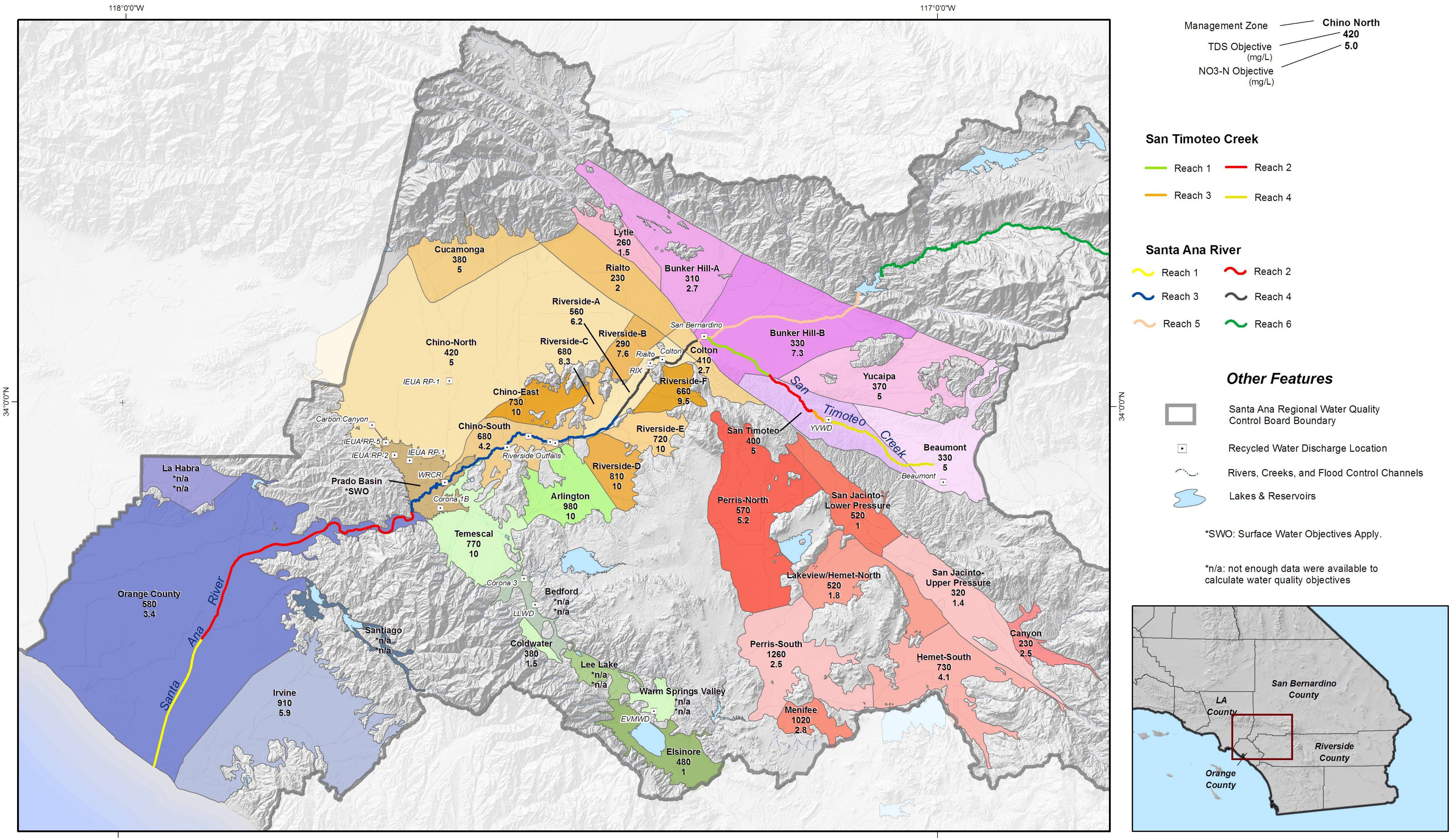
Section 1 Introduction describes the summary of previous work, the wasteload allocation approach, and the scope of work for this project.

Section 2 Model Description and Calibration describes the WLAM and its calibration.

Section 3 Comparison of Updated and Previous Models compares the updated model and the 2003 model. A description of the results and a discussion of the differences are provided herein.

Section 4 Planning Scenarios provides a description and evaluation of the planning scenarios evaluated with the WLAM.

Section 5 References provides the references that were utilized in this modeling effort.



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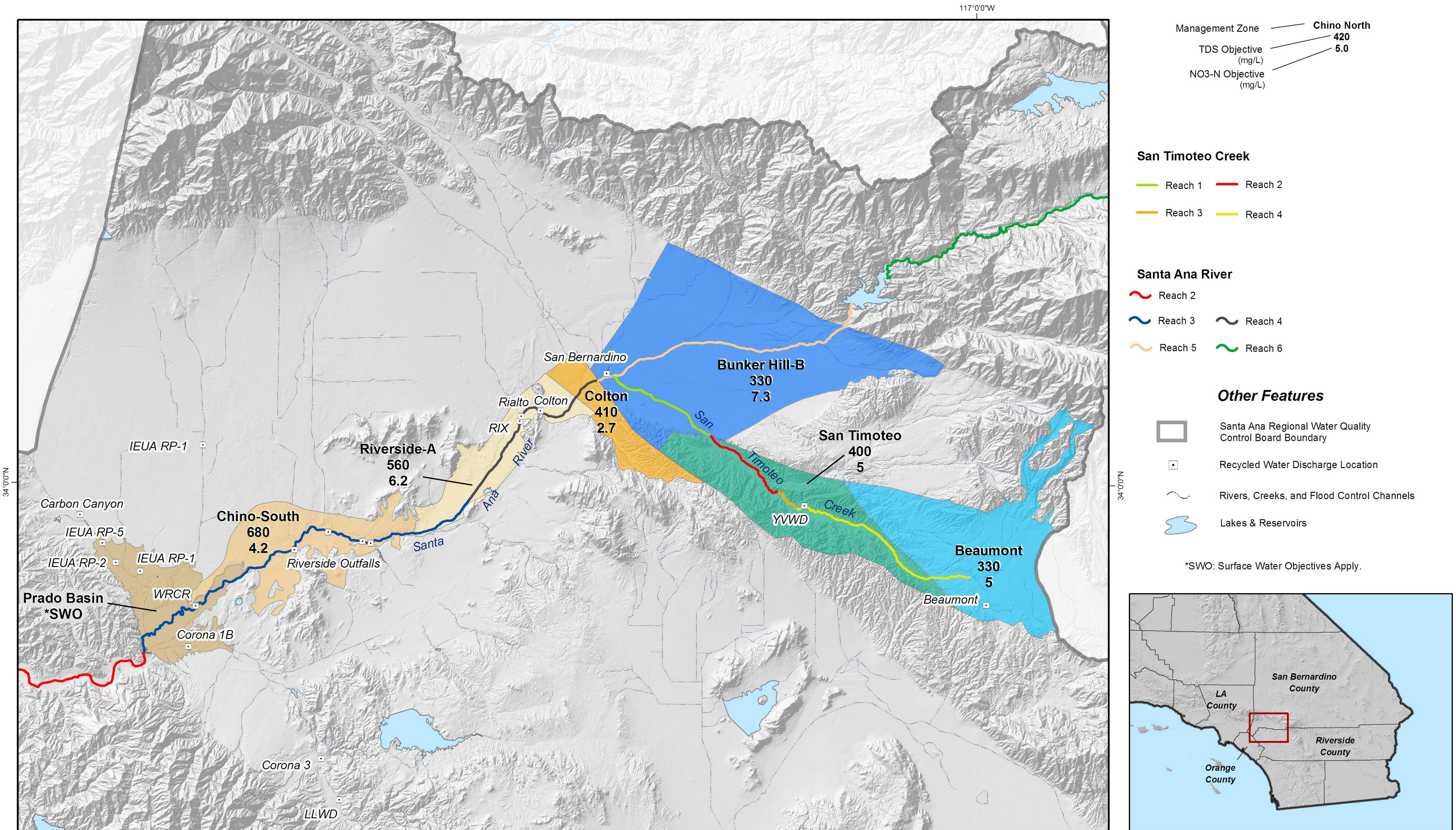
Basin Monitoring Program Task Force

2008 Wastload Allocation Model Report

California Regional Water Quality Control Board

Santa Ana Region Reaches and Management Zones

Figure 1-1



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Basin Monitoring Program Task Force

2008 Wasteload Allocation Model Report

California Regional Water Quality Control Board

Santa Ana Regional Water Quality Control Board Reaches and Management Zones Included in the WLA Model

Figure 1-2

2.1 Model Origin and Uses

The origin of the WLAM traces to the CBWCD and the Chino Basin Watermaster. These agencies wanted to estimate the storm water recharge in the Chino Basin that occurred in recharge basins, flood retention basins, and in unlined streams. WEI developed daily simulation models (RUNOFF and ROUTER) to estimate runoff, route the runoff through the Chino Basin drainage system, calculate recharge on a daily basis, and produce reports that summarized recharge performance. These models were initially developed for the western Chino Basin in 1994 (Mark J. Wildermuth, 1995) and were expanded to the entire Chino Basin in 1996 (WEI, 1998). Subsequently, the model was used in the Chino Basin to estimate the recharge performance of new basins and the recharge benefits of improved basin maintenance. The *Phase 2 Chino Basin Recharge Master Plan* (Black & Veatch, 2001) used the RUNOFF and ROUTER model results as a basis of recharge facility design and cost estimates.

In 2001, WEI updated the model to include water quality simulations and expanded the modeling area to the Santa Ana River Basin for the wasteload allocation investigation (WEI, 2002).

The WLAM was applied, along with the Storm Water Management Model (SWMM), to evaluate various water resources management alternatives and facilities for the Beaumont area (WEI, 2006).

WEI added a root zone (or top soil zone) soil moisture accounting module, ROOTZONE module, to the WLAM, and the WLAM became known as the R4 model (RAINFALL, RUNOFF, ROUTER, and ROOTZONE). The R4 model can be used to simulate rainfall infiltration to the soil zone, irrigation demand, evapotranspiration consumption, and deep percolation below root zone. WEI has successfully applied the R4 model to estimate 40 years of historical surface recharge in the Beaumont (report in preparation) and Arlington (WEI, 2008) Basins and 70 years of historical surface recharge in the Chino Basin (WEI, 2007).

2.2 Modeling Purpose and Goals

The modeling goals of this investigation are to estimate:

- Discharge, associated TDS and TIN concentrations in the Santa Ana River and its tributaries, and streambed recharge
- TDS and TIN metrics at key locations and in streambed recharge for selected reaches

These goals were accomplished by estimating long-term daily discharge time histories and associated TDS and TIN concentrations for the Santa Ana River and its major tributaries, assuming constant land use and POTW recycled water discharges for 2010 and 2020. Holding land use and POTW discharges constant for a fifty-year precipitation period (1950 through 1999) resulted in a stationary time series that includes wet and dry periods and, thus, allowing for the determination of statistics that could be used to evaluate the effectiveness of the current wasteload allocation included in the 2004 Basin Plan Amendment**.** This approach can also be used to test the effectiveness of new wasteload allocation proposals should the 2004 wasteload allocation be found not protective of the groundwater recharge beneficial use.

2.3 Wasteload Allocation Model

2.3.1 Model Organization

As illustrated in Figure 2-1, the model is organized into two major components or modules: RUNOFF and ROUTER. The RUNOFF module computes daily runoff from the land surface from daily precipitation, based on land use and soil data. The ROUTER module routes storm water runoff and all other point and nonpoint loads through the drainage system. The RUNOFF and ROUTER modules contain hydrologic, hydraulic, and water quality components. Detailed explanations of the algorithms used are provided in the sections that follow.

2.3.2 Rainfall Runoff Process

Daily runoff is estimated using a combination of methods:

- Runoff from the valley floor and some mountainous areas is calculated using a modified version of the method described in *Urban Hydrology for Small Watersheds* (USDA, 1986) and other references (SCS, 1985; Limbrunner, 2005).
- Daily discharge data from the USGS is used directly for mountainous areas where discharge records are complete.
- For small mountain watersheds with partial or no measured records, estimates of daily discharge are developed from nearby gaged watersheds, using regional analysis (regression or areal proration).

The mountain areas consist of the watersheds located in the San Bernardino, San Gabriel, and Santa Ana Mountains, and other mountainous/hill boundary areas. Mountain watershed hydrologic processes are similar to valley floor processes; though, some mountain watersheds produce sustained base flows and delayed runoff due to groundwater and snow pack storage. Measured daily discharges from mountain areas are assumed to be stationary; that is, their daily discharge statistics do not change over time due to influences from land development or other anthropogenic activities.

In contrast, valley floor areas are in a constant state of change, as land is converted from natural to agricultural and then to urban uses. There are no stationary historical stream discharge or water quality data in the valley floor area that can be used to estimate daily discharge and associated water quality statistics. Valley floor runoff is estimated using the Soil Conservation Service (SCS) method described in Section 4 of Chapter 10 of the *National Engineering Handbook* (NRCS, 2000).

The SCS method is based on the assumption that the ratio of actual retention to potential retention is same as the ratio to actual runoff to the effective rainfall. This is described mathematically as:

$$\frac{F}{S} = \frac{Q}{P - I_a} \tag{1}$$

Where F = the actual retention after runoff begins

S = the potential retention after runoff begins (S > F)

Q = the runoff

I_a = the initial abstraction

P = total rainfall

The continuity of storm water can be written as:

$$P = Q + F + I_a \tag{2}$$

This equation states that total rainfall is the sum of runoff, retention, and the initial abstraction. The equation can be rearranged as:

$$F = (P - I_a) - Q \tag{3}$$

Substituting equation (3) to (1) and rearranging for the total storm runoff (*Q*) results in the runoff equation:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \tag{4}$$

This is the basic rainfall-runoff relationship used in SCS method. Figure 2-2 illustrates the relationship between SCS method variables.

After reviewing results from many small experimental watersheds, Victor Mockus, the developer of the SCS method, developed an empirical relationship between the initial abstraction and the potential retention, which is expressed as:

$$I_a = 0.2S \tag{5}$$

By substituting I_a into equation (5), the rainfall-runoff equation becomes:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad when\, P > I_a \tag{6}$$

The potential retention (*S*) consists mainly of the infiltration that occurs after runoff begins and remains constant for an individual storm because it is the maximum retention that can occur under existing conditions if the storm continues without limit. A succession of storms increases soil moisture and reduces infiltration capacity, or potential retention (*S*). Conversely, periods of dry weather reduce soil moisture and increase *S*. With the SCS method, the change in *S* is based on an antecedent moisture condition (AMC), which is determined by the total rainfall in the 5-days preceding a storm. The *National Engineering Handbook* defines three levels of AMCs:

- AMC-I Lowest runoff potential. The Watershed soils are dry enough for satisfactory plowing or cultivation to take place.

- AMC-II The average condition.
- AMC-III The highest runoff potential. The watershed is practically saturated from antecedent rains.

The AMC-I condition is the lower limit of soil moisture, or the upper limit of potential retention *S*. Conversely, the AMC-III condition is the upper limit of soil moisture, or the lower limit of *S*.

The SCS simplified equations 4 and 6 through the introduction of the curve number (CN).

$$CN = \frac{1000}{10 + S} \tag{7}$$

The practical implication of this equation is that the CN approaches 100 when *S* approaches zero (when retention is negligible), and the CN approaches zero when *S* approaches infinity. Therefore, the CN indicates the runoff potential—the higher the CN, the higher the potential. The *National Engineering Handbook* contains a table of CNs for hydrologic soil types and various land use types and conditions for the AMC-II condition. Many hydrology manuals contain similar tables, modified for local conditions. Table 2-1 lists SCS method CNs, which were reproduced from the *Riverside County Hydrology Manual* (County of Riverside, 1978).

2.3.2.1 Curve Number Variability

Rainfall-runoff data do not fit the CN runoff concept precisely due to the variability of rainfall intensity and duration, total rainfall, AMCs, cover density, stage of growth, and temperature. This variability is accounted for by adjusting the curve numbers.

The *National Engineering Handbook,* chapter 10 (NRCS, 2000), contains a table of empirically determined CNs for three AMCs: CN_1, CN_2, and CN_3. This table also provides values for AMC-I and AMC-III based on average AMC-II conditions. WEI developed the following equations such that CN_1 and CN_3 (for AMC-I and AMC-III) could be derived from CN_2 (AMC-II) automatically within the model:

$$CN_1 = \frac{CN_2}{2.27 - 0.0125 * CN_2} \tag{8a}$$

$$CN_3 = \frac{CN_2}{0.44 + 0.0055 * CN_2} \tag{8b}$$

Figure 2-3 shows the data for CN_1, CN_2, and CN_3, and the fitted curves. To estimate curve numbers for given soil conditions, values were interpolated between CN_1 and CN_3, using soil moisture retention capacity. This approach is based on the work completed by Limbrunner et al. (2005) and is listed below.:

$$CN(t) = (CN_3 - CN_1) * \frac{S(t)}{S_{max}} + CN_1 \tag{9}$$

Where $S(t)$ is a variable that represents top soil zone storage at time t, and S_{max} is the maximum allowable storage under dry conditions. The storage variable is tracked on a daily basis such that $CN(t)$ can be tracked on a daily basis.

The value of the CN is a function of soil properties and land use data. Soil data is contained in soil surveys prepared by the SCS (1917, 1977, & 1980). The RUNOFF module computes daily runoff from each hydrologic area and writes these estimates to binary files that are subsequently used as input to the ROUTER module. The TDS and TIN concentrations associated with the daily runoff are generated from empirical relationships that relate TDS and TIN concentrations to the volume of runoff generated from each land use. The CN and the empirical relationships used to estimate the TDS and TIN concentrations of runoff are refined in calibration.

The RUNOFF module data requirements include:

- precipitation data
- daily evaporation data
- daily discharge data for mountain watersheds
- SCS soil surveys
- land use maps
- drainage maps
- as-built or design plans for all flood retention/recharge spreading basins and flood control facilities

2.3.3 Channel and Reservoir Routing

The ROUTER module is used to route the runoff estimated with the RUNOFF module through the drainage system in the upper Santa Ana watershed. The drainage system is descretized into nodes and links. The ROUTER module utilizes a routing plan that is based on a node-link pattern that describes the inflow or concentration points from the hydrologic areas of the RUNOFF module and the directional flow logic dictated by the streams, flood control channels, and retention basins. Runoff from hydrologic areas, non-tributary discharges, and boundary discharges are concentrated at nodes. Discharges are routed downstream from node to node via "links." The links are used to represent channels, flood control basins, conservation basins, and wetlands.

Routing through flood control basins, conservation basins, and wetlands is based on the continuity or mass balance equation (Viessman & Lewis, 1995). The continuity equation for flood analysis is expressed as:

$$\frac{\Delta S}{\Delta t} = I - O \qquad (10)$$

Where ΔS = the change of storage

Δt = the time step

I = inflow

O = outflow

This equation states that the storage change during a given period of time is the difference between total inflow and outflow over the same period. This equation was modified for the WLAM as follows:

$$\frac{\Delta S}{\Delta t} = I - O + P_r - E_v - P_c \tag{11}$$

Where:

P_r = direct precipitation

E_v = evaporation

P_c = percolation

For retention and groundwater recharge purposes, the WLAM uses rating curves for water storage facilities. For specified elevations, the link data file contains surface area, storage volume, discharge rate (for up to two outflow facilities), and percolation rate information.

The WLAM runs on a daily time step, but reservoirs are simulated on a smaller time step (more than 240 times steps per day) to achieve numerical stability.

Discharges are translated in channels without storage effects and include losses to recharge (in unlined or partially lined stream channels) and evaporation (from water surfaces). The ROUTER module uses Manning's equation to calculate velocity and the representative hydraulic elements of a channel. Manning's equation is as follows (in English units):

$$Q = \frac{1.486}{n} * A * R^{2/3} s^{1/2} \tag{12}$$

Where:

Q = the discharge in cubic feet per second (cfs)

A = the cross-sectional area (ft^2)

R = the hydraulic radius (ft)

s = the slope of the energy grade line and is approximated as the channel slope

n = Manning's roughness coefficient

Streambed recharge is equal to:

$$S_{rj} = L_j * W_j * P_{rj} \tag{13}$$

Where:

S_{rj} = the streambed recharge in link j (ft^3/day)

L_j = the length of link j (ft)

W_j = the permeable wetted perimeter in link *j* (ft)

P_{rj} = the daily percolation rate in link *j* (ft/day)

For constructed channels and storm drains, the channel geometry is directly entered into the ROUTER input files, and the ROUTER module computes the hydraulic elements of the channel. The hydraulic elements consist of a lookup table that includes the relationships of the cross-section area, top width, hydraulic radius, weighted Manning's *n*, and conveyance to depth. Channel cross-section data can be highly irregular for natural channels or channels that are predominantly natural. The Santa Ana River and portions of San Timoteo Creek were considered natural channels in this investigation. For natural channels, hydraulic elements were based on a HEC-RAS model, developed by the United States Army Corps of Engineers (USACE) for the Santa Ana River, and on topographic maps that were obtained from the County of Riverside for San Timoteo Creek.

Daily, monthly, and annual discharge/recharge volumes are computed by the ROUTER module. The results of the ROUTER module are written to output files, which are imported into spreadsheets for analysis.

2.3.4 Water Quality Constituents

2.3.4.1 Total Dissolved Solids

TDS is treated as a conservative constituent, it is assumed to not interact with other water quality parameters. All inflows to a model node have an associated TDS concentration. Discharges and associated TDS concentrations are completely mixed at each node and a discharge-weighted composite TDS concentration is computed and routed through each link to the downstream node. TDS concentrations can increase in a link due to evaporation.

2.3.4.2 Total Inorganic Nitrogen

TIN is a non-conservative constituent. The loss of TIN is calculated as a first order, linear sink within each link. TIN loss in a link is computed as:

$$C_{TIN_{ds}} = C_{TIN\,us} * e^{-kt} \qquad (14)$$

Where:

$C_{TIN_{ds}}$ = the TIN concentration discharged downstream from link *j* in mg/L-N

$C_{TIN\,us}$ = the TIN concentration discharged to link *j* from upstream links and local runoff and point loads in mg/L-N

k = the reaction rate (day^{-1})

t = the retention time, which is computed as reach length divided by the translation time through the link (day)

2.3.5 Computational Time Step and Simulation Period

The computational time step or period used in this study was one day. This period was selected due to modeling accuracy issues and data availability. Using longer periods, such as weeks, months, seasons, or a year, would lead to:

- Gross over-estimates of recharge in channels and conservation basins
- Underestimates of TDS and TIN concentrations in surface water discharge and streambed recharge during dry-weather discharge (the majority of the year)
- Overestimates of TDS and TIN concentrations in surface water discharge and streambed recharge during wet-weather discharge

Errors occur with long time steps because the estimated inflow and associated constituent mass is smeared out uniformly over the computational period. Runoff generally comes from storms that last a couple of days to less than one day.

Data availability also drives the selection of a time period. Daily discharge data is readily available from the USGS in digital format. As with discharge data, spatially representative, long-term, daily rainfall data are readily available in digital format. Higher frequency data (data with a time period of less than one day) are generally not available. The computational time step of one day was selected as a compromise between computational accuracy and data availability.

The simulation period used in this study spans October 1, 1950 through September 30, 1999, a period of 50 years or 18,263 days of continuous simulation.

2.4 Description of Model Data

The data types and sources used to build the WLAM files are discussed below. The majority of these data were collected from the San Bernardino County Flood Control District (SBCFCD), the USGS, the Riverside County Flood Control and Water Conservation District (RCFCWCD), and the County of Los Angeles. Specific data used include:

- Hydrologic subarea or storm water drainage area
- Precipitation data
- Land use data
- Hydrologic soil data
- Evaporation data
- Stream discharge data for mountain watersheds
- As-built or design plans and operational data for all flood retention and spreading basins and flood control facilities, including:
    - Channel geometry and type of lining (permeable, impermeable, or composite)
    - Rating tables for outlets of each flood retention and spreading basin
    - Relationships for the area and storage to water surface elevation for

each flood retention and spreading basin
    - Depth-percolation rate relationships for each flood retention and spreading basin
    - Rating tables for diversions
- Stream bottom percolation data
- Time histories of discharge and TDS and TIN concentrations for non-tributary discharges
- Reaction rate coefficients for nitrogen loss

Hydrologic Simulation Area. Figure 2-4 shows the hydrologic simulation areas (HSAs). The natural drainage areas were delineated from a USGS map and digital elevation model (DEM) data. The man-made storm water drainage system was overlain on the natural drainage system, and the drainage area was modified. In the last WLAM study, the total number of HSAs on the valley floor was 220, each with an average size of approximately 2,720 acres. For this study, the HSA coverage was further refined in the Prado, Arlington, Fontana, and Beaumont areas. For this study, the total number of HSAs is 259, each with an average size of approximately 2,320 acres.

Precipitation Data. Forty-three precipitation stations in the basin—with historical data covering the majority of the simulation period—were selected for use in the model. These data were obtained from Los Angeles, San Bernardino, and Riverside Counties. The stations are listed in Table 2-2, and their locations are shown in Figure 2-5.

Land Use Data. Existing and future land use data within the watershed was developed based on available Southern California Association of Governments (SCAG) information for 2000. SCAG compiled land use data for 1990, 1993, 2000, and 2005. The 2001 data fits the middle of calibration period and was used for calibration. SCAG classifies land use based on the Anderson land use code system, which numerically distinguishes various land use types.

The WLAM uses a different land use system that categorizes land use based on water use, runoff, and TIN/TDS wash-off rates. Table 2-3 lists the land use types used in the previous wasteload allocation study. As shown in this table, the previous study included 21 land use types. For this study, the total number of land use types was reduced to 12, as shown in Table 2-4. This table also shows the average percentage of impervious area for each land use type. These percentages were estimated based on published data in the county hydrology manuals (Riverside County, 1979; San Bernardino County, 1986). Pervious areas consist of agricultural uses, urban landscaping, fields, and undeveloped areas that allow some precipitation to infiltrate into the ground. Impervious areas consist of roofs, streets, parking lots, and other areas that do not allow for the percolation of precipitation or runoff.

Table 2-5 provides the relationship between Anderson and WLAM land use codes, and Table 2-6 summarizes land uses in the WLAM land use code system by area. Land use data was used to estimate the amount of pervious and impervious areas within each hydrologic simulation area. Figure 2-6 shows the distribution of land uses in the upper watershed, based on the SCAG data that was converted to the WLAM land use system. Figure 2-7 shows the drainage areas that land use statistics were calculated for in Table 2-6.

Soils and Hydrologic Soil Type Data. Hydrologic soil type delineations for the watershed are based on SCS soil surveys of the study area—*Soil Survey of San Bernardino County, Southwestern Part* (SCS, 1977), *Soil Survey of Western Riverside County* (SCS, 1971) *Soil Survey of the Pasadena Area, California* (SCS, 1917)—and the *San Bernardino County Flood Control Manual* (San Bernardino County, 1986). In the SCS method, soils are classified as type A, B, C, or D. Table 2-7 describes each land use type by SCS soil type.

Figure 2-8 shows the areal distribution of hydrologic soil types, based on mapping by San Bernardino County, Riverside County, and the SCS. In San Bernardino County, soil types A and B occupy 92 percent of the area. Whereas, in Riverside County, soil types A and B occupy only 43 percent of the area. This disparity may be due to differences in the geologic formations of the two areas, but it may also be due to different surveyors. Los Angeles County accounts for about 2 percent of the model area.

Hydrologic soil types and land uses were used to develop CNs. A CN reflects a soils ability to retain rainfall from storm events. CNs are lower for well-draining sandy soils and higher for poor-draining silty clay soils. CNs were estimated for the pervious part of each land use type within each drainage area, based on the various soil types and land uses recommended in the published county hydrology manuals (Riverside County, 1979; San Bernardino County, 1986). The values range from a low of 37 to a high of 89. Impervious areas were assumed to have a CN of 98. Table 2-7 lists the initial CN estimates. Please note that some CNs were modified during calibration.

Evaporation Rate. Evaporative losses of water stored in flood control and spreading basins were based on evaporation data that was collected at the Puddingstone Reservoir, located west of the City of Pomona. The County of Los Angeles collects data at this station daily.

Percolation Rates for Conservation Basins and Channels. Depth-percolation rate relationships for flood retention and conservation basins in the Chino Basin were based on estimates that were developed from CBWCD recharge monitoring programs and from the Chino Basin Watermaster Phase 2 Recharge Master Plan. Percolation rates for all other conservation basins and permeable channels were initially estimated (Moreland, 1972) and refined in calibration.

Daily Discharge Data. Daily discharge data were obtained from the USGS. Table 2-8 lists the stations used in this study, and Figure 2-9 shows the locations of these stations

Operational Characteristics of Flood Control and Conservation Basins. The operations of the flood control and spreading basins were based on static rule curves that define the operational relationship of storage, surface area, and outflow as a function of water surface elevation in each basin. Operational data for each basin were acquired from existing engineering documents, as-built construction drawings, and communications with USACE, SBCFCD, Pomona Valley Protective Association, and CBWCD staff.

TDS and TIN Data. TDS and TIN data were used to develop TDS and TIN generation curves for runoff, to identify the TDS and TIN concentrations in non-tributary inflows, and as calibration targets. These data were obtained from the Chino Basin Watermaster, the OCWD, the POTWs, the RCFCWCD, the Regional Board, the SBCFCD, and the USGS. Generally, each sampling event reported by these entities includes ammonia, nitrite, and nitrate, or nitrate and ammonia. TIN was assumed to be the sum of the reported inorganic nitrogen compounds: either ammonia + nitrite + nitrate, or ammonia + nitrate, respectively. Overall, nitrite concentrations are very small, and their absence does not materially affect the estimation of TIN concentrations. TIN estimates were not made if either ammonia or nitrate were missing. The number of TDS and TIN observations at selected stations during the calibration period are listed below:

Station	Number of Observations	
	TDS	TIN
Santa Ana River at MWD Crossing	849	163
Santa Ana River at below Prado Dam	4,315	264

TDS and TIN Generation Curves. The TDS and TIN concentrations in rainfall runoff from valley floor areas were estimated from data that were collected by the Chino Basin Watermaster and the Counties of San Bernardino and Riverside and from conservation basin TDS and TIN measurements made by the Chino Basin Watermaster. These concentrations were compared to measured or RUNOFF module-estimated discharges, and simple relationships between TDS, TIN, and runoff were developed for urban and mountain watersheds. These relationships were established for the last wasteload allocation investigation (WEI, 2003). Since the last investigation, WEI has collected more runoff water quality data from the counties, but these data did not include discharge measurements. Without discharge data, the TDS and TIN generation curves could not be updated from the 2003 investigation.

Non-tributary discharges. Non-tributary discharges include discharges to surface water from POTWs, water transfers from groundwater basins, and state project water discharged at the OC-59 turnout in San Antonio Creek. Discharge, TDS, and TIN time history data for the calibration period were obtained from POTWs and the annual reports of the Santa Ana Watermaster and others.

Lake Elsinore Discharge. Discharge and associated TDS concentrations from Lake Elsinore for the calibration period were estimated from the annual reports of the Santa Ana River Watermaster for water years 1994/95 through 2005/06 (Santa Ana River Watermaster, 2006). The TIN in Lake Elsinore discharge for the calibration period was estimated from published Lake monitoring data (Black & Veatch, 1994).

Rising Groundwater. The WLAM is not dynamically linked to a groundwater model. Therefore, a time series of rising water discharge to the stream network was synthesized from discharge measurement data where rising water is assumed to be occurring. Specifically, rising groundwater was estimated for the Santa Ana River at Riverside Narrows and at Prado Dam. Rising water may occur at other locations in the stream system; however, due to the lack of data needed to define the spatial and temporal distribution of rising groundwater at other locations, such time series could not be synthesized for this study.

OCWD Wetlands. The OCWD constructed about 400 acres of wetlands in the Prado reservoir, which it uses to treat some of the discharge of the Santa Ana River and all of the effluent from the Western Riverside Regional Water Recycling Plant. Fifty percent of Santa Ana River discharge, up to 100 cfs, is diverted into the wetlands. The TIN in effluent that is discharged from the wetlands back to the Santa Ana River was assumed to be 1 mg/L-N. A slight TDS increase occurs in the effluent of the wetlands due to evaporation and transpiration.

2.5 Calibration

Calibration is a process in which parameter adjustments are made to match the dynamic behavior of the WLAM with the observed behavior of the streams being simulated. In the process of calibration, model parameters are adjusted, subject to reasonable bounds, with manual methods and automatic parameter estimation (inverse) methods to match observed discharge and water quality. The WLAM was calibrated first for surface water and subsequently for TDS and TIN. The calibration period was 1994 through 2006. The PEST code (Doherty, 2004) was used to assist in the calibration of the WLAM. During the calibration process, parameters are adjusted until the model-generated results fit a set of observations as closely as possible. PEST adjusts model parameters until the fit between model output and field observations are optimized in terms of the weighted least square residuals. PEST is a public domain code that applies the Gauss-Marquardt-Levenberg algorithm. PEST has been successfully applied in many fields of the geophysical sciences, including groundwater and surface water modeling (Doherty & Johnston, 2003; Zarriello & Bent, 2004). The calibration results discussed herein are the combined results of manual and automated calibration.

2.5.1 Calibration Targets

Surface water discharge and associated TDS and TIN concentrations were calibrated by comparing model-estimated values against observed values at key locations in the upper watershed. The calibration of the WLAM for surface water discharge has improved since the previous application of the WLAM (WEI, 2002).

2.5.2 Surface Water Discharge Calibration

The surface water discharge calibration effort started at the upstream end of San Timoteo Creek and proceeded downstream. Daily and monthly discharge estimates from the WLAM were compared to measured data. Figures 2-10 through 2-16 compare model results with measured daily discharges at San Timoteo Creek near Loma Linda, Santa Ana River at E Street, Santa Ana River at MWD Crossing, Temescal Creek above Main Street, Chino Creek at Schaefer Avenue, Cucamonga Creek near Mira Loma, and Santa Ana River inflow to the Prado Basin. Figure 2-17a (all discharges) and Figure 2-17b (low discharges) are scatter plots of monthly measured and modeled discharge at all calibration locations. These figures also list the correlation coefficient (R-square) of the two data series (0.92).

Table 2-9 summarizes the calibration statistics used to evaluate accuracy of the model. This table lists, by station, the R-square, the root mean square error, and the Nash-Sutcliffe Efficiency (NSE) coefficient. These statistics were calculated with a daily aggregated monthly discharge.

The R-square statistic describes the fraction of variance in the observed data that can be explained by the WLAM. For monthly total discharge, the R-square ranges from a low of 0.77 for Temescal Creek at Main Street to a high of 0.93 for Cucamonga Creek near Mira Loma, Santa Ana River at E Street, and Santa Ana River at MWD Crossing. The average for all stations is about 0.87. This means that for Cucamonga Creek near Mira Loma, 93 percent of the variation in the observed discharges can be explained by the WLAM using the parameters developed in calibration. The other 7 percent can be explained by variability in the observed precipitation and surface water discharge measurements and model conceptualization. An R-square of 1.0 indicates that the regression line perfectly fits the data. Monthly R-square statistics are used because of the timing of storms and the routing assumptions used in the WLAM. For example, if a storm occurs late in the day, the computed runoff will occur that day. The observed runoff could occur the following day. This causes significant differences between daily observed and daily estimated WLAM discharges. However, these differences are almost entirely removed at a monthly period of evaluation.

The Root Mean Square Error (RMSE) is a measure of how close a fitted line (model result) is to data points (observed values). For every model result, the distance between the modeled and measured value (the error) is squared. These values are then summed for all points and divided by the total number of points, after which the square root is taken. The squaring is done so negative values do not cancel positive values. For the WLAM, the RMSE ranges from a low of 22.1 acre-ft/month (or about 12 percent of the average monthly flow) at San Timoteo Creek near Loma Linda to a high of 155 acre-ft/month (or about 1 percent of the average monthly flow) for the Santa Ana River below Prado Dam.

The NSE is a widely used metric for measuring the predictive power of hydrologic models. The NSE is defined as one minus the sum of the absolute squared differences between the model-estimated values and the measured data points normalized by the variance of the measured values during the modeled period (Nash & Sutcliffe, 1970). As values are squared, this metric puts emphasis on the modeling accuracy of larger events. The NSE can range from $-\infty$ to 1. An efficiency of 1 corresponds to a perfect match of modeled discharge to measured discharge. An efficiency of 0 ($E=0$) indicates that the model predictions are as accurate as the mean of the measured data; whereas, an efficiency less than zero ($-\infty<E<0$) occurs when the measured mean is a better predictor than the model. The closer the NSE is to 1, the more accurate the model is. For the WLAM, the NSE ranges from a low of 0.71 for Temescal Creek at Main Street to a high of 0.92 for Santa Ana River at E Street and for Santa Ana River below Prado Dam.

2.5.2.1 Stream Bottom Percolation Rate

Stream bottom percolation rates were calibrated with field measurements and validated against data from other models. In March 2005, Seven Oaks Dam released water that was recorded at USGS gaging stations near Mentone and E Street in San Bernardino (as shown in Figure 2-9). During the March 1, 2005 to April 2, 2005 period, the recorded rainfall at the Loma Linda gage was about 0.08 inches on March 18 and about 0.73 inches on March 22; there was very little precipitation at the Mentone gages: 0.14 and 0.55 inches of precipitation were recorded on March 4 and March 22, respectively. This reservoir release and the minimal precipitation provided an opportunity to calculate channel losses (and percolation rates) in the Santa Ana River between Seven Oaks Dam and E Street. The percolation rate was adjusted for this reach of the Santa Ana River until the modeled percolation rate fit the measured field data. Figure 2-18 shows the time series of discharge at Mentone and the observed and model estimated discharges at E Street. The model estimated daily discharges that follow the measured data very closely. Figure 2-19 is a scatter plot of the model-calculated discharge versus the observed discharge at E Street. The R-square of the measured and modeled calculated discharges is 0.91. The stream bottom percolation rate was estimated to be 1.95 ft/day.

The Chino Basin Watermaster developed a groundwater model using USGS MODFLOW model code (WEI, 2007). This model was also used to estimate streambed percolation in the Santa Ana River within Reach 3. At the conclusion of the WLAM calibration, the WLAM results for Reach 3 of the Santa Ana River were compared to percolation estimates made with the Watermaster MODFLOW model. This comparison is illustrated in Figure 2-20. The annual percolation values are very similar: the maximum difference between the two model estimates is 19 percent in 2006, and the average difference over the calibration period is 6 percent. Figure 2-21 is a scatter plot of the two data sets; the R-square is about 0.75.

2.5.3 TDS and TIN Calibration

TDS and TIN calibration was initiated at the conclusion of the hydraulic model calibration. The calibration period for TDS and TIN is the same as the hydraulic model (1994 through 2006). Due to the paucity of data, the use of objective numerical calibration criteria was not applicable. Calibration was completed manually for Santa Ana River at the MWD Crossing and Santa Ana River below Prado Dam. About 15 simulations were done to calibrate TDS, and 15 simulations were done to calibrate TIN. Figures 2-22 and 2-23 compare observed TDS and TIN concentrations and WLAM estimates at Santa Ana River at the MWD Crossing, respectively. Figures 2-24 and 2-25 compare observed TDS and TIN concentrations and WLAM estimates for Santa Ana River below Prado Dam, respectively.

The reaction rate coefficients developed in calibration to estimate nitrogen loss in surface discharge were 0.1 upstream of Riverside Narrows and 0.25 downstream of Riverside Narrows. The TDS and TIN concentrations in the rising water components near Riverside Narrows and Prado were:

Rising Water Area	TDS (Mg/L)	TIN (mg/L-N)
Riverside Narrows	900	11
Prado Vicinity	1,100	11

These are the same values derived in the previous wasteload allocation study (WEI, 2002) and are based on historical groundwater and surface water quality measurements and WLAM calibration.

2.6 Limitations in the Use of the WLAM

The WLAM, as currently developed and calibrated, can be used to estimate the TDS and TIN concentrations in surface water discharge and streambed recharge for the land use and groundwater conditions for which it has been calibrated. Assuming these conditions, the WLAM can be used to estimate surface water discharges and the TDS and TIN impacts of changes in recycled water and other non-tributary discharges to the Santa Ana River drainage system and, in particular, to Chino Basin tributaries, San Timoteo Creek, and the Santa Ana River between E Street and Prado Dam.

Table 2-1
SCS Method Curve Numbers[1,2]

Cover Type [3]	Quality of Cover [4]	Soil Group			
		A	B	C	D
Natural Covers					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzanita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with a canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Urban Covers					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Agricultural Covers					
Fallow (Land plowed but not tilled or seeded		76	85	90	92
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dry land (Annual grasses)	Poor	67	78		89
	Fair	50	69	79	84
	Good	38	61	74	80
Pasture, Irrigated (Legumes and perennial grasses)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87

Notes:

1. All curve numbers (CN) are for Antecedent Moisture Condition (AMC) II.
2. Reproduced from Hydrology Manual, Riverside County Flood Control and Water Conservation District, 1978
3. Quality of cover definitions:

   Poor - Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

   Fair - Moderate cover with 50 percent to 75 percent of the ground surface protected.

   Good - Heavy or dense cover with more than 75 percent of the ground surface protected.
4. See Plate C-2 in Hydrology Manual, Riverside County Flood Control and Water Conservation District for a detailed description of cover types

Table 2-2
Rainfall Stations Used in the WLAM

Thiessen Polygon ID	Station Number	Station Name	County	Elevation (ft)	Recording Period			Station Used for Missing Data
					Start	End	Average (in/yr)	
1	1021AUTO	Mira Loma Space Center	SB	804	1943	2006	12.0	
2	1026	Ontario Fire Station	SB	986	1934	2006	15.9	
3	2071	San Bernardino City - Devil	SB	1,870	1928	2006	23.7	
4	2159AUTO	Lytle Creek At Foothill Boulevard	SB	1,225	1948	2006	13.8	
5	2166	San Bernardino City - Newmark	SB	1,415	1928	2006	19.3	
6	2198	San Bernardino City - Lytle Creek	SB	1,225	1927	2006	16.2	
7	3014AUTO	Oak Glen	SB	4,680	1946	2006	27.1	3015
8	3273	Loma Linda (V.G.C.)	SB	1,063	1893	2006	13.4	3337 & 3000
9	1079	Chino - Imbach	SB	642	1929	2006	12.4	1026
10	1085	San Antonio Heights C.D.F.	SB	1,901	1944	2006	21.6	1290
11	3129	Yucaipa C.D.F.	SB	2,660	1951	2006	16.1	3014AUTO
12	1034	Claremont Pomona College	LA	1,196	1896	2006	16.8	1137
13	1067	Chino Substation - Edison	SB	670	1927	2006	13.8	1262
14	1175	Alta Loma Forney	SB	1,865	1956	2006	19.8	1192
15	2005B	Declez	SB	1,115	1943	2006	12.6	2005BAUTO
16	2009A	Reche Canyon - Manton	SB	2,030	1919	2006	13.3	3059AUTO
17	2015AUTO	Del Rosa Ranger Station	SB	1,747	1943	2006	18.7	2359
18	2017AUTO	Fontana 5N (Getchell)	SB	1,959	1958	2006	24.3	2017
19	2037AUTO	Lytle Creek Ranger Station	SB	2,730	1958	2006	27.1	2037
20	2146AUTO	San Bernardino County Hospital	SB	1,126	1985	2006	16.9	2146
21	2194	Fontana Union Water Company -	SB	1,289	1926	2006	16.7	2206 & 2206AUTO
22	2286AUTO	San Bernardino City - Hanford	SB	1,030	1930	2006	13.5	2286
23	3162AUTO	Santa Ana P.H. #3	SB	1,980	1980	2006	16.1	3162
24	1019AAUTO	Upland - Chapel	SB	1,601	1960	2006	18.5	1019
25	3058	Mentone - Blue Goose	SB	1,650	1928	2006	14.3	3120 & 3337AUTO
26	13	Beaumont	R	2,613	1929	2006	17.2	
27	35	Chase & Taylor	R	1,055	1930	2006	16.8	
28	67	Elsinore	R	1,285	1887	2006	11.9	
29	75	Temescal Cyn Ws	R	1,220	1905	2006	17.5	
30	177	Riverside East	R	986	1925	2006	10.4	
31	178	Riverside North	R	800	1925	2006	10.4	
32	179	Riverside South	R	840	1881	2006	10.1	
33	246	Wildomar	R	1,255	1907	2006	13.9	
34	7	Arlington	R	805	1963	2006	9.9	179
35	31	Calimesa	R	2,400	1958	2006	16.8	3014AUTO
36	36	Cherry Valley	R	2,860	1956	2006	19.3	13
37	44	Corona North	R	638	1956	2006	19.3	35
38	100	La Sierra	R	712	1905	2006	17.5	179
39	102	Lake Mathews	R	1,400	1905	2006	17.5	
40	202	Santiago Peak	R	5,638	1950	2006	33.5	102
41	250	Woodcrest	R	1,557	1956	2006	9.5	102
42	71	Gavilan Springs	R		1978	2006	12.6	102
43	265	Indian Hills	R	840	1956	2006	9.5	178

Table 2-3
Land Use Types Used in the 2003 Wasteload Allocation Study

WEI Land Use Code	Land Use Category/Description	Percentage of Impervious Area
1	Residential Rural Low Density	40
2	Residential Low Density	60
3	Residential High Density	80
4	Commercial	90
5	Industrial A	100
6	Industrial B	90
7	Industrial C	60
8	Industrial D	10
9	Industrial E	0
10	School	60
11	Agricultural, Non-Irrigated Crops & Pasture	2
12	Agricultural, Irrigated Crops & Pasture	2
13	Agricultural, Orchard & Vineyard	2
14	Agricultural, Other (Truck)	2
15	Agricultural, Nurseries (Truck)	2
16	Dairies and Livestock	5
17	Horse Ranch	2
18	Poultry Operations	90
19	Golf Courses, Cemeteries, Rec Parks, Gardens	5
20	Water Facilities	90
21	Vacant	0

Notes:

Reproduced from Hydrology Manual, Riverside County Flood Control and Water Conservation District, 1978, Plate D-5-6

Reproduced from Hydrology Manual, San Bernardino County , 1986, Figure C-4

Table 2-4
Land Use Types Used in the 2008 Study

WEI Land Use Code	Land Use Category/Description	Percentage of Impervious Area
1	Low Density Residential	30
2	Medium Density Residential	50
3	High Density Residential	75
4	Commercial	90
5	Industrial	90
6	Orchards and Vineyards	2
7	Irrigated Cropland and Improved Pasture Land, Golf course	2
8	Parks, schools	80
9	Dairy, poultry, horse ranch, etc	0
10	Impervious	100
11	Undeveloped	2
12	Native/mountain	2

Notes:

Reproduced from Hydrology Manual, Riverside County Flood Control and Water Conservation District, 1978, Plate D-5-6

Reproduced from Hydrology Manual, San Bernardino County , 1986, Figure C-4

Table 2-5
Land Use Conversion Table from Anderson Code to WLA Model Land Use Types

Anderson Land Use Classification	Description	Wildermuth Environmental Land Use Types
1000	URBAN OR BUILT-UP	
1100	Residential	
1110	Single Family Residential	Industrial C
1111	High Density Single Family Residential	Industrial C
1112	Low Density Single Family Residential	School
1120	Multi-Family Residential	Industrial C
1121	Mixed Multi-Family Residential	Industrial C
1122	Duplexes and Triplexes	Industrial C
1123	Low-Rise Apartments, Condos, Townhouses	Industrial C
1124	Medium-Rise Apartments and Condos	Industrial C
1125	High-Rise Apartments and Condos	Industrial C
1130	Mobile Homes and Trailer Parks	Industrial C
1131	Trailer Parks and Mobile Home Courts, High Density	Industrial C
1132	Trailer Parks and Mobile Home Courts, Low Density	Industrial C
1140	Mixed Residential	Industrial C
1150	Rural Residential	School
1151	Rural Residential High Density	School
1152	Rural Residential Low Density	School
1200	Commercial and Services	Agricultural, Non-Irrigated Crops & Pasture
1210	General Office Use	Agricultural, Non-Irrigated Crops & Pasture
1211	Low - Medium Rise Major Office Use	Agricultural, Non-Irrigated Crops & Pasture
1212	High Rise Major Office Use	Agricultural, Non-Irrigated Crops & Pasture
1213	Skyscrapers	Agricultural, Non-Irrigated Crops & Pasture
1220	Retail Stores and Commercial Services	Agricultural, Non-Irrigated Crops & Pasture
1221	Regional Shopping Mall	Agricultural, Non-Irrigated Crops & Pasture
1222	Retail Centers	Agricultural, Non-Irrigated Crops & Pasture
1223	Modern Strip Development	Agricultural, Non-Irrigated Crops & Pasture
1224	Older Strip Development	Agricultural, Non-Irrigated Crops & Pasture
1230	Other Commercial	Agricultural, Non-Irrigated Crops & Pasture
1231	Commercial Storage	Agricultural, Non-Irrigated Crops & Pasture
1232	Commercial Recreation	Agricultural, Non-Irrigated Crops & Pasture
1233	Hotels and Motels	Agricultural, Non-Irrigated Crops & Pasture
1244	Attended Pay Public Parking Facilities	Agricultural, Non-Irrigated Crops & Pasture
1240	Public Facilities	Agricultural, Non-Irrigated Crops & Pasture
1241	Government Offices	Agricultural, Non-Irrigated Crops & Pasture
1242	Police and Sheriff Stations	Agricultural, Non-Irrigated Crops & Pasture
1243	Fire Stations	Agricultural, Non-Irrigated Crops & Pasture
1244	Major Medical Health Care Facilities	Agricultural, Non-Irrigated Crops & Pasture
1245	Religious Facilities	Agricultural, Non-Irrigated Crops & Pasture
1246	Other Public Facilities	Agricultural, Non-Irrigated Crops & Pasture
1247	Non-Attended Public Parking Facilities	Agricultural, Non-Irrigated Crops & Pasture
1250	Special Use Facilities	Agricultural, Non-Irrigated Crops & Pasture
1251	Correctional Facilities	Agricultural, Non-Irrigated Crops & Pasture
1252	Special Care Facilities	Agricultural, Non-Irrigated Crops & Pasture
1253	Other Special Use Facilities	Agricultural, Non-Irrigated Crops & Pasture
1260	Educational Institutions	Agricultural, Non-Irrigated Crops & Pasture
1261	Pre-Schools/Day Care Centers	School
1262	Elementary Schools	School
1263	Junior or Intermediate High Schools	School
1264	Senior High Schools	School
1265	Colleges and Universities	School
1266	Trade Schools	School
1270	Military Installations	School
1271	Base (Built-up Area)	School
1272	Vacant Area	Industrial E

Table 2-5
Land Use Conversion Table from Anderson Code to WLA Model Land Use Types

Anderson Land Use Classification	Description	Wildermuth Environmental Land Use Types
1273 Air Field		Industrial D
1300 Industrial		Agricultural, Irrigated Crops & Pasture
1310 Light Industrial		Agricultural, Irrigated Crops & Pasture
1311 Manufacturing and Assembly		Agricultural, Irrigated Crops & Pasture
1312 Motion Picture		Agricultural, Non-Irrigated Crops & Pasture
1313 Packing Houses and Grain Elevators		Agricultural, Irrigated Crops & Pasture
1314 Research and Development		Agricultural, Irrigated Crops & Pasture
1320 Heavy Industrial		Agricultural, Irrigated Crops & Pasture
1321 Manufacturing		Agricultural, Irrigated Crops & Pasture
1322 Petroleum Refining and Processing		Agricultural, Irrigated Crops & Pasture
1323 Open Storage		Agricultural, Irrigated Crops & Pasture
1324 Major Metal Processing		Agricultural, Irrigated Crops & Pasture
1325 Chemical Processing		Agricultural, Irrigated Crops & Pasture
1330 Extraction		Industrial E
1331 Mineral Extraction-Other than gas and oil		Industrial E
1332 Mineral Extraction-Oil and gas		Industrial E
1400 Transportation, Communications, and Utilities		Industrial D
1410 Transportation		Industrial D
1411 Airports		Industrial D
1412 Railroads		Industrial E
1413 Freeways		Industrial D
1414 Park and Ride Lots		Industrial D
1415 Bus Terminals and Yards		Industrial D
1416 Truck Terminals		Industrial D
1417 Harbor Facilities		NA
1418 Navigation Aids		NA
1420 Communication Facilities		
1430 Utility Facilities		Industrial D
1431 Electrical Power Facilities		Industrial E
1432 Solid Waste Disposal Facilities		Industrial D
1433 Liquid Waste Disposal Facilities		Industrial D
1434 Water Storage Facilities		Industrial D
1435 Natural Gas and Petroleum Facilities		Industrial D
1436 Water Transfer Facilities		Industrial E
1437 Improved Flood Waterways and Structures		Industrial E
1438 Mixed Wind Energy Generation and Percolation Basin		Industrial D
1440 Maintenance Yards		Industrial D
1450 Mixed Transportation		Industrial D
1460 Mixed Transportation and Utility		Industrial D
1500 Mixed Commercial and Industrial		Agricultural, Non-Irrigated Crops & Pasture
1600 Mixed Urban		Industrial C
1700 Under Construction		Agricultural, Orchard & Vineyard
1800 Open Space and Recreation		Industrial E
1810 Golf Courses		Residential Low Density
1820 Local Parks and Recreation		Residential Low Density
1830 Regional Parks and Recreation		Residential Low Density
1840 Cemeteries		Residential Low Density
1850 Wildlife Preserves and Sanctuaries		Industrial E
1860 Specimen Gardens and Arboreta		Residential Low Density
1870 Beach Parks		NA
1880 Other Open Space and Recreation		Agricultural, Orchard & Vineyard
1900 Urban Vacant		Agricultural, Orchard & Vineyard
2000 AGRICULTURE		Residential Low Density
2100 Cropland and Improved Pasture Land		Residential Low Density
2110 Irrigated Cropland and Improved Pasture Land		Residential Low Density
2120 Non-Irrigated Cropland and Improved Pasture Land		Residential Rural Low Density
2200 Orchards and Vineyards		Commercial

Table 2-5
Land Use Conversion Table from Anderson Code to WLA Model Land Use Types

Anderson Land Use Classification	Description	Wildermuth Environmental Land Use Types
2300	Nurseries	Residential High Density
2400	Dairy and Intensive Livestock	Industrial B
2500	Poultry Operations	Industrial A
2600	Other Agriculture	Residential Low Density
2700	Horse Ranches	Residential Low Density
3000	VACANT	Agricultural, Orchard & Vineyard
3100	Vacant Undifferentiated	Industrial E
3200	Abandoned Orchards and Vineyards	Industrial E
3300	Vacant With Limited Improvements	Industrial E
4000	WATER	Industrial D
4100	Water, Undifferentiated	Industrial D
4200	Harbor Water Facilities	NA
4300	Marina Water Facilities	NA
4400	Water Within a Military Installation	NA
4500	Area of Inundation	Industrial D

Table 2-6

Summary of Land Use by Drainage Area in the Valley Floor of the Modeling Domain[1]

WEI Land Use Code	Land Use Type	Drainage Area Upstream of E Street Gaging Station		Drainage Area Between E Street and Riverside Narrows		Chino Drainage Area		Temescal/ Prado Drainage Area	
		Area (mi^2)	Percentage	Area (mi^2)	Percentage	Area (mi^2)	Percentage	Area (mi^2)	Percentage
1	Low Density Residential	17	6%	21	12%	15	6%	26	10%
2	Medium Density Residential	40	15%	36	21%	62	24%	18	7%
3	High Density Residential	7	2%	5	3%	9	3%	2	1%
4	Commercial	11	4%	10	6%	25	10%	6	2%
5	Industrial	3	1%	4	3%	12	5%	3	1%
6	Orchards and Vineyards	9	3%	6	4%	3	1%	14	5%
7	Irrigated Cropland and Improved Pasture Land, Golf course	3	1%	3	2%	19	7%	4	1%
8	Parks, schools	7	3%	6	3%	8	3%	3	1%
9	Dairy, poultry, horse ranch, etc	2	1%	3	2%	13	5%	3	1%
10	Impervious	13	5%	10	6%	24	9%	11	4%
11	Undeveloped	154	57%	68	39%	67	26%	183	67%
12	Native/mountain	7	2%	2	1%	1	0%	1	0%
Total		273	100%	174	100%	258	100%	274	100%

1. Drainage areas are for the valley flow exclude mountain areas.

Table 2-7
Hydrologic Properties of Each Land Use Type

WEI Land Use Code	Land Use Type	Percent Impervious	AMC	Curve Number			
				Soil Type			
				A	B	C	D
1	Low Density Residential	30	2	32	56	69	75
2	Medium Density Residential	50	2	32	56	69	75
3	High Density Residential	75	2	32	56	69	75
4	Commercial	90	2	32	56	69	75
5	Industrial	90	2	32	56	69	75
6	Orchards and Vineyards	2	2	39	62	75	81
7	Irrigated Cropland and Improved Pasture Land, Golf course	2	2	53	70	80	85
8	Parks, schools	80	2	39	61	74	80
9	Dairy, poultry, horse ranch, etc	0	2	1	1	1	1
10	Impervious	100	2	98	98	98	98
11	Undeveloped	2	2	78	86	91	93
12	Native/mountain	2	2	47	67	78	83

AMC - Antecedent moisture condition

Table 2-8
USGS Surface Water Gages in the Study Area

Station Number	Station Name	Drainage Area (sq mile)	Elevation (ft)	Recording Period	
				Start	End
Used for Boundary Inflow					
11051500	Santa Ana River Near Mentone	210	1,984	1896	2006
11051501	Santa Ana River Near Mentone + Canals	210	1,984	1912	2006
11054000	Mill Creek Near Yucaipa	42	2,916	1918	1986
11055500	Plunge Creek Near East Highlands	17	1,590	1919	2006
11055501	Plunge Creek Near East Highlands and Canals	17	1,590	1951	2006
11055800	City Creek Near Highland	20	1,580	1919	2006
11058500	E Twin Creek Near Arrowhead Springs	9	1,590	1920	2000
11062000	Lytle Creek Near Fontana	47	2,380	1918	2000
11063510	Cajon Cr Below Lone Pine Cr Near Keenbrook	57		1971	2000
11063680	Devil Cyn Creek Near San Bernardino	5	1,900	1920	2000
11067000	Day Creek Near Etiwanda	5	2,870	1928	1972
11073470	Cucamonga Creek Near Upland	10	2,600	1929	1975
Used for Calibration					
11057500	San Timoteo Creek Near Loma Linda	125	1,010	1954	2006
11059300	Santa Ana River at E-Street	541	940	1939	2006
11066460	Santa Ana River at MWD Crossing	852	685	1970	2006
11072100	Temescal Creek At Main St	224	600	1980	2006
11073360	Chino Creek at Schaefer Avenue	49	685	1969	2006
11073495	Cucamonga Creek Near Mira Loma	76	660	1968	2006
11074000	Santa Ana River Below Prado Dam	1,490	449	1940	2006

Table 2-9
Statistics of Calibration

Station Number	Station Name	Model Performance Statistics Based on Monthly Flow Data			
		R-square[1]	RMSE[2] (acre-ft/mo)	RMSE Percent of Average Flow[3]	NSE[4]
11057500	San Timoteo Creek Near Loma Linda	0.87	22.10	12.5%	0.76
11059300	Santa Ana River at E-Street	0.93	64.62	1.5%	0.92
11066460	Santa Ana River at MWD Crossing	0.93	104.86	1.0%	0.84
11072100	Temescal Creek At Main St	0.77	45.09	2.2%	0.71
11073360	Chino Creek at Schaefer Avenue	0.84	38.33	2.6%	0.84
11073495	Cucamonga Creek Near Mira Loma	0.79	62.35	1.6%	0.74
11074000	Santa Ana River Below Prado Dam	0.93	154.50	0.6%	0.92

1 -- R-square: Correlation Coefficient 0:1
2 -- RMSE: Root Mean Square Error
3 -- RMSE/Q - Root Mean Square Error divided by the mean monthly discharge at the measurement station over the calibration period
4 -- NSE: Nash-Sutcliffe Efficiency $-\infty$:1

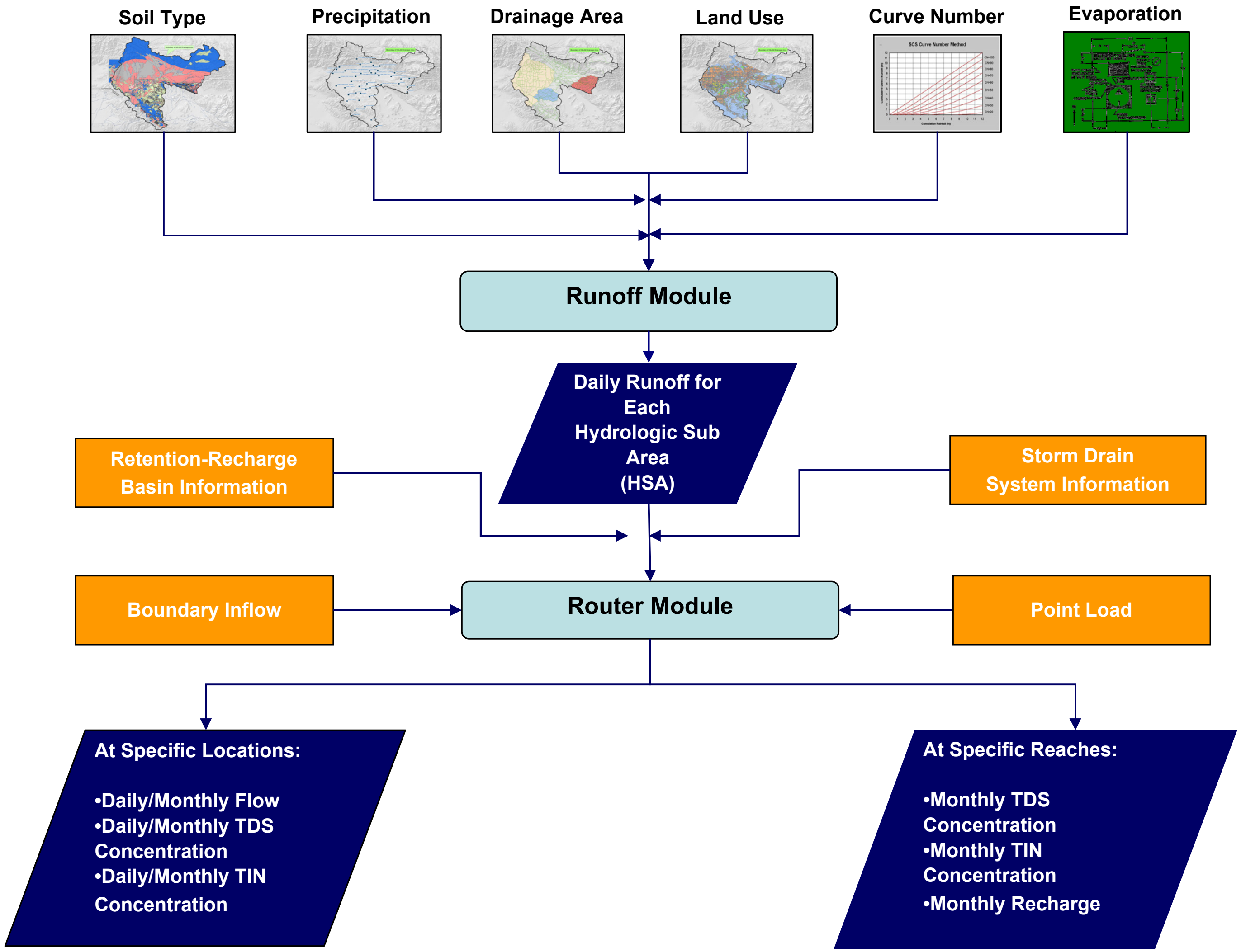
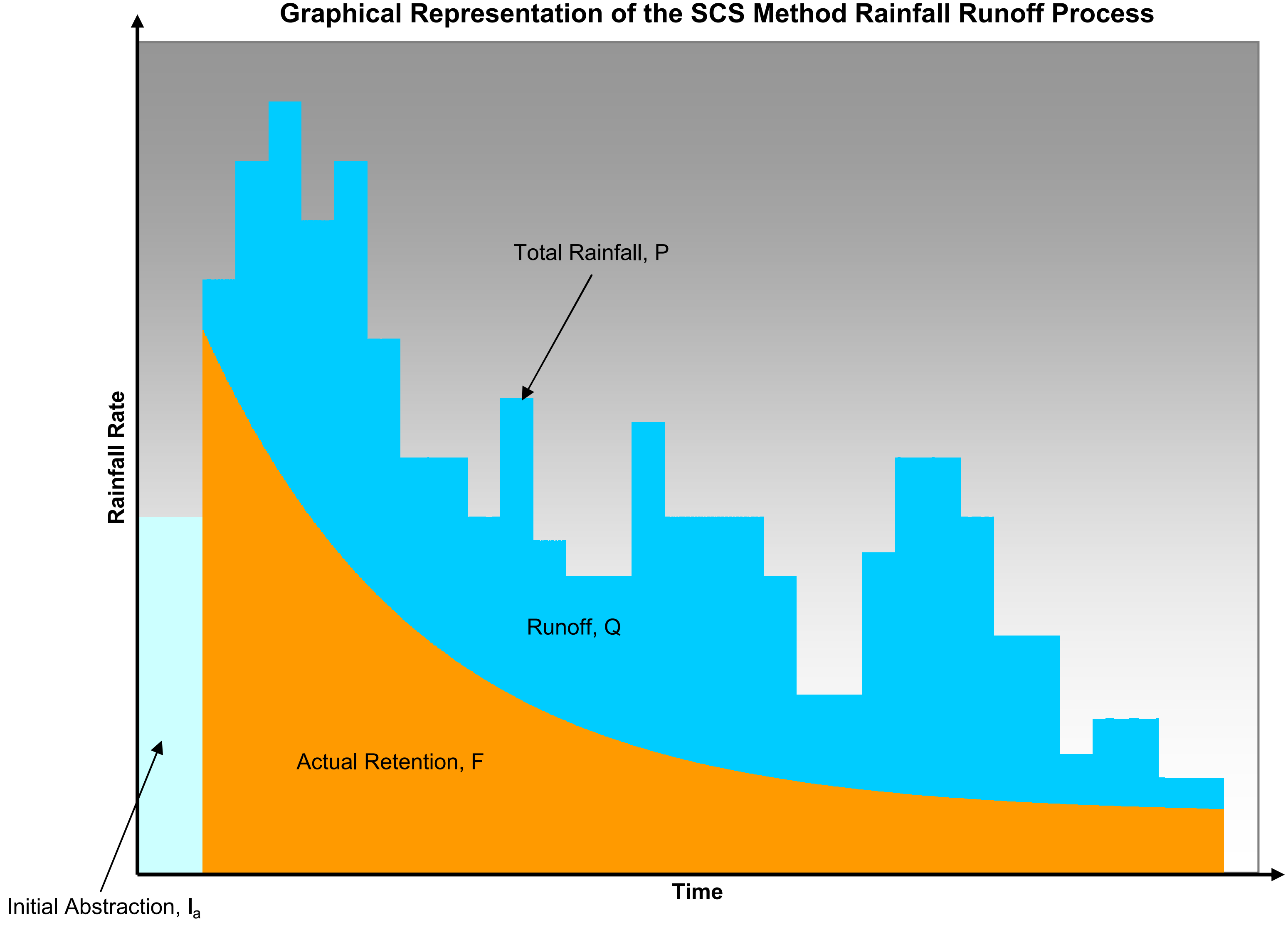


Figure 2-1
Organization of the Wasteload Allocation Model

Figure 2-2
Graphical Representation of the SCS Method Rainfall Runoff Process



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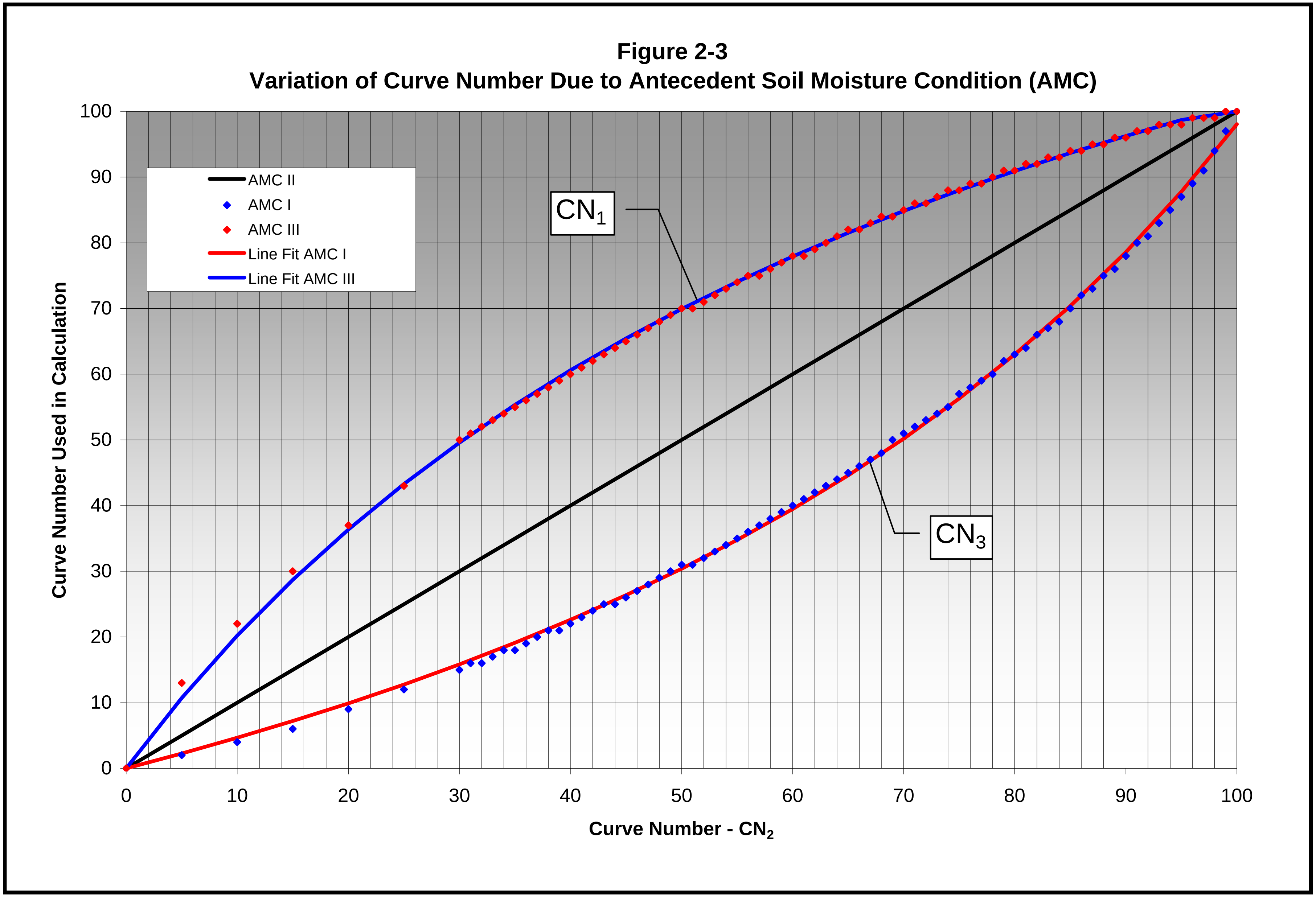
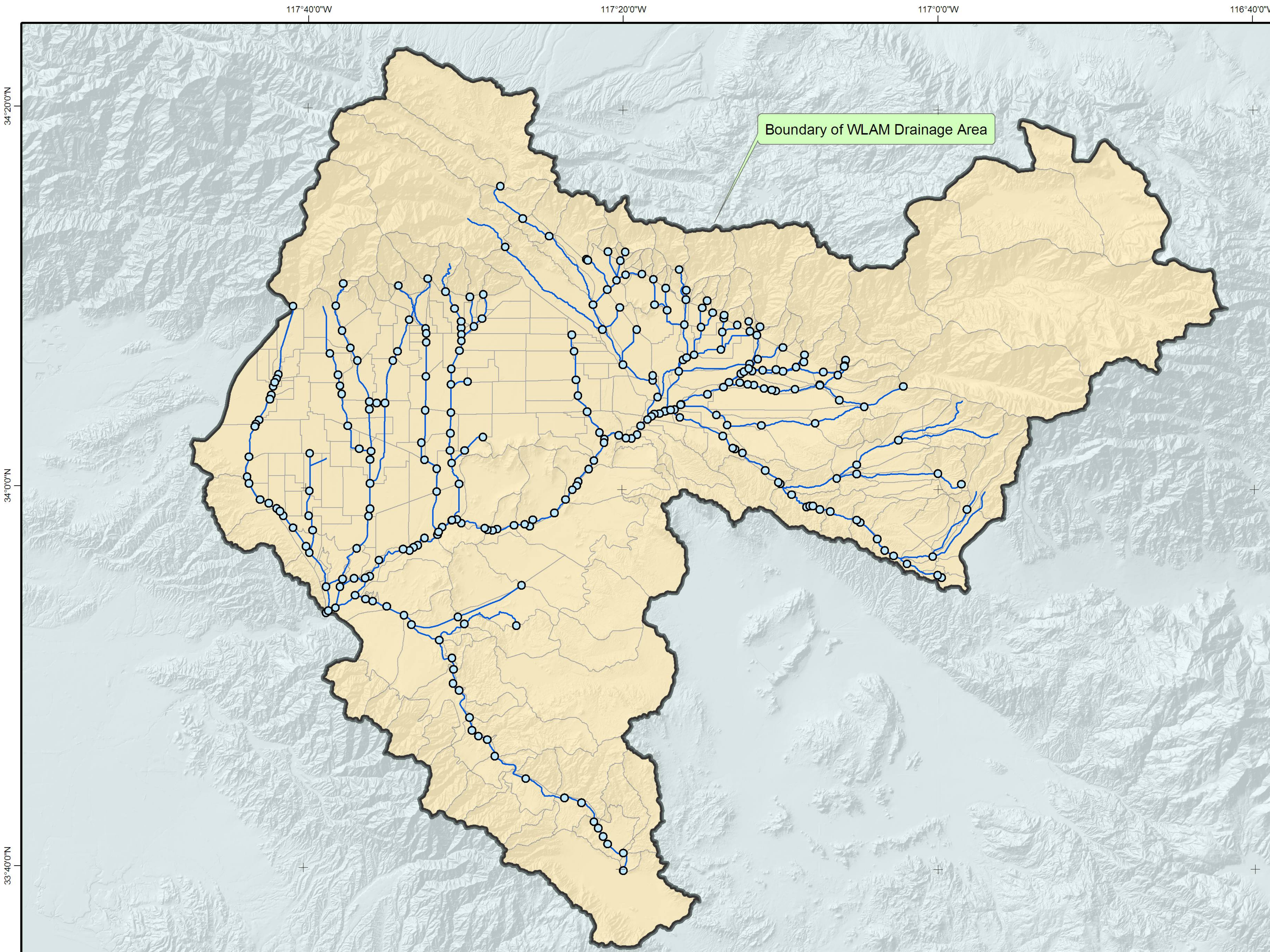


Figure 2-3
Variation of Curve Number Due to Antecedent Soil Moisture Condition (AMC)
AMC II
AMC I
AMC III
Line Fit AMC I
Line Fit AMC III
CN1
CN3
Curve Number Used in Calculation
Curve Number - CN2
0
10
20
30
40
50
60
70
80
90
100

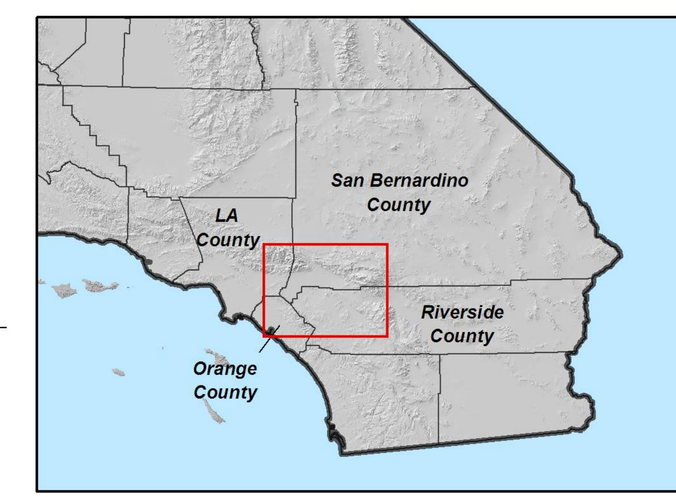


Main Features

WLAM Hydrologic Simulation Areas

R4 Routing Node

R4 Routing Link



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0 5 10 15 Miles

0 10 20 30 KM

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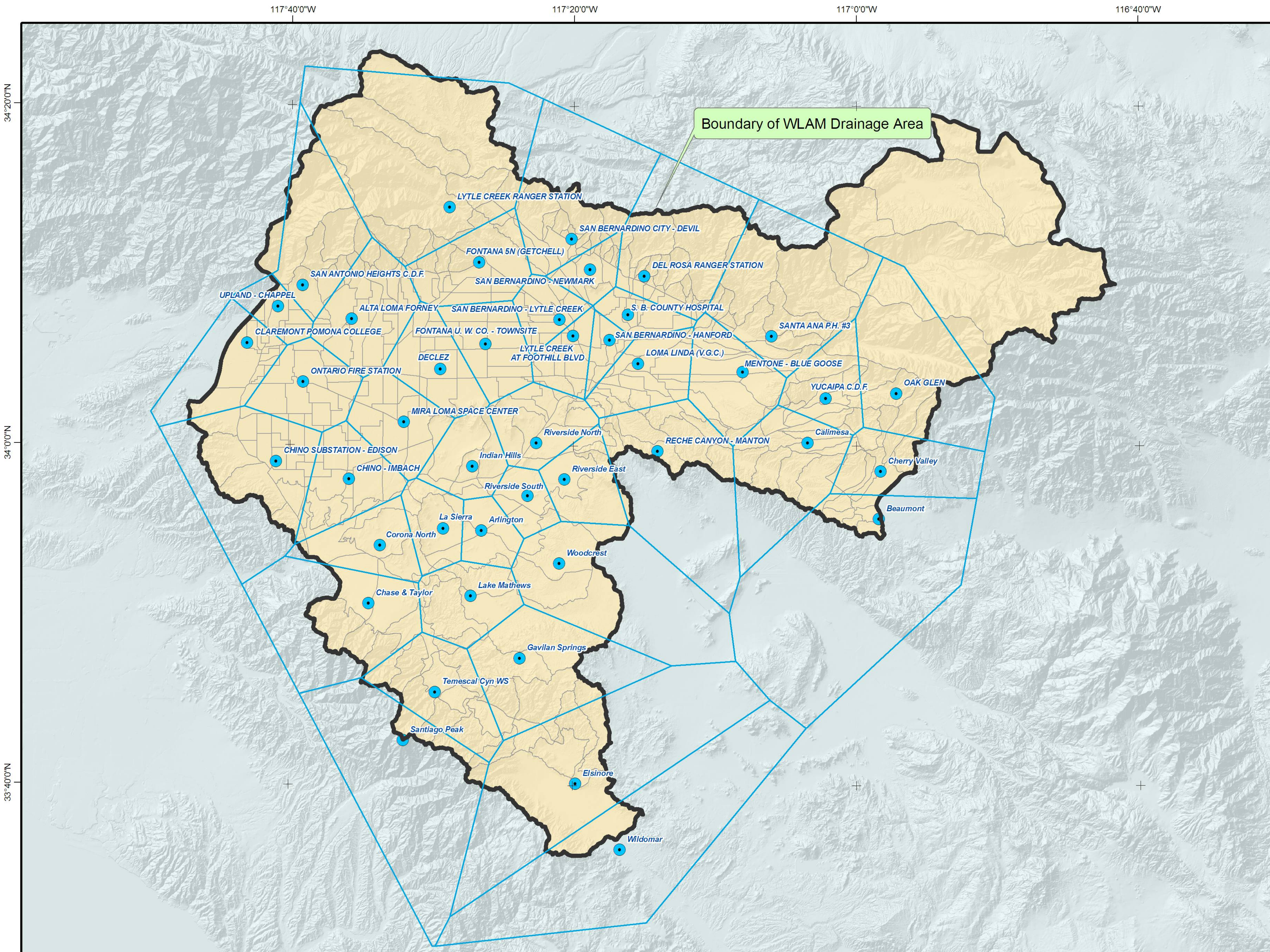
Location of Hydrologic Sub Areas, Model Links and Nodes

Figure 2-4

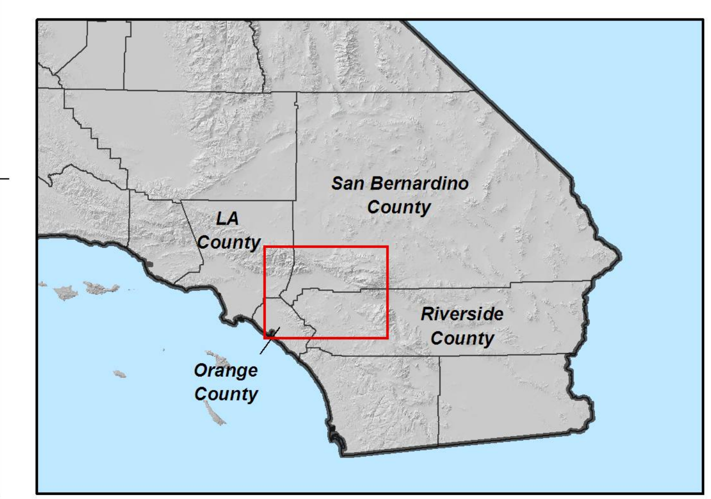


Main Features

WLAM Hydrologic Simulation Areas

Precipitation Station

Thiessen Polygons
(Precipitation Monitoring Station Area of Influence)



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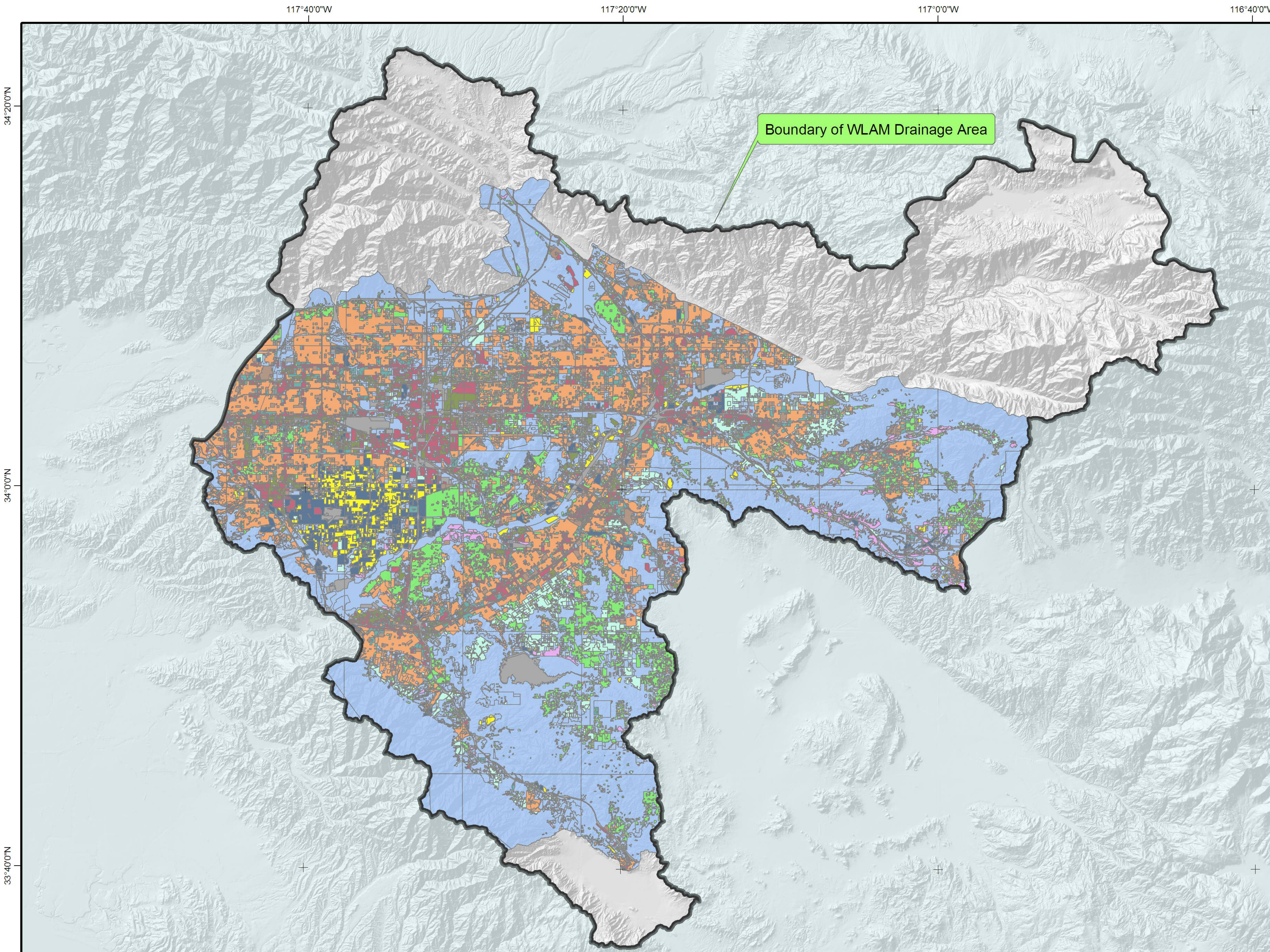
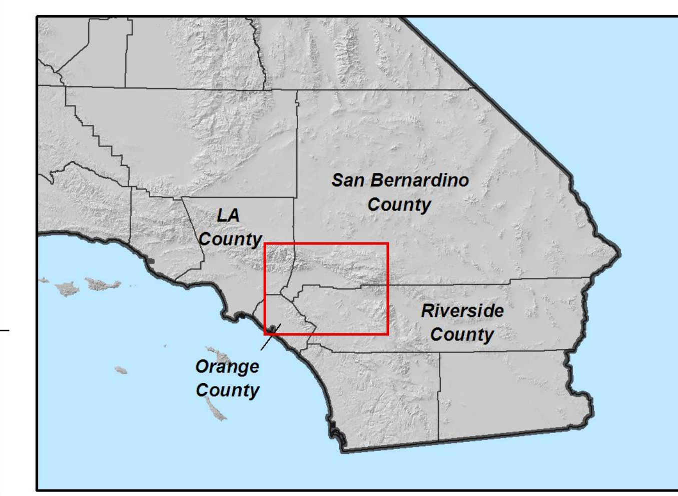
Location of Hydrologic Sub-Areas, Rainfall Monitoring Stations, and Thiessen Polygons

Figure 2-5



Main Features

- clip_feature
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial
- Industrial
- Orchards and Vineyards
- Irrigated Cropland and Improved Pasture Land, Golf Course
- Parks and schools
- Dairy, poultry, horse ranch, etc
- Impervious
- Undeveloped
- Native/mountain



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0 5 10 15 Miles
0 10 20 30 KM

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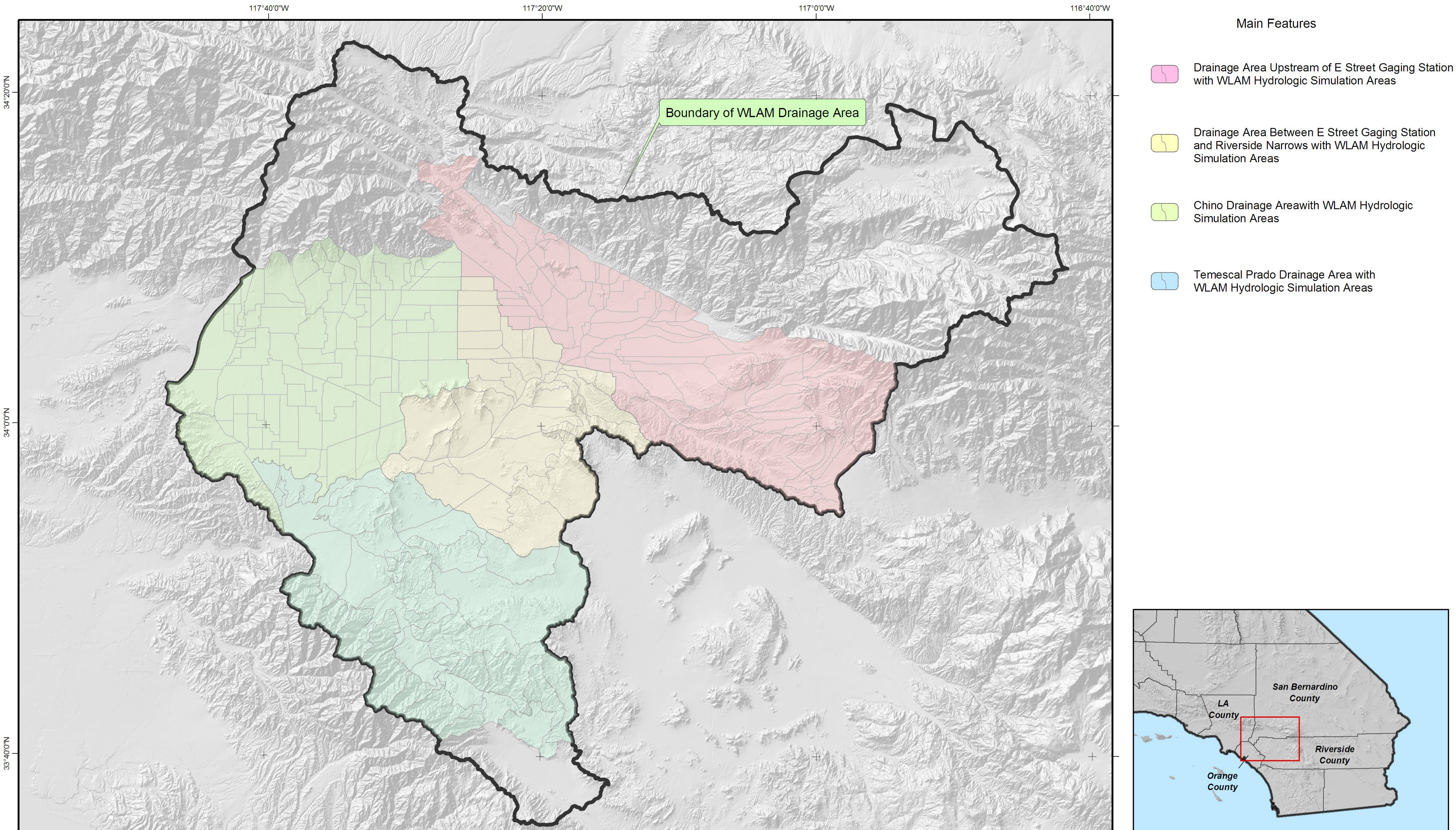
2001 Land Uses in the Upper Santa Ana Watershed

Figure 2-6



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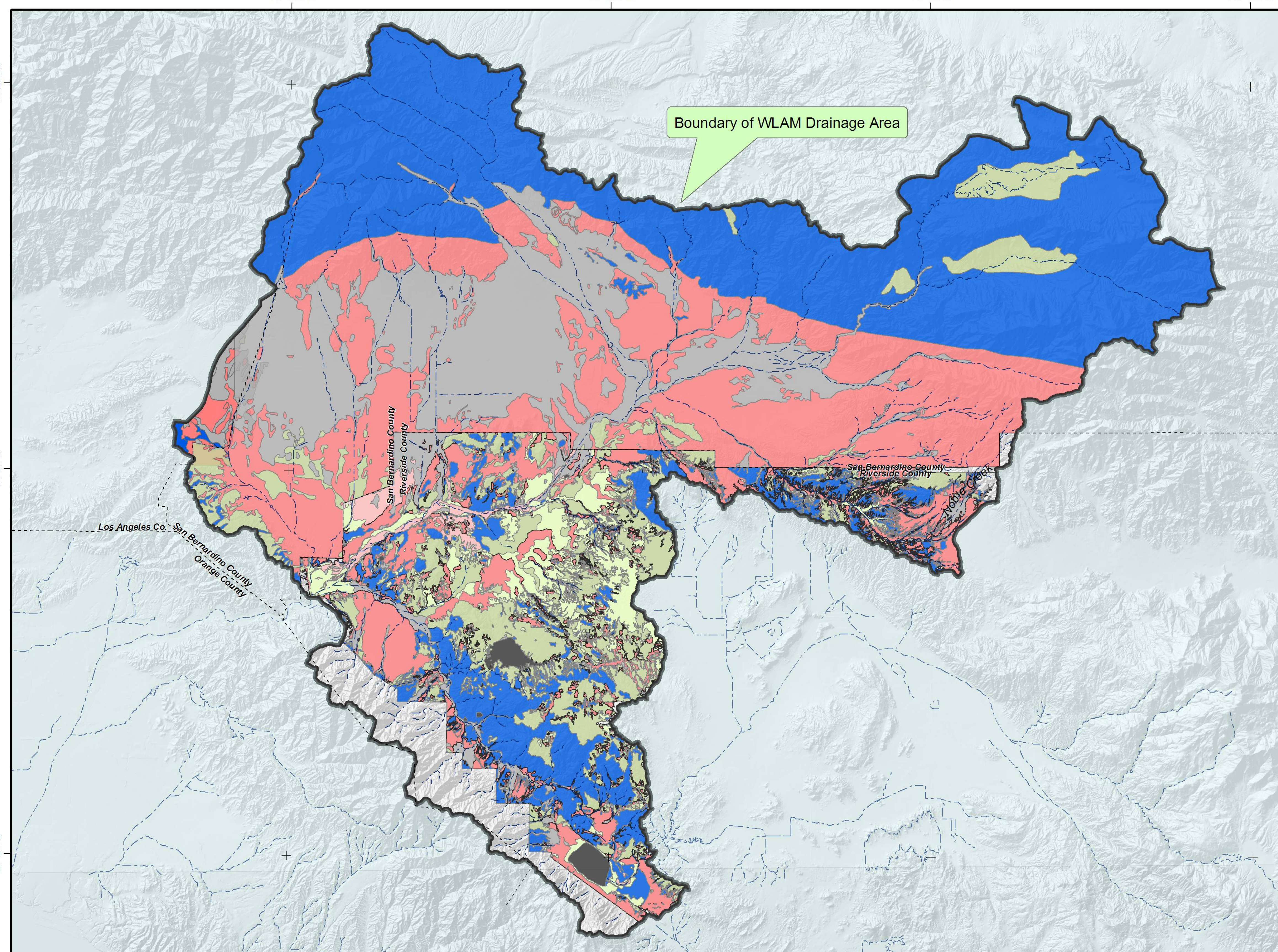
Summary Land Use Drainage Area in the Valley Floor of the Modeling Domain

Figure 2-7



Soil Conservation Service (SCS) Types

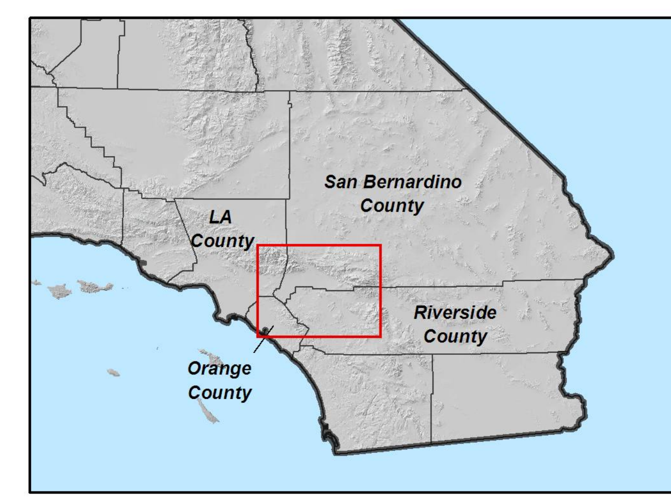
- A — Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission.
- B — Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
- C — Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.
- D — High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Hybrid Soil Types by Riverside County Flood Control District

- AB
- AC
- BC
- Water Body

Other Features

- WLAM Study Area Watershed
- Rivers, Creeks, and Flood Control Channels



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0 10 20 30 KM

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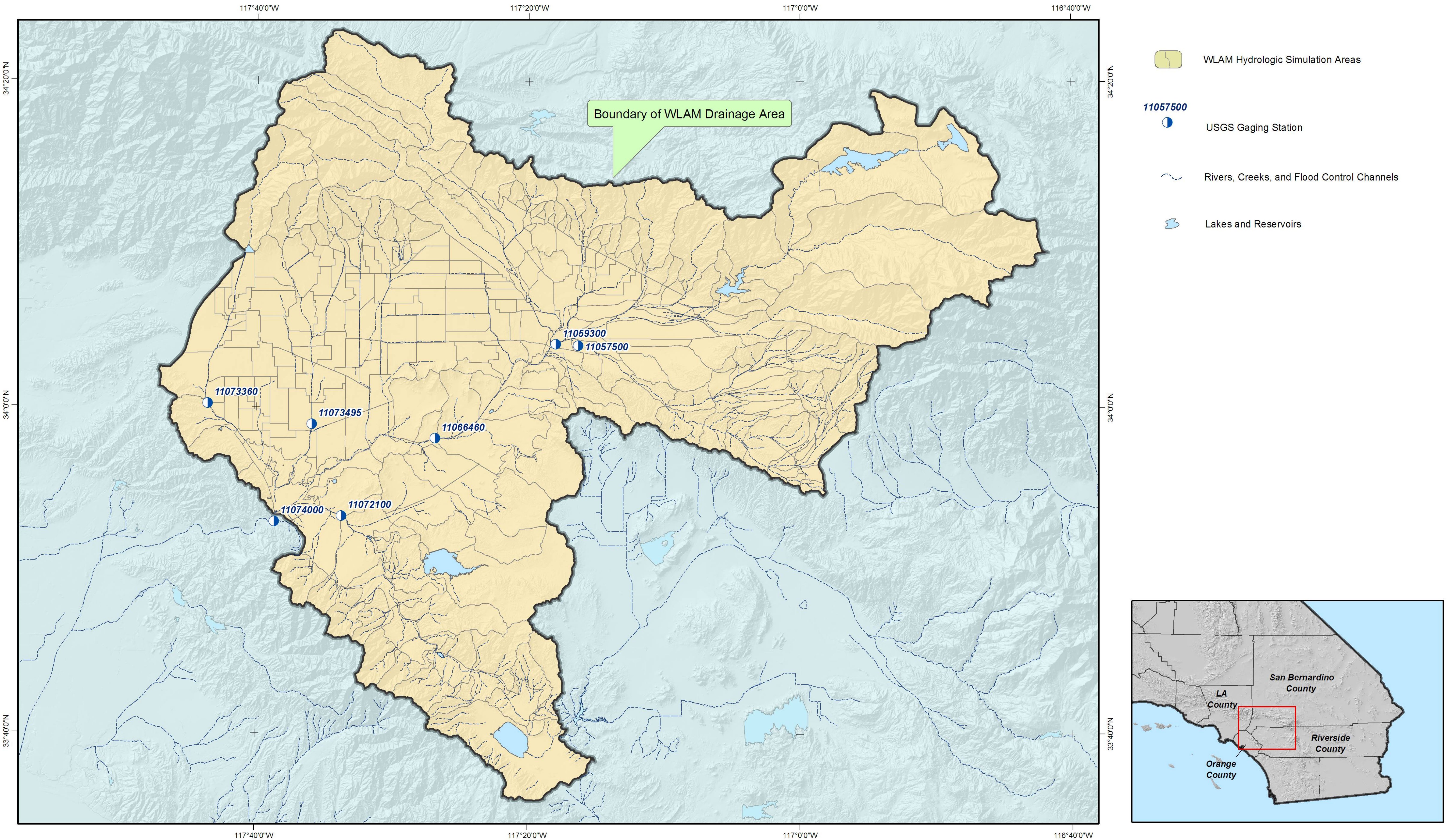
SCS Hydrologic Soil Map

Figure 2-8



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0 5 10 15 Miles
0 10 20 30 KM

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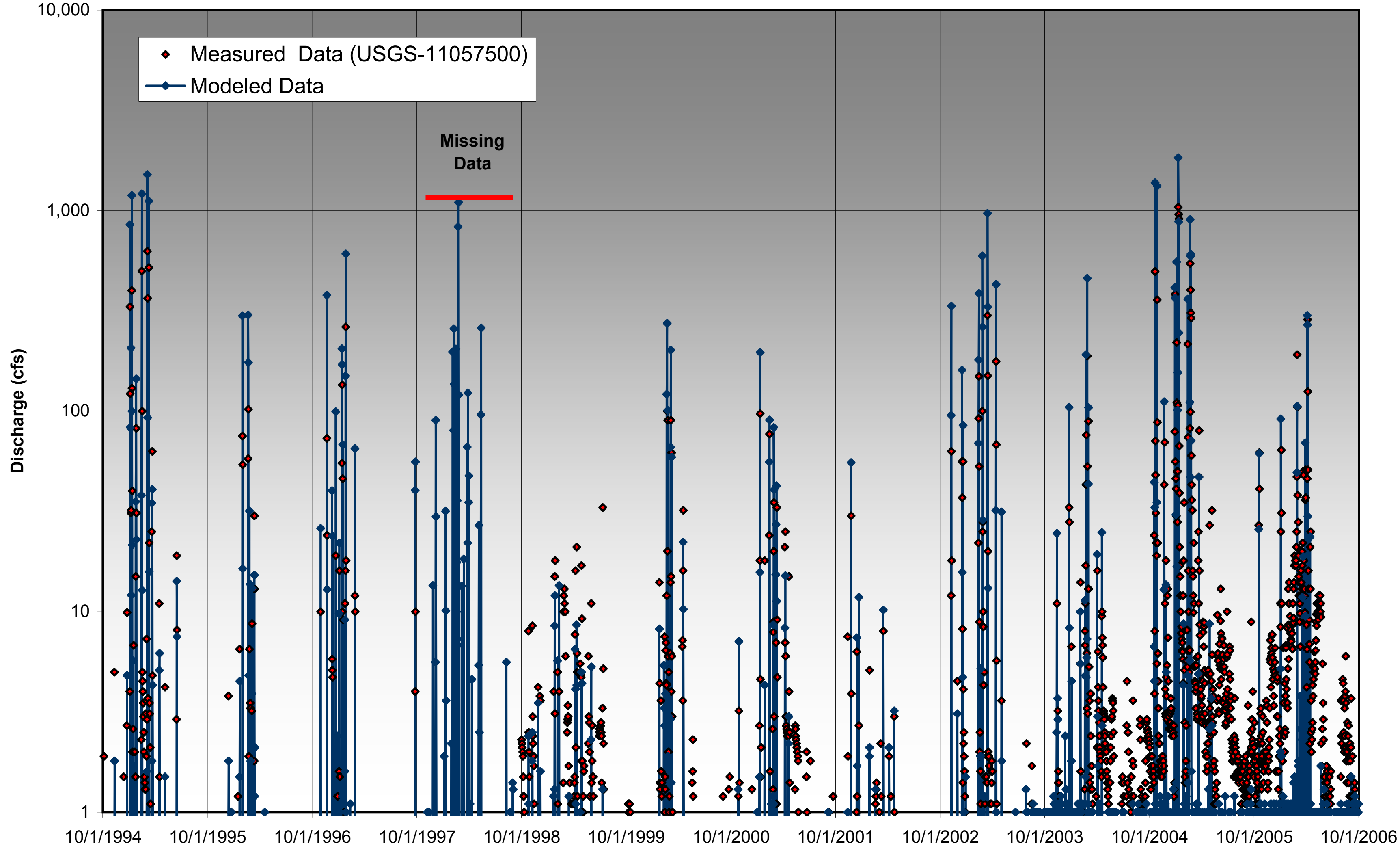
USGS Surface Water Monitoring Stations Used in Model Calibration

Figure 2-9

Figure 2-10
Comparison of Computed and Measured Discharge of San Timoteo Creek near Loma Linda



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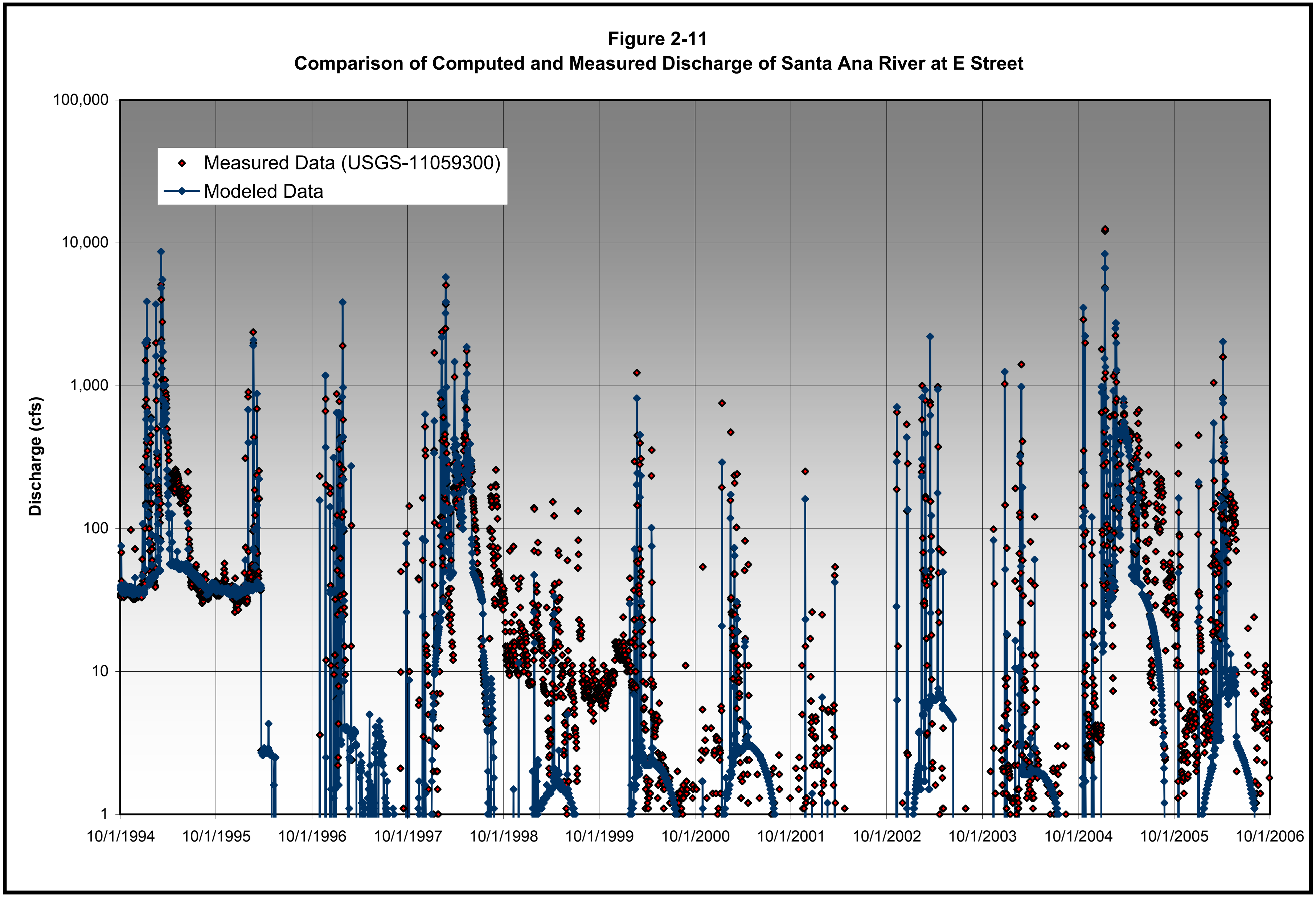
Figure 2-11
Comparison of Computed and Measured Discharge of Santa Ana River at E Street
Measured Data (USGS-11059300)
Modeled Data
Discharge (cfs)
100,000
10,000
1,000
100
10
1
10/1/1994
10/1/1995
10/1/1996
10/1/1997
10/1/1998
10/1/1999
10/1/2000
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10/1/2002
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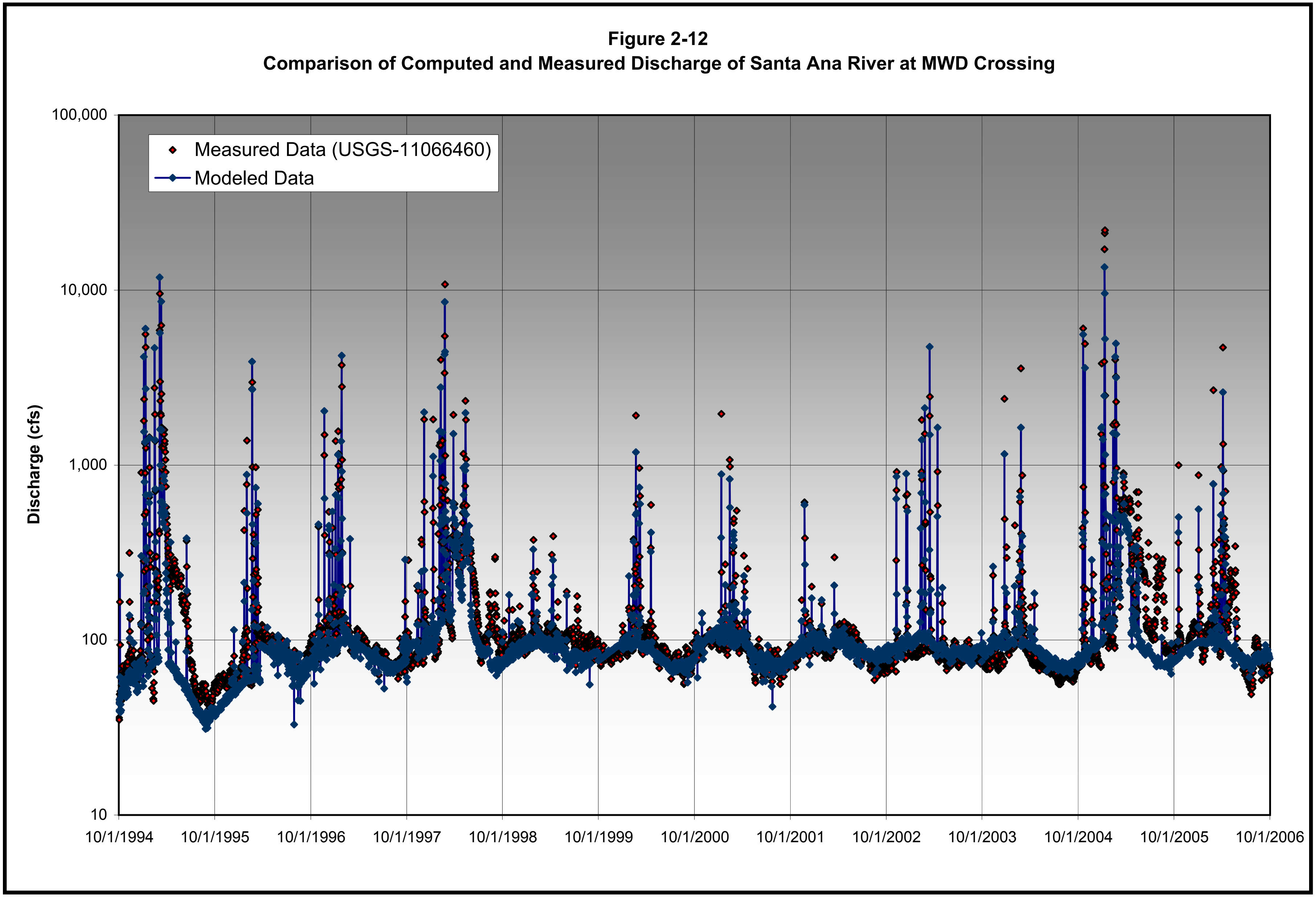
10/1/2004
10/1/2005
10/1/2006



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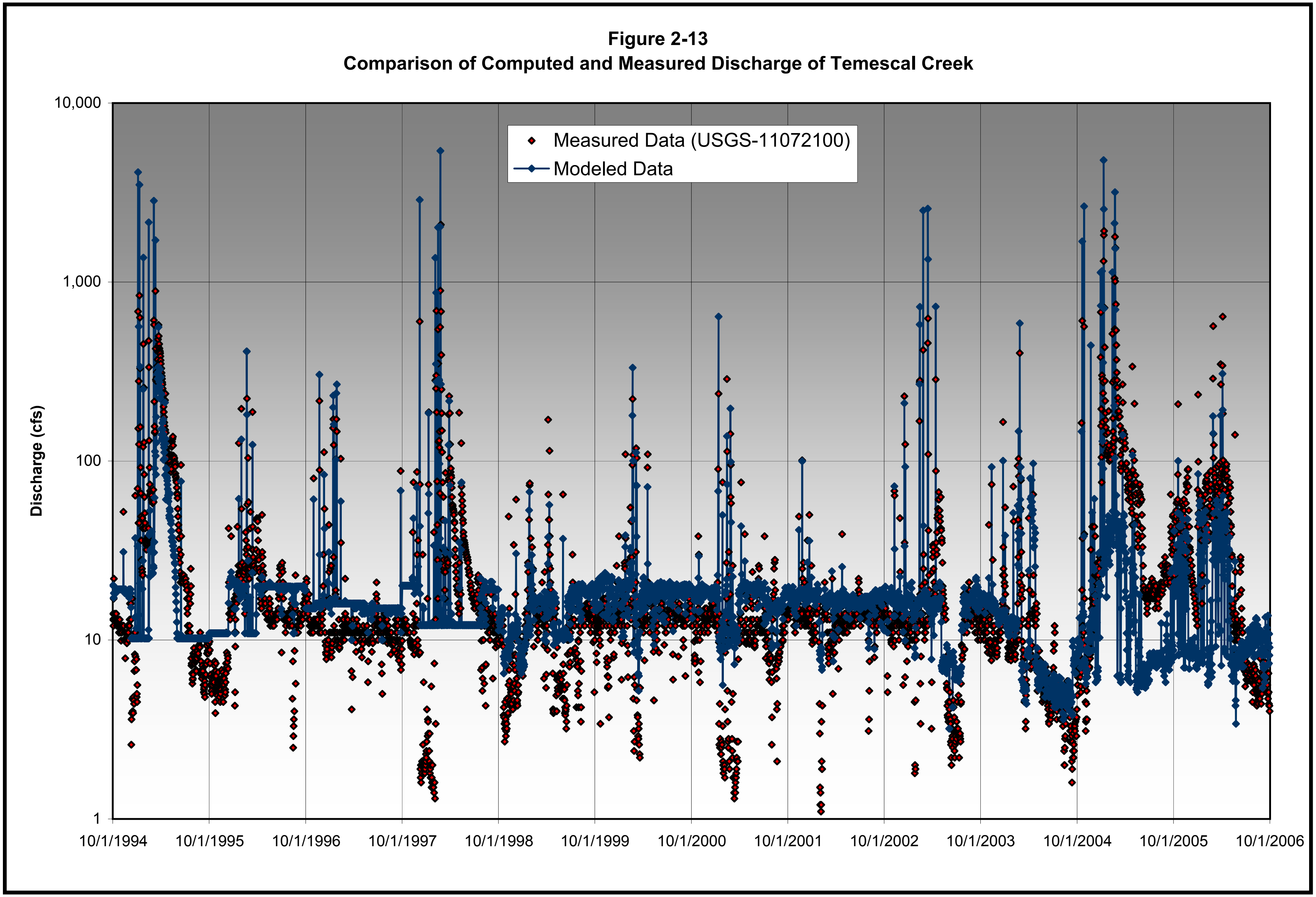

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Figure 2-14
Comparison of Computed and Measured Discharge of Chino Creek at Schaefer Avenue

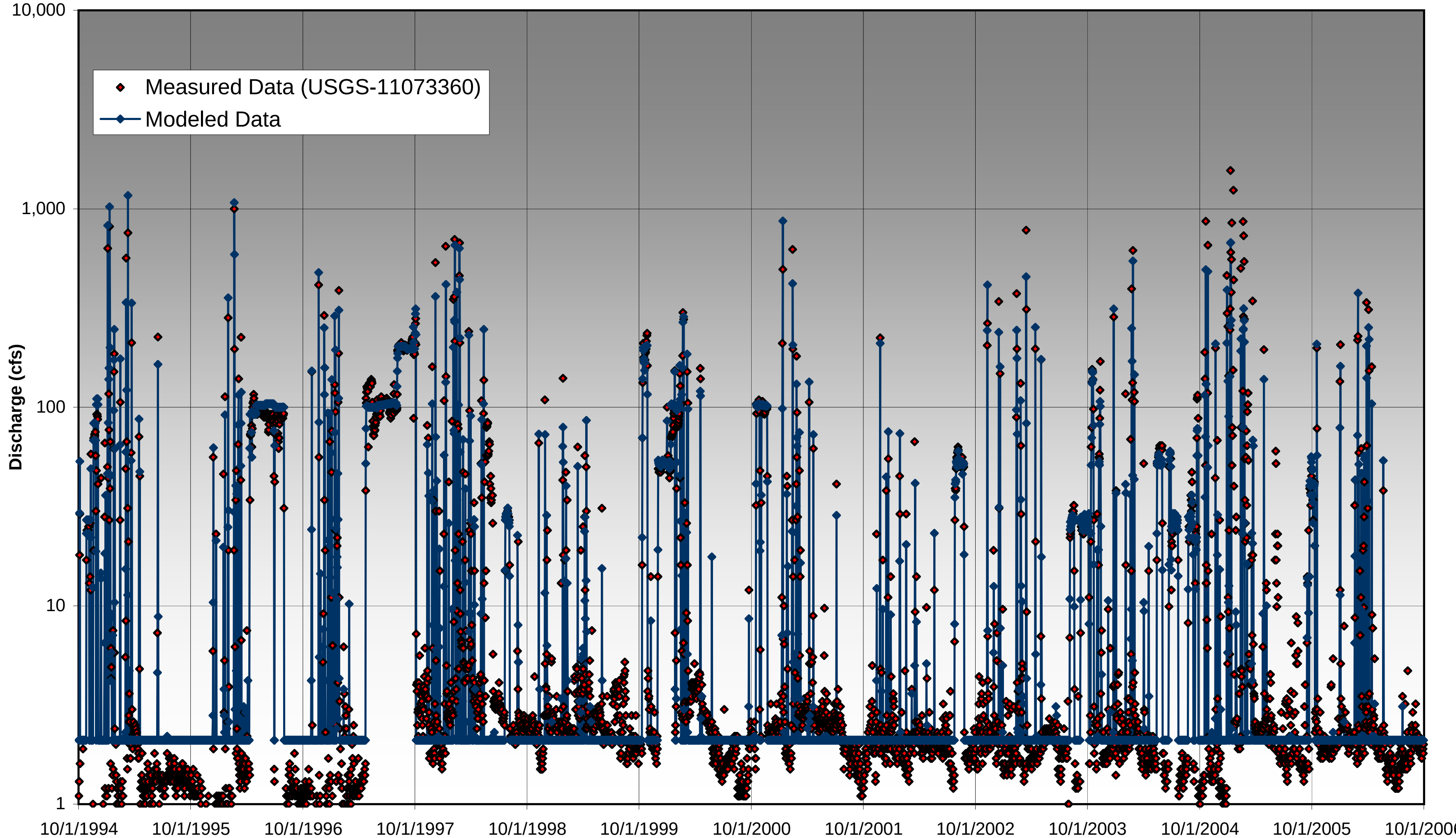

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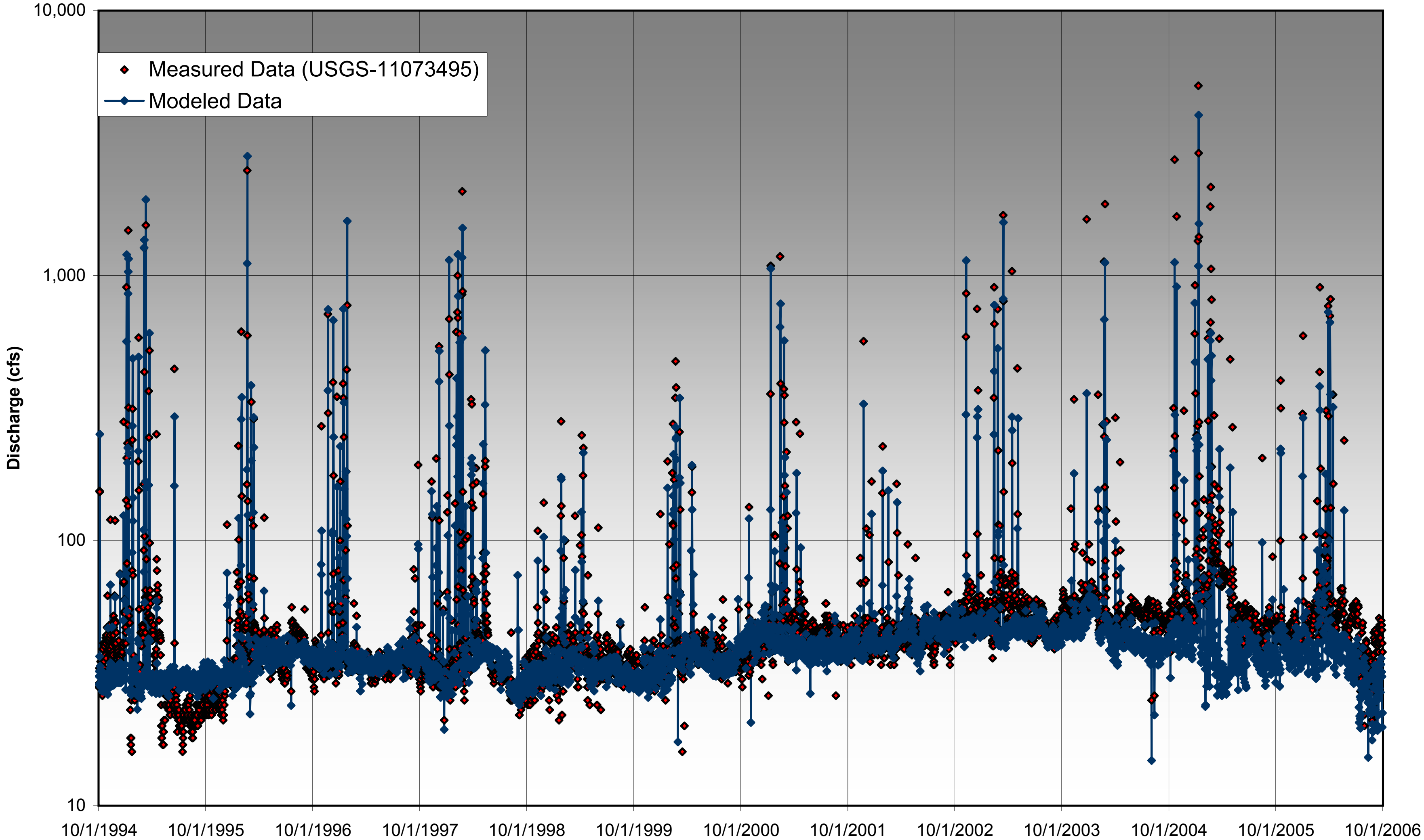
Figure 2-15
Comparison of Computed and Measured Discharge of Cucamonga Creek near Mira Loma



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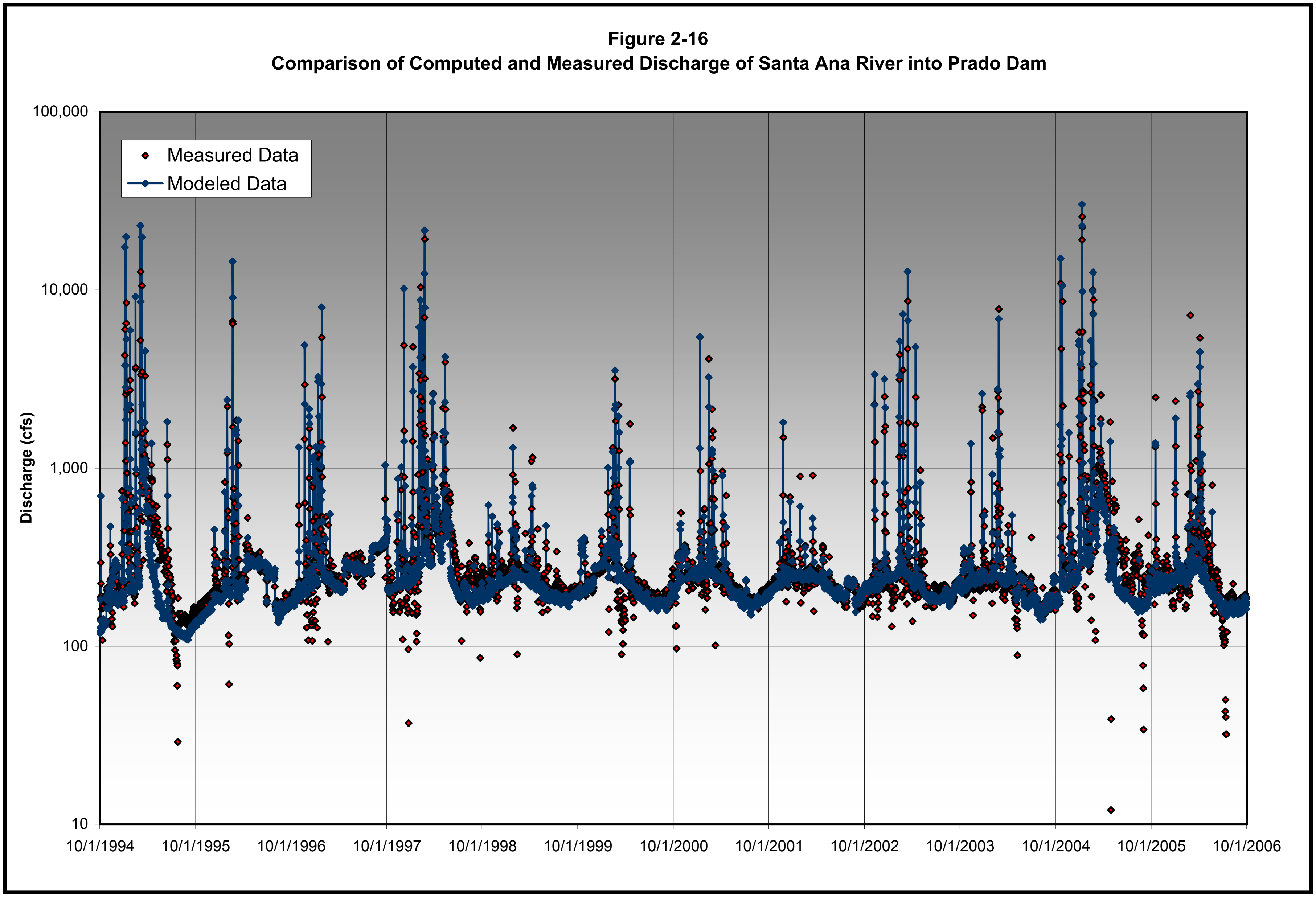

Figures 2-1_2-19

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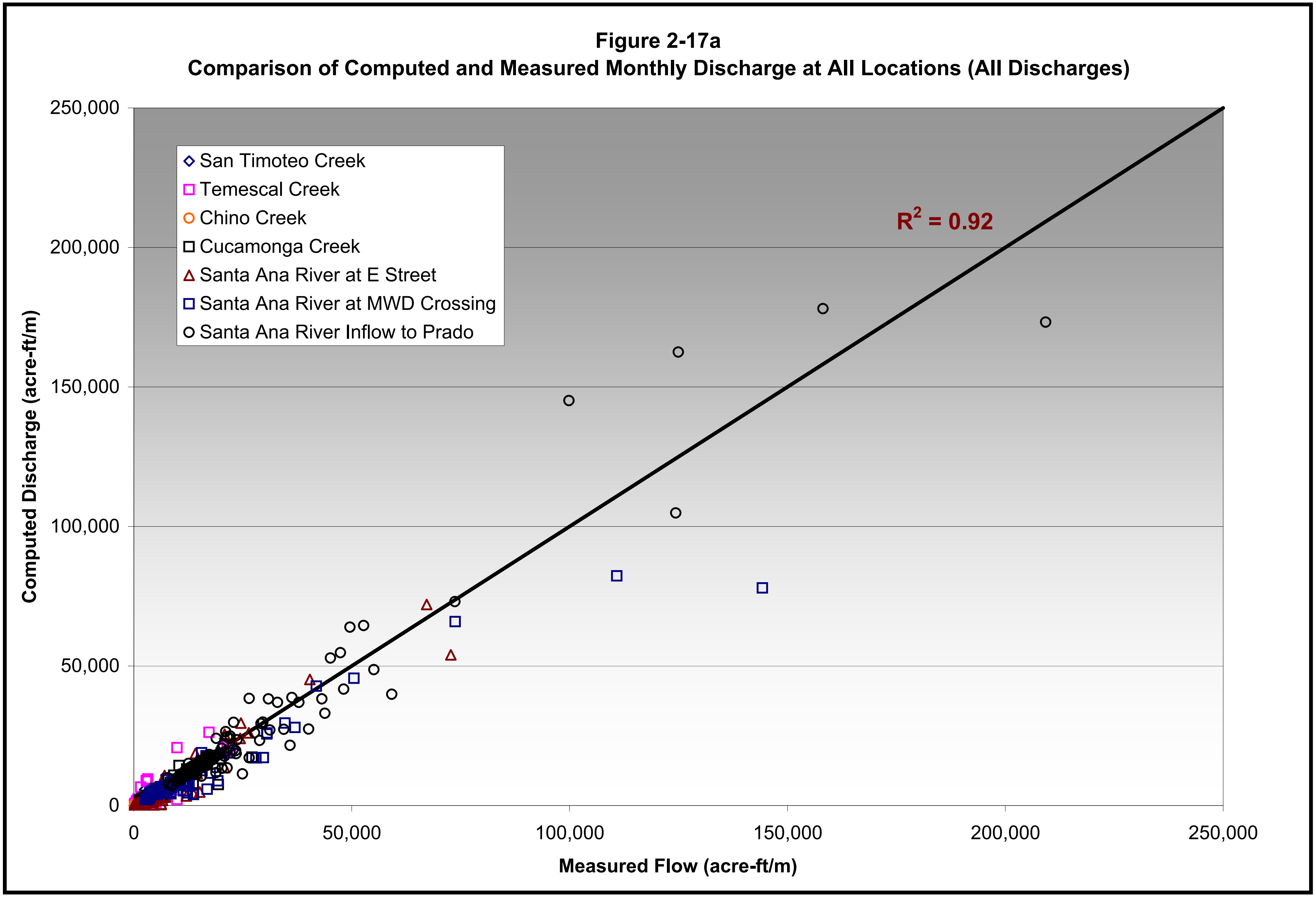

figure 2-17_rev

Figure 2-17b
Comparison of Computed and Measured Monthly Discharge at All Locations (Low Discharges)

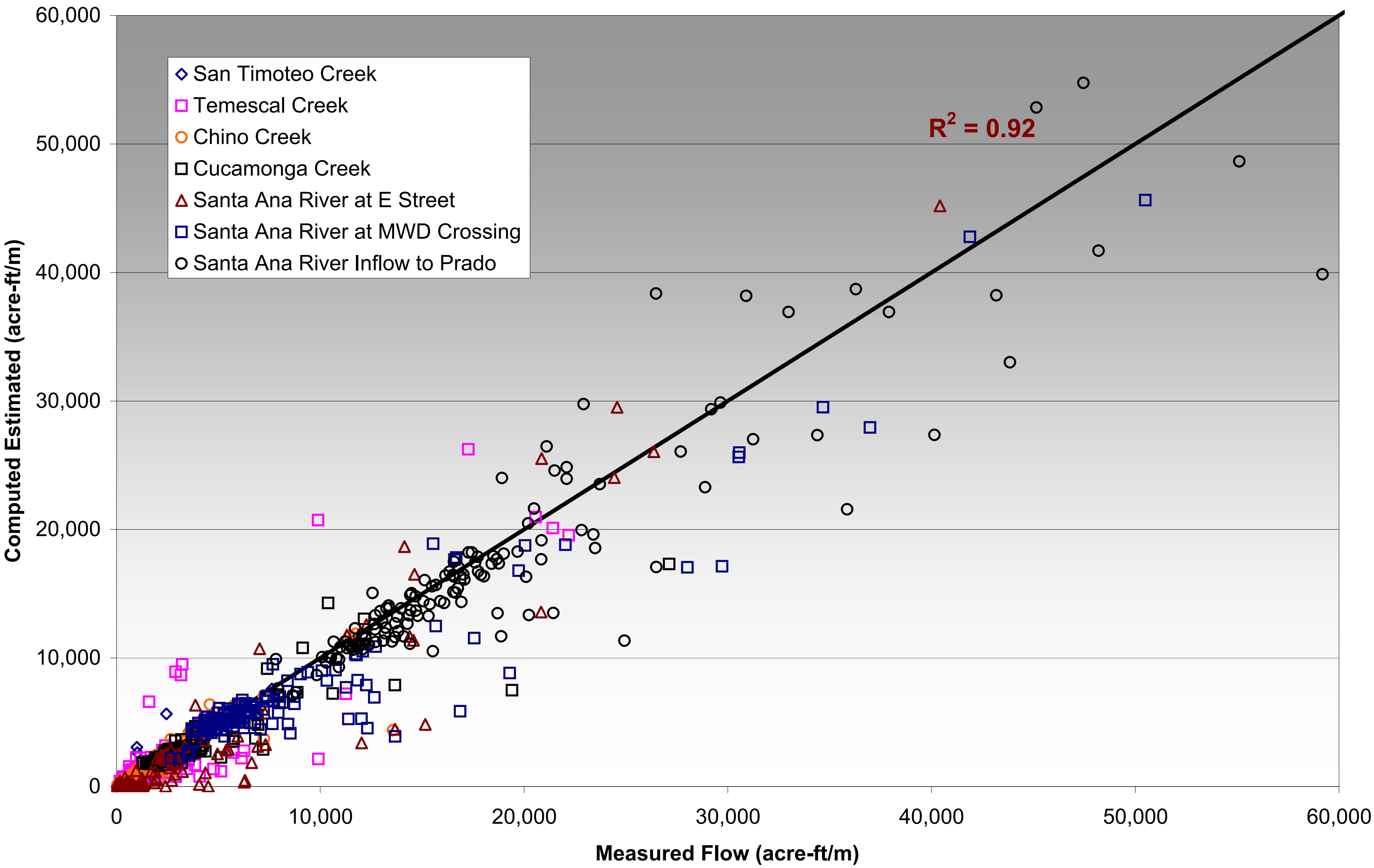

figure 2-17_rev

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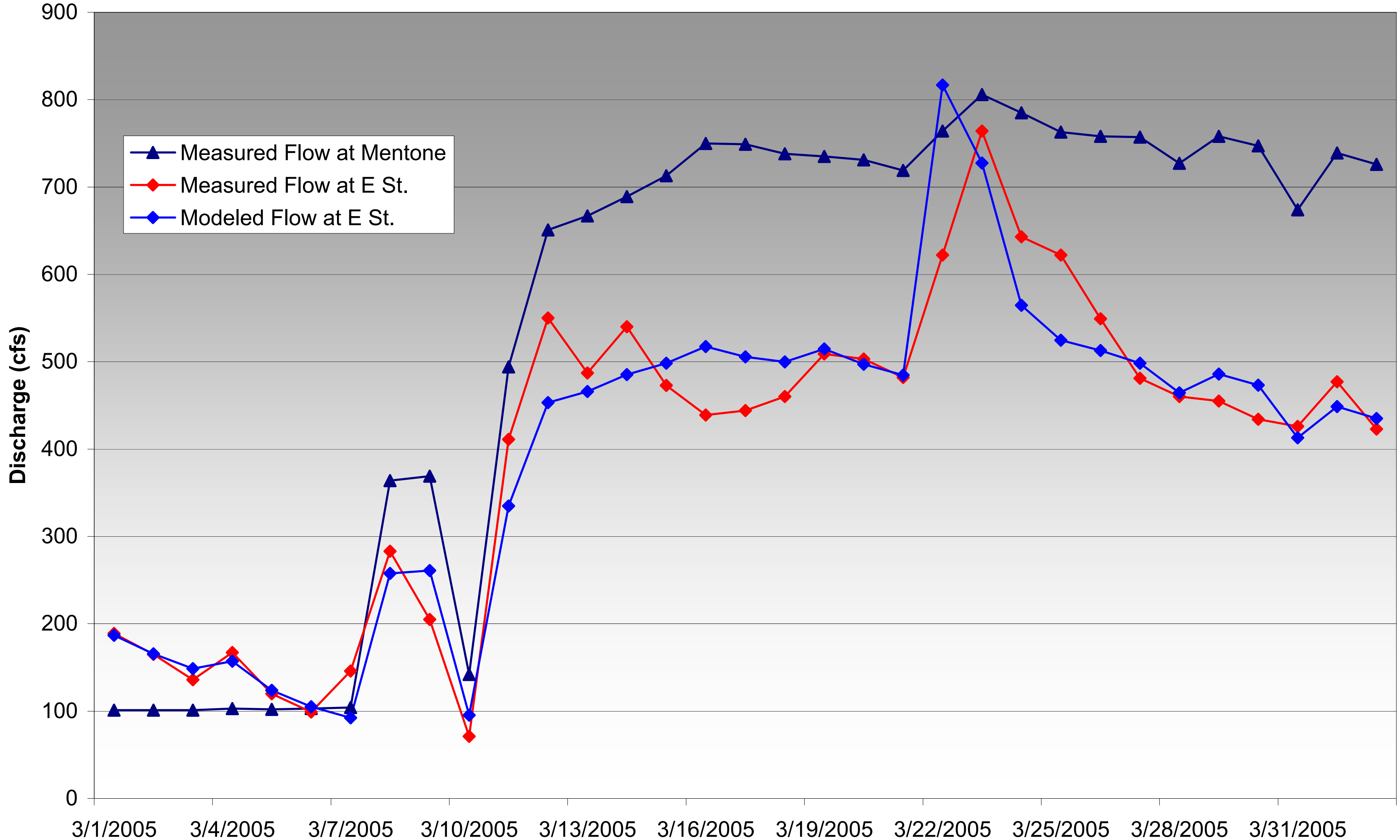
Figure 2-18
Comparison of Estimated and Measured Discharge of Santa Ana River at E Street in March 2005



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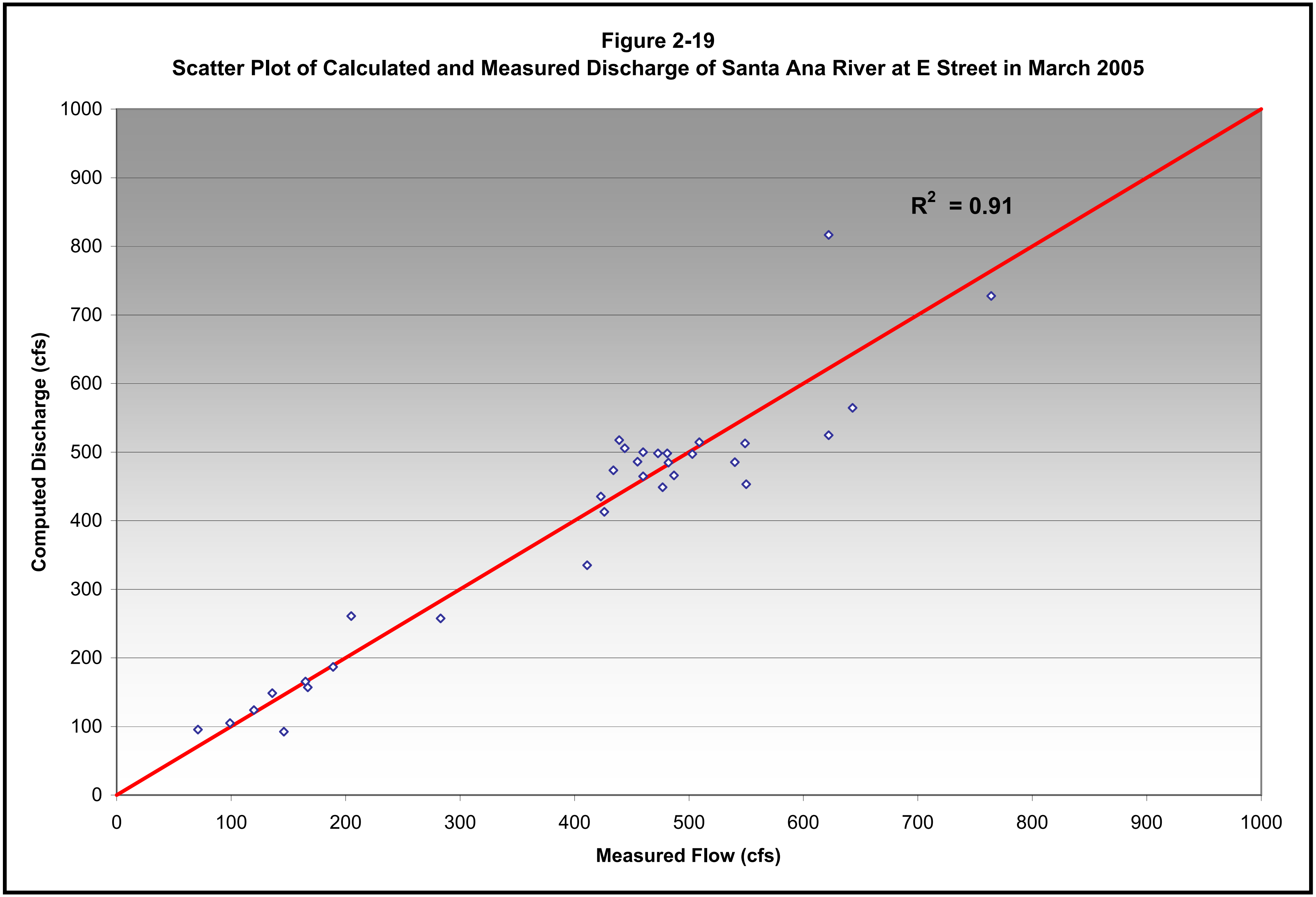

Figures 2-1_2-19

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Figure 2-20
Comparison of Santa Ana River Reach 3 Stream Percolation
Computed by the WLAM and the 2007 Chino Basin Groundwater Model

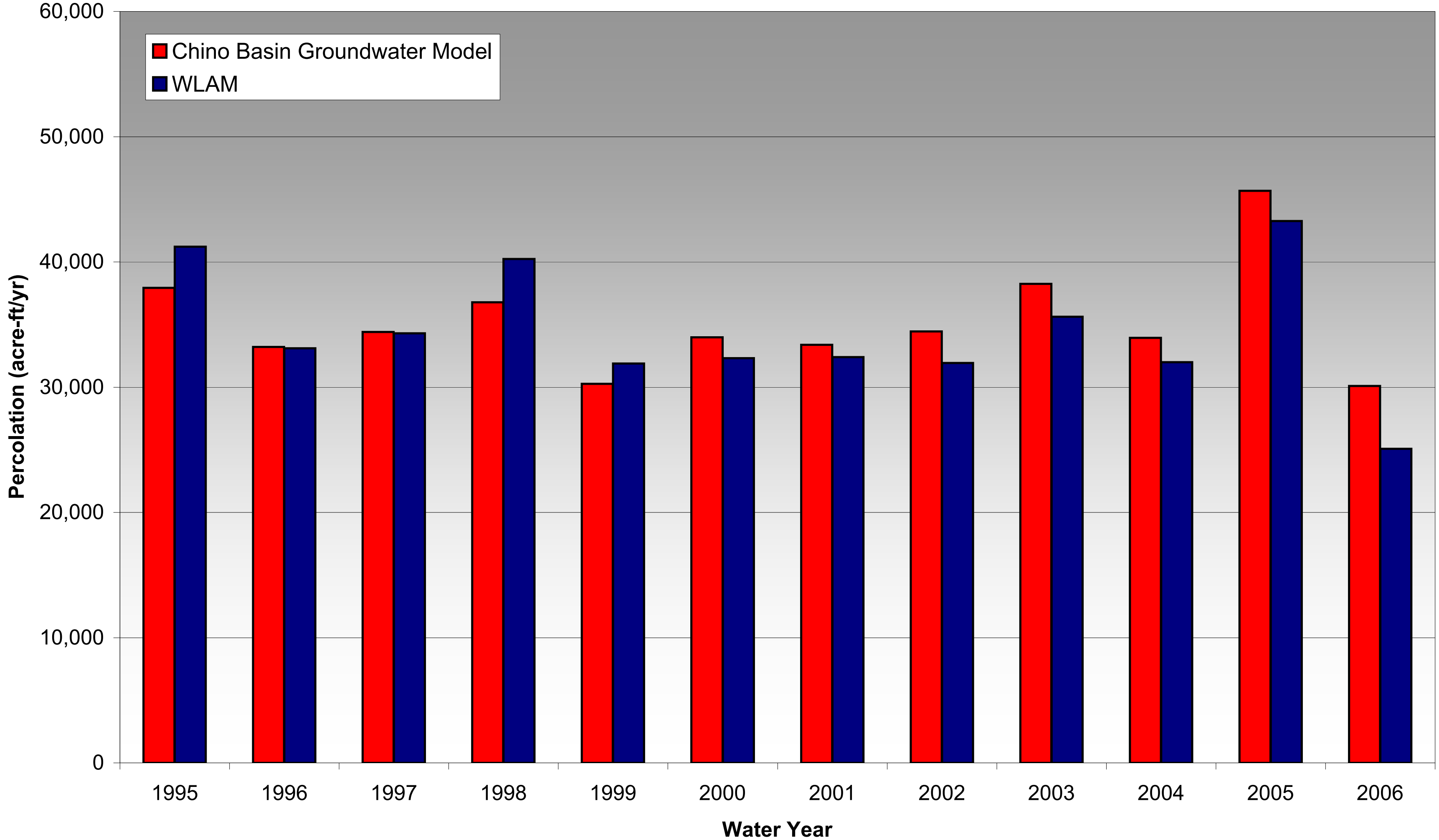

figure 2-20_2-21

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Figure 2-21
Scatter Plot of Santa Ana River Reach 3 Stream Percolation
Computed by the WLAM and the 2007 Chino Basin Groundwater Model

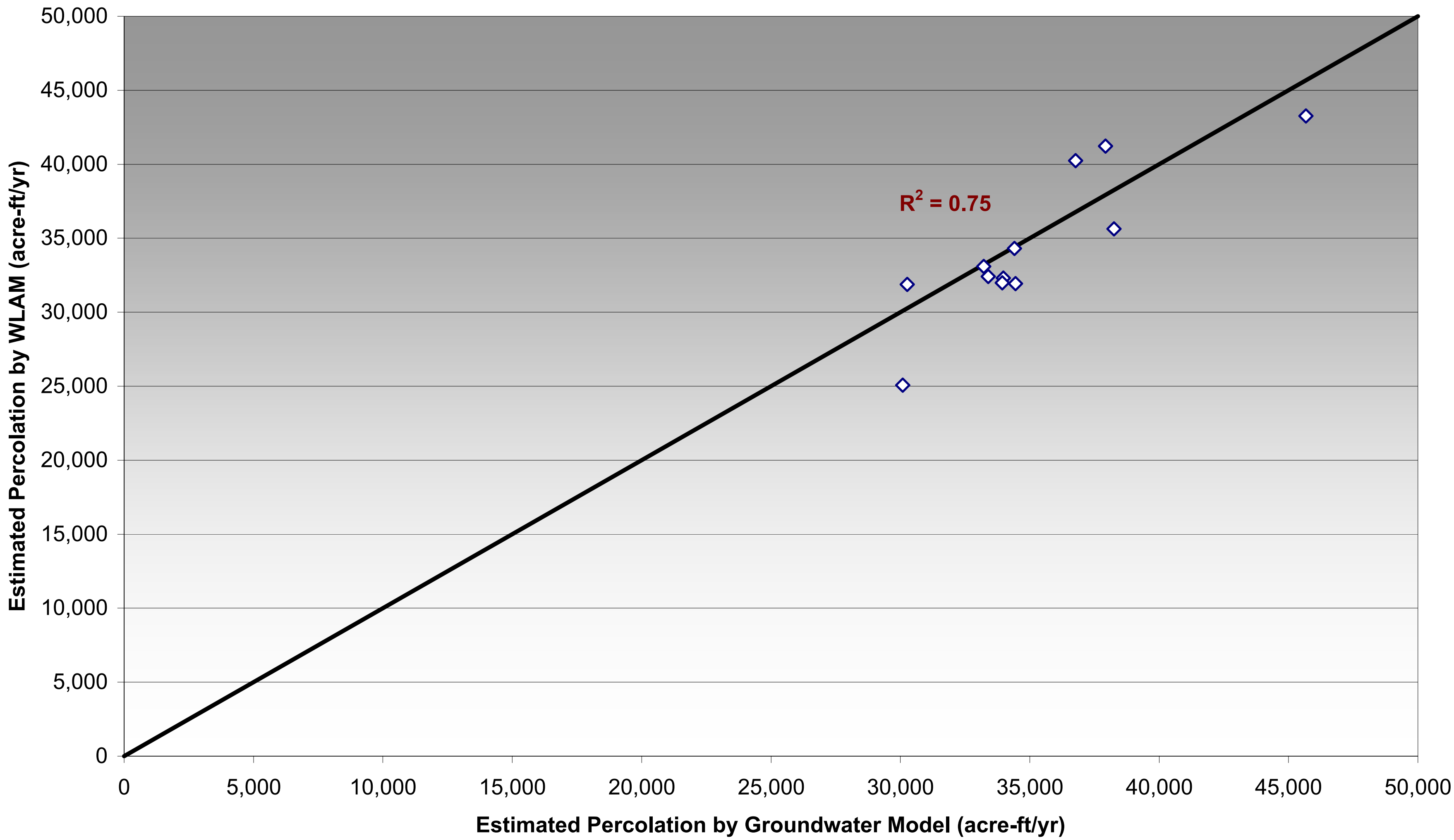

figure 2-20_2-21

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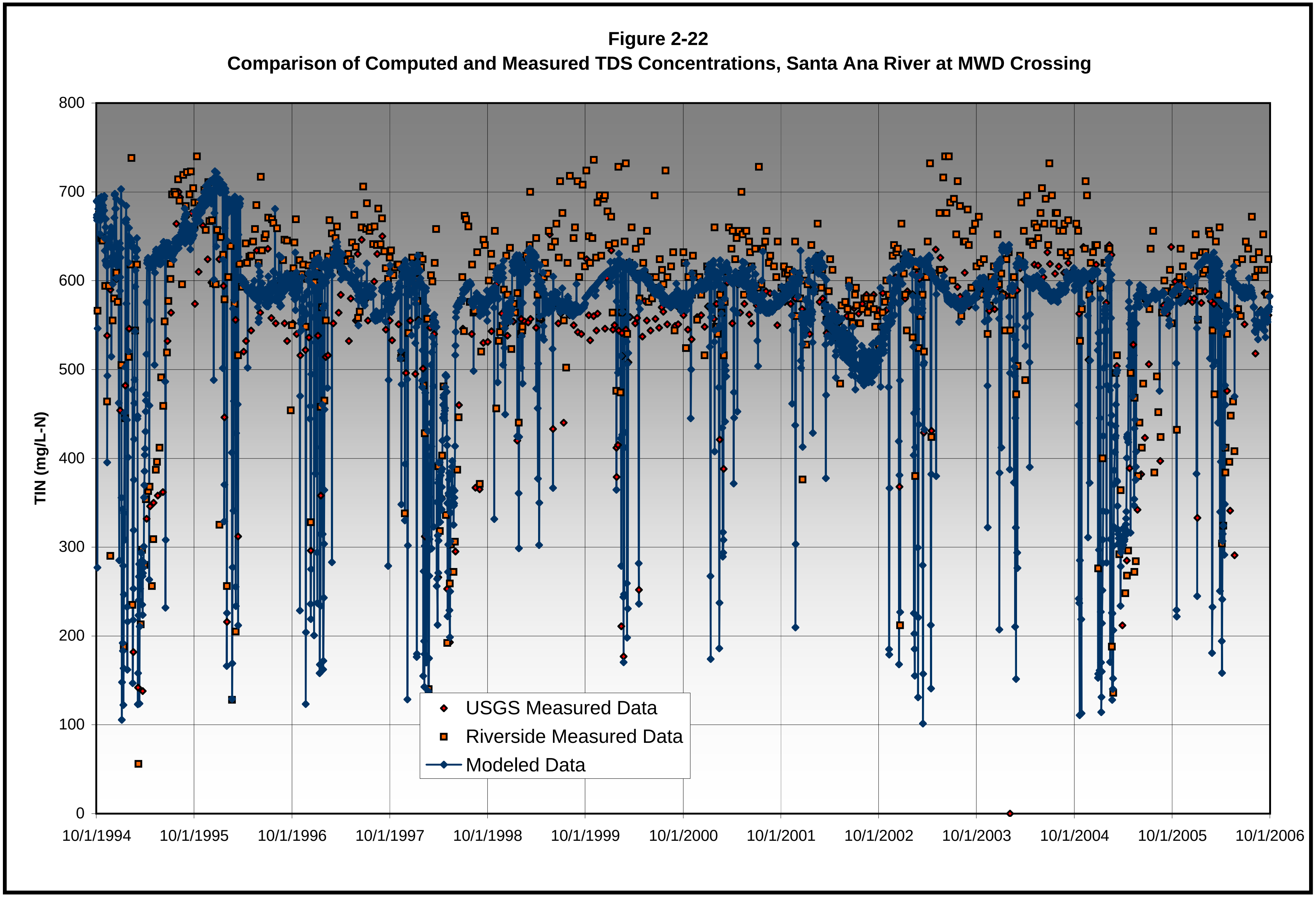

figure 2-22_2-25

Figure 2-23
Comparison of Computed and Measured TIN Concentrations, Santa Ana River at MWD Crossing

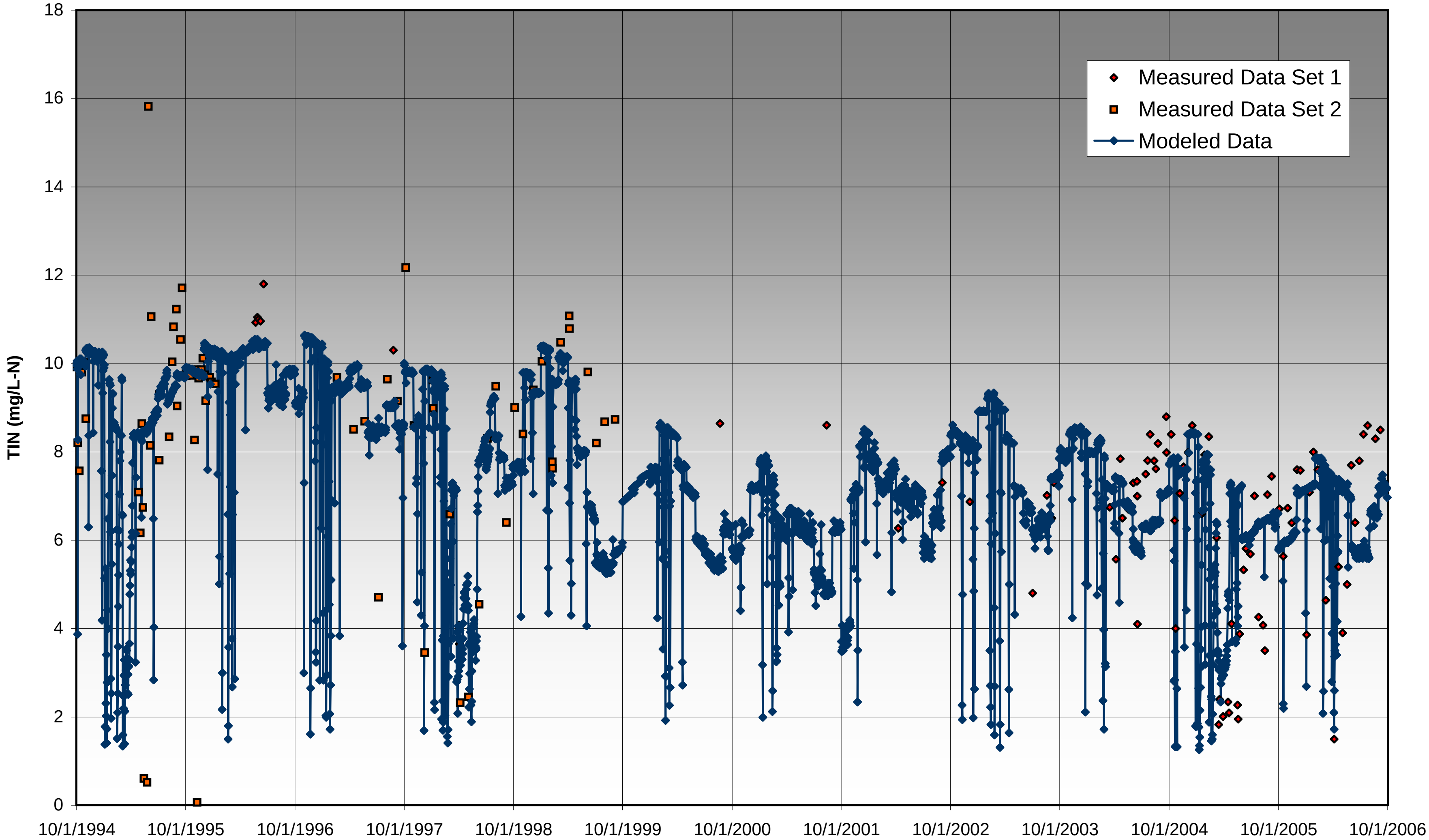

figure 2-22_2-25

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Figure 2-24
Comparison of Computed and Measured TDS Concentrations, Santa Ana River below Prado

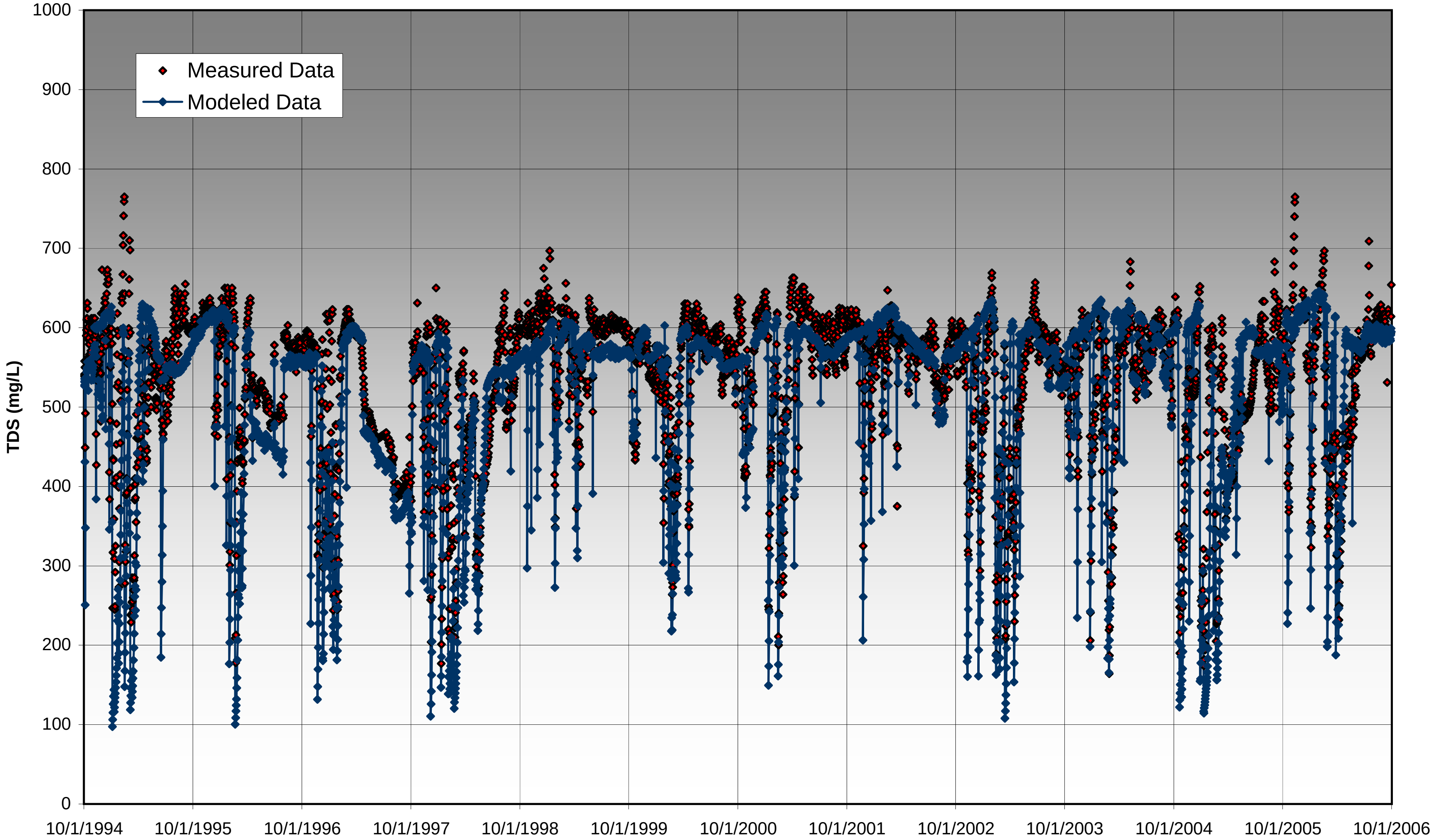


figure 2-22_2-25

WILDERMUTH ENVIRONMENTAL INC.

Figure 2-25
Comparison of Computed and Measured TIN Concentrations, Santa Ana River below Prado

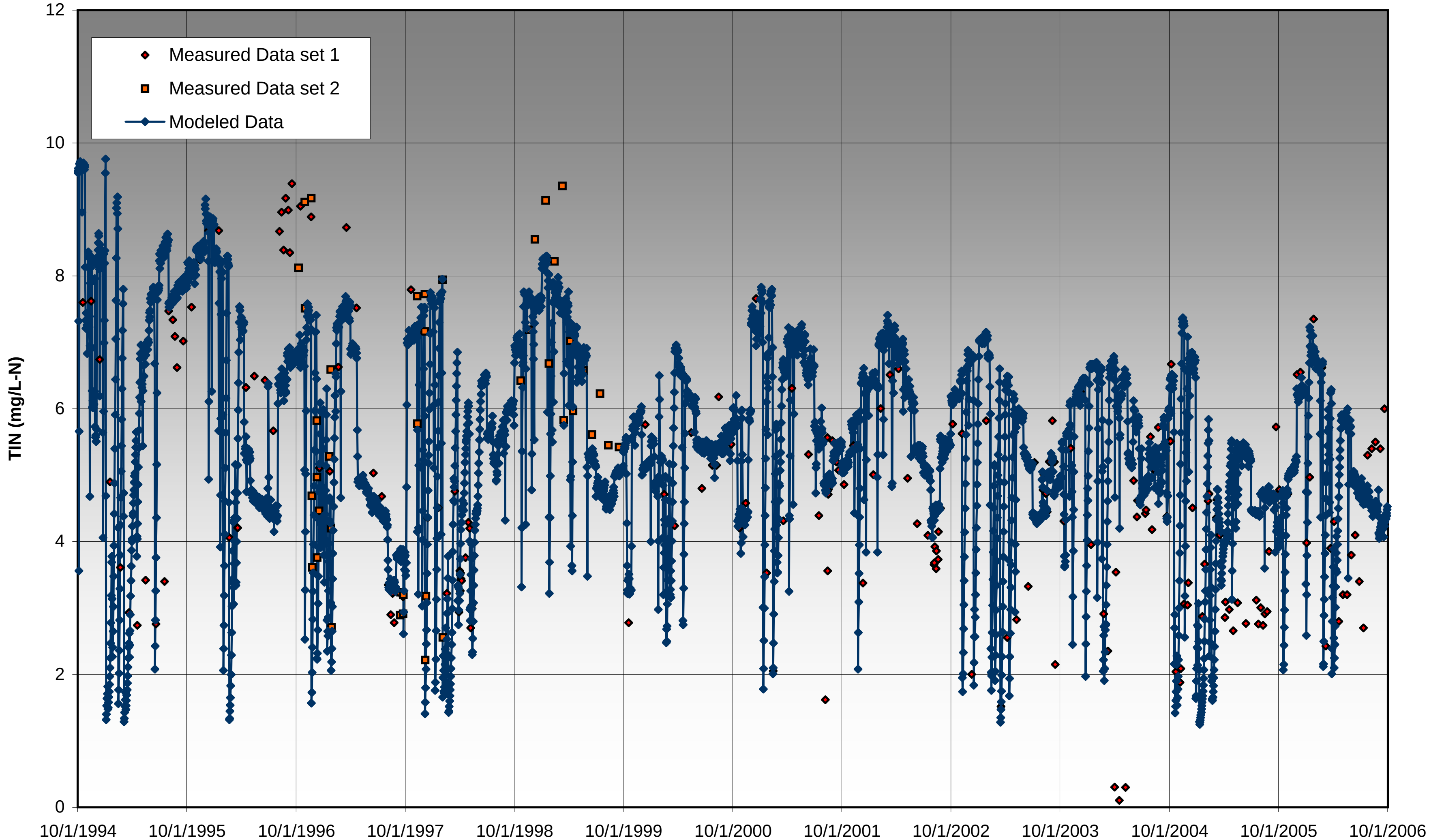


figure 2-22_2-25

Section 3 – Comparison of Updated and Previous Models

The updated WLAM was used to re-simulate the 2003 scenarios that were included in the 2004 Basin Plan Amendment. Upon completion, the results of the updated WLAM simulations were compared to the 2003 results. The purpose of this comparison was to determine if there were any significant differences between the 2003 WLAM and the 2008 WLAM as a result of model recalibration. The results of this comparison are discussed below.

3.1 2010A and 2010B Wasteload Allocation Simulations

The objective of the wasteload allocation simulations in 2003 was to determine if the then current wasteload allocation developed for the 1995 Basin Plan was still applicable for the ambient TDS and TIN concentrations and the proposed TDS and TIN objectives. This was done using the calibrated WLAM model to estimate the values of the 1995 Basin Plan metrics and other management metrics for future estimates of recycled water discharge to surface water. The metrics were evaluated assuming a constant recycled water discharge condition over a 50-year period (1949/50 to 1998/99). These simulations allowed for the evaluation of metrics for 2001 and 2010 recycled water discharge alternatives over long-term highly variable hydrologic conditions.

In total, three baseline scenarios or alternatives were evaluated in 2003:

- 2001 Baseline – essentially replicated the year 2001 recycled water discharge conditions and TDS and TIN permit levels.
- 2010 Baseline A (2010A) – consisted of 2010 projected recycled water production and reuse per the 1995 Basin Plan and the TDS and TIN concentrations of then existing permits.
- 2010 Baseline B (2010B) – consisted of 2010 projected recycled water production and reuse as recommended by the POTWs and water supply agencies and the TDS and TIN concentrations of then existing permits.

The simulations presented below are replications of the 2010A and 2010B simulations that were completed in 2003 and documented in *June 2003 Addendum TIN/TDS Study – Phase 2B of the Santa Ana Watershed Wasteload Allocation Investigation* (WEI, 2003), using the newly updated 2008 WLAM. The surface water discharges from POTWs and the associated TDS and TIN concentrations used in this scenario are documented Table 5-5 of the 2004 Basin Plan.

3.2 Comparison of the 2003 and 2008 Models

Tables 3-1 and 3-2 contain the metrics of the previous and current simulation results for TDS and TIN, respectively, over the same 50-year hydrologic period. Note that the evaluation metrics themselves have been modified. The 2003 report (WEI, 2003) metrics consisted of the average 1-year and 5-year volume-weighted average concentration; this is not how compliance is determined. Compliance is determined based on the maximum 1-year and 5-year volume-weighted average concentration. Tables 3-1 and 3-2 list the maximum 1-year and 5-year volume-weighted average TDS and TIN concentrations. Figures 3-1 and 3-2 show the estimated 5-year volume-weighted average TDS and TIN, respectively, over the modeled 50-

year period. From comparing the results of the two models, the following conclusions were reached:

- The updated model estimates a significantly lower TDS concentration (approximately 65mg/L for the 2010A 5-year average) and TIN concentration (approximately 1.3 mg/L-N for the 2010A 5-year average) for Reaches 2, 3, and 4 of the San Timoteo Creek.
- The updated model estimates an increased TDS concentration (approximately 73 mg/L for the 2010A 5-year average) and TIN concentration (approximately 1.2 mg/L-N for the 2010A 5-year average) for portions of Santa Ana River Reach 4 overlying the Riverside A management zone.
- The updated model estimates an increased TDS (approximately 26 mg/L for the 2010A 5-year average) for portions of Santa Ana River Reach 3 overlying the Chino South management zone.
- There is a little difference between model results for the August only TDS concentration (approximately 10 mg/L for the 2010A) and TIN concentration (approximately 0.1 mg/L-N for the 2010A) below Prado Dam.
- There is a negligible difference between the models results for the estimated maximum 5-year volume-weighted average TDS concentration (approximately 0 mg/L for the 2010A) and TIN concentration (approximately 0.1 mg/L-N for the 2010A) below Prado Dam. The maximum 5-year volume-weighted average TDS and TIN concentrations occur during dry periods. During wet periods, there is not a negligible difference between the two models. This difference is approximately 96 mg/L TDS for 2010A in 1982 and approximately 0.6 mg/L-N TIN for 2010A in 1969.

The significant differences in modeled water quality within the San Timoteo and Beaumont area can be explained by a better understanding of the conceptual hydrologic model and new data sources in the region. Since 2001, surface water and groundwater models were developed for the Beaumont Basin. This work provided an analysis and estimation of surface water runoff and recharge in the area. The runoff and recharge estimates of this modeling work were reviewed and incorporated in the updated WLAM. A problem in the development of the previous WLAM was the lack of surface water discharge data in San Timoteo Creek in the Beaumont and Yucaipa areas: the only USGS station available for the calibration period was 11057500 (San Timoteo Creek near Loma Linda), and its drainage area is 125 square miles. The YVWD and the San Timoteo Watershed Management Authority initiated monitoring programs along Noble, Coopers, San Timoteo, and Yucaipa Creeks in 2001 and began producing annual reports in 2004. These data have provided the locations of high groundwater where surface water discharge does not percolate in the stream bottom and were incorporated into the calibration, described in Section 2. As a result, the San Timoteo Creek simulation has been greatly improved.

In the previous WLAM, the Seven Oaks Dam was operated for flood control purposes only. Thus, the impacts of senior diversion water rights were not evaluated. In this study, two senior diversion water rights were incorporated: 1) for Bear Valley Municipal Water District and 2) for the SBVWCD (Fuller, 2008). Incorporating these diversions had a significant effect on storm water recharge. By comparison, about 6,000 acre-ft/yr more storm water percolated in Santa Ana River Reach 4 with the previous model than with the updated model. This accounts for the about 45 mg/L increase for the maximum 5-year average TDS concentration and the about 1.2 mg/L-N increase for the maximum 5-year average TIN concentration for Reach 4 of the Santa Ana River.

The updated 2008 model increased percolation rates in Reach 3 of the Santa Ana River during the calibration process. The updated rates result in a change of about 18,000 acre-ft/yr of increased percolation. This increase is consistent with available data and the updated 2007 Chino Basin Watermaster groundwater model (WEI, 2007). With storm water available only periodically during the winter, the water quality of the majority of the percolated is similar to the water quality of point-discharged sources and increases in TDS concentration. The maximum 5-year volume-weighted average TDS concentration increased about 26 mg/L in the 2008 model. And, the maximum 5-year volume-weighted average TIN concentration increased about 0.1 mg/L-N in the 2008 model.

During the calibration of the 2003 model, calibration data were only available for discharge below Prado Dam. The WLAM simulated Prado Dam discharge according to the procedures described in the USACE's Water Manual (USACE, 2000). Actual operations were quite different than described in the Water Manual. This affected model calibration for high runoff periods. Low flow calibration for the 2003 model was very good, as shown in Figure 2-18 of the 2003 model report (WEI, 2003).

During 2008 model calibration, the USACE provided estimated daily discharge into the Prado Basin, which was used as a calibration target. These data were estimated from storage changes behind Prado Dam and outflow through Prado Dam. As shown in Figure 2-16, the 2008 model calibration results show good agreement between measured and modeled discharge below Prado Dam during high and low runoff periods. This is an improvement upon the 2003 model, particularly during high discharge periods.

Table 3-1

Comparison of the Estimated TDS Concentration Metrics Using the 2003 WLAM and 2008 WLAM with the 2010 Baseline A and 2010 Baseline B Planning Alternatives in the 2004 Basin Plan Amendment

Point Where Metric is Evaluated	Underlying Management Zone	TDS Objective (mg/L)	Current Ambient Water Quality (mg/L)	Assimilative Capacity (mg/L)	Compliance Period	Compliance Metric: 2003 Model Evaluation 2010A (mg/L)	2003 Model Evaluation 2010B (mg/L)	2008 Model Evaluation 2010A (mg/L)	2008 Model Evaluation 2010B (mg/L)
						Maximum Value for the Volume-Weighted Average Surface Water [1]			
Santa Ana River below Prado Dam, Reach 2	na	700*	na	na	August	610	646	600	640
						Maximum Value for the Volume-Weighted Average Discharge [1]			
Santa Ana River below Prado Dam, Reach 2	na	650**	na	na	5-Year	537	522	537	520
						Maximum Value for the Volume-Weighted Average Recharge [1]			
Santa Ana River Reach 3 Recharge	Chino South	680	940	na	1-year 5-year	617 584	638 603	629 610	652 629
Santa Ana River Reach 4 Recharge	Riverside A	560	440	120	1-year 5-year	475 401	468 395	519 474	514 469
San Timoteo Creek Reach 2 Recharge	San Timoteo	400	-	na	1-year 5-year	526 509	190 176	532 443	166 131
San Timoteo Creek Reaches 3 and 4 Recharge	San Timoteo	400	-	na	1-year 5-year	524 507	506 472	490 443	440 369
San Timoteo Creek Reaches 3 and 4 Recharge	Beaumont	330	260	70	1-year 5-year	524 507	506 472	490 443	440 369

Notes

1 -- Volume-weighted average recharge values include appropriated adjustments for nitrogen loss during percolation

*-- August Only Surface Water TDS Objective

** -- 5 Five-year moving average Surface Water TDS Objective

Table 3-2

Comparison of the Estimated TIN Concentration Metrics Using the 2003 WLAM and 2008 WLAM with the 2010 Baseline A and 2010 B Baseline Planning Alternatives in the 2004 Basin Plan Amendment

Point Where Metric is Evaluated	Underlying Management Zone	TIN Objective (mg/L)	Current Ambient Water Quality (mg/L)	Assimilative Capacity (mg/L)	Compliance Period	Compliance Metric: 2003 Model Evaluation 2010A (mg/L)	Compliance Metric: 2003 Model Evaluation 2010B (mg/L)	Compliance Metric: 2008 Model Evaluation 2010A (mg/L)	Compliance Metric: 2008 Model Evaluation 2010B (mg/L)
						Maximum Value for the Volume-Weighted Average Surface Water [1]			
Santa Ana River below Prado Dam, Reach 2	na	10.0*	na	na	August	9.6	9.2	9.6	9.3
						Maximum Value for the Volume-Weighted Average Discharge [1]			
Santa Ana River below Prado Dam, Reach 2	na	na	na	na	5-Year	8.0	7.1	8.1	7.2
						Maximum Value for the Volume-Weighted Average Recharge [1]			
Santa Ana River Reach 3 Recharge	Chino South	4.2	25.7	na	1-year 5-year	4.6 4.4	4.6 4.3	4.6 4.5	4.6 4.5
Santa Ana River Reach 4 Recharge	Riverside A	6.2	4.9	1.3	1-year 5-year	6.4 5.2	6.3 5.2	7.1 6.4	7.1 6.4
San Timoteo Creek Reach 2 Recharge	San Timoteo	5.0	-	na	1-year 5-year	7.2 6.9	1.1 1.1	6.9 5.7	1.2 0.9
San Timoteo Creek Reaches 3 and 4 Recharge	San Timoteo	5.0	-	na	1-year 5-year	7.1 6.9	6.9 6.3	6.2 5.5	5.4 4.4
San Timoteo Creek Reaches 3 and 4 Recharge	Beaumont	5.0	1.6	3.4	1-year 5-year	7.1 6.9	6.9 6.3	6.2 5.5	5.4 4.4

Notes

1 -- Volume-weighted average recharge values include appropriated adjustments for nitrogen loss during percolation

*-- Surface Water TIN Objective

Figure 3-1
Estimated 5-Year Volume-Weighted TDS Concentration for the Santa Ana River below Prado Dam for the 2010A and 2010B Scenarios - Estimated with the 2003 and 2008 Models

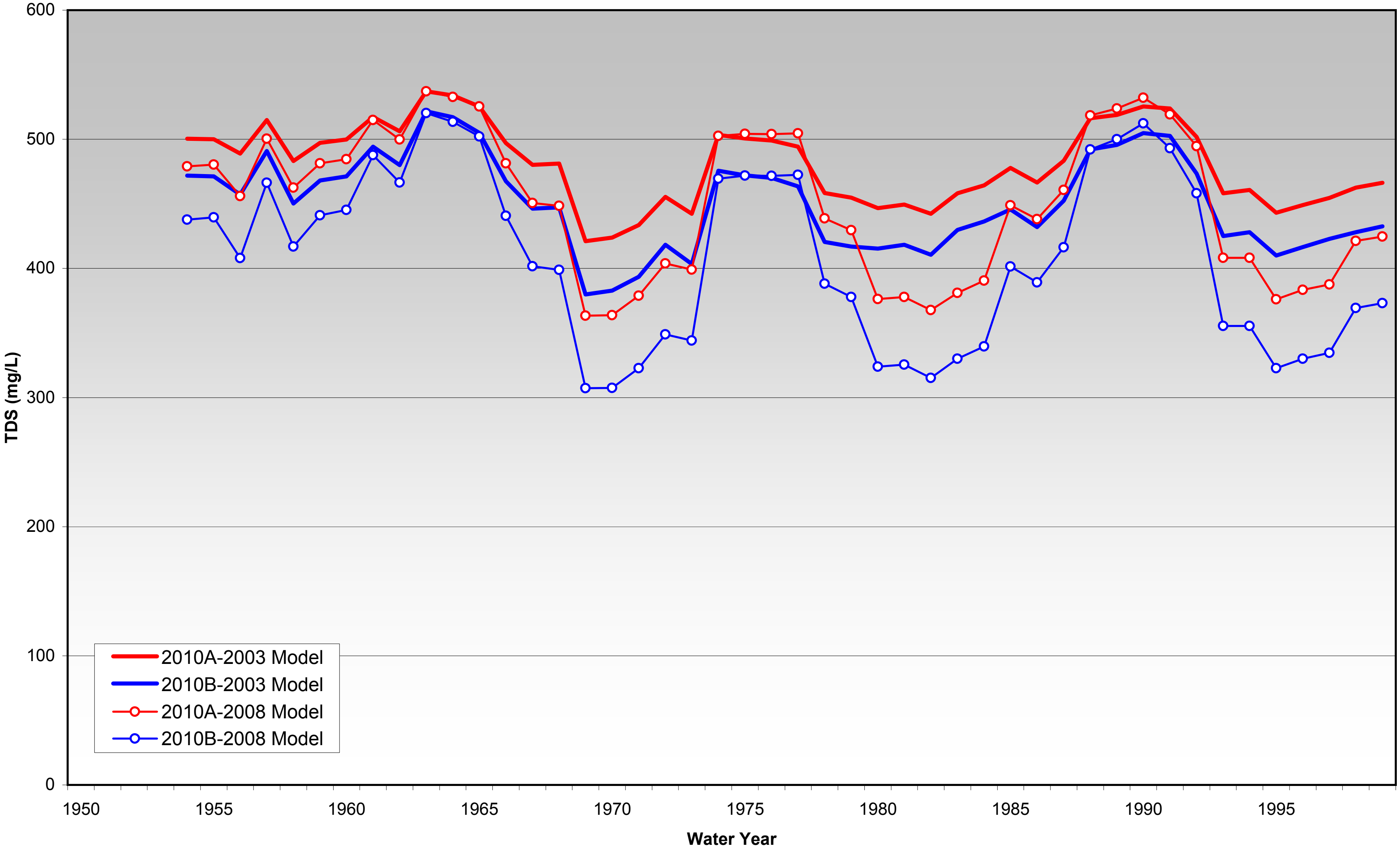
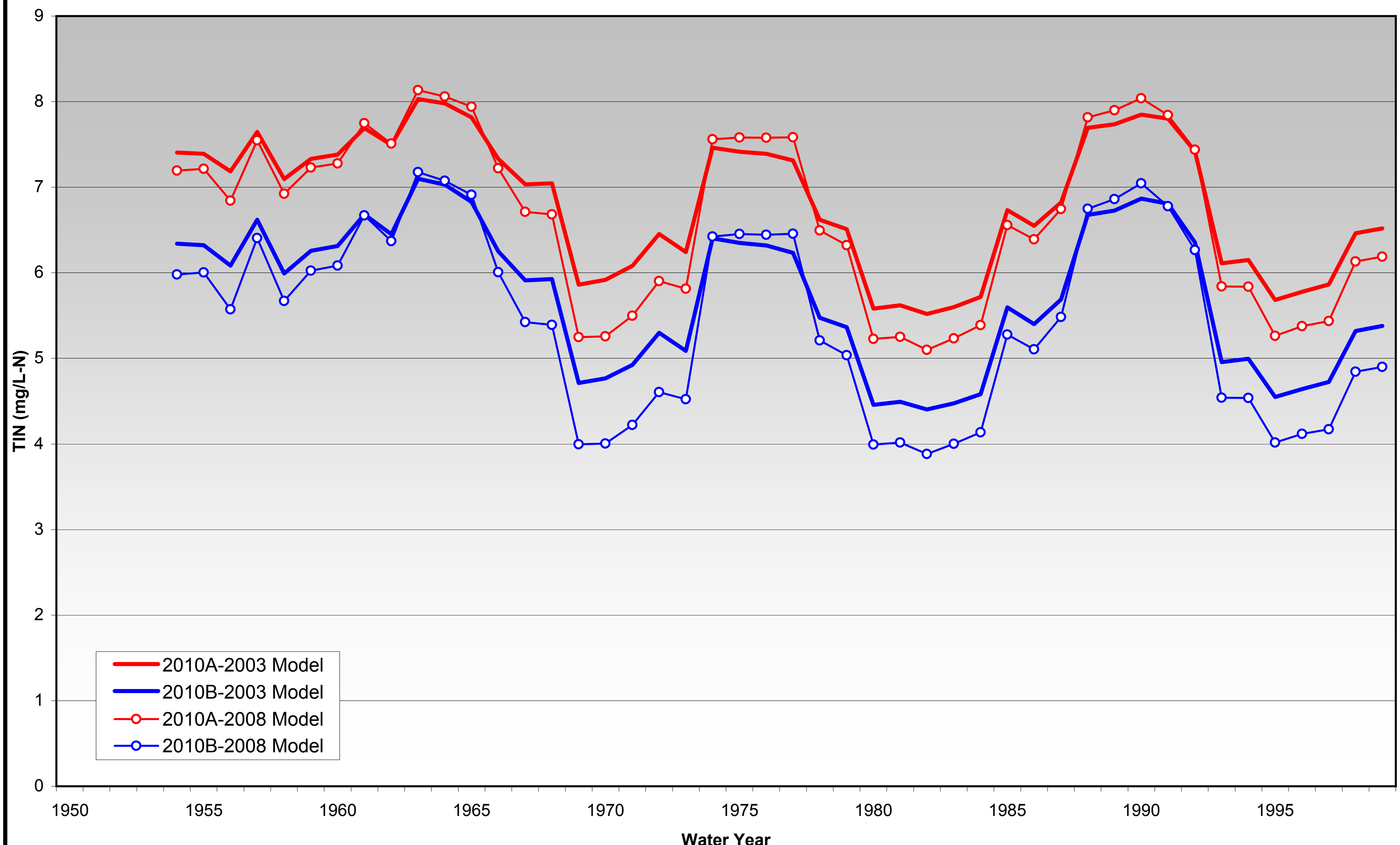


Figure 3-2
Estimated 5-Year Volume-Weighted TIN Concentration for the Santa Ana River below Prado Dam for the 2010A and 2010B Scenarios - Estimated with the 2003 and 2008 Models



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4.1 Planning Simulations

Using the updated WLAM, WEI evaluated varying wasteload discharge scenarios to determine how projected discharges to the Santa Ana River will affect water quality. Based on feedback from the June 2, 2008 Basin Monitoring Task Force meeting, four wasteload allocation scenarios were identified. On November 19, 2008, two additional scenarios were identified for simulation. The first scenarios, 2010A and 2010B, collectively referred to as Scenario 1, are described in Section 3 of this report and are essentially the WLA in the 2004 Basin Plan. The five additional scenarios and their simulation results are discussed below.

4.1.1 Scenario 2 – 2010 and 2020 Worst Case Discharge with the Seven Oaks Diversion

In this scenario, future recycled water reuse plans from POTWs with permit TDS concentration limits less than the TDS concentration objective for the Orange County management zone (580 mg/L) are assumed to be fully implemented, and the recycled water reuse for POTWs that discharge recycled water with TDS concentration limits greater than the Orange County management zone TDS concentration objective are assumed to remain at 2007 levels. The changes in Santa Ana River discharge at Seven Oaks Dam, caused by the proposed diversion of low TDS concentration storm water by the SBVMWD and the Western Municipal Water District (WMWD), is also assumed to occur. This scenario will likely result in the highest TDS concentrations in all reaches of the River where discharge occurs. The formulas for calculating the discharge of each POTW are provided below.

If a POTW permit limit for TDS concentration is <580 mg/L:

Then the POTW Discharge to the Santa Ana River = Projected Plant Discharge – Projected Recycled Water Reuse Amount

If a POTW permit limit for TDS concentration is >580 mg/L:

Then the POTW Discharge to Santa Ana River = Projected Plant Discharge or Permitted Discharge, whichever is greater – 2007 Recycled Water Reuse Amount

Table 4-1 lists the POTW wastewater facility planned design capacities, the permit limits for TDS and TIN concentrations, the 2004 Basin Plan wasteload allocation discharge, the projected discharge for Scenario 2, and the projected recycled water reuse for Scenario 2.

4.1.2 Scenario 3 – 2010 and 2020 Worst Case Discharge without the Seven Oaks Diversion

This simulation is identical to Scenario 2 with the exception that the SBVMWD and WMWD diversion at Seven Oaks Dam is assumed not to occur. The SBVMWD and WMWD diversion is associated with the SBVMWD and WMWD Santa Ana River Water Right Application. The water right application is anticipated to be approved in 2009. This simulation was conducted in case a Basin Plan Amendment is prepared prior to the approval of the SBVMWD and WMWD diversion permit.

Table 4-2 lists the POTW wastewater facility design capacities, the permit limits for TDS and TIN concentrations, the 2004 Basin Plan wasteload allocation discharge, the projected discharge for Scenario 3, and the projected recycled water reuse for Scenario 3.

4.1.3 Scenario 4 – 2010 and 2020 Worst Case Mass Discharge

This simulation assumes that all POTWs discharge at plant capacity with no recycled water reuse. The changes in Santa Ana River discharge at Seven Oaks Dam, caused by the proposed diversion of low TDS concentration storm water by SBVMWD and WMWD, is assumed to occur.

Table 4-3 lists the POTW wastewater facility design capacities, the permit limits for TDS and TIN concentrations, the 2004 Basin Plan wasteload allocation discharge, the projected discharge for Scenario 4, and the projected recycled water reuse for Scenario 4.

4.1.4 Scenario 5 – 2010 and 2020 Planned Discharge

This simulation assumes that all POTWs discharge at their planned discharge rates in 2010 and 2020. The diversion of low TDS concentration storm water by SBVMWD and WMWD is assumed to occur.

Table 4-4 lists the POTW wastewater facility design capacities, the permit limits for TDS and TIN concentrations, the 2004 Basin Plan wasteload allocation discharge, the projected discharge for Scenario 5, and the projected recycled water reuse for Scenario 5.

4.1.5 Scenario 6 – 2010 and 2020 Planned Discharge with Additional Discharge Point and Increase TDS Permit Condition

This scenario is the same as Scenario 5 with two differences. The first is the addition of discharge from March Wastewater Reclamation Facility into Santa Ana River in Reach 3. The discharge will be to the Jefferson Street Storm Drain in the City of Riverside. This storm drain discharges to the Santa Ana River via Hole Lake and is assumed to occur from November through April of each year. The second difference is an increase in the TDS concentration of the EMWD's recycled water discharge to Temescal Wash near Nichols Road. The EMWD's existing TDS concentration limit is 650 mg/L. In this scenario, the EMWD's TDS concentration limit was increased to 700 mg/L.

Table 4-5 lists the POTW wastewater facility design capacities, the permit limits for TDS and TIN concentrations, the 2004 Basin Plan wasteload allocation discharge, the projected discharge for Scenario 6, and the projected recycled water reuse for Scenario 6.

4.2 Planning Assumptions

4.2.1 Hydrology

A daily 50-year precipitation record for the period of 1949/50 to 1998/99 was used for the planning simulations. This period allowed for the evaluation of metrics for recycled water discharge alternatives over long-term highly variable hydrologic conditions. A total of 43 precipitation stations were used to estimate daily precipitation across the model domain. Precipitation varies by elevation and location. Two gages with complete 50-year records but differing precipitation statistics include the Ontario Fire Station gage (Station 1026) and the San Bernardino City – Devil gage (Station 2071). Over the 50-year period, the Ontario Fire Station gage has a mean annual total precipitation of 15.9 inches, and the San Bernardino City – Devil gage has a mean annual total precipitation of 23.7 inches.

4.2.2 Planning Land Use

Land use data within the watershed was developed for the 50-year planning period based on available SCAG data for 2001 and 2005.

4.2.3 Non-Tributary Discharges

No discharges of State Water Project water through OC-59 or groundwater from the San Bernardino area were assumed to occur in these simulations.

4.2.4 Seven Oaks Reservoir Operations

The SBVWMD and the WMWD have filed a water rights application with the State Water Resources Control Board (SWRCB) to divert up to 200,000 acre-ft of water per year from the Santa Ana River (SBVWMD & WMWD, 2004). There are existing senior water rights to divert water from the Seven Oaks Dam (Fuller, 2008):

1. Diversions by senior water rights claimants, which range between historical diversions and up to 88 cfs
2. Diversion by the SBVWCD of up to 10,800 acre-ft per year
3. Releases of surface water from Seven Oaks Dam of up to 1,000 cfs for 2 days when water is available to accommodate habitat restoration
4. Operation of Seven Oaks Dam for flood control or seasonal storage

WEI developed a computer model to simulate operations at Seven Oaks Dam with and without the SBVMWD and WMWD applied diversion rights of up to 1,500 cfs. The Seven Oaks Dam simulation results are used as a boundary inflow for the WLAM.

4.2.5 Prado Wetlands Operations

The nitrogen loss provided by the Prado wetlands was set to zero because the wetlands were built and funded by OCWD to provide treatment of Santa Ana River discharge above that provided by the POTWs that discharge to the River. The TDS increase caused by the Prado wetlands was included in the WLAM simulation by treating the Prado wetlands as a surface water reservoir.

4.2.6 Hidden Valley Wetlands Operations

The Hidden Valley Wetlands were used in the planning simulations for the City of Riverside's discharge of up to 10 mgd (Johannesson, 2008) for Scenarios 2, 3, 4, 5 and 6. TIN removal was assumed to be 5.3 mg/L-N for discharge routed through the wetlands. A TDS increase 7.6 mg/L was also assumed for water passing through the wetlands. The nitrogen decrease and TDS increase are the average increase and decrease in concentrations based on the City of Riverside's daily operational data, gathered at the wetlands from 1994 through 1999. These are the same assumptions applied in the 2003 WLAM.

4.2.7 Lake Elsinore Discharge

Historical outflow from Lake Elsinore could not be used in the WLAM planning simulations due to planned operational changes. Planned operations at Lake Elsinore will utilize a reduced storage capacity, causing more frequent discharge (outflow) from the Lake.

The EVMWD plans to discharge recycled water to the Lake, thereby operating the Lake at 1,240 feet mean sea level. For the WLAM simulations, Lake Elsinore discharges were estimated based on the HEC-5 simulations developed by Riverside County, which reflect planned operations.

WEI obtained the HEC-5 model output files and built a constantly stirred reactor model for TDS using the inflow, outflow, and storage data. A long-term volume-weighted average TDS concentration of 543 mg/L was estimated based on following assumptions:

- The initial conditions for TDS and TIN concentrations are 1,100 mg/L and 1 mg/L-N, respectively (Black & Veatch, 1994).
- Storm water inflow TDS and TIN concentrations of 180 mg/L and 1 mg/L-N, respectively (WEI, 2001).
- EVMWD wastewater discharge to the Lake equals their permit TDS limit of 700 mg/L.

Based on the County of Riverside HEC-5 model, there were five years (six instances) of significant discharge from Lake Elsinore. Table 4-6 lists the periods of discharge, the average discharge, the total discharge, and the calculated TDS concentration. The discharge periods listed in Table 4-6 were used as model inputs for the WLAM. These discharge periods used the volume-weighted average TDS concentration (543 mg/L) and a TIN concentration of 1 mg/L-N. The TIN concentration is based on the normal range of TIN for Lake Elsinore, 0.5 mg/L-N to 1.5 mg/L-N, and the Lake ambient TIN concentration limit of 1.5 mg/L-N (Black & Veatch, 1994). When outflow occurs after major runoff events, the storm water inflow significantly reduces the TIN prior to spilling.

4.2.8 Nitrogen Loss Rate in Streambed Recharge

For streambed recharge, a 25 percent reduction in TIN concentrations was assumed to occur, per the direction of the Task Force, in all reaches where percolation occurs except for the Chino South management zone where a 50 percent reduction was assumed. This assumption is consistent with the 2004 Basin Plan.

4.2.9 Chino Basin Facilities Improvement Program

The Chino Basin Facilities Improvements Program (CBFIP) is a joint project of the Chino Basin Watermaster, the CBWCD, the IEUA, and the SBCFCD. The objective of the CBFIP is to increase the recharge of storm, imported, and recycled water to the Chino Groundwater Basin. Under the CBFIP, improvements associated with the following basins were made: Victoria, San Sevaine, Banana, Hickory, Jurupa, RP3, Declez, Lower Day, 7th and 8th Street, Turner, College Heights, Upland, and Brooks. CBFIP construction was completed in December 2005. WEI obtained detailed information on the projects and incorporated this information into the WLAM.

4.2.10 San Timoteo Creek Project

The USACE and the SBCFCD constructed 18 debris basins along San Timoteo Creek between California Street and Cypress Way. Construction was completed in 2006. WEI obtained detailed information on this project and incorporated it into the WLAM.

4.3 Metrics Used to Evaluate the Wasteload Allocation Scenarios

In the 2003 WLAM evaluation, six metrics were developed based on surface water stream reaches and two locations along the Santa Ana River. For this investigation, the presentation of the metrics was modified slightly to provide better management information related to groundwater recharge from the surface water system. The modified presentation is based on groundwater management zone boundaries rather than surface water reaches. The evaluation statistics also changed from the average of the 1-year and 5-year volume-weighted averages to the maximum 1-year and 5-year volume-weighted averages. This new presentation is shown both in the tables and the improved time history charts.

4.4 Results of the Wasteload Allocation Simulations

Tables 4-7 and 4-8 summarize the estimated TDS and TIN concentration metrics for each point where metrics were evaluated for the 2001 Baseline and show the maximum volume-weighted TDS and TIN concentrations of surface water recharge for each groundwater management zone.

Appendices B through K contain detailed tabular and graphical results of the 2010 and 2020 conditions for each scenario. Moreover, the tables and figures in these appendices show the 50-year time series of discharge and associated volume-weighted TDS and TIN concentrations within each management zone and metric location. The contents of each appendix are listed below:

- Appendix B – Scenario 2, Year 2010 Simulation Results
- Appendix C – Scenario 2, Year 2020 Simulation Results
- Appendix D – Scenario 3, Year 2010 Simulation Results
- Appendix E – Scenario 3, Year 2020 Simulation Results
- Appendix F – Scenario 4, Year 2010 Simulation Results
- Appendix G – Scenario 4, Year 2020 Simulation Results
- Appendix H – Scenario 5, Year 2010 Simulation Results
- Appendix I – Scenario 5, Year 2020 Simulation Results
- Appendix J – Scenario 6, Year 2010 Simulation Results
- Appendix K – Scenario 6, Year 2020 Simulation Results

The specific results for each metric are provided below for each scenario. Unless otherwise noted, the volume-weighted average discussed is the maximum 5-year volume-weighted average over the 50-year simulation period. Tables 4-7 and 4-8 validate the current wasteload allocation for reaches and management zones where the maximum 1-yr and 5-yr volume-weighted average recharge does not exceed an objective. The occurrence of a projected 1-yr and/or 5-yr volume-weighted average recharge exceeding an objective in any one scenario does not mean that the current wasteload allocation is deficient for that scenario. The appendices contain projected time series of recharge and 1-yr and 5-yr metrics for each scenario. In some cases, the maximum 1-yr and 5-yr metrics exceed an objective for a few years in the 50-year simulation period (e.g. TDS in the Bunker Hill B management zone); in other cases, the exceedances are chronic (e.g. TIN in the Chino South management zone). In these latter cases, the Regional Board must use its discretion in evaluating the results presented herein to determine the need for a change in the wasteload allocation or to pursue some other regulatory approach.

4.4.1 Beaumont Management Zone

Portions of San Timoteo Creek and Coopers Creek overly the Beaumont management zone. The City of Beaumont discharges into Coopers Creek within the Beaumont management zone, and due to high groundwater, streambed recharge does not occur. The surface water discharge passes through the Beaumont management zone and into the San Timoteo management zone: no recycled water recharges within the Beaumont management zone.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for the Beaumont management zone. The water quality objectives for the Beaumont management zone are 330 mg/L for TDS and 5 mg/L-N for TIN. The maximum 1-year and 5-year volume-weighted streambed recharge concentrations for TDS and TIN were the same for all scenarios in the Beaumont management zone. As listed in Table 4-7 and 4-8, the 1-year and 5-year volume-weighted TDS concentrations are 166 mg/L and 124 mg/L for 2010 and 2020. The 1-year and 5-year volume-weighted TIN concentrations are 1.2 mg/L-N and 1.0 mg/L-N for 2010 and

2020. The 2004 Basin Plan water quality objectives for the Beaumont management zone were not exceeded; the existing wasteload allocation is acceptable for all scenarios.

4.4.2 San Timoteo Management Zone

The majority of the San Timoteo Creek system (Reach 2, Reach 3, and most of Reach 4) overlies the San Timoteo management zone, as shown in Figure 1-2. The San Timoteo management zone extends from the confluence of Coopers Creek and San Timoteo Creek to the downstream end of Reach 2 of San Timoteo Creek. Streambed recharge within this management zone consists of storm water and recycled water from the City of Beaumont and the YVWD. The City of Beaumont discharges recycled water to Coopers Creek, and the YVWD discharges recycled water to San Timoteo Creek at the upstream end of Reach 3. No portion of San Timoteo Creek is lined within the San Timoteo management zone.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for the San Timoteo management zone. A detailed annual summary of model results for each scenario has been included in Appendices A through K.

The maximum 1-year and 5-year volume-weighted streambed recharge concentration for TDS range between 436 mg/L and 465 mg/L for the 1-year compliance period and 388 mg/L and 457 mg/l for the 5-year compliance period. The maximum 1-year and 5-year volume-weighted TIN concentrations range between 3.7 mg/L-N and 3.9 mg/L-N for the 1-year compliance period and 3.3 mg/L-N and 3.7 mg/l-N for the 5-year compliance period. The water quality objectives for the San Timoteo management zone are 400 mg/L for TDS and 5 mg/L-N for TIN. In Scenarios 2, 3, 4, 5, and 6, the 5-year volume-weighted average TDS concentration exceeds the 2004 Basin Plan water quality objective. Currently, it is unknown whether there is assimilative capacity in this management zone due to insufficiencies in available data for computing current ambient TDS and TIN concentrations (WEI, 2008).

A review of the projected time series of recharge and the 1-yr TDS metrics for each scenario (illustrated graphically in the appendices) shows that the number of annual occurrences where the volume-weighed TDS concentration in recharge exceeds the objective is 26 times out of 50 (slightly greater than 50 percent) for all scenarios except Scenario 4, in which the number of exceedances is 34 out of 50. For 2020, the number of exceedances declines to 6 out of 50 for all scenarios except Scenario 4, in which the number of exceedances remains 34.

4.4.3 Bunker Hill B Management Zone

Reach 5 of the Santa Ana River and Reach 1 of San Timoteo Creek overlay the Bunker Hill B management zone, as shown on Figure 1-2. There are no POTW discharges to the Santa Ana River in this management zone except discharges from the Cities of Redlands and San Bernardino when the storm water discharge in the Santa Ana River is large and they are then permitted to divert recycled water directly to the Santa Ana River. For this investigation, these recycled water discharges were assumed to not occur. The water quality differences between the scenarios are dictated by changes in upstream discharges to San Timoteo Creek and the SBVMWD and WMWD diversion at Seven Oaks Dam on the Santa Ana River. San Timoteo Creek Reach 1 is lined for about 20,000 feet or about 80 percent of its length within the

Bunker Hill B management zone. With the exception of below its confluence with San Timoteo Creek, the Santa Ana River is dry unless there are storms or releases from the Seven Oaks Dam. Discharge in San Timoteo Creek is composed of infrequent storm water discharge, the continuous discharge of recycled water from the YVWD, and occasionally recycled water discharge from the City of Beaumont when storm water is present.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for the Bunker Hill B management zone. A detailed annual summary of model results for each scenario has been included in Appendices A through K.

The maximum 1-year and 5-year volume-weighted streambed recharge concentration for TDS range between 259 mg/L and 452 mg/L for the 1-year compliance period and 211 mg/L and 377 mg/l for the 5-year compliance period. The maximum 1-year and 5-year volume-weighted TIN concentrations range between 2.0 mg/L-N and 3.3 mg/L-N for the 1-year compliance period and 1.6 mg/L-N and 2.8 mg/L-N for the 5-year compliance period. The water quality objectives for the Bunker Hill B management zone are 330 mg/L for TDS and 7.3 mg/L-N for TIN. In Scenarios 2, 3, 4, 5, and 6, the 5-year volume-weighted average TDS concentration exceeds the 2004 Basin Plan water quality objective. There is a 50 mg/L of assimilative capacity for TDS and 1.9 mg/L-N of assimilative capacity for TIN in the Bunker Hill B management zone (WEI, 2008).

A review of the projected time series of recharge and 1-yr TDS metrics for each scenario (illustrated graphically in the appendices) shows that the number of annual occurrences where the volume-weighed TDS concentration in recharge exceeds the TDS objective ranges between 9 and 11 out of 50 (about 20 percent of the time) for all scenarios except Scenario 4, in which the number of exceedances is 29 out of 50. For 2020, the number of exceedances declines to zero out of 50 for all scenarios except Scenario 4, in which the number of exceedances is 10 out of 50. Inspection of the projected time series of recharge and the 1-yr and 5-yr TDS metrics clearly shows that the majority of the time the 1-yr and 5-yr TDS metrics are less than the TDS objective and that the volume of recharge is relatively small when the 1-yr and 5-yr TDS metrics exceed the TDS objective. Most of recharge occurs at TDS concentrations that are less than the TDS objective.

4.4.4 Colton Management Zone

The Colton management zone is shown in Figure 1-2. The Colton management zone is downstream of the San Jacinto Fault and upstream of the Rialto-Colton Fault. This area overlies the upper portion of Reach 4 of the Santa Ana River. There are no POTW discharges to the Santa Ana River in this management zone. The water quality differences between the scenarios are dictated by changes in upstream POTW discharges and the SBVMWD and WMWD diversion at Seven Oaks Dam. Outside of storm events or Seven Oaks Dam releases, discharge within the River is typically low to dry.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for the Colton management zone. A detailed annual summary of model results for each scenario has been included in Appendices A through K.

The maximum 1-year and 5-year volume-weighted streambed recharge concentration for TDS is 182 mg/L for the 1-year compliance period (all scenarios are the same) and ranges between 158 mg/L and 173 mg/l for the 5-year compliance period. The maximum 1-year and 5-year volume-weighted average TIN concentration is 1.4 mg/L-N for the 1- year compliance period (all scenarios are the same) and ranges 1.2 mg/L-N and 1.3 mg/L-N for the 5-year compliance period. The water quality objectives for the Colton management zone are 410 mg/L for TDS and 2.7 mg/L-N for TIN. The 2004 Basin Plan water quality objectives are not exceeded under any scenario. The existing wasteload allocation is adequate for the Colton management zone.

4.4.5 Riverside A Management Zone

The Riverside A management zone is shown in Figure 1-2. The Riverside A management zone is downstream of the Rialto-Colton Fault and the Colton management zone and upstream of the Riverside Narrows. This management zone contains the upper portion of Santa Ana River Reach 3 and the majority of Santa Ana River Reach 4. POTW dischargers within this management zone include the City of Rialto and the City San Bernardino/City of Colton RIX facility. The Santa Ana River is not lined within this management zone and is typically dry upstream of the Rialto and RIX discharge locations.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for the Riverside A management zone. A detailed annual summary of model results for each scenario has been included in Appendices A through K.

The maximum 1-year and 5-year volume-weighted streambed recharge concentrations for TDS range between 509 mg/L and 522 mg/L for the 1-year compliance period and 470 mg/L and 483 mg/l for the 5-year compliance period. The maximum 1-year and 5-year volume-weighted TIN concentrations range from 7.1 mg/L-N to 7.2 mg/L-N for the 1-year compliance period and 6.5 mg/L-N to 6.6 mg/L-N for the 5-year compliance period. The water quality objectives for the Riverside A management zone are 560 mg/L for TDS and 6.2 mg/L-N for TIN. In Scenarios 2, 3, 4, 5, and 6, the 5-year volume-weighted average TIN concentration exceeds the 2004 Basin Plan water quality objective. There is a 120 mg/L of assimilative capacity for TDS and 1.3 mg/L-N of assimilative capacity for TIN in the Riverside A management zone (WEI, 2008).

A review of the projected time series of recharge and the 1-yr TIN metrics (illustrated graphically in the appendices) for each scenario in 2010 shows that the number of annual occurrences where the volume-weighed TIN concentration in recharge exceeds the TIN objective is 22 times out of 50 (slightly less than half of the time) for all scenarios except Scenario 4, in which the number of exceedances is 26 out of 50. The same is true for 2020. Inspection of the projected time series of recharge and the 1-yr and 5-yr TIN metrics clearly shows that the most of the time the 1-yr and 5-yr TIN metrics are less than the TIN objective and that the volume of recharge is relatively small when the 1-yr and 5-yr TIN metrics exceed the TIN objective. Furthermore, the projected time series of recharge and 1-yr TIN metrics show that most of the recharge occurs at TIN concentrations that are less than the TIN objective.

4.4.6 Chino South Management Zone

The Chino South management zone is located downstream of the Riverside Narrows and upstream of the Prado management zone, as shown in Figure 1-2. This area contains most of Santa Ana River Reach 3. The only POTW discharger within this management zone is the City of Riverside, but recycled water discharge is typically continuous from the Riverside A management zone into Chino South. No portion of the Santa Ana River is lined within the Chino South management zone.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for each groundwater management zone. A detailed annual summary of model results for each scenario has been included in Appendices A through K.

The maximum 1-year and 5-year volume-weighted concentrations for TDS range between 638 mg/L and 678 mg/L for the 1-year compliance period and 618 mg/L and 655 mg/l for the 5-year compliance period. The maximum 1-year and 5-year volume-weighted TIN concentrations range between 4.8 mg/L-N and 5.0 mg/L-N for the 1-year compliance period and 4.6 mg/L-N and 4.8 mg/L-N for the 5-year compliance period. The water quality objectives for the Chino South management zone are 680 mg/L for TDS and 4.2 mg/L-N for TIN. In Scenarios 2, 3, 4, 5 and 6, the 5-year volume-weighted average TIN concentration exceeds the 2004 Basin Plan water quality objective. There is no assimilative capacity for TIN or TDS in the Chino South management zone (WEI, 2008).

A review of the projected time series of recharge and the 1-yr TIN metrics (illustrated graphically in the appendices) for each scenario in 2010 shows that the number of annual occurrences where the volume-weighed TIN concentration of recharge exceeds the TIN objective ranges between 38 to 40 times out of 50 (about 80 percent of the time). For 2020, the range is 39 to 40 times out of 50. Inspection of the projected time series of recharge and 1-yr TIN metrics shows that most of the recharge occurs at TIN concentrations that are greater than the TIN objective.

4.4.7 Santa Ana River below Prado Dam

Reach 2 of the Santa Ana River runs from 17th Street in Santa Ana to Prado Dam. The water quality objective for the Prado management zone is a surface water objective. The compliance point for this surface water objective is measured at the Santa Ana River USGS gaging station located immediately downstream of Prado Dam. Under current and future conditions, the Santa Ana River discharges continuously from Prado Dam to the OCWD diversion works and spreading facilities upstream of 17th Street. No recycled water is discharged directly into Reach 2. Wasteload allocations developed prior to the 2004 Basin Plan Amendment aimed to protect beneficial uses in Orange County by setting TDS and TIN concentration limits for upstream POTW dischargers such that TDS and TIN concentrations of 700 mg/L and 10 mg/L-N, respectively, were met at Prado Dam during the period of lowest discharge (typically August). The Basin Plan contains a five-year, volume-weighted TDS objective for Reach 2 of 650 mg/L that must also be met to protect the beneficial uses of groundwater in Orange County.

Tables 4-7 and 4-8 summarize the results of each modeling scenario for each groundwater management zone. A detailed annual summary of model results for each scenario has been included in Appendices A through K.

The maximum August only volume-weighted streambed recharge concentration is 665 mg/L for TDS and 8.6 mg/L-N for TIN. The maximum 5-year volume-weighted streambed recharge TDS and TIN concentrations below Prado Dam are 567 mg/L and 7.5 mg/L-N, respectively. The August only TDS and TIN water quality objectives for Santa Ana River below Prado Dam are 700 mg/L and 10 mg/L-N, respectively. As stated above, the surface water quality objective for below Prado Dam is a 5-year volume-weighted average of 650 mg/L for TDS (there is no objective for TIN). The 2004 Basin Plan water quality objectives were not exceeded. The existing wasteload allocation is acceptable for all scenarios.

4.5 Summary

Figures 4-1 and 4-2 show the 5-year volume-weighted average concentrations for TDS and TIN for all scenarios in 2010 below Prado Dam. The following conclusions can be drawn from Figures 4-1 and 4-2, Tables 4-7 and 4-8, and the data tables in Appendices B through K:

- Scenario 2 - Worst Case POTW Discharge with the Seven Oaks Diversion: this scenario brackets (has the highest estimated TDS and TIN concentrations) all scenarios except Scenario 4 (the maximum mass discharge).
- Based on estimated TDS and TIN concentrations for the August only, 1-year volume-weighted average, and 5-year volume-weighted average compliance periods, there is little difference between Scenario 2 (Worst Case POTW Discharge with the Seven Oaks Diversion) and Scenario 3 (Worst Case POTW Discharge without the Seven Oaks Diversion).
- Scenario 4 – Maximum Mass Discharge: this scenario results in the highest 1-year and 5-year volume-weighted TDS and TIN concentrations.
- Based on estimated TDS and TIN concentrations for the August only, 1-year volume-weighted average, and 5-year volume-weighted average compliance periods, there is little difference between Scenario 5 (Planned Discharge) and Scenario 6 (Planned Discharge with Additional Discharge Point and Increased TDS Permit Condition).
- The following management zones have TDS or TIN metrics for streambed recharge that exceed Basin Plan objectives and have assimilative capacity:
  - Bunker Hill B management zone – TDS
  - Riverside A management zone – TIN
- In all modeled scenarios, the TIN concentration of Santa Ana River streambed recharge exceeds the Chino South management zone TIN objective. There is no assimilative capacity for TIN in the Chino South management zone.

Table 4-1
Wasteload Allocation Model, Scenario 2 Conditions

Agency	Year	Design Capacity (MGD)	Permit Discharge (MGD)	Permit TDS (mg/L)	Permit TIN (mg/L)	2008 Projected Plant Discharge (MGD)	2008 Projected Recycling (MGD)	2008 Projected Discharge to SAR (MGD)	2007 Actual Recycled Water (MGD)	2010-A or 1995 BP Recycling (MGD)	2010-B or 2001 BP Recycling (MGD)	Scenario 2 - Max TDS with Diversion: TDS (mg/L)	TIN (mg/L)	Projected Recycling (MGD)	Discharge to Santa Ana River (MGD)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	= (3)	= (4)	= (6) or (8)	(13)
San Timoteo Creek															
City of Beaumont[A]	2010	4.0	4.0	490	6	3.0	0.0	3.0	NA	0.2	1.3	490	6	0.0	3.0
Wastewater Treatment Plant #1	2020	4.0	NA	490	6	6.1	4.3	1.8				490	6	4.3	1.8
Yucaipa Valley Water District[B]	2010	6.7	4.5	540	6	6.6	0.0	6.6	NA	0.0	5.7	540	6	0.0	6.6
H. N. Wochholz WTP	2020	11.0	NA	540	6	8.2	7.3	0.9				540	6	7.3	0.9
Santa Ana River Reach 4															
City of Rialto[C]	2010	11.7	11.7	490	10	9.0	0.4	8.6	NA	0.2	Combined with RIX	490	10	0.4	8.6
Rialto Wastewater Treatment Plant	2020	11.7	NA	490	10	12.0	2.4	9.6				490	10	2.4	9.6
San Bernardino/Colton[D]	2010	40.0	64.0	550	10	30.0	16.0	14.0	NA	0.1	23.5	550	10	16.0	14.0
RIX Facility	2020	40.0	NA	550	10	30.0	16.0	14.0				550	10	16.0	14.0
Santa Ana River Reach 3															
City of Riverside[E]	2010	40.0	40.0	650	13<38 MGD 10>38 MGD	40.0	1.5	38.5	0.2	0.0	0.0	650	12.86	0.2	39.8
Regional Water Quality Control Plant	2020	52.2	NA	650	13<38 MGD 10>38 MGD	50.0	8.9	41.1				650	12.29	0.2	49.8
Chino Creek/Cucamonga Creek/Prado Basin															
Inland Empire Utilities Agency[F]	2010	44.0	44.0	550	8	34.0	13.0	21.0	NA	1.7	42.9	550	8	13.0	21.0
RP1 001 Prado	2020	44.0	NA	550	8	36.0	23.0	13.0				550	8	23.0	13.0
Inland Empire Utilities Agency[F]	2010	11.0	9.7	550	8	10.0	7.0	3.0	NA	NA		550	8	7.0	3.0
Carbon Canyon WRP	2020	12.0	NA	550	8	12.0	9.0	3.0				550	8	9.0	3.0
Inland Empire Utilities Agency[F]	2010	15.0	15.0	550	8	12.0	4.0	8.0	NA	NA		550	8	4.0	8.0
RP-5	2020	24.0	NA	550	8	24.0	10.0	14.0				550	8	10.0	14.0
Inland Empire Utilities Agency[F]	2010	14.0	14.0	550	8	14.0	12.0	2.0	NA	4.5		550	8	12.0	2.0
RP1 002 Cucamonga and RP 4	2020	14.0	NA	550	8	14.0	12.0	2.0				550	8	12.0	2.0
Western Riverside Count[G]	2010	8.0	8.0	625	10	7.2	1.0	6.2	0.0	0.0	0.0	625	10	0.0	8.0
Regional Wastewater Authority WTP	2020	14.0	NA	625	10	11.6	2.0	9.6				625	10	0.0	11.6
Temescal Creek															
City of Corona[H]	2010	11.5	9.0	700	10	9.2	7.7	1.5	0.8	0.9	2.8	700	10	0.8	8.4
Wastewater Treatment Plant #1	2020	14.5	NA	700	10	11.6	10.1	1.5				700	10	0.8	10.8
City of Corona[H]	2010	-	-	-	-	-	-	-	NA			-	-	-	-
Wastewater Treatment Plant #2	2020	-	-	-	-	-	-	-				-	-	-	-
City of Corona[H]	2010	1.0	1.0	700	10	0.5	0.5	0.0	0.3			700	10	0.3	0.7
Wastewater Treatment Plant #3	2020	1.0	NA	700	10	0.8	0.8	0.0				700	10	0.3	0.7
Lee Lake Water District[H]	2010	2.3	1.6	650	13	0.9	0.6	0.2	0.4	0.0	0.0	650	13	0.4	1.2
Wastewater Treatment Plant	2020	2.3	NA	650	13	1.2	0.9	0.4				650	13	0.4	1.2
Elsinore Valley Municipal Water District[I]	2010	8.0	8.0	700	13	7.1	7.1	0.0	1.2	0.0	0.0	700	13	1.2	6.8
Regional WWRP	2020	12.0	NA	700	13	11.1	11.1	0.0				700	13	1.2	9.9
Eastern Municipal Water District[J]	2010	52.1	52.5	650	10	56.2	42.4	62*	29.2	0.0	0.0	650	10	29.2	27.0
(all treatment plants combined)	2020	77.3	NA	650	10	71.2	49.4	72*				650	10	29.2	42.0

References:
A - Joe Reichenberger, Beaumont Cherry Valley Water District
B - Jack Nelson, Yucaipa Valley Water District
C - William Hunt, Consultant to the City of Rialto
D - John Claus, City of San Bernardino
E - Chandra Johannesson, City of Riverside
F - LeAnne Hamilton - Inland Empire Utilities Agency
G - Linda Garcia, Western Municipal Water District
H - SAWPA OWOW Recycled Water Pillar Draft Document
I - Phil Miller - Elsinore Valley Municipal Water District
J - Jayne Joy - Eastern Municipal Water District (rate applied for 6 months (Oct-Mar))

Table 4-2
Wasteload Allocation Model, Scenario 3 Conditions

Agency	Year	Design Capacity (MGD)	Permit Discharge (MGD)	Permit TDS (mg/L)	Permit TIN (mg/L)	2008 Projected Plant Discharge (MGD)	2008 Projected Recycling (MGD)	2008 Projected Discharge to SAR (MGD)	2007 Actual Recycled Water (MGD)	2010-A or 1995 BP Recycling (MGD)	2010-B or 2001 BP Recycling (MGD)	Scenario 3 - Max TDS w/o Diversion: TDS (mg/L)	TIN (mg/L)	Projected Recycling (MGD)	Discharge to Santa Ana River (MGD)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	= (3)	= (4)	= (6) or (8)	(14)
San Timoteo Creek															
City of Beaumont[A]	2010	4.0	4.0	490	6	3.0	0.0	3.0	NA	0.2	1.3	490	6	0.0	3.0
Wastewater Treatment Plant #1	2020	4.0	NA	490	6	6.1	4.3	1.8				490	6	4.3	1.8
Yucaipa Valley Water District[B]	2010	6.7	4.5	540	6	6.6	0.0	6.6	NA	0.0	5.7	540	6	0.0	6.6
H. N. Wochholz WTP	2020	11.0	NA	540	6	8.2	7.3	0.9				540	6	7.3	0.9
Santa Ana River Reach 4															
City of Rialto[C]	2010	11.7	11.7	490	10	9.0	0.4	8.6	NA	0.2	Combined with RIX	490	10	0.4	8.6
Rialto Wastewater Treatment Plant	2020	11.7	NA	490	10	12.0	2.4	9.6				490	10	2.4	9.6
San Bernardino/Colton[D]	2010	40.0	64.0	550	10	30.0	16.0	14.0	NA	0.1	23.5	550	10	16.0	14.0
RIX Facility	2020	40.0	NA	550	10	30.0	16.0	14.0				550	10	16.0	14.0
Santa Ana River Reach 3															
City of Riverside[E]	2010	40.0	40.0	650	13<38 MGD 10>38 MGD	40.0	1.5	38.5	0.2	0.0	0.0	650	12.86	0.2	39.8
Regional Water Quality Control Plant	2020	52.2	NA	650	13<38 MGD 10>38 MGD	50.0	8.9	41.1				650	12.29	0.2	49.8
Chino Creek/Cucamonga Creek/Prado Basin															
Inland Empire Utilities Agency[F]	2010	44.0	44.0	550	8	34.0	13.0	21.0	NA	1.7	42.9	550	8	13.0	21.0
RP1 001 Prado	2020	44.0	NA	550	8	36.0	23.0	13.0				550	8	23.0	13.0
Inland Empire Utilities Agency[F]	2010	11.0	9.7	550	8	10.0	7.0	3.0	NA	NA		550	8	7.0	3.0
Carbon Canyon WRP	2020	12.0	NA	550	8	12.0	9.0	3.0				550	8	9.0	3.0
Inland Empire Utilities Agency[F]	2010	15.0	15.0	550	8	12.0	4.0	8.0	NA	NA		550	8	4.0	8.0
RP-5	2020	24.0	NA	550	8	24.0	10.0	14.0				550	8	10.0	14.0
Inland Empire Utilities Agency[F]	2010	14.0	14.0	550	8	14.0	12.0	2.0	NA	4.5		550	8	12.0	2.0
RP1 002 Cucamonga and RP 4	2020	14.0	NA	550	8	14.0	12.0	2.0				550	8	12.0	2.0
Western Riverside Count[G]	2010	8.0	8.0	625	10	7.2	1.0	6.2	0.0	0.0	0.0	625	10	0.0	8.0
Regional Wastewater Authority WTP	2020	14.0	NA	625	10	11.6	2.0	9.6				625	10	0.0	11.6
Temescal Creek															
City of Corona[H]	2010	11.5	9.0	700	10	9.2	7.7	1.5	0.8	0.9	2.8	700	10	0.8	8.4
Wastewater Treatment Plant #1	2020	14.5	NA	700	10	11.6	10.1	1.5				700	10	0.8	10.8
City of Corona[H]	2010	-	-	-	-	-	-	-	NA			-	-	-	-
Wastewater Treatment Plant #2	2020	-	-	-	-	-	-	-				-	-	-	-
City of Corona[H]	2010	1.0	1.0	700	10	0.5	0.5	0.0	0.3			700	10	0.3	0.7
Wastewater Treatment Plant #3	2020	1.0	NA	700	10	0.8	0.8	0.0				700	10	0.3	0.7
Lee Lake Water District[H]	2010	2.3	1.6	650	13	0.9	0.6	0.2	0.4	0.0	0.0	650	13	0.4	1.2
Wastewater Treatment Plant	2020	2.3	NA	650	13	1.2	0.9	0.4				650	13	0.4	1.2
Elsinore Valley Municipal Water District[I]	2010	8.0	8.0	700	13	7.1	7.1	0.0	1.2	0.0	0.0	700	13	1.2	6.8
Regional WWRP	2020	12.0	NA	700	13	11.1	11.1	0.0				700	13	1.2	9.9
Eastern Municipal Water District[J]	2010	52.1	52.5	650	10	56.2	42.4	62*	29.2	0.0	0.0	650	10	29.2	27.0
(all treatment plants combined)	2020	77.3	NA	650	10	71.2	49.4	72*				650	10	29.2	42.0

References:
A - Joe Reichenberger, Beaumont Cherry Valley Water District
B - Jack Nelson, Yucaipa Valley Water District
C - William Hunt, Consultant to the City of Rialto
D - John Claus, City of San Bernardino
E - Chandra Johannesson, City of Riverside
F - LeAnne Hamilton - Inland Empire Utilities Agency
G - Linda Garcia, Western Municipal Water District
H - SAWPA OWOW Recycled Water Pillar Draft Document
I - Phil Miller - Elsinore Valley Municipal Water District
J - Jayne Joy - Eastern Municipal Water District (rate applied for 6 months (Oct-Mar))

Table 4-3
Wasteload Allocation Model, Scenario 4 Conditions

Agency	Year	Design Capacity (MGD)	Permit Discharge (MGD)	Permit TDS (mg/L)	Permit TIN (mg/L)	2008 Projected Plant Discharge (MGD)	2008 Projected Recycling (MGD)	2008 Projected Discharge to SAR (MGD)	2007 Actual Recycled Water (MGD)	2010-A or 1995 BP Recycling (MGD)	2010-B or 2001 BP Recycling (MGD)	Scenario 4 - Plant Capacity Discharge: TDS (mg/L)	Scenario 4 - Plant Capacity Discharge: TIN (mg/L)	Scenario 4 - Plant Capacity Discharge: Projected Recycling (MGD)	Scenario 4 - Plant Capacity Discharge: Discharge to Santa Ana River (MGD)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	= (3)	= (4)	(15)	= (1)
San Timoteo Creek															
City of Beaumont[A]	2010	4.0	4.0	490	6	3.0	0.0	3.0	NA	0.2	1.3	490	6	0.0	4.0
Wastewater Treatment Plant #1	2020	4.0	NA	490	6	6.1	4.3	1.8				490	6	0.0	4.0
Yucaipa Valley Water District[B]	2010	6.7	4.5	540	6	6.6	0.0	6.6	NA	0.0	5.7	540	6	0.0	6.7
H. N. Wochholz WTP	2020	11.0	NA	540	6	8.2	7.3	0.9				540	6	0.0	11.0
Santa Ana River Reach 4															
City of Rialto[C]	2010	11.7	11.7	490	10	9.0	0.4	8.6	NA	0.2	Combined with RIX	490	10	0.0	11.7
Rialto Wastewater Treatment Plant	2020	11.7	NA	490	10	12.0	2.4	9.6				490	10	0.0	11.7
San Bernardino/Colton[D]	2010	40.0	64.0	550	10	30.0	16.0	14.0	NA	0.1	23.5	550	10	0.0	40.0
RIX Facility	2020	40.0	NA	550	10	30.0	16.0	14.0				550	10	0.0	40.0
Santa Ana River Reach 3															
City of Riverside[E]	2010	40.0	40.0	650	13<38 MGD 10>38 MGD	40.0	1.5	38.5	0.2	0.0	0.0	650	12.85	0.0	40.0
Regional Water Quality Control Plant	2020	52.2	NA	650	13<38 MGD 10>38 MGD	50.0	8.9	41.1				650	12.2	0.0	52.2
Chino Creek/Cucamonga Creek/Prado Basin															
Inland Empire Utilities Agency[F]	2010	44.0	44.0	550	8	34.0	13.0	21.0	NA	1.7	42.9	550	8	0.0	44.0
RP1 001 Prado	2020	44.0	NA	550	8	36.0	23.0	13.0				550	8	0.0	44.0
Inland Empire Utilities Agency[F]	2010	11.0	9.7	550	8	10.0	7.0	3.0	NA	NA		550	8	0.0	11.0
Carbon Canyon WRP	2020	12.0	NA	550	8	12.0	9.0	3.0				550	8	0.0	12.0
Inland Empire Utilities Agency[F]	2010	15.0	15.0	550	8	12.0	4.0	8.0	NA	NA		550	8	0.0	15.0
RP-5	2020	24.0	NA	550	8	24.0	10.0	14.0				550	8	0.0	24.0
Inland Empire Utilities Agency[F]	2010	14.0	14.0	550	8	14.0	12.0	2.0	NA	4.5		550	8	0.0	14.0
RP1 002 Cucamonga and RP 4	2020	14.0	NA	550	8	14.0	12.0	2.0				550	8	0.0	14.0
Western Riverside Count[G]	2010	8.0	8.0	625	10	7.2	1.0	6.2	0.0	0.0	0.0	625	10	0.0	8.0
Regional Wastewater Authority WTP	2020	14.0	NA	625	10	11.6	2.0	9.6				625	10	0.0	14.0
Temescal Creek															
City of Corona[H]	2010	11.5	9.0	700	10	9.2	7.7	1.5	0.8	0.9	2.8	700	10	0.0	11.5
Wastewater Treatment Plant #1	2020	14.5	NA	700	10	11.6	10.1	1.5				700	10	0.0	14.5
City of Corona[H]	2010	-	-	-	-	-	-	-	NA			-	-	-	-
Wastewater Treatment Plant #2	2020	-	-	-	-	-	-	-				-	-	-	-
City of Corona[H]	2010	1.0	1.0	700	10	0.5	0.5	0.0	0.3			700	10	0.0	1.0
Wastewater Treatment Plant #3	2020	1.0	NA	700	10	0.8	0.8	0.0				700	10	0.0	1.0
Lee Lake Water District[H]	2010	2.3	1.6	650	13	0.9	0.6	0.2	0.4	0.0	0.0	650	13	0.0	2.3
Wastewater Treatment Plant	2020	2.3	NA	650	13	1.2	0.9	0.4				650	13	0.0	2.3
Elsinore Valley Municipal Water District[I]	2010	8.0	8.0	700	13	7.1	7.1	0.0	1.2	0.0	0.0	700	13	0.0	8.0
Regional WWRP	2020	12.0	NA	700	13	11.1	11.1	0.0				700	13	0.0	12.0
Eastern Municipal Water District[J]	2010	52.1	52.5	650	10	56.2	42.4	62*	29.2	0.0	0.0	650	10	0.0	52.1
(all treatment plants combined)	2020	77.3	NA	650	10	71.2	49.4	72*				650	10	0.0	77.3

References:
A - Joe Reichenberger, Beaumont Cherry Valley Water District
B - Jack Nelson, Yucaipa Valley Water District
C - William Hunt, Consultant to the City of Rialto
D - John Claus, City of San Bernardino
E - Chandra Johannesson, City of Riverside
F - LeAnne Hamilton - Inland Empire Utilities Agency
G - Linda Garcia, Western Municipal Water District
H - SAWPA OWOW Recycled Water Pillar Draft Document
I - Phil Miller - Elsinore Valley Municipal Water District
J - Jayne Joy - Eastern Municipal Water District (rate applied for 6 months (Oct-Mar))

Table 4-4
Wasteload Allocation Model, Scenario 5 Conditions

Agency	Year	Design Capacity (MGD)	Permit Discharge (MGD)	Permit TDS (mg/L)	Permit TIN (mg/L)	2008 Projected Plant Discharge (MGD)	2008 Projected Recycling (MGD)	2008 Projected Discharge to SAR (MGD)	2007 Actual Recycled Water (MGD)	2010-A or 1995 BP Recycling (MGD)	2010-B or 2001 BP Recycling (MGD)	Scenario 5 - Planned Water Recycling: TDS (mg/L)	Scenario 5 - Planned Water Recycling: TIN (mg/L)	Scenario 5 - Planned Water Recycling: Projected Recycling (MGD)	Scenario 5 - Planned Water Recycling: Discharge to Santa Ana River (MGD)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(7)	(9)	(10)	= (3)	= (4)	= (6)	= (5) - (6)
San Timoteo Creek															
City of Beaumont[A]	2010	4.0	4.0	490	6	3.0	0.0	3.0	NA	0.2	1.3	490	6	0.0	3.0
Wastewater Treatment Plant #1	2020	4.0	NA	490	6	6.1	4.3	1.8				490	6	4.3	1.8
Yucaipa Valley Water District[B]	2010	6.7	4.5	540	6	6.6	0.0	6.6	NA	0.0	5.7	540	6	0.0	6.6
H. N. Wochholz WTP	2020	11.0	NA	540	6	8.2	7.3	0.9				540	6	7.3	0.9
Santa Ana River Reach 4															
City of Rialto[C]	2010	11.7	11.7	490	10	9.0	0.4	8.6	NA	0.2	Combined with RIX	490	10	0.4	8.6
Rialto Wastewater Treatment Plant	2020	11.7	NA	490	10	12.0	2.4	9.6				490	10	2.4	9.6
San Bernardino/Colton[D]	2010	40.0	64.0	550	10	30.0	16.0	14.0	NA	0.1	23.5	550	10	16.0	14.0
RIX Facility	2020	40.0	NA	550	10	30.0	16.0	14.0				550	10	16.0	14.0
Santa Ana River Reach 3															
City of Riverside[E]	2010	40.0	40.0	650	13<38 MGD 10>38 MGD	40.0	1.5	38.5	0.2	0.0	0.0	650	13<38 MGD 10>38 MGD	1.5	38.5
Regional Water Quality Control Plant	2020	52.2	NA	650	13<38 MGD 10>38 MGD	50.0	8.9	41.1				650	13<38 MGD 10>38 MGD	8.9	41.1
Chino Creek/Cucamonga Creek/Prado Basin															
Inland Empire Utilities Agency[F]	2010	44.0	44.0	550	8	34.0	13.0	21.0	NA	1.7	42.9	550	8	13.0	21.0
RP1 001 Prado	2020	44.0	NA	550	8	36.0	23.0	13.0				550	8	23.0	13.0
Inland Empire Utilities Agency[F]	2010	11.0	9.7	550	8	10.0	7.0	3.0	NA	NA		550	8	7.0	3.0
Carbon Canyon WRP	2020	12.0	NA	550	8	12.0	9.0	3.0				550	8	9.0	3.0
Inland Empire Utilities Agency[F]	2010	15.0	15.0	550	8	12.0	4.0	8.0	NA	NA		550	8	4.0	8.0
RP-5	2020	24.0	NA	550	8	24.0	10.0	14.0				550	8	10.0	14.0
Inland Empire Utilities Agency[F]	2010	14.0	14.0	550	8	14.0	12.0	2.0	NA	4.5		550	8	12.0	2.0
RP1 002 Cucamonga and RP 4	2020	14.0	NA	550	8	14.0	12.0	2.0				550	8	12.0	2.0
Western Riverside Count[G]	2010	8.0	8.0	625	10	7.2	1.0	6.2	0.0	0.0	0.0	625	10	1.0	6.2
Regional Wastewater Authority WTP	2020	14.0	NA	625	10	11.6	2.0	9.6				625	10	2.0	9.6
Temescal Creek															
City of Corona[H]	2010	11.5	9.0	700	10	9.2	7.7	1.5	0.8	0.9	2.8	700	10	7.7	1.5
Wastewater Treatment Plant #1	2020	14.5	NA	700	10	11.6	10.1	1.5				700	10	10.1	1.5
City of Corona[H]	2010	-	-	-	-	-	-	-	NA			-	-	-	0.0
Wastewater Treatment Plant #2	2020	-	-	-	-	-	-	-				-	-	-	0.0
City of Corona[H]	2010	1.0	1.0	700	10	0.5	0.5	0.0	0.3			700	10	0.5	0.0
Wastewater Treatment Plant #3	2020	1.0	NA	700	10	0.8	0.8	0.0				700	10	0.8	0.0
Lee Lake Water District[H]	2010	2.3	1.6	650	13	0.9	0.6	0.2	0.4	0.0	0.0	650	13	0.6	0.2
Wastewater Treatment Plant	2020	2.3	NA	650	13	1.2	0.9	0.4				650	13	0.9	0.4
Elsinore Valley Municipal Water District[I]	2010	8.0	8.0	700	13	7.1	7.1	0.0	1.2	0.0	0.0	700	13	7.1	0.0
Regional WWRP	2020	12.0	NA	700	13	11.1	11.1	0.0				700	13	11.1	0.0
Eastern Municipal Water District[J]	2010	52.1	52.5	650	10	56.2	42.4	62*	29.2	0.0	0.0	650	10	42.4	13.8
(all treatment plants combined)	2020	77.3	NA	650	10	71.2	49.4	72*				650	10	49.4	21.8

References:
A - Joe Reichenberger, Beaumont Cherry Valley Water District
B - Jack Nelson, Yucaipa Valley Water District
C - William Hunt, Consultant to the City of Rialto
D - John Claus, City of San Bernardino
E - Chandra Johannesson, City of Riverside
F - LeAnne Hamilton - Inland Empire Utilities Agency
G - Linda Garcia, Western Municipal Water District
H - SAWPA OWOW Recycled Water Pillar Draft Document
I - Phil Miller - Elsinore Valley Municipal Water District
J - Jayne Joy - Eastern Municipal Water District (rate applied for 6 months (Oct-Mar))

Table 4-5
Wasteload Allocation Model, Scenario 6 Conditions

Agency	Year	Design Capacity (MGD)	Permit Discharge (MGD)	Permit TDS (mg/L)	Permit TIN (mg/L)	2008 Projected Plant Discharge (MGD)	2008 Projected Recycling (MGD)	2008 Projected Discharge to SAR (MGD)	2007 Actual Recycled Water (MGD)	2010-A or 1995 BP Recycling (MGD)	2010-B or 2001 BP Recycling (MGD)	Scenario 6 - Planned Water Recycling: TDS (mg/L)	TIN (mg/L)	Projected Recycling (MGD)	Discharge to Santa Ana River (MGD)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(7)	(9)	(10)	= (3)	= (4)	= (6)	= (5) - (6)
San Timoteo Creek															
City of Beaumont[A]	2010	4.0	4.0	490	6	3.0	0.0	3.0	NA	0.2	1.3	490	6	0.0	3.0
Wastewater Treatment Plant #1	2020	4.0	NA	490	6	6.1	4.3	1.8				490	6	4.3	1.8
Yucaipa Valley Water District[B]	2010	6.7	4.5	540	6	6.6	0.0	6.6	NA	0.0	5.7	540	6	0.0	6.6
H. N. Wochholz WTP	2020	11.0	NA	540	6	8.2	7.3	0.9				540	6	7.3	0.9
Santa Ana River Reach 4															
City of Rialto[C]	2010	11.7	11.7	490	10	9.0	0.4	8.6	NA	0.2	Combined with RIX	490	10	0.4	8.6
Rialto Wastewater Treatment Plant	2020	11.7	NA	490	10	12.0	2.4	9.6				490	10	2.4	9.6
San Bernardino/Colton[D]	2010	40.0	64.0	550	10	30.0	16.0	14.0	NA	0.1	23.5	550	10	16.0	14.0
RIX Facility	2020	40.0	NA	550	10	30.0	16.0	14.0				550	10	16.0	14.0
Santa Ana River Reach 3															
City of Riverside[E]	2010	40.0	40.0	650	13<38 MGD 10>38 MGD	40.0	1.5	38.5	0.2	0.0	0.0	650	13<38 MGD 10>38 MGD	1.5	38.5
Regional Water Quality Control Plant	2020	52.2	NA	650	13<38 MGD 10>38 MGD	50.0	8.9	41.1				650	13<38 MGD 10>38 MGD	8.9	41.1
Western Municipal Water District[G]	2010	3.0	NA	550	6	3.0	0.7	2.3	NA	NA	NA	550	6	0.7	2.3
March Wastewater Reclamation Facility	2020	5.0	NA	550	6	5.0	0.7	4.3				550	6	0.7	4.3
Chino Creek/Cucamonga Creek/Prado Basin															
Inland Empire Utilities Agency[F]	2010	44.0	44.0	550	8	34.0	13.0	21.0	NA	1.7	42.9	550	8	13.0	21.0
RP1 001 Prado	2020	44.0	NA	550	8	36.0	23.0	13.0				550	8	23.0	13.0
Inland Empire Utilities Agency[F]	2010	11.0	9.7	550	8	10.0	7.0	3.0	NA	NA		550	8	7.0	3.0
Carbon Canyon WRP	2020	12.0	NA	550	8	12.0	9.0	3.0				550	8	9.0	3.0
Inland Empire Utilities Agency[F]	2010	15.0	15.0	550	8	12.0	4.0	8.0	NA	NA		550	8	4.0	8.0
RP-5	2020	24.0	NA	550	8	24.0	10.0	14.0				550	8	10.0	14.0
Inland Empire Utilities Agency[F]	2010	14.0	14.0	550	8	14.0	12.0	2.0	NA	4.5		550	8	12.0	2.0
RP1 002 Cucamonga and RP 4	2020	14.0	NA	550	8	14.0	12.0	2.0				550	8	12.0	2.0
Western Riverside Count[G]	2010	8.0	8.0	625	10	7.2	1.0	6.2	0.0	0.0	0.0	625	10	1.0	6.2
Regional Wastewater Authority WTP	2020	14.0	NA	625	10	11.6	2.0	9.6				625	10	2.0	9.6
Temescal Creek															
City of Corona[H]	2010	11.5	9.0	700	10	9.2	7.7	1.5	0.8	0.9	2.8	700	10	7.7	1.5
Wastewater Treatment Plant #1	2020	14.5	NA	700	10	11.6	10.1	1.5				700	10	10.1	1.5
City of Corona[H]	2010	-	-	-	-	-	-	-	NA			-	-	-	0.0
Wastewater Treatment Plant #2	2020	-	-	-	-	-	-	-				-	-	-	0.0
City of Corona[H]	2010	1.0	1.0	700	10	0.5	0.5	0.0	0.3			700	10	0.5	0.0
Wastewater Treatment Plant #3	2020	1.0	NA	700	10	0.8	0.8	0.0				700	10	0.8	0.0
Lee Lake Water District[H]	2010	2.3	1.6	650	13	0.9	0.6	0.2	0.4	0.0	0.0	650	13	0.6	0.2
Wastewater Treatment Plant	2020	2.3	NA	650	13	1.2	0.9	0.4				650	13	0.9	0.4
Elsinore Valley Municipal Water District[I]	2010	8.0	8.0	700	13	7.1	7.1	0.0	1.2	0.0	0.0	700	13	7.1	0.0
Regional WWRP	2020	12.0	NA	700	13	11.1	11.1	0.0				700	13	11.1	0.0
Eastern Municipal Water District[J]	2010	52.1	52.5	650	10	56.2	42.4	62*	29.2	0.0	0.0	700	10	42.4	13.8
(all treatment plants combined)	2020	77.3	NA	650	10	71.2	49.4	72*				700	10	49.4	21.8

References:

A - Joe Reichenberger, Beaumont Cherry Valley Water District
B - Jack Nelson, Yucaipa Valley Water District
C - William Hunt, Consultant to the City of Rialto
D - John Claus, City of San Bernardino
E - Chandra Johannesson, City of Riverside
F - LeAnne Hamilton - Inland Empire Utilities Agency
G - Linda Garcia, Western Municipal Water District (rate applied for 5 months (Nov-Mar))
H - SAWPA OWOW Recycled Water Pillar Draft Document
I - Phil Miller - Elsinore Valley Municipal Water District
J - Jayne Joy - Eastern Municipal Water District (rate applied for 6 months (Oct-Mar))

Table 4-6
Modeled Lake Elsinore Discharge and
Water Quailty during Periods of Outflow

Period of Overflow[1]		Days	Average Flow (cfs)	Total Flow (acre-ft)	Average TDS (mg/L)
From	To				
3/3/69	5/31/69	90	34	6,107	617
2/3/79	7/8/79	156	22	10,312	624
2/14/80	3/9/80	25	583	28,841	575
3/20/80	8/2/80	136	120	32,402	465
3/4/83	8/31/83	181	93	33,217	674
1/29/93	7/20/93	173	141	48,326	441
				Arithmetic Average	566
				Volume Weighted Average	537

1. Period of overflow estimated with County of Riverside HEC-5 model.

Table 4-7
Comparison of Estimated Metrics for Scenario 2, 3, 4, 5, and 6 Model Runs and Corresponding TDS Objectives for Management Zones Impacted by Streambed Recharge

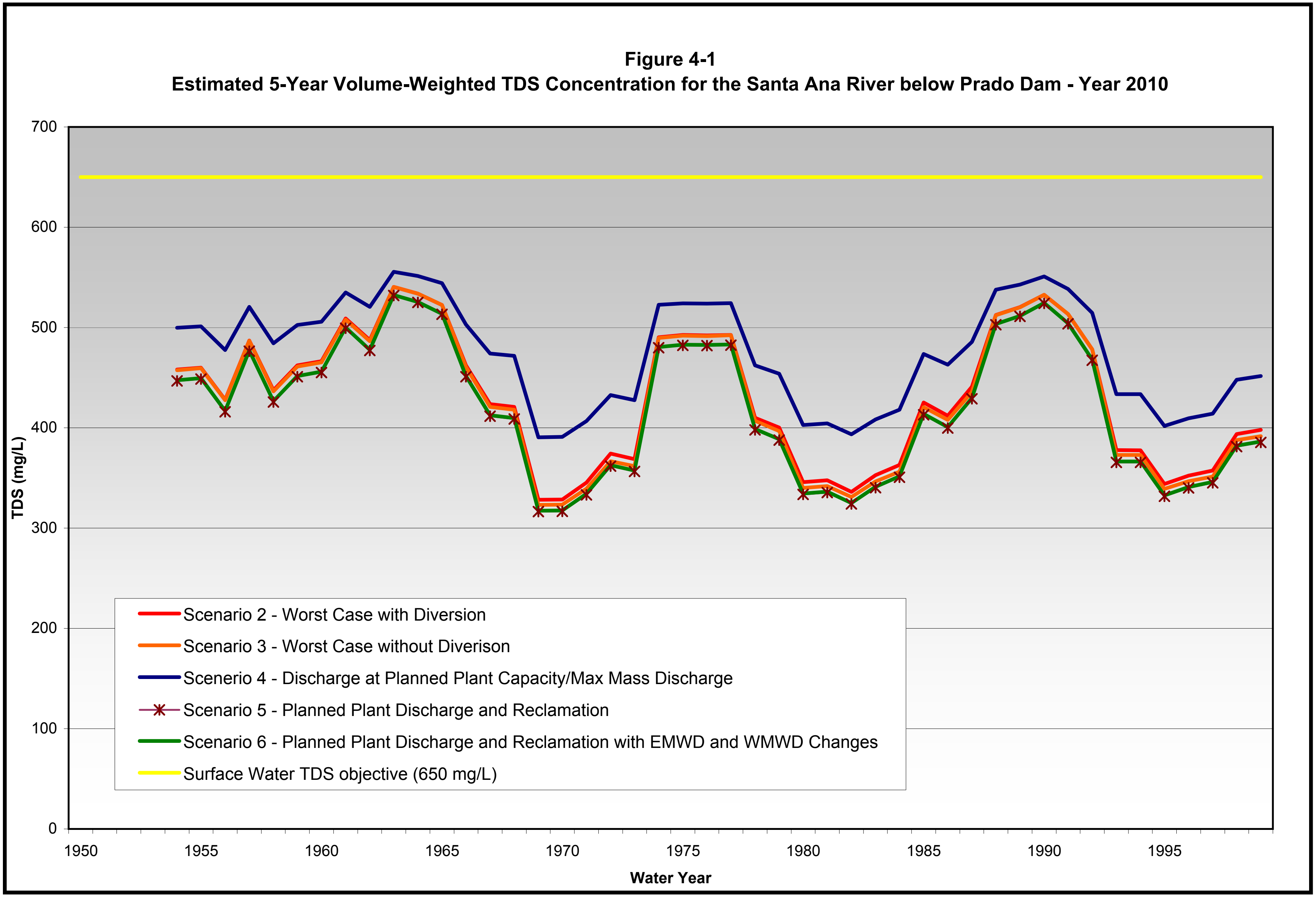
Reach	Underlying Management Zone	TDS Objective (mg/L)	Current Ambient Water Quality (mg/L)	Assimilative Capacity (mg/L)	Compliance Period	Compliance Metric									
						Scenario 2[1]		Scenario 3[2]		Scenario 4[3]		Scenario 5[4]		Scenario 6[5]	
						2010 (mg/L)	2020 (mg/L)	2010 (mg/L)	2020 (mg/L)	2010 (mg/L)	2020 (mg/L)	2010 (mg/L)	2020 (mg/L)	2010 (mg/L)	2020 (mg/L)
						Maximum Value for the Volume-Weighted Discharge for the Planning Period Hydrology									
Santa Ana River at below Prado Dam, Reach 2	na	700*	na	na	August Only[6]	662	665	662	665	615	615	662	664	662	664
						Maximum Value for the Volume-Weighted Discharge for the Planning Period Hydrology									
Santa Ana River at below Prado Dam, Reach 2	na	650**	na	na	5-Year	541	556	540	556	556	567	532	534	532	535
						Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology									
Santa Ana River from Prado Dam to Riverside Narrows, Reach 3	Chino South	680	940	none	1-year 5-year	678 655	672 650	678 655	672 650	638 618	639 619	677 651	672 648	676 650	672 648
Santa Ana River from Riverside Narrows to the Rialto Colton Barrier Projection, Reaches 3 and 4	Riverside A	560	440	120	1-year 5-year	510 471	509 470	510 471	509 470	522 483	522 483	510 471	509 470	510 471	509 470
Santa Ana River from the Rialto Colton Barrier Projection to the San Jacinto Fault, Reach 4	Colton	410	450	none	1-year 5-year	182 158	182 158	182 173	182 172	182 158	182 158	182 158	182 158	182 158	182 158
Santa Ana River from the San Jacinto Fault to Seven Oaks Dam, Reach 5	Bunker Hill B	330	280	50	1-year 5-year	415 331	259 212	415 325	259 211	415 332	452 377	415 331	259 212	415 331	259 212
San Timoteo Creek from San Timoteo Canyon Rd to confluent with Cooper's Creek	San Timoteo	400	-	Unknown[7]	1-year 5-year	457 422	436 388	457 422	436 388	465 437	465 437	457 422	436 388	457 422	436 388
Nobel Creek below Mountain View Channel and San Timoteo Creek in Beaumont Management Zone	Beaumont	330	260	70	1-year 5-year	166 124	166 124	166 124	166 124	166 124	166 124	166 124	166 124	166 124	166 124

Notes
1 -- Scenario 2 represents the Worst Case POTW Discharge with the San Bernardino Valley Municipal Water District (SBVMWD)/Western Municipal Water District (WMWD) Diversion at Seven Oaks Dam.
2 -- Scenario 3 represents the Worst Case Discharge without the SBVMWD/WMWD Diversion at Seven Oaks Dam.
3 -- Scenario 4 represents the Worst Case Mass Discharge.
4 -- Scenario 5 represents planned POTW discharge (2010/2020) with theSBVMWD/WMWD Diversion at Seven Oaks Dam.
5 -- Scenario 6 represents planned POTW discharge (2010/2020) including March Wastewater Reclamation Facility discharged to the Santa Ana River, increased permit TDS limit for Eastern Municipal Water District, and the SBVMWD/WMWD Diversion at Seven Oaks Dam.
6 -- August Only represents the lowest flow period on the Santa Ana at below Prado Dam when the contribution of recycled water discharged to the River is assumed to be the greatest.
7 -- Insufficient data to determine ambient TDS concentration (Wildermuth, 2008).
*-- August Only Surface Water TDS Objective
** -- 5 Five-year moving average Surface Water TDS Objective

Table 4-8
Comparison of Estimated Metrics for Scenario 2, 3, 4, 5, and 6 Model Runs and Corresponding TIN Objectives for Management Zones Impacted by Streambed Recharge

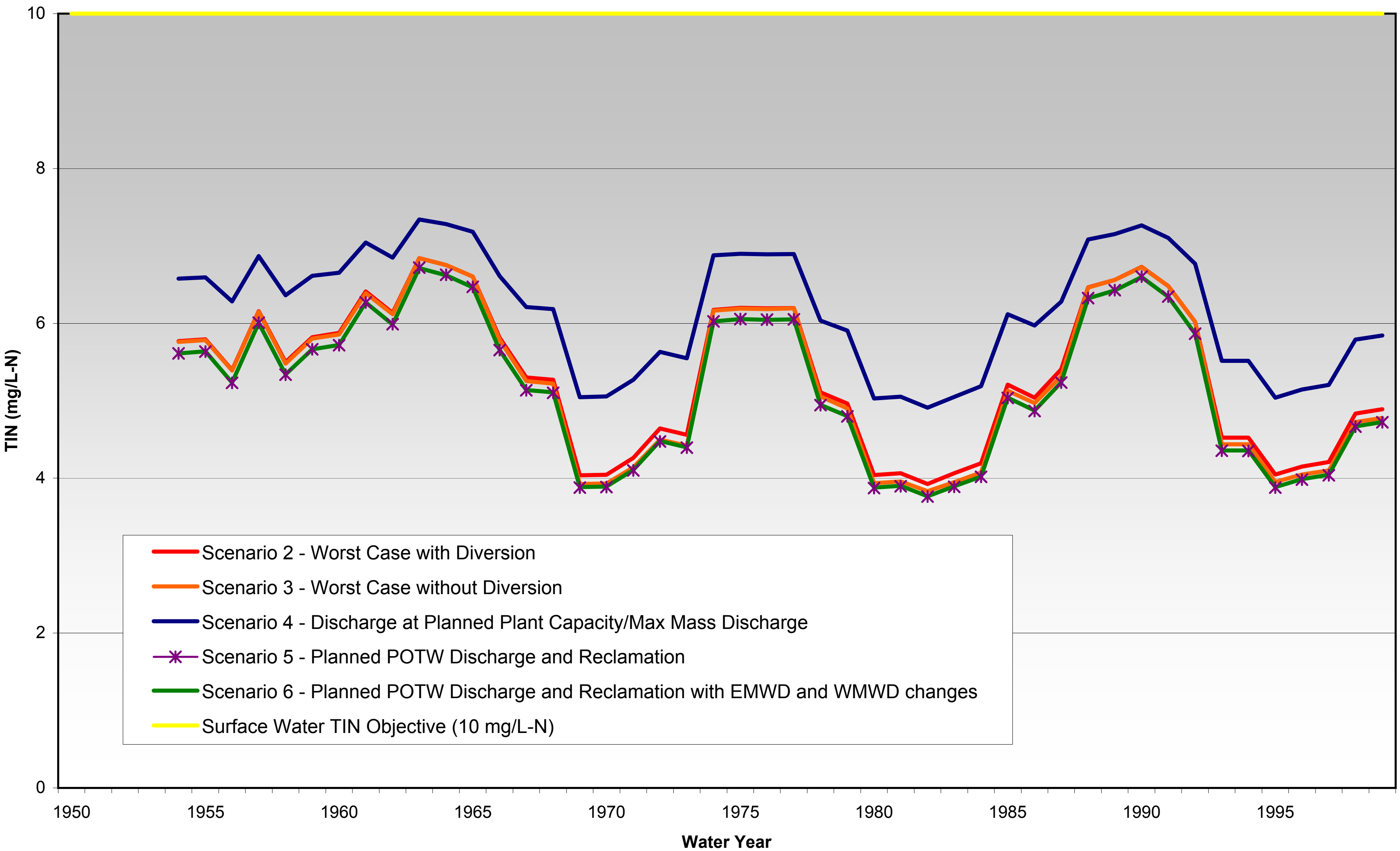
Reach	Underlying Management Zone	TIN Objective	Current Ambient Water Quality	Assimilative Capacity	Compliance Period	Compliance Metric									
						Scenario 2[1]		Scenario 3[2]		Scenario 4[3]		Scenario 5[4]		Scenario 6[5]	
						2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
		(mg/L)	(mg/L)	(mg/L)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
						Maximum Value for the Volume-Weighted Discharge for the Planning Period Hydrology									
Santa Ana River at below Prado Dam, Reach 2	na	10*	na	na	August Only[6]	8.5	8.6	8.5	8.6	8.3	8.4	8.5	8.5	8.4	8.4
						Maximum Value for the Volume-Weighted Discharge for the Planning Period Hydrology									
Santa Ana River at below Prado Dam, Reach 2	na	na	na	na	5-Year	6.8	7.0	6.8	7.0	7.3	7.5	6.7	6.7	6.7	6.7
						Maximum Value for the Volume-Weighted Recharge for the Planning Period Hydrology									
Santa Ana River from Prado Dam to Riverside Narrows, Reach 3	Chino South	4.2	25.7	none	1-year 5-year	5.0 4.8	4.9 4.8	5.0 4.8	4.9 4.8	4.8 4.6	4.8 4.6	5.0 4.8	4.9 4.8	5.0 4.8	4.9 4.7
Santa Ana River from Riverside Narrows to the Rialto Colton Barrier Projection, Reaches 3 and 4	Riverside A	6.2	4.9	1.3	1-year 5-year	7.1 6.5	7.2 6.5	7.1 6.5	7.2 6.5	7.2 6.6	7.2 6.6	7.1 6.5	7.2 6.5	7.1 6.5	7.2 6.5
Santa Ana River from the Rialto Colton Barrier Projection to the San Jacinto Fault, Reach 4	Colton	2.7	2.9	none	1-year 5-year	1.4 1.2	1.4 1.2	1.4 1.3	1.4 1.3	1.4 1.2	1.4 1.2	1.4 1.2	1.4 1.2	1.4 1.2	1.4 1.2
Santa Ana River from the San Jacinto Fault to Seven Oaks Dam, Reach 5	Bunker Hill B	7.3	5.4	1.9	1-year 5-year	3.1 2.5	2.0 1.6	3.1 2.4	2.0 1.6	3.1 2.5	3.3 2.8	3.1 2.5	2.0 1.6	3.1 2.5	2.0 1.6
San Timoteo Creek from San Timoteo Canyon Rd to confluent with Cooper's Creek	San Timoteo	5	-	Unknown[7]	1-year 5-year	3.9 3.6	3.7 3.3	3.9 3.6	3.7 3.3	3.9 3.7	3.9 3.7	3.9 3.6	3.7 3.3	3.9 3.6	3.7 3.3
Nobel Creek below Mountain View Channel and San Timoteo Creek in Beaumont Management Zone	Beaumont	5	1.6	3.4	1-year 5-year	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0	1.2 1.0

Notes
1 -- Scenario 2 represents the Worst Case POTW Discharge with the San Bernardino Valley Municipal Water District (SBVMWD)/Western Municipal Water District (WMWD) Diversion at Seven Oaks Dam.
2 -- Scenario 3 represents the Worst Case Discharge without the SBVMWD/WMWD Diversion at Seven Oaks Dam.
3 -- Scenario 4 represents the Worst Case Mass Discharge.
4 -- Scenario 5 represents planned POTW discharge (2010/2020) with theSBVMWD/WMWD Diversion at Seven Oaks Dam.
5 -- Scenario 6 represents planned POTW discharge (2010/2020) including March Wastewater Reclamation Facility discharged to the Santa Ana River, increased permit TDS limit for Eastern Municipal Water District, and the SBVMWD/WMWD Diversion at Seven Oaks Dam.
6 -- August Only represents the lowest flow period on the Santa Ana at below Prado Dam when the contribution of recycled water discharged to the River is assumed to be the greatest.
7 -- Insufficient data to determine ambient TIN concentration (Wildermuth, 2008).
*-- Surface Water TIN Objective



WILDERMUTH™ ENVIRONMENTAL INC.

Figure 4-2
Estimated 5-Year Volume-Weighted TIN Concentration for the Santa Ana River below Prado Dam - Year 2010



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Appendix A

Comments and Responses

A-1 INLAND EMPIRE UTILITIES AGENCY 2008 SANTA ANA RIVER WLAM REPORT COMMENTS AND RESPONSES

Comment Number	Reference	Comment	Response
1	Figure 1-2	In Figure 1-2, the legend includes the river reaches, but not the management zones. Since the management zones are the real focus of the modeling results presentation, and they are shown in different colors, we suggest adding that to the legend. We also suggest using more contrasting colors for the zones in reach 3, rather than different shades of beige.	Comment noted. Each management zone on Figure 1-2 is individually labeled.
2	Prado Wetlands	Early in the document, it mentions that the model assumes the OCWD Prado Wetlands project removes nitrogen down to 1 mg/l. However, in all the model runs, no credit was given for nitrogen removal in the Prado wetlands. An editorial comment is that the explanation given for this apparent inconsistency should be stated more clearly.	Section 4.2.3 addresses this issue. The text in this section states that nitrogen loss provided by the Prado wetlands was set to zero in the planning simulations because the wetlands were built and funded by OCWD to provide treatment of Santa Ana River discharge beyond what is provided by the POTWs that discharge to the River. The TDS increase caused by the Prado wetlands was included in the WLAM simulation by treating the Prado wetlands as a surface water reservoir. OCWD is not under any order or contract to operate these wetlands. And in point of fact, the OCWD has complete discretion as to whether to operate the wetlands or not and therefore as a conservative approach, the nitrogen loss was not accounted for.
3	Section 4	The section that summarizes the results of the wasteload allocations is organized by sub-sections for each management zone, but it skips from Chino South Management Zone to the zone below the dam. The Prado Management Zone is not. Since IEUA discharges to the Prado Management Zone, it would be helpful to connect the dots by making reference to the Prado Zone in the results section, indicating that it has only surface water objectives, and the impacts are shown by the “below the dam” results.	Comment noted. Section 4.4.7 text revised to respond to the comment.

A-2 ORANGE COUNTY WATER DISTRICT 2008 SANTA ANA RIVER WLAM REPORT COMMENTS AND RESPONSES

Comment Number	Reference	Comment	Response
1	Section 4	Please specify what land use was used in the planning simulations.	Comment noted. Text revised to respond to the comment.
2	Section 4	Please provide additional statistics on the 1950-1999 precipitation period; provide the mean and average for the 50-year period for the stations with the longest period of record, and compare the mean and average over the 50-year period to the mean and average over the entire record.	Comment noted. Text revised to respond to the comment.
3	Section 2	Please provide a water budget for the calibration model period and the future planning scenarios; the water budget should include each inflow and outflow component, and the total inflow and outflow.	The scope of work for this project was prepared based on the Wasteload Allocation Model report prepared in 2002, which did not include a water budget of this kind. A water budget is out of the scope of work for this project.
4	p. 2-14	There appears to be a formatting problem on the bottom of page 2-14 and top of page 2-15	Commented noted, formatting revised.
5	p. 2-15	Please provide the basis of the values for TDS and TIN concentrations of rising water shown at the top of page 2-15	The initial condition for rising water TIN and TDS are based on historical groundwater and surface water quality measurements and wasteload allocation calibration. Section 4 text revised to respond to the comment.
6	Table 3-1 and Table 3-2	In Table 3-1, maximum values are compared between the 2003 model evaluation and the 2008 model evaluation; were these maximum values from the same time period? If they are from different time periods, please specify which time periods each is from.	Table 3-1 and Table 3-2 list the maximum 1-year and 5-year volume-weighted average TDS and TIN concentrations for estimated with the 2003 model and the 2008 model. Both model results were estimated assuming the same constant recycled water discharge condition over a 50-year period of 1949/50 to 1998/99. Section 3.2 was revised to address this comment.
7	Section 3	In addition to the information shown in Tables 3-1 and 3-2, it would be beneficial to provide graphs showing the 2003 model results and 2008 model results at below Prado Dam for TDS and TIN; this would allow the reader to more clearly see how the model results compare.	Comment noted, text revised and figures added.
8	Table 4-5	Regarding Scenario 6, which is similar to Scenario 5 except	Comment noted. For Scenario 6, the discharge from EMWD

OCWD COMMENTS AND RESPONSES

Comment Number	Reference	Comment	Response
		that discharge from the March Wastewater Reclamation Facility is added and the Eastern MWD TDS concentration limit was increased from 650 mg/L to 700 mg/L, Table 4-5 lists the Eastern MWD TDS limit as 650 mg/L. Perhaps this is a typographical error or we are not reading the table correctly. Please clarify what TDS limit was used in Scenario 6 for the Eastern MWD discharge.	was modeled with a TDS concentration of 700 mg/L. Revised table to respond to the comment.
9	Table 4-5	In Table 4-5, the upper right hand cell has the text 'Scenario 5 – Planned Water Recycling'. However, the title for Table 4-5 indicates it regards Scenario 6. Please clarify if the text 'Scenario 5 – Planned Water Recycling' is a typographical error or perhaps we are not reading the table correctly.	Comment noted. The table header was incorrectly labeled Scenario 5 instead of Scenario 6. Revised table to respond to the comment.
10	Section 4	In Scenario 6, the March Wastewater Reclamation Facility TDS was specified at 550 mg/L. The formulation of this scenario with the March reclamation facility at a 550 mg/L TDS and the Eastern MWD scenario at 700 mg/L may mask the impact of the increased TDS of the Eastern MWD scenario. By combining the two changes into one scenario, it is not possible to evaluate the effects of the Eastern MWD change.	Comment noted. To simulate the two permit conditions independently would require additional simulations.
11	Section 4	For the 5-year volume-weighted TDS and TIN concentrations for the SAR below Prado Dam shown in Figure 4-1 and 4-2 (and Table 4-7 and 4-8), the volume weighting should be based on the amount of SAR flow that is recharged into the Orange County Management Zone. If the volume weighting is based on total flow in the river, the volume-weighted concentration will not provide a realistic measure with respect to the Orange County Management Zone. In wet years, there are large quantities of low-TDS concentration storm flow in Reach 2 of the SAR that cannot be recharged into the Orange	Comment noted. This issue has been discussed since 1996 by the Nitrogen-N/TDS Task Force. The metric used herein is the metric used by the Regional Water Quality Control Board. The OCWD should pursue this comment with the Regional Water Quality Control Board.

OCWD COMMENTS AND RESPONSES

Comment Number	Reference	Comment	Response
		County Management Zone.	
12	Section 4	The model results from the planning scenarios are compared to the Santa Ana River Reach 2 and Reach 3 water quality objectives. Based on this comparison, the report concludes in Section 4.4.7 that "The 2004 Basin Plan water quality objectives were not exceeded; the existing wasteload allocation is acceptable for all scenarios." Based on the model results presented in the report, the surface water quality objectives for Reach 2 and Reach 3 of the SAR were not exceeded. However, there is no assimilative capacity for TDS in the Orange County Management Zone, as documented in studies conducted for the Basin Monitoring Task Force. Because there is no assimilative capacity in the Orange County Management Zone for TDS, it is not clear that all the planning scenarios are acceptable. Some of the planning scenarios could cause or contribute to the exceedance of the TDS water quality in the Orange County Management Zone. This is an issue that the Basin Monitoring Task Force should discuss in additional detail.	Comment noted. This issue has been discussed since 1996 by the Nitrogen-N/TDS Task Force. The metric used herein is the metric used by the Regional Water Quality Control Board. The OCWD should pursue this comment with the Regional Water Quality Control Board.

A-3 Regional Water Quality Control Board 2008 Santa Ana River WLAM Report Comments and Responses

Comment Number	Reference	Comment	Response
1	p. 2-6	Page 2-6 Section 2.4 "Precipitation and Data" should be "Precipitation Data"	Comment noted. Text revised to respond to the comment.
2	Section 3 and Section 4	My major concerns are the management zones where the in-stream concentrations exceed WQOs for the underlying GW MZs. I understand that these model scenarios have to ensure that WQOs for TDS and TIN at the SAR below Prado Dam is protected, PLUS that the TDS and TIN WQOs for the underlying GW MZs are protected. The former is true, fortunately, but the latter is not always true, as I will point out in this e-mail. Although the in-stream concentrations are results of total recharge that includes stormwater and Ag runoff, we still need to know why the WQOs are exceeded. Otherwise I don't think these scenarios are acceptable. Either the discharge limits need to be revised so that the WQOs are met, or WQOs need to be revised so that the current permit limits do not cause exceedance of WQOs (not knowing what causing the exceedance of WQOs puts the burden of proof on dischargers). Specific examples:	Comment noted.
3	Section 3	Table 3-1 indicates that the WLA model runs in 2003 and 2008 predicted in-stream TDS concentrations in San Timoteo Creek Reach 2, Reach 3 and 4 (in STM groundwater management zone), San Timoteo Creek Reach 3 and 4 (in Beaumont GW management zone) exceeded TDS Objectives most of the time. Table 3-2 shows the WLA model runs in 2003 and 2008 predicted in-stream TIN concentrations that Santa Ana River Reach 3, Reach 4, STM Creek reaches exceeded TIN WQOs mostly.	Tables 3-1 and 3-2 are comparisons of results generated with the 2003 WLAM and the 2008 WLAM for the 2010A and 2010B planning scenarios that were included in the 2004 Basin Plan Amendment. These tables have no regulatory significance in this investigation. The purpose of simulating the 2010A and 2010B scenarios with both versions of the WLAM was to determine how different the planning predictions would be with the updated 2008 WLAM. The philosophical point of your comment is addressed in our response to your comments below.

Comment Number	Reference	Comment	Response
4	Section 4, Page 4-10	P. 4-10 Last bullet states the streambed concentration for TIN for all modeled scenarios exceeds the Chino South BP Objective.	This is true. It goes on to say that there is no assimilative capacity for TIN. In this situation, the Regional Board must either modify the discharge permits for the POTWs that contribute to the TIN in the streambed recharge exceeding the objective, increase the TIN objective for Chino South, or some combination of these strategies. Not that the text of this bullet has been modified from "the streambed concentration for TIN" to "the TIN concentration in the streambed recharge."
5	Section 4, Page 4-10	P. 4-10 Second to last bullet states that Bunker Hill B exceed TDS objective but has assimilative capacity. Please indicated how much of the assimilative capacity is used by the recharge (or how much assimilative capacity is left for other discharges) . I have the same concerns for Riverside A management zone.	The WLAM projects that the average TDS concentration in streambed recharge in Bunker Hill B management zone will exceed the Bunker Hill B management zone TDS objective. Currently there is assimilative capacity for TDS in the Bunker Hill B management zone. The WLAM projects that the average TIN concentration in streambed recharge in the Riverside A management zone will exceed the Riverside A management zone TIN objective. Currently there is assimilative capacity for TIN in the Riverside A management zone. The WLAM does not have the ability to project how much of the assimilative capacity is used by this recharge.
6	Table 4-7	Table 4-7 indicates that TDS WQOs for Bunker Hill B and San Timoteo Management zones are exceeded for many of the scenarios.	To be clear Table 4-7 indicates that the maximum one-year and five-year volume-weighted TDS concentrations in streambed recharge exceeds the underlying TDS objectives for these management zones for some of the planning scenarios. There is currently assimilative capacity in the Bunker Hill B management zone and the Regional Board has the discretion to allow the streambed recharge to encroach into the assimilative capacity or not. The status of assimilative capacity in the San Timoteo management zone is not known.

Comment Number	Reference	Comment	Response
7	Table 4-8	Table 4-8 shows that the TIN WQOs are exceeded for Chino South and Riverside A management zones.	To be clear Table 4-8 indicates that the maximum one-year and five-year volume-weighted TIN concentrations in streambed recharge exceeds the underlying TIN objectives for these management zones for all of the planning scenarios. There is currently assimilative capacity in the Riverside A management zone and the Regional Board has the discretion to allow the streambed recharge to encroach into the assimilative capacity or not. There is currently no assimilative capacity in the Chino South management zone. In this situation, the Regional Board must either modify the discharge permits for the POTWs that contribute to the TIN in the streambed recharge exceeding the objective, increase the TIN objective for Chino South, or some combination of these strategies.
8		It would be useful for WEI to develop a simplified spreadsheet management tool that would be track the surface water quality as a result of change in discharge of recycled water in the SAR watershed. This tool will assist the RB staff and individual discharger to evaluate the impact without having WEI running the entire model.	Comment noted. Alternatively the WLAM documentation could be prepared and training could be provided to enable the Regional Board staff to efficiently run the WLAM.

A-4 SAWPA 2008 SANTA ANA RIVER WLAM REPORT COMMENTS AND RESPONSES

Comment Number	Reference	Comment	Response
1	Throughout	Title Page. For the report title, please revise title to indicate "2008 Santa Ana River Wasteload Allocation Model Report".	Comment noted. Text revised to respond to the comment.
2	p. 2-3	Page 2-3. Section 2.3.2 The denominator of equation (5) appears to be missing a coefficient in order to equal the value shown after Ia=0.2S is substituted. Please confirm.	Equation 5 as written in the text is correct. The denominator of Equation 4 is $(P-I_a)+S$. In equation 5, $I_a = 0.2S$. So, the denominator becomes $(P-I_a)+S = (P-0.2S) + S = P+0.8S$, which is the denominator of Equation 6.
3	p. 2-9	Page 2-9. Section 2.4 Land Use Data. Please explain why the latest SCAG land use maps of the Year 2005 were not used for the calibration and why the Year 2001 was considered as the best fit for calibration of models.	One land use characterization is applied for the calibration period. The calibration period for the model is from water year 1995 to 2006. Considering available land use data and time period, 2001 is representative of the middle of the calibration period and the best estimate.
4	p. 2-14	Page 2-14. Section 2.5.3 TDS and TIN Calibration. Please add "of the" after "conclusion" in the first sentence of the first paragraph.	Comment noted. Text revised to respond to the comment.
5	Table 2-5	Table 2-5. Land Use Conversion Table. For many of the categories, there appears to be unusual conversions from the Anderson Code to the WE Inc. land use categories. For example, Anderson Code Rural Residential is now WE – School or Anderson General Office Use to WE Agriculture. Please double check table.	Comment noted. When condensing tables during the report preparation errors were introduced. The table containing the conversion errors and has been replaced.
6	Table 2-7	Table 2-7. Land use type – parks, schools is shown as 80% impervious. This appears too high as compared to other development. Please confirm.	See response to comment 5.
7	p. 4-3	Page 4-3. Section 4.2.2 First paragraph. Please correct acronym for "SWRCB". Section 4.2.4 Hidden Valley Operations. Next to last sentence. Change "if" to "of".	Comment noted. Text revised to respond to the comment.
8	p. 4-4	Page 4-4. Section 4.2.5 Lake Elsinore Discharge. Please improve sentence structure of 5th sentence in last paragraph. Section 4.2.6 Change "were" to "where".	Comment noted. Text revised to respond to the comment.

A-5 WESTERN MUNICIPAL WATER DISTRICT 2008 SANTA ANA RIVER WLAM REPORT COMMENTS AND RESPONSES

Comment Number	Reference	Comment	Response
1	p. 4-6	On page 4-6 section 4.4.1 paragraph 2, San Timoteo Management Zone should be replaced with Beaumont Management Zone.	Comment noted. Text revised to respond to the comment.
2	p. 4-7	On page 4-7, section 4.4.2, paragraph 1,line 3, 422 mg/L should be 457 mg/L	Comment noted. Text revised to respond to the comment.
3	p. 4-7	On page 4-7, section 4.4.2, paragraph 1,line 5, 3.6 mg/L-N should be 3.7 mg/L-N	Comment noted. Text revised to respond to the comment.
4	Section 4	On page 4-7, section 4.4.3 note that there is assimilative capacity for TDS and TIN in the management zone discussions.	Comment noted. Text revised to respond to the comment.

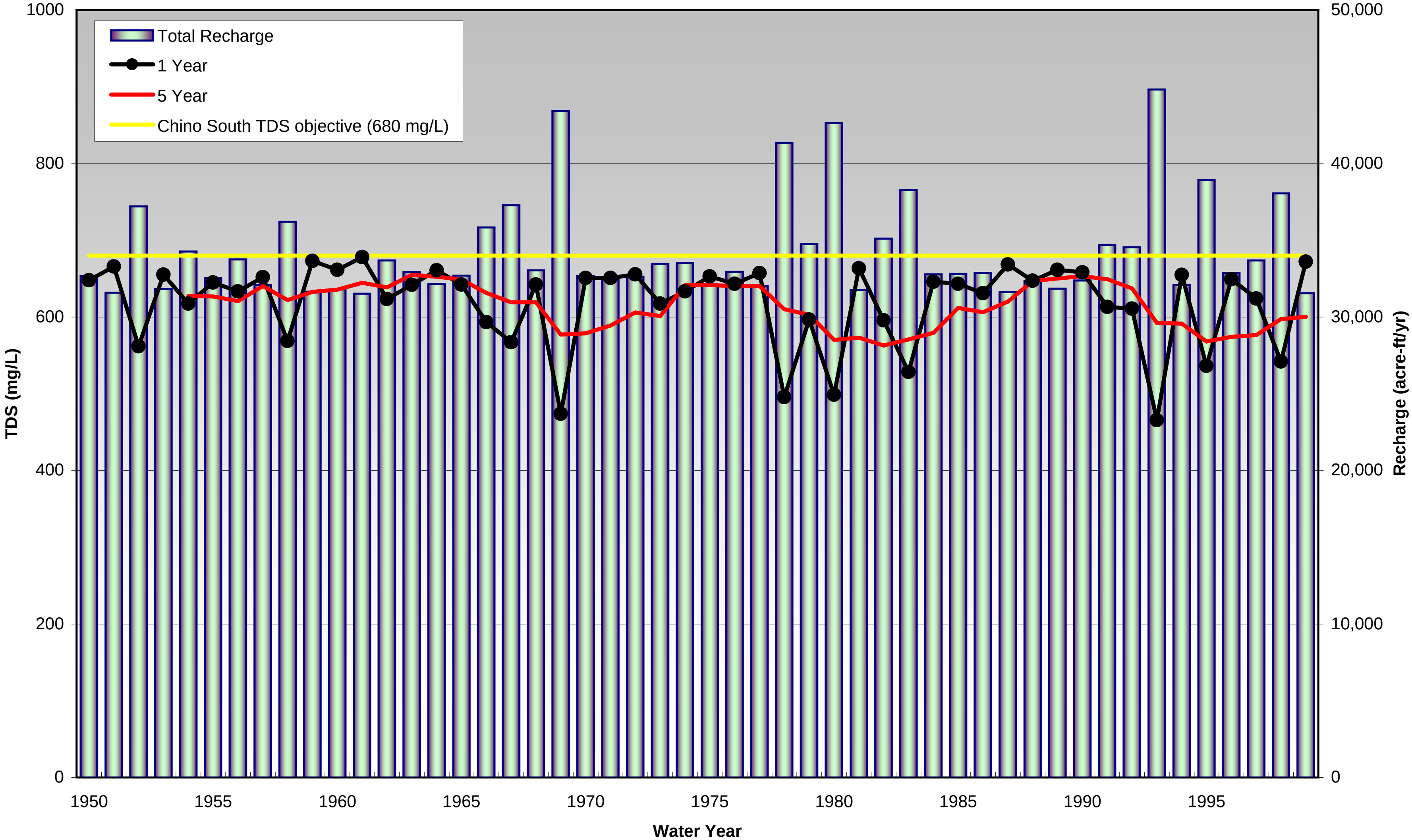
Appendix B

Scenario 2, Year 2010 Simulation Results (Summary Matrices and Graphs)

Table B-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 2 - Year 2010
(mg/L)

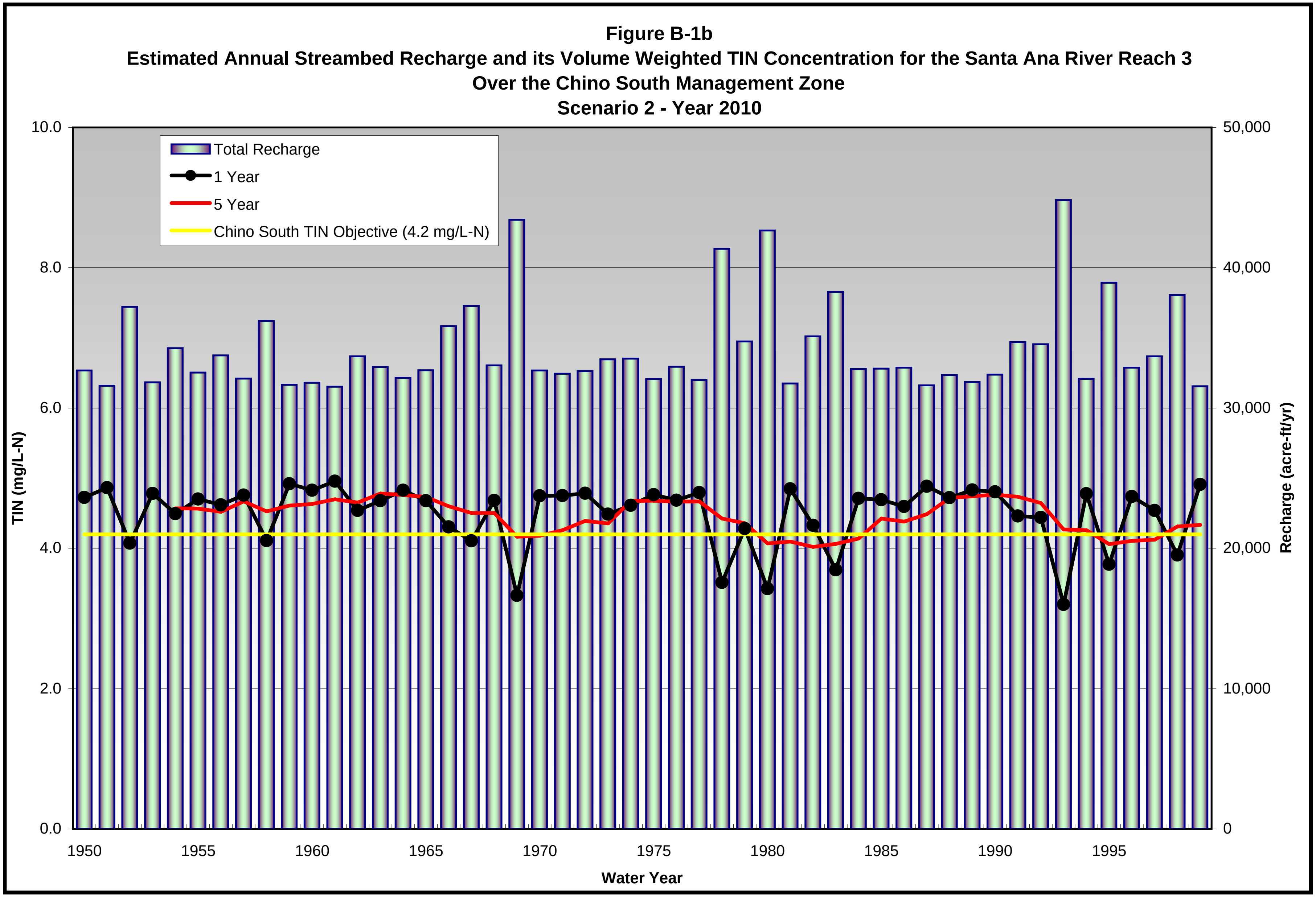
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	648				4.7			
1951	666	657			4.9	4.8		
1952	562	610	622		4.1	4.4	4.5	
1953	655	605	624		4.8	4.4	4.5	
1954	618	636	609	627	4.5	4.6	4.4	4.6
1955	645	631	639	627	4.7	4.6	4.7	4.6
1956	633	639	632	621	4.6	4.7	4.6	4.5
1957	652	642	643	640	4.8	4.7	4.7	4.7
1958	569	608	616	622	4.1	4.4	4.5	4.5
1959	673	617	629	633	4.9	4.5	4.6	4.6
1960	661	667	631	636	4.8	4.9	4.6	4.6
1961	678	670	671	644	5.0	4.9	4.9	4.7
1962	623	650	654	639	4.5	4.7	4.8	4.7
1963	642	633	647	655	4.7	4.6	4.7	4.8
1964	661	651	642	653	4.8	4.8	4.7	4.8
1965	642	651	648	649	4.7	4.8	4.7	4.7
1966	593	617	631	631	4.3	4.5	4.6	4.6
1967	567	580	599	619	4.1	4.2	4.3	4.5
1968	642	602	599	619	4.7	4.4	4.4	4.5
1969	474	546	553	577	3.3	3.9	4.0	4.2
1970	651	550	578	579	4.7	3.9	4.2	4.2
1971	651	651	580	589	4.8	4.8	4.2	4.3
1972	656	653	652	606	4.8	4.8	4.8	4.4
1973	617	636	641	601	4.5	4.6	4.7	4.4
1974	633	625	635	641	4.6	4.6	4.6	4.7
1975	653	643	634	642	4.8	4.7	4.6	4.7
1976	643	648	643	640	4.7	4.7	4.7	4.7
1977	657	650	651	640	4.8	4.7	4.7	4.7
1978	496	566	590	610	3.5	4.1	4.3	4.4
1979	597	542	576	603	4.3	3.9	4.1	4.4
1980	499	543	526	570	3.4	3.8	3.7	4.1
1981	664	569	578	573	4.8	4.0	4.1	4.1
1982	595	628	578	563	4.3	4.6	4.1	4.0
1983	528	561	592	571	3.7	4.0	4.3	4.1
1984	646	583	587	580	4.7	4.2	4.2	4.1
1985	643	645	602	612	4.7	4.7	4.3	4.4
1986	631	637	640	606	4.6	4.6	4.7	4.4
1987	668	649	647	620	4.9	4.7	4.7	4.5
1988	647	658	649	647	4.7	4.8	4.7	4.7
1989	662	654	659	650	4.8	4.8	4.8	4.7
1990	658	660	656	653	4.8	4.8	4.8	4.8
1991	613	635	643	649	4.5	4.6	4.7	4.7
1992	611	612	627	637	4.4	4.5	4.6	4.6
1993	466	529	554	592	3.2	3.7	4.0	4.3
1994	655	545	565	591	4.8	3.9	4.0	4.3
1995	536	590	542	568	3.8	4.2	3.8	4.1
1996	649	588	609	574	4.7	4.2	4.4	4.1
1997	624	637	600	576	4.5	4.6	4.3	4.1
1998	542	581	602	597	3.9	4.2	4.4	4.3
1999	672	601	608	600	4.9	4.4	4.4	4.3

Figure B-1a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 3 Over the Chino South Management Zone
Scenario 2 - Year 2010



R_S210a_matrix.xls -- Fig 1a

WILDERMUTH ENVIRONMENTAL INC.

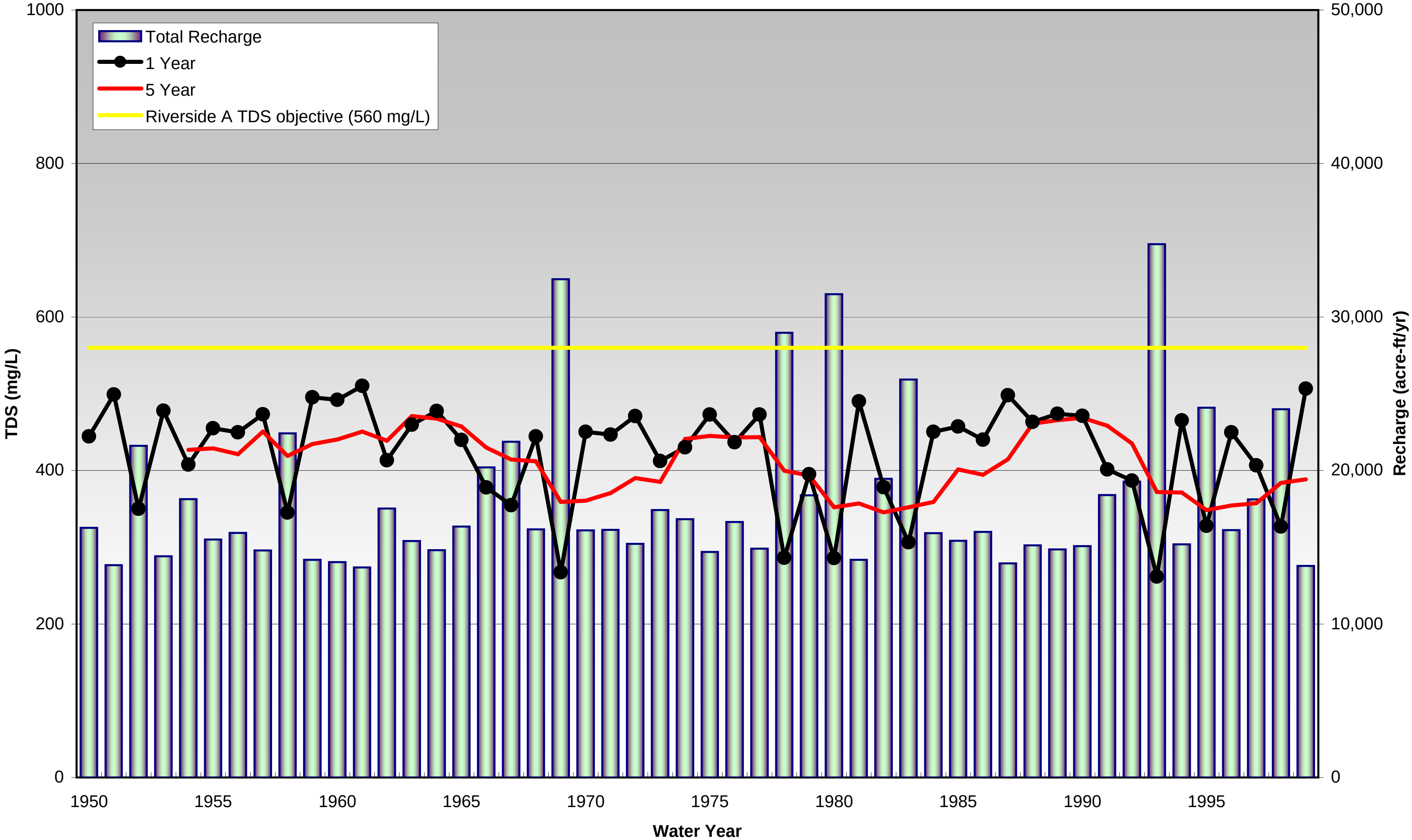


R_S210a_matrix.xls -- Fig 1b

Table B-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 2 - Year 2010
(mg/L)

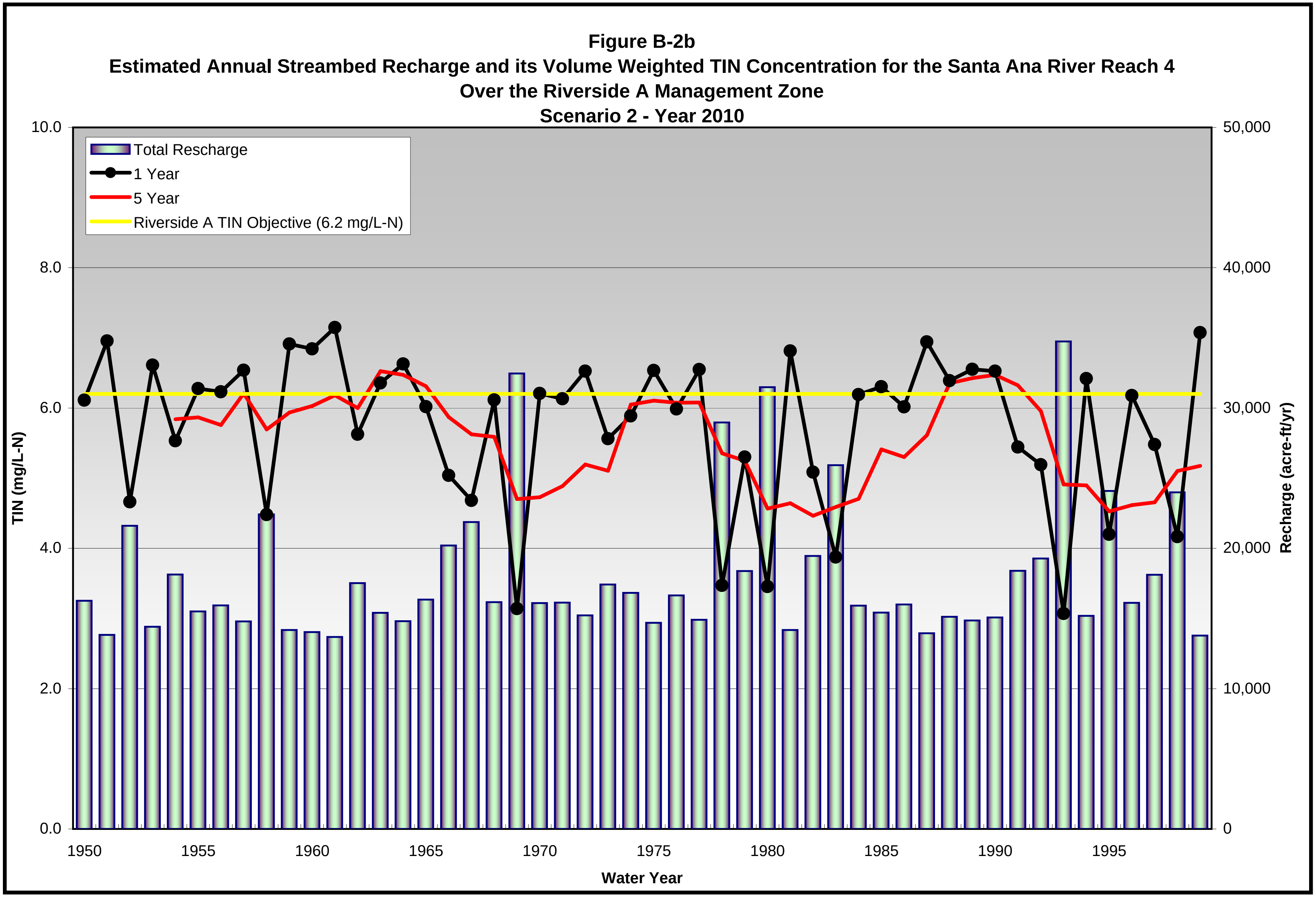
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	499	470			7.0	6.5		
1952	350	408	420		4.7	5.6	5.7	
1953	478	401	428		6.6	5.4	5.9	
1954	408	439	403	427	5.5	6.0	5.5	5.8
1955	455	429	444	429	6.3	5.9	6.1	5.9
1956	450	452	436	421	6.2	6.3	6.0	5.8
1957	473	461	459	451	6.5	6.4	6.3	6.2
1958	345	396	412	419	4.5	5.3	5.6	5.7
1959	495	403	423	434	6.9	5.4	5.7	5.9
1960	492	494	428	440	6.8	6.9	5.8	6.0
1961	510	501	499	451	7.1	7.0	7.0	6.2
1962	413	456	467	439	5.6	6.3	6.5	6.0
1963	460	435	457	471	6.4	6.0	6.3	6.5
1964	478	468	448	468	6.6	6.5	6.2	6.5
1965	440	458	458	457	6.0	6.3	6.3	6.3
1966	378	406	426	430	5.0	5.5	5.8	5.9
1967	355	366	386	414	4.7	4.9	5.2	5.6
1968	445	393	388	412	6.1	5.3	5.2	5.6
1969	267	326	335	359	3.1	4.1	4.3	4.7
1970	450	328	357	361	6.2	4.2	4.6	4.7
1971	447	449	358	371	6.1	6.2	4.7	4.9
1972	471	458	456	390	6.5	6.3	6.3	5.2
1973	412	440	442	385	5.6	6.0	6.1	5.1
1974	430	421	436	441	5.9	5.7	6.0	6.0
1975	473	450	437	445	6.5	6.2	6.0	6.1
1976	437	454	445	443	6.0	6.2	6.1	6.1
1977	473	454	460	443	6.5	6.3	6.3	6.1
1978	286	350	374	400	3.5	4.5	4.9	5.4
1979	395	329	363	393	5.3	4.2	4.7	5.2
1980	286	326	311	352	3.5	4.1	3.9	4.6
1981	490	349	362	357	6.8	4.5	4.7	4.6
1982	378	425	358	346	5.1	5.8	4.7	4.5
1983	306	337	374	352	3.9	4.4	5.0	4.6
1984	450	361	367	359	6.2	4.8	4.9	4.7
1985	457	454	387	401	6.3	6.2	5.2	5.4
1986	440	449	449	394	6.0	6.2	6.2	5.3
1987	498	467	464	415	6.9	6.4	6.4	5.6
1988	463	480	466	461	6.4	6.7	6.4	6.4
1989	474	468	478	466	6.6	6.5	6.6	6.4
1990	471	472	469	468	6.5	6.5	6.5	6.5
1991	401	433	445	458	5.4	5.9	6.1	6.3
1992	387	394	416	435	5.2	5.3	5.7	6.0
1993	262	306	331	372	3.1	3.8	4.2	4.9
1994	465	324	341	371	6.4	4.1	4.4	4.9
1995	328	381	325	348	4.2	5.1	4.1	4.5
1996	450	377	401	354	6.2	5.0	5.4	4.6
1997	407	427	386	357	5.5	5.8	5.1	4.7
1998	327	361	386	384	4.2	4.7	5.1	5.1
1999	506	392	397	389	7.1	5.2	5.3	5.2

Figure B-2a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 2 - Year 2010



R_S210a_matrix.xls -- Fig 2a

WILDERMUTH™ ENVIRONMENTAL INC.

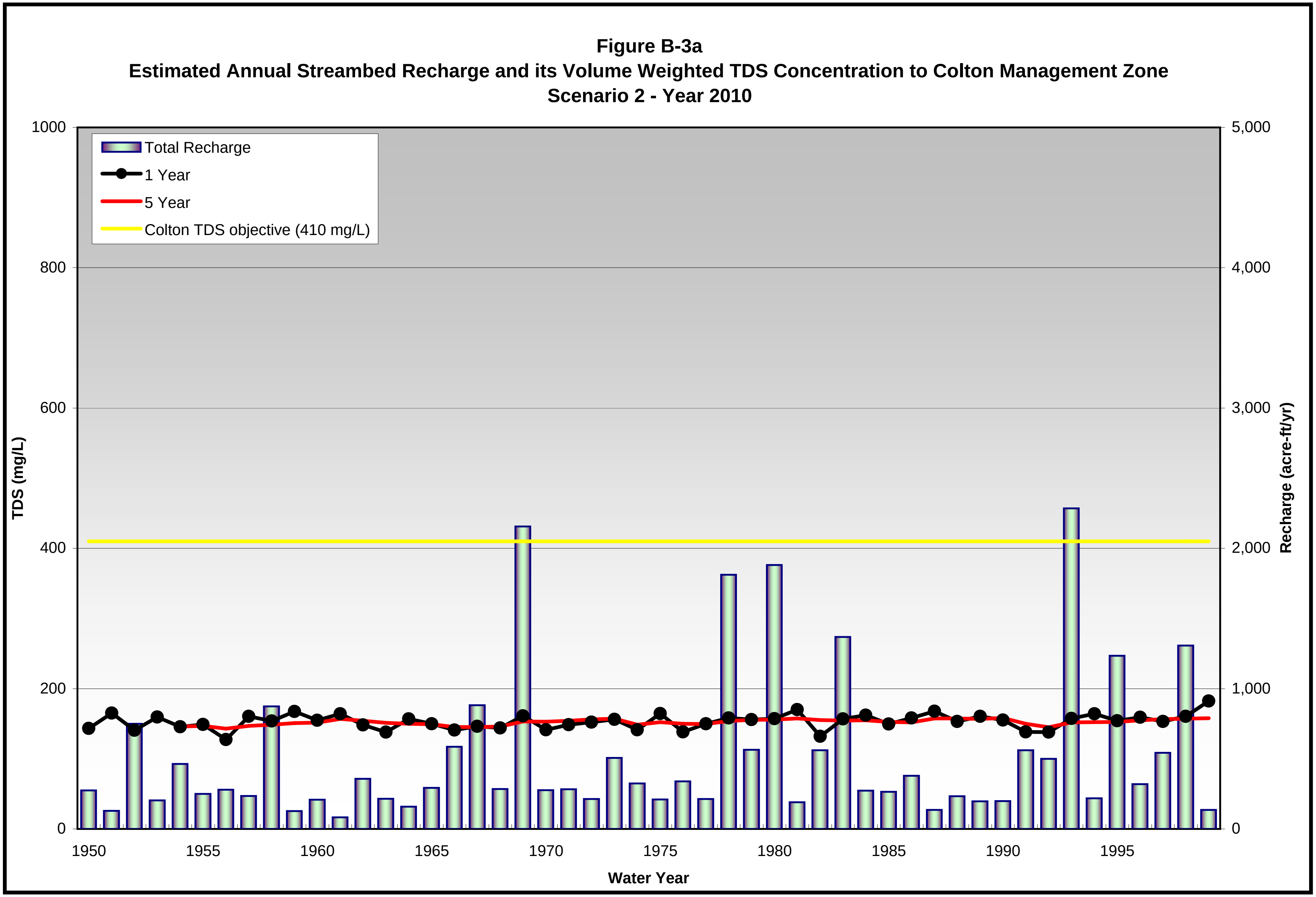


R_S210a_matrix.xls -- Fig 2b

WILDERMUTH™ ENVIRONMENTAL INC.

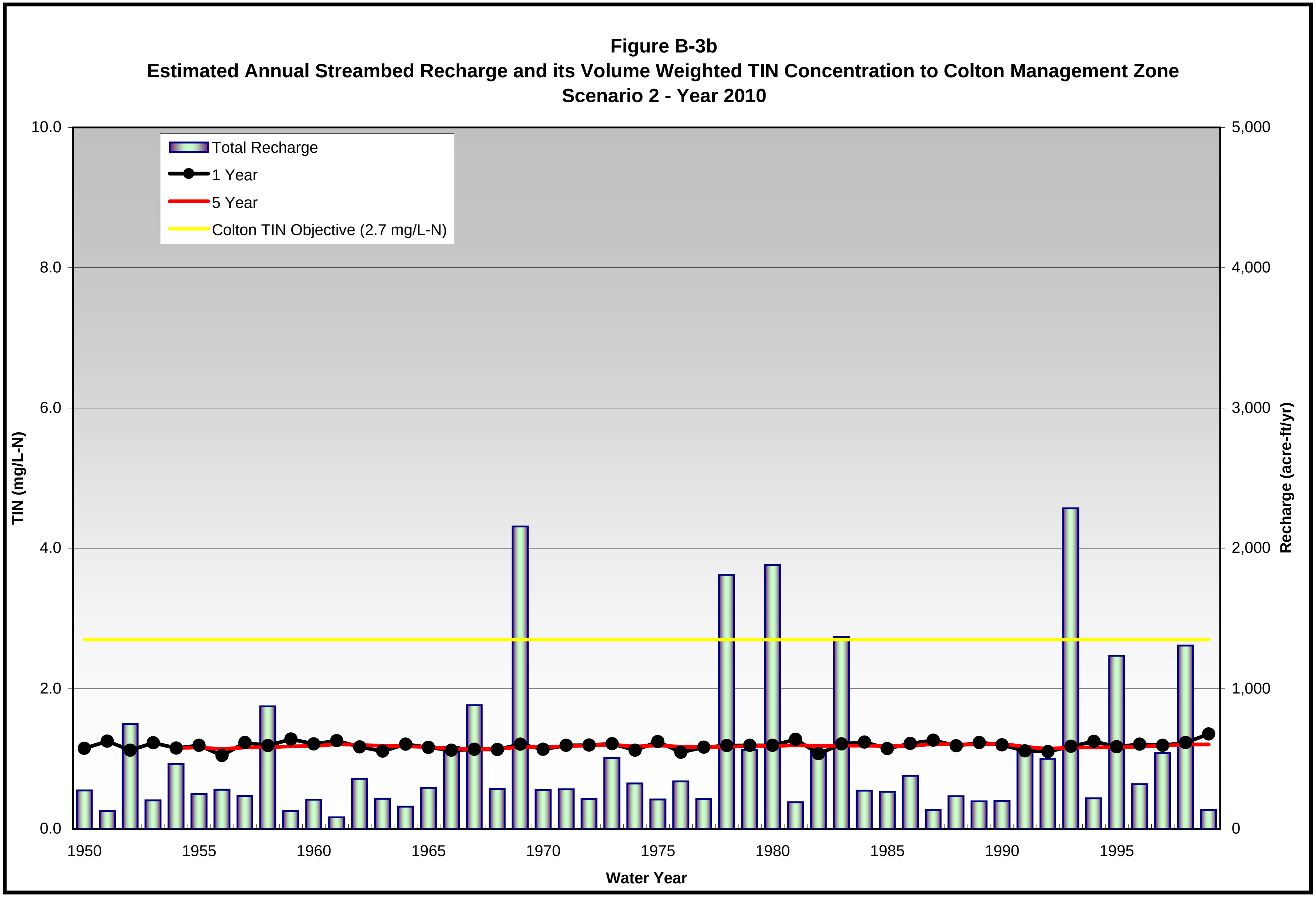
Table B-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 2 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	143				1.1			
1951	165	150			1.3	1.2		
1952	141	144	144		1.1	1.1	1.1	
1953	160	145	147		1.2	1.1	1.2	
1954	146	150	145	146	1.2	1.2	1.1	1.2
1955	149	147	150	147	1.2	1.2	1.2	1.2
1956	127	138	141	143	1.0	1.1	1.1	1.1
1957	160	142	145	147	1.2	1.1	1.1	1.2
1958	154	155	150	149	1.2	1.2	1.2	1.2
1959	168	156	157	151	1.3	1.2	1.2	1.2
1960	155	160	156	152	1.2	1.2	1.2	1.2
1961	164	158	161	157	1.3	1.2	1.2	1.2
1962	148	151	152	154	1.2	1.2	1.2	1.2
1963	138	144	147	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	150	152	148	149	1.2	1.2	1.2	1.2
1966	141	144	146	145	1.1	1.1	1.1	1.1
1967	146	144	145	145	1.1	1.1	1.1	1.1
1968	144	146	144	146	1.1	1.1	1.1	1.1
1969	161	159	156	153	1.2	1.2	1.2	1.2
1970	141	159	157	153	1.1	1.2	1.2	1.2
1971	149	145	158	154	1.2	1.2	1.2	1.2
1972	152	150	147	156	1.2	1.2	1.2	1.2
1973	156	155	153	157	1.2	1.2	1.2	1.2
1974	141	150	151	149	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	146	150	1.1	1.2	1.1	1.2
1977	150	143	149	150	1.2	1.1	1.2	1.2
1978	158	157	155	154	1.2	1.2	1.2	1.2
1979	156	158	157	156	1.2	1.2	1.2	1.2
1980	157	157	157	156	1.2	1.2	1.2	1.2
1981	170	158	158	158	1.3	1.2	1.2	1.2
1982	132	142	153	155	1.1	1.1	1.2	1.2
1983	157	150	152	154	1.2	1.2	1.2	1.2
1984	162	158	151	155	1.2	1.2	1.2	1.2
1985	150	156	157	152	1.1	1.2	1.2	1.2
1986	158	155	157	152	1.2	1.2	1.2	1.2
1987	168	161	157	158	1.3	1.2	1.2	1.2
1988	153	159	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	143	146	150	1.1	1.1	1.2	1.2
1992	138	138	141	145	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	155	152	1.2	1.2	1.2	1.2
1995	154	156	157	153	1.2	1.2	1.2	1.2
1996	159	155	156	155	1.2	1.2	1.2	1.2
1997	153	155	155	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	163	160	158	1.4	1.2	1.2	1.2



R_S210a_matrix.xls -- Fig 3a

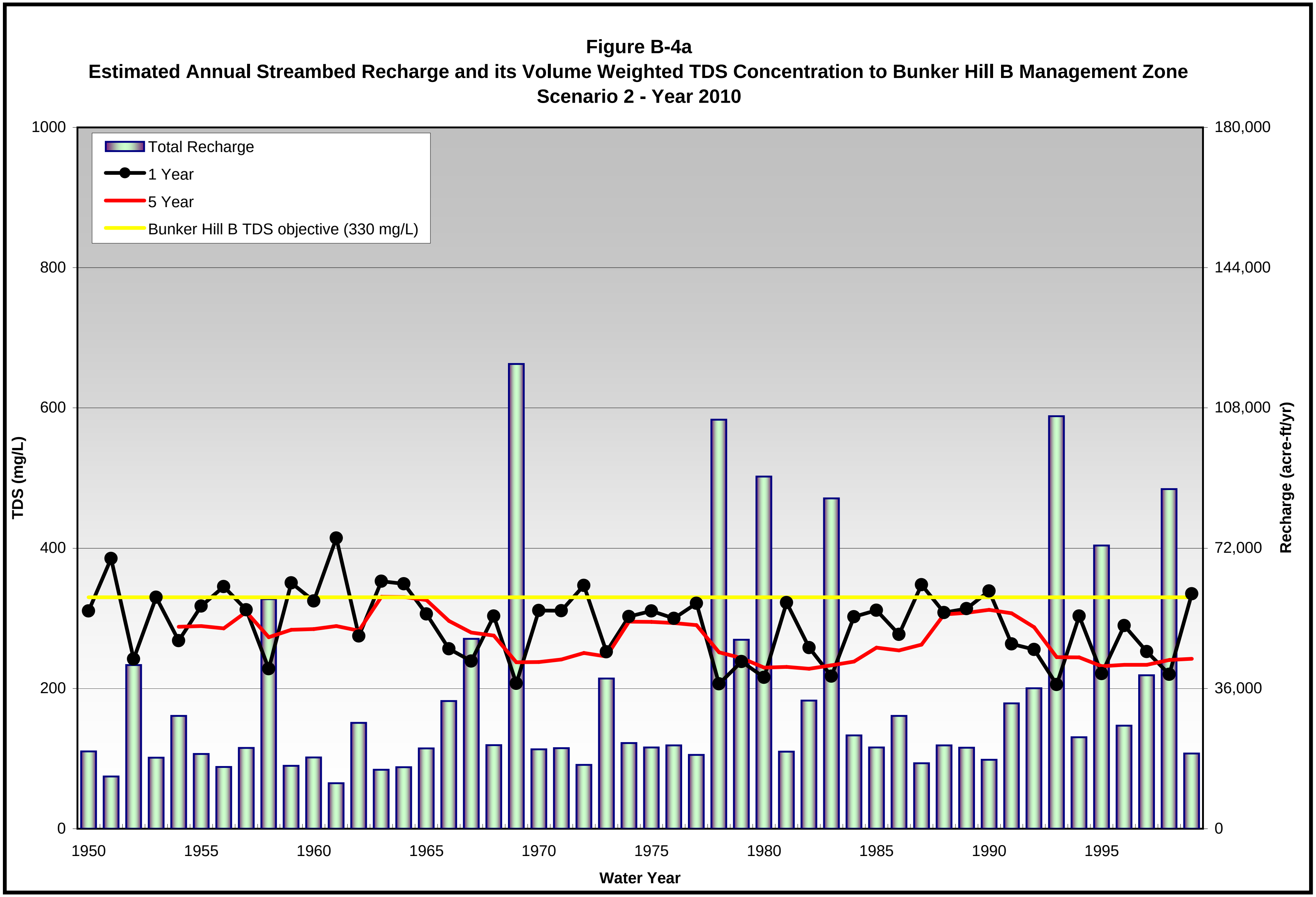
WILDERMUTH ENVIRONMENTAL INC.



R_S210a_matrix.xls -- Fig 3b

Table B-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 2 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	311				2.4			
1951	385	341			2.8	2.6		
1952	242	277	286		1.9	2.1	2.2	
1953	330	269	290		2.4	2.0	2.2	
1954	268	292	268	288	2.0	2.2	2.0	2.2
1955	318	288	299	289	2.4	2.2	2.2	2.2
1956	345	330	302	286	2.6	2.5	2.3	2.2
1957	312	327	323	309	2.3	2.4	2.4	2.3
1958	228	250	266	273	1.7	1.9	2.0	2.1
1959	351	254	267	284	2.6	1.9	2.0	2.1
1960	325	337	268	285	2.4	2.5	2.0	2.1
1961	415	360	357	289	3.1	2.7	2.6	2.2
1962	275	317	319	282	2.1	2.4	2.4	2.1
1963	353	303	327	331	2.7	2.3	2.5	2.5
1964	349	351	315	330	2.6	2.7	2.4	2.5
1965	306	325	333	326	2.3	2.4	2.5	2.5
1966	256	276	292	296	2.0	2.1	2.2	2.3
1967	239	246	258	280	1.8	1.9	1.9	2.1
1968	303	259	258	275	2.3	1.9	2.0	2.1
1969	207	222	226	237	1.5	1.6	1.7	1.8
1970	311	222	233	238	2.4	1.6	1.7	1.8
1971	311	311	234	241	2.4	2.4	1.7	1.8
1972	347	327	321	251	2.6	2.5	2.4	1.9
1973	252	280	289	246	1.9	2.1	2.2	1.8
1974	303	270	287	295	2.3	2.0	2.2	2.2
1975	310	306	281	295	2.3	2.3	2.1	2.2
1976	300	305	304	293	2.3	2.3	2.3	2.2
1977	321	310	310	290	2.4	2.3	2.3	2.2
1978	207	224	235	252	1.5	1.7	1.8	1.9
1979	238	217	228	243	1.8	1.6	1.7	1.8
1980	216	224	216	230	1.6	1.7	1.6	1.7
1981	322	235	236	231	2.4	1.7	1.8	1.7
1982	258	282	240	228	2.0	2.1	1.8	1.7
1983	218	229	242	233	1.6	1.7	1.8	1.7
1984	302	236	241	238	2.3	1.8	1.8	1.8
1985	312	307	248	258	2.3	2.3	1.9	1.9
1986	277	292	295	254	2.1	2.2	2.2	1.9
1987	348	303	306	263	2.6	2.3	2.3	2.0
1988	308	326	305	305	2.3	2.4	2.3	2.3
1989	314	311	321	308	2.3	2.3	2.4	2.3
1990	339	325	319	312	2.5	2.4	2.4	2.3
1991	264	290	297	307	2.0	2.2	2.2	2.3
1992	256	259	276	287	1.9	2.0	2.1	2.2
1993	206	218	227	244	1.5	1.6	1.7	1.8
1994	303	223	230	244	2.2	1.7	1.7	1.8
1995	221	241	223	232	1.7	1.8	1.7	1.7
1996	290	240	252	234	2.2	1.8	1.9	1.7
1997	253	268	243	234	1.9	2.0	1.8	1.7
1998	220	230	240	241	1.6	1.7	1.8	1.8
1999	335	241	244	242	2.5	1.8	1.8	1.8



R_S210a_matrix.xls -- Fig 4a

Figure B-4b

Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Bunker Hill B Management Zone

Scenario 2 - Year 2010

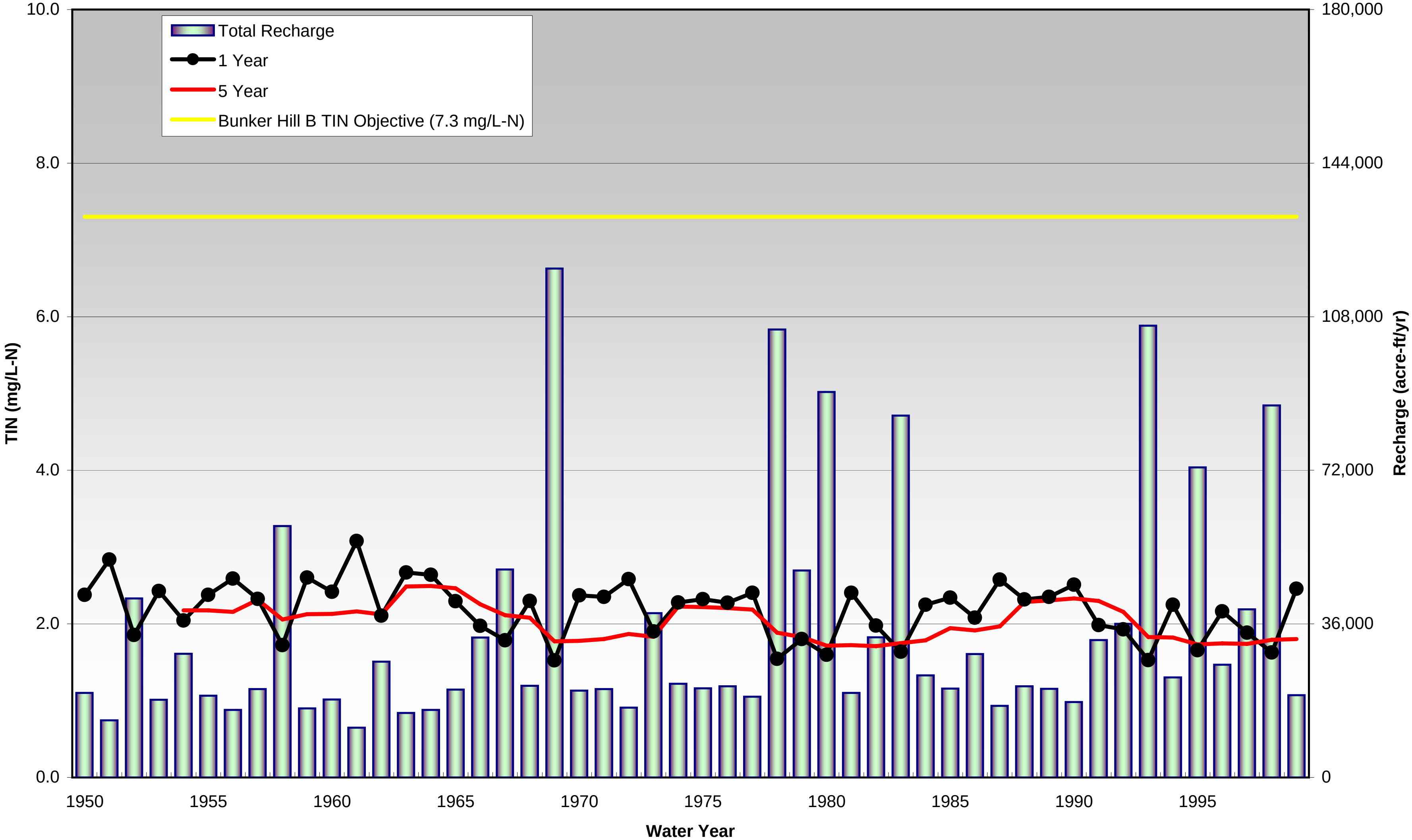


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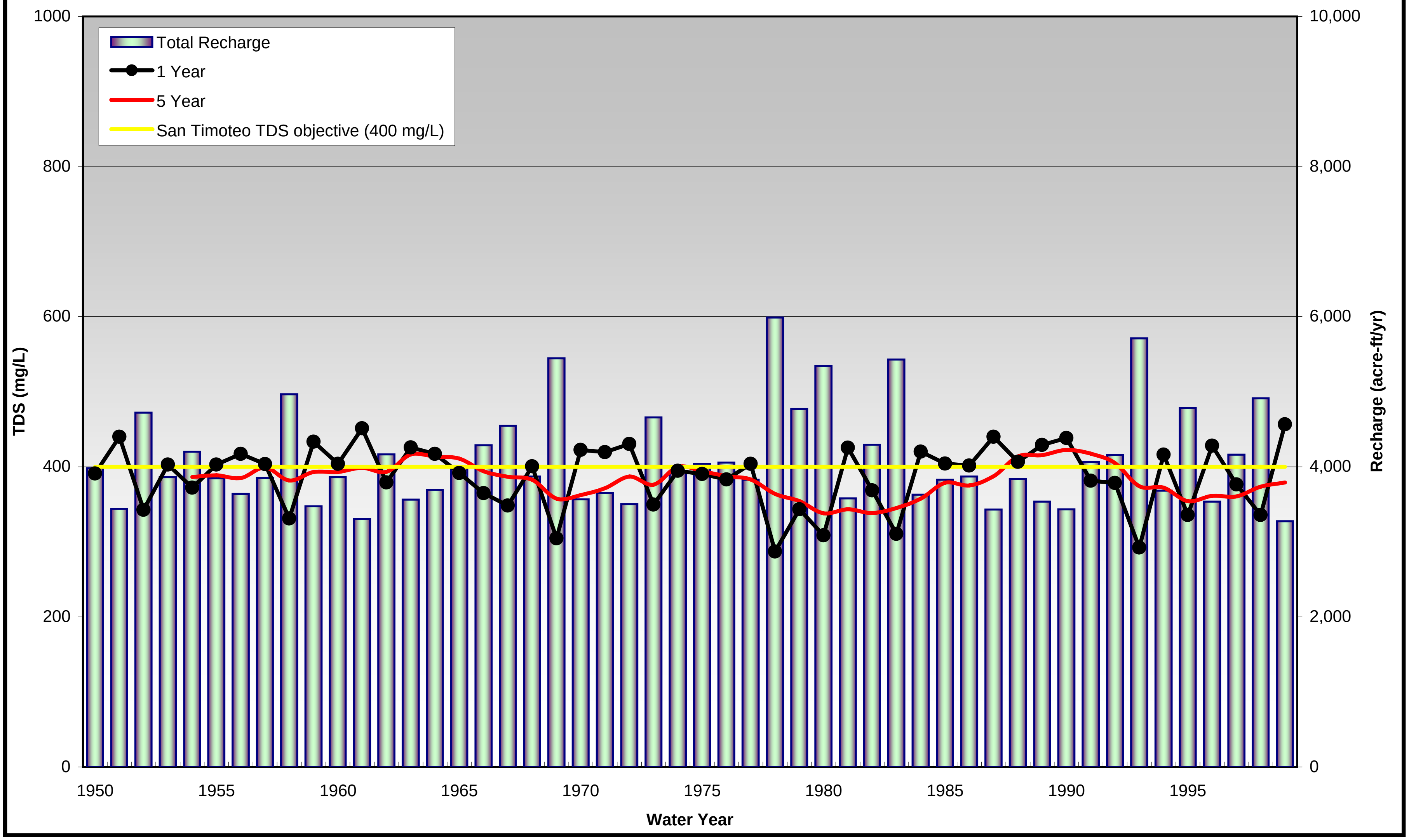
Table B-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 2 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	391				3.3			
1951	440	414			3.7	3.5		
1952	343	384	386		2.9	3.2	3.3	
1953	403	370	390		3.4	3.1	3.3	
1954	372	387	370	386	3.2	3.3	3.1	3.3
1955	403	387	392	389	3.4	3.3	3.3	3.3
1956	417	410	396	385	3.5	3.5	3.4	3.3
1957	403	410	408	399	3.4	3.5	3.4	3.4
1958	331	363	379	382	2.8	3.1	3.2	3.2
1959	433	373	383	393	3.7	3.2	3.2	3.3
1960	404	418	383	393	3.4	3.5	3.2	3.3
1961	451	426	428	398	3.8	3.6	3.6	3.4
1962	379	411	408	393	3.2	3.5	3.4	3.3
1963	426	400	416	416	3.6	3.4	3.5	3.5
1964	417	421	406	413	3.5	3.6	3.4	3.5
1965	392	404	411	411	3.3	3.4	3.5	3.5
1966	365	378	390	394	3.1	3.2	3.3	3.3
1967	348	356	367	387	3.0	3.0	3.1	3.3
1968	401	372	370	383	3.4	3.2	3.1	3.2
1969	304	344	346	358	2.6	2.9	2.9	3.0
1970	422	351	366	362	3.6	3.0	3.1	3.1
1971	419	421	371	371	3.5	3.6	3.1	3.1
1972	430	425	424	387	3.6	3.6	3.6	3.3
1973	349	384	395	376	2.9	3.2	3.3	3.2
1974	395	370	388	400	3.3	3.1	3.3	3.4
1975	390	392	376	394	3.3	3.3	3.2	3.3
1976	383	387	389	387	3.2	3.3	3.3	3.3
1977	404	393	392	383	3.4	3.3	3.3	3.2
1978	287	333	347	364	2.4	2.8	2.9	3.1
1979	343	312	336	354	2.9	2.6	2.8	3.0
1980	309	325	311	338	2.6	2.7	2.6	2.9
1981	425	355	351	343	3.6	3.0	3.0	2.9
1982	369	394	360	338	3.1	3.3	3.0	2.9
1983	310	336	360	345	2.6	2.8	3.0	2.9
1984	420	354	359	358	3.6	3.0	3.0	3.0
1985	404	412	369	379	3.4	3.5	3.1	3.2
1986	402	403	408	375	3.4	3.4	3.4	3.2
1987	440	420	414	387	3.7	3.5	3.5	3.3
1988	406	422	415	414	3.4	3.6	3.5	3.5
1989	429	417	424	415	3.6	3.5	3.6	3.5
1990	438	434	424	422	3.7	3.7	3.6	3.6
1991	381	408	414	418	3.2	3.5	3.5	3.5
1992	378	380	397	405	3.2	3.2	3.4	3.4
1993	292	329	344	374	2.5	2.8	2.9	3.2
1994	416	341	352	372	3.5	2.9	3.0	3.2
1995	336	371	339	354	2.8	3.1	2.9	3.0
1996	428	375	388	361	3.6	3.2	3.3	3.1
1997	376	400	375	361	3.2	3.4	3.2	3.1
1998	336	354	375	373	2.8	3.0	3.2	3.2
1999	457	384	381	379	3.9	3.2	3.2	3.2

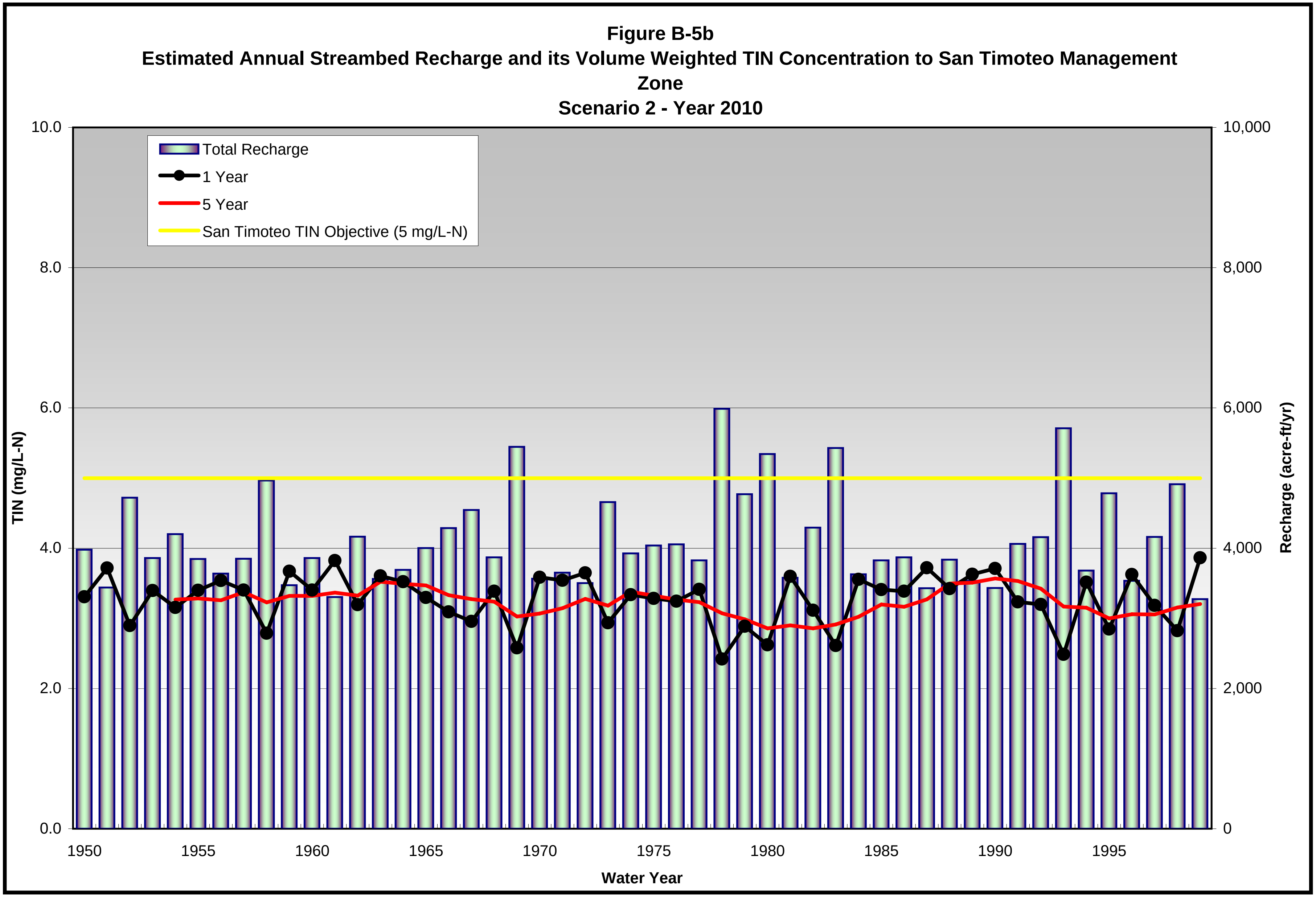
San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan

Figure B-5a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to San Timoteo Management Zone
Scenario 2 - Year 2010



R_S210a_matrix.xls -- Fig 5a

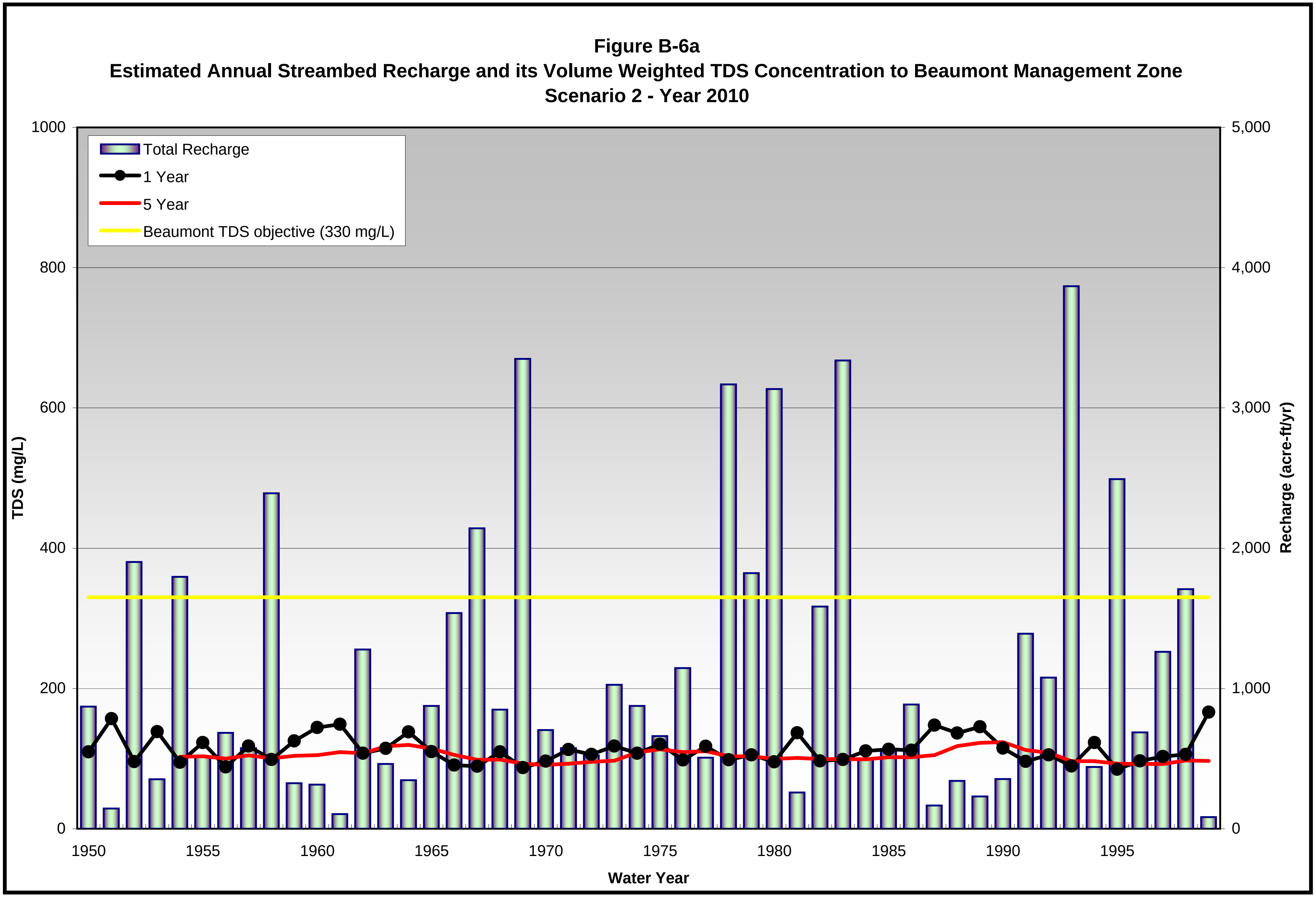
WILDERMUTH ENVIRONMENTAL INC.



R_S210a_matrix.xls -- Fig 5b

Table B-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 2 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8



R_S210a_matrix.xls -- Fig 6a

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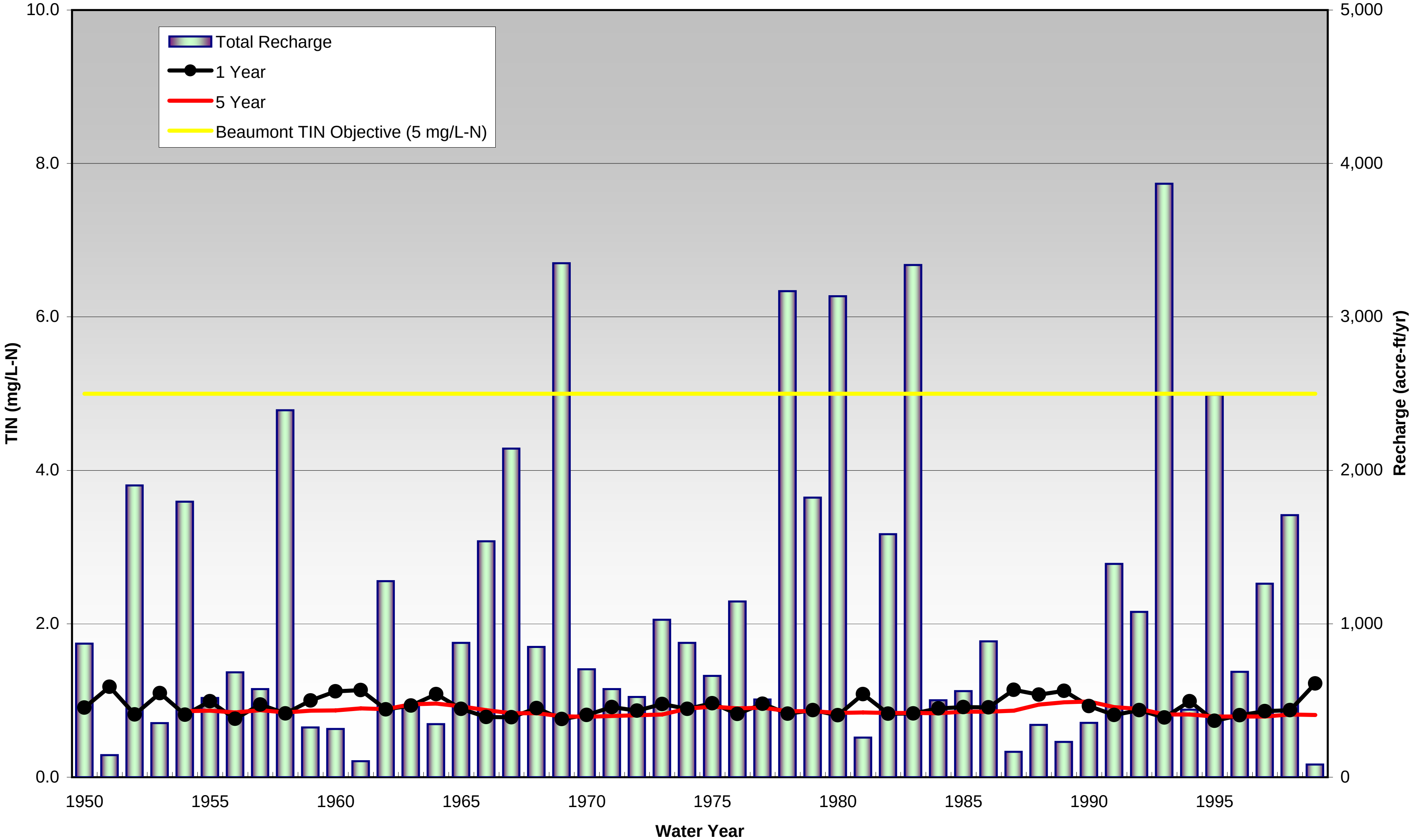
Figure B-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 2 - Year 2010

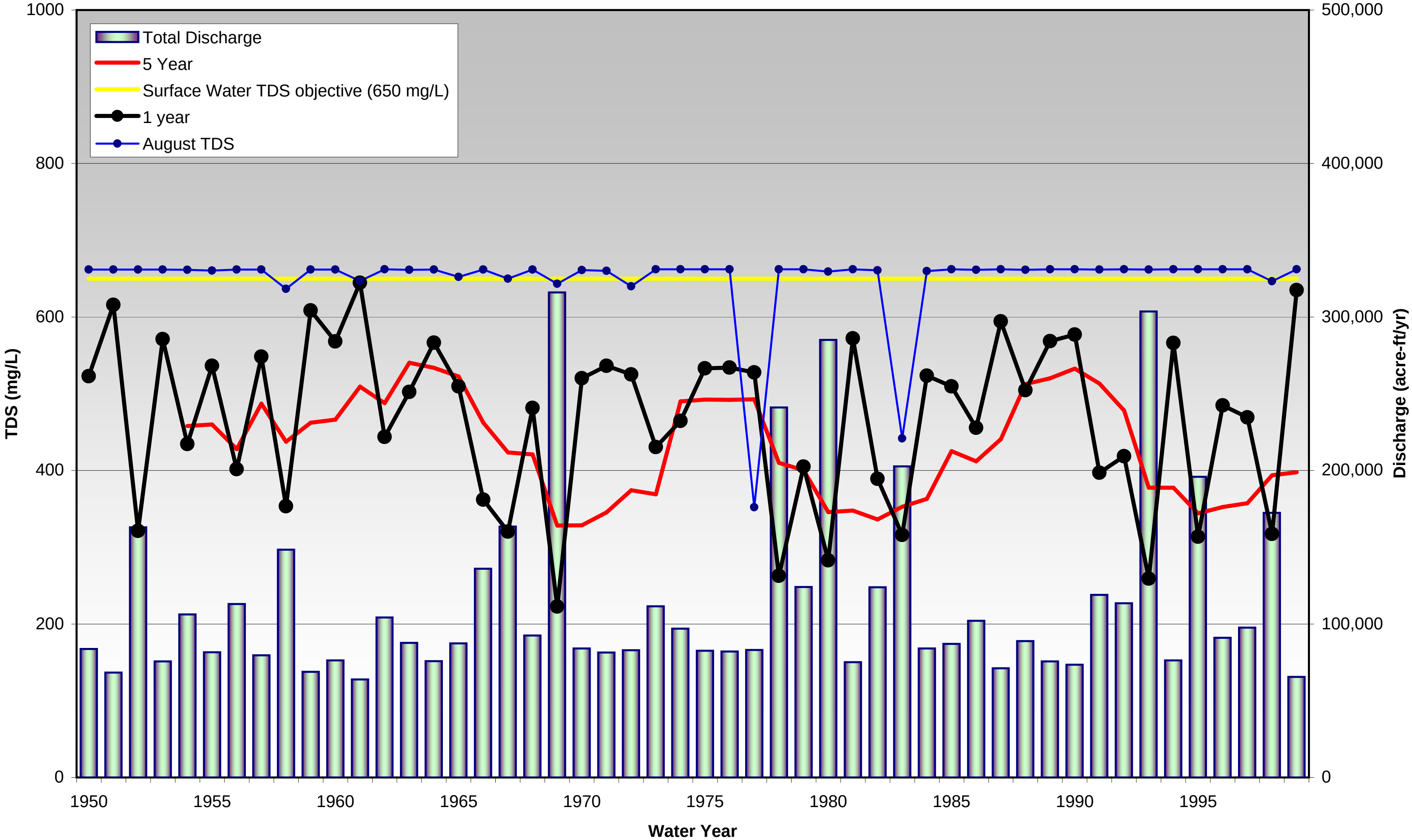


R_S210a_matrix.xls -- Fig 6b

Table B-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 2 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	523				662	6.6				8.5
1951	616	565			662	7.8	7.1			8.5
1952	321	408	439		662	4.0	5.1	5.5		8.5
1953	571	401	448		662	7.2	5.0	5.6		8.5
1954	434	491	411	458	661	5.5	6.2	5.2	5.8	8.5
1955	536	479	505	460	661	6.8	6.0	6.4	5.8	8.5
1956	402	458	450	428	662	5.1	5.8	5.7	5.4	8.5
1957	548	462	484	487	662	6.9	5.9	6.1	6.2	8.5
1958	353	421	415	438	637	4.4	5.3	5.2	5.5	8.2
1959	609	434	465	462	662	7.7	5.4	5.8	5.8	8.5
1960	568	587	469	466	662	7.2	7.4	5.9	5.9	8.5
1961	645	603	605	509	647	8.2	7.6	7.7	6.4	8.3
1962	444	520	535	488	662	5.6	6.6	6.8	6.1	8.5
1963	502	470	514	541	661	6.4	5.9	6.5	6.8	8.5
1964	566	532	498	534	662	7.2	6.7	6.3	6.8	8.5
1965	510	536	524	523	652	6.4	6.8	6.6	6.6	8.4
1966	362	420	457	462	662	4.5	5.2	5.7	5.8	8.5
1967	320	339	378	424	650	3.9	4.2	4.7	5.3	8.4
1968	481	379	373	421	662	6.1	4.7	4.6	5.3	8.5
1969	223	281	292	328	643	2.6	3.4	3.6	4.0	8.2
1970	520	285	322	329	661	6.6	3.5	4.0	4.0	8.5
1971	536	528	328	345	660	6.8	6.7	4.0	4.3	8.5
1972	525	531	527	374	640	6.7	6.7	6.7	4.6	8.2
1973	430	471	490	369	662	5.4	5.9	6.2	4.6	8.5
1974	465	446	469	490	662	5.9	5.6	5.9	6.2	8.5
1975	533	496	471	493	662	6.7	6.3	5.9	6.2	8.5
1976	534	534	508	492	662	6.7	6.7	6.4	6.2	8.5
1977	528	531	532	493	352	6.7	6.7	6.7	6.2	4.4
1978	263	331	372	410	662	3.2	4.1	4.6	5.1	8.5
1979	405	311	351	400	662	5.0	3.8	4.3	5.0	8.5
1980	283	320	299	346	659	2.8	3.5	3.4	4.0	8.5
1981	572	343	359	348	662	7.2	3.7	4.1	4.1	8.5
1982	389	458	355	336	661	4.9	5.8	4.0	3.9	8.5
1983	316	344	386	353	442	3.6	4.1	4.7	4.1	5.5
1984	523	377	380	363	660	6.6	4.5	4.6	4.2	8.5
1985	510	516	408	425	662	6.4	6.5	4.9	5.2	8.5
1986	456	481	494	412	661	5.7	6.0	6.2	5.0	8.5
1987	594	513	512	441	662	7.5	6.5	6.5	5.4	8.5
1988	505	544	510	512	661	6.4	6.9	6.4	6.5	8.5
1989	569	534	552	520	662	7.2	6.7	7.0	6.6	8.5
1990	577	573	547	533	662	7.3	7.3	6.9	6.7	8.5
1991	397	466	495	513	662	5.0	5.9	6.2	6.5	8.5
1992	419	408	448	478	662	5.2	5.1	5.6	6.0	8.5
1993	259	302	323	378	662	2.7	3.4	3.8	4.5	8.5
1994	566	321	343	378	662	7.1	3.6	4.0	4.5	8.5
1995	314	384	318	344	662	3.6	4.6	3.6	4.0	8.5
1996	485	368	410	352	662	6.1	4.4	5.0	4.2	8.5
1997	469	477	394	357	662	5.9	6.0	4.8	4.2	8.5
1998	317	372	401	394	647	3.9	4.6	5.0	4.8	8.3
1999	635	405	424	398	662	8.1	5.1	5.3	4.9	8.5

Figure B-7a
Estimated Annual Discharge and its Volume Weighted TDS Concentration in Santa Ana River Flow at below Prado
Scenario 2 - Year 2010



R_S210a_matrix.xls -- Fig 7a

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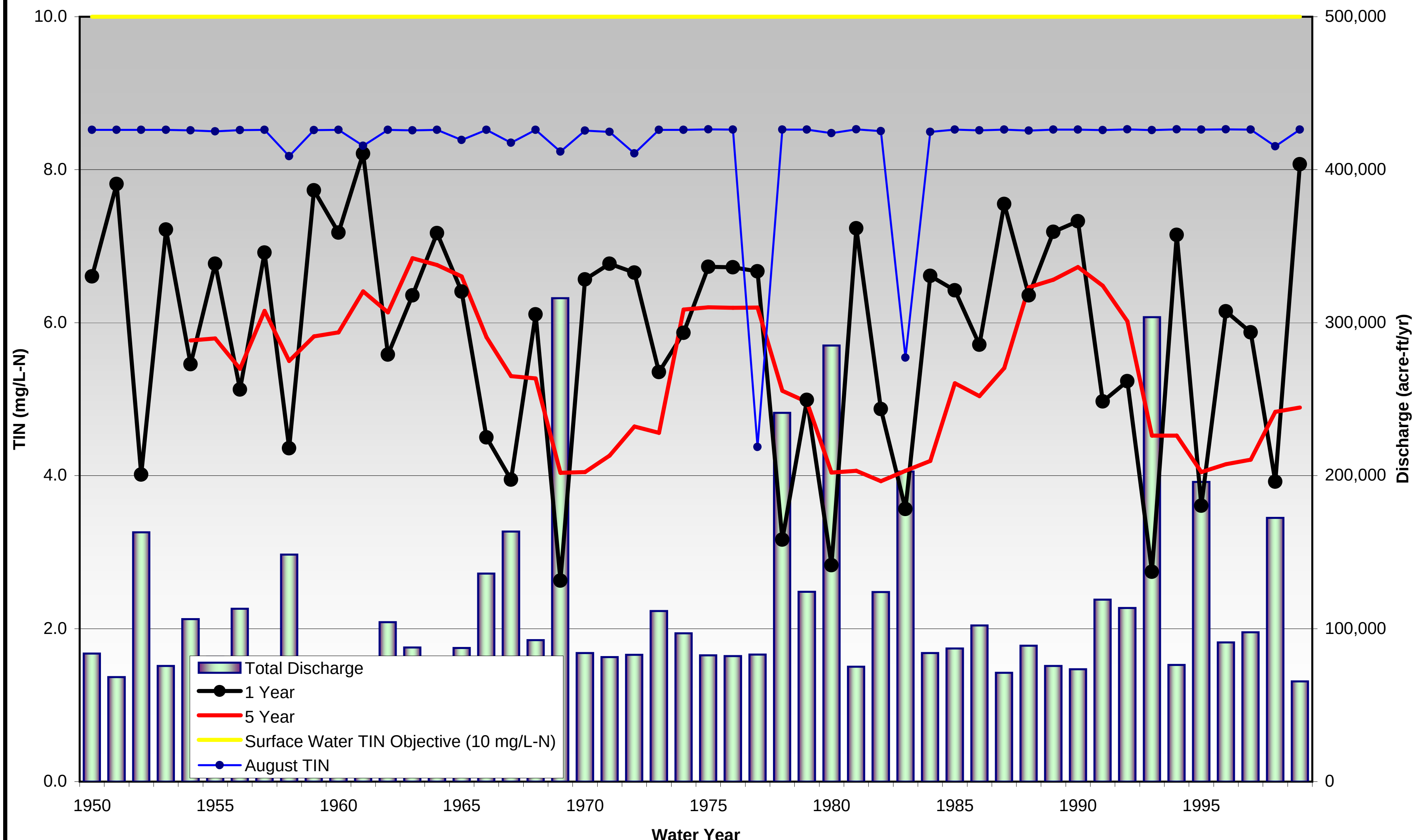
Figure B-7b

Estimated Annual Discharge and its Volume Weighted TIN Concentration in Santa Ana River Flow at below Prado

Scenario 2 - Year 2010



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Appendix C

Scenario 2, Year 2020 Simulation Results (Summary Matrices and Graphs)

Table C-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 2 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	643				4.7			
1951	661	652			4.8	4.8		
1952	560	606	618		4.1	4.4	4.5	
1953	651	602	620		4.8	4.4	4.5	
1954	613	632	606	623	4.5	4.6	4.4	4.5
1955	641	627	635	623	4.7	4.6	4.6	4.5
1956	629	634	627	617	4.6	4.6	4.6	4.5
1957	648	638	639	636	4.7	4.7	4.7	4.6
1958	567	605	613	618	4.1	4.4	4.5	4.5
1959	667	614	625	629	4.9	4.5	4.6	4.6
1960	656	662	627	631	4.8	4.8	4.6	4.6
1961	672	664	665	640	4.9	4.9	4.9	4.7
1962	619	645	649	634	4.5	4.7	4.7	4.6
1963	637	628	642	650	4.7	4.6	4.7	4.8
1964	656	646	637	648	4.8	4.7	4.7	4.7
1965	638	647	643	644	4.7	4.7	4.7	4.7
1966	590	613	626	627	4.3	4.5	4.6	4.6
1967	565	577	596	615	4.1	4.2	4.3	4.5
1968	638	599	596	615	4.7	4.4	4.3	4.5
1969	474	545	551	574	3.3	3.9	4.0	4.2
1970	646	548	575	576	4.7	3.9	4.2	4.2
1971	646	646	577	586	4.7	4.7	4.2	4.2
1972	650	648	648	602	4.8	4.7	4.7	4.4
1973	614	632	637	598	4.5	4.6	4.6	4.3
1974	629	621	631	637	4.6	4.5	4.6	4.6
1975	648	638	630	637	4.7	4.7	4.6	4.7
1976	639	643	638	636	4.7	4.7	4.7	4.6
1977	652	645	646	636	4.8	4.7	4.7	4.6
1978	495	563	587	606	3.5	4.1	4.2	4.4
1979	594	540	573	600	4.3	3.9	4.1	4.3
1980	497	541	525	567	3.4	3.8	3.7	4.1
1981	658	566	575	570	4.8	4.0	4.1	4.1
1982	592	624	575	560	4.3	4.6	4.1	4.0
1983	527	558	589	568	3.7	4.0	4.2	4.1
1984	641	580	584	577	4.7	4.2	4.2	4.1
1985	639	640	599	608	4.7	4.7	4.3	4.4
1986	627	633	636	603	4.6	4.6	4.6	4.4
1987	663	645	643	616	4.9	4.7	4.7	4.5
1988	643	653	644	643	4.7	4.8	4.7	4.7
1989	657	650	654	646	4.8	4.7	4.8	4.7
1990	653	655	651	648	4.8	4.8	4.8	4.7
1991	608	630	639	644	4.4	4.6	4.7	4.7
1992	607	608	622	633	4.4	4.4	4.5	4.6
1993	465	527	552	589	3.2	3.7	3.9	4.3
1994	650	542	562	588	4.8	3.9	4.0	4.2
1995	535	587	540	565	3.8	4.2	3.8	4.1
1996	644	585	605	571	4.7	4.2	4.4	4.1
1997	620	632	596	573	4.5	4.6	4.3	4.1
1998	541	578	599	594	3.9	4.2	4.4	4.3
1999	667	598	605	597	4.9	4.3	4.4	4.3

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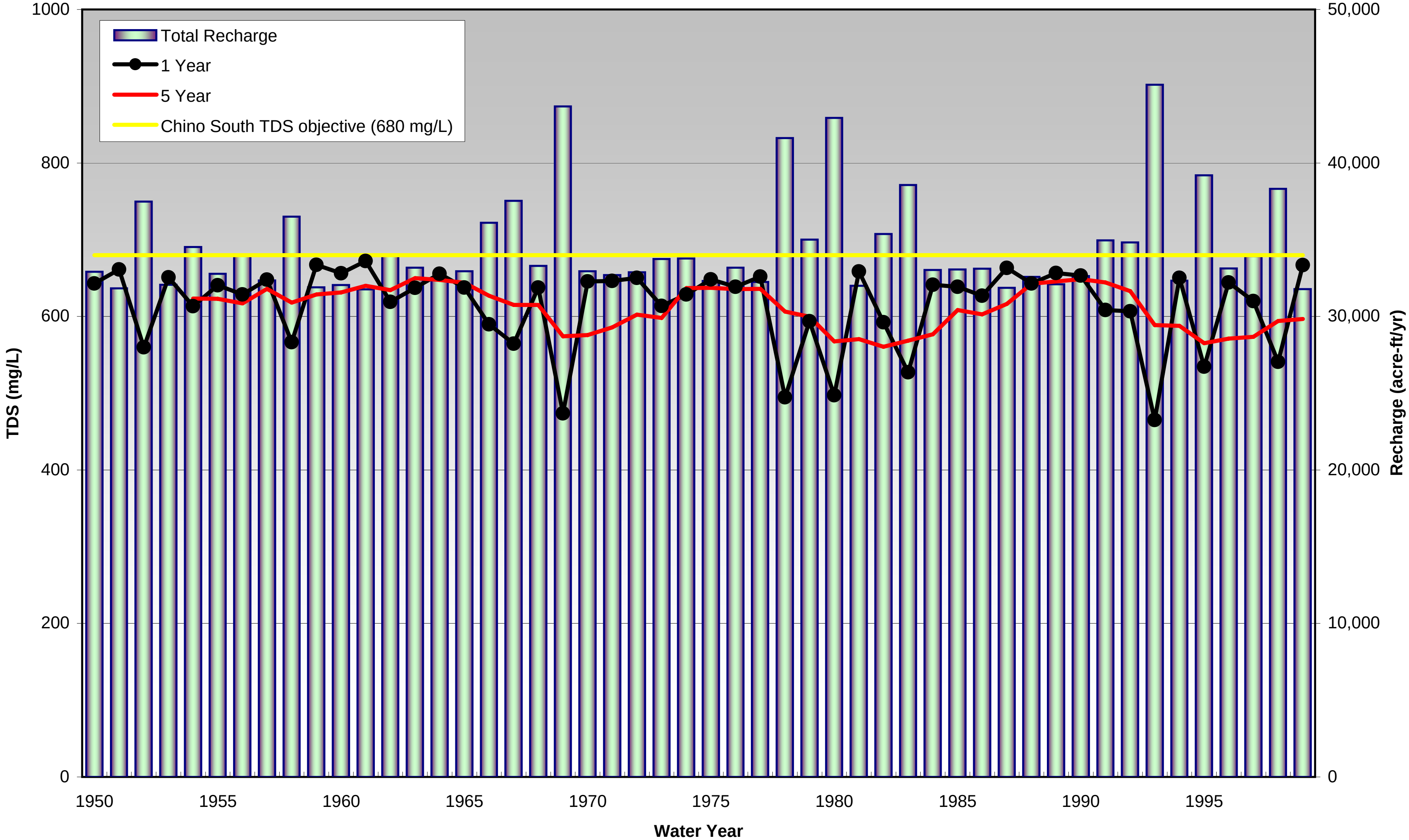
Figure C-1a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 3 Over the Chino South Management Zone
Scenario 2 - Year 2020



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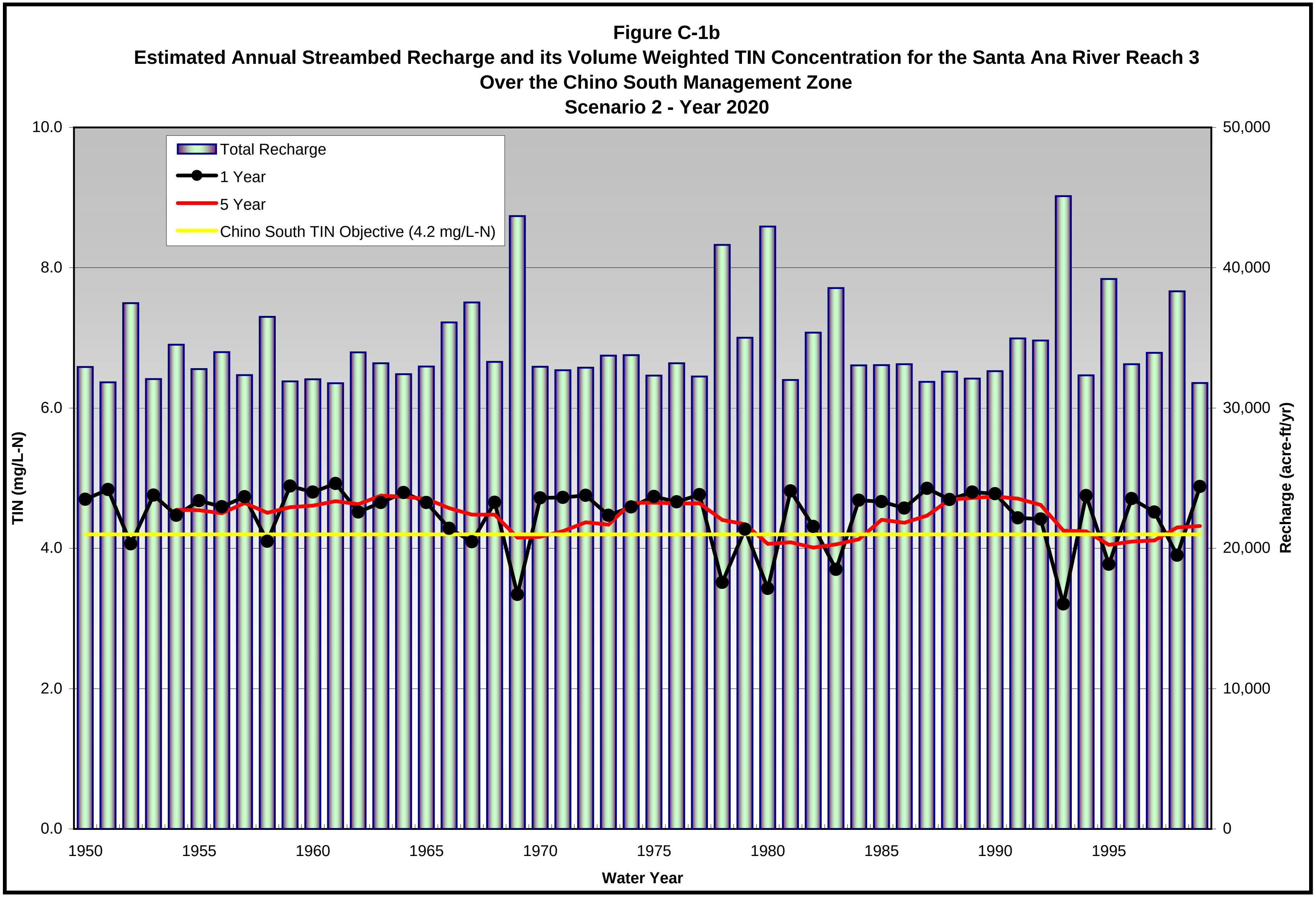

R_S220a_matrix.xls -- Fig 1b

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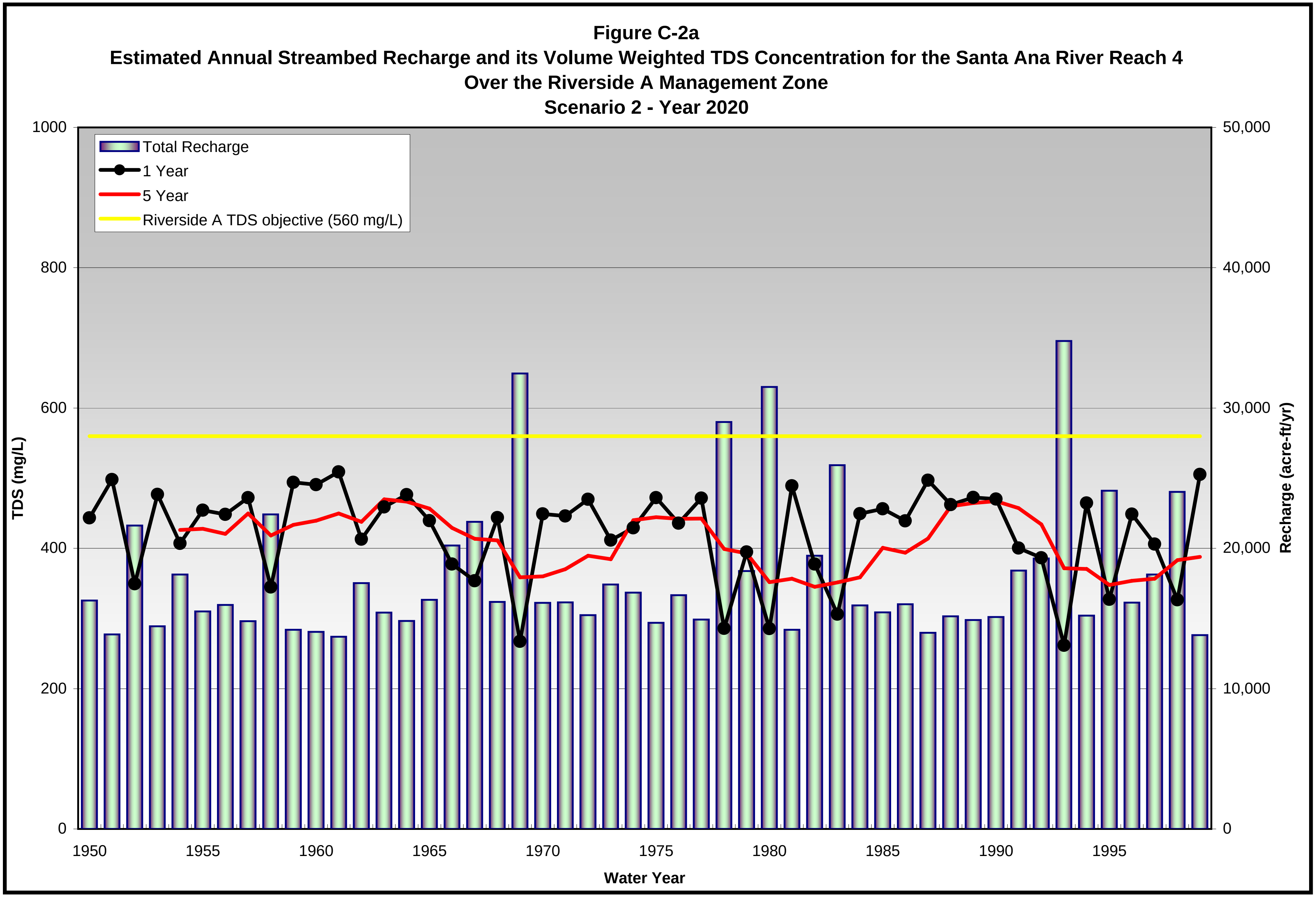
Table C-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 2 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	498	469			7.0	6.5		
1952	350	408	419		4.7	5.6	5.7	
1953	477	400	428		6.6	5.4	5.9	
1954	407	438	403	426	5.5	6.0	5.5	5.8
1955	454	429	443	428	6.3	5.9	6.1	5.9
1956	448	451	435	421	6.2	6.3	6.0	5.8
1957	472	460	458	450	6.5	6.4	6.4	6.2
1958	345	396	411	418	4.5	5.3	5.6	5.7
1959	494	403	423	434	6.9	5.4	5.8	5.9
1960	491	492	427	440	6.8	6.9	5.8	6.0
1961	509	500	498	450	7.2	7.0	7.0	6.2
1962	413	455	466	438	5.6	6.3	6.5	6.0
1963	459	434	456	470	6.4	6.0	6.3	6.5
1964	477	468	448	467	6.6	6.5	6.2	6.5
1965	439	457	458	457	6.0	6.3	6.3	6.3
1966	377	405	426	429	5.1	5.5	5.8	5.9
1967	354	365	386	414	4.7	4.9	5.2	5.6
1968	444	392	387	411	6.1	5.3	5.2	5.6
1969	267	326	335	359	3.2	4.1	4.3	4.7
1970	449	328	357	360	6.2	4.2	4.7	4.7
1971	446	448	357	370	6.1	6.2	4.7	4.9
1972	470	458	455	390	6.5	6.3	6.3	5.2
1973	412	439	441	385	5.6	6.0	6.1	5.1
1974	429	420	435	440	5.9	5.7	6.0	6.1
1975	472	449	436	444	6.6	6.2	6.0	6.1
1976	436	453	445	442	6.0	6.3	6.1	6.1
1977	472	453	459	442	6.6	6.3	6.4	6.1
1978	286	349	373	399	3.5	4.5	4.9	5.4
1979	395	328	363	393	5.3	4.2	4.8	5.3
1980	286	326	311	352	3.5	4.1	3.9	4.6
1981	489	349	362	357	6.8	4.5	4.7	4.7
1982	378	425	357	345	5.1	5.8	4.7	4.5
1983	306	337	373	352	3.9	4.4	5.0	4.6
1984	449	361	366	359	6.2	4.8	4.9	4.7
1985	456	453	386	401	6.3	6.3	5.2	5.4
1986	439	448	448	394	6.0	6.2	6.2	5.3
1987	497	466	463	414	6.9	6.5	6.4	5.6
1988	462	479	465	460	6.4	6.7	6.4	6.4
1989	473	467	477	465	6.6	6.5	6.6	6.4
1990	470	471	468	467	6.5	6.5	6.5	6.5
1991	400	432	444	457	5.4	5.9	6.1	6.3
1992	387	393	415	434	5.2	5.3	5.7	6.0
1993	262	306	330	371	3.1	3.8	4.2	4.9
1994	464	323	341	371	6.4	4.1	4.4	4.9
1995	327	380	325	348	4.2	5.1	4.1	4.5
1996	449	376	400	354	6.2	5.0	5.4	4.6
1997	406	426	385	357	5.5	5.8	5.1	4.7
1998	327	361	385	383	4.2	4.7	5.1	5.1
1999	505	392	396	388	7.1	5.2	5.3	5.2



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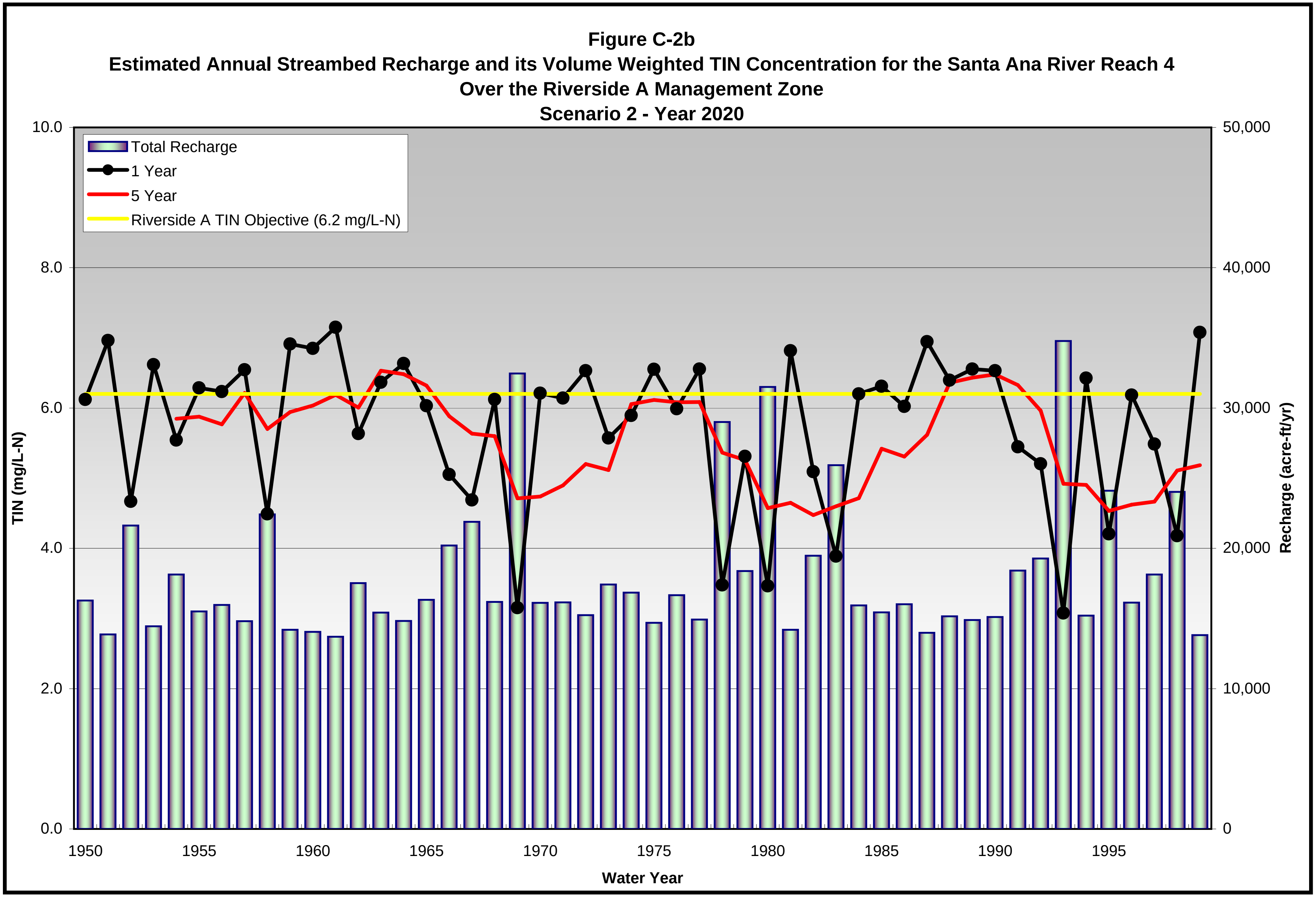


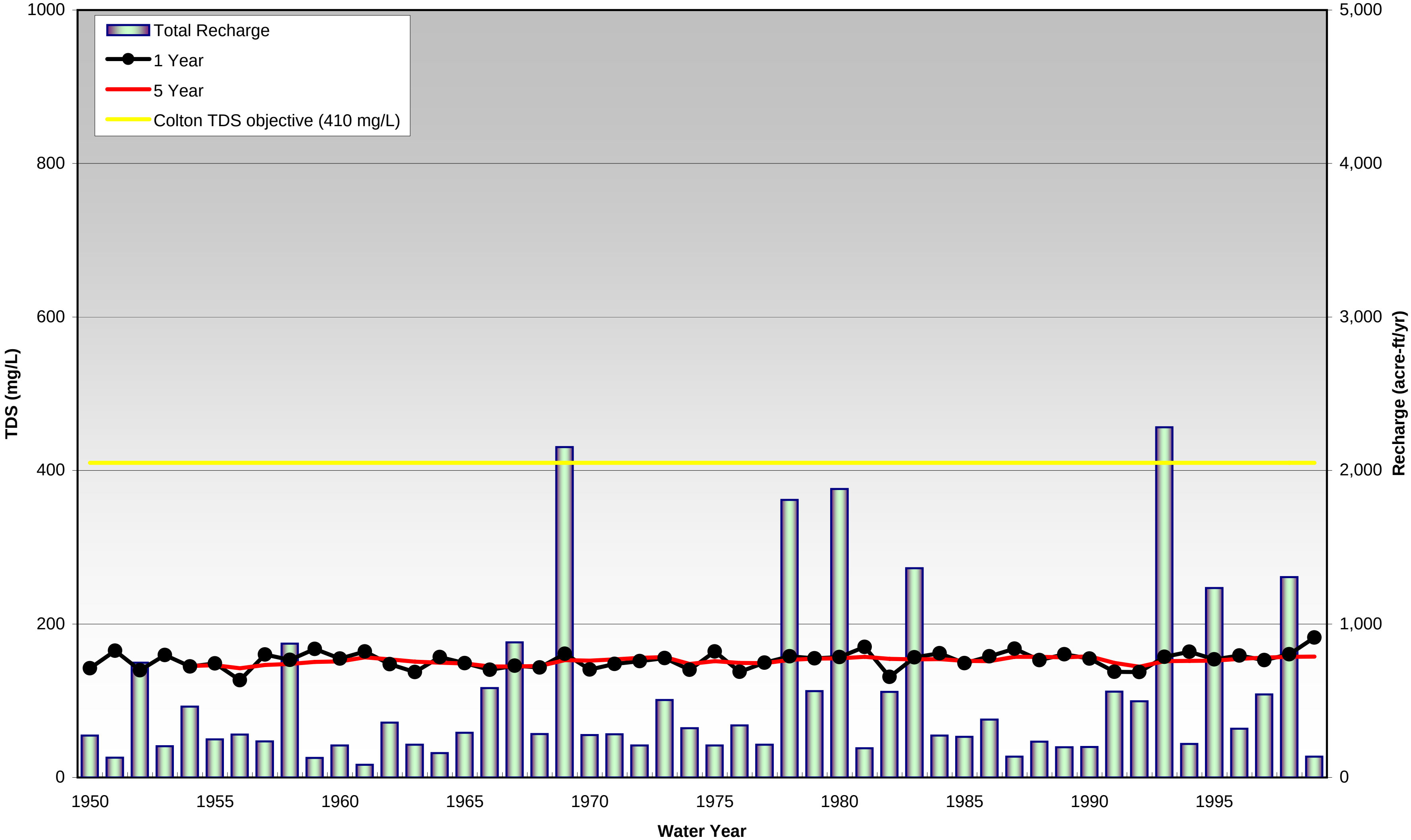
R_S220a_matrix.xls -- Fig 2b

WILDERMUTH™ ENVIRONMENTAL INC.

Table C-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 2 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	142				1.1			
1951	165	150			1.3	1.2		
1952	140	143	143		1.1	1.1	1.1	
1953	160	144	146		1.2	1.1	1.2	
1954	144	149	144	145	1.1	1.2	1.1	1.2
1955	149	146	149	146	1.2	1.2	1.2	1.2
1956	127	137	141	142	1.0	1.1	1.1	1.1
1957	160	142	144	146	1.2	1.1	1.1	1.2
1958	153	155	149	148	1.2	1.2	1.2	1.2
1959	168	155	156	150	1.3	1.2	1.2	1.2
1960	155	160	155	151	1.2	1.2	1.2	1.2
1961	164	158	161	156	1.3	1.2	1.2	1.2
1962	147	151	152	154	1.2	1.2	1.2	1.2
1963	137	144	146	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	149	152	147	148	1.2	1.2	1.2	1.2
1966	140	143	145	145	1.1	1.1	1.1	1.1
1967	146	143	144	145	1.1	1.1	1.1	1.1
1968	143	145	143	145	1.1	1.1	1.1	1.1
1969	161	159	155	153	1.2	1.2	1.2	1.2
1970	141	159	157	152	1.1	1.2	1.2	1.2
1971	148	144	158	154	1.2	1.2	1.2	1.2
1972	152	150	146	156	1.2	1.2	1.2	1.2
1973	156	154	153	157	1.2	1.2	1.2	1.2
1974	140	150	150	148	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	145	149	1.1	1.1	1.1	1.2
1977	150	142	148	149	1.2	1.1	1.2	1.2
1978	158	157	154	153	1.2	1.2	1.2	1.2
1979	155	157	157	155	1.2	1.2	1.2	1.2
1980	157	156	157	155	1.2	1.2	1.2	1.2
1981	170	158	157	157	1.3	1.2	1.2	1.2
1982	131	141	152	155	1.1	1.1	1.2	1.2
1983	156	149	151	154	1.2	1.2	1.2	1.2
1984	162	157	151	154	1.2	1.2	1.2	1.2
1985	149	155	156	152	1.1	1.2	1.2	1.2
1986	158	154	156	151	1.2	1.2	1.2	1.2
1987	168	161	157	157	1.3	1.2	1.2	1.2
1988	153	158	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	142	146	149	1.1	1.1	1.2	1.2
1992	137	137	140	144	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	154	152	1.2	1.2	1.2	1.2
1995	154	155	156	152	1.2	1.2	1.2	1.2
1996	159	155	156	154	1.2	1.2	1.2	1.2
1997	153	155	154	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	162	160	158	1.4	1.2	1.2	1.2

Figure C-3a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Colton Management Zone
Scenario 2 - Year 2020



R_S220a_matrix.xls -- Fig 3a

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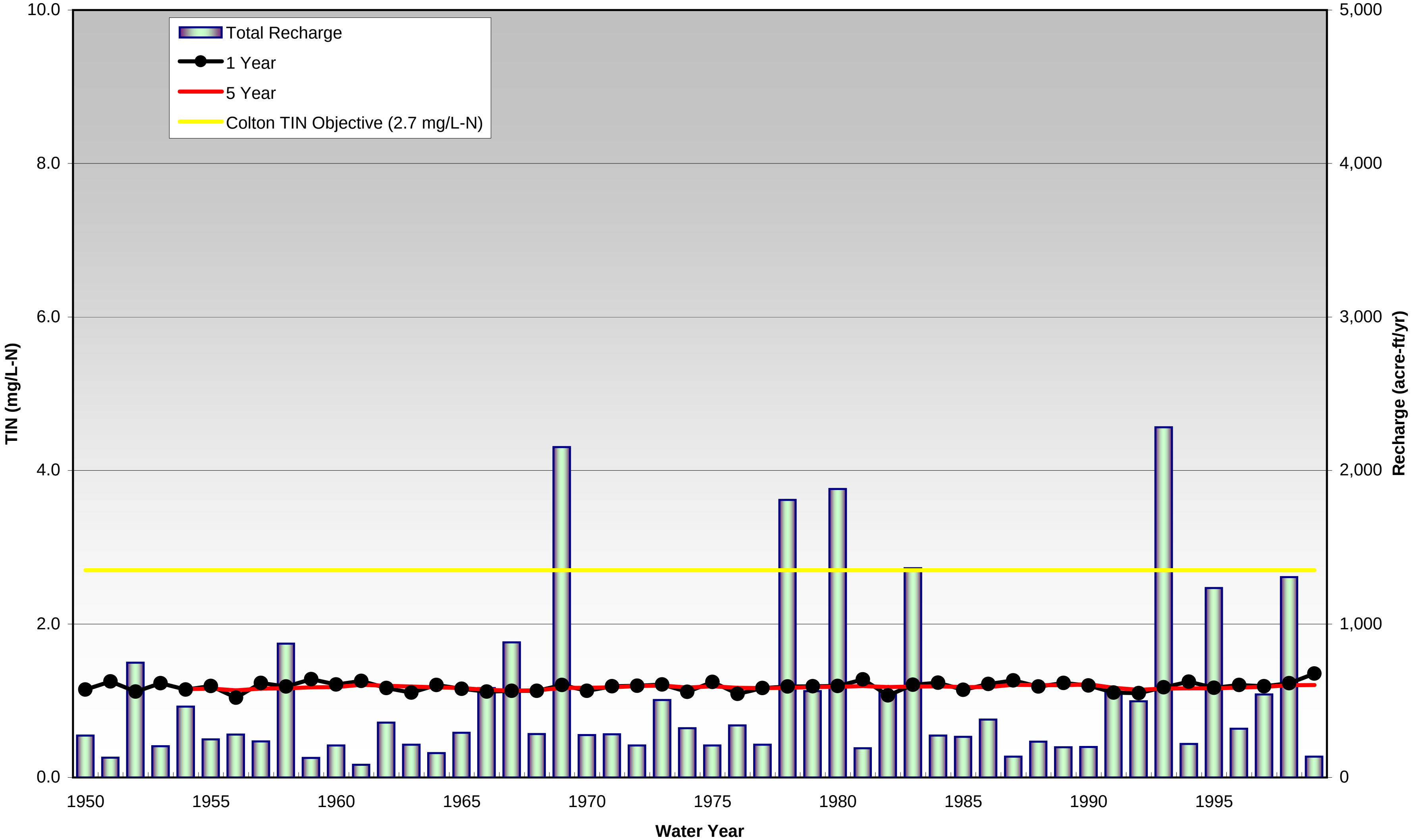
Figure C-3b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Colton Management Zone
Scenario 2 - Year 2020



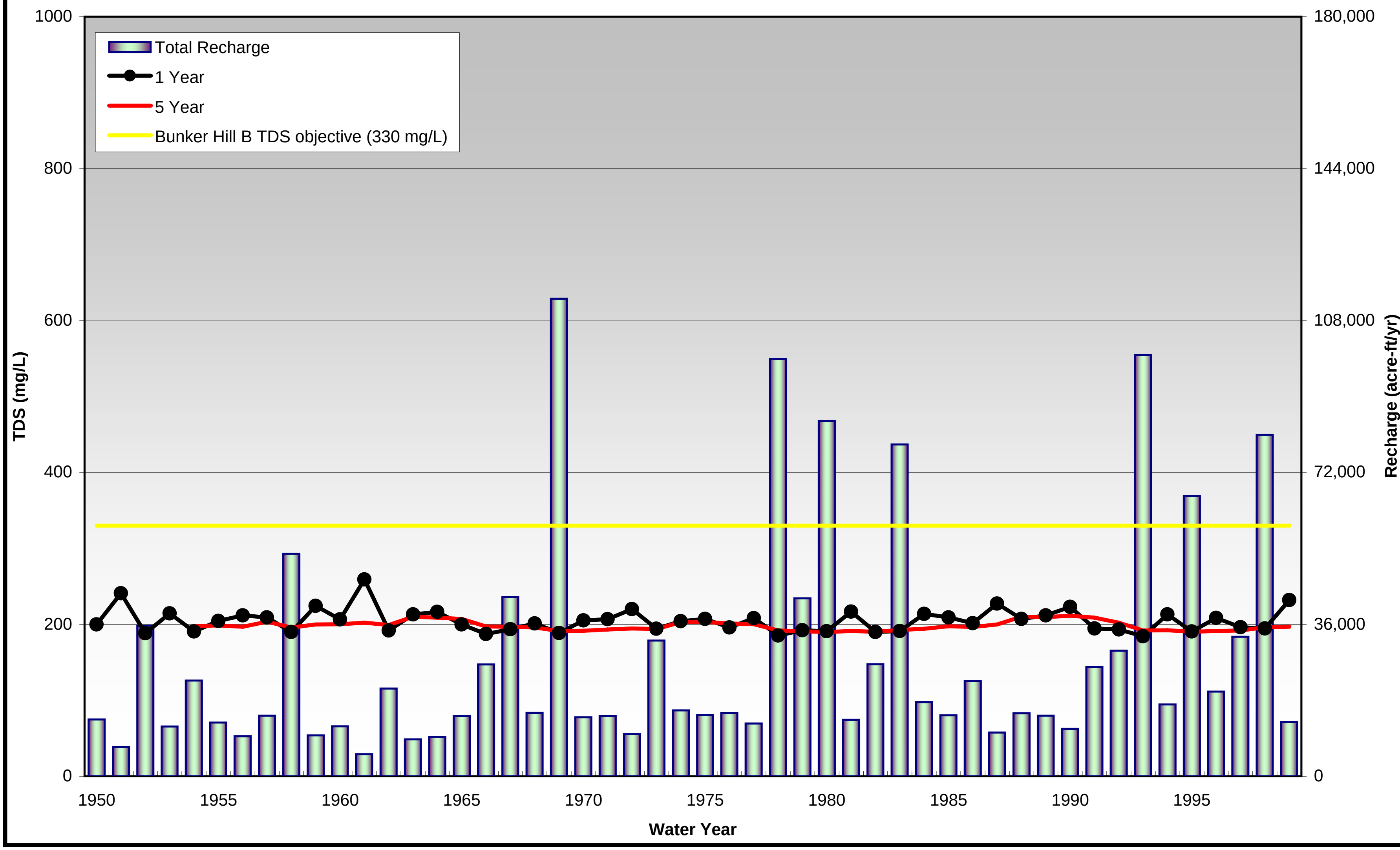
R_S220a_matrix.xls -- Fig 3b

WILDERMUTH ENVIRONMENTAL INC.

Table C-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 2 - Year 2020
(mg/L)

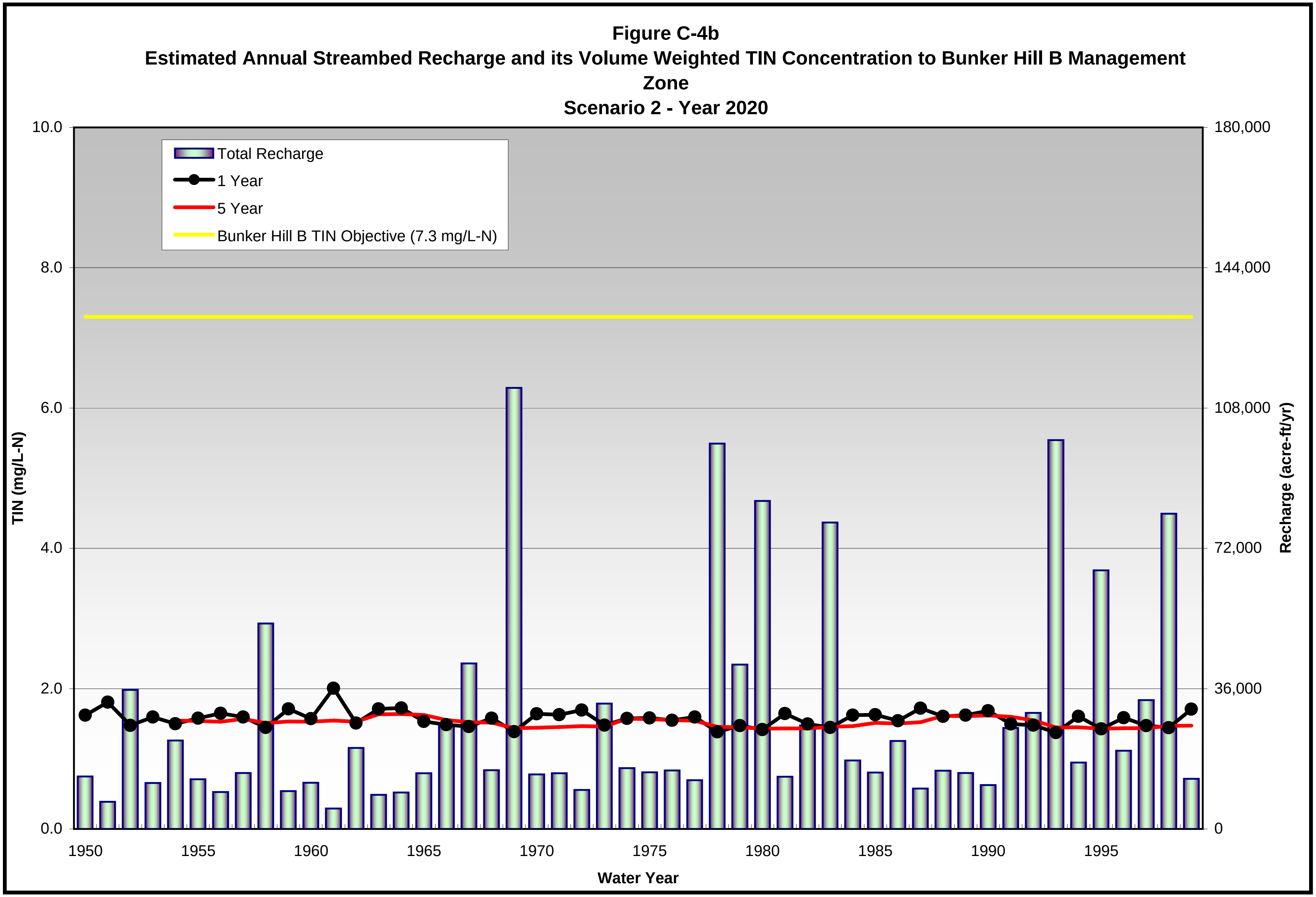
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	200				1.6			
1951	241	214			1.8	1.7		
1952	188	197	197		1.5	1.5	1.6	
1953	214	195	201		1.6	1.5	1.5	
1954	191	199	193	198	1.5	1.5	1.5	1.5
1955	204	196	200	199	1.6	1.5	1.5	1.5
1956	212	208	199	197	1.6	1.6	1.6	1.5
1957	209	210	208	204	1.6	1.6	1.6	1.6
1958	190	194	196	196	1.4	1.5	1.5	1.5
1959	224	195	198	200	1.7	1.5	1.5	1.5
1960	207	215	197	200	1.6	1.6	1.5	1.5
1961	259	223	223	202	2.0	1.7	1.7	1.5
1962	192	206	206	199	1.5	1.6	1.6	1.5
1963	213	198	207	210	1.7	1.6	1.6	1.6
1964	217	215	203	209	1.7	1.7	1.6	1.6
1965	200	207	208	207	1.5	1.6	1.6	1.6
1966	187	192	196	197	1.5	1.5	1.5	1.6
1967	194	191	193	197	1.5	1.5	1.5	1.5
1968	201	196	193	196	1.6	1.5	1.5	1.5
1969	189	190	191	191	1.4	1.4	1.4	1.4
1970	205	190	192	192	1.6	1.4	1.4	1.4
1971	207	206	192	193	1.6	1.6	1.4	1.5
1972	220	212	210	195	1.7	1.7	1.6	1.5
1973	194	200	202	194	1.5	1.5	1.6	1.5
1974	204	197	201	203	1.6	1.5	1.5	1.6
1975	207	206	200	203	1.6	1.6	1.5	1.6
1976	196	201	202	201	1.6	1.6	1.6	1.6
1977	208	201	203	200	1.6	1.6	1.6	1.5
1978	185	188	189	192	1.4	1.4	1.4	1.5
1979	192	187	189	191	1.5	1.4	1.4	1.4
1980	191	191	189	190	1.4	1.4	1.4	1.4
1981	217	195	194	191	1.6	1.4	1.5	1.4
1982	190	199	194	190	1.5	1.5	1.5	1.4
1983	191	191	194	193	1.4	1.5	1.5	1.5
1984	214	195	194	194	1.6	1.5	1.5	1.5
1985	209	212	197	198	1.6	1.6	1.5	1.5
1986	201	204	207	197	1.5	1.6	1.6	1.5
1987	227	210	209	200	1.7	1.6	1.6	1.5
1988	207	215	209	210	1.6	1.7	1.6	1.6
1989	212	209	214	209	1.6	1.6	1.6	1.6
1990	223	217	213	212	1.7	1.6	1.6	1.6
1991	195	203	206	209	1.5	1.6	1.6	1.6
1992	193	194	199	202	1.5	1.5	1.5	1.5
1993	184	186	188	192	1.4	1.4	1.4	1.4
1994	213	189	190	192	1.6	1.4	1.4	1.4
1995	190	195	189	190	1.4	1.5	1.4	1.4
1996	208	195	198	191	1.6	1.5	1.5	1.4
1997	196	201	195	192	1.5	1.5	1.5	1.4
1998	194	195	197	196	1.4	1.5	1.5	1.5
1999	232	200	199	197	1.7	1.5	1.5	1.5

Figure C-4a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Bunker Hill B Management Zone
Scenario 2 - Year 2020



R_S220a_matrix.xls -- Fig 4a

WILDERMUTH ENVIRONMENTAL INC.



R_S220a_matrix.xls -- Fig 4b

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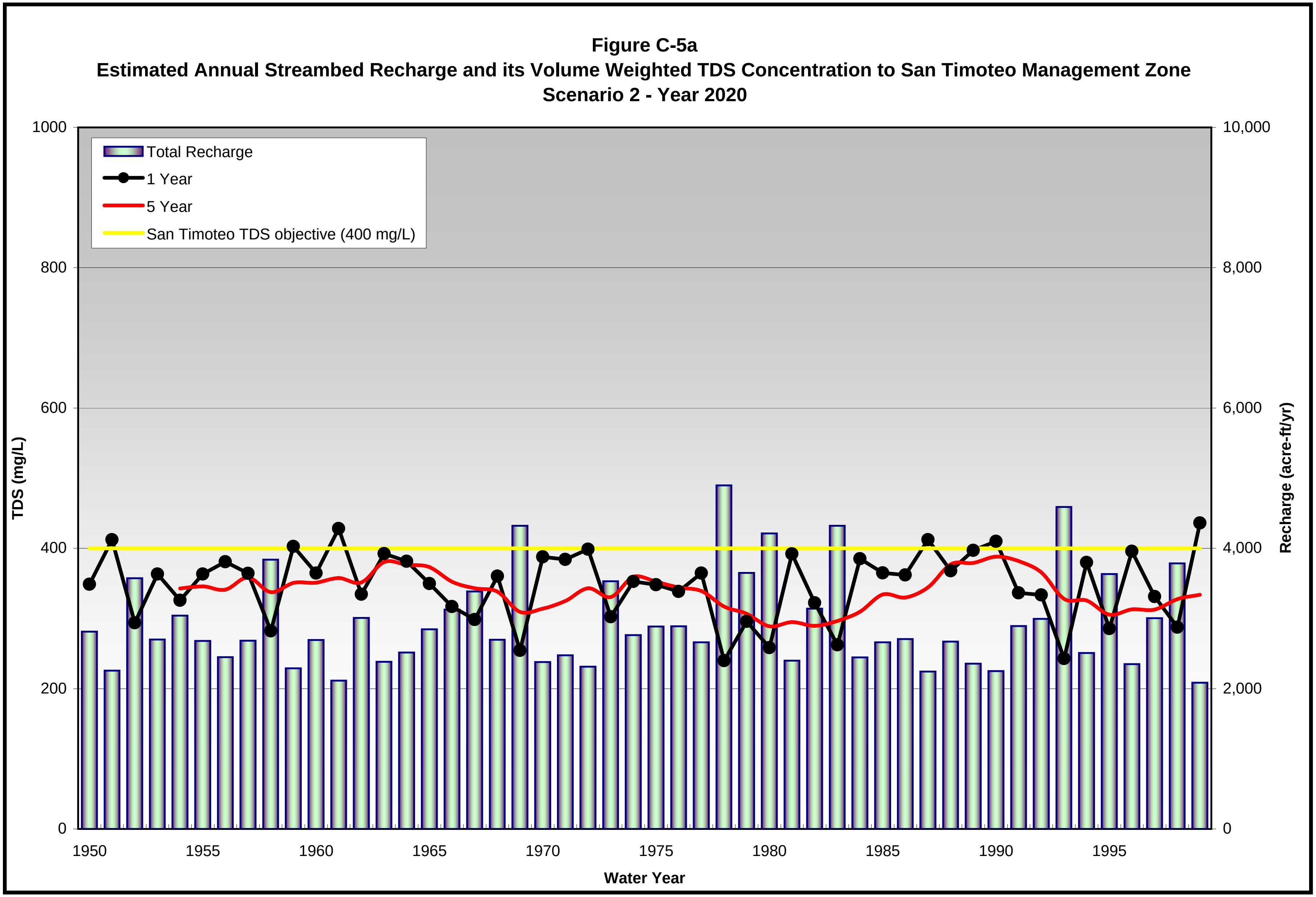
Table C-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 2 - Year 2020
(mg/L)

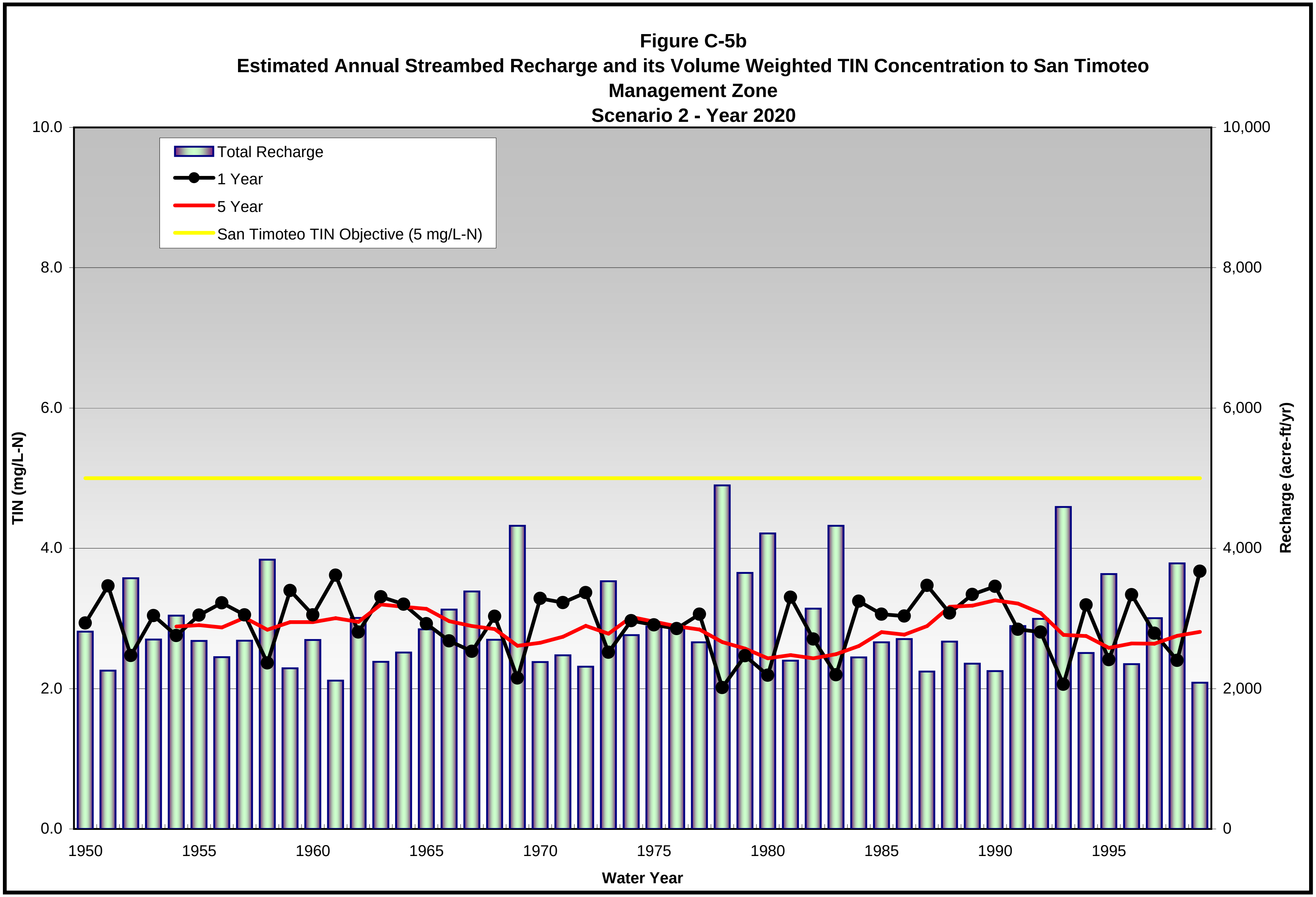
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	349				2.9			
1951	412	377			3.5	3.2		
1952	294	340	343		2.5	2.9	2.9	
1953	363	324	347		3.0	2.7	2.9	
1954	326	344	324	343	2.8	2.9	2.7	2.9
1955	363	343	350	346	3.0	2.9	2.9	2.9
1956	381	372	355	341	3.2	3.1	3.0	2.9
1957	364	372	369	358	3.1	3.1	3.1	3.0
1958	282	316	334	338	2.4	2.6	2.8	2.8
1959	403	327	339	351	3.4	2.8	2.8	2.9
1960	365	382	339	351	3.1	3.2	2.8	2.9
1961	428	393	396	358	3.6	3.3	3.3	3.0
1962	335	373	370	351	2.8	3.1	3.1	3.0
1963	392	360	379	380	3.3	3.0	3.2	3.2
1964	382	387	367	377	3.2	3.3	3.1	3.2
1965	350	365	373	373	2.9	3.1	3.1	3.1
1966	317	333	347	352	2.7	2.8	2.9	3.0
1967	298	307	320	343	2.5	2.6	2.7	2.9
1968	360	326	323	338	3.0	2.8	2.7	2.8
1969	255	295	296	310	2.2	2.5	2.5	2.6
1970	388	302	319	314	3.3	2.6	2.7	2.7
1971	384	386	324	325	3.2	3.3	2.7	2.7
1972	399	391	390	343	3.4	3.3	3.3	2.9
1973	302	341	354	331	2.5	2.9	3.0	2.8
1974	353	324	344	359	3.0	2.7	2.9	3.0
1975	348	350	332	352	2.9	2.9	2.8	3.0
1976	338	343	346	344	2.9	2.9	2.9	2.9
1977	365	351	350	339	3.1	3.0	2.9	2.8
1978	240	284	299	317	2.0	2.4	2.5	2.7
1979	296	264	288	307	2.5	2.2	2.4	2.6
1980	259	276	262	289	2.2	2.3	2.2	2.4
1981	392	307	303	295	3.3	2.6	2.5	2.5
1982	322	353	312	289	2.7	3.0	2.6	2.4
1983	262	288	313	297	2.2	2.4	2.6	2.5
1984	385	307	312	310	3.2	2.6	2.6	2.6
1985	365	375	323	334	3.1	3.1	2.7	2.8
1986	362	363	370	330	3.0	3.0	3.1	2.8
1987	412	385	378	344	3.5	3.2	3.2	2.9
1988	368	388	379	377	3.1	3.3	3.2	3.2
1989	397	382	391	379	3.3	3.2	3.3	3.2
1990	410	403	390	388	3.5	3.4	3.3	3.3
1991	337	369	378	382	2.8	3.1	3.2	3.2
1992	334	335	356	366	2.8	2.8	3.0	3.1
1993	243	279	295	328	2.1	2.4	2.5	2.8
1994	380	291	304	326	3.2	2.5	2.6	2.7
1995	286	324	289	306	2.4	2.7	2.4	2.6
1996	396	329	344	313	3.3	2.8	2.9	2.6
1997	331	360	330	313	2.8	3.0	2.8	2.6
1998	288	307	330	328	2.4	2.6	2.8	2.8
1999	436	340	337	334	3.7	2.9	2.8	2.8

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan



R_S220a_matrix.xls -- Fig 5a

WILDERMUTH ENVIRONMENTAL INC.

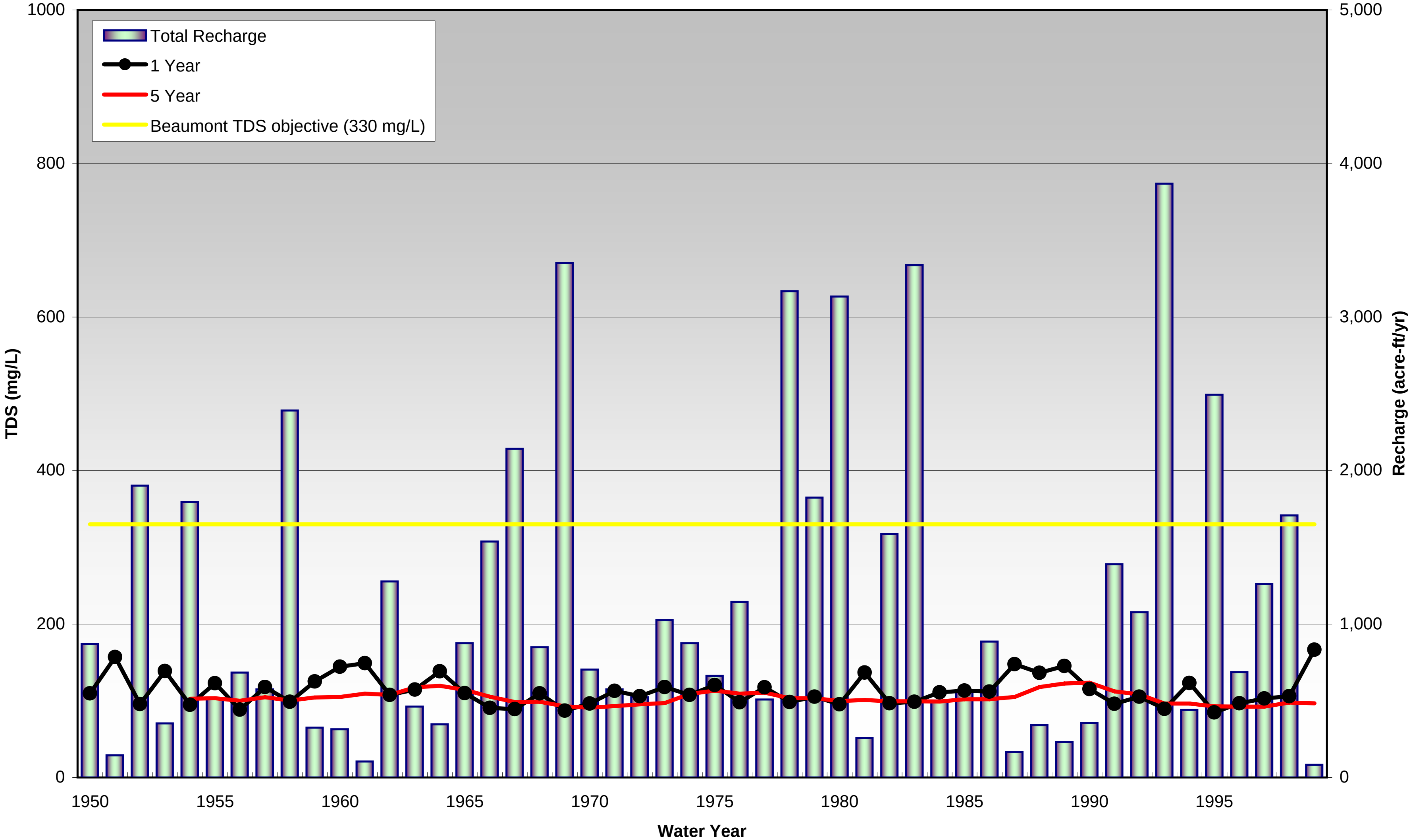


R_S220a_matrix.xls -- Fig 5b

Table C-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 2 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8

Figure C-6a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Beaumont Management Zone
Scenario 2 - Year 2020



R_S220a_matrix.xls -- Fig 6a

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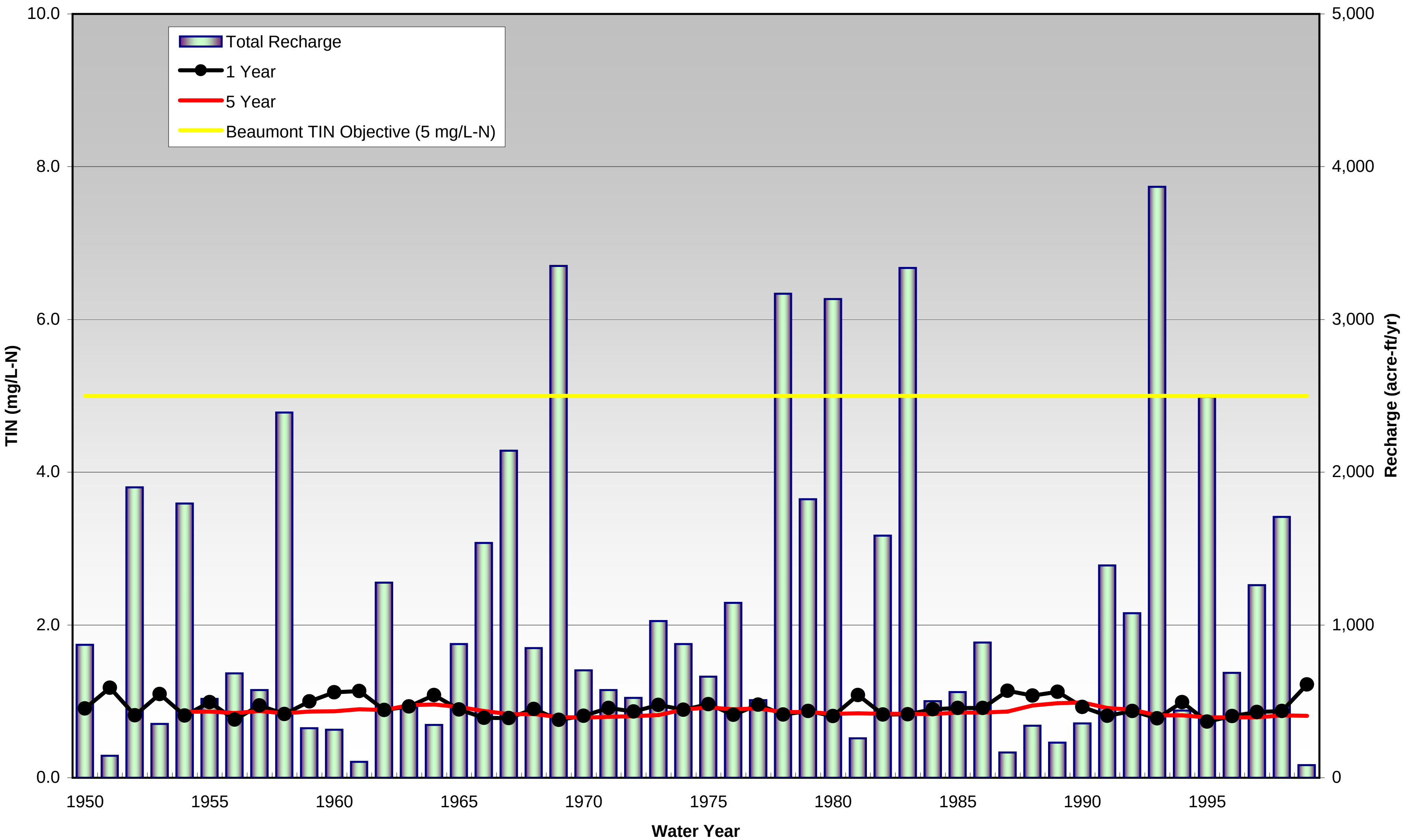
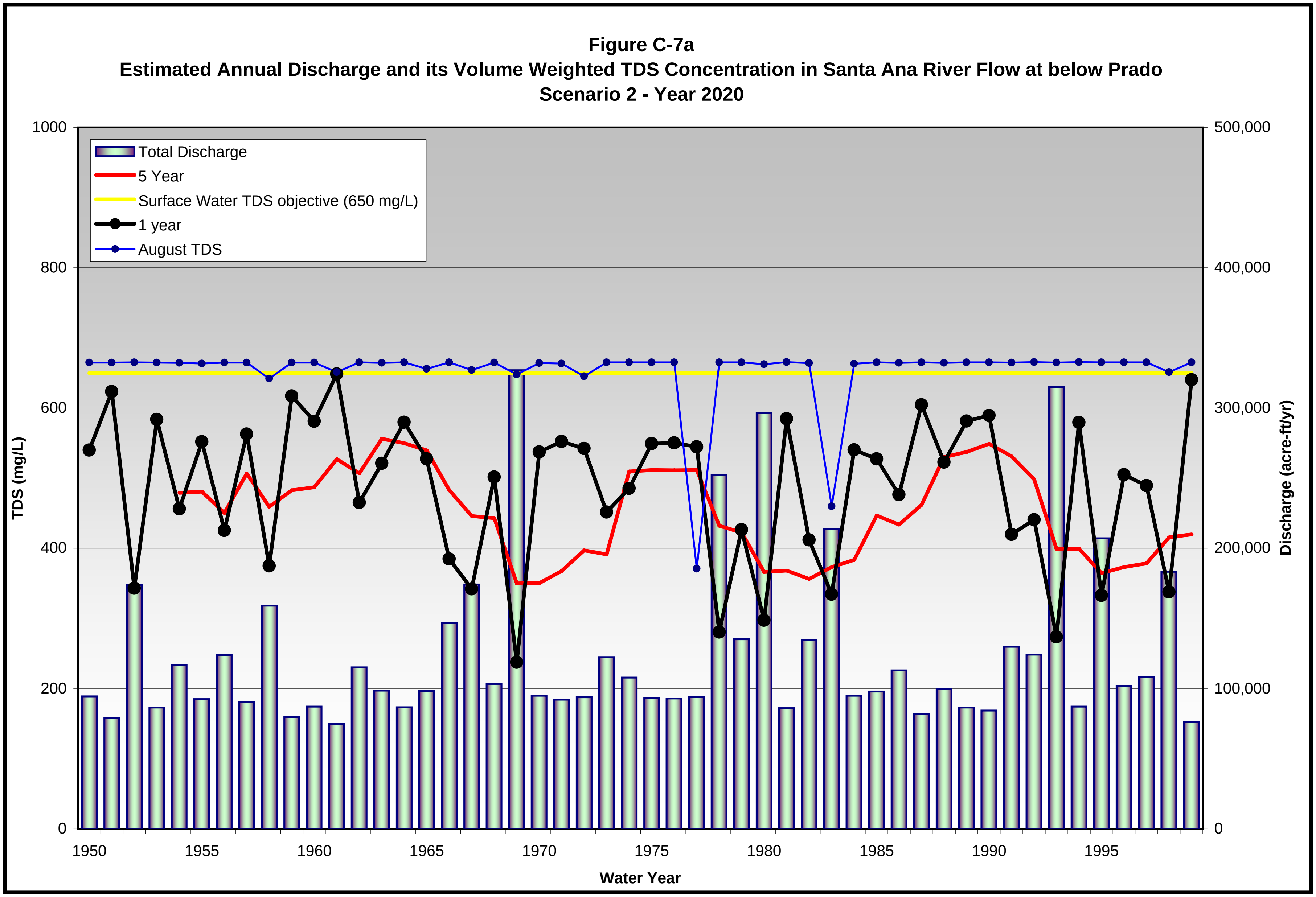
Figure C-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 2 - Year 2020



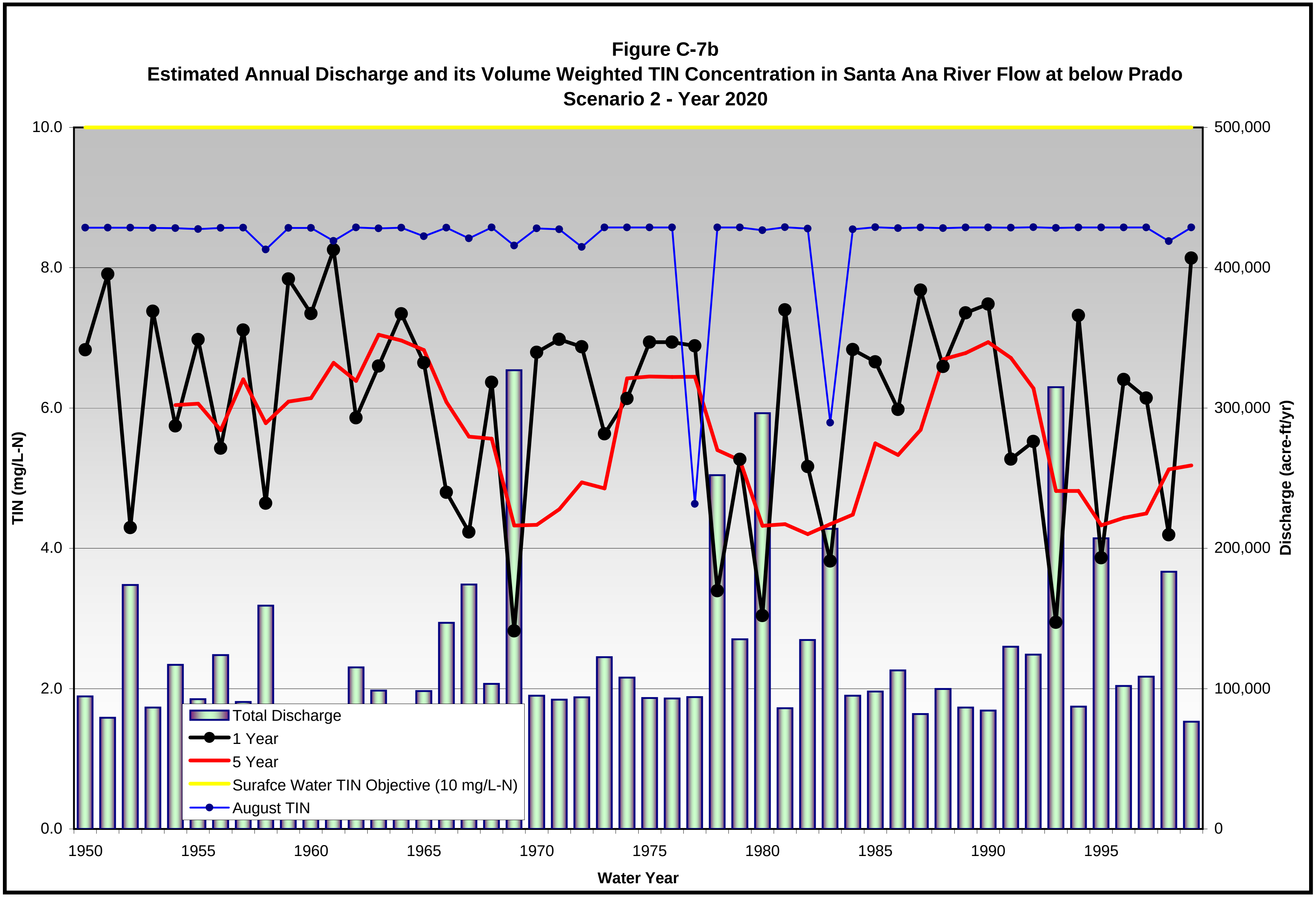
R_S220a_matrix.xls -- Fig 6b

Table C-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 2 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	540				665	6.8				8.6
1951	623	578			665	7.9	7.3			8.6
1952	343	431	461		665	4.3	5.4	5.8		8.6
1953	584	423	470		665	7.4	5.3	5.9		8.6
1954	456	511	433	479	664	5.7	6.4	5.5	6.0	8.6
1955	552	499	524	481	664	7.0	6.3	6.6	6.1	8.6
1956	426	480	471	450	665	5.4	6.1	6.0	5.7	8.6
1957	563	484	504	507	665	7.1	6.1	6.4	6.4	8.6
1958	375	443	437	459	642	4.6	5.5	5.5	5.8	8.3
1959	617	456	485	483	665	7.8	5.7	6.1	6.1	8.6
1960	581	598	489	487	665	7.3	7.6	6.1	6.1	8.6
1961	649	612	614	527	651	8.3	7.8	7.8	6.6	8.4
1962	465	537	551	507	665	5.9	6.8	7.0	6.4	8.6
1963	521	491	532	556	664	6.6	6.2	6.7	7.0	8.6
1964	580	549	517	550	665	7.3	6.9	6.5	7.0	8.6
1965	528	552	541	540	656	6.6	7.0	6.8	6.8	8.4
1966	385	442	478	483	665	4.8	5.5	6.0	6.1	8.6
1967	342	362	401	446	654	4.2	4.5	5.0	5.6	8.4
1968	501	402	396	443	665	6.4	5.0	4.9	5.6	8.6
1969	238	301	313	350	648	2.8	3.7	3.8	4.3	8.3
1970	538	305	344	351	664	6.8	3.7	4.2	4.3	8.6
1971	552	545	349	368	663	7.0	6.9	4.3	4.6	8.5
1972	542	547	544	397	645	6.9	6.9	6.9	4.9	8.3
1973	452	491	509	391	665	5.6	6.2	6.4	4.9	8.6
1974	485	467	489	510	665	6.1	5.9	6.2	6.4	8.6
1975	549	515	491	512	665	6.9	6.5	6.2	6.5	8.6
1976	550	550	526	511	665	6.9	6.9	6.6	6.4	8.6
1977	545	547	548	512	371	6.9	6.9	6.9	6.4	4.6
1978	281	352	394	432	665	3.4	4.3	4.9	5.4	8.6
1979	427	332	373	422	665	5.3	4.0	4.6	5.3	8.6
1980	298	338	317	366	662	3.0	3.7	3.6	4.3	8.5
1981	585	362	379	368	665	7.4	4.0	4.3	4.3	8.6
1982	412	479	375	356	664	5.2	6.0	4.3	4.2	8.6
1983	334	364	408	373	460	3.8	4.3	4.9	4.3	5.8
1984	540	398	402	384	663	6.8	4.7	4.9	4.5	8.5
1985	528	534	429	447	665	6.7	6.7	5.2	5.5	8.6
1986	476	500	513	434	664	6.0	6.3	6.5	5.3	8.6
1987	605	530	529	462	665	7.7	6.7	6.7	5.7	8.6
1988	523	560	528	530	664	6.6	7.1	6.7	6.7	8.6
1989	581	550	567	537	665	7.4	6.9	7.2	6.8	8.6
1990	589	585	562	549	665	7.5	7.4	7.1	6.9	8.6
1991	420	487	514	531	665	5.3	6.1	6.5	6.7	8.6
1992	441	430	470	498	665	5.5	5.4	5.9	6.3	8.6
1993	274	321	344	399	665	2.9	3.7	4.0	4.8	8.6
1994	579	340	364	399	665	7.3	3.9	4.3	4.8	8.6
1995	333	406	338	365	665	3.9	4.9	3.9	4.3	8.6
1996	505	390	431	373	665	6.4	4.7	5.3	4.4	8.6
1997	490	497	416	378	665	6.1	6.3	5.1	4.5	8.6
1998	338	394	423	416	651	4.2	4.9	5.3	5.1	8.4
1999	640	427	445	420	665	8.1	5.4	5.6	5.2	8.6



R_S220a_matrix.xls -- Fig 7a



R_S220a_matrix.xls -- Fig 7b

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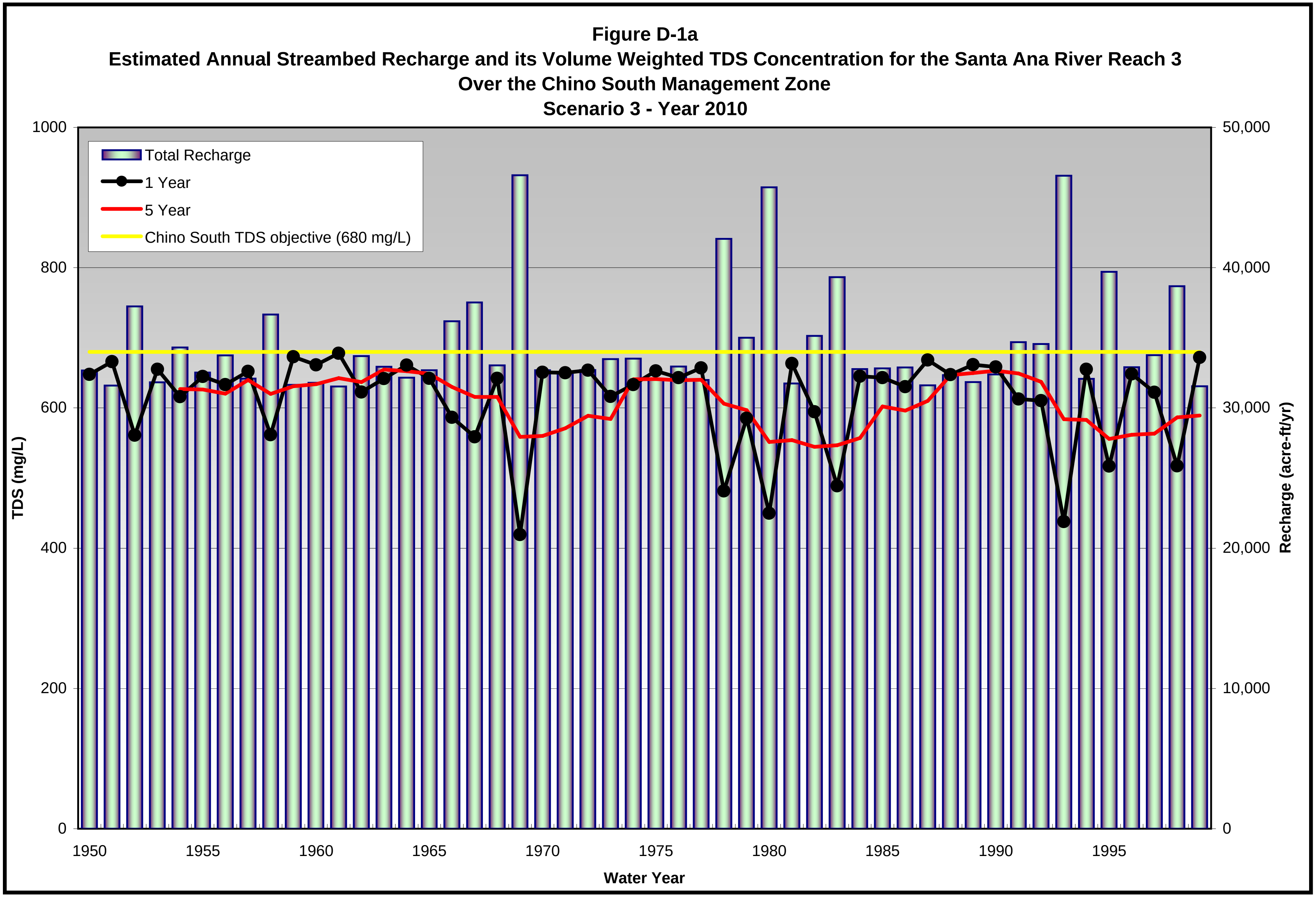
Appendix D

Scenario 3, Year 2010 Simulation Results (Summary Matrices and Graphs)

Table D-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 3 - Year 2010
(mg/L)

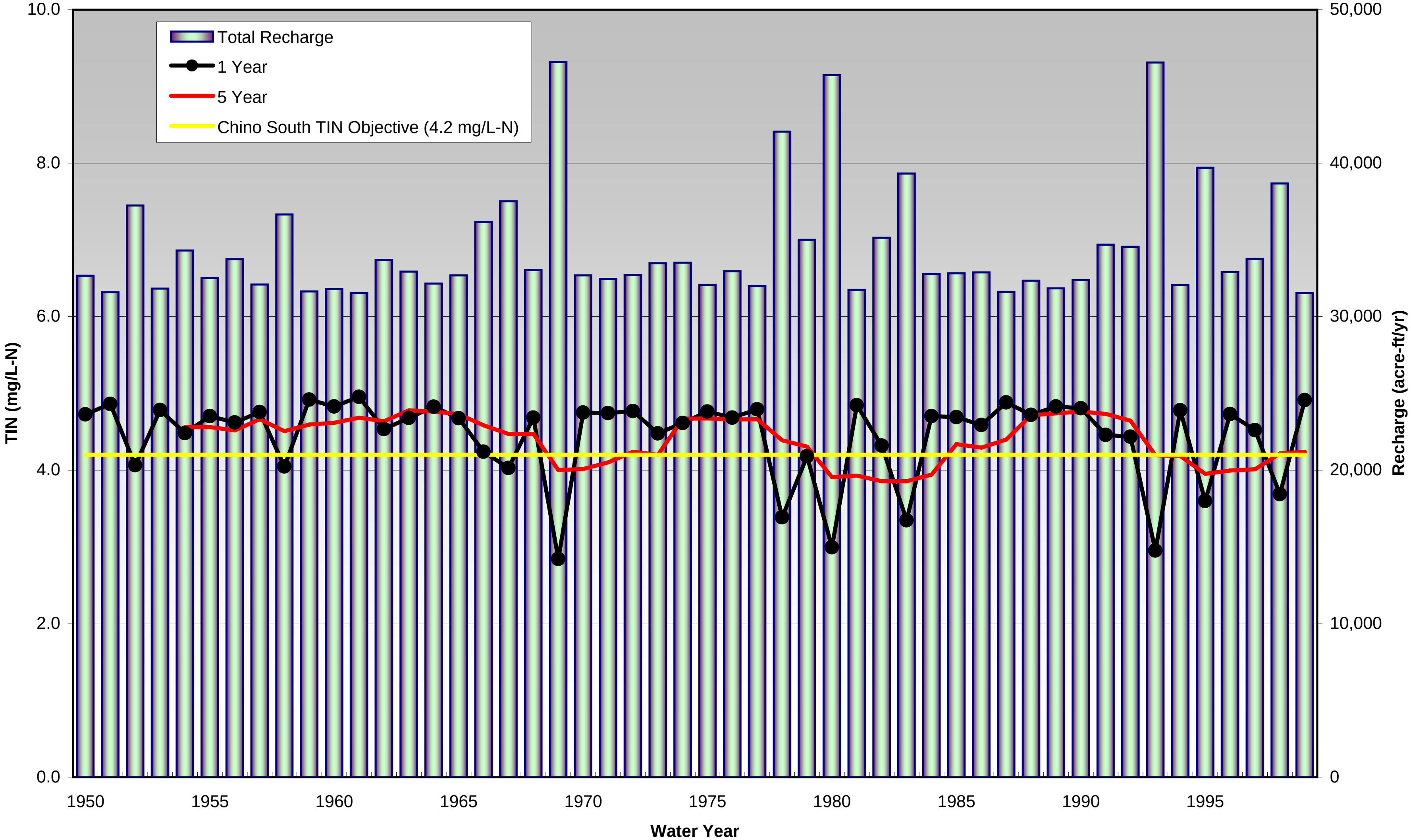
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	648				4.7			
1951	666	657			4.9	4.8		
1952	561	609	622		4.1	4.4	4.5	
1953	655	604	624		4.8	4.4	4.5	
1954	616	635	608	627	4.5	4.6	4.4	4.6
1955	645	630	638	626	4.7	4.6	4.7	4.6
1956	633	639	631	620	4.6	4.7	4.6	4.5
1957	652	642	643	640	4.8	4.7	4.7	4.7
1958	562	604	613	620	4.0	4.4	4.5	4.5
1959	673	613	626	631	4.9	4.5	4.5	4.6
1960	661	667	629	634	4.8	4.9	4.6	4.6
1961	678	670	671	643	5.0	4.9	4.9	4.7
1962	623	649	653	637	4.5	4.7	4.8	4.6
1963	642	632	647	655	4.7	4.6	4.7	4.8
1964	661	651	642	653	4.8	4.8	4.7	4.8
1965	642	651	648	649	4.7	4.8	4.7	4.7
1966	586	613	628	630	4.2	4.4	4.6	4.6
1967	559	572	594	616	4.0	4.1	4.3	4.5
1968	642	598	594	616	4.7	4.3	4.3	4.5
1969	419	512	527	559	2.8	3.6	3.7	4.0
1970	651	515	552	560	4.7	3.6	3.9	4.0
1971	650	651	554	571	4.7	4.7	4.0	4.1
1972	654	652	652	589	4.8	4.8	4.8	4.2
1973	616	635	640	584	4.5	4.6	4.7	4.2
1974	633	625	634	641	4.6	4.5	4.6	4.7
1975	653	643	634	641	4.8	4.7	4.6	4.7
1976	643	648	643	640	4.7	4.7	4.7	4.7
1977	657	650	651	640	4.8	4.7	4.7	4.7
1978	482	557	584	606	3.4	4.0	4.2	4.4
1979	585	529	566	597	4.2	3.7	4.1	4.3
1980	450	509	499	551	3.0	3.5	3.5	3.9
1981	664	537	552	554	4.8	3.8	3.9	3.9
1982	594	627	555	544	4.3	4.6	3.9	3.9
1983	489	539	576	547	3.3	3.8	4.1	3.9
1984	645	560	571	557	4.7	4.0	4.1	3.9
1985	643	644	586	602	4.7	4.7	4.2	4.3
1986	630	637	640	596	4.6	4.6	4.7	4.3
1987	668	649	647	610	4.9	4.7	4.7	4.4
1988	647	658	648	647	4.7	4.8	4.7	4.7
1989	662	654	659	650	4.8	4.8	4.8	4.7
1990	658	660	656	653	4.8	4.8	4.8	4.8
1991	613	635	643	649	4.5	4.6	4.7	4.7
1992	610	612	626	637	4.4	4.4	4.6	4.6
1993	438	511	542	584	3.0	3.6	3.8	4.2
1994	655	526	552	583	4.8	3.7	3.9	4.2
1995	517	579	523	556	3.6	4.1	3.7	4.0
1996	648	576	601	562	4.7	4.1	4.3	4.0
1997	622	635	591	564	4.5	4.6	4.2	4.0
1998	517	566	592	586	3.7	4.1	4.3	4.2
1999	672	587	598	589	4.9	4.2	4.3	4.2



R_S310a_matrix.xls -- Fig 1a

WILDERMUTH ENVIRONMENTAL INC.

Figure D-1b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 3 Over the Chino South Management Zone
Scenario 3 - Year 2010

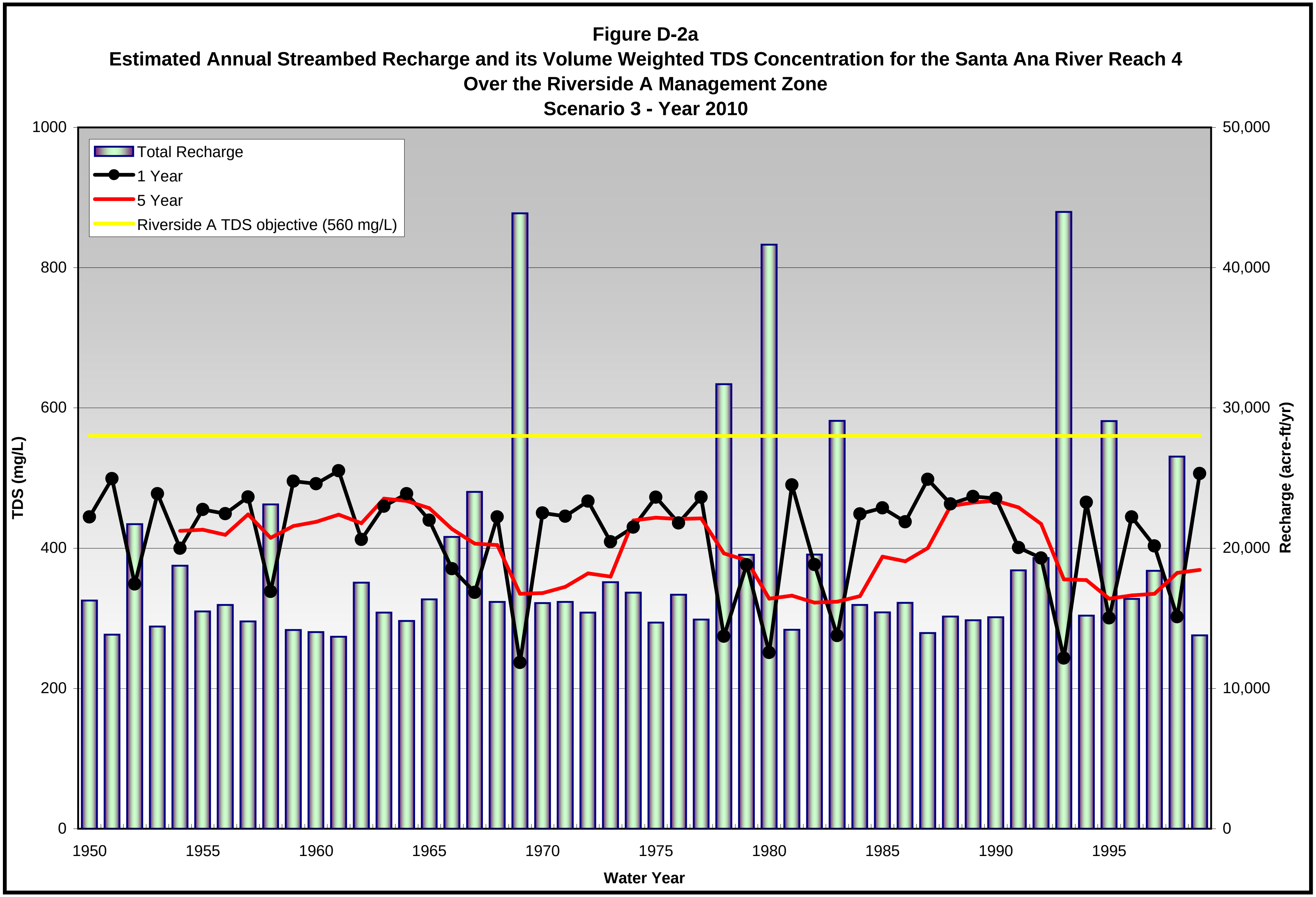


R_S310a_matrix.xls -- Fig 1b

WILDERMUTH ENVIRONMENTAL INC.

Table D-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 3 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	499	470			7.0	6.5		
1952	349	407	419		4.6	5.5	5.7	
1953	478	400	428		6.6	5.4	5.8	
1954	400	434	400	425	5.4	5.9	5.4	5.8
1955	455	425	440	426	6.3	5.8	6.0	5.8
1956	449	452	433	419	6.2	6.2	5.9	5.7
1957	473	461	459	448	6.5	6.4	6.3	6.2
1958	338	391	408	415	4.3	5.2	5.5	5.6
1959	495	398	419	432	6.9	5.3	5.7	5.9
1960	492	494	424	438	6.8	6.9	5.7	6.0
1961	510	501	499	448	7.1	7.0	7.0	6.1
1962	412	455	467	436	5.6	6.3	6.5	5.9
1963	460	435	457	471	6.4	6.0	6.3	6.5
1964	478	468	448	467	6.6	6.5	6.2	6.5
1965	440	458	458	457	6.0	6.3	6.3	6.3
1966	371	401	423	427	4.9	5.4	5.7	5.8
1967	337	353	376	407	4.3	4.6	5.0	5.5
1968	445	380	377	404	6.1	5.0	5.0	5.4
1969	237	293	306	335	2.4	3.4	3.7	4.2
1970	450	294	326	336	6.2	3.4	4.0	4.2
1971	446	448	326	345	6.1	6.2	4.0	4.4
1972	467	456	454	364	6.4	6.3	6.3	4.7
1973	409	436	439	360	5.5	5.9	6.0	4.6
1974	430	419	434	440	5.9	5.7	5.9	6.0
1975	473	450	435	443	6.5	6.2	5.9	6.1
1976	436	453	445	442	6.0	6.2	6.1	6.0
1977	473	453	460	442	6.5	6.2	6.3	6.1
1978	275	338	364	392	3.2	4.3	4.7	5.2
1979	376	313	349	383	4.9	3.9	4.5	5.0
1980	251	291	286	328	2.7	3.4	3.3	4.1
1981	490	312	329	332	6.8	3.7	4.0	4.1
1982	377	424	329	323	5.1	5.8	4.1	4.0
1983	275	316	355	324	3.2	4.0	4.6	4.0
1984	449	337	349	332	6.2	4.3	4.5	4.1
1985	457	453	368	388	6.3	6.2	4.8	5.1
1986	438	447	448	381	6.0	6.1	6.1	5.0
1987	498	466	463	400	6.9	6.4	6.4	5.3
1988	463	480	465	460	6.4	6.7	6.4	6.3
1989	474	468	478	465	6.6	6.5	6.6	6.4
1990	471	472	469	468	6.5	6.5	6.5	6.5
1991	401	432	445	458	5.4	5.9	6.1	6.3
1992	386	393	415	435	5.2	5.3	5.7	5.9
1993	243	287	312	355	2.6	3.4	3.8	4.6
1994	465	300	321	355	6.4	3.6	4.0	4.6
1995	301	357	300	328	3.6	4.6	3.6	4.1
1996	445	353	381	333	6.1	4.5	5.0	4.2
1997	403	423	367	335	5.4	5.7	4.8	4.2
1998	302	343	370	365	3.7	4.4	4.8	4.7
1999	506	372	382	369	7.1	4.8	5.0	4.8



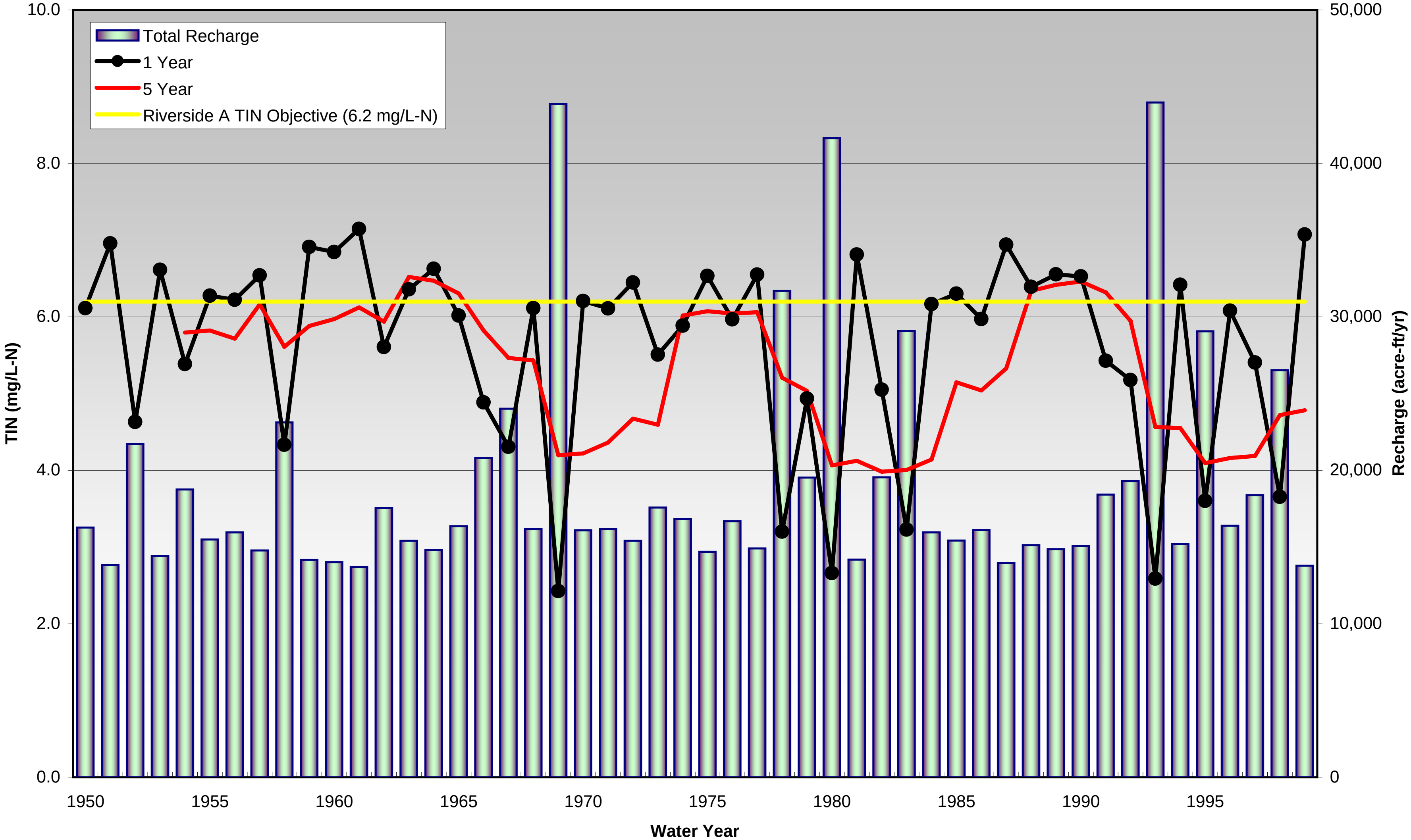
R_S310a_matrix.xls -- Fig 2a

WILDERMUTH ENVIRONMENTAL INC.

Figure D-2b

Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4 Over the Riverside A Management Zone

Scenario 3 - Year 2010



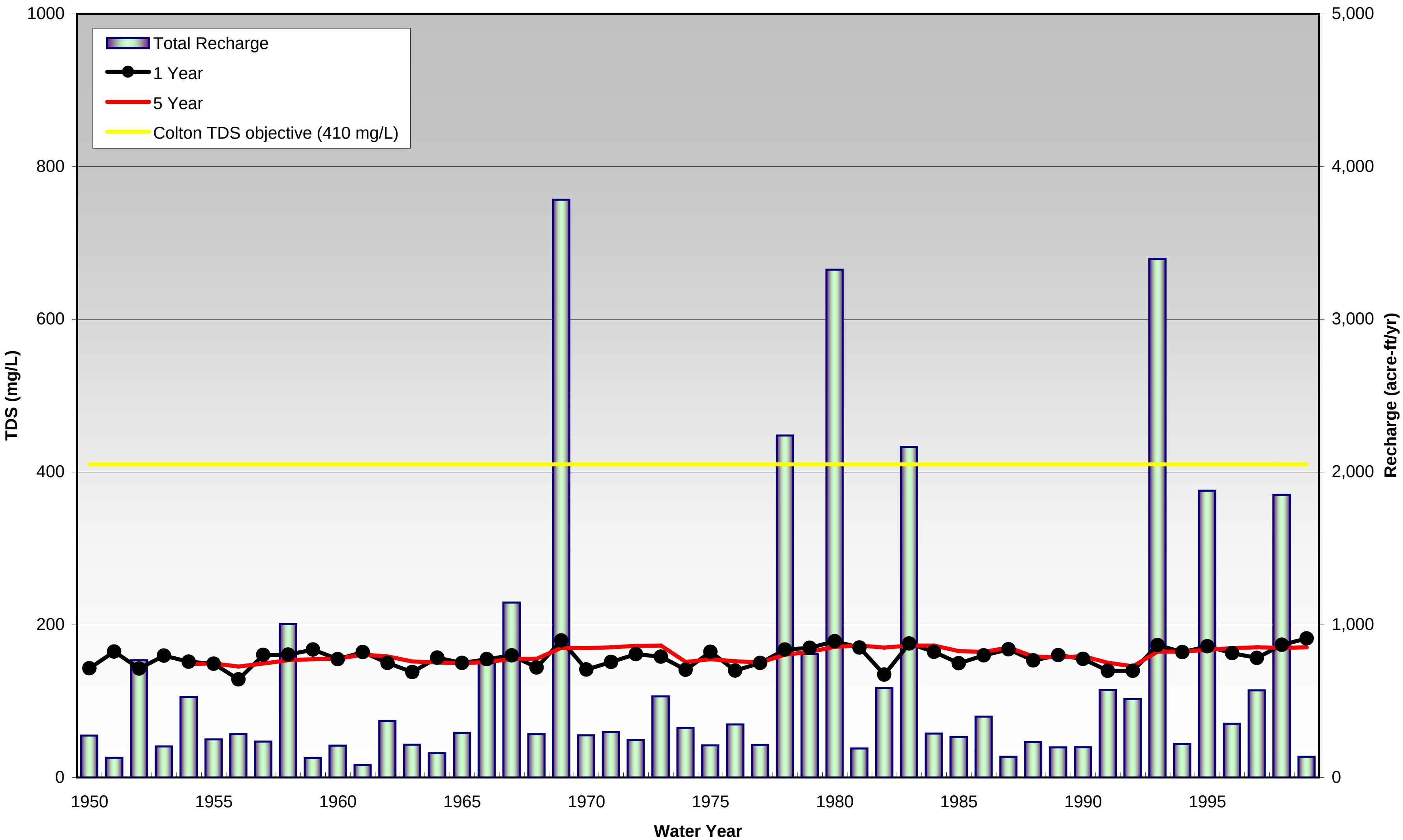
R_S310a_matrix.xls -- Fig 2b

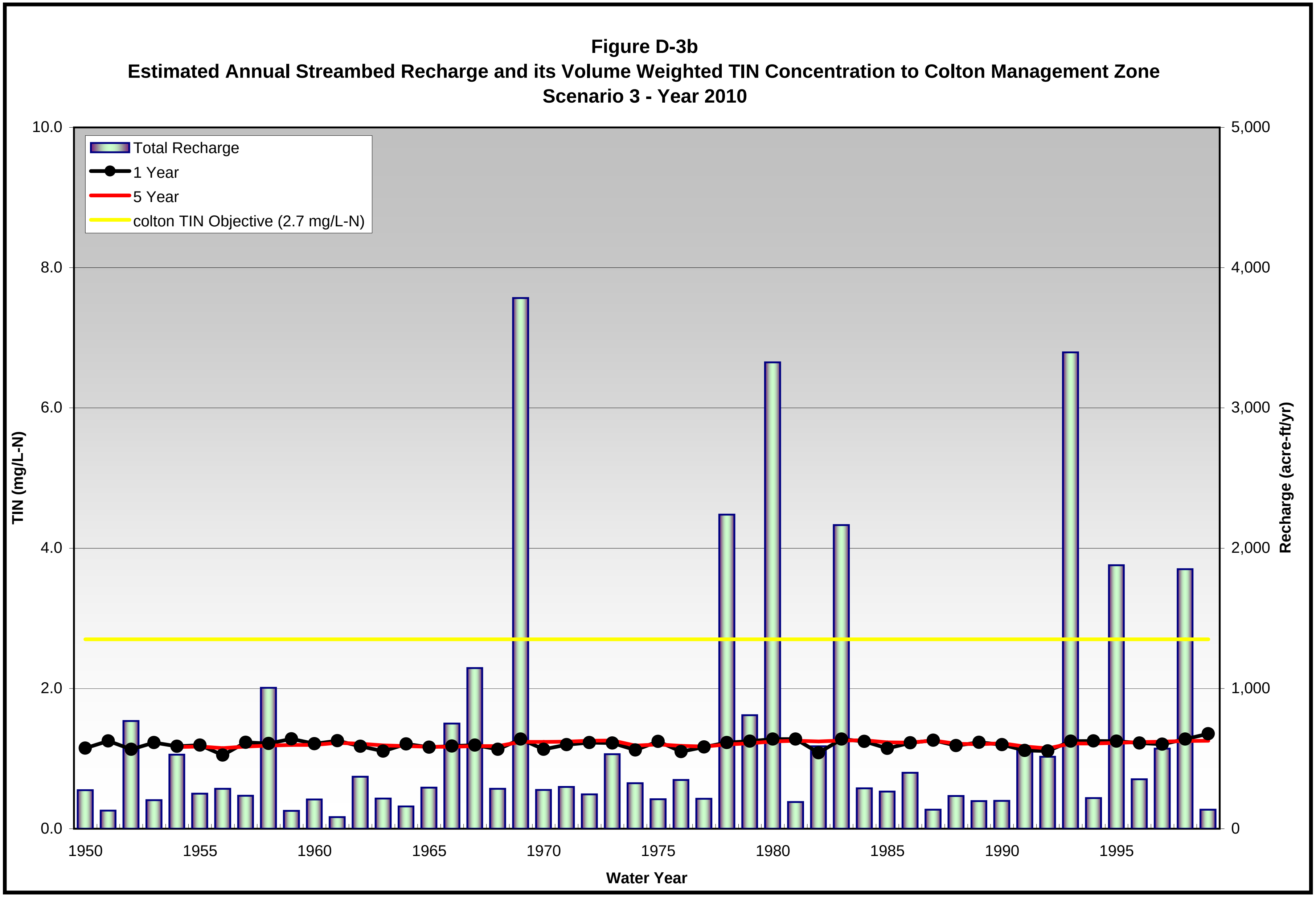
WILDERMUTH ENVIRONMENTAL INC.

Table D-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 3 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	143				1.1			
1951	165	150			1.3	1.2		
1952	143	146	145		1.1	1.1	1.1	
1953	160	146	148		1.2	1.2	1.2	
1954	152	154	148	149	1.2	1.2	1.2	1.2
1955	149	151	153	149	1.2	1.2	1.2	1.2
1956	128	138	145	145	1.0	1.1	1.1	1.1
1957	160	143	145	149	1.2	1.1	1.2	1.2
1958	161	161	155	153	1.2	1.2	1.2	1.2
1959	168	162	162	155	1.3	1.2	1.2	1.2
1960	155	160	161	156	1.2	1.2	1.2	1.2
1961	164	158	161	161	1.3	1.2	1.2	1.2
1962	150	153	153	159	1.2	1.2	1.2	1.2
1963	138	146	148	152	1.1	1.2	1.2	1.2
1964	157	146	148	151	1.2	1.1	1.2	1.2
1965	150	152	148	150	1.2	1.2	1.2	1.2
1966	155	154	154	151	1.2	1.2	1.2	1.2
1967	160	158	157	155	1.2	1.2	1.2	1.2
1968	144	157	156	156	1.1	1.2	1.2	1.2
1969	179	177	173	170	1.3	1.3	1.3	1.2
1970	141	177	175	170	1.1	1.3	1.3	1.2
1971	151	146	175	171	1.2	1.2	1.3	1.2
1972	161	156	151	173	1.2	1.2	1.2	1.3
1973	158	159	157	173	1.2	1.2	1.2	1.3
1974	141	152	154	151	1.1	1.2	1.2	1.2
1975	164	150	154	155	1.2	1.2	1.2	1.2
1976	140	149	146	152	1.1	1.2	1.1	1.2
1977	150	144	149	151	1.2	1.1	1.2	1.2
1978	167	166	163	161	1.2	1.2	1.2	1.2
1979	170	168	167	164	1.2	1.2	1.2	1.2
1980	179	177	174	171	1.3	1.3	1.3	1.2
1981	170	178	177	173	1.3	1.3	1.3	1.3
1982	135	143	172	170	1.1	1.1	1.3	1.2
1983	175	167	167	173	1.3	1.2	1.2	1.3
1984	164	174	166	173	1.2	1.3	1.2	1.3
1985	150	157	172	165	1.1	1.2	1.3	1.2
1986	160	156	158	165	1.2	1.2	1.2	1.2
1987	168	162	158	170	1.3	1.2	1.2	1.3
1988	153	159	159	158	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	159	1.2	1.2	1.2	1.2
1991	140	144	147	150	1.1	1.1	1.2	1.2
1992	140	140	142	146	1.1	1.1	1.1	1.1
1993	173	169	165	165	1.2	1.2	1.2	1.2
1994	164	173	169	165	1.3	1.2	1.2	1.2
1995	172	171	173	167	1.2	1.2	1.2	1.2
1996	163	170	170	169	1.2	1.2	1.2	1.2
1997	157	159	168	171	1.2	1.2	1.2	1.2
1998	174	170	169	170	1.3	1.3	1.3	1.3
1999	182	174	170	170	1.4	1.3	1.3	1.3

Figure D-3a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Colton Management Zone
Scenario 3 - Year 2010



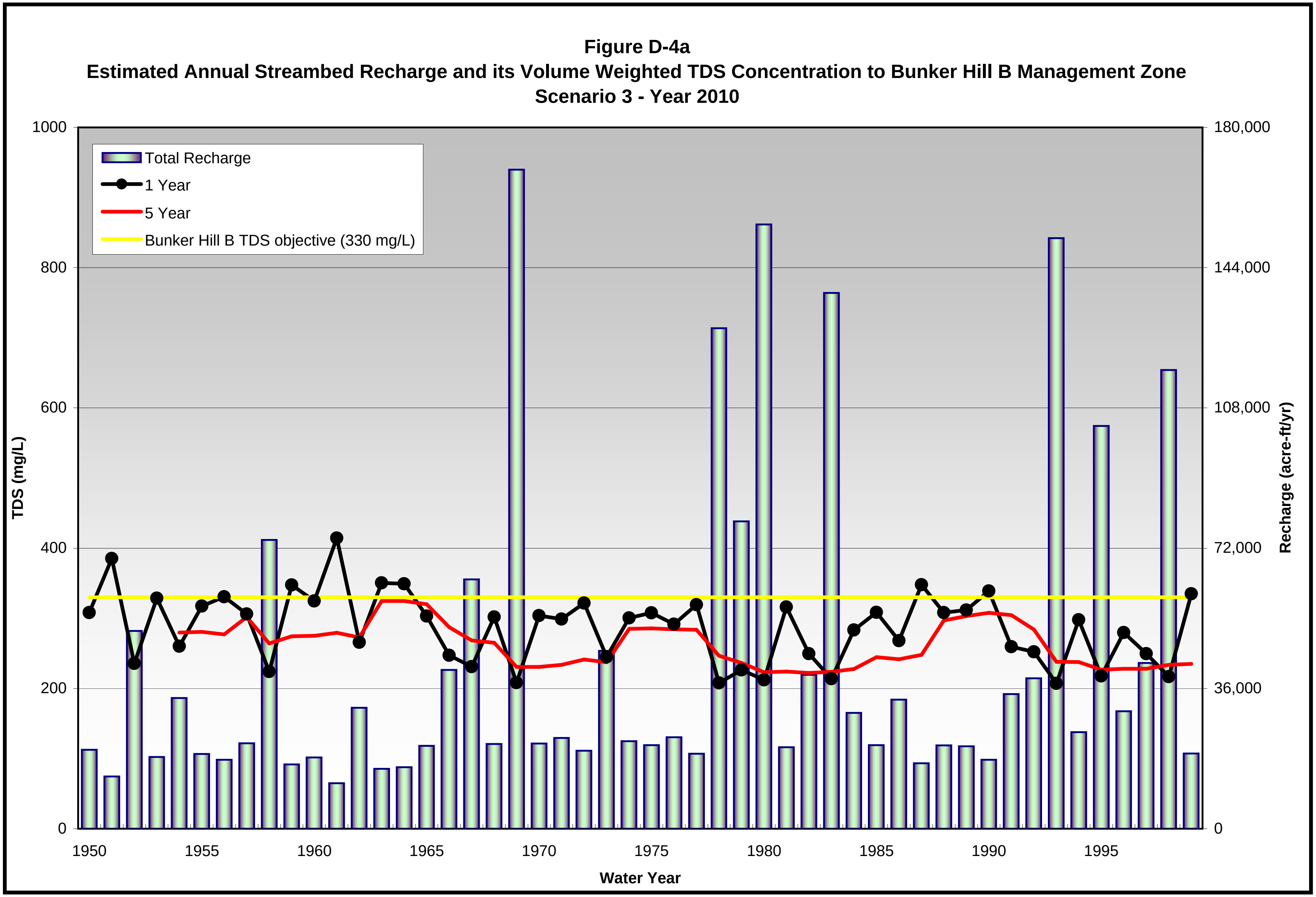


R_S310a_matrix.xls -- Fig 3b

WILDERMUTH™ ENVIRONMENTAL INC.

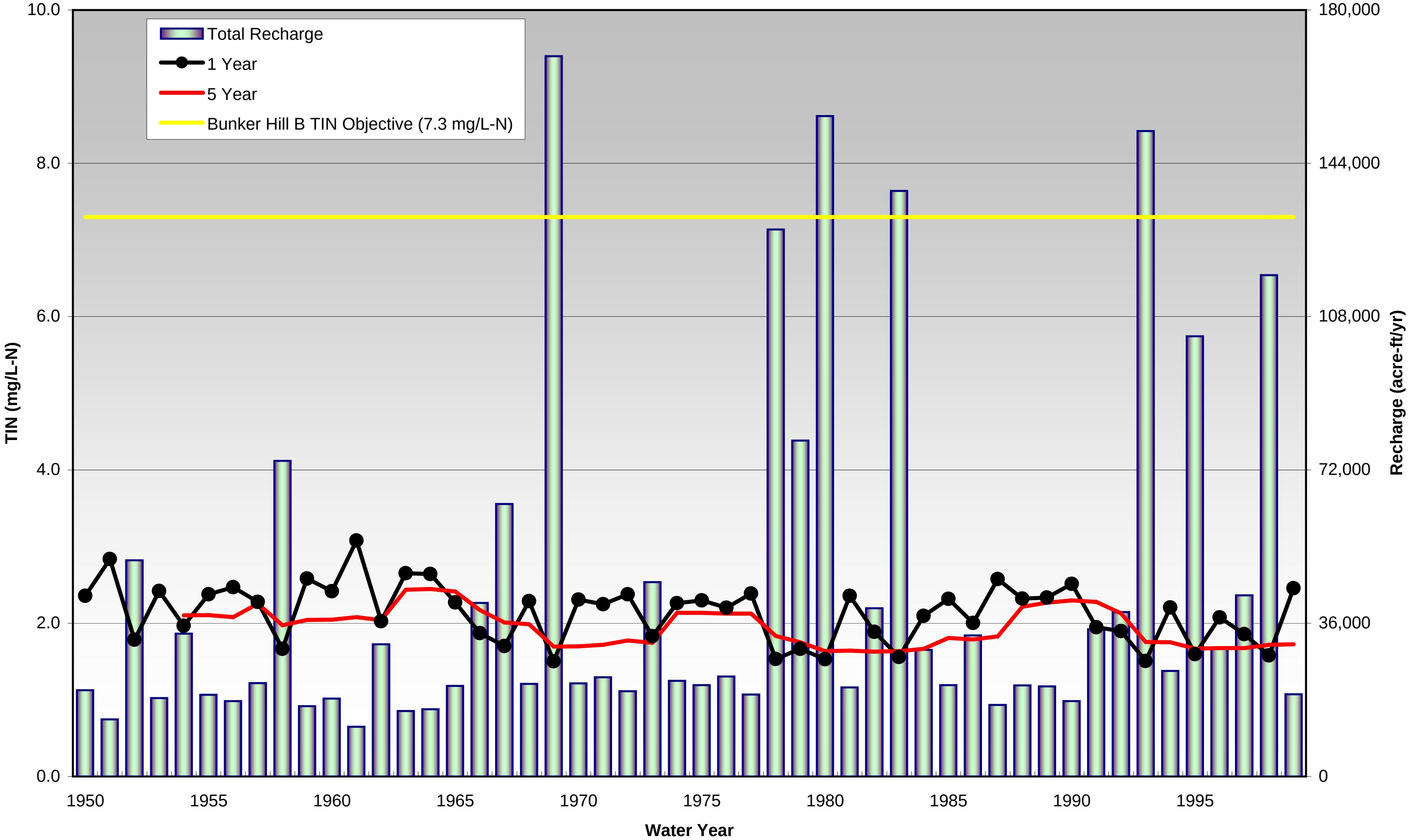
Table D-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 3 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	308				2.4			
1951	385	339			2.8	2.5		
1952	236	267	277		1.8	2.0	2.1	
1953	329	260	281		2.4	2.0	2.1	
1954	260	285	260	280	2.0	2.1	2.0	2.1
1955	317	281	293	281	2.4	2.1	2.2	2.1
1956	331	324	294	277	2.5	2.4	2.2	2.1
1957	306	317	317	302	2.3	2.4	2.4	2.3
1958	224	243	256	264	1.7	1.8	1.9	2.0
1959	348	246	258	274	2.6	1.8	1.9	2.0
1960	325	336	260	275	2.4	2.5	1.9	2.0
1961	415	360	355	280	3.1	2.7	2.6	2.1
1962	266	307	312	273	2.0	2.3	2.3	2.0
1963	350	294	318	325	2.7	2.2	2.4	2.4
1964	349	350	308	325	2.6	2.6	2.3	2.4
1965	303	323	331	320	2.3	2.4	2.5	2.4
1966	247	266	283	287	1.9	2.0	2.1	2.2
1967	231	237	248	269	1.7	1.8	1.9	2.0
1968	302	249	248	265	2.3	1.9	1.9	2.0
1969	208	219	222	231	1.5	1.6	1.6	1.7
1970	304	219	228	231	2.3	1.6	1.7	1.7
1971	299	301	228	234	2.2	2.3	1.7	1.7
1972	322	309	308	241	2.4	2.3	2.3	1.8
1973	245	268	276	237	1.8	2.0	2.1	1.7
1974	300	263	277	285	2.3	2.0	2.1	2.1
1975	308	304	274	286	2.3	2.3	2.1	2.1
1976	292	299	300	284	2.2	2.2	2.3	2.1
1977	319	304	305	284	2.4	2.3	2.3	2.1
1978	208	222	232	247	1.5	1.6	1.7	1.8
1979	226	215	224	236	1.7	1.6	1.7	1.7
1980	212	217	214	223	1.5	1.6	1.6	1.6
1981	316	224	225	224	2.4	1.6	1.6	1.6
1982	249	273	229	222	1.9	2.0	1.7	1.6
1983	214	222	232	224	1.6	1.6	1.7	1.6
1984	283	226	231	228	2.1	1.7	1.7	1.7
1985	309	294	235	244	2.3	2.2	1.7	1.8
1986	268	284	284	242	2.0	2.1	2.1	1.8
1987	348	295	299	248	2.6	2.2	2.2	1.8
1988	308	326	299	297	2.3	2.4	2.2	2.2
1989	312	310	321	303	2.3	2.3	2.4	2.3
1990	339	324	318	308	2.5	2.4	2.4	2.3
1991	260	286	294	305	1.9	2.1	2.2	2.3
1992	252	256	272	284	1.9	1.9	2.0	2.1
1993	207	216	223	238	1.5	1.6	1.6	1.8
1994	298	220	226	238	2.2	1.6	1.7	1.8
1995	218	233	219	227	1.6	1.7	1.6	1.7
1996	280	232	242	228	2.1	1.7	1.8	1.7
1997	249	262	236	228	1.9	1.9	1.7	1.7
1998	217	226	234	234	1.6	1.7	1.7	1.7
1999	335	234	237	235	2.5	1.7	1.7	1.7



R_S310a_matrix.xls -- Fig 4a

Figure D-4b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Bunker Hill B Management Zone
Scenario 3 - Year 2010

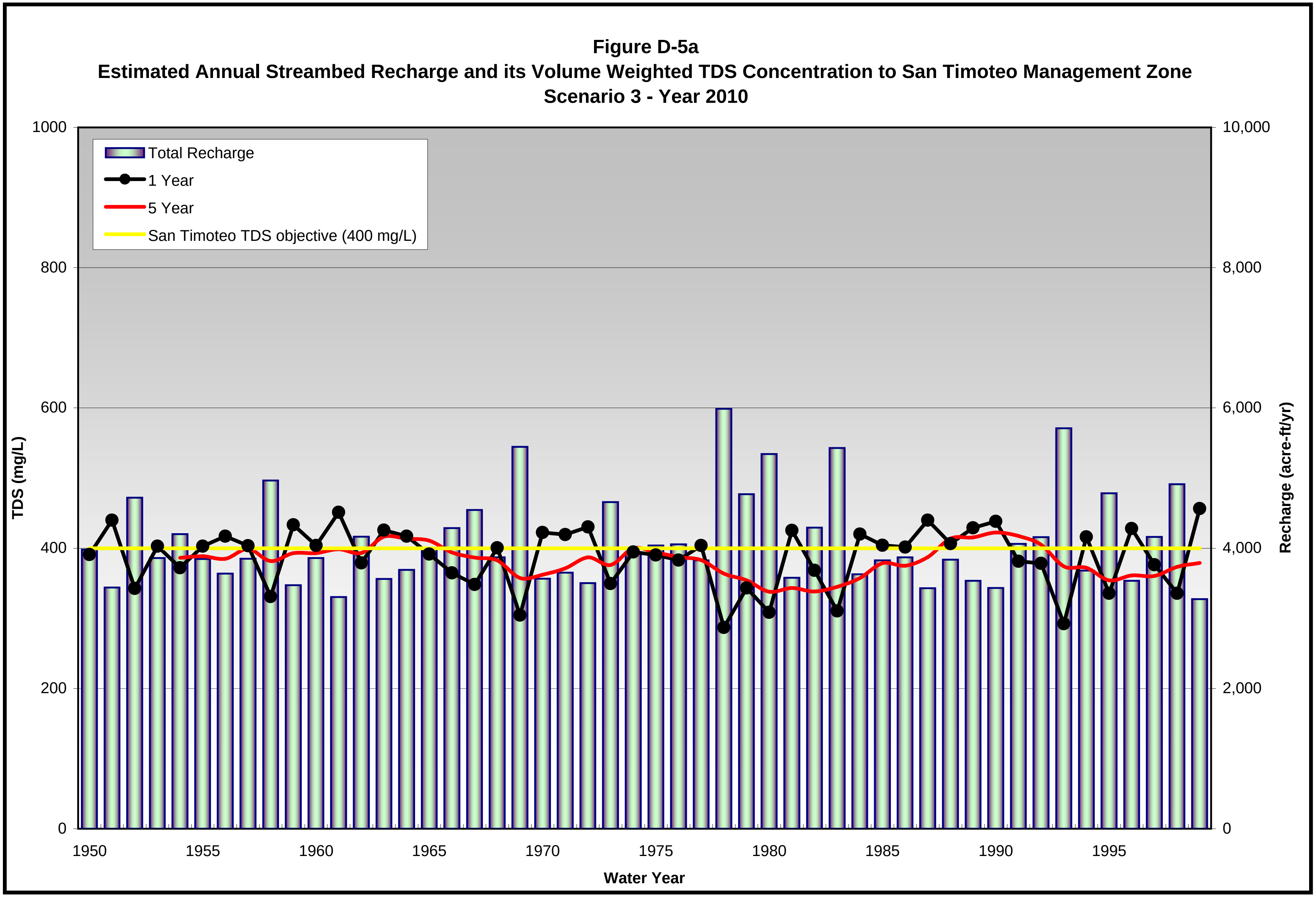


WILDERMUTH™ ENVIRONMENTAL INC.

Table D-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 3 - Year 2010
(mg/L)

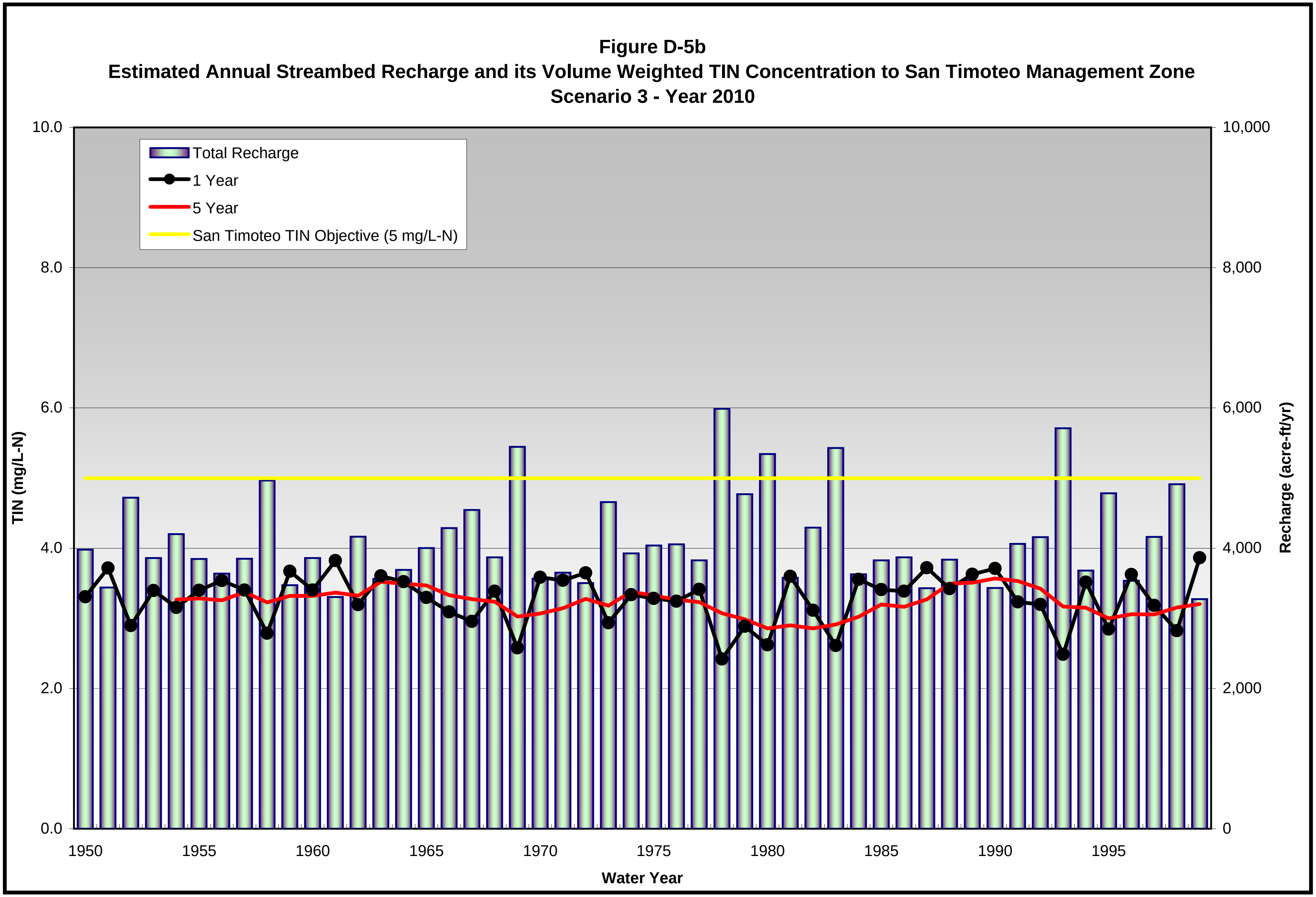
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	391				3.3			
1951	440	414			3.7	3.5		
1952	343	384	386		2.9	3.2	3.3	
1953	403	370	390		3.4	3.1	3.3	
1954	372	387	370	386	3.2	3.3	3.1	3.3
1955	403	387	392	389	3.4	3.3	3.3	3.3
1956	417	410	396	385	3.5	3.5	3.4	3.3
1957	403	410	408	399	3.4	3.5	3.4	3.4
1958	331	363	379	382	2.8	3.1	3.2	3.2
1959	433	373	383	393	3.7	3.2	3.2	3.3
1960	404	418	383	393	3.4	3.5	3.2	3.3
1961	451	426	428	398	3.8	3.6	3.6	3.4
1962	379	411	408	393	3.2	3.5	3.4	3.3
1963	426	400	416	416	3.6	3.4	3.5	3.5
1964	417	421	406	413	3.5	3.6	3.4	3.5
1965	392	404	411	411	3.3	3.4	3.5	3.5
1966	365	378	390	394	3.1	3.2	3.3	3.3
1967	348	356	367	387	3.0	3.0	3.1	3.3
1968	401	372	370	383	3.4	3.2	3.1	3.2
1969	304	344	346	358	2.6	2.9	2.9	3.0
1970	422	351	366	362	3.6	3.0	3.1	3.1
1971	419	421	371	371	3.5	3.6	3.1	3.1
1972	430	425	424	387	3.6	3.6	3.6	3.3
1973	349	384	395	376	2.9	3.2	3.3	3.2
1974	395	370	388	400	3.3	3.1	3.3	3.4
1975	390	392	376	394	3.3	3.3	3.2	3.3
1976	383	387	389	387	3.2	3.3	3.3	3.3
1977	404	393	392	383	3.4	3.3	3.3	3.2
1978	287	333	347	364	2.4	2.8	2.9	3.1
1979	343	312	336	354	2.9	2.6	2.8	3.0
1980	309	325	311	338	2.6	2.7	2.6	2.9
1981	425	355	351	343	3.6	3.0	3.0	2.9
1982	369	394	360	338	3.1	3.3	3.0	2.9
1983	310	336	360	345	2.6	2.8	3.0	2.9
1984	420	354	359	358	3.6	3.0	3.0	3.0
1985	404	412	369	379	3.4	3.5	3.1	3.2
1986	402	403	408	375	3.4	3.4	3.4	3.2
1987	440	420	414	387	3.7	3.5	3.5	3.3
1988	406	422	415	414	3.4	3.6	3.5	3.5
1989	429	417	424	415	3.6	3.5	3.6	3.5
1990	438	434	424	422	3.7	3.7	3.6	3.6
1991	381	408	414	418	3.2	3.5	3.5	3.5
1992	378	380	397	405	3.2	3.2	3.4	3.4
1993	292	329	344	374	2.5	2.8	2.9	3.2
1994	416	341	352	372	3.5	2.9	3.0	3.2
1995	336	371	339	354	2.8	3.1	2.9	3.0
1996	428	375	388	361	3.6	3.2	3.3	3.1
1997	376	400	375	361	3.2	3.4	3.2	3.1
1998	336	354	375	373	2.8	3.0	3.2	3.2
1999	457	384	381	379	3.9	3.2	3.2	3.2

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan



R_S310a_matrix.xls -- Fig 5a

WILDERMUTH ENVIRONMENTAL INC.

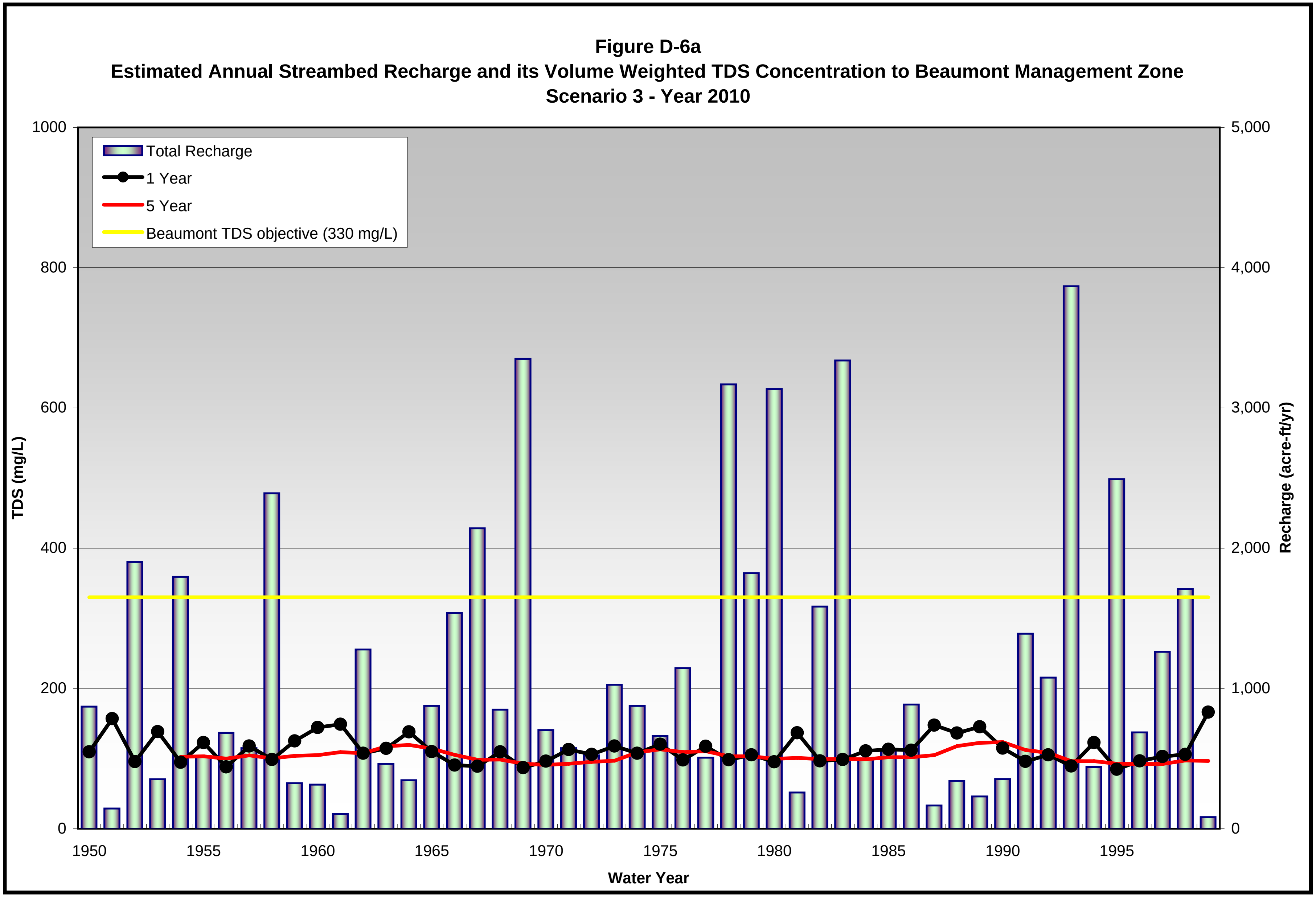


R_S310a_matrix.xls -- Fig 5b

WILDERMUTH ENVIRONMENTAL INC.

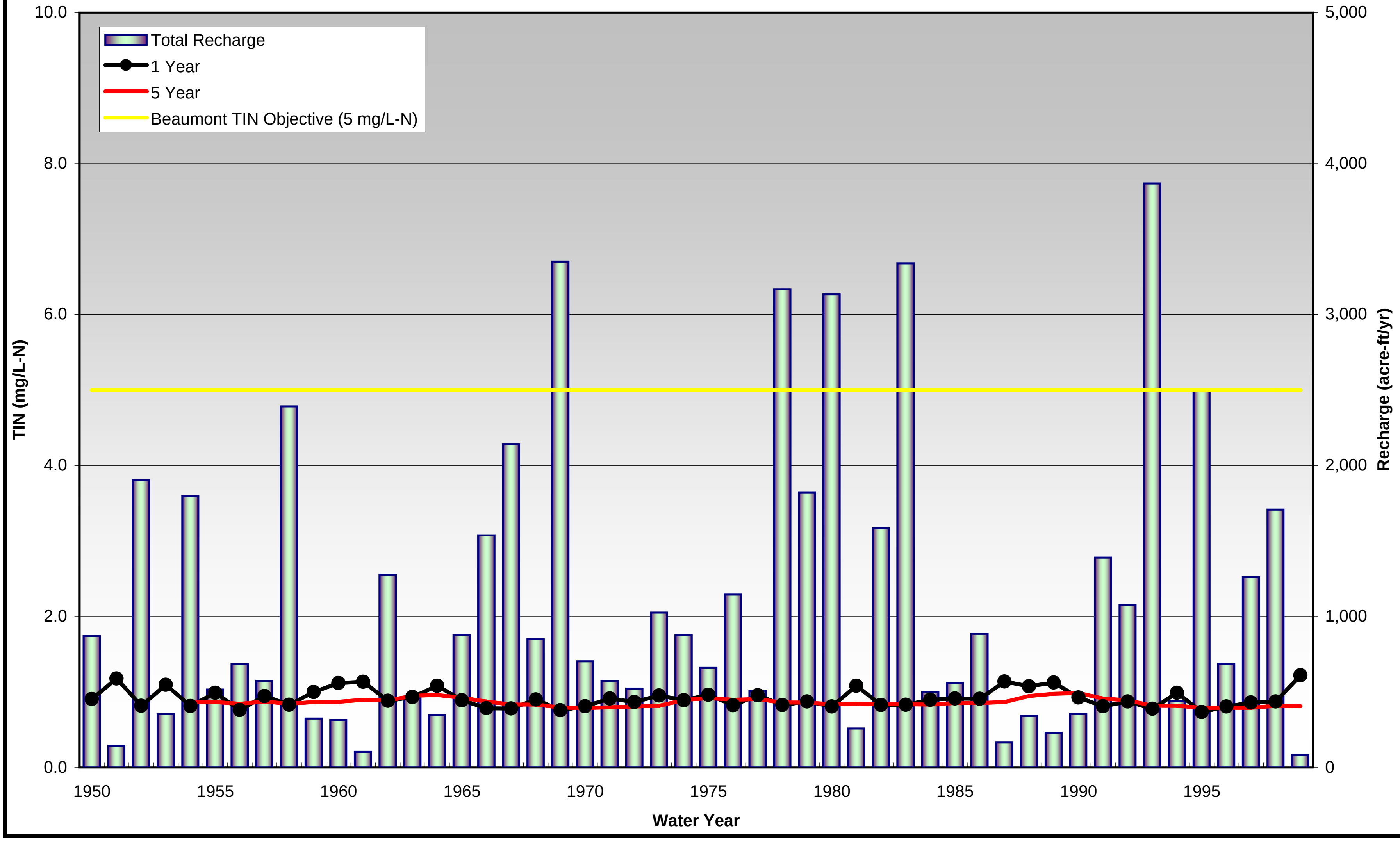
Table D-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 3 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8



R_S310a_matrix.xls -- Fig 6a

Figure D-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 3 - Year 2010

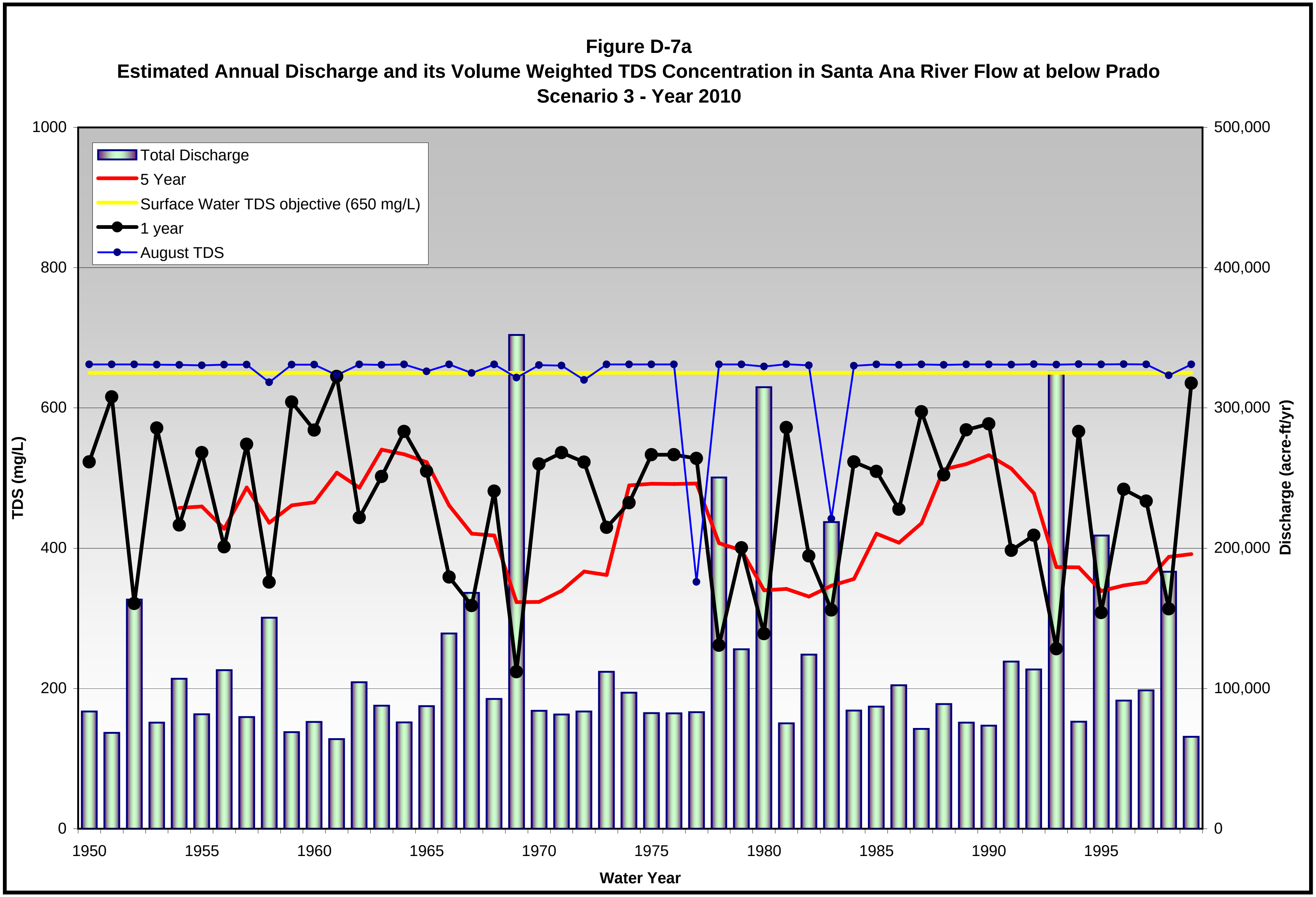


R_S310a_matrix.xls -- Fig 6b

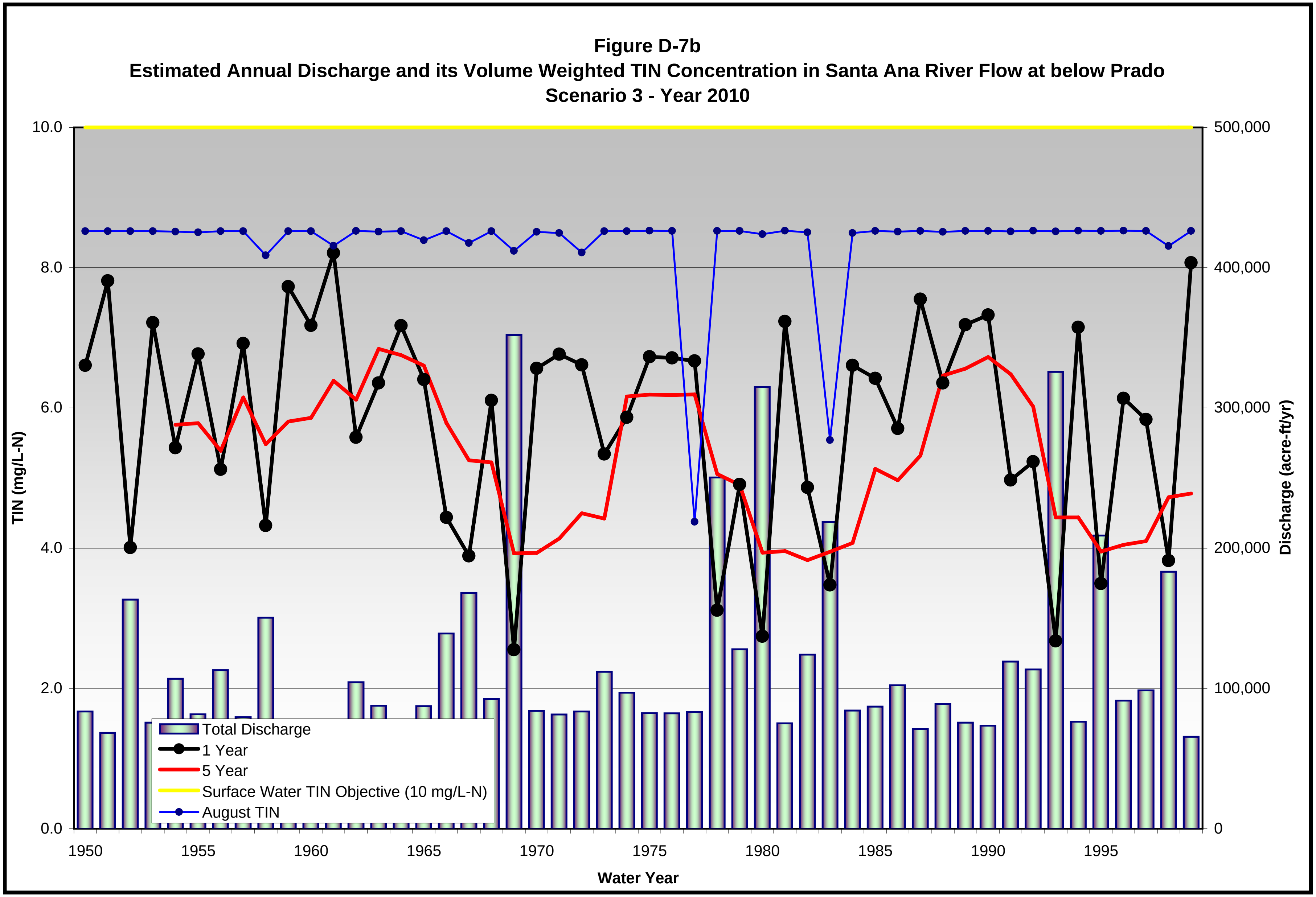
WILDERMUTH ENVIRONMENTAL INC.

Table D-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 3 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	523				662	6.6				8.5
1951	616	565			662	7.8	7.1			8.5
1952	321	408	439		662	4.0	5.1	5.5		8.5
1953	571	400	448		662	7.2	5.0	5.6		8.5
1954	433	490	410	457	661	5.4	6.2	5.2	5.8	8.5
1955	536	478	504	459	661	6.8	6.0	6.4	5.8	8.5
1956	402	458	449	428	662	5.1	5.8	5.7	5.4	8.5
1957	548	462	484	487	662	6.9	5.9	6.1	6.1	8.5
1958	352	420	414	436	637	4.3	5.2	5.2	5.5	8.2
1959	609	432	463	461	662	7.7	5.4	5.8	5.8	8.5
1960	568	587	467	465	662	7.2	7.4	5.9	5.9	8.5
1961	645	603	605	508	647	8.2	7.6	7.7	6.4	8.3
1962	444	520	535	486	662	5.6	6.6	6.8	6.1	8.5
1963	502	470	514	540	661	6.4	5.9	6.5	6.8	8.5
1964	566	532	498	534	662	7.2	6.7	6.3	6.8	8.5
1965	510	536	524	523	652	6.4	6.8	6.6	6.6	8.4
1966	359	417	454	461	662	4.4	5.2	5.7	5.8	8.5
1967	318	337	375	421	650	3.9	4.1	4.6	5.3	8.4
1968	481	376	370	418	662	6.1	4.7	4.6	5.2	8.5
1969	224	277	288	323	643	2.6	3.3	3.5	3.9	8.2
1970	520	281	316	323	661	6.6	3.3	3.8	3.9	8.5
1971	536	528	321	339	660	6.8	6.7	3.9	4.1	8.5
1972	523	529	526	367	640	6.6	6.7	6.6	4.5	8.2
1973	430	470	489	362	662	5.3	5.9	6.1	4.4	8.5
1974	465	446	468	490	662	5.9	5.6	5.9	6.2	8.5
1975	533	496	471	492	662	6.7	6.3	5.9	6.2	8.5
1976	533	533	508	491	662	6.7	6.7	6.4	6.2	8.5
1977	528	531	532	492	352	6.7	6.7	6.7	6.2	4.4
1978	261	328	369	407	662	3.1	4.0	4.5	5.1	8.5
1979	400	308	348	397	662	4.9	3.7	4.3	4.9	8.5
1980	278	313	295	340	659	2.7	3.4	3.3	3.9	8.5
1981	572	335	351	342	662	7.2	3.6	3.9	4.0	8.5
1982	389	458	348	331	661	4.9	5.8	3.9	3.8	8.5
1983	312	340	381	346	442	3.5	4.0	4.6	3.9	5.5
1984	523	370	376	356	660	6.6	4.3	4.5	4.1	8.5
1985	510	516	402	421	662	6.4	6.5	4.8	5.1	8.5
1986	455	480	493	408	661	5.7	6.0	6.2	5.0	8.5
1987	594	512	511	436	662	7.5	6.5	6.4	5.3	8.5
1988	505	544	510	512	661	6.4	6.9	6.4	6.5	8.5
1989	569	534	552	520	662	7.2	6.7	7.0	6.6	8.5
1990	577	573	547	533	662	7.3	7.3	6.9	6.7	8.5
1991	397	466	495	513	662	5.0	5.9	6.2	6.5	8.5
1992	419	408	448	478	662	5.2	5.1	5.6	6.0	8.5
1993	257	299	320	373	662	2.7	3.3	3.7	4.4	8.5
1994	566	315	338	373	662	7.1	3.5	3.9	4.4	8.5
1995	308	377	313	339	662	3.5	4.5	3.5	4.0	8.5
1996	484	362	403	347	662	6.1	4.3	4.9	4.0	8.5
1997	467	475	388	351	662	5.8	6.0	4.7	4.1	8.5
1998	313	367	396	388	647	3.8	4.5	4.9	4.7	8.3
1999	635	398	418	392	662	8.1	4.9	5.2	4.8	8.5



R_S310a_matrix.xls -- Fig 7a



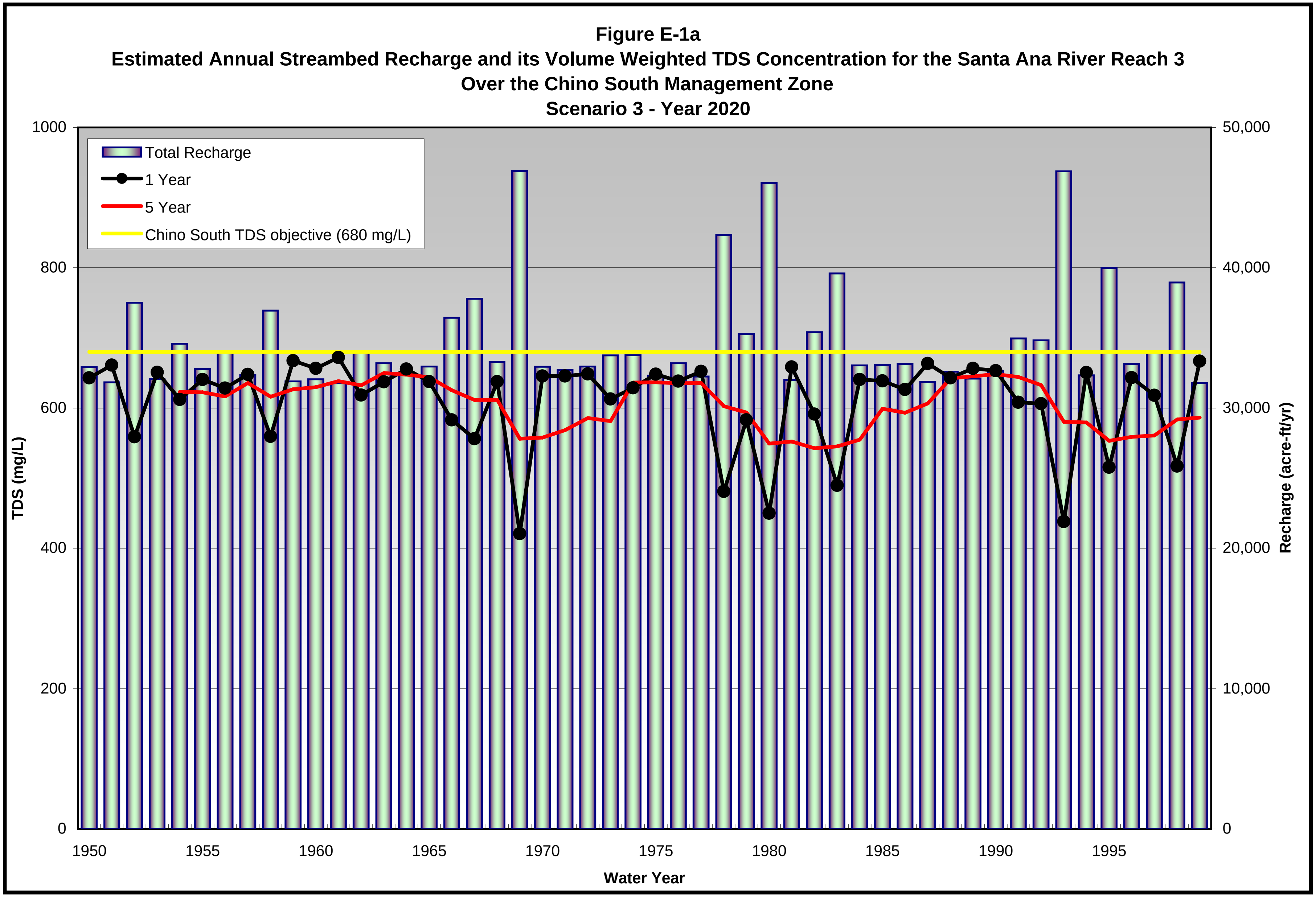
R_S310a_matrix.xls -- Fig 7b

Appendix E

Scenario 3, Year 2020 Simulation Results (Summary Matrices and Graphs)

Table E-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 3 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	643				4.7			
1951	661	652			4.8	4.8		
1952	559	606	618		4.1	4.4	4.5	
1953	651	601	620		4.8	4.4	4.5	
1954	612	631	605	623	4.5	4.6	4.4	4.5
1955	641	626	634	622	4.7	4.6	4.6	4.5
1956	628	634	627	616	4.6	4.6	4.6	4.5
1957	648	638	639	636	4.7	4.7	4.7	4.6
1958	560	601	610	616	4.0	4.4	4.4	4.5
1959	667	610	622	627	4.9	4.4	4.5	4.6
1960	656	662	624	630	4.8	4.8	4.5	4.6
1961	672	664	665	638	4.9	4.9	4.9	4.7
1962	619	644	648	632	4.5	4.7	4.7	4.6
1963	637	628	642	650	4.7	4.6	4.7	4.8
1964	656	646	637	648	4.8	4.7	4.7	4.7
1965	638	647	643	644	4.7	4.7	4.7	4.7
1966	583	609	624	625	4.2	4.4	4.5	4.6
1967	556	569	590	612	4.0	4.1	4.3	4.5
1968	638	594	590	612	4.7	4.3	4.3	4.5
1969	421	511	525	556	2.9	3.6	3.7	4.0
1970	646	514	550	558	4.7	3.6	3.9	4.0
1971	646	646	552	568	4.7	4.7	3.9	4.1
1972	649	647	647	586	4.7	4.7	4.7	4.2
1973	613	631	636	581	4.5	4.6	4.6	4.2
1974	629	621	630	636	4.6	4.5	4.6	4.6
1975	648	638	630	637	4.7	4.7	4.6	4.6
1976	638	643	638	635	4.7	4.7	4.7	4.6
1977	652	645	646	636	4.8	4.7	4.7	4.6
1978	481	555	581	603	3.4	4.0	4.2	4.4
1979	583	527	564	594	4.2	3.7	4.0	4.3
1980	450	508	499	549	3.0	3.5	3.5	3.9
1981	658	536	550	552	4.8	3.8	3.9	3.9
1982	591	623	553	543	4.3	4.5	3.9	3.9
1983	490	538	574	545	3.4	3.8	4.1	3.9
1984	641	558	569	555	4.7	4.0	4.1	3.9
1985	639	640	583	599	4.7	4.7	4.2	4.3
1986	626	633	635	593	4.6	4.6	4.6	4.3
1987	663	644	643	607	4.9	4.7	4.7	4.4
1988	643	653	644	642	4.7	4.8	4.7	4.7
1989	657	650	654	645	4.8	4.7	4.8	4.7
1990	653	655	651	648	4.8	4.8	4.8	4.7
1991	608	630	638	644	4.4	4.6	4.7	4.7
1992	606	607	622	633	4.4	4.4	4.5	4.6
1993	438	510	539	580	3.0	3.6	3.8	4.2
1994	650	525	550	579	4.8	3.7	3.9	4.2
1995	516	576	522	553	3.6	4.1	3.7	3.9
1996	643	574	597	559	4.7	4.1	4.3	4.0
1997	618	631	588	561	4.5	4.6	4.2	4.0
1998	517	564	589	584	3.7	4.1	4.3	4.2
1999	667	584	595	586	4.9	4.2	4.3	4.2



R_S320a_matrix.xls -- Fig 1a

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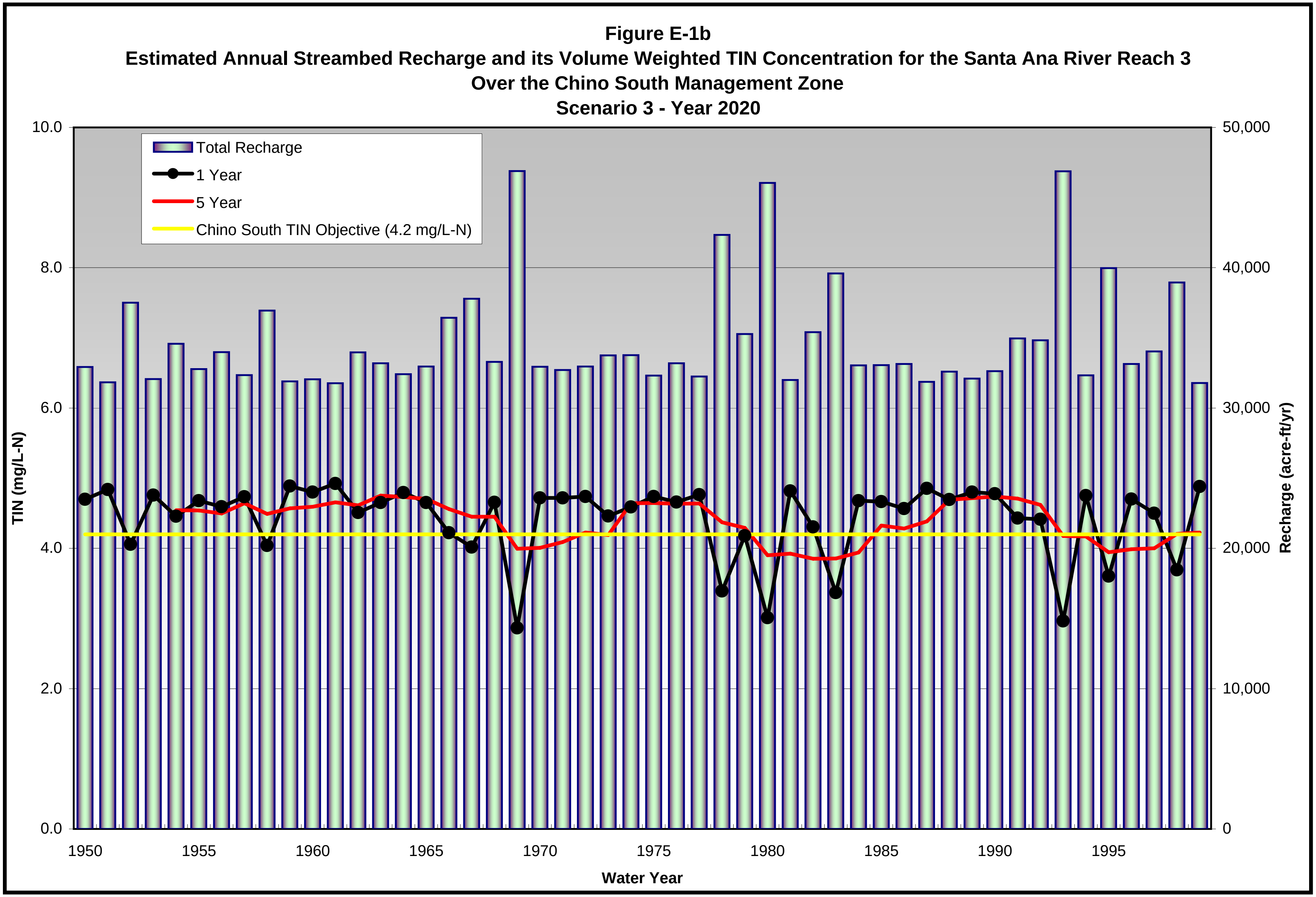
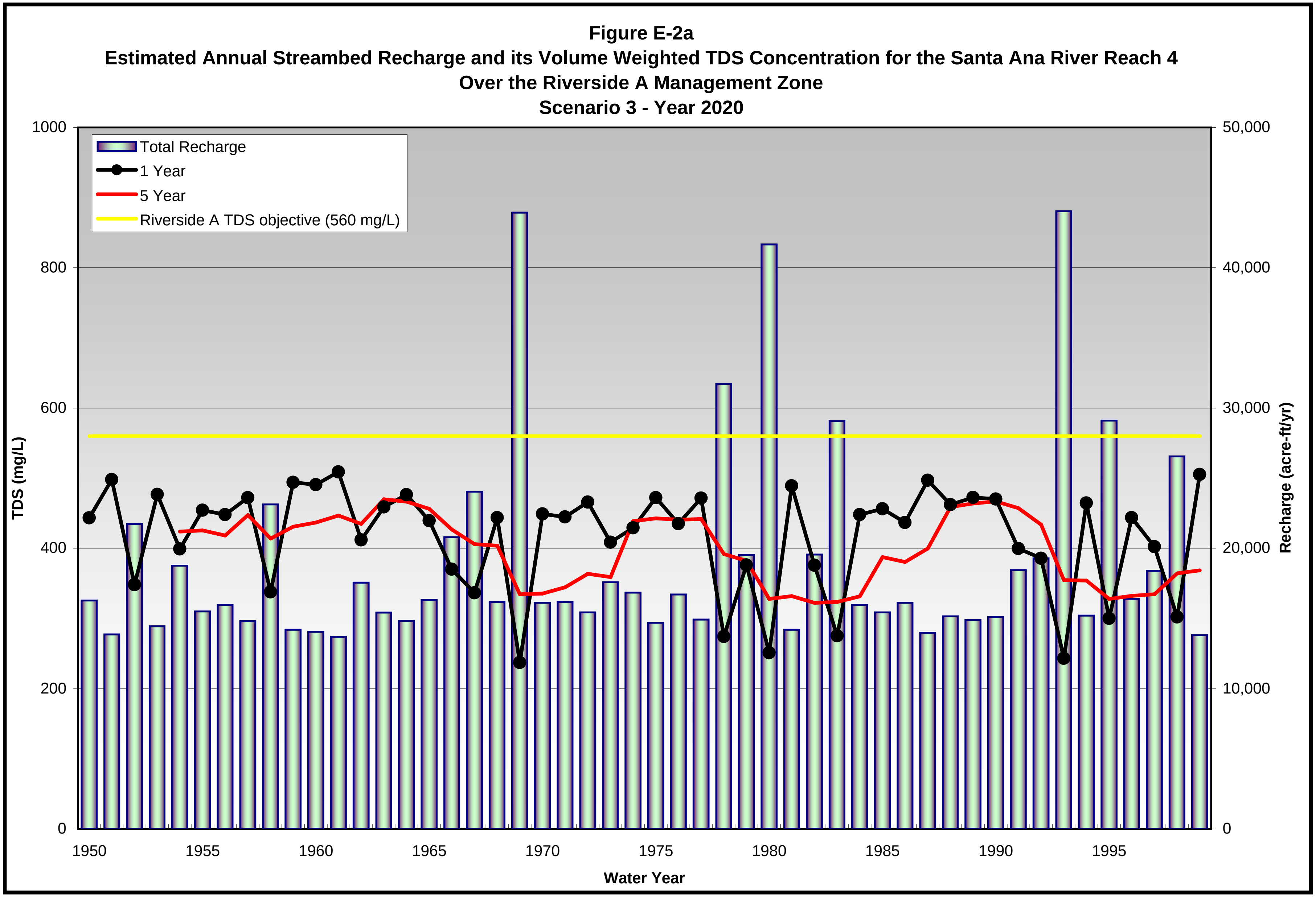


Figure E-1b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 3
Over the Chino South Management Zone
Scenario 3 - Year 2020
Total Recharge
1 Year
5 Year
Chino South TIN Objective (4.2 mg/L-N)
TIN (mg/L-N)
Recharge (acre-ft/yr)
Water Year
10.0
8.0
6.0
4.0
2.0
0.0
50,000
40,000
30,000
20,000
10,000
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

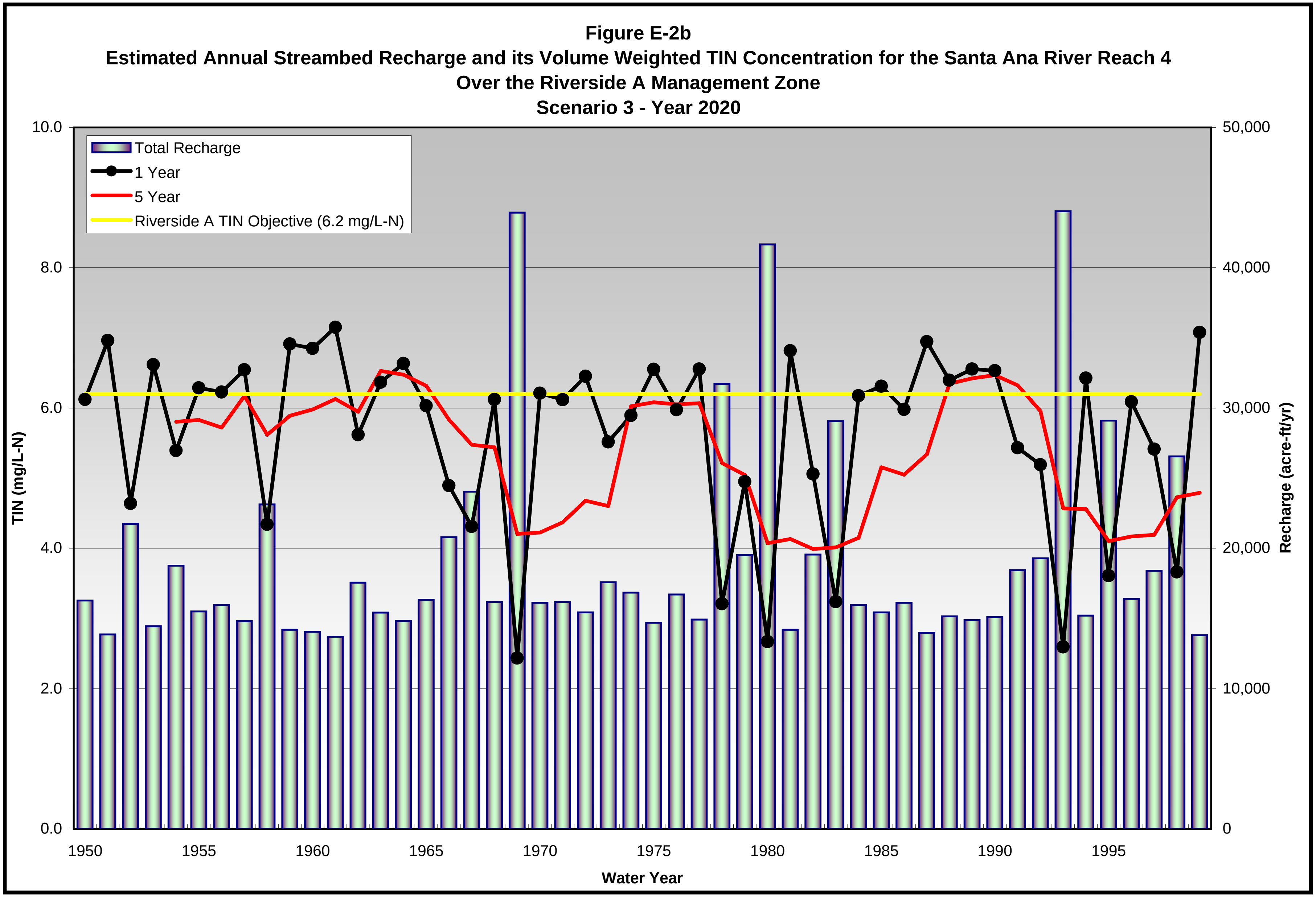
Table E-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 3 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	498	469			7.0	6.5		
1952	348	407	418		4.6	5.5	5.7	
1953	477	400	427		6.6	5.4	5.9	
1954	399	433	399	424	5.4	5.9	5.4	5.8
1955	454	424	440	426	6.3	5.8	6.0	5.8
1956	448	451	432	418	6.2	6.3	5.9	5.7
1957	472	460	458	447	6.5	6.4	6.3	6.2
1958	338	390	407	414	4.3	5.2	5.5	5.6
1959	494	397	419	431	6.9	5.3	5.7	5.9
1960	491	492	423	437	6.8	6.9	5.7	6.0
1961	509	500	498	447	7.2	7.0	7.0	6.1
1962	412	455	466	435	5.6	6.3	6.5	5.9
1963	459	434	456	470	6.4	6.0	6.3	6.5
1964	477	468	447	467	6.6	6.5	6.2	6.5
1965	439	457	458	456	6.0	6.3	6.3	6.3
1966	370	401	422	427	4.9	5.4	5.7	5.8
1967	336	352	375	406	4.3	4.6	5.0	5.5
1968	444	380	376	404	6.1	5.0	5.0	5.4
1969	237	293	305	334	2.4	3.4	3.7	4.2
1970	449	294	326	336	6.2	3.4	4.0	4.2
1971	445	447	326	345	6.1	6.2	4.0	4.4
1972	466	455	453	364	6.5	6.3	6.3	4.7
1973	409	435	439	359	5.5	6.0	6.0	4.6
1974	429	419	433	439	5.9	5.7	5.9	6.0
1975	472	449	435	443	6.6	6.2	6.0	6.1
1976	435	453	444	441	6.0	6.2	6.1	6.1
1977	472	452	459	442	6.6	6.2	6.3	6.1
1978	274	337	363	392	3.2	4.3	4.7	5.2
1979	376	313	349	382	4.9	3.9	4.5	5.0
1980	251	291	285	328	2.7	3.4	3.3	4.1
1981	489	312	328	332	6.8	3.7	4.0	4.1
1982	376	424	328	322	5.1	5.8	4.1	4.0
1983	275	316	355	323	3.2	4.0	4.6	4.0
1984	448	337	349	331	6.2	4.3	4.5	4.1
1985	456	452	367	387	6.3	6.2	4.8	5.2
1986	437	446	447	381	6.0	6.1	6.2	5.0
1987	497	465	462	400	6.9	6.4	6.4	5.3
1988	462	479	464	459	6.4	6.7	6.4	6.3
1989	473	467	477	464	6.6	6.5	6.6	6.4
1990	470	471	468	467	6.5	6.5	6.5	6.5
1991	400	431	444	457	5.4	5.9	6.1	6.3
1992	386	393	415	434	5.2	5.3	5.7	6.0
1993	243	287	312	355	2.6	3.4	3.8	4.6
1994	464	300	321	354	6.4	3.6	4.0	4.6
1995	300	357	300	328	3.6	4.6	3.6	4.1
1996	444	352	380	332	6.1	4.5	5.0	4.2
1997	402	422	366	334	5.4	5.7	4.8	4.2
1998	302	343	370	364	3.7	4.4	4.8	4.7
1999	505	372	381	368	7.1	4.8	5.0	4.8



R_S320a_matrix.xls -- Fig 2a

WILDERMUTH™ ENVIRONMENTAL INC.



R_S320a_matrix.xls -- Fig 2b

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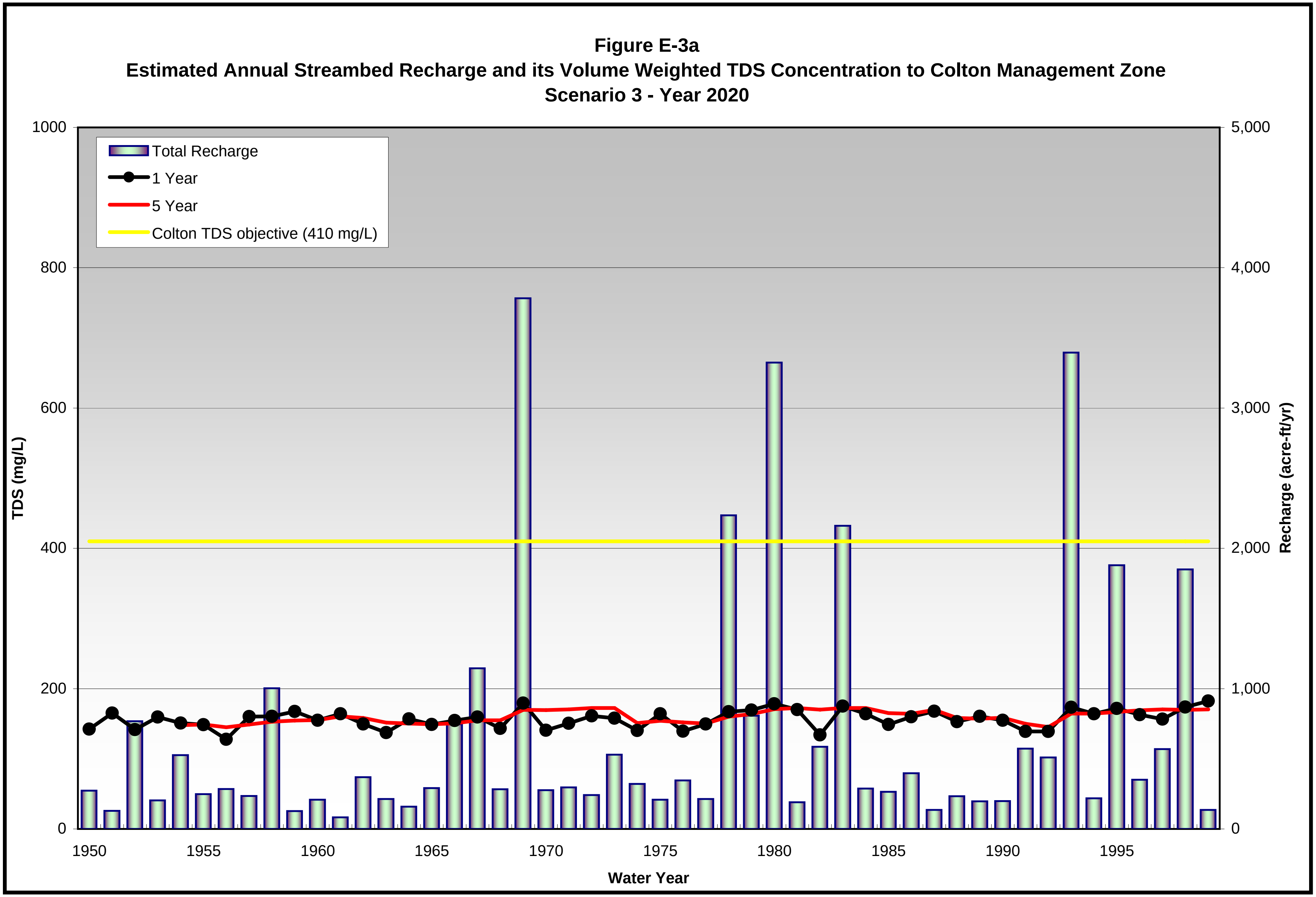
Table E-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 3 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	142				1.1			
1951	165	150			1.3	1.2		
1952	142	145	144		1.1	1.1	1.1	
1953	160	146	148		1.2	1.1	1.2	
1954	151	153	147	148	1.2	1.2	1.2	1.2
1955	149	150	152	149	1.2	1.2	1.2	1.2
1956	128	138	144	145	1.0	1.1	1.1	1.1
1957	160	143	145	149	1.2	1.1	1.1	1.2
1958	161	160	154	153	1.2	1.2	1.2	1.2
1959	168	161	161	155	1.3	1.2	1.2	1.2
1960	155	160	160	155	1.2	1.2	1.2	1.2
1961	164	158	161	161	1.3	1.2	1.2	1.2
1962	149	152	153	158	1.2	1.2	1.2	1.2
1963	137	145	147	152	1.1	1.1	1.2	1.2
1964	157	146	148	150	1.2	1.1	1.2	1.2
1965	149	152	147	149	1.2	1.2	1.2	1.2
1966	155	153	153	151	1.2	1.2	1.2	1.2
1967	159	158	156	155	1.2	1.2	1.2	1.2
1968	143	156	156	155	1.1	1.2	1.2	1.2
1969	179	177	173	170	1.3	1.3	1.2	1.2
1970	141	177	174	169	1.1	1.3	1.3	1.2
1971	151	146	175	170	1.2	1.2	1.3	1.2
1972	161	155	150	172	1.2	1.2	1.2	1.3
1973	158	159	157	172	1.2	1.2	1.2	1.3
1974	140	151	153	151	1.1	1.2	1.2	1.2
1975	164	150	154	154	1.2	1.2	1.2	1.2
1976	139	149	146	152	1.1	1.2	1.1	1.2
1977	150	143	149	150	1.2	1.1	1.2	1.2
1978	167	166	162	160	1.2	1.2	1.2	1.2
1979	169	168	167	164	1.2	1.2	1.2	1.2
1980	178	177	173	171	1.3	1.3	1.3	1.2
1981	170	178	176	172	1.3	1.3	1.3	1.3
1982	134	143	172	170	1.1	1.1	1.2	1.2
1983	175	166	167	172	1.3	1.2	1.2	1.3
1984	164	174	166	172	1.2	1.3	1.2	1.3
1985	149	157	171	165	1.1	1.2	1.3	1.2
1986	160	155	158	164	1.2	1.2	1.2	1.2
1987	168	162	157	170	1.3	1.2	1.2	1.3
1988	153	158	159	158	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	159	1.2	1.2	1.2	1.2
1991	139	143	147	150	1.1	1.1	1.2	1.2
1992	139	139	141	145	1.1	1.1	1.1	1.1
1993	173	169	165	164	1.2	1.2	1.2	1.2
1994	164	173	169	165	1.2	1.2	1.2	1.2
1995	172	171	172	167	1.2	1.2	1.2	1.2
1996	163	170	170	169	1.2	1.2	1.2	1.2
1997	157	159	167	170	1.2	1.2	1.2	1.2
1998	174	170	169	170	1.3	1.3	1.3	1.3
1999	182	174	170	170	1.4	1.3	1.3	1.3



R_S320a_matrix.xls -- Fig 3a

WILDERMUTH ENVIRONMENTAL INC.

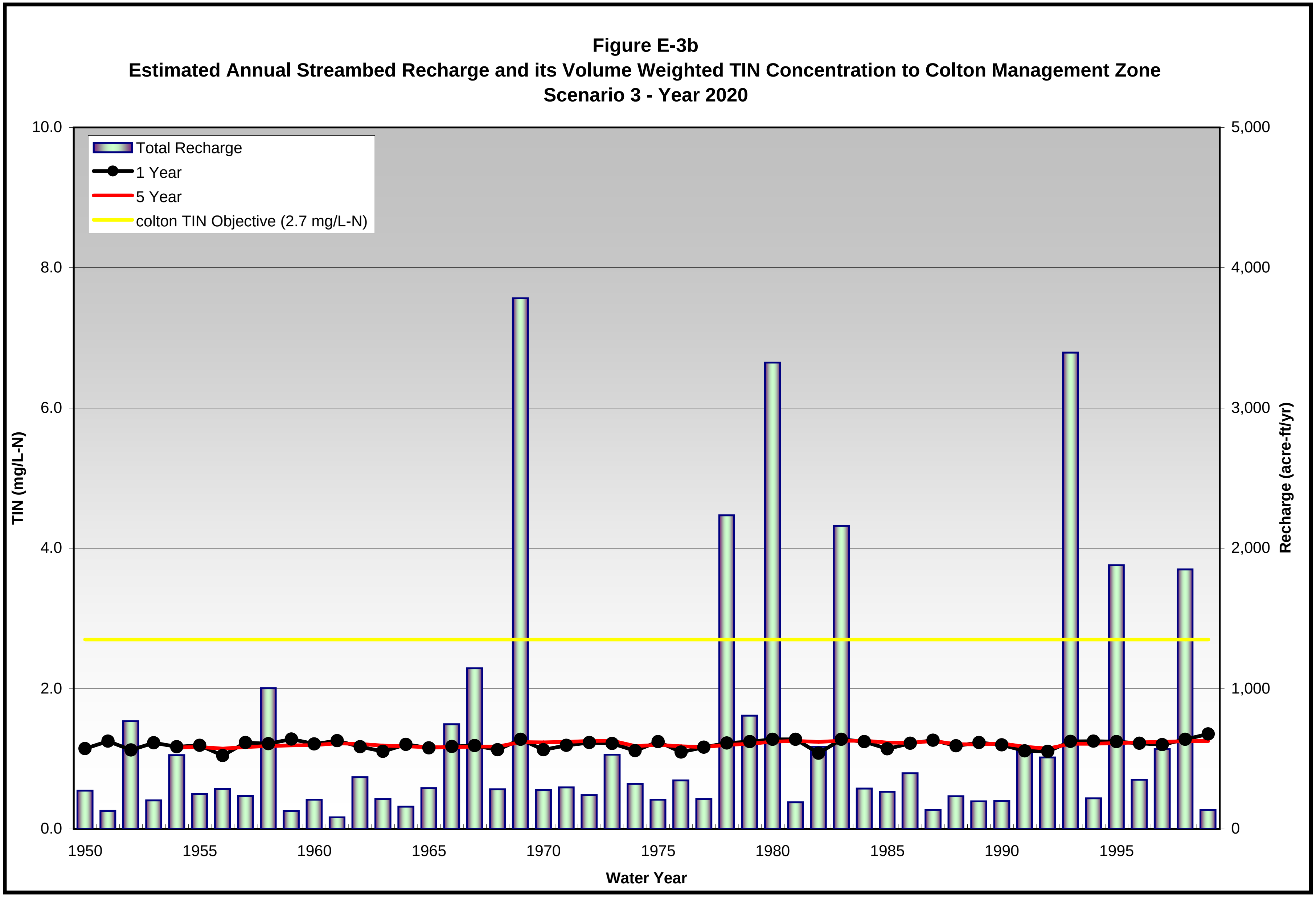


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Table E-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 3 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	200				1.6			
1951	241	214			1.8	1.7		
1952	192	198	199		1.5	1.5	1.5	
1953	214	197	201		1.6	1.5	1.5	
1954	194	200	196	199	1.5	1.5	1.5	1.5
1955	204	197	201	200	1.6	1.5	1.5	1.5
1956	211	207	200	198	1.6	1.6	1.5	1.5
1957	209	210	208	204	1.6	1.6	1.6	1.6
1958	194	197	198	198	1.4	1.5	1.5	1.5
1959	224	198	200	201	1.7	1.5	1.5	1.5
1960	207	215	199	201	1.6	1.6	1.5	1.5
1961	259	223	223	203	2.0	1.7	1.7	1.5
1962	194	205	206	201	1.5	1.6	1.6	1.5
1963	213	199	207	210	1.7	1.6	1.6	1.6
1964	217	215	203	209	1.7	1.7	1.6	1.6
1965	200	206	208	207	1.5	1.6	1.6	1.6
1966	192	195	198	199	1.5	1.5	1.5	1.5
1967	197	195	196	199	1.5	1.5	1.5	1.5
1968	201	198	196	198	1.6	1.5	1.5	1.5
1969	195	196	196	196	1.4	1.4	1.4	1.4
1970	205	196	196	196	1.6	1.4	1.4	1.4
1971	207	206	197	197	1.6	1.6	1.4	1.5
1972	217	211	209	198	1.6	1.6	1.6	1.5
1973	196	202	203	198	1.5	1.5	1.5	1.5
1974	204	199	202	203	1.6	1.5	1.5	1.6
1975	207	206	200	204	1.6	1.6	1.5	1.5
1976	197	202	203	202	1.5	1.6	1.6	1.5
1977	208	202	204	201	1.6	1.6	1.6	1.5
1978	190	192	193	195	1.4	1.4	1.4	1.5
1979	198	193	194	195	1.5	1.4	1.4	1.5
1980	198	198	195	196	1.4	1.4	1.4	1.4
1981	216	200	199	197	1.6	1.4	1.4	1.4
1982	193	200	198	196	1.5	1.5	1.4	1.4
1983	198	197	198	198	1.4	1.5	1.5	1.4
1984	212	200	199	199	1.6	1.5	1.5	1.5
1985	209	211	201	201	1.6	1.6	1.5	1.5
1986	202	205	207	200	1.5	1.6	1.6	1.5
1987	227	209	209	202	1.7	1.6	1.6	1.5
1988	207	215	209	210	1.6	1.7	1.6	1.6
1989	212	209	214	209	1.6	1.6	1.6	1.6
1990	223	216	213	211	1.7	1.6	1.6	1.6
1991	196	203	206	209	1.5	1.5	1.6	1.6
1992	194	195	199	202	1.5	1.5	1.5	1.5
1993	193	193	193	196	1.4	1.4	1.4	1.4
1994	212	195	195	196	1.6	1.4	1.4	1.5
1995	196	199	196	195	1.4	1.5	1.4	1.4
1996	208	199	201	196	1.6	1.5	1.5	1.4
1997	197	202	198	197	1.5	1.5	1.5	1.4
1998	198	198	199	199	1.4	1.4	1.5	1.5
1999	232	202	201	200	1.7	1.5	1.5	1.5

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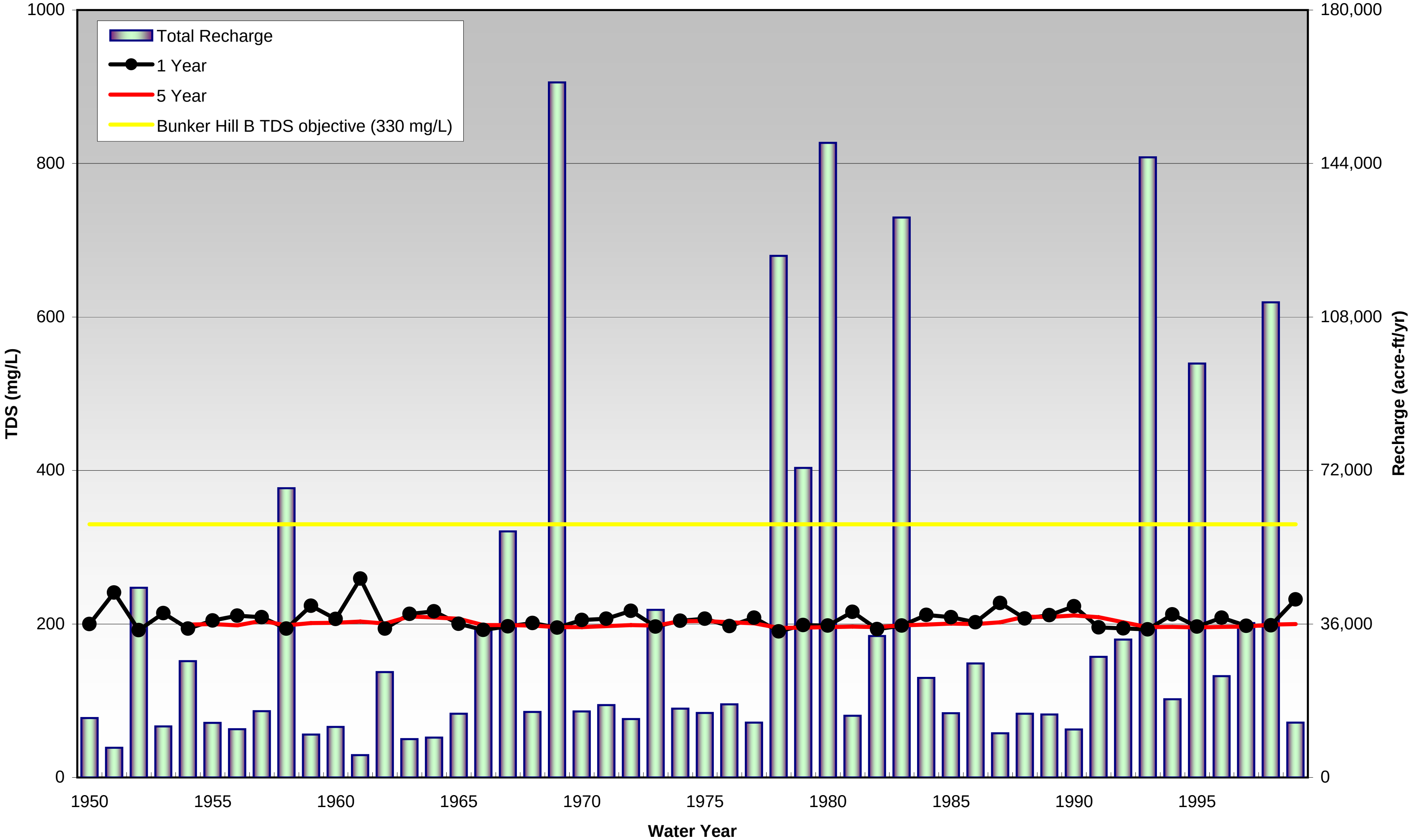
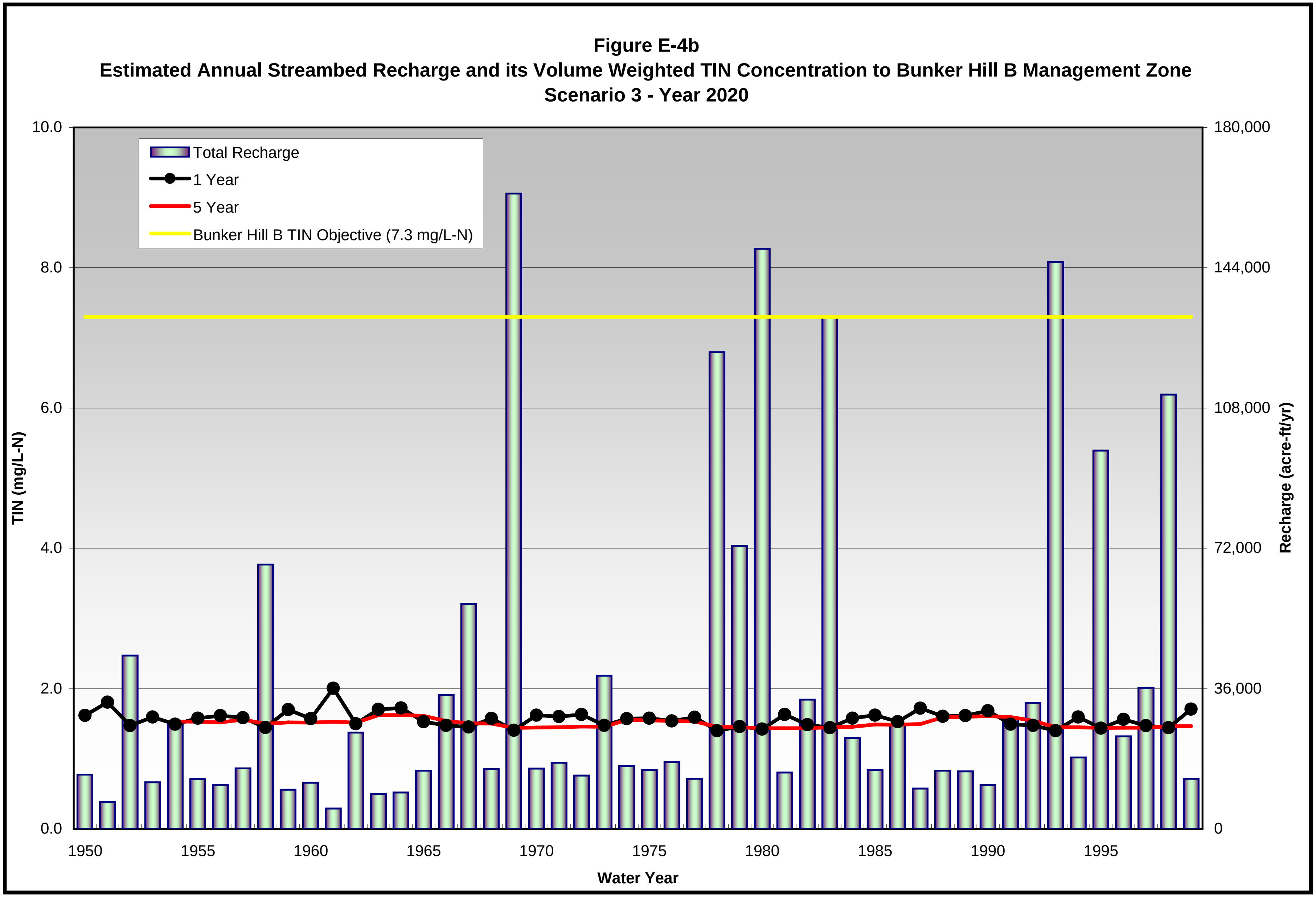
Figure E-4a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Bunker Hill B Management Zone
Scenario 3 - Year 2020



R_S320a_matrix.xls -- Fig 4a

WILDERMUTH ENVIRONMENTAL INC.



R_S320a_matrix.xls -- Fig 4b

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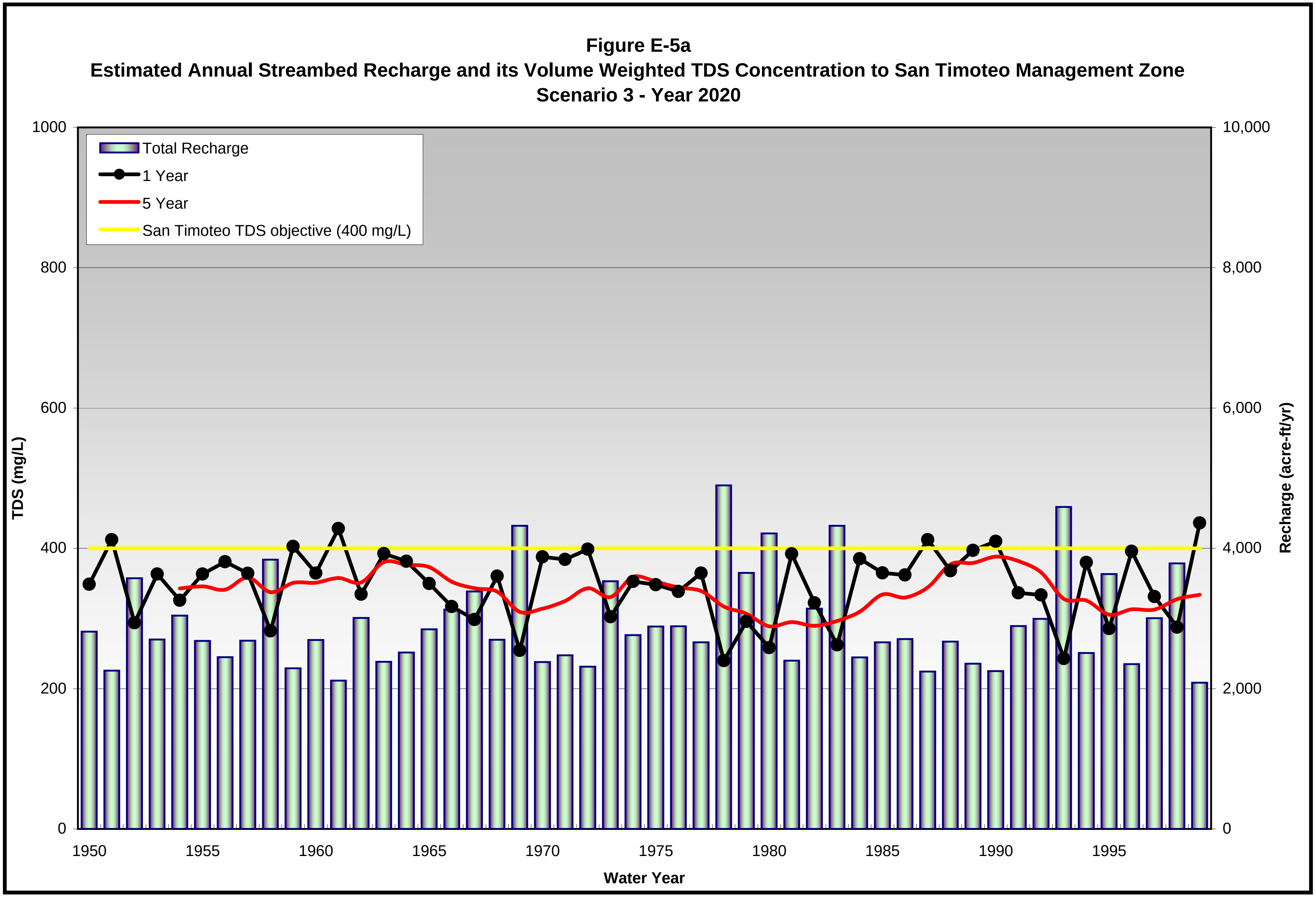
Table E-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 3 - Year 2020
(mg/L)

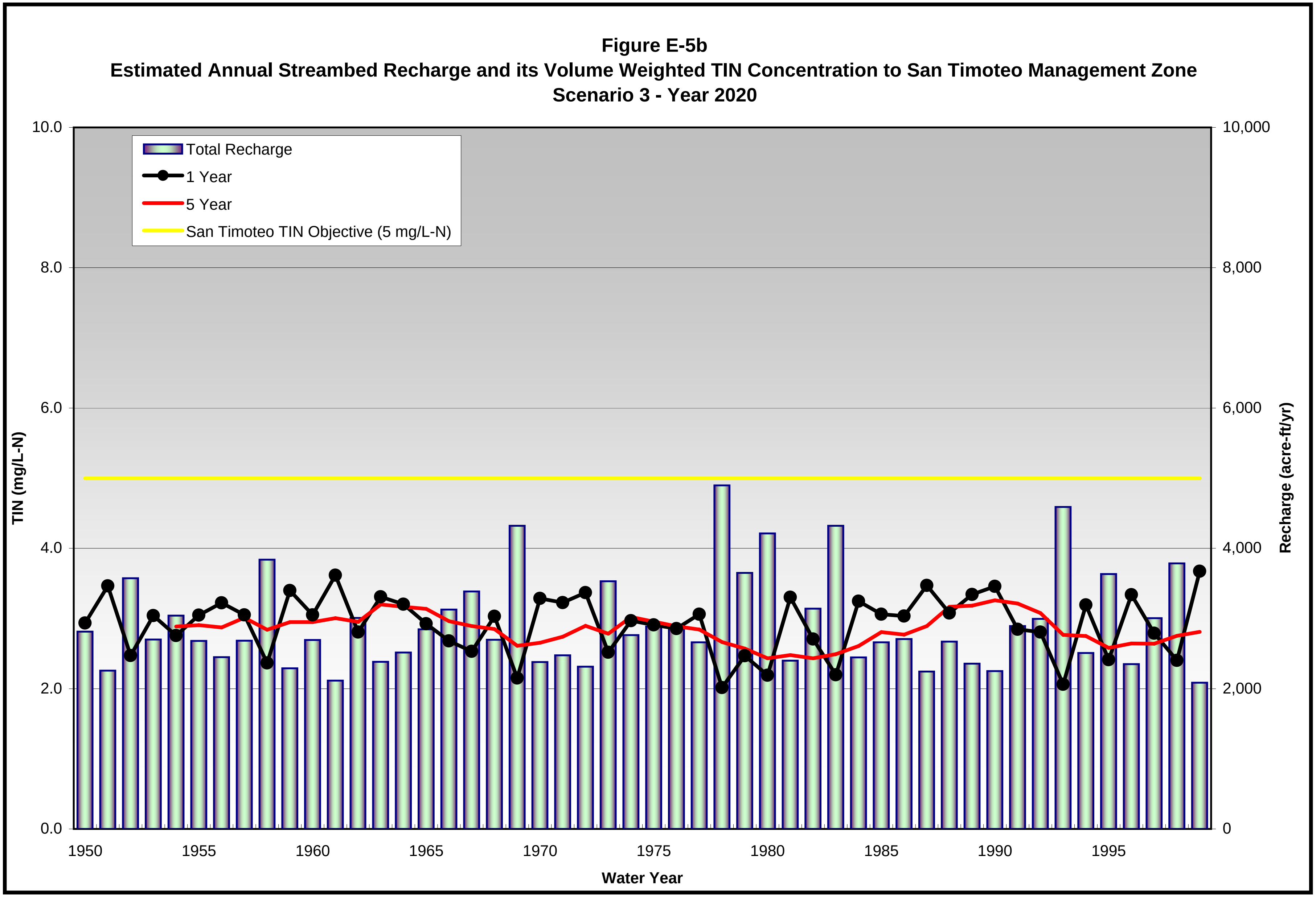
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	349				2.9			
1951	412	377			3.5	3.2		
1952	294	340	343		2.5	2.9	2.9	
1953	363	324	347		3.0	2.7	2.9	
1954	326	344	324	343	2.8	2.9	2.7	2.9
1955	363	343	350	346	3.0	2.9	2.9	2.9
1956	381	372	355	341	3.2	3.1	3.0	2.9
1957	364	372	369	358	3.1	3.1	3.1	3.0
1958	282	316	334	338	2.4	2.6	2.8	2.8
1959	403	327	339	351	3.4	2.8	2.8	2.9
1960	365	382	339	351	3.1	3.2	2.8	2.9
1961	428	393	396	358	3.6	3.3	3.3	3.0
1962	335	373	370	351	2.8	3.1	3.1	3.0
1963	392	360	379	380	3.3	3.0	3.2	3.2
1964	382	387	367	377	3.2	3.3	3.1	3.2
1965	350	365	373	373	2.9	3.1	3.1	3.1
1966	317	333	347	352	2.7	2.8	2.9	3.0
1967	298	307	320	343	2.5	2.6	2.7	2.9
1968	360	326	323	338	3.0	2.8	2.7	2.8
1969	255	295	296	310	2.2	2.5	2.5	2.6
1970	388	302	319	314	3.3	2.6	2.7	2.7
1971	384	386	324	325	3.2	3.3	2.7	2.7
1972	399	391	390	343	3.4	3.3	3.3	2.9
1973	302	341	354	331	2.5	2.9	3.0	2.8
1974	353	324	344	359	3.0	2.7	2.9	3.0
1975	348	350	332	352	2.9	2.9	2.8	3.0
1976	338	343	346	344	2.9	2.9	2.9	2.9
1977	365	351	350	339	3.1	3.0	2.9	2.8
1978	240	284	299	317	2.0	2.4	2.5	2.7
1979	296	264	288	307	2.5	2.2	2.4	2.6
1980	259	276	262	289	2.2	2.3	2.2	2.4
1981	392	307	303	295	3.3	2.6	2.5	2.5
1982	322	353	312	289	2.7	3.0	2.6	2.4
1983	262	288	313	297	2.2	2.4	2.6	2.5
1984	385	307	312	310	3.2	2.6	2.6	2.6
1985	365	375	323	334	3.1	3.1	2.7	2.8
1986	362	363	370	330	3.0	3.0	3.1	2.8
1987	412	385	378	344	3.5	3.2	3.2	2.9
1988	368	388	379	377	3.1	3.3	3.2	3.2
1989	397	382	391	379	3.3	3.2	3.3	3.2
1990	410	403	390	388	3.5	3.4	3.3	3.3
1991	337	369	378	382	2.8	3.1	3.2	3.2
1992	334	335	356	366	2.8	2.8	3.0	3.1
1993	243	279	295	328	2.1	2.4	2.5	2.8
1994	380	291	304	326	3.2	2.5	2.6	2.7
1995	286	324	289	306	2.4	2.7	2.4	2.6
1996	396	329	344	313	3.3	2.8	2.9	2.6
1997	331	360	330	313	2.8	3.0	2.8	2.6
1998	288	307	330	328	2.4	2.6	2.8	2.8
1999	436	340	337	334	3.7	2.9	2.8	2.8

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1!



R_S320a_matrix.xls -- Fig 5a

WILDERMUTH™ ENVIRONMENTAL INC.

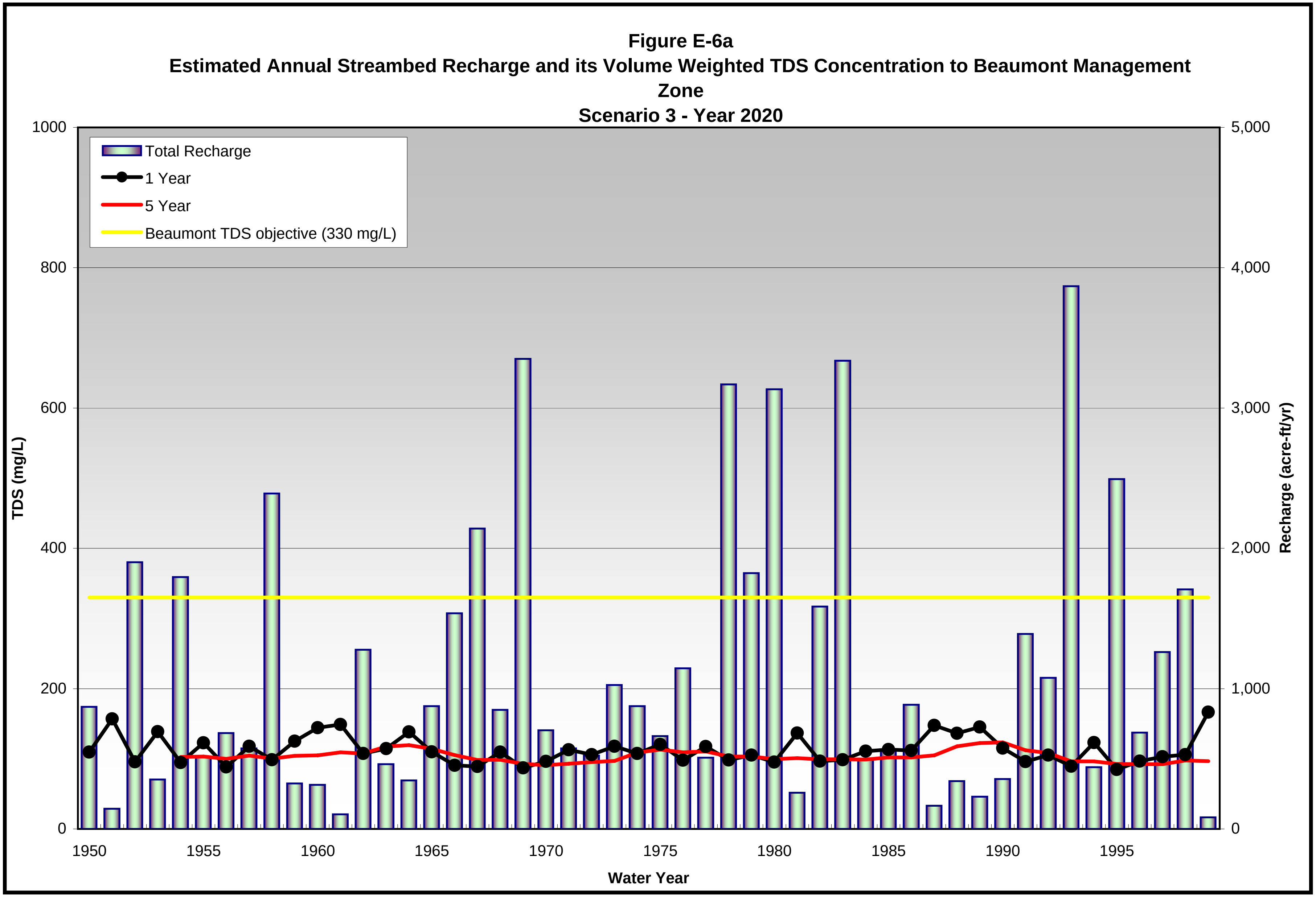


R_S320a_matrix.xls -- Fig 5b

WILDERMUTH ENVIRONMENTAL INC.

Table E-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 3 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8



R_S320a_matrix.xls -- Fig 6a

Figure E-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 3 - Year 2020

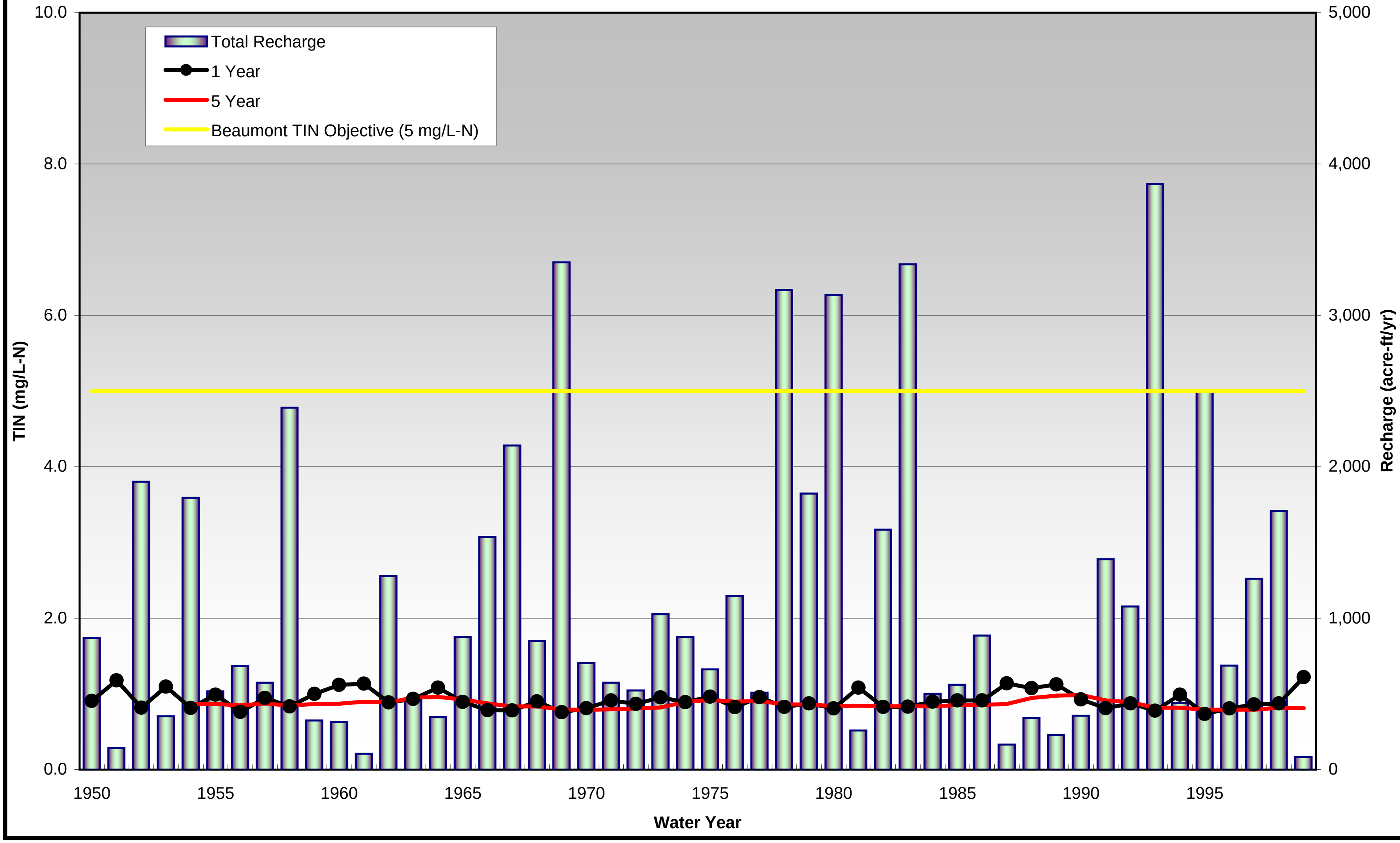


Table E-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 3 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	540				665	6.8				8.6
1951	623	578			665	7.9	7.3			8.6
1952	343	431	460		665	4.3	5.4	5.8		8.6
1953	584	423	470		665	7.4	5.3	5.9		8.6
1954	455	510	433	479	664	5.7	6.4	5.4	6.0	8.6
1955	552	498	523	480	664	7.0	6.3	6.6	6.1	8.6
1956	426	480	471	450	665	5.4	6.1	6.0	5.7	8.6
1957	563	484	504	506	665	7.1	6.1	6.4	6.4	8.6
1958	373	441	436	458	642	4.6	5.5	5.5	5.8	8.3
1959	617	454	483	482	665	7.8	5.7	6.1	6.1	8.6
1960	581	598	488	486	665	7.3	7.6	6.1	6.1	8.6
1961	649	612	614	526	651	8.3	7.8	7.8	6.6	8.4
1962	465	537	551	506	665	5.9	6.8	7.0	6.4	8.6
1963	521	491	532	556	664	6.6	6.2	6.7	7.0	8.6
1964	580	549	516	550	665	7.3	6.9	6.5	7.0	8.6
1965	528	552	541	540	656	6.6	7.0	6.8	6.8	8.4
1966	381	439	476	482	665	4.7	5.5	6.0	6.1	8.6
1967	339	359	397	443	654	4.2	4.4	4.9	5.5	8.4
1968	501	399	393	440	665	6.4	5.0	4.9	5.5	8.6
1969	237	296	308	344	648	2.7	3.5	3.7	4.2	8.3
1970	538	299	337	345	664	6.8	3.6	4.1	4.2	8.6
1971	552	545	342	361	663	7.0	6.9	4.1	4.4	8.5
1972	540	546	543	389	645	6.8	6.9	6.9	4.8	8.3
1973	451	490	508	384	665	5.6	6.2	6.4	4.7	8.6
1974	485	467	488	509	665	6.1	5.9	6.1	6.4	8.6
1975	549	515	491	511	665	6.9	6.5	6.2	6.4	8.6
1976	550	550	526	511	665	6.9	6.9	6.6	6.4	8.6
1977	545	547	548	511	371	6.9	6.9	6.9	6.4	4.6
1978	279	349	391	429	665	3.3	4.3	4.8	5.3	8.6
1979	422	328	369	419	665	5.2	4.0	4.5	5.2	8.6
1980	292	330	312	360	662	2.9	3.6	3.5	4.2	8.5
1981	585	353	370	362	665	7.4	3.9	4.2	4.2	8.6
1982	412	479	367	351	664	5.2	6.0	4.2	4.1	8.6
1983	329	360	403	366	460	3.7	4.2	4.9	4.2	5.8
1984	540	391	397	376	663	6.8	4.6	4.8	4.4	8.5
1985	528	534	423	442	665	6.7	6.7	5.1	5.4	8.6
1986	476	500	512	429	664	6.0	6.3	6.5	5.3	8.6
1987	605	530	529	456	665	7.7	6.7	6.7	5.6	8.6
1988	523	560	528	530	664	6.6	7.1	6.7	6.7	8.6
1989	581	550	567	537	665	7.4	6.9	7.2	6.8	8.6
1990	589	585	562	549	665	7.5	7.4	7.1	6.9	8.6
1991	420	487	514	531	665	5.3	6.1	6.5	6.7	8.6
1992	441	430	470	498	665	5.5	5.4	5.9	6.3	8.6
1993	270	316	339	394	665	2.9	3.6	4.0	4.7	8.6
1994	579	334	358	394	665	7.3	3.8	4.2	4.7	8.6
1995	326	398	331	359	665	3.7	4.8	3.8	4.2	8.6
1996	504	383	425	367	665	6.4	4.6	5.2	4.3	8.6
1997	487	495	409	372	665	6.1	6.2	5.0	4.4	8.6
1998	333	389	418	409	651	4.1	4.8	5.2	5.0	8.4
1999	640	420	439	413	665	8.1	5.2	5.5	5.1	8.6

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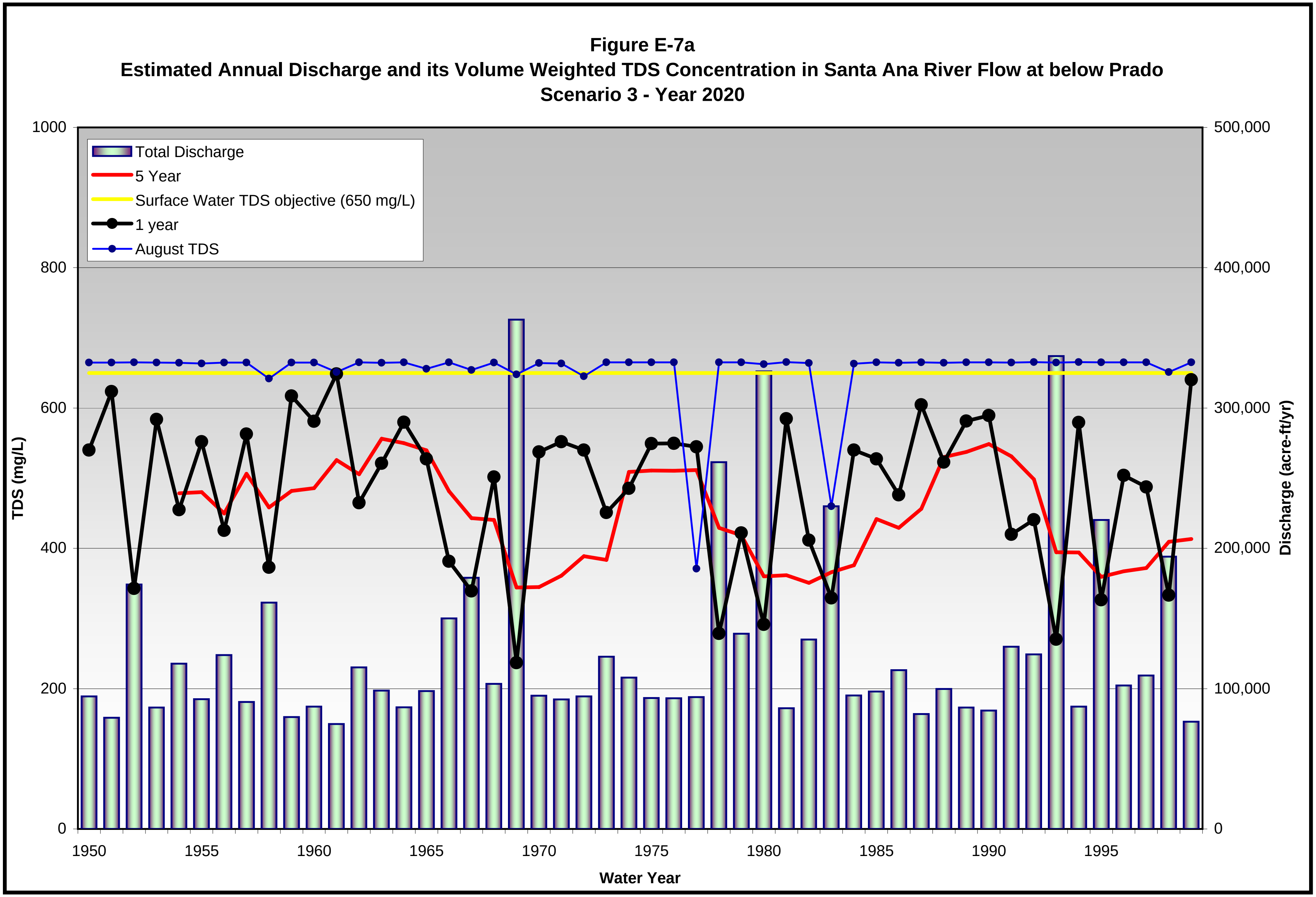
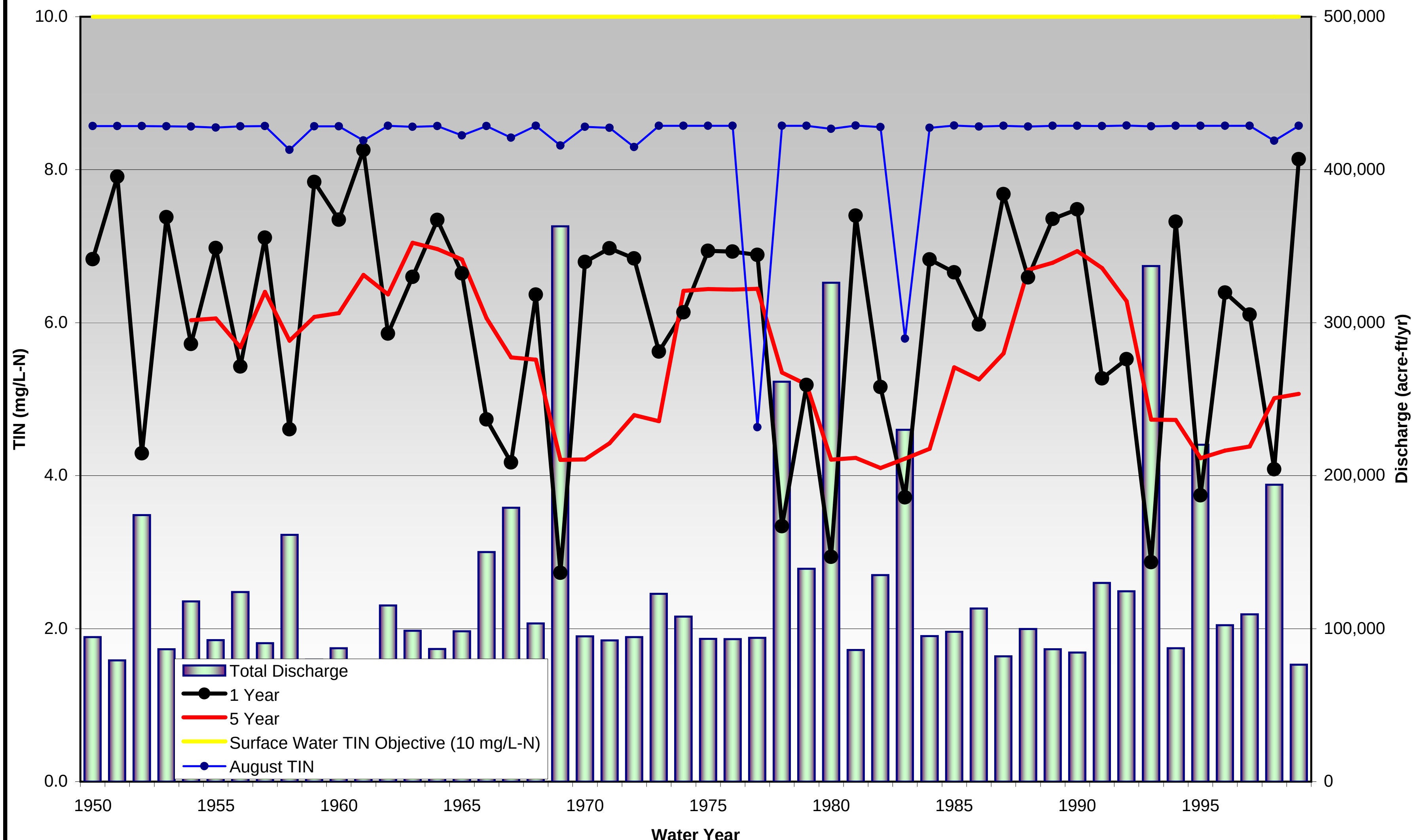


R_S320a_matrix.xls -- Fig 7a

Figure E-7b
Estimated Annual Discharge and its Volume Weighted TIN Concentration in Santa Ana River Flow at below Prado
Scenario 3 - Year 2020

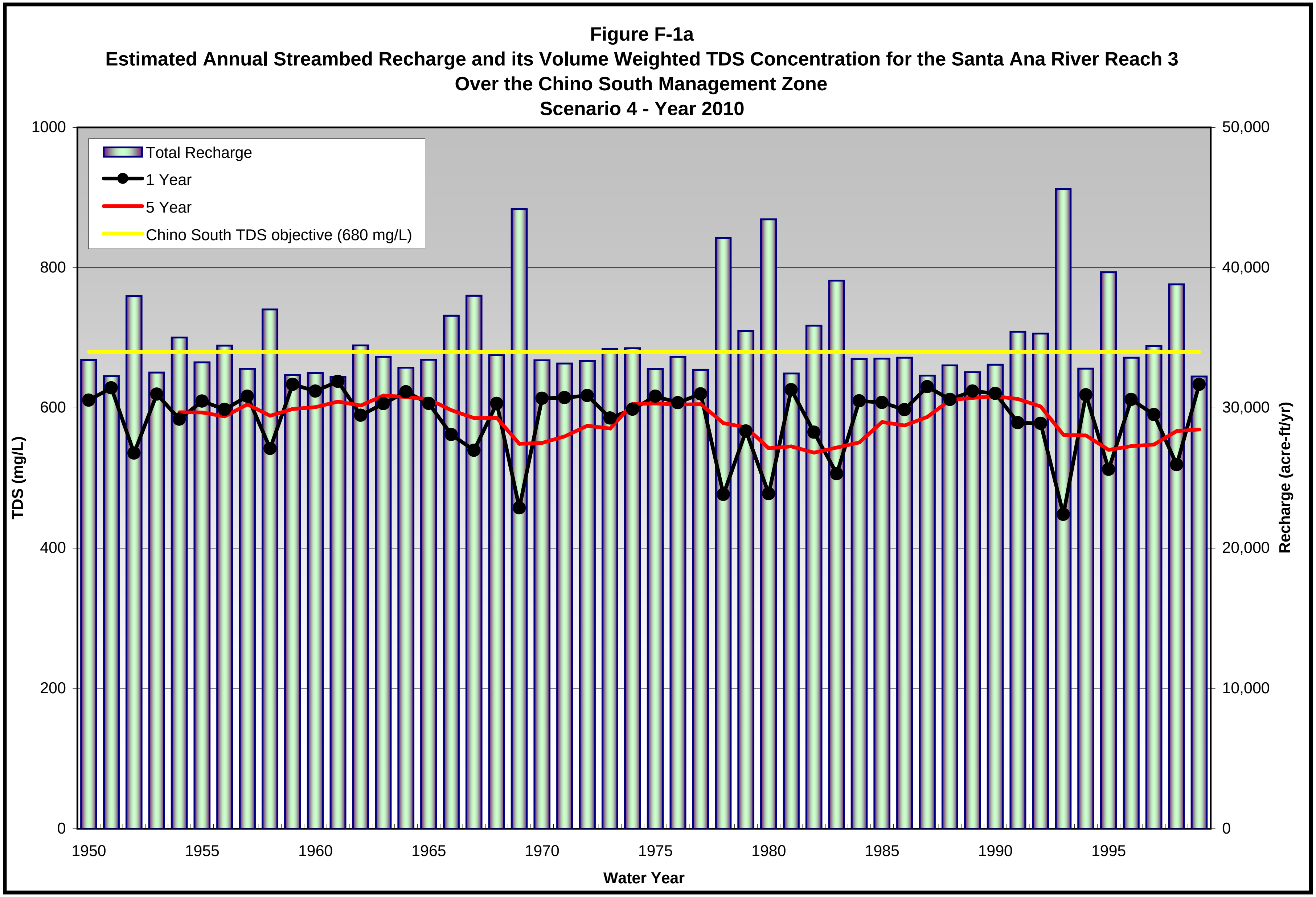


Appendix F

Scenario 4, Year 2010 Simulation Results (Summary Matrices and Graphs)

Table F-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 4 - Year 2010
(mg/L)

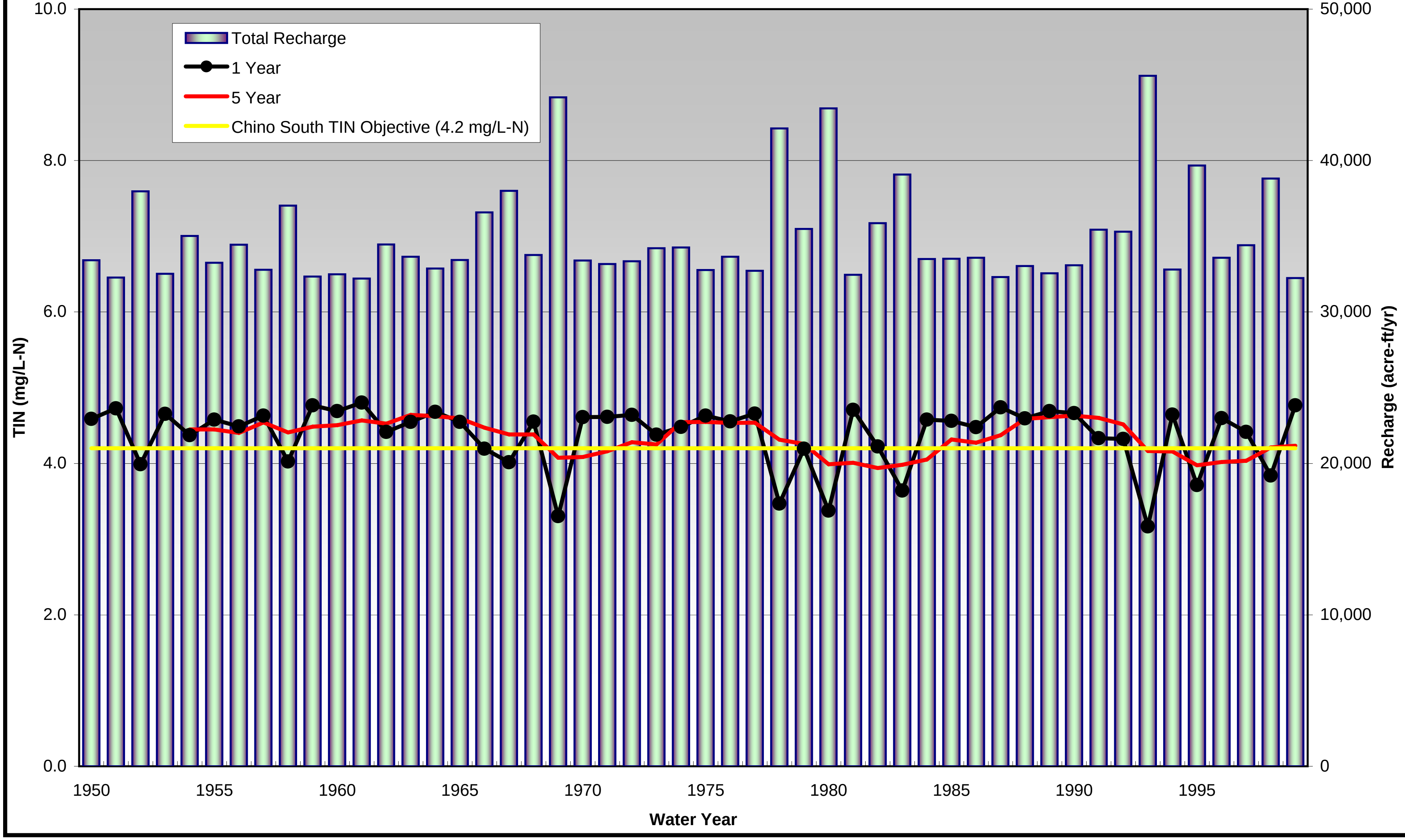
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	611				4.6			
1951	629	620			4.7	4.7		
1952	536	578	589		4.0	4.3	4.4	
1953	620	574	591		4.7	4.3	4.4	
1954	584	601	578	594	4.4	4.5	4.3	4.4
1955	610	597	604	593	4.6	4.5	4.5	4.4
1956	598	604	597	588	4.5	4.5	4.5	4.4
1957	617	607	608	605	4.6	4.6	4.6	4.5
1958	542	577	584	589	4.0	4.3	4.4	4.4
1959	633	585	595	598	4.8	4.4	4.5	4.5
1960	624	629	597	601	4.7	4.7	4.5	4.5
1961	638	631	632	609	4.8	4.7	4.8	4.6
1962	589	613	617	603	4.4	4.6	4.6	4.5
1963	606	598	611	618	4.5	4.5	4.6	4.6
1964	623	614	606	616	4.7	4.6	4.5	4.6
1965	607	615	612	612	4.5	4.6	4.6	4.6
1966	562	583	596	597	4.2	4.4	4.5	4.5
1967	540	551	568	586	4.0	4.1	4.2	4.4
1968	606	571	568	586	4.6	4.3	4.2	4.4
1969	457	522	528	549	3.3	3.8	3.9	4.1
1970	614	525	550	550	4.6	3.9	4.1	4.1
1971	615	614	552	559	4.6	4.6	4.1	4.2
1972	618	616	615	574	4.6	4.6	4.6	4.3
1973	586	601	606	571	4.4	4.5	4.5	4.2
1974	598	592	600	606	4.5	4.4	4.5	4.5
1975	617	607	600	606	4.6	4.6	4.5	4.5
1976	607	612	607	605	4.6	4.6	4.6	4.5
1977	620	614	615	605	4.7	4.6	4.6	4.5
1978	477	539	560	578	3.5	4.0	4.2	4.3
1979	567	518	548	572	4.2	3.8	4.1	4.3
1980	478	518	504	543	3.4	3.7	3.6	4.0
1981	626	541	549	545	4.7	3.9	4.0	4.0
1982	565	594	549	536	4.2	4.5	4.0	3.9
1983	506	534	562	543	3.6	3.9	4.2	4.0
1984	610	554	558	551	4.6	4.1	4.1	4.1
1985	608	609	571	580	4.6	4.6	4.2	4.3
1986	598	603	605	575	4.5	4.5	4.5	4.3
1987	630	614	612	587	4.7	4.6	4.6	4.4
1988	612	621	613	611	4.6	4.7	4.6	4.6
1989	624	618	622	614	4.7	4.6	4.7	4.6
1990	621	622	619	617	4.7	4.7	4.6	4.6
1991	579	599	607	613	4.3	4.5	4.6	4.6
1992	578	579	592	602	4.3	4.3	4.4	4.5
1993	448	505	527	562	3.2	3.7	3.9	4.2
1994	619	519	538	561	4.6	3.8	4.0	4.2
1995	512	560	517	540	3.7	4.1	3.8	4.0
1996	612	558	577	546	4.6	4.1	4.3	4.0
1997	590	601	568	548	4.4	4.5	4.2	4.0
1998	519	553	571	567	3.8	4.1	4.3	4.2
1999	634	571	577	569	4.8	4.3	4.3	4.2



R_S410a_matrix.xls -- Fig 1a

WILDERMUTH ENVIRONMENTAL INC.

Figure F-1b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 3
Over the Chino South Management Zone
Scenario 4 - Year 2010

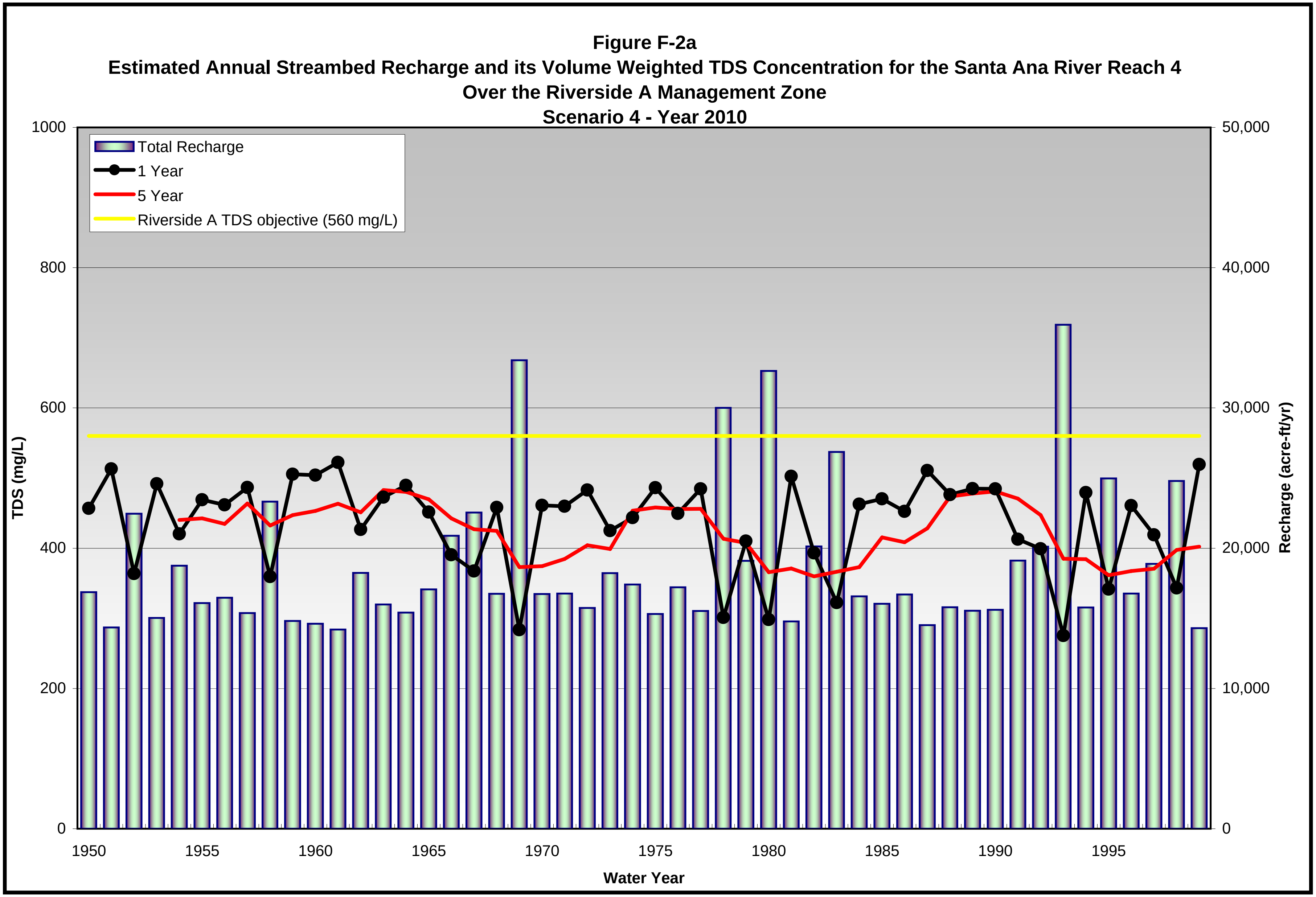


R_S410a_matrix.xls -- Fig 1b

WILDERMUTH ENVIRONMENTAL INC.

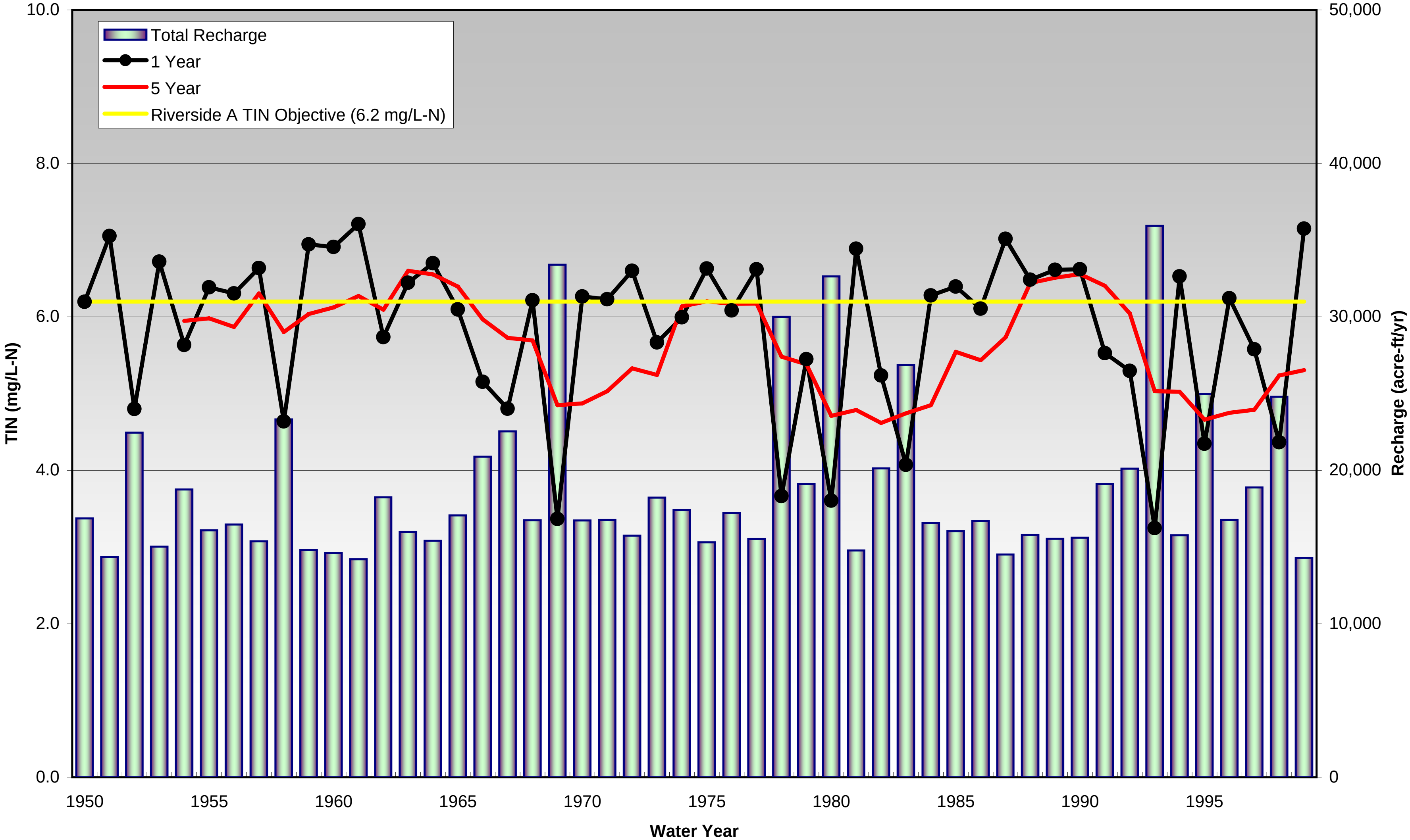
Table F-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 4 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	457				6.2			
1951	513	483			7.1	6.6		
1952	364	422	433		4.8	5.7	5.8	
1953	492	415	442		6.7	5.6	6.0	
1954	420	452	417	440	5.6	6.1	5.6	5.9
1955	469	443	458	442	6.4	6.0	6.2	6.0
1956	462	465	449	435	6.3	6.3	6.1	5.9
1957	487	474	472	464	6.6	6.5	6.4	6.3
1958	360	410	425	432	4.6	5.4	5.7	5.8
1959	505	416	436	447	6.9	5.5	5.9	6.0
1960	504	505	441	453	6.9	6.9	5.9	6.1
1961	522	513	510	463	7.2	7.1	7.0	6.3
1962	427	469	480	451	5.7	6.4	6.5	6.1
1963	473	448	470	483	6.4	6.1	6.4	6.6
1964	490	481	461	480	6.7	6.6	6.3	6.6
1965	452	470	471	470	6.1	6.4	6.4	6.4
1966	391	418	439	442	5.2	5.6	5.9	6.0
1967	367	379	399	427	4.8	5.0	5.3	5.7
1968	458	406	401	425	6.2	5.4	5.3	5.7
1969	284	342	350	373	3.4	4.3	4.5	4.8
1970	461	343	372	374	6.3	4.3	4.8	4.9
1971	460	460	372	385	6.2	6.2	4.8	5.0
1972	483	471	468	404	6.6	6.4	6.4	5.3
1973	425	452	454	399	5.7	6.1	6.1	5.2
1974	444	434	449	454	6.0	5.8	6.1	6.1
1975	486	463	450	458	6.6	6.3	6.1	6.2
1976	450	467	459	456	6.1	6.3	6.2	6.2
1977	485	466	473	456	6.6	6.3	6.4	6.2
1978	301	364	387	413	3.7	4.7	5.1	5.5
1979	410	344	378	407	5.4	4.4	4.9	5.4
1980	298	340	326	366	3.6	4.3	4.1	4.7
1981	503	362	376	371	6.9	4.6	4.9	4.8
1982	393	440	371	360	5.2	5.9	4.8	4.6
1983	322	353	389	366	4.1	4.6	5.1	4.7
1984	463	376	381	373	6.3	4.9	5.0	4.9
1985	470	466	401	416	6.4	6.3	5.3	5.5
1986	452	461	462	409	6.1	6.2	6.3	5.4
1987	511	480	476	428	7.0	6.5	6.5	5.7
1988	476	493	478	474	6.5	6.7	6.5	6.4
1989	485	481	490	478	6.6	6.5	6.7	6.5
1990	485	485	482	481	6.6	6.6	6.6	6.6
1991	413	445	457	471	5.5	6.0	6.2	6.4
1992	399	406	428	447	5.3	5.4	5.8	6.0
1993	276	320	344	385	3.2	4.0	4.4	5.0
1994	479	338	355	384	6.5	4.2	4.5	5.0
1995	341	395	339	362	4.3	5.2	4.3	4.7
1996	461	389	414	368	6.2	5.1	5.5	4.7
1997	419	439	399	371	5.6	5.9	5.3	4.8
1998	343	376	400	398	4.4	4.9	5.3	5.2
1999	519	408	411	402	7.2	5.4	5.4	5.3



R_S410a_matrix.xls -- Fig 2a

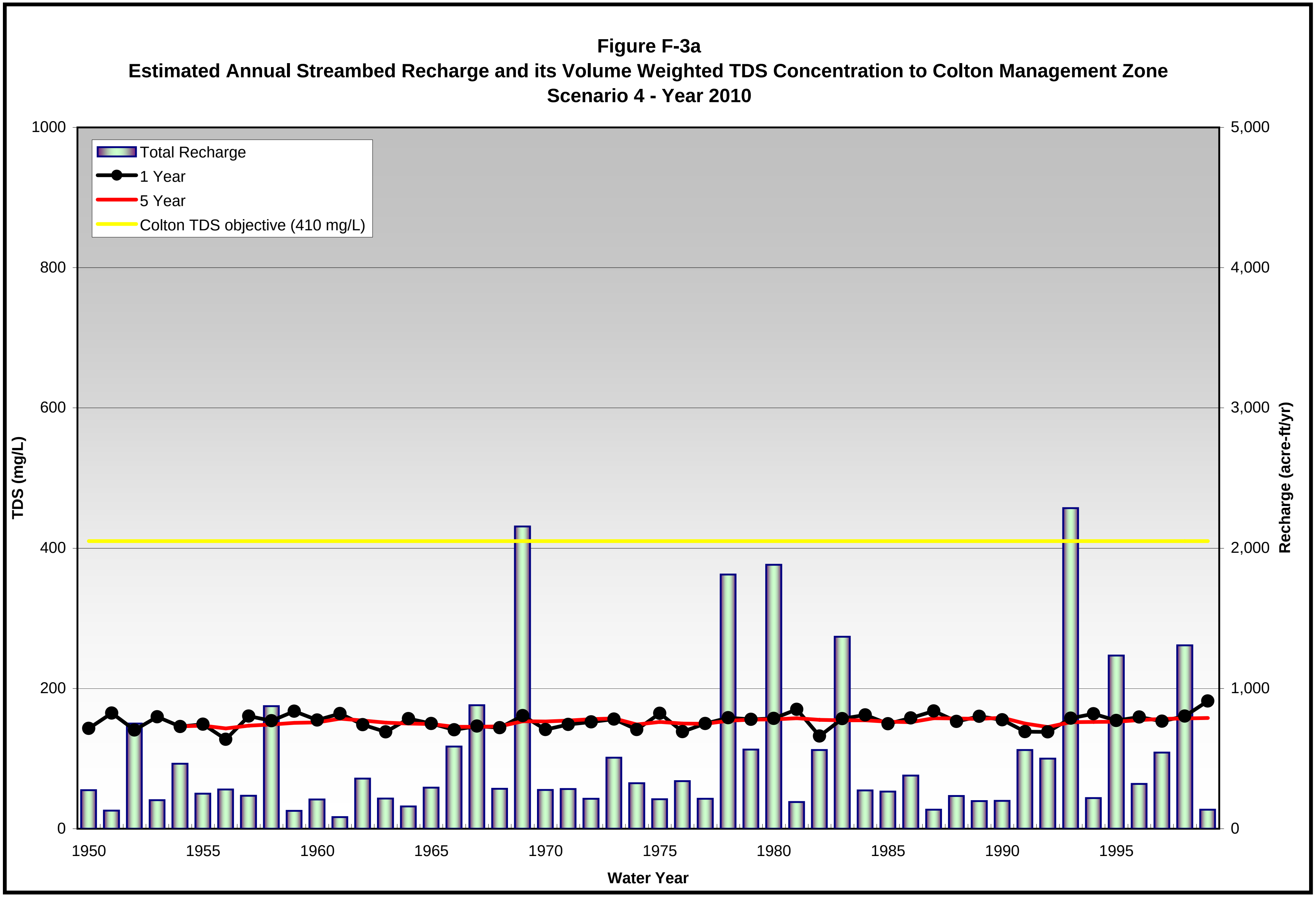
Figure F-2b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 4 - Year 2010



WILDERMUTH™ ENVIRONMENTAL INC.

Table F-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 4 - Year 2010
(mg/L)

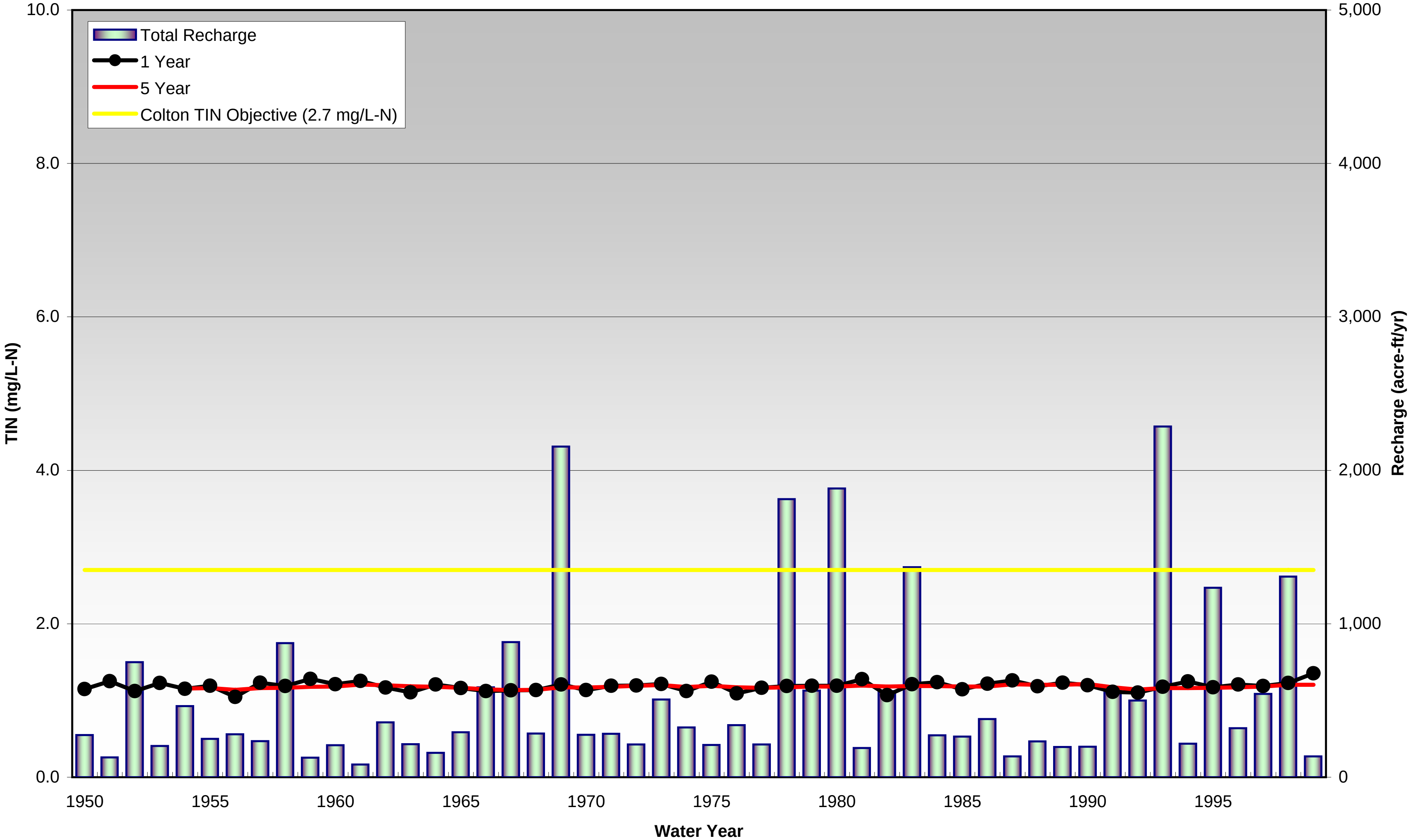
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	143				1.2			
1951	165	150			1.3	1.2		
1952	141	144	144		1.1	1.1	1.1	
1953	160	145	147		1.2	1.1	1.2	
1954	146	150	145	146	1.2	1.2	1.1	1.2
1955	149	147	150	147	1.2	1.2	1.2	1.2
1956	128	138	141	143	1.0	1.1	1.1	1.1
1957	160	142	145	147	1.2	1.1	1.1	1.2
1958	154	155	150	149	1.2	1.2	1.2	1.2
1959	168	156	157	151	1.3	1.2	1.2	1.2
1960	155	160	156	152	1.2	1.2	1.2	1.2
1961	164	158	161	157	1.3	1.2	1.2	1.2
1962	148	151	152	154	1.2	1.2	1.2	1.2
1963	138	144	147	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	150	152	148	149	1.2	1.2	1.2	1.2
1966	141	144	146	145	1.1	1.1	1.1	1.1
1967	146	144	145	145	1.1	1.1	1.1	1.1
1968	144	146	144	146	1.1	1.1	1.1	1.1
1969	161	159	156	153	1.2	1.2	1.2	1.2
1970	141	159	157	153	1.1	1.2	1.2	1.2
1971	149	145	158	154	1.2	1.2	1.2	1.2
1972	152	150	147	156	1.2	1.2	1.2	1.2
1973	156	155	153	157	1.2	1.2	1.2	1.2
1974	141	150	151	149	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	146	150	1.1	1.2	1.1	1.2
1977	150	143	149	150	1.2	1.1	1.2	1.2
1978	158	157	155	154	1.2	1.2	1.2	1.2
1979	156	158	157	156	1.2	1.2	1.2	1.2
1980	157	157	158	156	1.2	1.2	1.2	1.2
1981	170	158	158	158	1.3	1.2	1.2	1.2
1982	132	142	153	155	1.1	1.1	1.2	1.2
1983	157	150	152	154	1.2	1.2	1.2	1.2
1984	162	158	151	155	1.2	1.2	1.2	1.2
1985	150	156	157	153	1.1	1.2	1.2	1.2
1986	158	155	157	152	1.2	1.2	1.2	1.2
1987	168	161	157	158	1.3	1.2	1.2	1.2
1988	153	158	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	143	146	150	1.1	1.1	1.2	1.2
1992	138	138	141	145	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	155	152	1.2	1.2	1.2	1.2
1995	154	156	157	153	1.2	1.2	1.2	1.2
1996	159	155	156	155	1.2	1.2	1.2	1.2
1997	153	155	155	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	163	160	158	1.4	1.2	1.2	1.2



R_S410a_matrix.xls -- Fig 3a

WILDERMUTH ENVIRONMENTAL INC.

Figure F-3b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Colton Management Zone
Scenario 4 - Year 2010

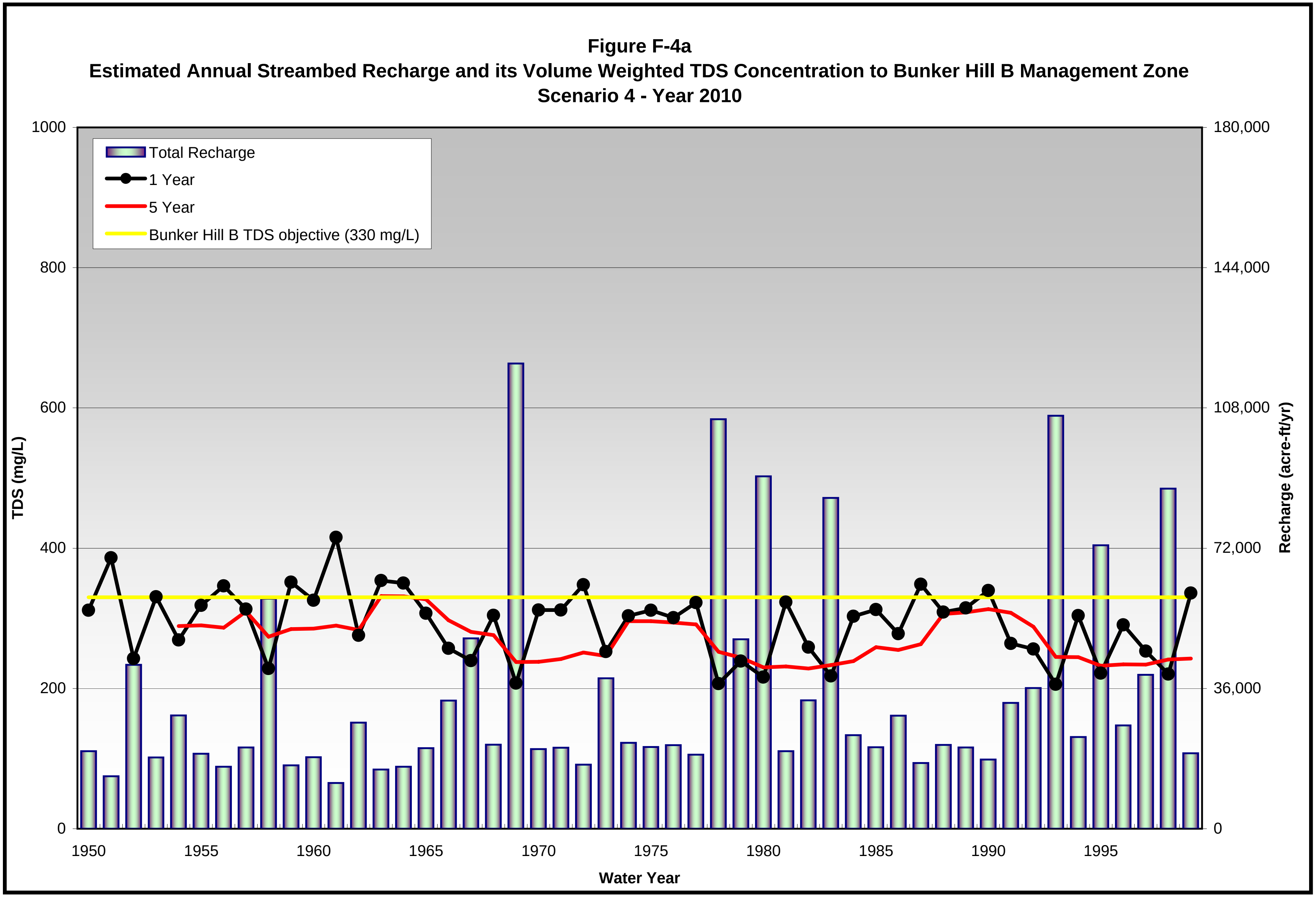


R_S410a_matrix.xls -- Fig 3b

WILDERMUTH™ ENVIRONMENTAL INC.

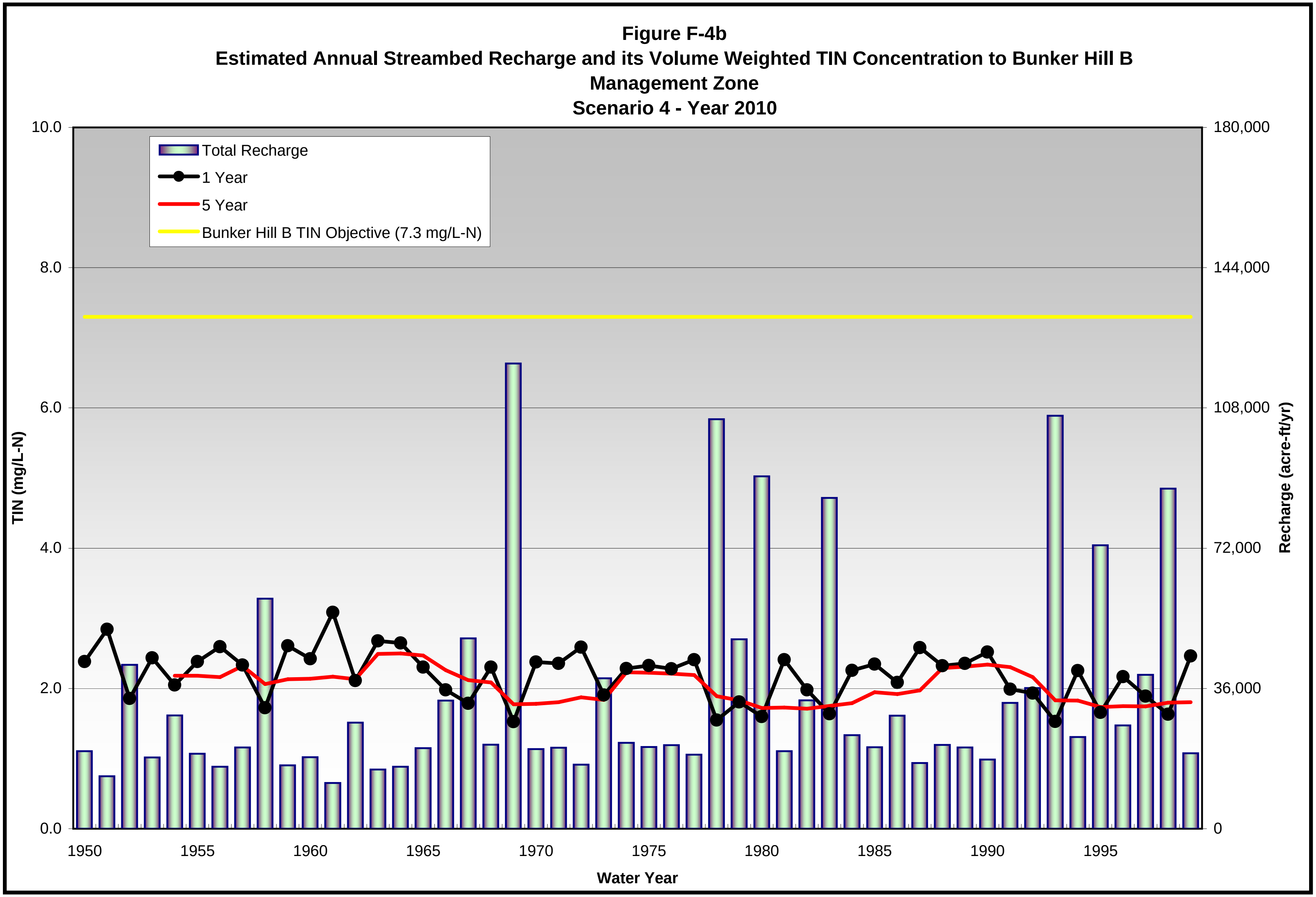
Table F-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 4 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	312				2.4			
1951	386	342			2.8	2.6		
1952	243	277	286		1.9	2.1	2.2	
1953	331	269	291		2.4	2.0	2.2	
1954	269	293	269	289	2.0	2.2	2.0	2.2
1955	318	289	300	290	2.4	2.2	2.3	2.2
1956	346	331	303	287	2.6	2.5	2.3	2.2
1957	313	327	324	310	2.3	2.4	2.4	2.3
1958	228	251	266	274	1.7	1.9	2.0	2.1
1959	351	255	268	285	2.6	1.9	2.0	2.1
1960	326	338	269	285	2.4	2.5	2.0	2.1
1961	415	361	357	290	3.1	2.7	2.7	2.2
1962	276	318	320	283	2.1	2.4	2.4	2.1
1963	354	304	328	332	2.7	2.3	2.5	2.5
1964	350	352	316	331	2.6	2.7	2.4	2.5
1965	307	326	334	327	2.3	2.5	2.5	2.5
1966	257	277	293	297	2.0	2.1	2.2	2.3
1967	240	247	259	281	1.8	1.9	2.0	2.1
1968	304	259	259	276	2.3	1.9	2.0	2.1
1969	208	222	227	238	1.5	1.6	1.7	1.8
1970	312	223	234	238	2.4	1.7	1.7	1.8
1971	312	312	234	242	2.4	2.4	1.7	1.8
1972	348	328	322	251	2.6	2.5	2.4	1.9
1973	253	281	290	246	1.9	2.1	2.2	1.8
1974	303	271	288	296	2.3	2.0	2.2	2.2
1975	311	307	281	296	2.3	2.3	2.1	2.2
1976	301	306	305	294	2.3	2.3	2.3	2.2
1977	322	311	311	291	2.4	2.3	2.3	2.2
1978	207	225	236	252	1.5	1.7	1.8	1.9
1979	239	217	229	244	1.8	1.6	1.7	1.8
1980	216	224	217	230	1.6	1.7	1.6	1.7
1981	323	235	236	231	2.4	1.7	1.8	1.7
1982	259	283	241	229	2.0	2.1	1.8	1.7
1983	218	229	243	233	1.6	1.7	1.8	1.8
1984	303	237	242	239	2.3	1.8	1.8	1.8
1985	312	307	249	259	2.3	2.3	1.9	1.9
1986	278	292	296	255	2.1	2.2	2.2	1.9
1987	349	304	307	263	2.6	2.3	2.3	2.0
1988	309	326	306	306	2.3	2.4	2.3	2.3
1989	315	312	322	309	2.4	2.3	2.4	2.3
1990	340	326	320	313	2.5	2.4	2.4	2.3
1991	264	291	298	308	2.0	2.2	2.2	2.3
1992	256	260	276	288	1.9	2.0	2.1	2.2
1993	206	219	227	245	1.5	1.6	1.7	1.8
1994	304	224	231	245	2.3	1.7	1.7	1.8
1995	222	242	223	232	1.7	1.8	1.7	1.7
1996	291	240	252	234	2.2	1.8	1.9	1.7
1997	253	268	244	234	1.9	2.0	1.8	1.7
1998	220	231	241	241	1.6	1.7	1.8	1.8
1999	336	241	245	243	2.5	1.8	1.8	1.8



R_S410a_matrix.xls -- Fig 4a

WILDERMUTH ENVIRONMENTAL INC.



R_S410a_matrix.xls -- Fig 4b

Table F-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 4 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	411				3.5			
1951	452	430			3.8	3.6		
1952	368	405	407		3.1	3.4	3.4	
1953	421	393	410		3.6	3.3	3.5	
1954	395	408	393	407	3.4	3.5	3.3	3.4
1955	421	408	412	409	3.6	3.5	3.5	3.5
1956	433	427	416	406	3.7	3.6	3.5	3.4
1957	422	427	425	418	3.6	3.6	3.6	3.5
1958	357	386	400	403	3.0	3.3	3.4	3.4
1959	446	396	404	413	3.8	3.3	3.4	3.5
1960	422	434	404	413	3.6	3.7	3.4	3.5
1961	461	440	442	418	3.9	3.7	3.7	3.5
1962	401	428	426	413	3.4	3.6	3.6	3.5
1963	440	419	432	433	3.7	3.5	3.7	3.7
1964	433	437	424	430	3.7	3.7	3.6	3.6
1965	412	422	428	428	3.5	3.6	3.6	3.6
1966	389	400	410	414	3.3	3.4	3.5	3.5
1967	374	381	391	408	3.2	3.2	3.3	3.5
1968	419	395	393	404	3.6	3.4	3.3	3.4
1969	333	370	371	382	2.8	3.1	3.1	3.2
1970	438	376	390	386	3.7	3.2	3.3	3.3
1971	435	436	394	394	3.7	3.7	3.3	3.3
1972	444	439	439	408	3.8	3.7	3.7	3.5
1973	374	405	415	398	3.2	3.4	3.5	3.4
1974	414	393	408	419	3.5	3.3	3.5	3.5
1975	411	412	399	414	3.5	3.5	3.4	3.5
1976	404	408	410	408	3.4	3.4	3.5	3.5
1977	422	413	412	404	3.6	3.5	3.5	3.4
1978	315	359	373	387	2.7	3.0	3.2	3.3
1979	369	339	362	379	3.1	2.9	3.1	3.2
1980	337	352	338	364	2.9	3.0	2.9	3.1
1981	440	380	376	369	3.7	3.2	3.2	3.1
1982	392	414	384	364	3.3	3.5	3.3	3.1
1983	338	362	384	370	2.9	3.1	3.2	3.1
1984	436	379	383	382	3.7	3.2	3.2	3.2
1985	422	429	392	401	3.6	3.6	3.3	3.4
1986	420	421	426	397	3.6	3.6	3.6	3.4
1987	452	435	431	408	3.8	3.7	3.6	3.5
1988	424	437	432	431	3.6	3.7	3.6	3.6
1989	443	433	439	432	3.8	3.7	3.7	3.7
1990	451	447	439	437	3.8	3.8	3.7	3.7
1991	403	425	431	434	3.4	3.6	3.7	3.7
1992	400	402	417	423	3.4	3.4	3.5	3.6
1993	321	356	370	397	2.7	3.0	3.1	3.4
1994	432	367	377	395	3.7	3.1	3.2	3.3
1995	362	394	365	379	3.1	3.3	3.1	3.2
1996	442	398	408	385	3.8	3.4	3.5	3.3
1997	399	419	398	385	3.4	3.6	3.4	3.3
1998	362	379	397	396	3.0	3.2	3.4	3.4
1999	465	405	403	401	3.9	3.4	3.4	3.4

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan

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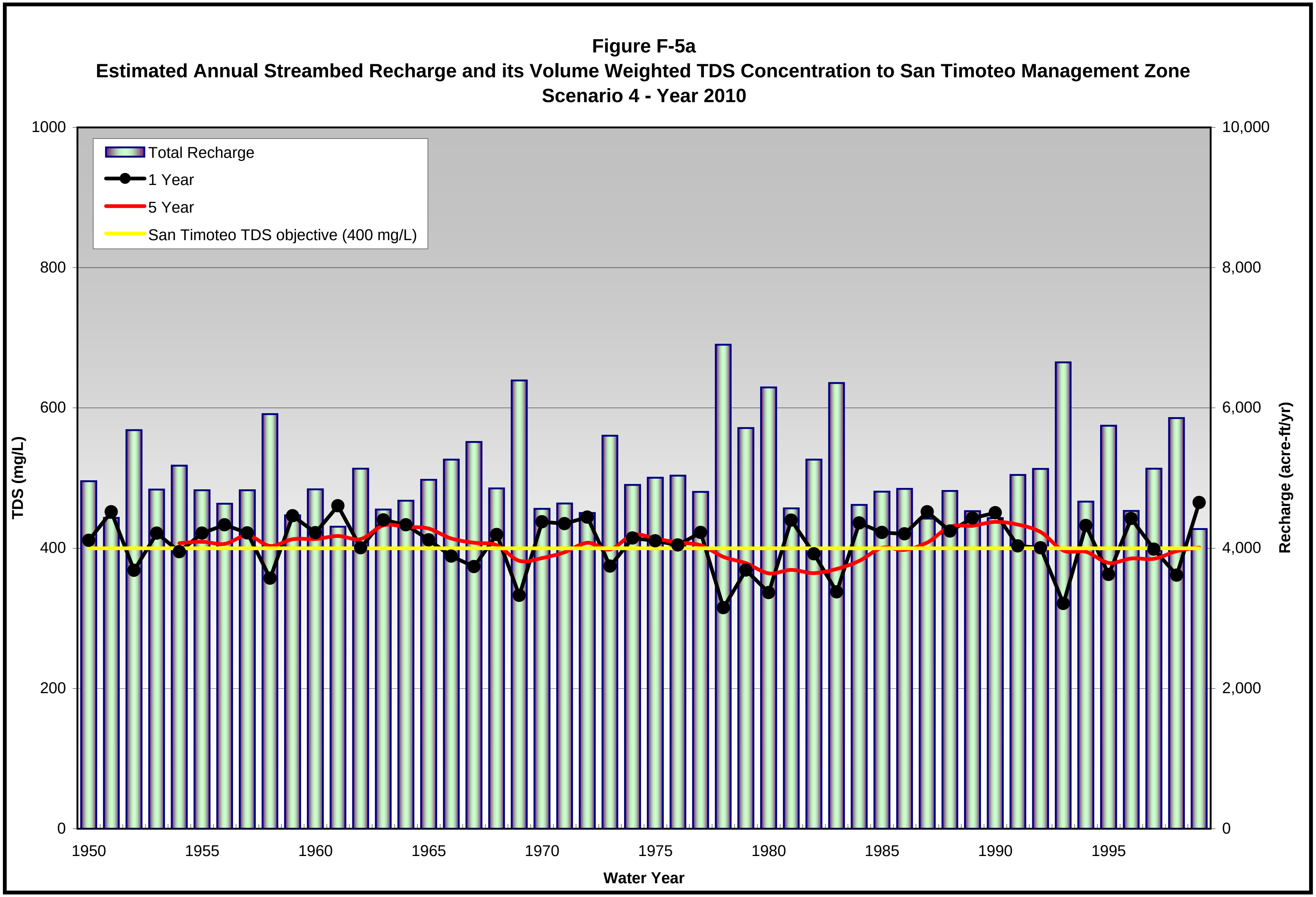

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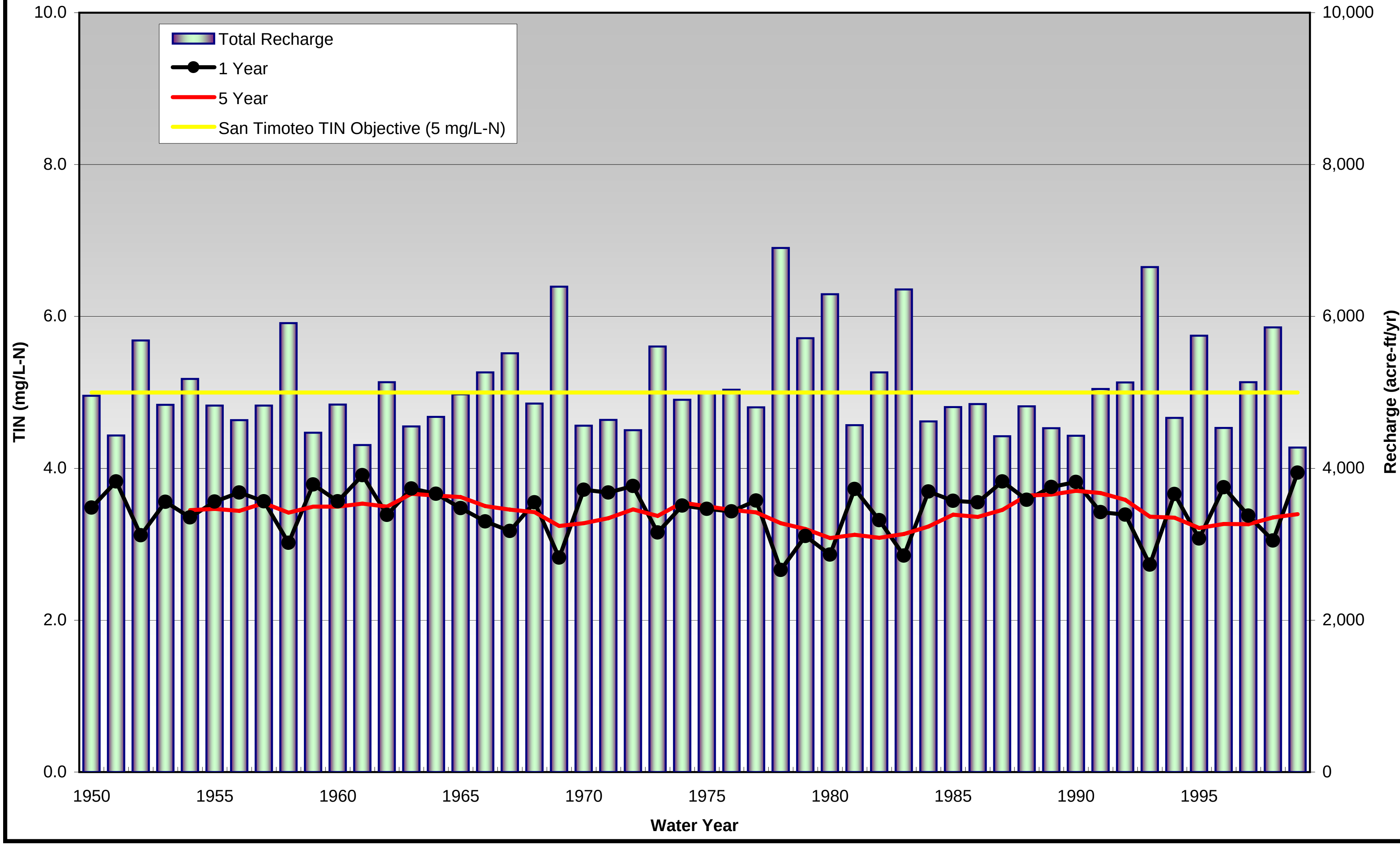
Figure F-5b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to San Timoteo Management Zone
Scenario 4 - Year 2010



WILDERMUTH™ ENVIRONMENTAL INC.

Table F-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 4 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8

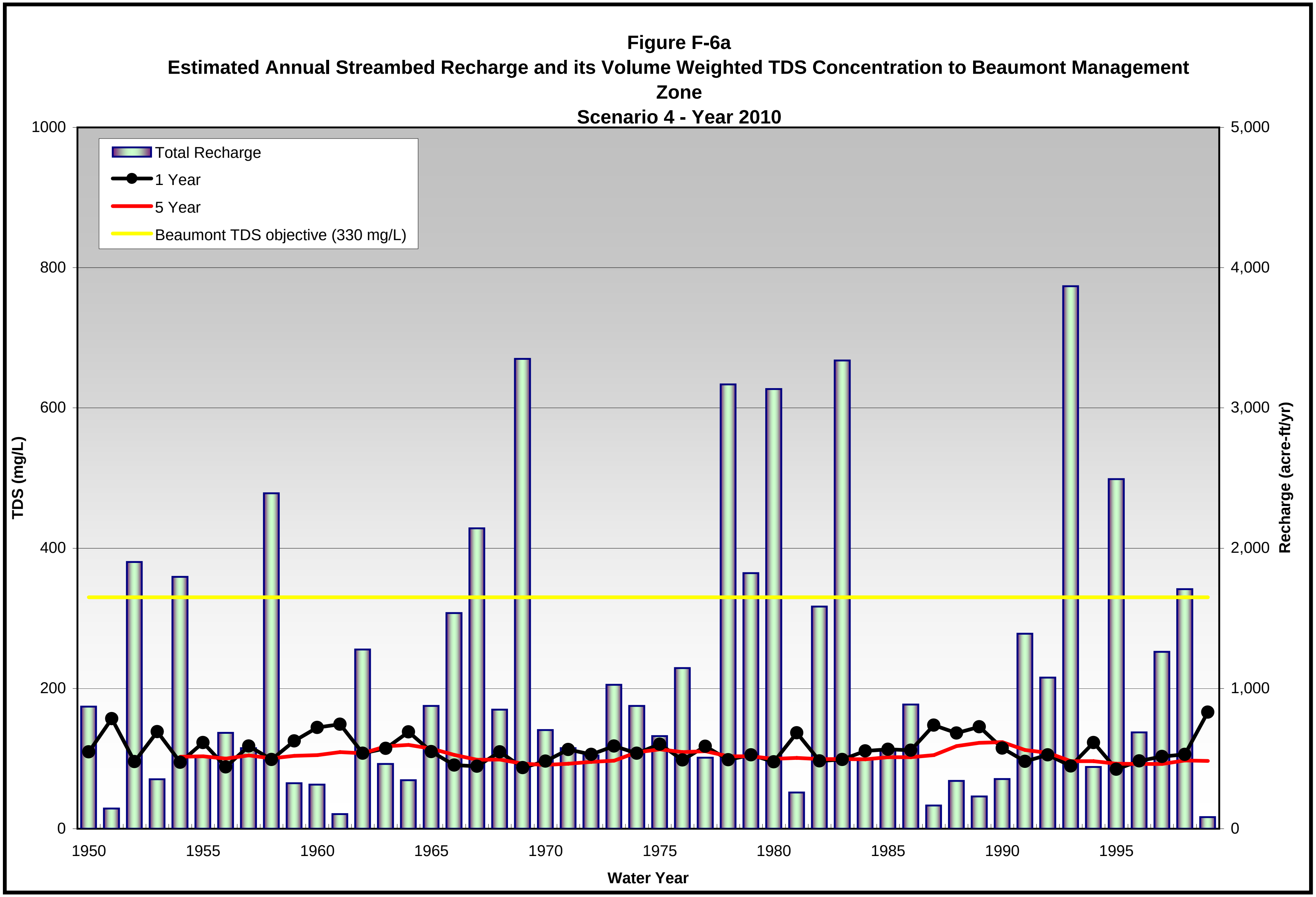


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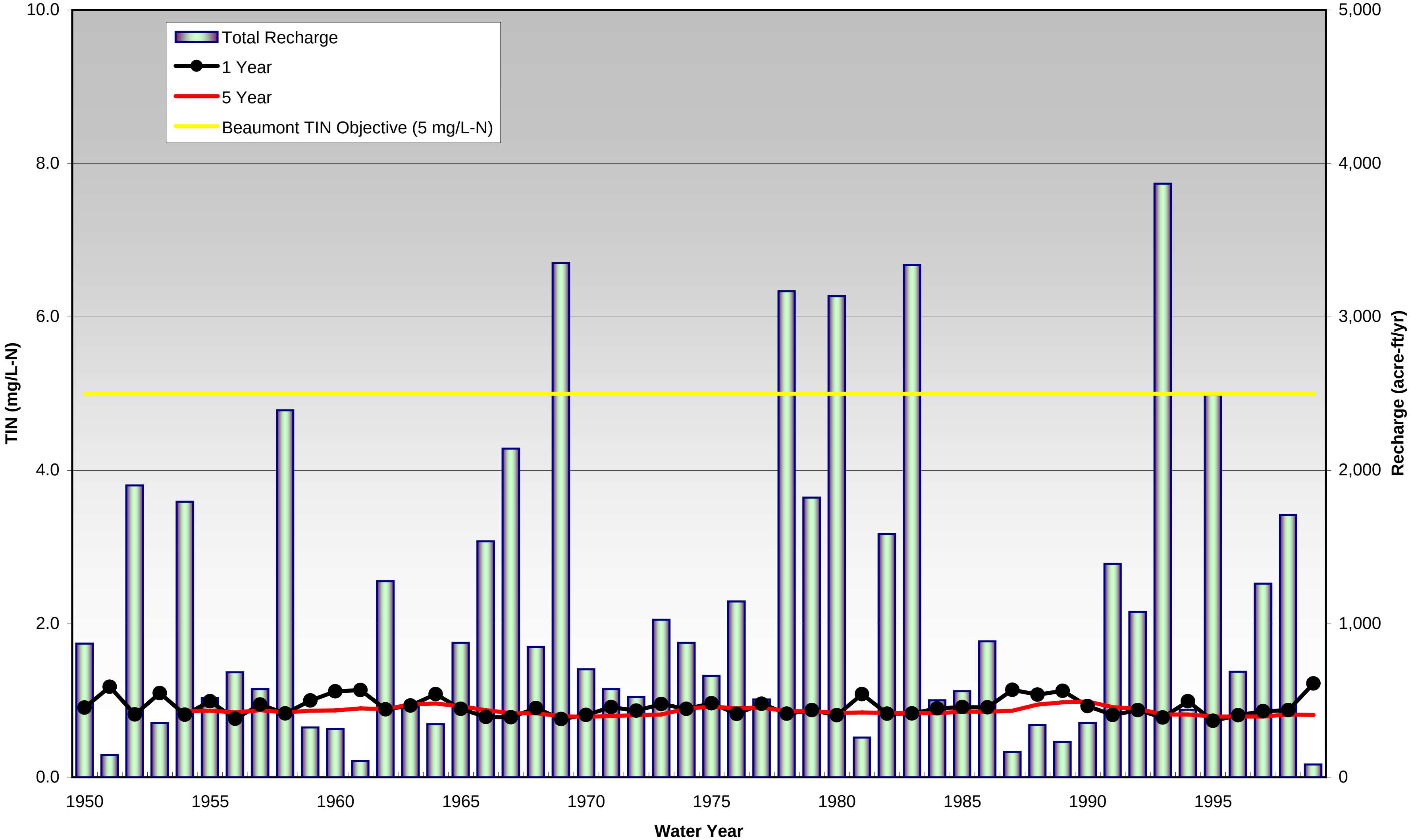
Figure F-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 4 - Year 2010



R_S410a_matrix.xls -- Fig 6b

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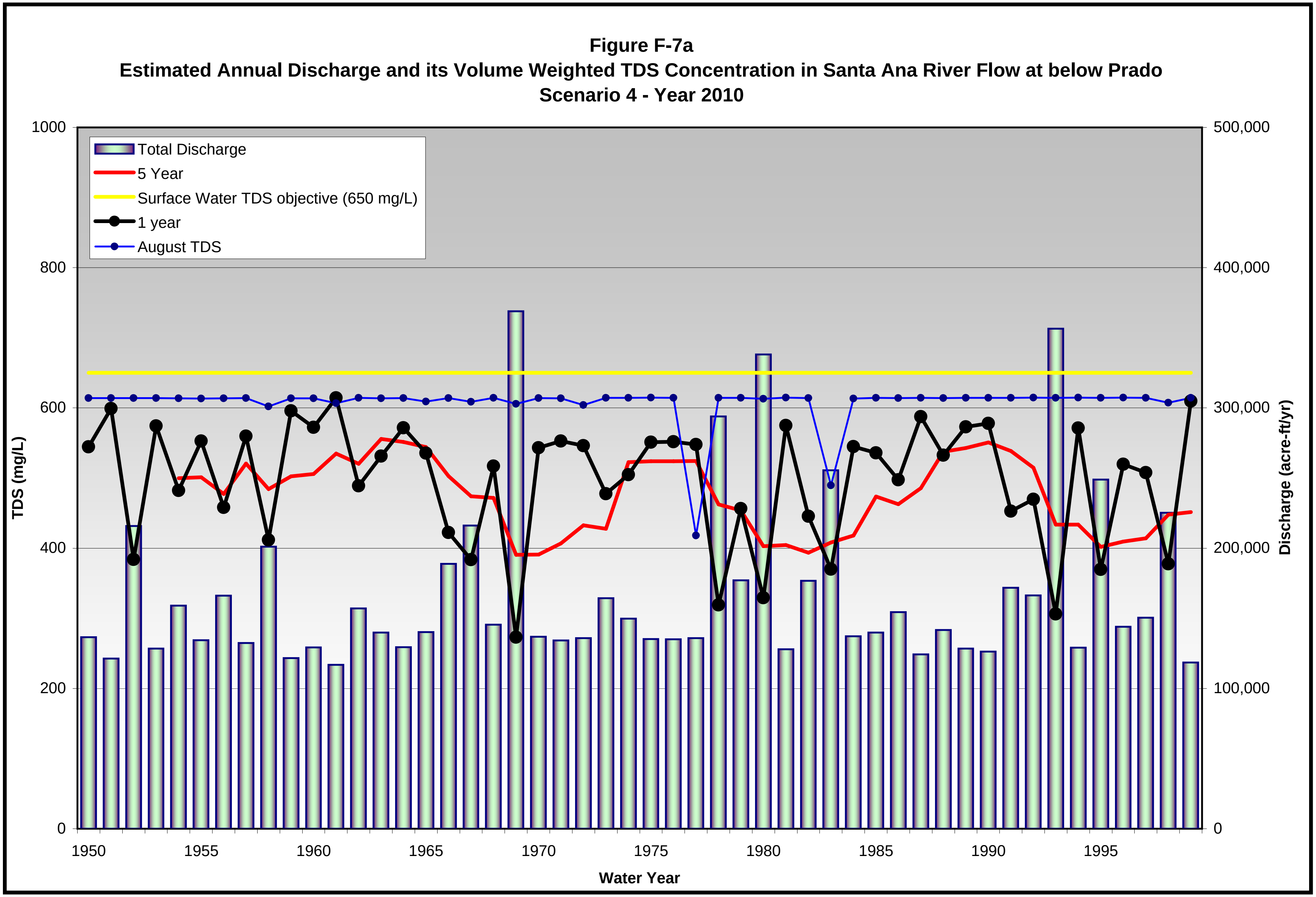
Table F-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 4 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	545				614	7.2				8.3
1951	599	570			614	7.9	7.5			8.3
1952	384	461	485		614	5.0	6.1	6.4		8.3
1953	574	455	493		614	7.6	6.0	6.5		8.3
1954	482	523	464	500	614	6.3	6.9	6.1	6.6	8.3
1955	553	515	533	501	613	7.3	6.8	7.0	6.6	8.3
1956	458	501	494	477	614	6.1	6.6	6.5	6.3	8.3
1957	560	503	519	521	614	7.4	6.7	6.9	6.9	8.3
1958	412	471	466	484	602	5.3	6.1	6.1	6.4	8.1
1959	596	481	504	503	614	7.9	6.3	6.6	6.6	8.3
1960	572	584	507	506	614	7.6	7.7	6.7	6.7	8.3
1961	615	592	594	535	607	8.2	7.8	7.9	7.0	8.2
1962	489	542	552	521	614	6.4	7.2	7.3	6.8	8.3
1963	531	509	539	556	614	7.0	6.7	7.1	7.3	8.3
1964	572	551	528	551	614	7.6	7.3	7.0	7.3	8.3
1965	536	553	545	544	609	7.0	7.3	7.2	7.2	8.2
1966	422	471	499	503	614	5.5	6.2	6.6	6.6	8.3
1967	383	402	436	474	609	5.0	5.2	5.7	6.2	8.2
1968	517	437	432	472	614	6.8	5.7	5.6	6.2	8.3
1969	273	342	354	390	606	3.4	4.4	4.5	5.0	8.2
1970	543	346	384	391	614	7.2	4.4	5.0	5.1	8.3
1971	553	548	389	407	614	7.3	7.2	5.0	5.3	8.3
1972	546	550	547	433	604	7.2	7.3	7.2	5.6	8.2
1973	478	509	522	428	614	6.2	6.7	6.9	5.5	8.3
1974	505	491	507	523	614	6.7	6.4	6.7	6.9	8.3
1975	551	527	509	524	615	7.3	6.9	6.7	6.9	8.3
1976	552	551	535	524	615	7.3	7.3	7.0	6.9	8.3
1977	548	550	550	524	418	7.2	7.2	7.3	6.9	5.5
1978	319	391	430	462	614	4.0	5.0	5.6	6.0	8.3
1979	457	371	410	454	614	5.9	4.7	5.3	5.9	8.3
1980	329	373	353	403	613	3.7	4.4	4.3	5.0	8.3
1981	575	397	413	404	615	7.6	4.7	5.1	5.1	8.3
1982	446	500	410	393	614	5.8	6.6	5.0	4.9	8.3
1983	370	401	441	408	490	4.5	5.0	5.6	5.1	6.5
1984	545	431	436	418	613	7.2	5.4	5.6	5.2	8.3
1985	536	540	459	474	615	7.1	7.1	5.9	6.1	8.3
1986	498	516	525	463	614	6.5	6.8	6.9	6.0	8.3
1987	588	538	537	486	614	7.8	7.1	7.1	6.3	8.3
1988	533	558	536	538	614	7.0	7.4	7.1	7.1	8.3
1989	573	552	563	543	614	7.6	7.3	7.4	7.2	8.3
1990	578	576	560	551	615	7.7	7.6	7.4	7.3	8.3
1991	453	506	526	538	614	5.9	6.7	6.9	7.1	8.3
1992	470	461	493	515	615	6.1	6.0	6.5	6.8	8.3
1993	306	358	382	434	614	3.5	4.4	4.8	5.5	8.3
1994	571	377	400	434	615	7.5	4.6	5.0	5.5	8.3
1995	370	439	374	402	614	4.6	5.6	4.6	5.0	8.3
1996	520	425	461	410	615	6.9	5.4	5.9	5.1	8.3
1997	508	514	448	414	614	6.7	6.8	5.8	5.2	8.3
1998	378	430	455	448	607	4.9	5.6	5.9	5.8	8.2
1999	610	458	473	452	614	8.1	6.0	6.2	5.8	8.3



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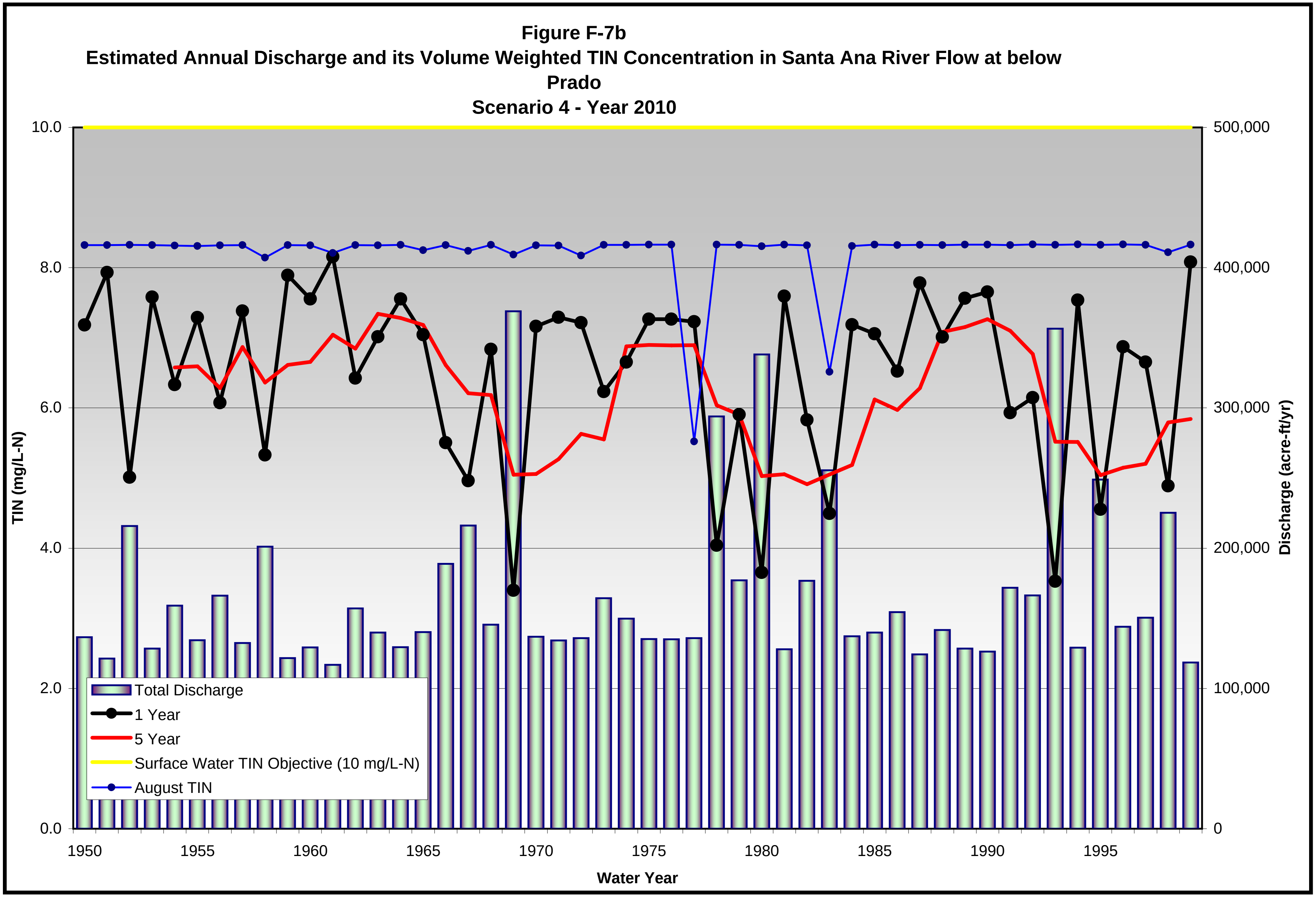

R_S410a_matrix.xls -- Fig 7b

Appendix G

Scenario 4, Year 2020 Simulation Results (Summary Matrices and Graphs)

Table G-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 4 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	612				4.6			
1951	630	621			4.7	4.7		
1952	538	580	590		4.0	4.3	4.4	
1953	621	576	593		4.7	4.3	4.4	
1954	585	603	579	595	4.4	4.5	4.3	4.5
1955	611	598	605	595	4.6	4.5	4.5	4.5
1956	599	605	598	589	4.5	4.5	4.5	4.4
1957	618	608	609	607	4.6	4.6	4.6	4.5
1958	544	579	586	590	4.0	4.3	4.4	4.4
1959	634	586	596	600	4.8	4.4	4.5	4.5
1960	625	630	599	603	4.7	4.7	4.5	4.5
1961	639	632	633	610	4.8	4.7	4.8	4.6
1962	591	614	618	605	4.4	4.6	4.6	4.5
1963	607	599	612	619	4.5	4.5	4.6	4.6
1964	624	615	607	617	4.7	4.6	4.5	4.6
1965	608	616	613	613	4.5	4.6	4.6	4.6
1966	564	585	597	598	4.2	4.4	4.5	4.5
1967	542	553	570	587	4.0	4.1	4.2	4.4
1968	608	573	570	587	4.6	4.3	4.2	4.4
1969	461	524	530	551	3.3	3.9	3.9	4.1
1970	615	527	551	552	4.6	3.9	4.1	4.1
1971	616	615	554	561	4.6	4.6	4.1	4.2
1972	619	617	616	576	4.6	4.6	4.6	4.3
1973	587	603	607	572	4.4	4.5	4.5	4.3
1974	599	593	602	607	4.5	4.4	4.5	4.5
1975	618	608	601	608	4.6	4.6	4.5	4.6
1976	609	613	609	606	4.6	4.6	4.6	4.5
1977	621	615	616	607	4.7	4.6	4.6	4.5
1978	479	541	562	580	3.5	4.0	4.2	4.3
1979	569	521	550	574	4.2	3.8	4.1	4.3
1980	480	520	506	545	3.4	3.8	3.7	4.0
1981	627	543	551	547	4.7	4.0	4.0	4.0
1982	567	596	551	538	4.2	4.5	4.0	4.0
1983	509	537	564	546	3.7	3.9	4.2	4.0
1984	611	556	560	553	4.6	4.1	4.1	4.1
1985	609	610	573	582	4.6	4.6	4.2	4.3
1986	599	604	607	577	4.5	4.5	4.5	4.3
1987	631	615	613	589	4.7	4.6	4.6	4.4
1988	614	622	615	613	4.6	4.7	4.6	4.6
1989	625	619	623	616	4.7	4.6	4.7	4.6
1990	622	623	620	618	4.7	4.7	4.7	4.6
1991	580	600	608	614	4.3	4.5	4.6	4.6
1992	579	580	593	603	4.3	4.3	4.4	4.5
1993	451	507	529	563	3.2	3.7	3.9	4.2
1994	620	522	540	562	4.6	3.8	4.0	4.2
1995	515	562	519	542	3.7	4.1	3.8	4.0
1996	613	560	579	548	4.6	4.1	4.3	4.0
1997	592	602	570	550	4.4	4.5	4.2	4.0
1998	522	555	573	569	3.9	4.1	4.3	4.2
1999	635	573	579	571	4.8	4.3	4.3	4.2

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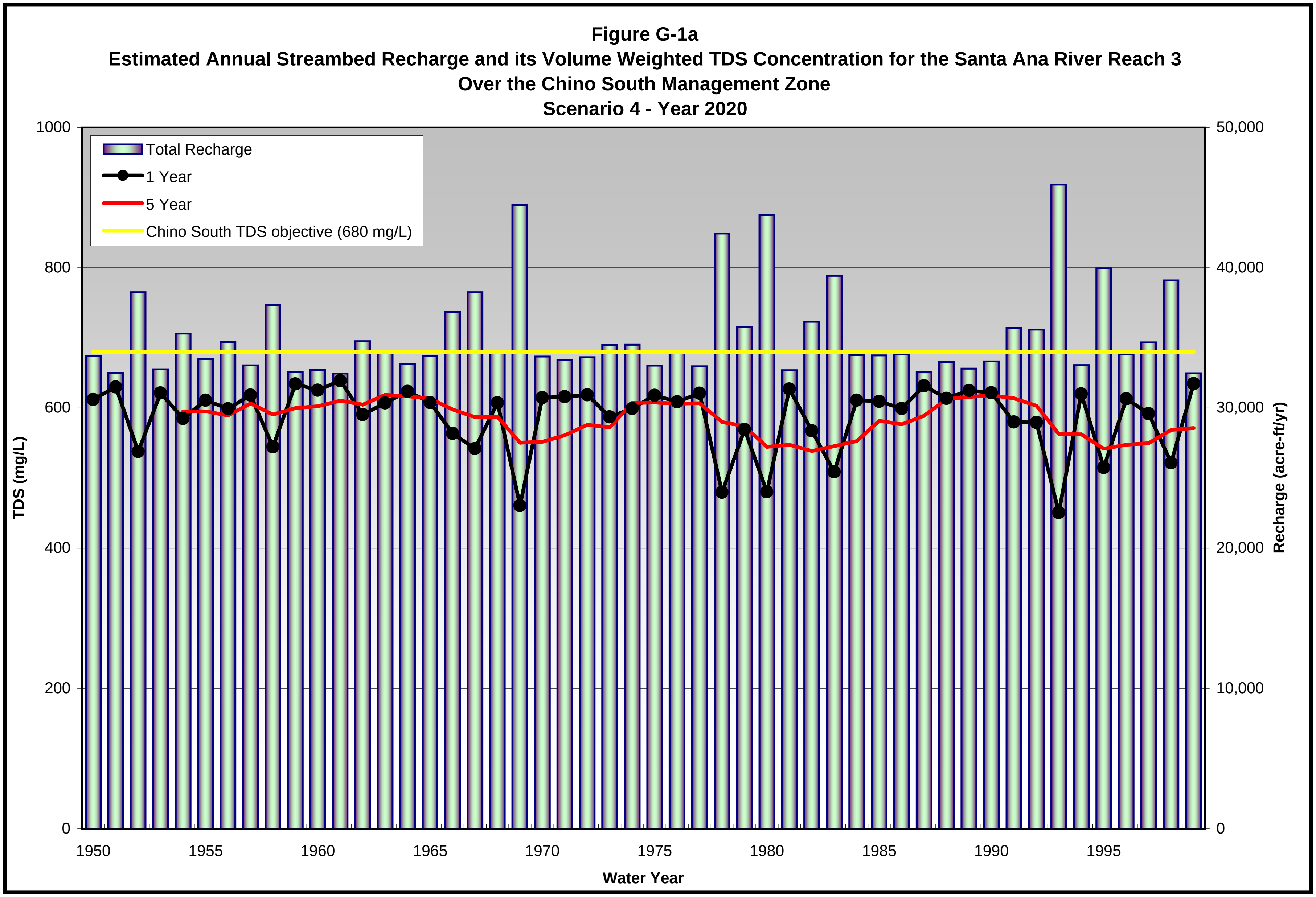
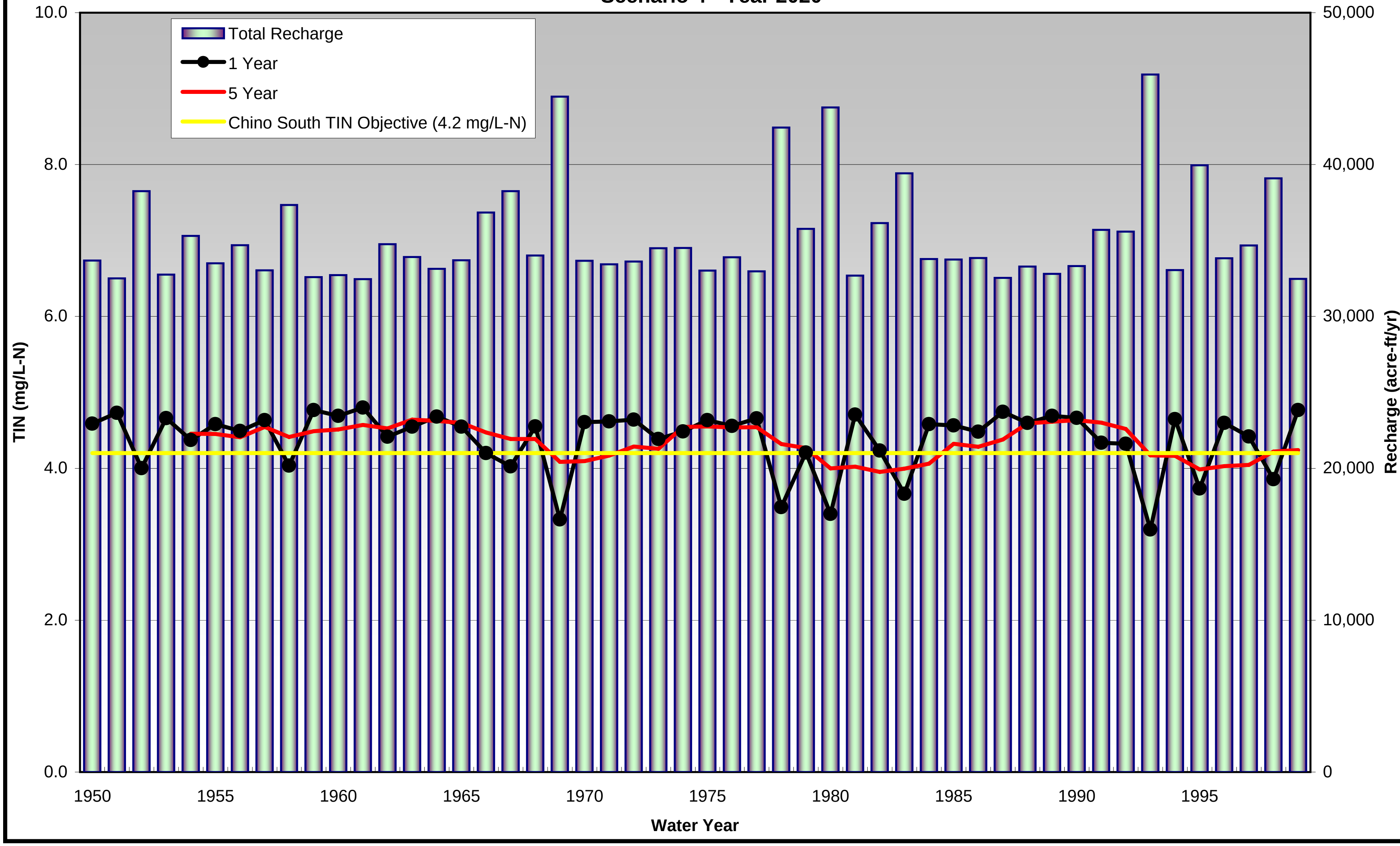


R_S420a_matrix.xls -- Fig 1a

Figure G-1b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 3 Over the Chino South Management Zone
Scenario 4 - Year 2020



R_S420a_matrix.xls -- Fig 1b

Table G-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 4 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	457				6.2			
1951	513	483			7.1	6.6		
1952	364	422	433		4.8	5.7	5.8	
1953	492	415	442		6.7	5.6	6.0	
1954	420	452	417	440	5.6	6.1	5.6	5.9
1955	469	443	457	442	6.4	6.0	6.2	6.0
1956	462	465	449	435	6.3	6.3	6.1	5.9
1957	487	474	472	464	6.6	6.5	6.4	6.3
1958	359	410	425	432	4.6	5.4	5.7	5.8
1959	505	416	436	447	6.9	5.5	5.8	6.0
1960	504	505	440	453	6.9	6.9	5.9	6.1
1961	522	513	510	463	7.2	7.1	7.0	6.3
1962	427	469	480	451	5.7	6.4	6.5	6.1
1963	472	448	470	483	6.4	6.1	6.4	6.6
1964	489	481	461	480	6.7	6.6	6.3	6.6
1965	451	469	470	470	6.1	6.4	6.4	6.4
1966	390	418	438	442	5.2	5.6	5.9	6.0
1967	368	379	399	427	4.8	5.0	5.3	5.7
1968	458	406	401	425	6.2	5.4	5.3	5.7
1969	284	342	350	373	3.4	4.3	4.5	4.8
1970	461	343	372	374	6.3	4.3	4.8	4.9
1971	460	460	372	385	6.2	6.2	4.8	5.0
1972	483	471	468	404	6.6	6.4	6.4	5.3
1973	425	452	454	399	5.7	6.1	6.1	5.2
1974	444	434	449	453	6.0	5.8	6.1	6.1
1975	486	463	450	458	6.6	6.3	6.1	6.2
1976	450	467	459	456	6.1	6.3	6.2	6.2
1977	485	466	472	456	6.6	6.3	6.4	6.2
1978	301	364	387	413	3.7	4.7	5.1	5.5
1979	410	344	378	407	5.4	4.4	4.9	5.4
1980	298	340	326	366	3.6	4.3	4.1	4.7
1981	503	362	376	371	6.9	4.6	4.9	4.8
1982	393	440	371	360	5.2	5.9	4.8	4.6
1983	322	353	389	366	4.1	4.6	5.1	4.7
1984	463	376	381	373	6.3	4.9	5.0	4.8
1985	470	466	401	415	6.4	6.3	5.3	5.5
1986	452	461	462	409	6.1	6.2	6.3	5.4
1987	511	479	476	428	7.0	6.5	6.5	5.7
1988	476	493	478	473	6.5	6.7	6.5	6.4
1989	485	481	490	478	6.6	6.5	6.7	6.5
1990	485	485	482	481	6.6	6.6	6.6	6.6
1991	413	445	457	471	5.5	6.0	6.2	6.4
1992	399	406	428	447	5.3	5.4	5.8	6.0
1993	276	320	344	385	3.2	4.0	4.4	5.0
1994	479	338	355	384	6.5	4.2	4.5	5.0
1995	342	395	339	362	4.3	5.2	4.3	4.7
1996	461	389	414	368	6.2	5.1	5.5	4.7
1997	419	439	399	371	5.6	5.9	5.3	4.8
1998	343	376	399	398	4.4	4.9	5.3	5.2
1999	519	408	411	402	7.2	5.4	5.4	5.3

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Figure G-2a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 4 Over the Riverside A Management Zone
Scenario 4 - Year 2020

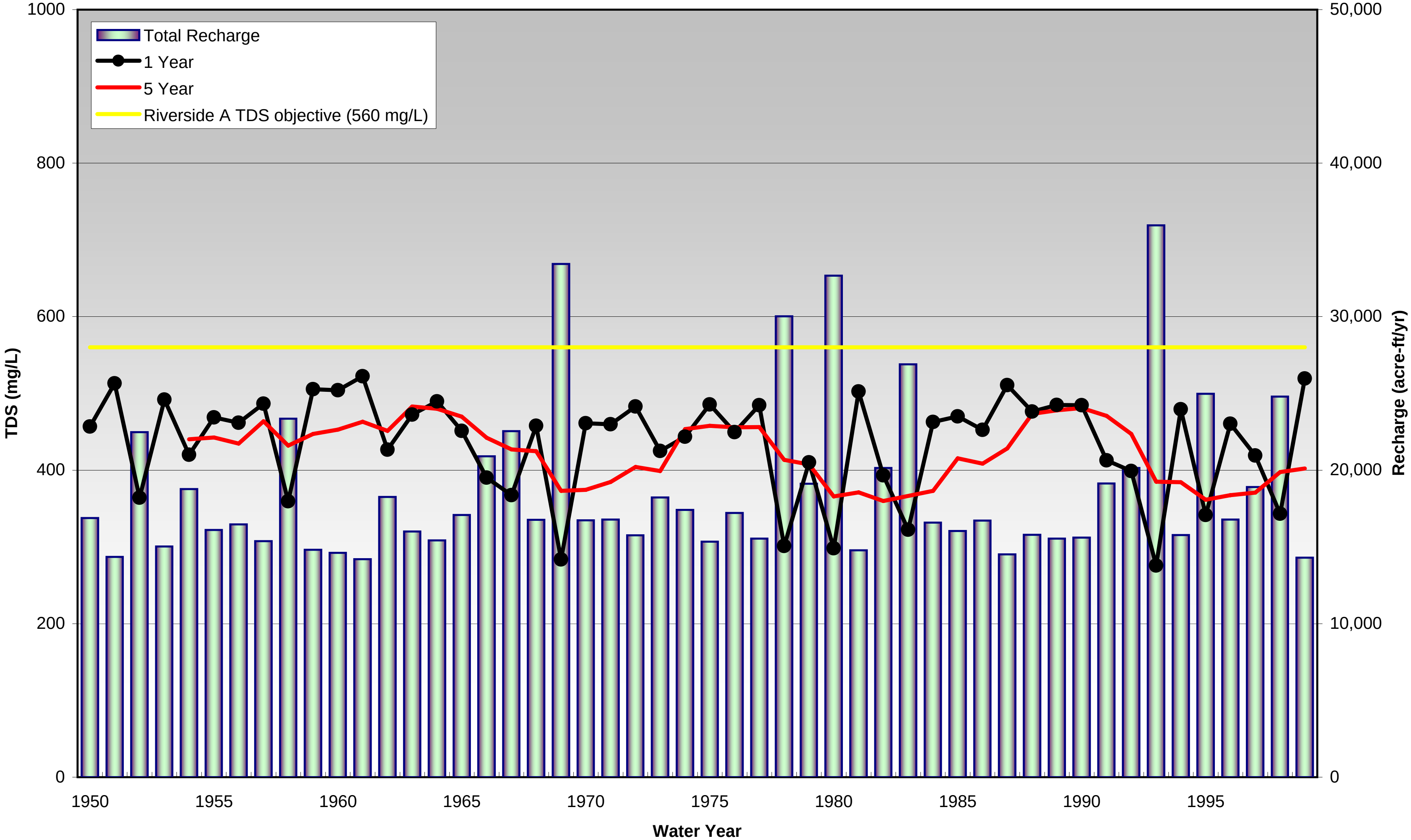

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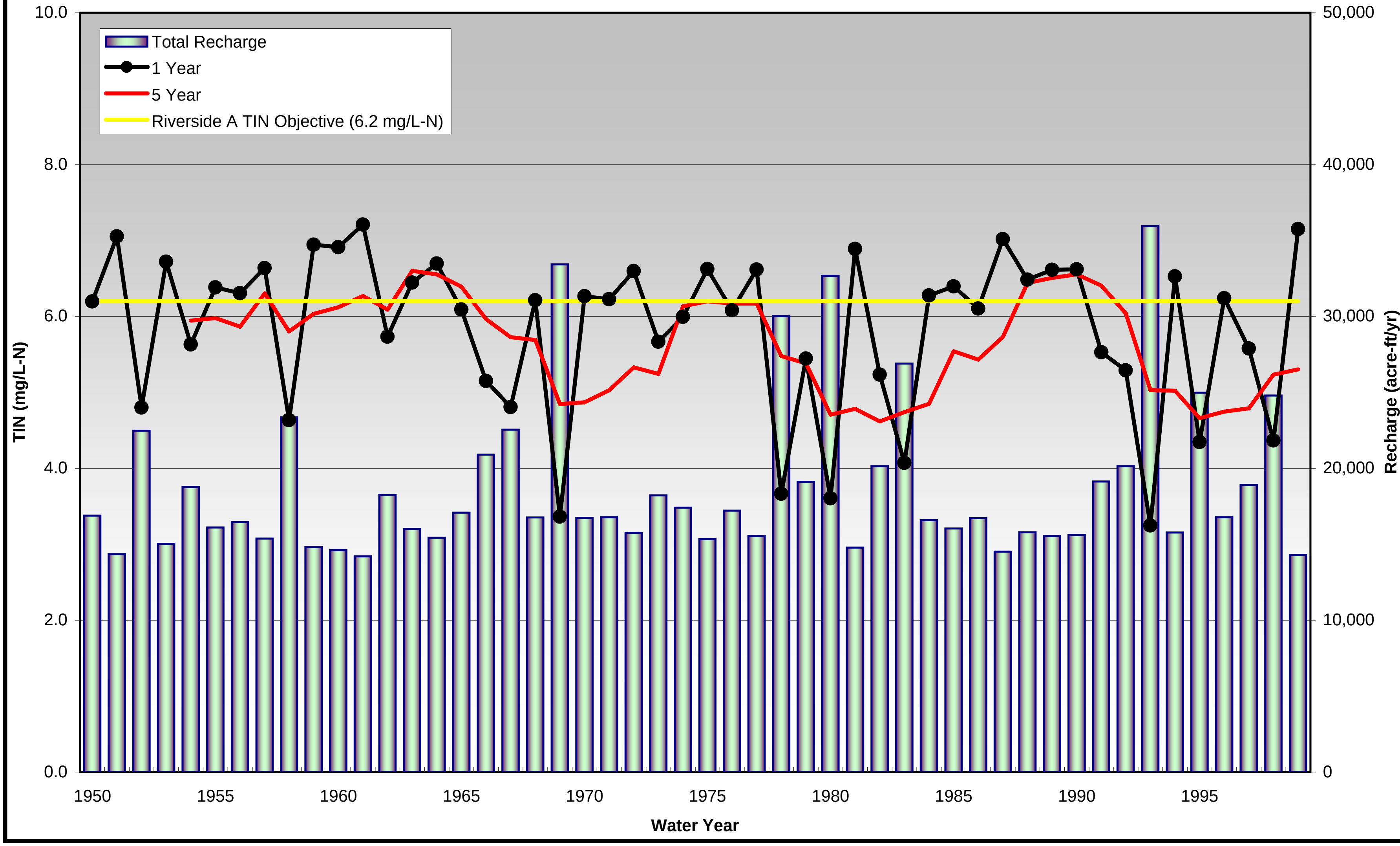
Figure G-2b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 4 - Year 2020



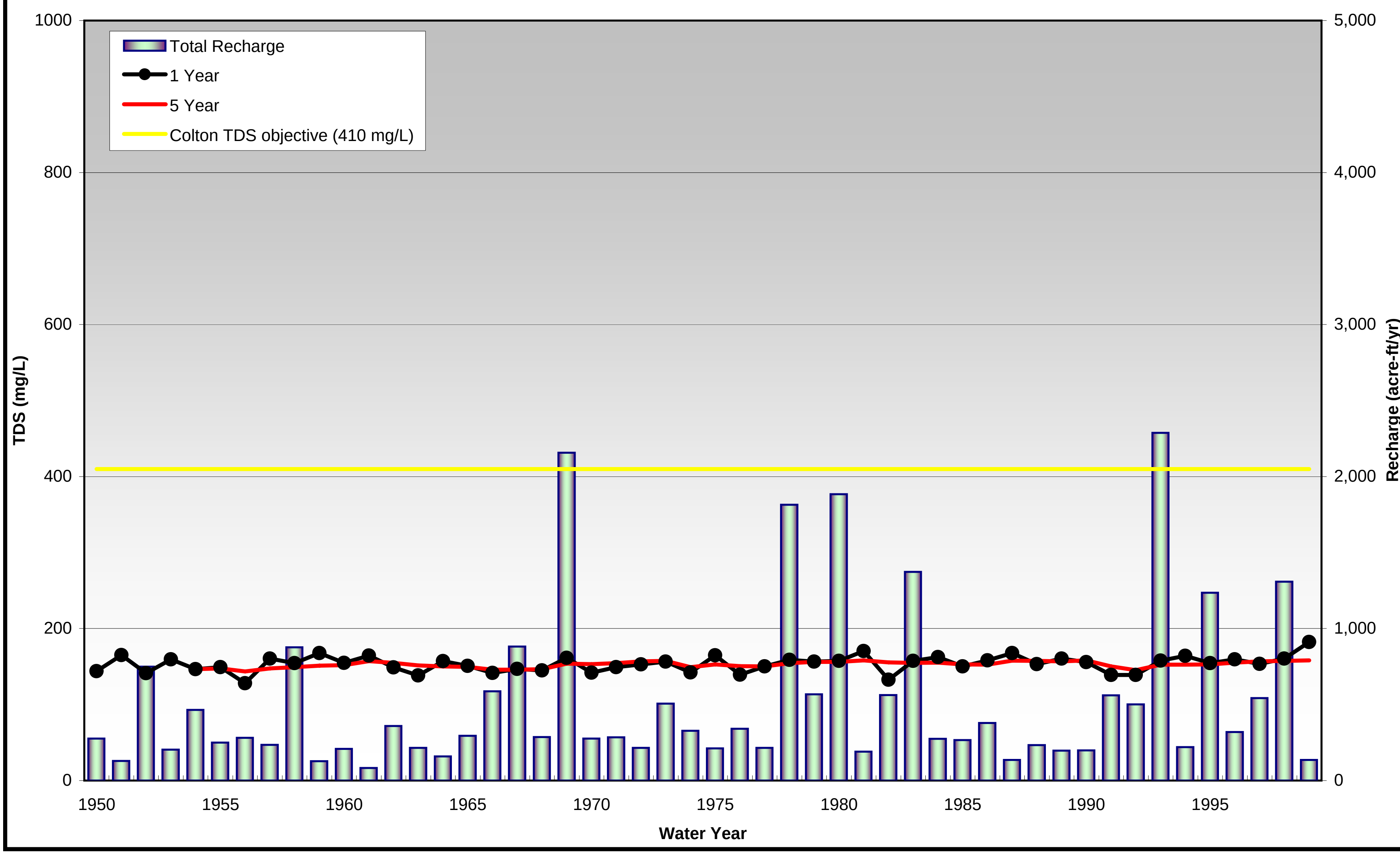
R_S420a_matrix.xls -- Fig 2b

WILDERMUTH™ ENVIRONMENTAL INC.

Table G-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 4 - Year 2020
(mg/L)

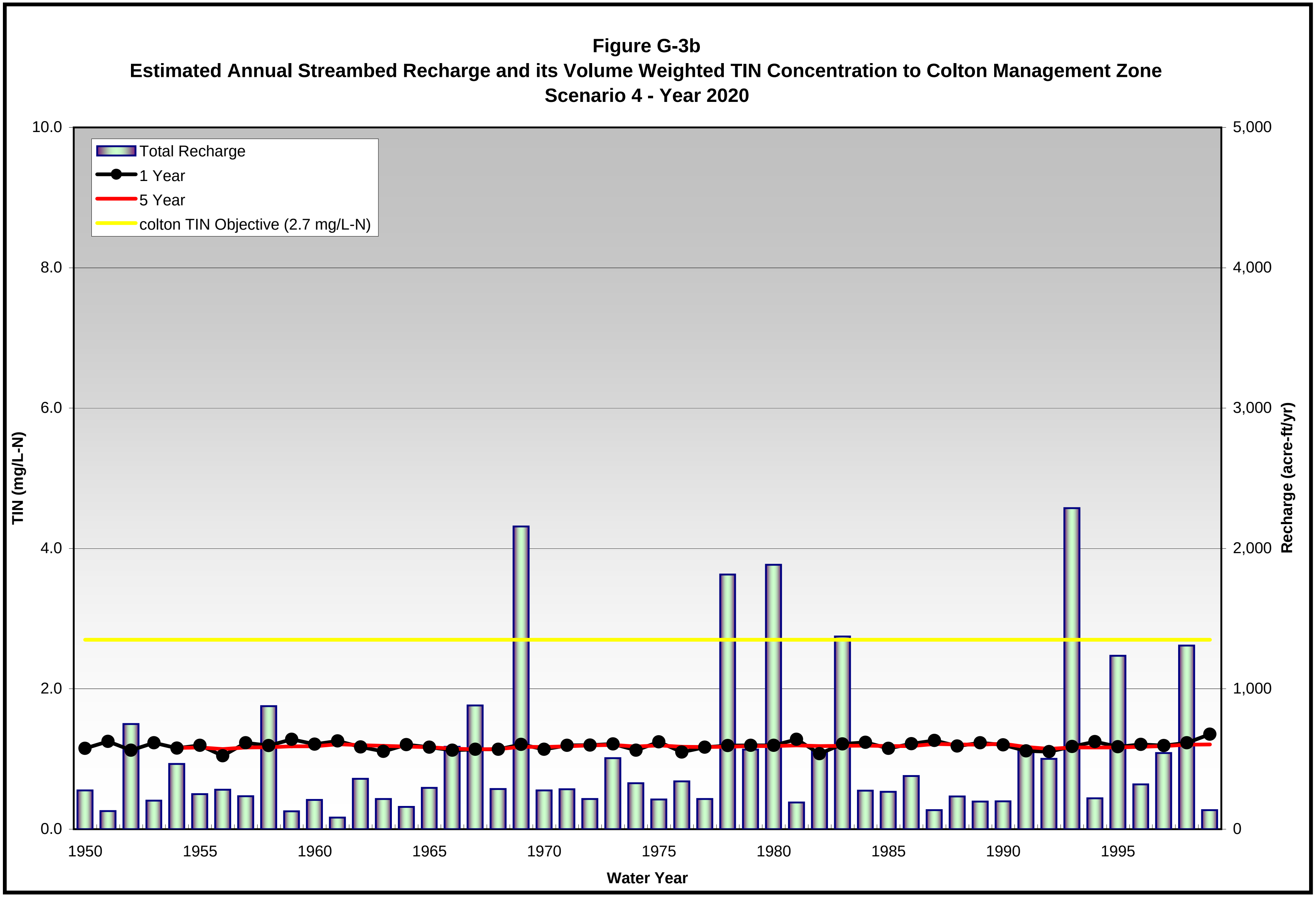
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	144				1.2			
1951	165	151			1.3	1.2		
1952	141	145	144		1.1	1.1	1.1	
1953	160	145	147		1.2	1.1	1.2	
1954	146	150	146	147	1.2	1.2	1.2	1.2
1955	149	147	150	147	1.2	1.2	1.2	1.2
1956	128	138	142	143	1.0	1.1	1.1	1.1
1957	161	143	145	147	1.2	1.1	1.2	1.2
1958	154	156	150	149	1.2	1.2	1.2	1.2
1959	168	156	157	151	1.3	1.2	1.2	1.2
1960	155	160	156	152	1.2	1.2	1.2	1.2
1961	164	158	161	157	1.3	1.2	1.2	1.2
1962	149	152	153	155	1.2	1.2	1.2	1.2
1963	138	145	147	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	151	153	148	150	1.2	1.2	1.2	1.2
1966	141	145	146	146	1.1	1.1	1.1	1.1
1967	147	145	146	146	1.1	1.1	1.1	1.1
1968	145	146	145	146	1.1	1.1	1.1	1.1
1969	161	160	156	154	1.2	1.2	1.2	1.2
1970	142	159	158	153	1.1	1.2	1.2	1.2
1971	149	146	158	155	1.2	1.2	1.2	1.2
1972	153	151	148	157	1.2	1.2	1.2	1.2
1973	157	155	154	158	1.2	1.2	1.2	1.2
1974	142	151	151	149	1.1	1.2	1.2	1.2
1975	165	151	154	153	1.2	1.2	1.2	1.2
1976	139	149	146	150	1.1	1.2	1.1	1.2
1977	150	143	149	150	1.2	1.1	1.2	1.2
1978	159	158	155	154	1.2	1.2	1.2	1.2
1979	156	158	157	156	1.2	1.2	1.2	1.2
1980	157	157	158	156	1.2	1.2	1.2	1.2
1981	170	159	158	158	1.3	1.2	1.2	1.2
1982	133	142	153	155	1.1	1.1	1.2	1.2
1983	157	150	152	155	1.2	1.2	1.2	1.2
1984	163	158	152	155	1.2	1.2	1.2	1.2
1985	150	157	157	153	1.2	1.2	1.2	1.2
1986	158	155	157	152	1.2	1.2	1.2	1.2
1987	168	161	157	158	1.3	1.2	1.2	1.2
1988	153	159	158	158	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	156	158	156	158	1.2	1.2	1.2	1.2
1991	139	143	147	150	1.1	1.1	1.2	1.2
1992	139	139	142	145	1.1	1.1	1.1	1.1
1993	158	154	152	152	1.2	1.2	1.2	1.2
1994	164	158	155	153	1.2	1.2	1.2	1.2
1995	154	156	157	153	1.2	1.2	1.2	1.2
1996	159	155	156	155	1.2	1.2	1.2	1.2
1997	153	156	155	157	1.2	1.2	1.2	1.2
1998	161	158	159	157	1.2	1.2	1.2	1.2
1999	182	163	160	158	1.4	1.2	1.2	1.2

Figure G-3a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Colton Management Zone
Scenario 4 - Year 2020



R_S420a_matrix.xls -- Fig 3a

WILDERMUTH ENVIRONMENTAL INC.

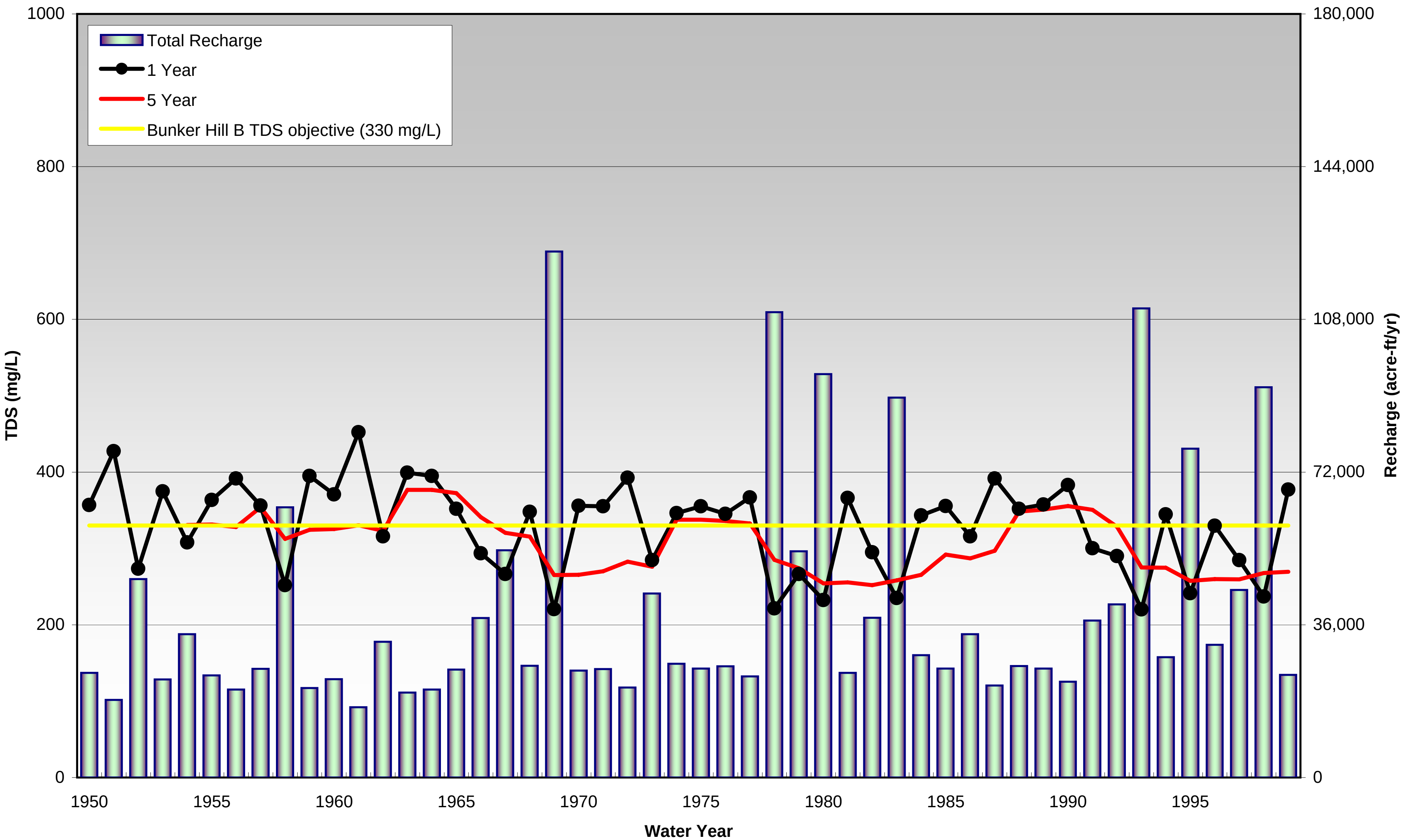


R_S420a_matrix.xls -- Fig 3b

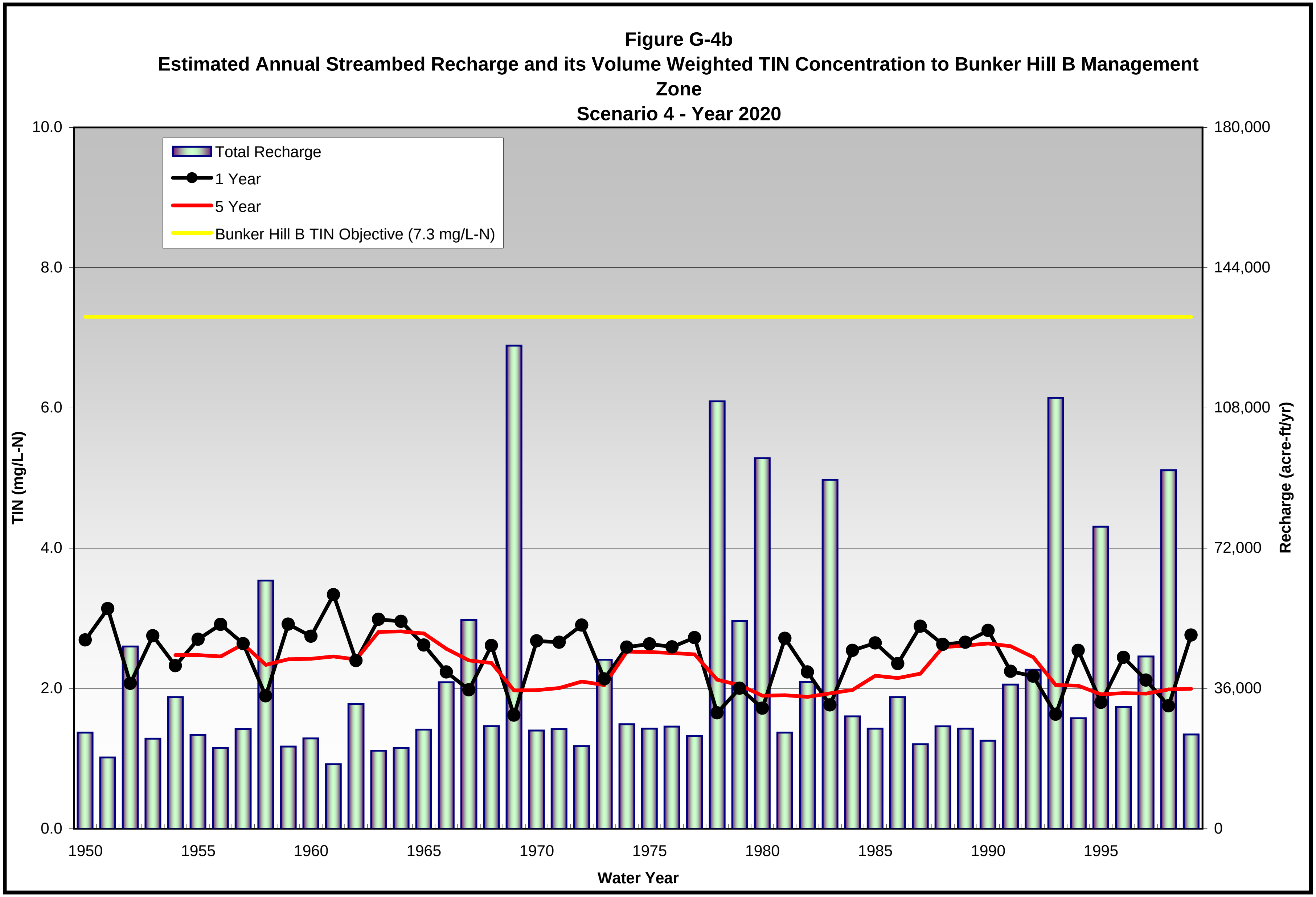
Table G-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 4 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	357				2.7			
1951	427	387			3.1	2.9		
1952	273	317	328		2.1	2.4	2.5	
1953	375	307	332		2.8	2.3	2.5	
1954	308	335	307	331	2.3	2.5	2.3	2.5
1955	363	331	344	331	2.7	2.5	2.6	2.5
1956	392	376	347	328	2.9	2.8	2.6	2.5
1957	356	372	369	354	2.6	2.8	2.7	2.6
1958	252	282	303	312	1.9	2.1	2.3	2.3
1959	395	288	304	325	2.9	2.1	2.3	2.4
1960	371	382	305	325	2.7	2.8	2.3	2.4
1961	452	405	401	330	3.3	3.0	3.0	2.5
1962	316	362	365	323	2.4	2.7	2.7	2.4
1963	399	348	373	377	3.0	2.6	2.8	2.8
1964	395	397	361	377	3.0	3.0	2.7	2.8
1965	352	371	380	372	2.6	2.8	2.8	2.8
1966	294	317	336	341	2.2	2.4	2.5	2.6
1967	266	278	294	321	2.0	2.1	2.2	2.4
1968	348	293	293	315	2.6	2.2	2.2	2.4
1969	220	243	249	265	1.6	1.8	1.8	2.0
1970	356	243	259	265	2.7	1.8	1.9	2.0
1971	355	356	260	270	2.7	2.7	1.9	2.0
1972	393	372	367	283	2.9	2.8	2.7	2.1
1973	285	320	330	276	2.1	2.4	2.5	2.0
1974	346	308	328	338	2.6	2.3	2.4	2.5
1975	355	351	321	338	2.6	2.6	2.4	2.5
1976	345	350	349	336	2.6	2.6	2.6	2.5
1977	367	356	355	333	2.7	2.7	2.6	2.5
1978	221	247	263	285	1.7	1.8	2.0	2.1
1979	266	236	253	274	2.0	1.8	1.9	2.0
1980	232	245	235	254	1.7	1.8	1.7	1.9
1981	366	260	262	256	2.7	1.9	1.9	1.9
1982	295	323	268	252	2.2	2.4	2.0	1.9
1983	235	253	271	258	1.8	1.9	2.0	1.9
1984	343	261	270	265	2.5	2.0	2.0	2.0
1985	356	349	278	292	2.6	2.6	2.1	2.2
1986	316	333	336	287	2.4	2.5	2.5	2.1
1987	392	345	349	297	2.9	2.6	2.6	2.2
1988	352	370	348	348	2.6	2.7	2.6	2.6
1989	357	355	366	351	2.7	2.6	2.7	2.6
1990	383	369	363	356	2.8	2.7	2.7	2.6
1991	300	332	339	350	2.2	2.5	2.5	2.6
1992	290	295	315	328	2.2	2.2	2.3	2.4
1993	220	239	251	275	1.6	1.8	1.9	2.0
1994	345	246	256	275	2.5	1.8	1.9	2.0
1995	241	269	244	258	1.8	2.0	1.8	1.9
1996	330	267	283	260	2.4	2.0	2.1	1.9
1997	285	303	272	259	2.1	2.3	2.0	1.9
1998	237	253	267	268	1.8	1.9	2.0	2.0
1999	377	266	271	269	2.8	2.0	2.0	2.0

Figure G-4a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Bunker Hill B Management Zone
Scenario 4 - Year 2020



R_S420a_matrix.xls -- Fig 4a



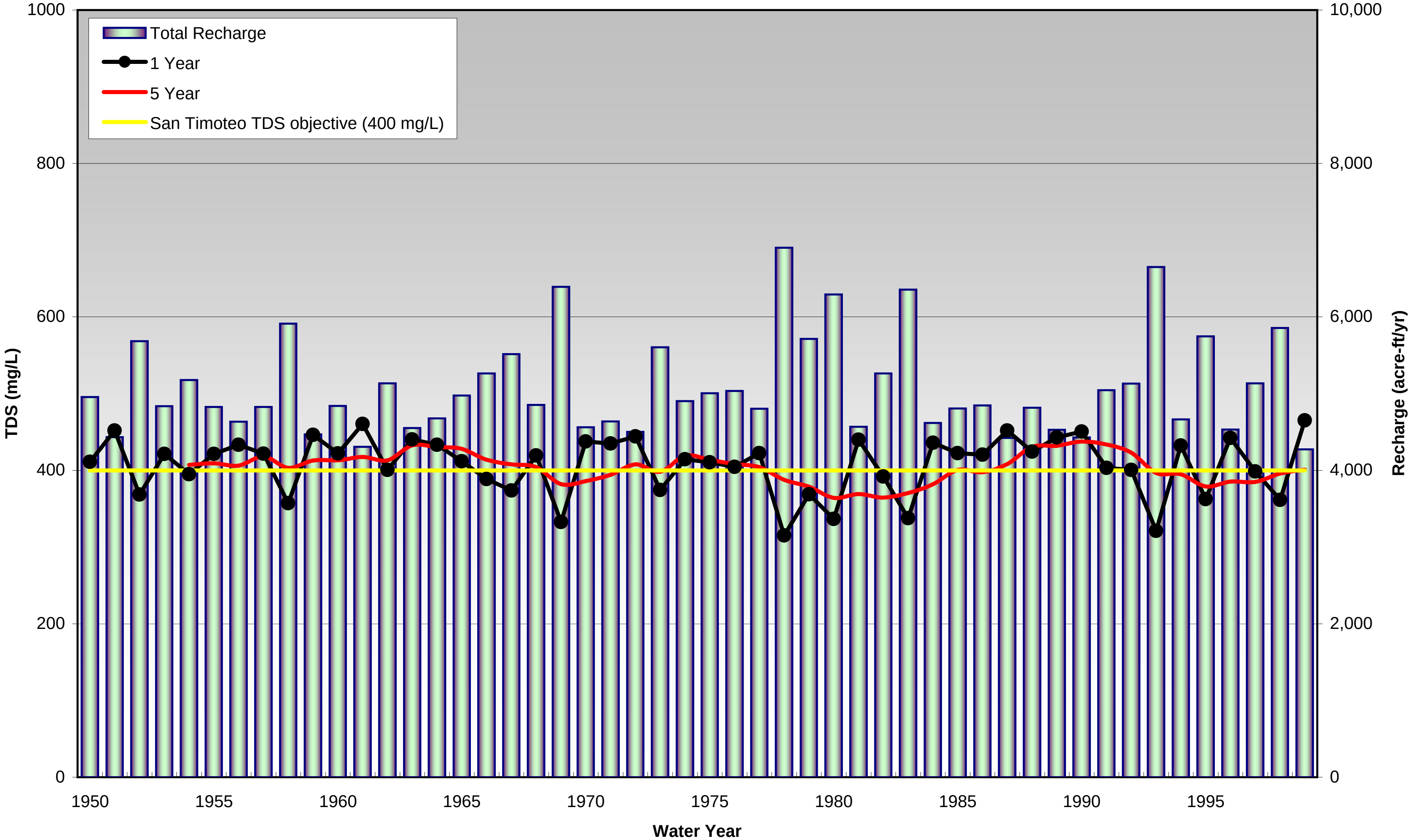
R_S420a_matrix.xls -- Fig 4b

Table G-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 4 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	411				3.5			
1951	452	430			3.8	3.6		
1952	368	405	407		3.1	3.4	3.4	
1953	421	393	410		3.6	3.3	3.5	
1954	395	408	393	407	3.4	3.5	3.3	3.4
1955	421	408	412	409	3.6	3.5	3.5	3.5
1956	433	427	416	406	3.7	3.6	3.5	3.4
1957	422	427	425	418	3.6	3.6	3.6	3.5
1958	357	386	400	403	3.0	3.3	3.4	3.4
1959	446	396	404	413	3.8	3.3	3.4	3.5
1960	422	434	404	413	3.6	3.7	3.4	3.5
1961	461	440	442	418	3.9	3.7	3.7	3.5
1962	401	428	426	413	3.4	3.6	3.6	3.5
1963	440	419	432	433	3.7	3.5	3.7	3.7
1964	433	437	424	430	3.7	3.7	3.6	3.6
1965	412	422	428	428	3.5	3.6	3.6	3.6
1966	389	400	410	414	3.3	3.4	3.5	3.5
1967	374	381	391	408	3.2	3.2	3.3	3.5
1968	419	395	393	404	3.6	3.4	3.3	3.4
1969	333	370	371	382	2.8	3.1	3.1	3.2
1970	438	376	390	386	3.7	3.2	3.3	3.3
1971	435	436	394	394	3.7	3.7	3.3	3.3
1972	444	439	439	408	3.8	3.7	3.7	3.5
1973	374	405	415	398	3.2	3.4	3.5	3.4
1974	414	393	408	419	3.5	3.3	3.5	3.5
1975	411	412	399	414	3.5	3.5	3.4	3.5
1976	404	408	410	408	3.4	3.4	3.5	3.5
1977	422	413	412	404	3.6	3.5	3.5	3.4
1978	315	359	373	387	2.7	3.0	3.2	3.3
1979	369	339	362	379	3.1	2.9	3.1	3.2
1980	337	352	338	364	2.9	3.0	2.9	3.1
1981	440	380	376	369	3.7	3.2	3.2	3.1
1982	392	414	384	364	3.3	3.5	3.3	3.1
1983	338	362	384	370	2.9	3.1	3.2	3.1
1984	436	379	383	382	3.7	3.2	3.2	3.2
1985	422	429	392	401	3.6	3.6	3.3	3.4
1986	420	421	426	397	3.6	3.6	3.6	3.4
1987	452	435	431	408	3.8	3.7	3.6	3.5
1988	424	437	432	431	3.6	3.7	3.6	3.6
1989	443	433	439	432	3.8	3.7	3.7	3.7
1990	451	447	439	437	3.8	3.8	3.7	3.7
1991	403	425	431	434	3.4	3.6	3.7	3.7
1992	400	402	417	423	3.4	3.4	3.5	3.6
1993	321	356	370	397	2.7	3.0	3.1	3.4
1994	432	367	377	395	3.7	3.1	3.2	3.3
1995	362	394	365	379	3.1	3.3	3.1	3.2
1996	442	398	408	385	3.8	3.4	3.5	3.3
1997	399	419	398	385	3.4	3.6	3.4	3.3
1998	362	379	397	396	3.0	3.2	3.4	3.4
1999	465	405	403	401	3.9	3.4	3.4	3.4

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan

Figure G-5a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to San Timoteo Management Zone
Scenario 4 - Year 2020



R_S420a_matrix.xls -- Fig 5a

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Figure G-5b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to San Timoteo Management Zone
Scenario 4 - Year 2020

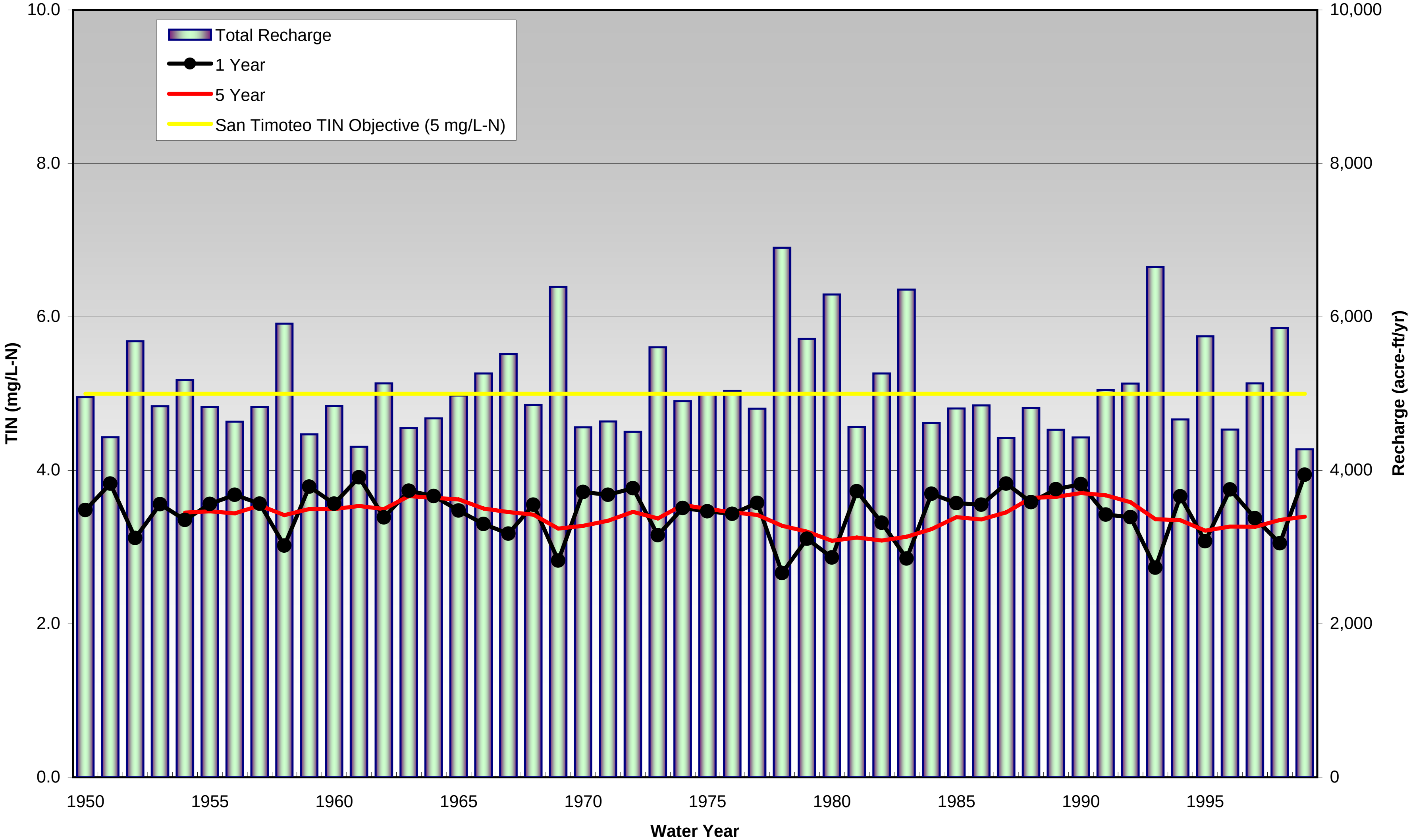
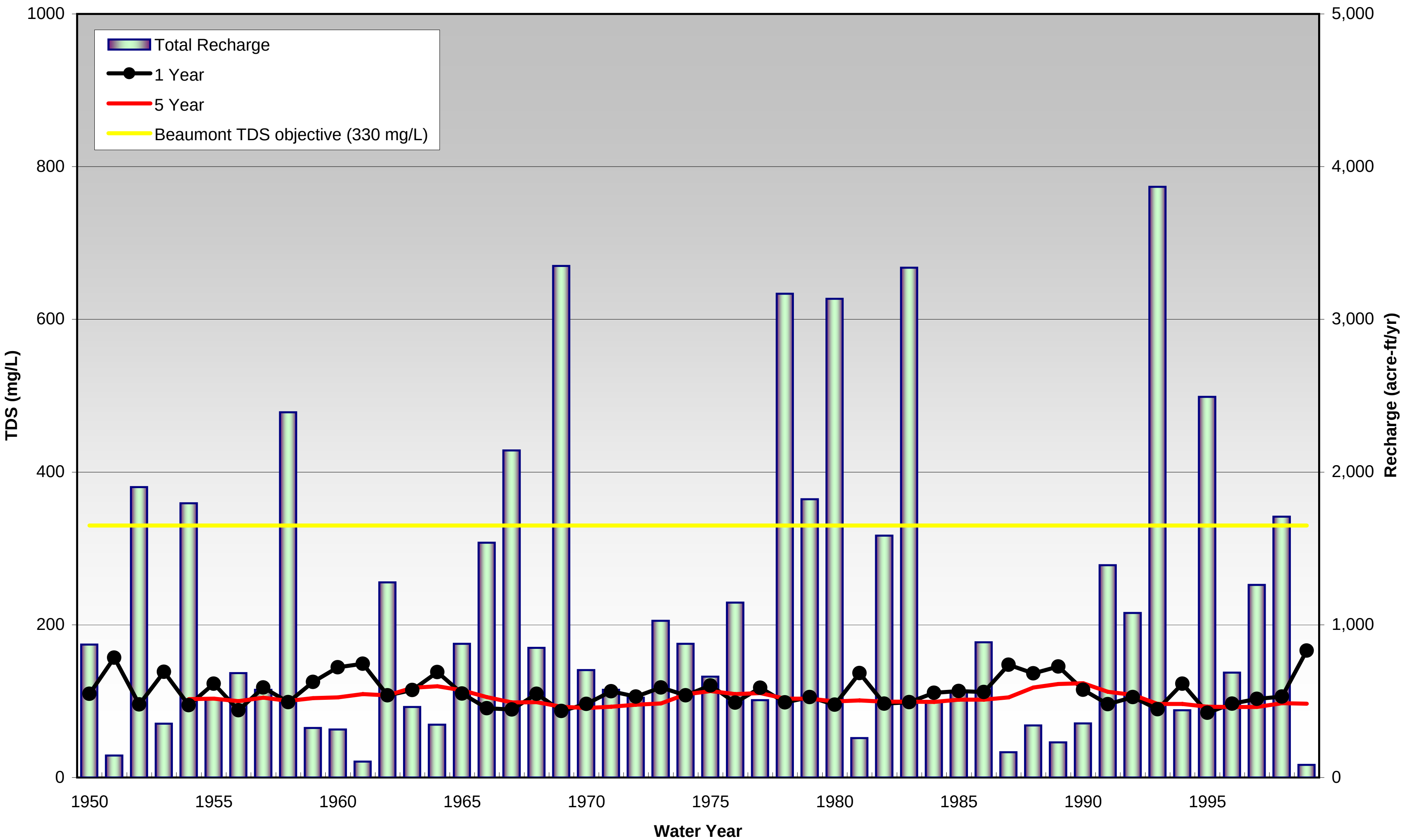


Table G-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 4 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8

Figure G-6a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Beaumont Management Zone
Scenario 4 - Year 2020



R_S420a_matrix.xls -- Fig 6a

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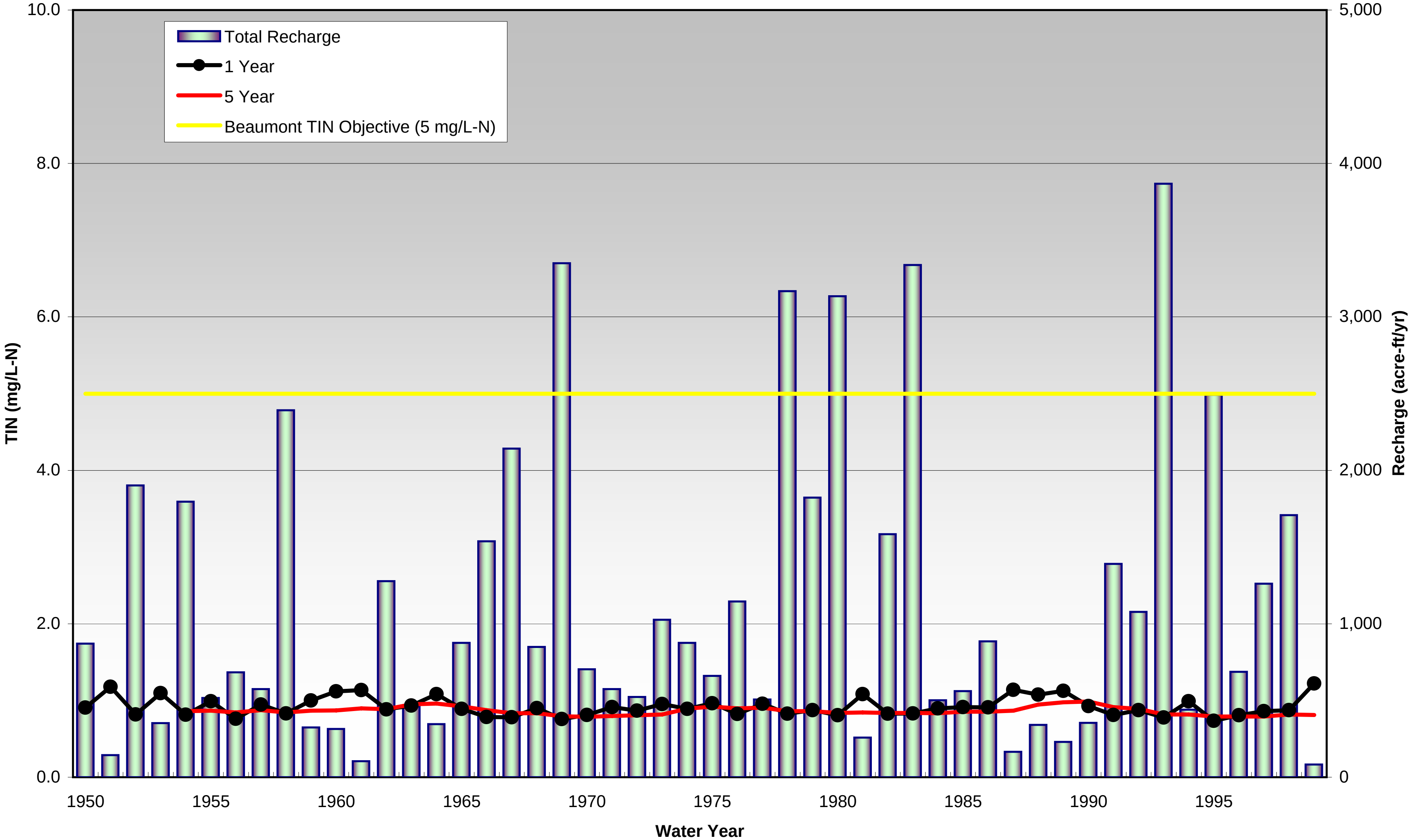
Figure G-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 4 - Year 2020

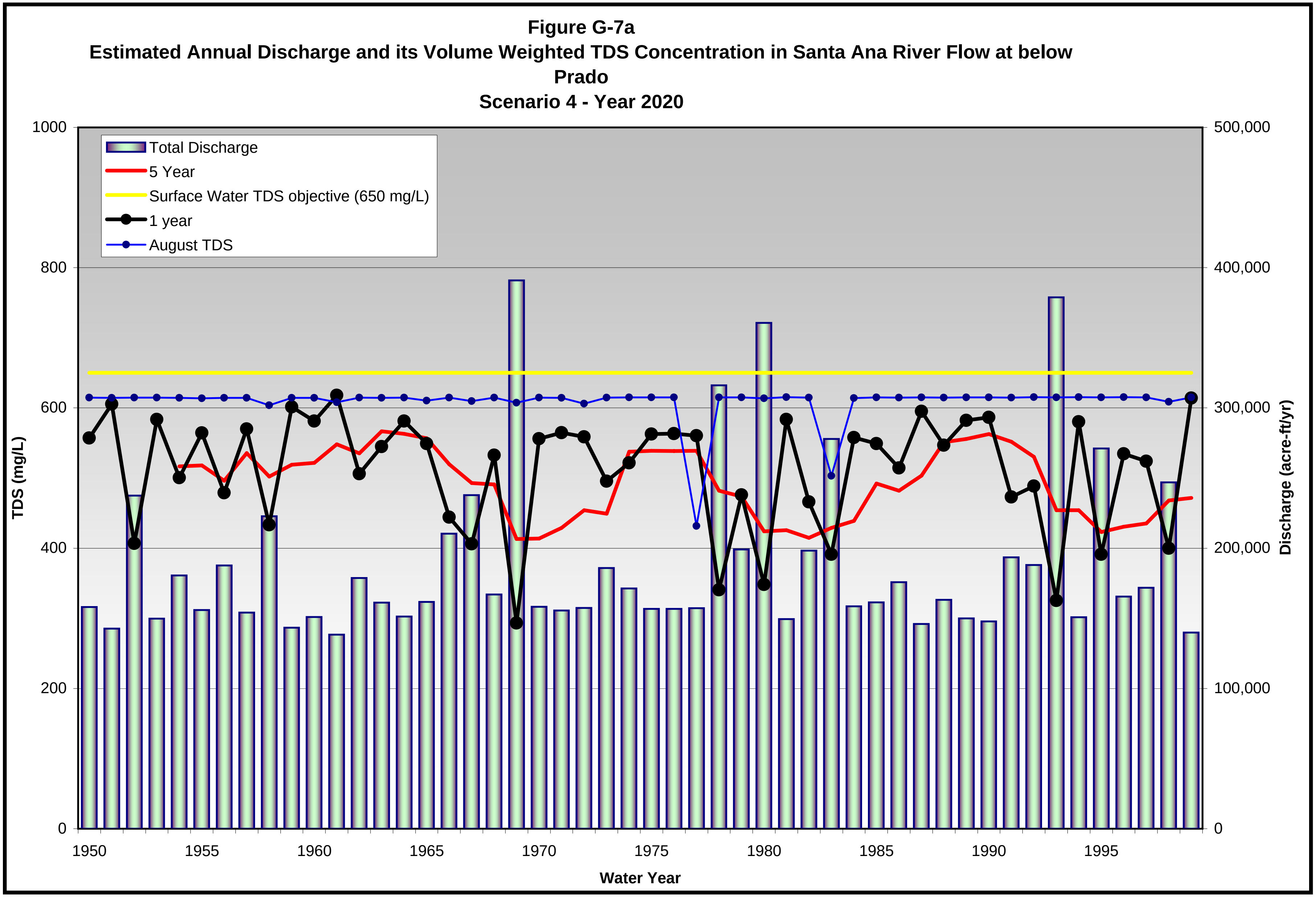


R_S420a_matrix.xls -- Fig 6b

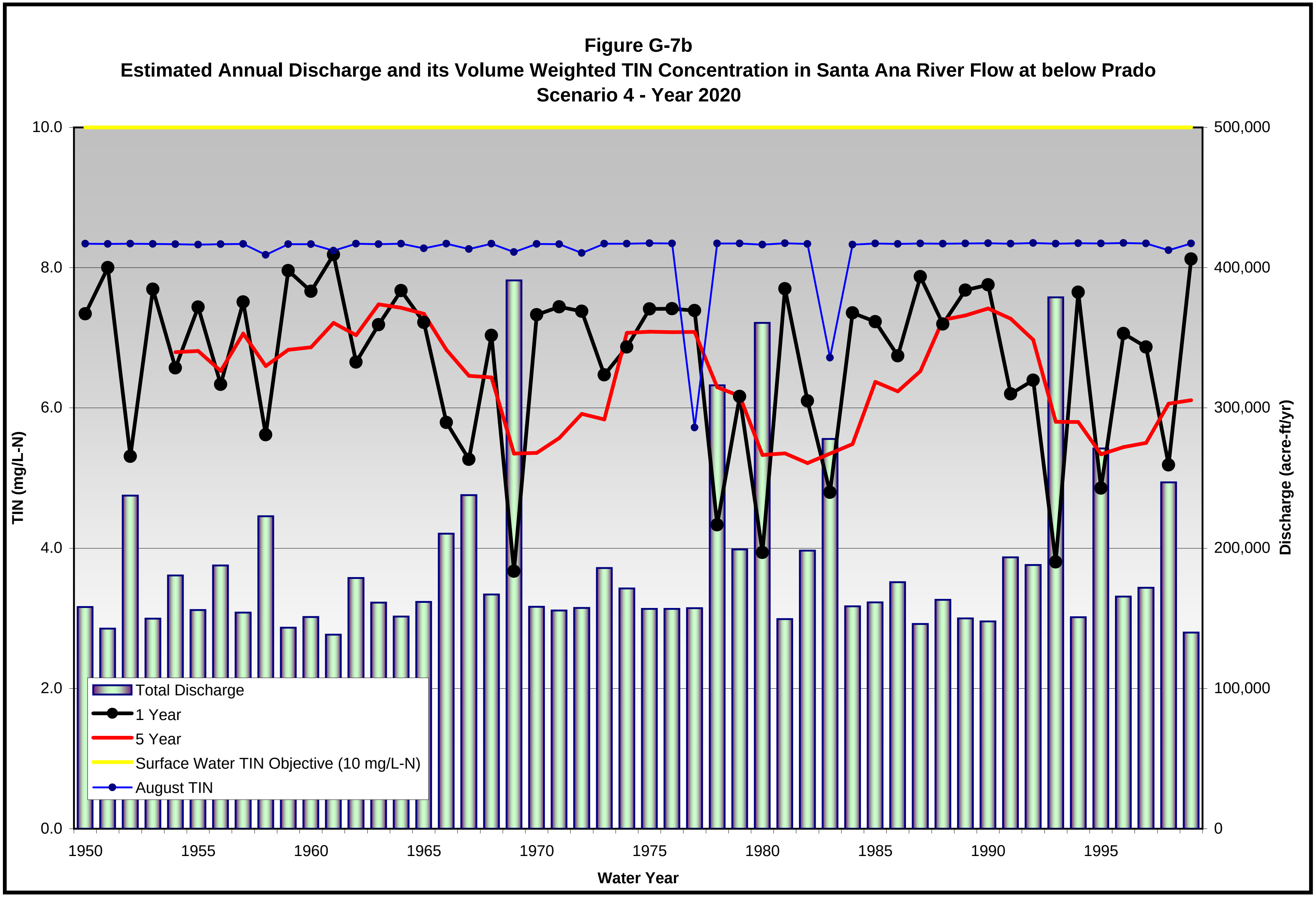
WILDERMUTH™ ENVIRONMENTAL INC.

Table G-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 4 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	557				615	7.3				8.3
1951	605	580			615	8.0	7.7			8.3
1952	407	481	503		615	5.3	6.3	6.6		8.3
1953	584	475	510		615	7.7	6.2	6.7		8.3
1954	501	538	483	517	614	6.6	7.1	6.3	6.8	8.3
1955	564	530	547	518	614	7.4	7.0	7.2	6.8	8.3
1956	479	518	512	496	614	6.3	6.8	6.7	6.5	8.3
1957	570	520	534	536	614	7.5	6.9	7.0	7.1	8.3
1958	433	489	486	502	604	5.6	6.4	6.4	6.6	8.2
1959	602	499	520	519	614	8.0	6.5	6.8	6.8	8.3
1960	581	591	523	522	614	7.7	7.8	6.9	6.9	8.3
1961	618	599	600	548	608	8.2	7.9	7.9	7.2	8.2
1962	506	555	563	535	615	6.7	7.3	7.4	7.0	8.3
1963	545	525	552	567	614	7.2	6.9	7.3	7.5	8.3
1964	581	562	542	563	615	7.7	7.4	7.1	7.4	8.3
1965	549	565	558	557	610	7.2	7.4	7.4	7.3	8.3
1966	444	490	516	520	615	5.8	6.4	6.8	6.8	8.3
1967	406	424	457	493	610	5.3	5.5	6.0	6.5	8.3
1968	533	458	454	491	615	7.0	6.0	5.9	6.4	8.3
1969	293	365	377	413	607	3.7	4.7	4.9	5.4	8.2
1970	556	369	407	414	615	7.3	4.7	5.3	5.4	8.3
1971	565	560	412	429	614	7.4	7.4	5.3	5.6	8.3
1972	559	562	560	454	606	7.4	7.4	7.4	5.9	8.2
1973	496	525	537	449	615	6.5	6.9	7.1	5.8	8.3
1974	522	508	524	538	615	6.9	6.7	6.9	7.1	8.3
1975	563	541	525	539	615	7.4	7.1	6.9	7.1	8.3
1976	563	563	548	539	615	7.4	7.4	7.2	7.1	8.3
1977	560	562	562	539	432	7.4	7.4	7.4	7.1	5.7
1978	341	414	451	482	615	4.3	5.3	5.9	6.3	8.3
1979	476	393	432	474	615	6.2	5.0	5.6	6.2	8.3
1980	348	394	375	424	614	3.9	4.7	4.6	5.3	8.3
1981	584	417	434	426	615	7.7	5.0	5.4	5.4	8.3
1982	466	517	431	415	615	6.1	6.8	5.3	5.2	8.3
1983	391	422	461	429	503	4.8	5.3	5.9	5.3	6.7
1984	558	452	456	439	614	7.4	5.7	5.8	5.5	8.3
1985	549	553	478	492	615	7.2	7.3	6.1	6.4	8.3
1986	514	531	540	482	615	6.7	7.0	7.1	6.2	8.3
1987	595	551	550	504	615	7.9	7.3	7.2	6.5	8.3
1988	547	570	550	551	615	7.2	7.5	7.2	7.3	8.3
1989	582	564	574	556	615	7.7	7.4	7.6	7.3	8.3
1990	587	584	571	563	615	7.8	7.7	7.5	7.4	8.3
1991	473	522	541	552	615	6.2	6.9	7.1	7.3	8.3
1992	488	481	510	530	615	6.4	6.3	6.7	7.0	8.4
1993	325	379	403	454	615	3.8	4.7	5.1	5.8	8.3
1994	580	398	422	454	615	7.6	4.9	5.3	5.8	8.3
1995	391	459	396	423	615	4.9	5.9	4.9	5.3	8.3
1996	535	446	480	431	615	7.1	5.7	6.2	5.4	8.4
1997	524	529	468	435	615	6.9	7.0	6.0	5.5	8.3
1998	400	451	475	468	609	5.2	5.9	6.2	6.1	8.3
1999	614	477	492	472	615	8.1	6.2	6.4	6.1	8.3



R_S420a_matrix.xls -- Fig 7a



R_S420a_matrix.xls -- Fig 7b

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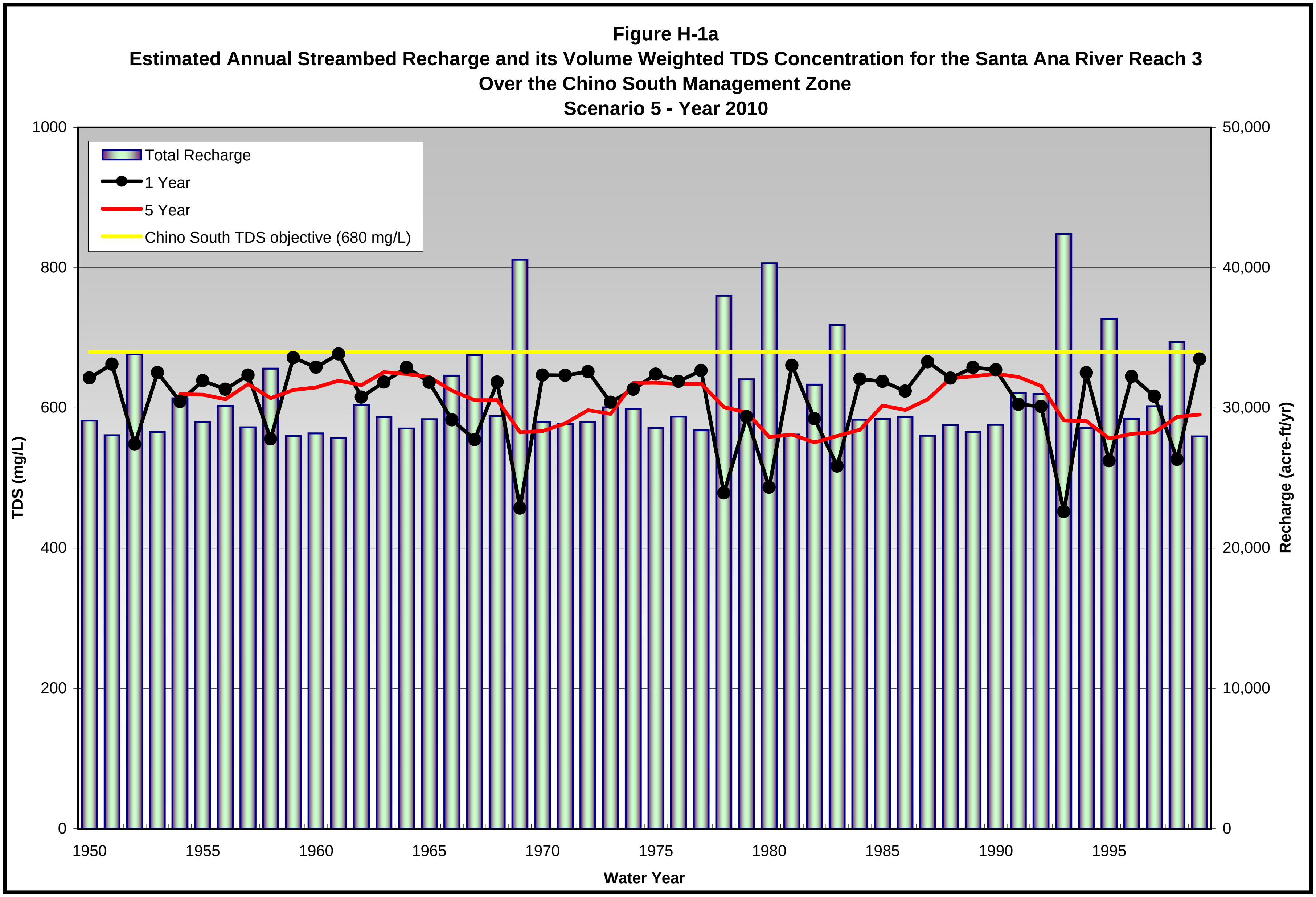
Appendix H

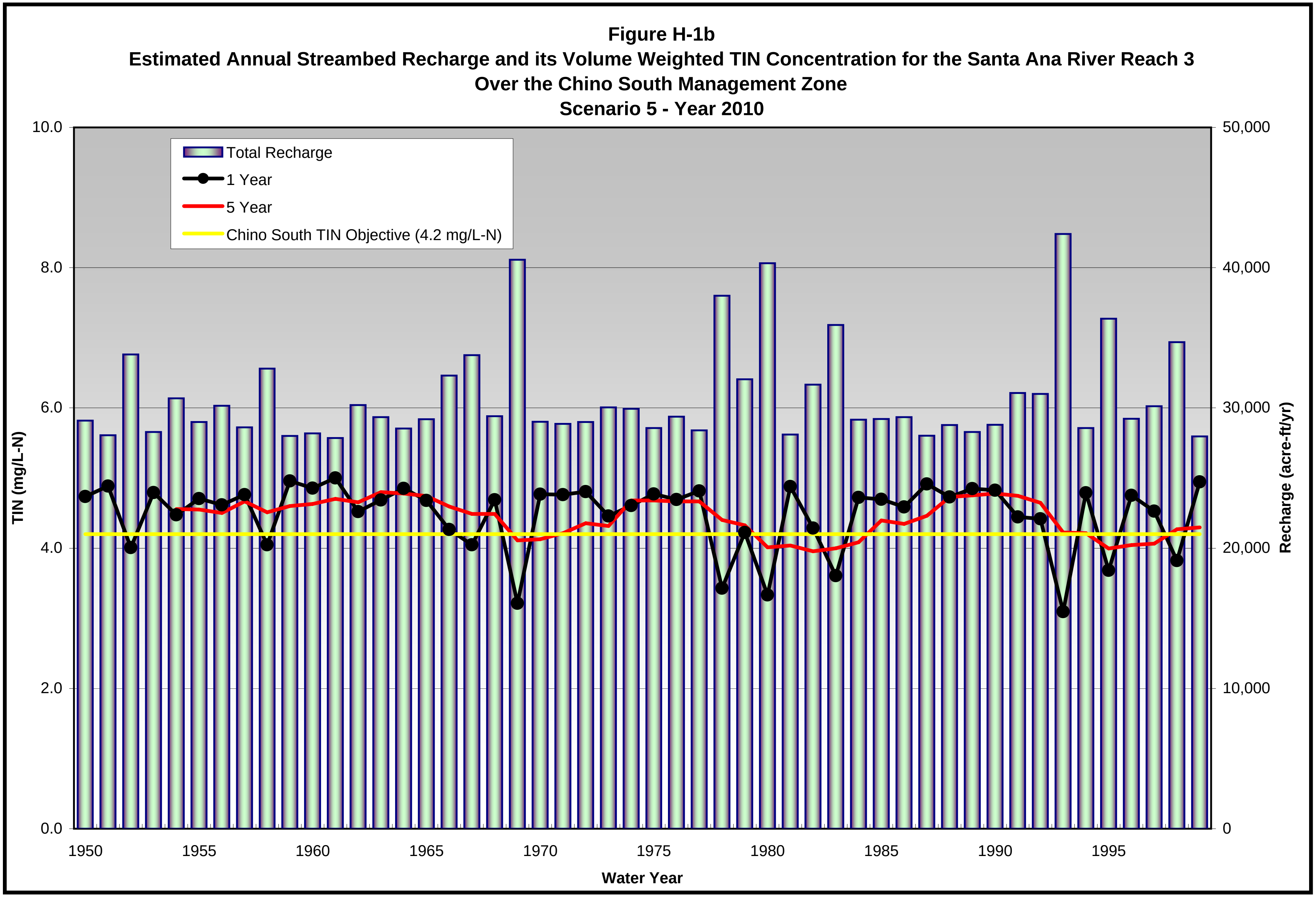
Scenario 5, Year 2010 Simulation Results (Summary Matrices and Graphs)

Table H-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 5 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	643				4.7			
1951	662	652			4.9	4.8		
1952	548	600	614		4.0	4.4	4.5	
1953	650	595	616		4.8	4.4	4.5	
1954	609	629	600	620	4.5	4.6	4.4	4.6
1955	639	624	632	619	4.7	4.6	4.7	4.6
1956	627	633	625	613	4.6	4.7	4.6	4.5
1957	647	637	637	634	4.8	4.7	4.7	4.7
1958	556	598	608	614	4.0	4.4	4.5	4.5
1959	672	609	621	626	5.0	4.5	4.6	4.6
1960	658	665	625	629	4.9	4.9	4.6	4.6
1961	677	668	669	639	5.0	4.9	4.9	4.7
1962	615	645	649	633	4.5	4.8	4.8	4.7
1963	637	626	642	651	4.7	4.6	4.7	4.8
1964	658	647	636	648	4.9	4.8	4.7	4.8
1965	636	647	644	644	4.7	4.8	4.7	4.7
1966	583	608	624	625	4.3	4.5	4.6	4.6
1967	555	569	589	611	4.0	4.2	4.3	4.5
1968	637	593	590	611	4.7	4.3	4.3	4.5
1969	457	533	540	565	3.2	3.8	3.9	4.1
1970	647	536	566	567	4.8	3.9	4.1	4.1
1971	646	647	569	578	4.8	4.8	4.1	4.2
1972	652	649	648	597	4.8	4.8	4.8	4.4
1973	608	630	635	591	4.5	4.6	4.7	4.3
1974	627	617	629	636	4.6	4.5	4.6	4.7
1975	648	637	627	636	4.8	4.7	4.6	4.7
1976	638	643	637	634	4.7	4.7	4.7	4.7
1977	653	646	646	634	4.8	4.8	4.8	4.7
1978	479	553	579	601	3.4	4.0	4.2	4.4
1979	588	529	565	594	4.2	3.8	4.1	4.3
1980	487	531	513	559	3.3	3.7	3.6	4.0
1981	661	558	568	562	4.9	4.0	4.0	4.0
1982	584	620	567	551	4.3	4.6	4.1	4.0
1983	517	549	582	560	3.6	3.9	4.2	4.0
1984	641	573	577	569	4.7	4.1	4.2	4.1
1985	638	639	593	604	4.7	4.7	4.3	4.4
1986	624	631	634	597	4.6	4.6	4.7	4.3
1987	666	644	642	612	4.9	4.7	4.7	4.5
1988	642	654	644	642	4.7	4.8	4.7	4.7
1989	658	650	655	645	4.8	4.8	4.8	4.8
1990	654	656	651	649	4.8	4.8	4.8	4.8
1991	605	629	638	644	4.4	4.6	4.7	4.7
1992	602	604	620	631	4.4	4.4	4.6	4.6
1993	452	515	542	582	3.1	3.7	3.9	4.2
1994	650	532	553	581	4.8	3.8	4.0	4.2
1995	525	580	529	557	3.7	4.2	3.7	4.0
1996	645	578	600	563	4.8	4.2	4.4	4.0
1997	617	631	590	565	4.5	4.6	4.3	4.1
1998	527	568	592	587	3.8	4.2	4.3	4.3
1999	670	590	599	590	4.9	4.3	4.4	4.3



R_S510a_matrix.xls -- Fig 1a



R_S510a_matrix.xls -- Fig 1b

Table H-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 5 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	499	470			7.0	6.5		
1952	350	408	420		4.7	5.6	5.7	
1953	478	401	428		6.6	5.4	5.9	
1954	408	439	403	427	5.5	6.0	5.5	5.8
1955	455	429	444	429	6.3	5.9	6.1	5.9
1956	450	452	436	421	6.2	6.3	6.0	5.8
1957	473	461	459	451	6.5	6.4	6.3	6.2
1958	345	396	412	419	4.5	5.3	5.6	5.7
1959	495	403	423	434	6.9	5.4	5.7	5.9
1960	492	494	428	440	6.8	6.9	5.8	6.0
1961	510	501	499	451	7.1	7.0	7.0	6.2
1962	413	456	467	439	5.6	6.3	6.5	6.0
1963	460	435	457	471	6.4	6.0	6.3	6.5
1964	478	468	448	468	6.6	6.5	6.2	6.5
1965	440	458	458	457	6.0	6.3	6.3	6.3
1966	378	406	426	430	5.0	5.5	5.8	5.9
1967	355	366	386	414	4.7	4.9	5.2	5.6
1968	445	393	388	412	6.1	5.3	5.2	5.6
1969	267	326	335	359	3.1	4.1	4.3	4.7
1970	450	328	357	361	6.2	4.2	4.6	4.7
1971	447	449	358	371	6.1	6.2	4.7	4.9
1972	471	458	456	390	6.5	6.3	6.3	5.2
1973	412	440	442	385	5.6	6.0	6.1	5.1
1974	430	421	436	441	5.9	5.7	6.0	6.0
1975	473	450	437	445	6.5	6.2	6.0	6.1
1976	437	454	445	443	6.0	6.2	6.1	6.1
1977	473	454	460	443	6.5	6.3	6.3	6.1
1978	286	350	374	400	3.5	4.5	4.9	5.4
1979	395	329	363	393	5.3	4.2	4.7	5.2
1980	286	326	311	352	3.5	4.1	3.9	4.6
1981	490	349	362	357	6.8	4.5	4.7	4.6
1982	378	425	358	346	5.1	5.8	4.7	4.5
1983	306	337	374	352	3.9	4.4	5.0	4.6
1984	450	361	367	359	6.2	4.8	4.9	4.7
1985	457	454	387	401	6.3	6.2	5.2	5.4
1986	440	449	449	394	6.0	6.2	6.2	5.3
1987	498	467	464	415	6.9	6.4	6.4	5.6
1988	463	480	466	461	6.4	6.7	6.4	6.4
1989	474	468	478	466	6.6	6.5	6.6	6.4
1990	471	472	469	468	6.5	6.5	6.5	6.5
1991	401	433	445	458	5.4	5.9	6.1	6.3
1992	387	394	416	435	5.2	5.3	5.7	6.0
1993	262	306	331	372	3.1	3.8	4.2	4.9
1994	465	324	341	371	6.4	4.1	4.4	4.9
1995	328	381	325	348	4.2	5.1	4.1	4.5
1996	450	377	401	354	6.2	5.0	5.4	4.6
1997	407	427	386	357	5.5	5.8	5.1	4.7
1998	327	361	386	384	4.2	4.7	5.1	5.1
1999	506	392	397	389	7.1	5.2	5.3	5.2

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Figure H-2a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 4 Over the Riverside A Management Zone
Scenario 5 - Year 2010

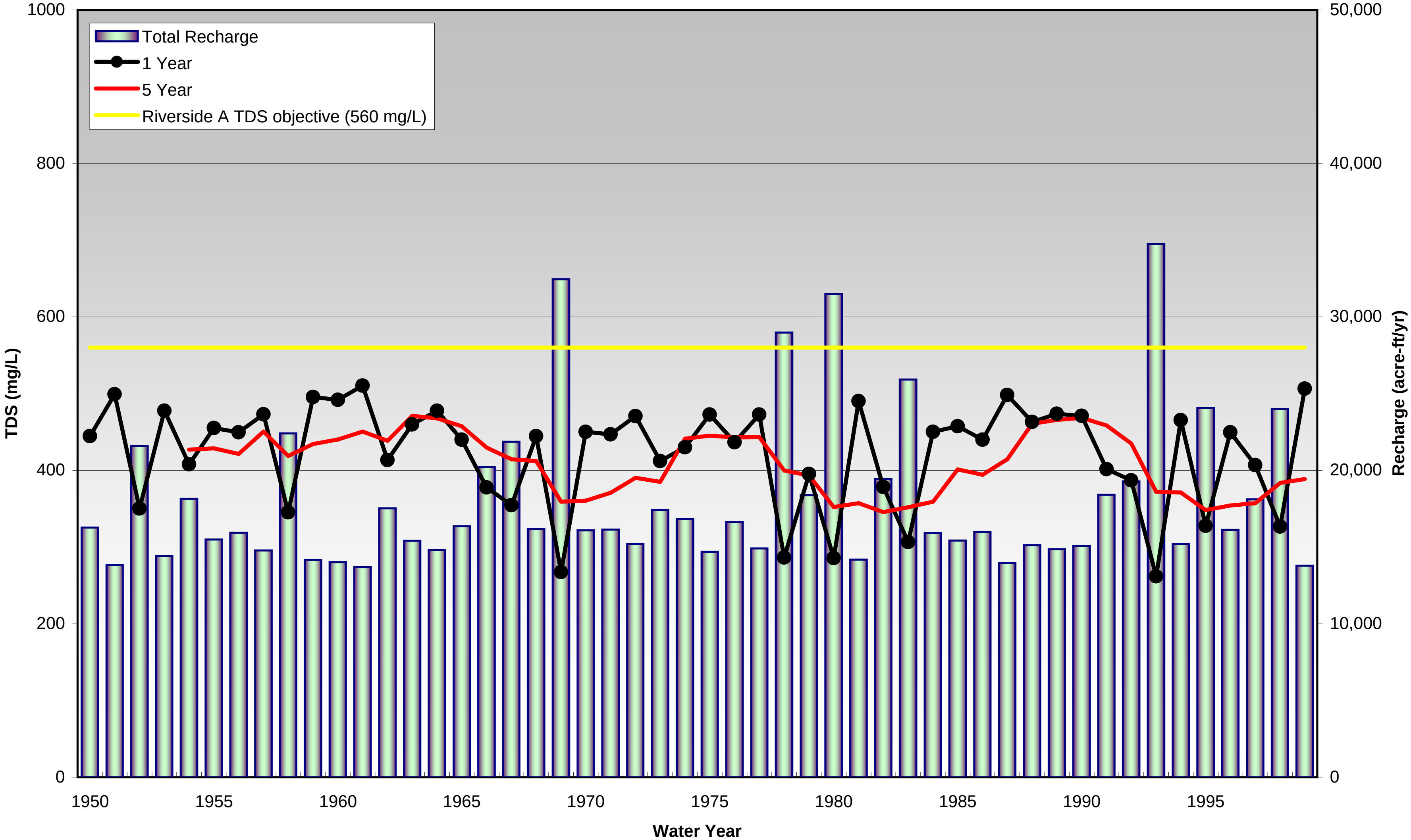

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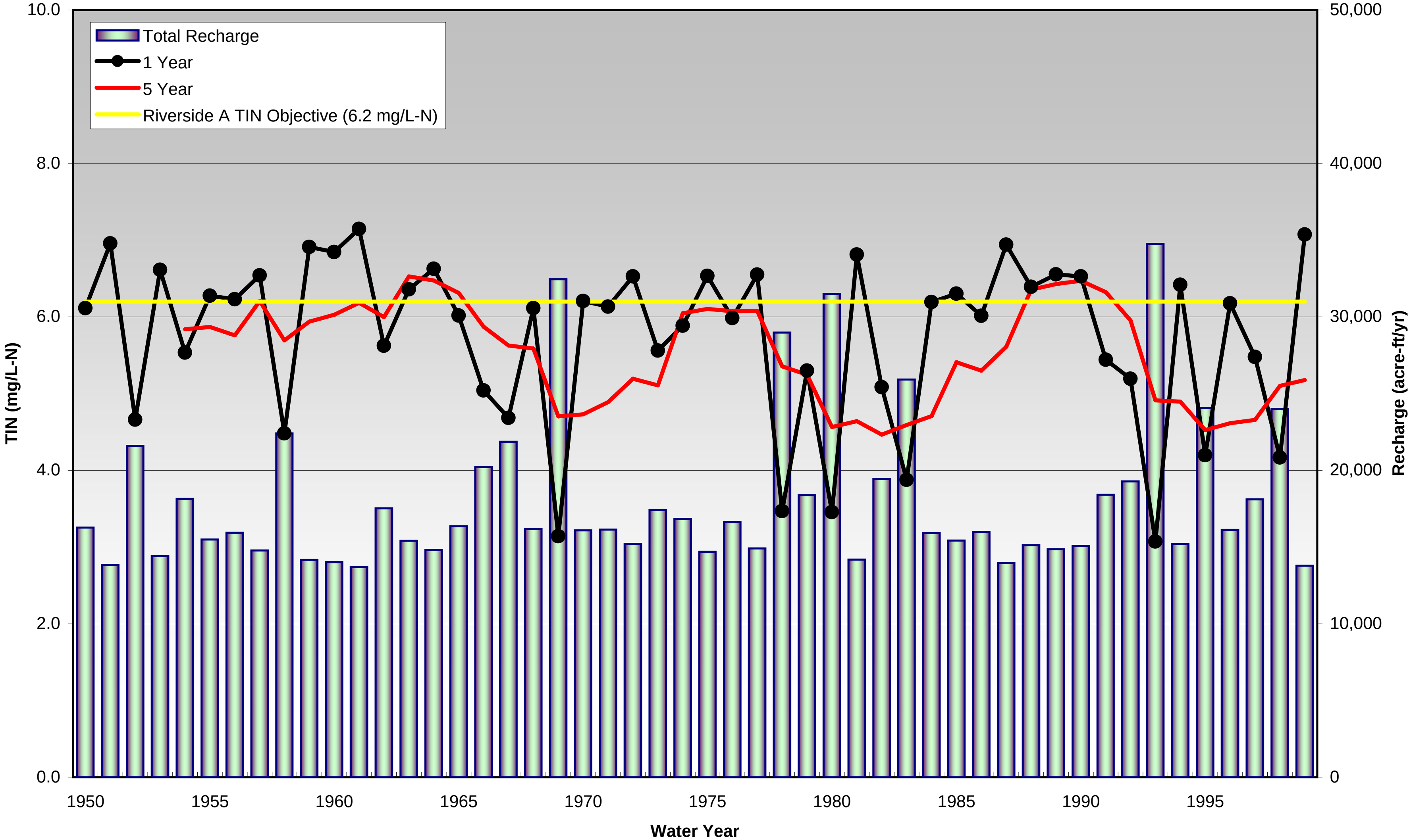
Figure H-2b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 5 - Year 2010



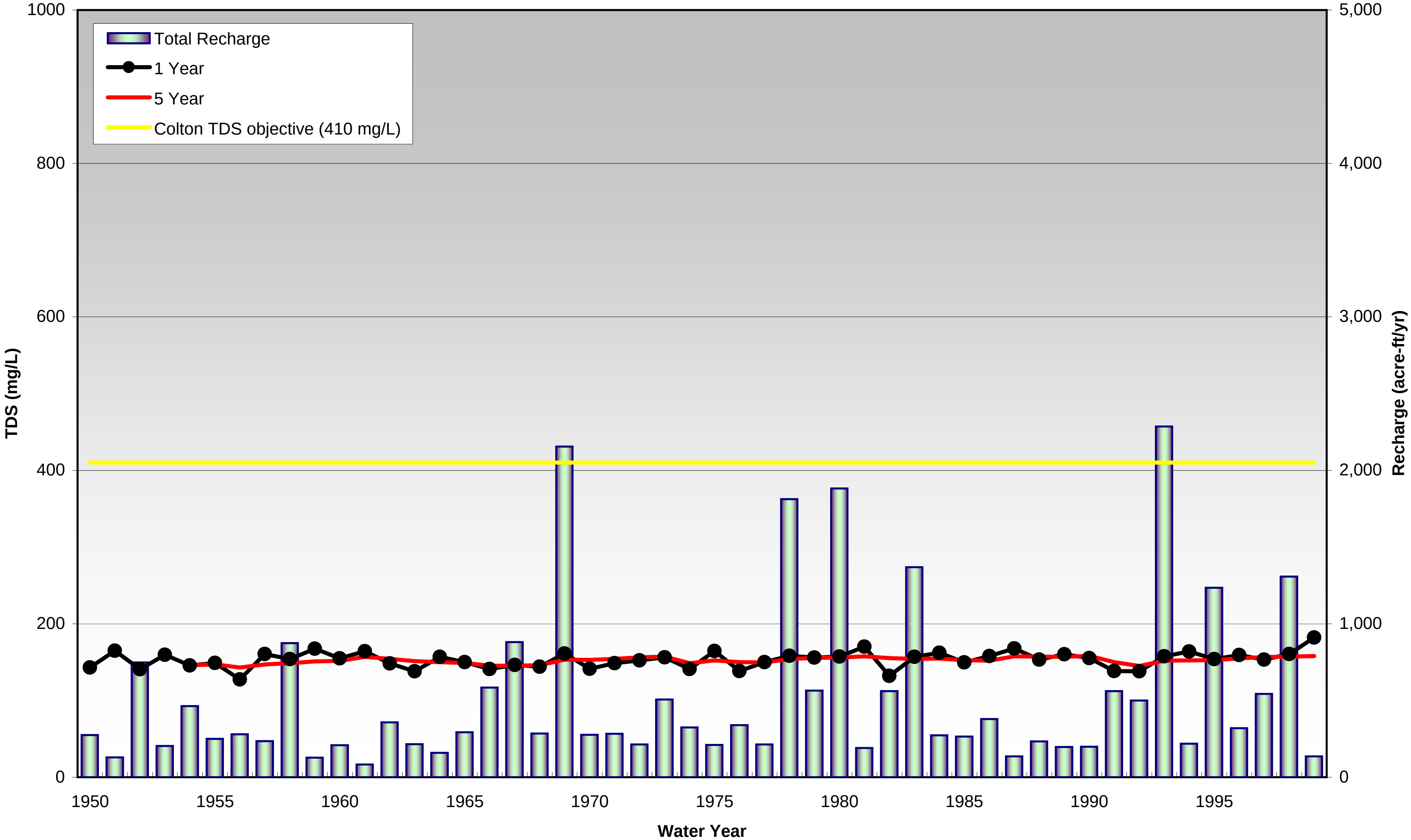
R_S510a_matrix.xls -- Fig 2b

WILDERMUTH™ ENVIRONMENTAL INC.

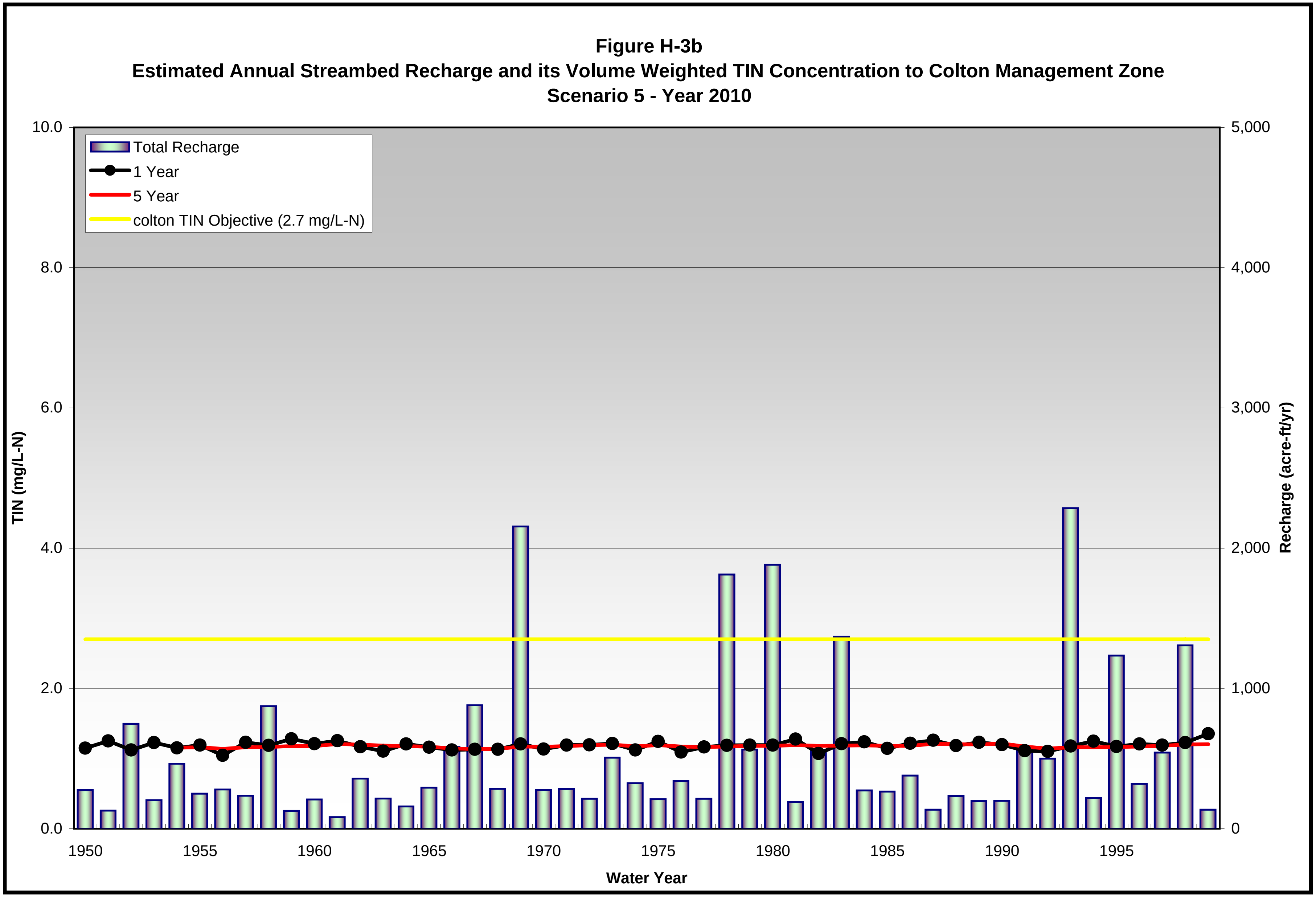
Table H-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 5 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	143				1.1			
1951	165	150			1.3	1.2		
1952	141	144	144		1.1	1.1	1.1	
1953	160	145	147		1.2	1.1	1.2	
1954	146	150	145	146	1.2	1.2	1.1	1.2
1955	149	147	150	147	1.2	1.2	1.2	1.2
1956	127	138	141	143	1.0	1.1	1.1	1.1
1957	160	142	145	147	1.2	1.1	1.1	1.2
1958	154	155	150	149	1.2	1.2	1.2	1.2
1959	168	156	157	151	1.3	1.2	1.2	1.2
1960	155	160	156	152	1.2	1.2	1.2	1.2
1961	164	158	161	157	1.3	1.2	1.2	1.2
1962	148	151	152	154	1.2	1.2	1.2	1.2
1963	138	144	147	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	150	152	148	149	1.2	1.2	1.2	1.2
1966	141	144	146	145	1.1	1.1	1.1	1.1
1967	146	144	145	145	1.1	1.1	1.1	1.1
1968	144	146	144	146	1.1	1.1	1.1	1.1
1969	161	159	156	153	1.2	1.2	1.2	1.2
1970	141	159	157	153	1.1	1.2	1.2	1.2
1971	149	145	158	154	1.2	1.2	1.2	1.2
1972	152	150	147	156	1.2	1.2	1.2	1.2
1973	156	155	153	157	1.2	1.2	1.2	1.2
1974	141	150	151	149	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	146	150	1.1	1.2	1.1	1.2
1977	150	143	149	150	1.2	1.1	1.2	1.2
1978	158	157	155	154	1.2	1.2	1.2	1.2
1979	156	158	157	156	1.2	1.2	1.2	1.2
1980	157	157	157	156	1.2	1.2	1.2	1.2
1981	170	158	158	158	1.3	1.2	1.2	1.2
1982	132	142	153	155	1.1	1.1	1.2	1.2
1983	157	150	152	154	1.2	1.2	1.2	1.2
1984	162	158	151	155	1.2	1.2	1.2	1.2
1985	150	156	157	152	1.1	1.2	1.2	1.2
1986	158	155	157	152	1.2	1.2	1.2	1.2
1987	168	161	157	158	1.3	1.2	1.2	1.2
1988	153	159	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	143	146	150	1.1	1.1	1.2	1.2
1992	138	138	141	145	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	155	152	1.2	1.2	1.2	1.2
1995	154	156	157	153	1.2	1.2	1.2	1.2
1996	159	155	156	155	1.2	1.2	1.2	1.2
1997	153	155	155	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	163	160	158	1.4	1.2	1.2	1.2

Figure H-3a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Colton Management Zone
Scenario 5 - Year 2010



R_S510a_matrix.xls -- Fig 3a



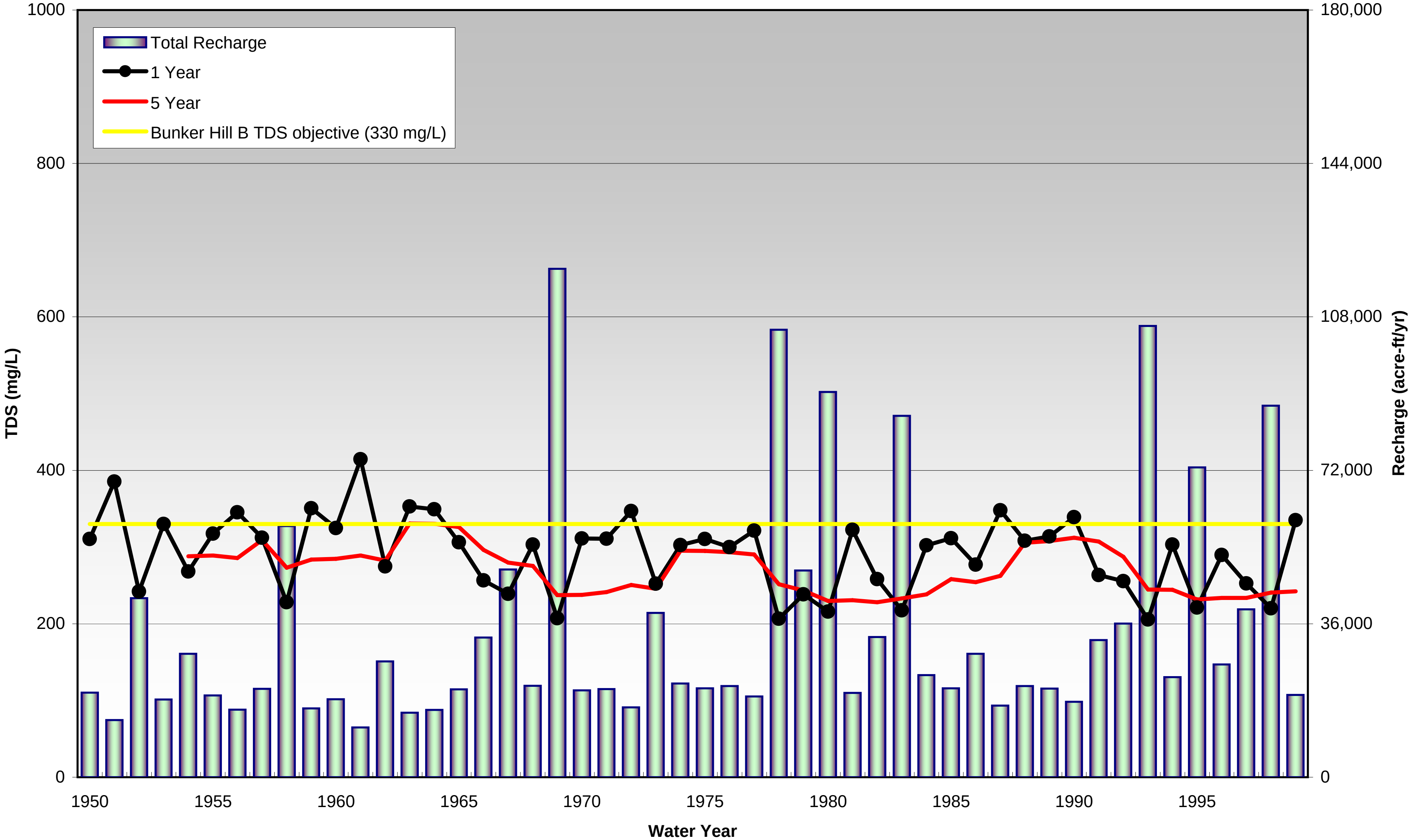
R_S510a_matrix.xls -- Fig 3b

WILDERMUTH ENVIRONMENTAL INC.

Table H-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 5 - Year 2010
(mg/L)

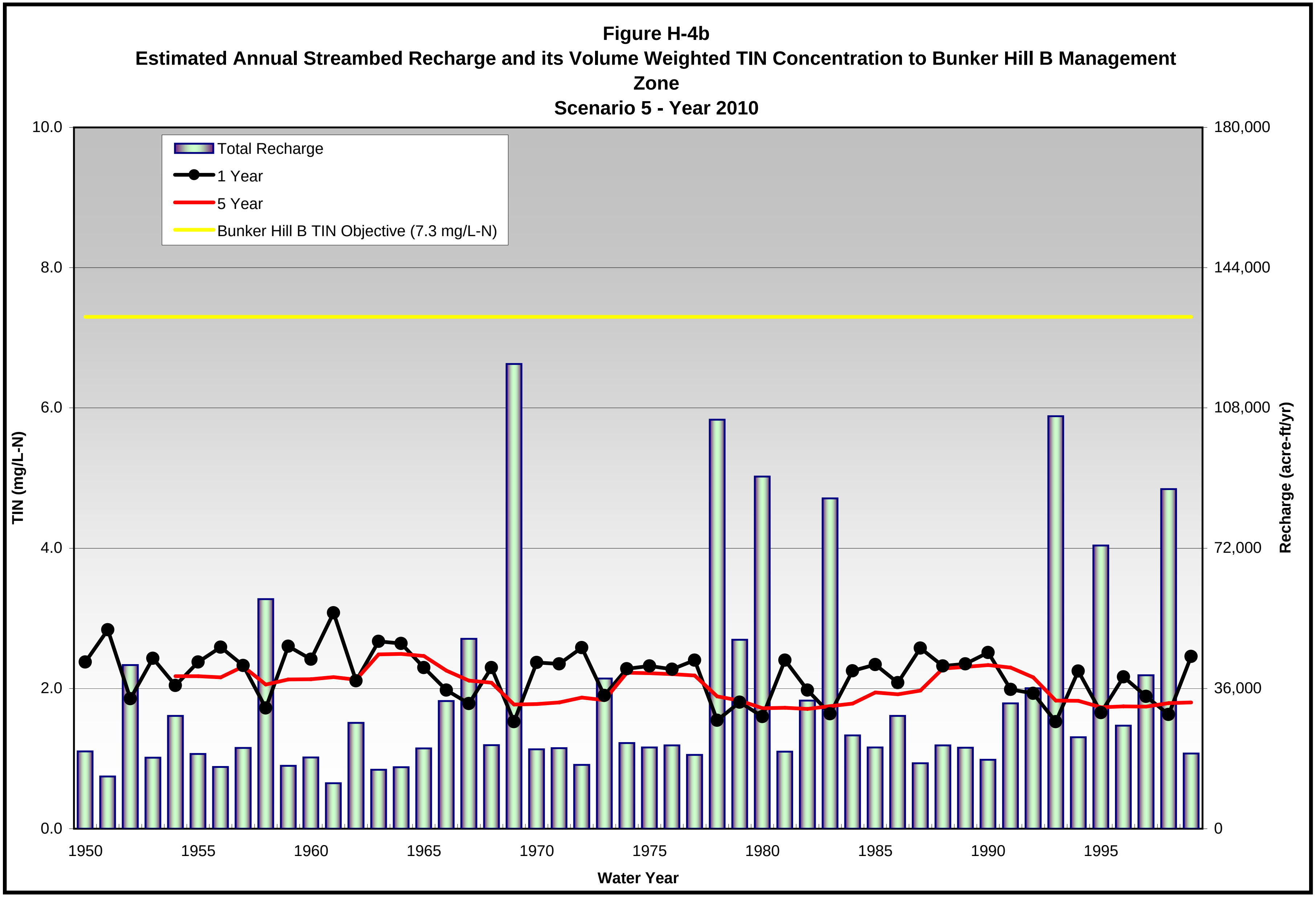
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	311				2.4			
1951	385	341			2.8	2.6		
1952	242	277	286		1.9	2.1	2.2	
1953	330	269	290		2.4	2.0	2.2	
1954	268	292	268	288	2.0	2.2	2.0	2.2
1955	318	288	299	289	2.4	2.2	2.2	2.2
1956	345	330	302	286	2.6	2.5	2.3	2.2
1957	312	327	323	309	2.3	2.4	2.4	2.3
1958	228	250	266	273	1.7	1.9	2.0	2.1
1959	351	254	267	284	2.6	1.9	2.0	2.1
1960	325	337	268	285	2.4	2.5	2.0	2.1
1961	415	360	357	289	3.1	2.7	2.6	2.2
1962	275	317	319	282	2.1	2.4	2.4	2.1
1963	353	303	327	331	2.7	2.3	2.5	2.5
1964	349	351	315	330	2.6	2.7	2.4	2.5
1965	306	325	333	326	2.3	2.4	2.5	2.5
1966	256	276	292	296	2.0	2.1	2.2	2.3
1967	239	246	258	280	1.8	1.9	1.9	2.1
1968	303	259	258	275	2.3	1.9	2.0	2.1
1969	207	222	226	237	1.5	1.6	1.7	1.8
1970	311	222	233	238	2.4	1.6	1.7	1.8
1971	311	311	234	241	2.4	2.4	1.7	1.8
1972	347	327	321	251	2.6	2.5	2.4	1.9
1973	252	280	289	246	1.9	2.1	2.2	1.8
1974	303	270	287	295	2.3	2.0	2.2	2.2
1975	310	306	281	295	2.3	2.3	2.1	2.2
1976	300	305	304	293	2.3	2.3	2.3	2.2
1977	321	310	310	290	2.4	2.3	2.3	2.2
1978	207	224	235	252	1.5	1.7	1.8	1.9
1979	238	217	228	243	1.8	1.6	1.7	1.8
1980	216	224	216	230	1.6	1.7	1.6	1.7
1981	322	235	236	231	2.4	1.7	1.8	1.7
1982	258	282	240	228	2.0	2.1	1.8	1.7
1983	218	229	242	233	1.6	1.7	1.8	1.7
1984	302	236	241	238	2.3	1.8	1.8	1.8
1985	312	307	248	258	2.3	2.3	1.9	1.9
1986	277	292	295	254	2.1	2.2	2.2	1.9
1987	348	303	306	263	2.6	2.3	2.3	2.0
1988	308	326	305	305	2.3	2.4	2.3	2.3
1989	314	311	321	308	2.3	2.3	2.4	2.3
1990	339	325	319	312	2.5	2.4	2.4	2.3
1991	264	290	297	307	2.0	2.2	2.2	2.3
1992	256	259	276	287	1.9	2.0	2.1	2.2
1993	206	218	227	244	1.5	1.6	1.7	1.8
1994	303	223	230	244	2.2	1.7	1.7	1.8
1995	221	241	223	232	1.7	1.8	1.7	1.7
1996	290	240	252	234	2.2	1.8	1.9	1.7
1997	253	268	243	234	1.9	2.0	1.8	1.7
1998	220	230	240	241	1.6	1.7	1.8	1.8
1999	335	241	244	242	2.5	1.8	1.8	1.8

Figure H-4a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Bunker Hill B Management Zone
Scenario 5 - Year 2010



R_S510a_matrix.xls -- Fig 4a

WILDERMUTH ENVIRONMENTAL INC.

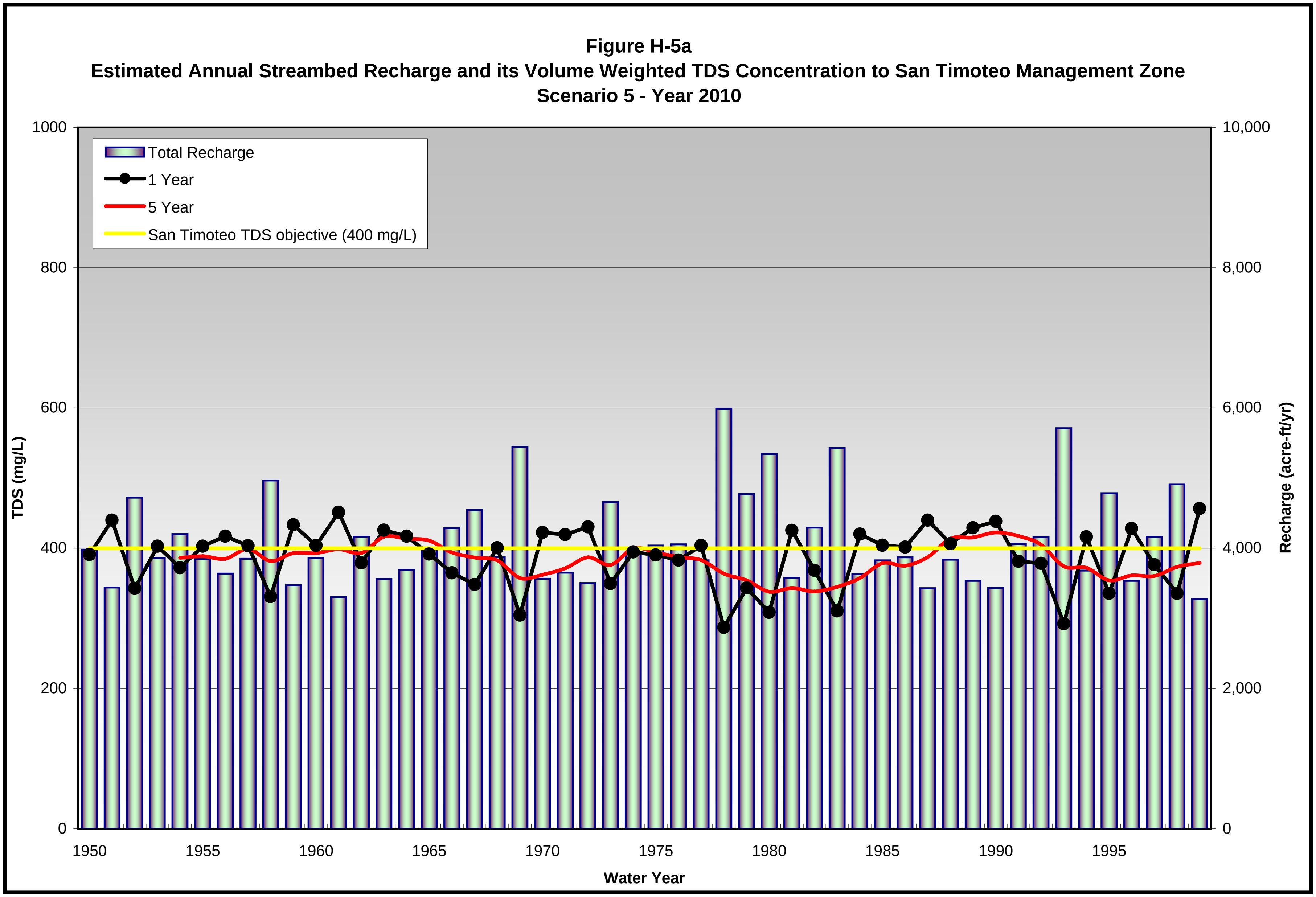


R_S510a_matrix.xls -- Fig 4b

Table H-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 5 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	391				3.3			
1951	440	414			3.7	3.5		
1952	343	384	386		2.9	3.2	3.3	
1953	403	370	390		3.4	3.1	3.3	
1954	372	387	370	386	3.2	3.3	3.1	3.3
1955	403	387	392	389	3.4	3.3	3.3	3.3
1956	417	410	396	385	3.5	3.5	3.4	3.3
1957	403	410	408	399	3.4	3.5	3.4	3.4
1958	331	363	379	382	2.8	3.1	3.2	3.2
1959	433	373	383	393	3.7	3.2	3.2	3.3
1960	404	418	383	393	3.4	3.5	3.2	3.3
1961	451	426	428	398	3.8	3.6	3.6	3.4
1962	379	411	408	393	3.2	3.5	3.4	3.3
1963	426	400	416	416	3.6	3.4	3.5	3.5
1964	417	421	406	413	3.5	3.6	3.4	3.5
1965	392	404	411	411	3.3	3.4	3.5	3.5
1966	365	378	390	394	3.1	3.2	3.3	3.3
1967	348	356	367	387	3.0	3.0	3.1	3.3
1968	401	372	370	383	3.4	3.2	3.1	3.2
1969	304	344	346	358	2.6	2.9	2.9	3.0
1970	422	351	366	362	3.6	3.0	3.1	3.1
1971	419	421	371	371	3.5	3.6	3.1	3.1
1972	430	425	424	387	3.6	3.6	3.6	3.3
1973	349	384	395	376	2.9	3.2	3.3	3.2
1974	395	370	388	400	3.3	3.1	3.3	3.4
1975	390	392	376	394	3.3	3.3	3.2	3.3
1976	383	387	389	387	3.2	3.3	3.3	3.3
1977	404	393	392	383	3.4	3.3	3.3	3.2
1978	287	333	347	364	2.4	2.8	2.9	3.1
1979	343	312	336	354	2.9	2.6	2.8	3.0
1980	309	325	311	338	2.6	2.7	2.6	2.9
1981	425	355	351	343	3.6	3.0	3.0	2.9
1982	369	394	360	338	3.1	3.3	3.0	2.9
1983	310	336	360	345	2.6	2.8	3.0	2.9
1984	420	354	359	358	3.6	3.0	3.0	3.0
1985	404	412	369	379	3.4	3.5	3.1	3.2
1986	402	403	408	375	3.4	3.4	3.4	3.2
1987	440	420	414	387	3.7	3.5	3.5	3.3
1988	406	422	415	414	3.4	3.6	3.5	3.5
1989	429	417	424	415	3.6	3.5	3.6	3.5
1990	438	434	424	422	3.7	3.7	3.6	3.6
1991	381	408	414	418	3.2	3.5	3.5	3.5
1992	378	380	397	405	3.2	3.2	3.4	3.4
1993	292	329	344	374	2.5	2.8	2.9	3.2
1994	416	341	352	372	3.5	2.9	3.0	3.2
1995	336	371	339	354	2.8	3.1	2.9	3.0
1996	428	375	388	361	3.6	3.2	3.3	3.1
1997	376	400	375	361	3.2	3.4	3.2	3.1
1998	336	354	375	373	2.8	3.0	3.2	3.2
1999	457	384	381	379	3.9	3.2	3.2	3.2

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan



R_S510a_matrix.xls -- Fig 5a

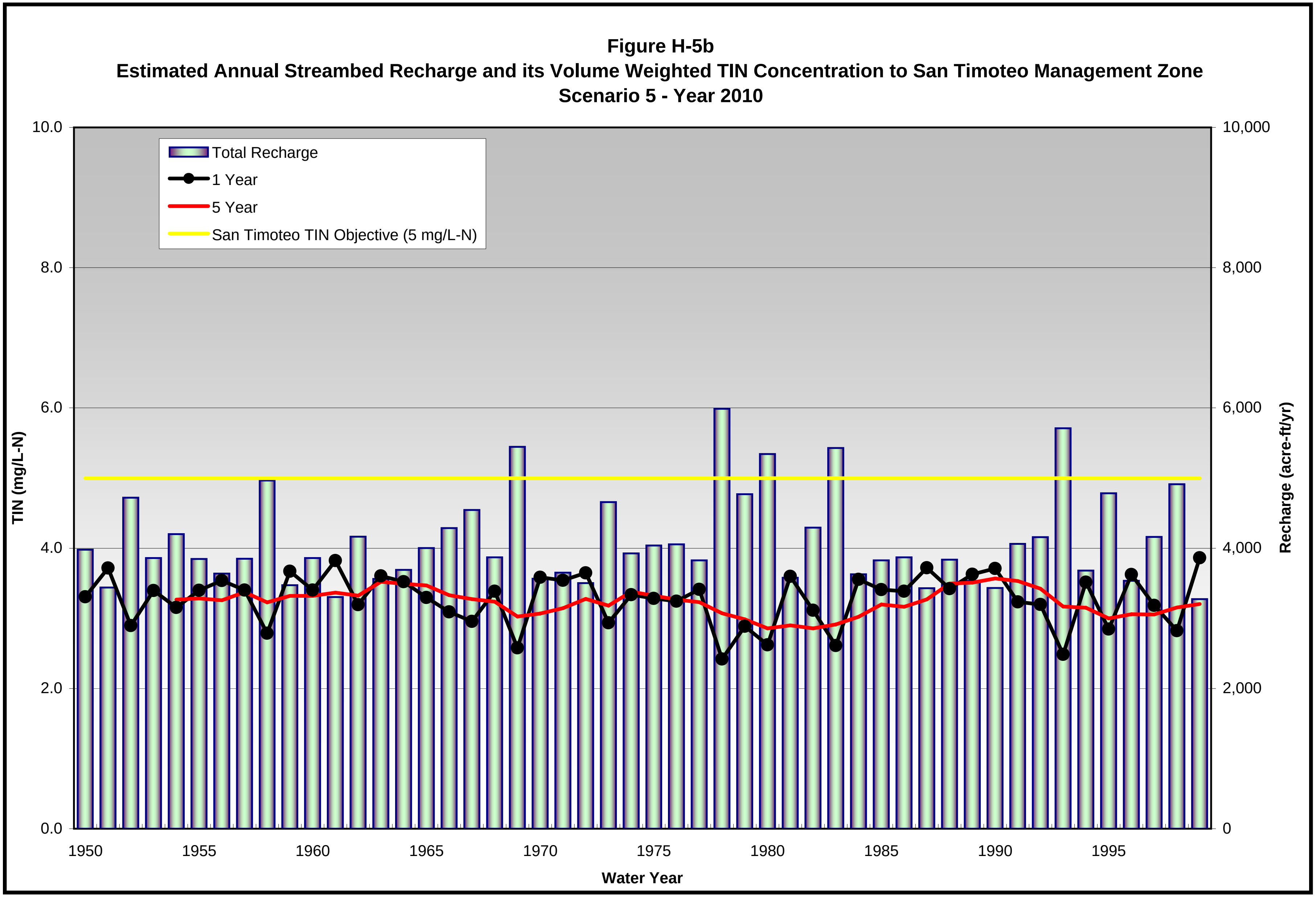
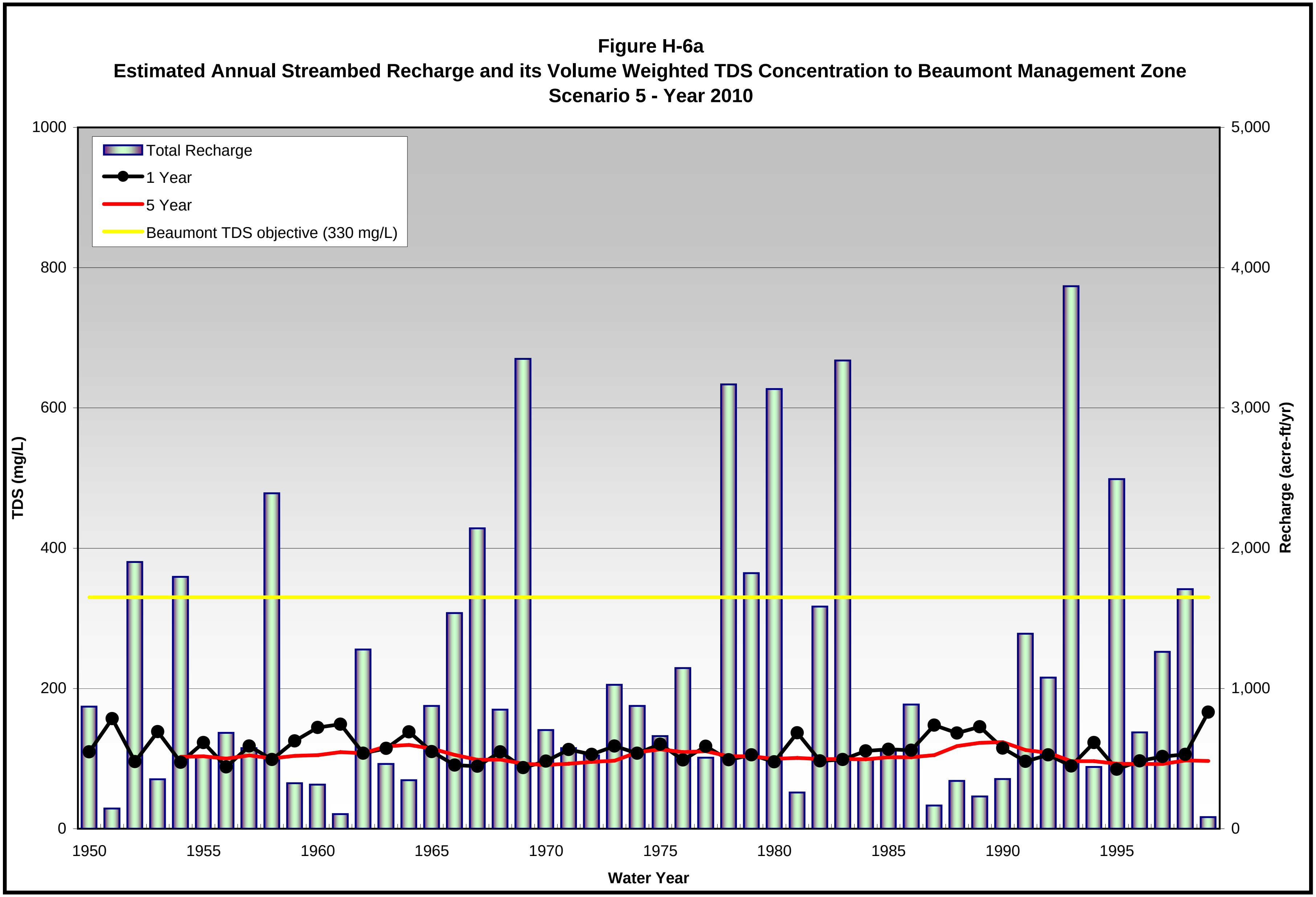


Figure H-5b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to San Timoteo Management Zone
Scenario 5 - Year 2010
Total Recharge
1 Year
5 Year
San Timoteo TIN Objective (5 mg/L-N)
TIN (mg/L-N)
Recharge (acre-ft/yr)
Water Year
10.0
8.0
6.0
4.0
2.0
0.0
10,000
8,000
6,000
4,000
2,000
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

Table H-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 5 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8



R_S510a_matrix.xls -- Fig 6a

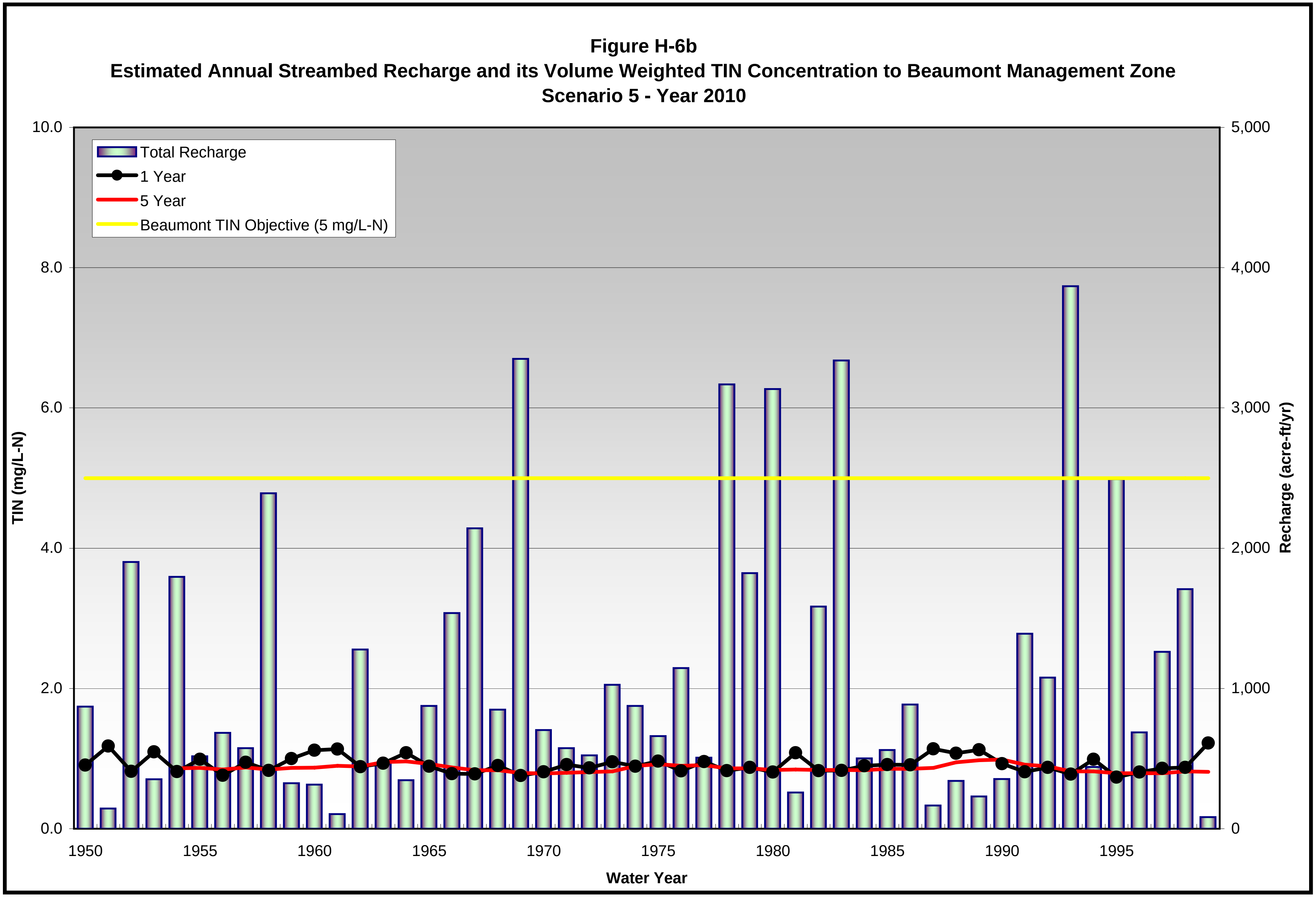


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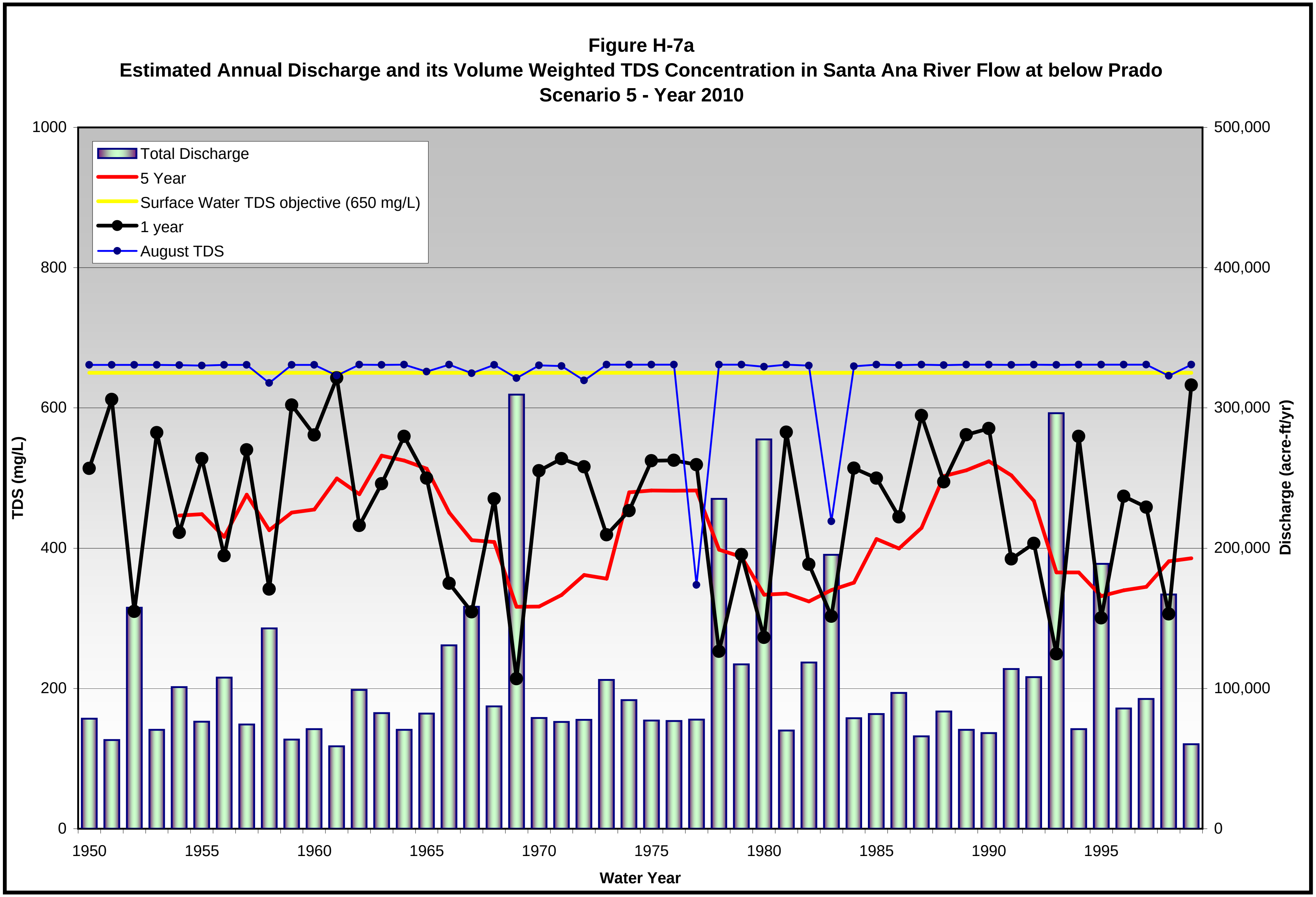
Table H-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 5 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	514				661	6.5				8.5
1951	612	558			661	7.7	7.0			8.5
1952	310	396	427		662	3.9	5.0	5.4		8.5
1953	565	388	437		661	7.1	4.9	5.5		8.5
1954	422	481	399	447	661	5.3	6.0	5.0	5.6	8.5
1955	528	468	495	449	660	6.6	5.9	6.2	5.6	8.5
1956	389	447	438	416	661	5.0	5.7	5.5	5.2	8.5
1957	540	451	474	476	661	6.8	5.7	6.0	6.0	8.5
1958	342	410	403	426	636	4.2	5.1	5.0	5.3	8.2
1959	604	423	454	451	661	7.7	5.3	5.7	5.7	8.5
1960	561	582	458	455	661	7.1	7.3	5.7	5.7	8.5
1961	643	598	600	499	646	8.2	7.6	7.6	6.3	8.3
1962	432	511	526	477	662	5.4	6.4	6.6	6.0	8.5
1963	492	459	504	532	661	6.2	5.8	6.4	6.7	8.5
1964	559	523	487	525	662	7.1	6.6	6.1	6.6	8.5
1965	500	527	515	513	652	6.3	6.6	6.5	6.5	8.4
1966	350	408	446	451	662	4.3	5.1	5.6	5.7	8.5
1967	309	328	366	412	649	3.8	4.0	4.5	5.1	8.3
1968	470	366	361	409	661	6.0	4.6	4.5	5.1	8.5
1969	214	270	281	316	642	2.5	3.3	3.4	3.9	8.2
1970	511	274	310	317	661	6.4	3.3	3.8	3.9	8.5
1971	528	519	316	333	660	6.6	6.5	3.9	4.1	8.5
1972	516	522	518	362	639	6.5	6.6	6.5	4.5	8.2
1973	419	460	480	357	662	5.2	5.8	6.0	4.4	8.5
1974	453	435	458	480	662	5.7	5.4	5.7	6.0	8.5
1975	525	486	460	482	662	6.6	6.1	5.8	6.1	8.5
1976	525	525	498	482	662	6.6	6.6	6.3	6.0	8.5
1977	519	522	523	482	348	6.5	6.6	6.6	6.1	4.3
1978	253	319	360	398	662	3.0	3.9	4.4	4.9	8.5
1979	391	299	339	388	662	4.8	3.6	4.2	4.8	8.5
1980	273	308	287	334	659	2.7	3.3	3.2	3.9	8.5
1981	565	332	346	335	662	7.1	3.6	3.9	3.9	8.5
1982	377	447	343	324	660	4.7	5.6	3.9	3.8	8.5
1983	303	331	374	340	438	3.4	3.9	4.5	3.9	5.5
1984	514	364	368	351	659	6.5	4.3	4.4	4.0	8.5
1985	500	507	395	413	662	6.3	6.4	4.7	5.0	8.5
1986	445	470	483	400	661	5.6	5.9	6.1	4.9	8.5
1987	589	503	502	429	662	7.5	6.3	6.3	5.2	8.5
1988	495	536	500	503	661	6.2	6.8	6.3	6.3	8.5
1989	562	525	544	511	662	7.1	6.6	6.9	6.4	8.5
1990	571	566	539	524	662	7.2	7.2	6.8	6.6	8.5
1991	385	454	484	504	661	4.8	5.7	6.1	6.3	8.5
1992	407	395	437	467	662	5.1	4.9	5.5	5.9	8.5
1993	249	291	312	366	661	2.6	3.3	3.6	4.4	8.5
1994	559	309	331	365	662	7.0	3.5	3.8	4.4	8.5
1995	301	371	306	332	662	3.4	4.4	3.5	3.9	8.5
1996	474	355	397	340	662	6.0	4.2	4.8	4.0	8.5
1997	458	466	381	345	662	5.7	5.9	4.6	4.0	8.5
1998	306	360	389	381	646	3.8	4.5	4.8	4.7	8.3
1999	633	393	412	385	662	8.0	4.9	5.1	4.7	8.5



R_S510a_matrix.xls -- Fig 7a

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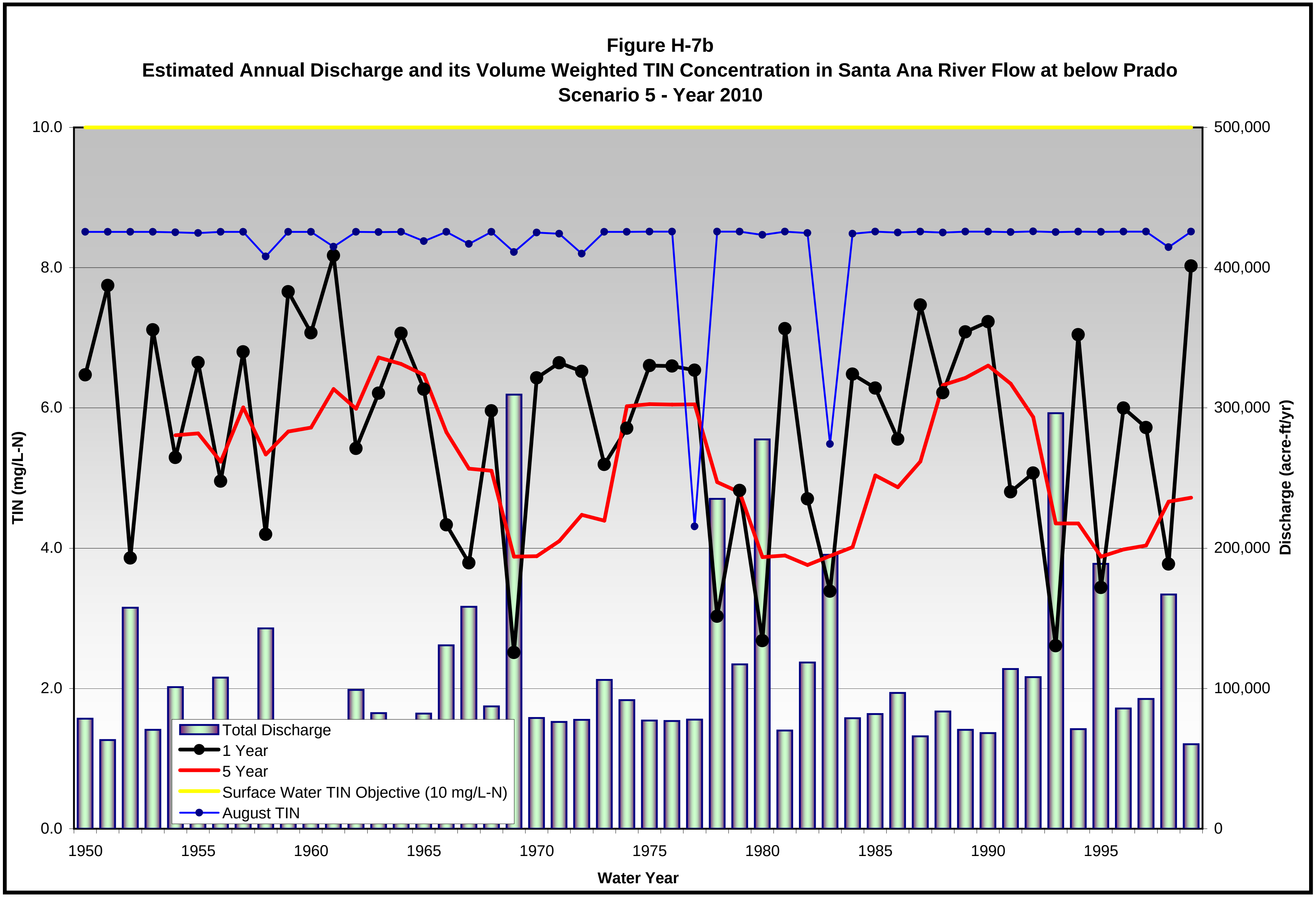

R_S510a_matrix.xls -- Fig 7b

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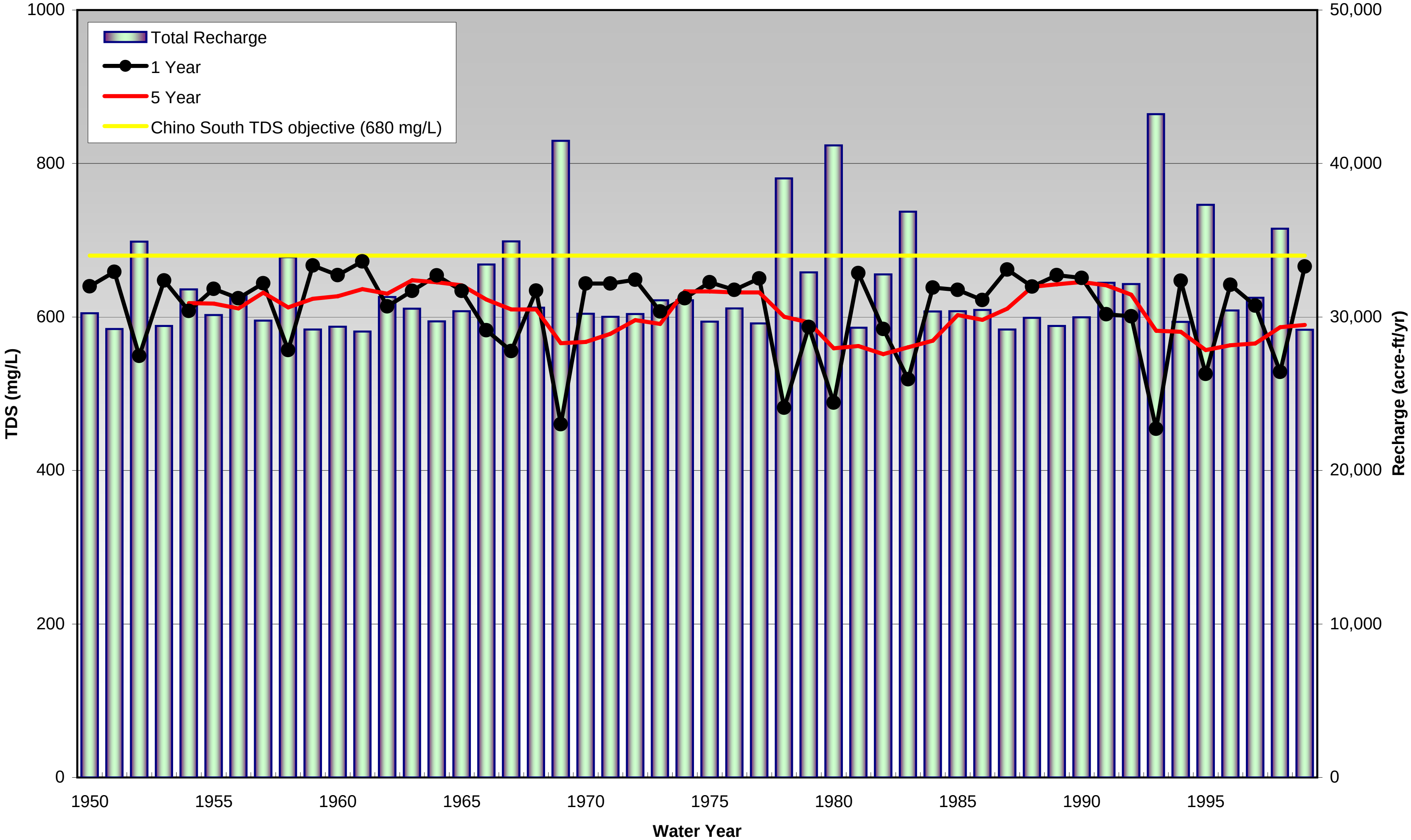
Appendix I

Scenario 5, Year 2020 Simulation Results (Summary Matrices and Graphs)

Table I-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	640				4.7			
1951	659	649			4.8	4.8		
1952	549	599	612		4.0	4.4	4.5	
1953	648	594	614		4.8	4.3	4.5	
1954	608	627	599	618	4.5	4.6	4.4	4.5
1955	637	622	630	617	4.7	4.6	4.6	4.5
1956	625	630	623	611	4.6	4.6	4.6	4.5
1957	644	634	635	632	4.7	4.7	4.7	4.6
1958	557	598	606	613	4.0	4.4	4.4	4.5
1959	667	608	619	624	4.9	4.4	4.5	4.6
1960	655	661	623	627	4.8	4.9	4.6	4.6
1961	672	663	665	636	4.9	4.9	4.9	4.7
1962	614	642	646	630	4.5	4.7	4.7	4.6
1963	634	624	639	648	4.6	4.6	4.7	4.8
1964	654	644	634	645	4.8	4.7	4.6	4.7
1965	634	644	641	641	4.6	4.7	4.7	4.7
1966	583	607	622	623	4.2	4.4	4.6	4.6
1967	556	569	589	610	4.0	4.1	4.3	4.5
1968	634	592	589	610	4.7	4.3	4.3	4.5
1969	460	534	541	566	3.2	3.8	3.9	4.1
1970	644	538	567	567	4.7	3.9	4.1	4.1
1971	644	644	569	578	4.7	4.7	4.1	4.2
1972	649	646	645	596	4.8	4.7	4.7	4.3
1973	607	628	633	591	4.4	4.6	4.6	4.3
1974	624	616	627	633	4.6	4.5	4.6	4.6
1975	645	635	625	634	4.7	4.7	4.6	4.6
1976	635	640	635	632	4.7	4.7	4.7	4.6
1977	650	643	643	632	4.8	4.7	4.7	4.6
1978	482	554	579	600	3.4	4.0	4.2	4.4
1979	587	530	565	593	4.2	3.8	4.1	4.3
1980	489	532	515	559	3.3	3.7	3.6	4.0
1981	657	559	568	562	4.8	4.0	4.0	4.0
1982	584	619	567	552	4.3	4.5	4.1	4.0
1983	519	550	581	560	3.6	3.9	4.2	4.0
1984	638	573	577	569	4.7	4.1	4.2	4.1
1985	635	637	592	603	4.7	4.7	4.3	4.4
1986	622	629	632	596	4.6	4.6	4.6	4.3
1987	662	642	640	611	4.9	4.7	4.7	4.4
1988	640	651	641	639	4.7	4.8	4.7	4.7
1989	654	647	652	642	4.8	4.7	4.8	4.7
1990	651	653	648	646	4.8	4.8	4.8	4.7
1991	603	626	635	641	4.4	4.6	4.7	4.7
1992	601	602	618	629	4.4	4.4	4.5	4.6
1993	454	517	543	582	3.1	3.7	3.9	4.2
1994	647	533	554	581	4.8	3.8	4.0	4.2
1995	526	580	531	557	3.7	4.2	3.7	4.0
1996	642	578	599	563	4.7	4.1	4.3	4.0
1997	615	628	590	566	4.5	4.6	4.3	4.1
1998	529	569	592	587	3.8	4.1	4.3	4.3
1999	666	590	598	590	4.9	4.3	4.4	4.3

Figure I-1a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 3 Over the Chino South Management Zone
Scenario 5 - Year 2020



R_S520a_matrix.xls -- Fig 1a

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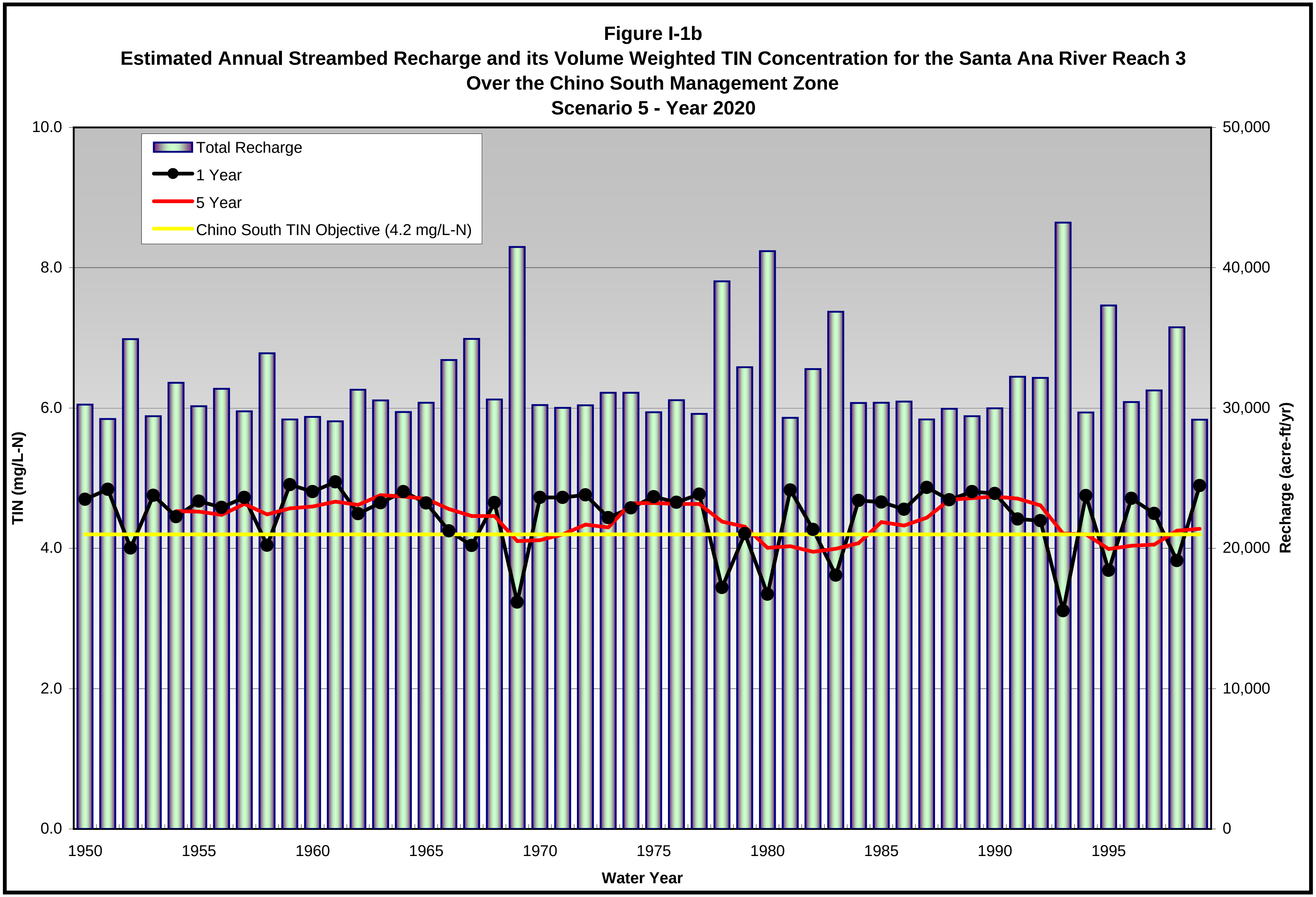

R_S520a_matrix.xls -- Fig 1b

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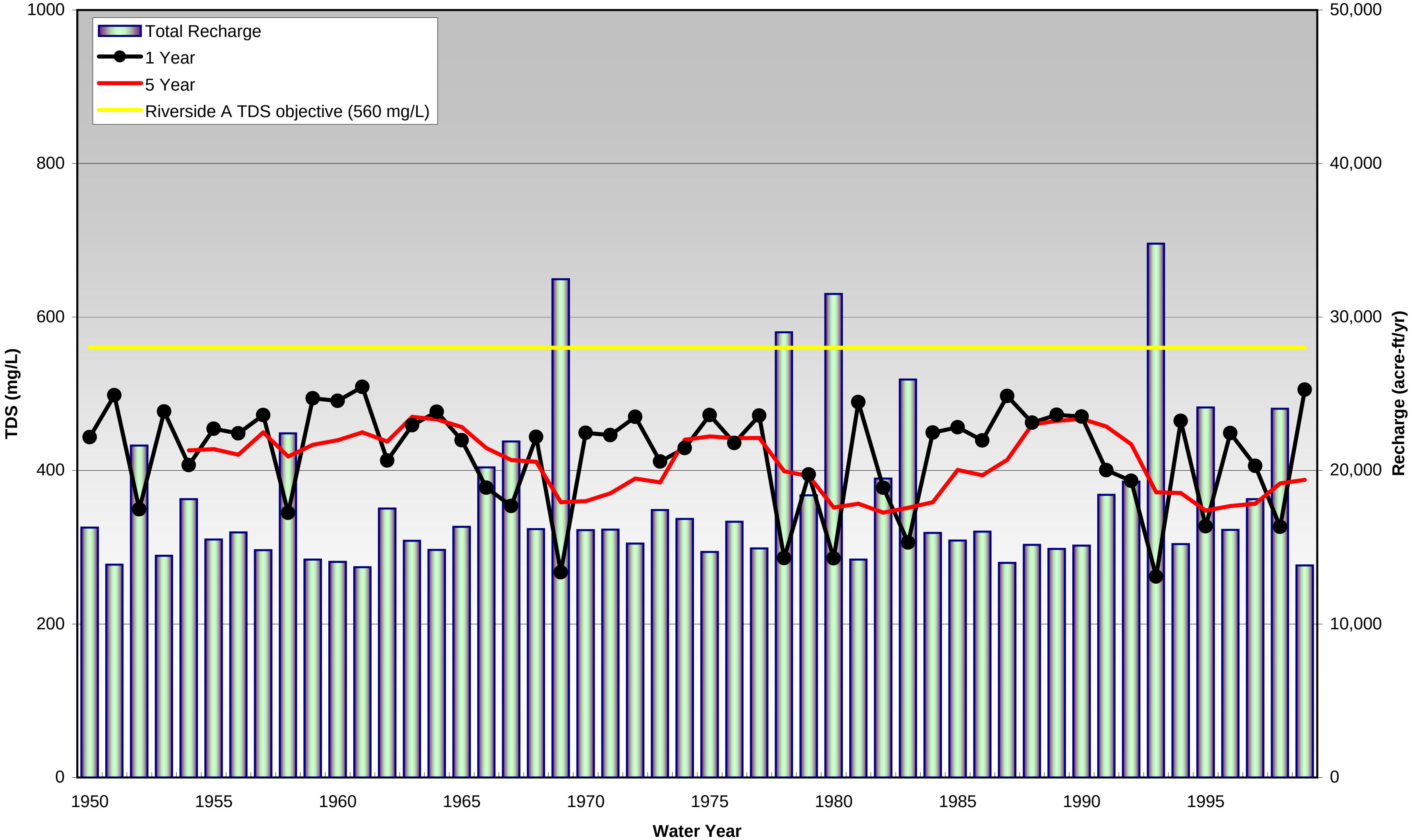
Table I-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	498	469			7.0	6.5		
1952	350	408	419		4.7	5.6	5.7	
1953	477	400	428		6.6	5.4	5.9	
1954	407	438	403	426	5.5	6.0	5.5	5.8
1955	454	429	443	428	6.3	5.9	6.1	5.9
1956	448	451	435	421	6.2	6.3	6.0	5.8
1957	472	460	458	450	6.5	6.4	6.4	6.2
1958	345	396	411	418	4.5	5.3	5.6	5.7
1959	494	403	423	434	6.9	5.4	5.8	5.9
1960	491	492	427	440	6.8	6.9	5.8	6.0
1961	509	500	498	450	7.2	7.0	7.0	6.2
1962	413	455	466	438	5.6	6.3	6.5	6.0
1963	459	434	456	470	6.4	6.0	6.3	6.5
1964	477	468	448	467	6.6	6.5	6.2	6.5
1965	439	457	458	457	6.0	6.3	6.3	6.3
1966	377	405	426	429	5.1	5.5	5.8	5.9
1967	354	365	386	414	4.7	4.9	5.2	5.6
1968	444	392	387	411	6.1	5.3	5.2	5.6
1969	267	326	335	359	3.2	4.1	4.3	4.7
1970	449	328	357	360	6.2	4.2	4.7	4.7
1971	446	448	357	370	6.1	6.2	4.7	4.9
1972	470	458	455	390	6.5	6.3	6.3	5.2
1973	412	439	441	385	5.6	6.0	6.1	5.1
1974	429	420	435	440	5.9	5.7	6.0	6.1
1975	472	449	436	444	6.6	6.2	6.0	6.1
1976	436	453	445	442	6.0	6.3	6.1	6.1
1977	472	453	459	442	6.6	6.3	6.4	6.1
1978	286	349	373	399	3.5	4.5	4.9	5.4
1979	395	328	363	393	5.3	4.2	4.8	5.3
1980	286	326	311	352	3.5	4.1	3.9	4.6
1981	489	349	362	357	6.8	4.5	4.7	4.7
1982	378	425	357	345	5.1	5.8	4.7	4.5
1983	306	337	373	352	3.9	4.4	5.0	4.6
1984	449	361	366	359	6.2	4.8	4.9	4.7
1985	456	453	386	401	6.3	6.3	5.2	5.4
1986	439	448	448	394	6.0	6.2	6.2	5.3
1987	497	466	463	414	6.9	6.5	6.4	5.6
1988	462	479	465	460	6.4	6.7	6.4	6.4
1989	473	467	477	465	6.6	6.5	6.6	6.4
1990	470	471	468	467	6.5	6.5	6.5	6.5
1991	400	432	444	457	5.4	5.9	6.1	6.3
1992	387	393	415	434	5.2	5.3	5.7	6.0
1993	262	306	330	371	3.1	3.8	4.2	4.9
1994	464	323	341	371	6.4	4.1	4.4	4.9
1995	327	380	325	348	4.2	5.1	4.1	4.5
1996	449	376	400	354	6.2	5.0	5.4	4.6
1997	406	426	385	357	5.5	5.8	5.1	4.7
1998	327	361	385	383	4.2	4.7	5.1	5.1
1999	505	392	396	388	7.1	5.2	5.3	5.2

Figure I-2a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 5 - Year 2020



R_S520a_matrix.xls -- Fig 2a

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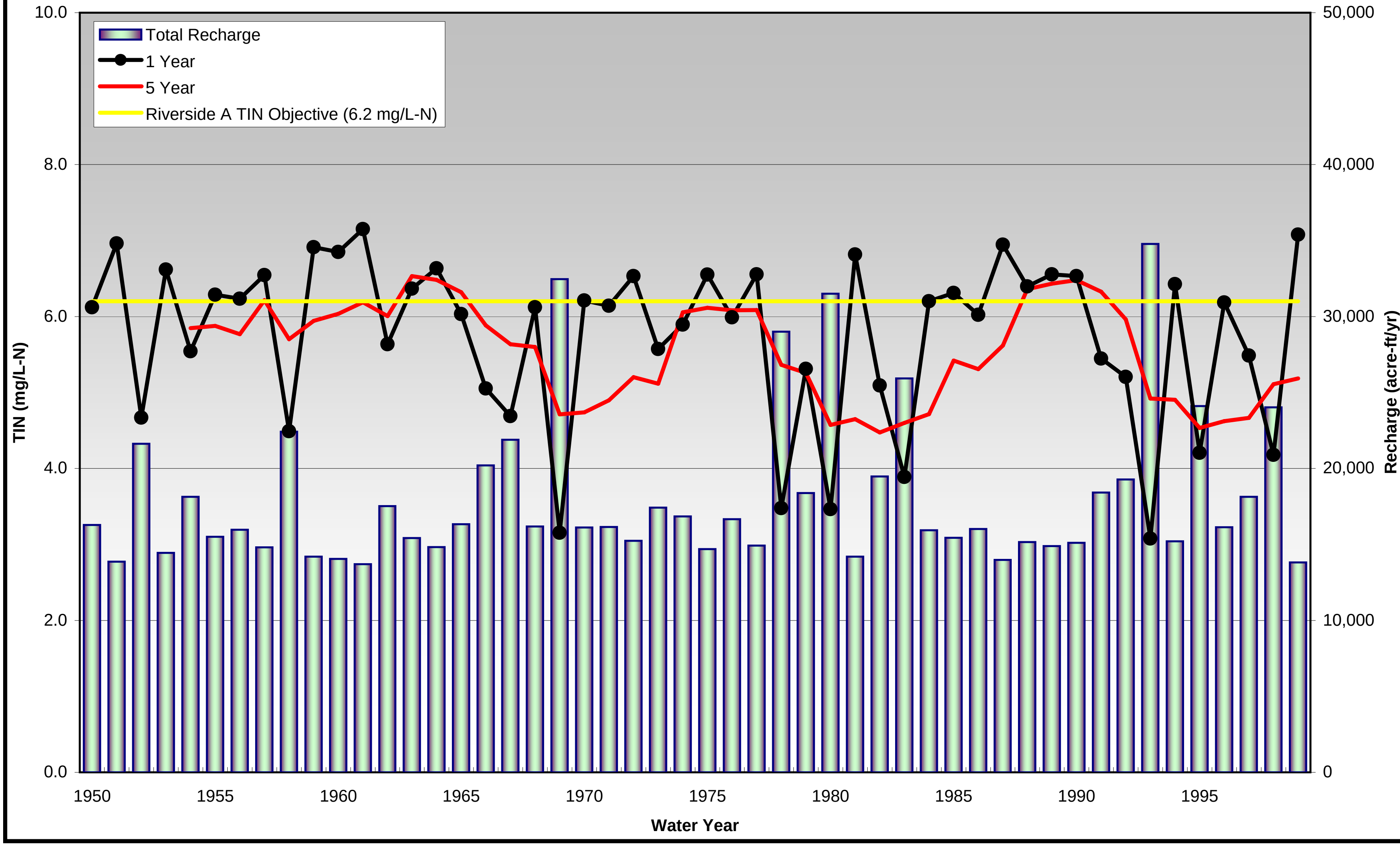
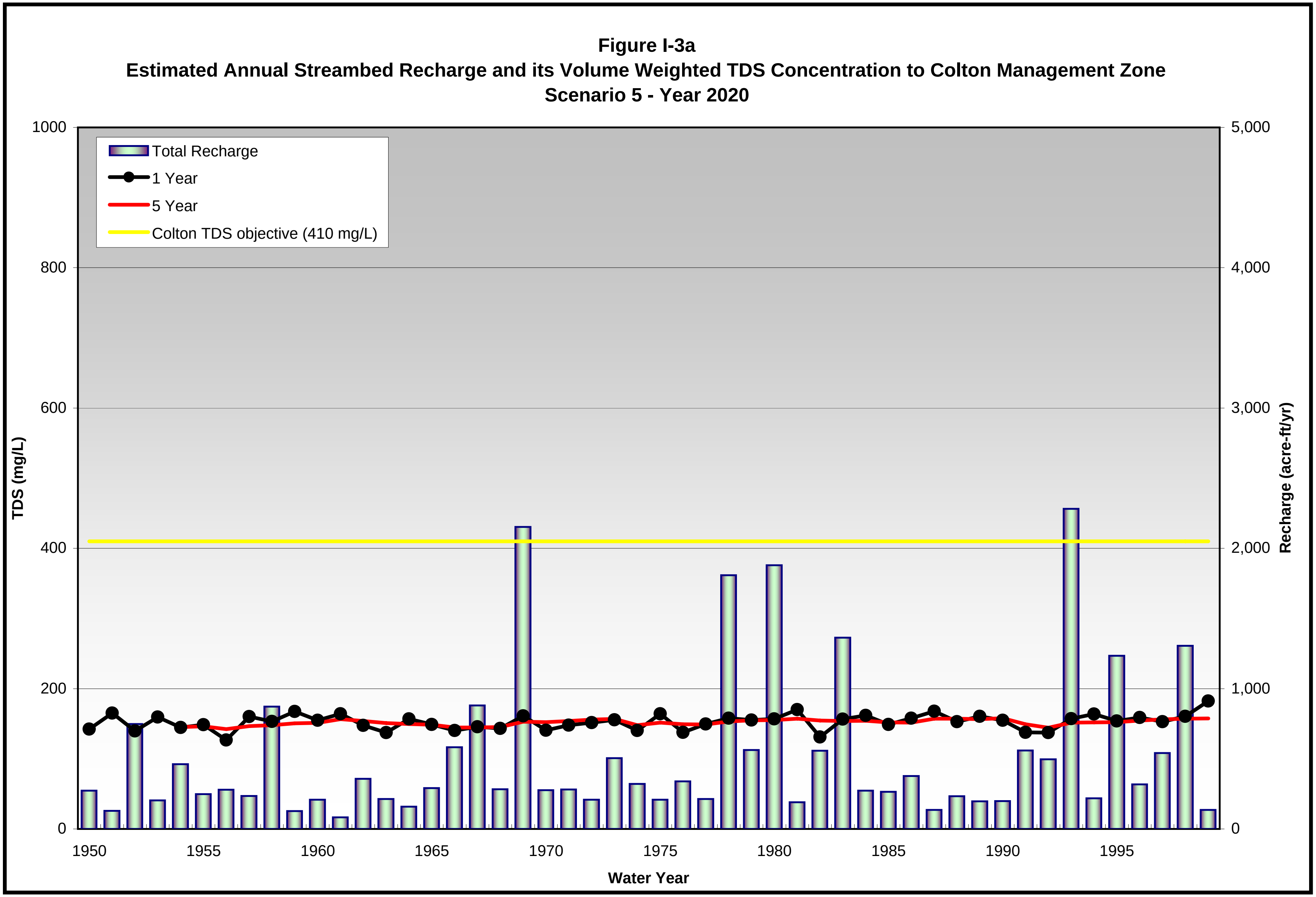
Figure I-2b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 5 - Year 2020



R_S520a_matrix.xls -- Fig 2b

Table I-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	142				1.1			
1951	165	150			1.3	1.2		
1952	140	143	143		1.1	1.1	1.1	
1953	160	144	146		1.2	1.1	1.2	
1954	144	149	144	145	1.1	1.2	1.1	1.2
1955	149	146	149	146	1.2	1.2	1.2	1.2
1956	127	137	141	142	1.0	1.1	1.1	1.1
1957	160	142	144	146	1.2	1.1	1.1	1.2
1958	153	155	149	148	1.2	1.2	1.2	1.2
1959	168	155	156	150	1.3	1.2	1.2	1.2
1960	155	160	155	151	1.2	1.2	1.2	1.2
1961	164	158	161	156	1.3	1.2	1.2	1.2
1962	147	151	152	154	1.2	1.2	1.2	1.2
1963	137	144	146	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	149	152	147	148	1.2	1.2	1.2	1.2
1966	140	143	145	145	1.1	1.1	1.1	1.1
1967	146	143	144	145	1.1	1.1	1.1	1.1
1968	143	145	143	145	1.1	1.1	1.1	1.1
1969	161	159	155	153	1.2	1.2	1.2	1.2
1970	141	159	157	152	1.1	1.2	1.2	1.2
1971	148	144	158	154	1.2	1.2	1.2	1.2
1972	152	150	146	156	1.2	1.2	1.2	1.2
1973	156	154	153	157	1.2	1.2	1.2	1.2
1974	140	150	150	148	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	145	149	1.1	1.1	1.1	1.2
1977	150	142	148	149	1.2	1.1	1.2	1.2
1978	158	157	154	153	1.2	1.2	1.2	1.2
1979	155	157	157	155	1.2	1.2	1.2	1.2
1980	157	156	157	155	1.2	1.2	1.2	1.2
1981	170	158	157	157	1.3	1.2	1.2	1.2
1982	131	141	152	155	1.1	1.1	1.2	1.2
1983	156	149	151	154	1.2	1.2	1.2	1.2
1984	162	157	151	154	1.2	1.2	1.2	1.2
1985	149	155	156	152	1.1	1.2	1.2	1.2
1986	158	154	156	151	1.2	1.2	1.2	1.2
1987	168	161	157	157	1.3	1.2	1.2	1.2
1988	153	158	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	142	146	149	1.1	1.1	1.2	1.2
1992	137	137	140	144	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	154	152	1.2	1.2	1.2	1.2
1995	154	155	156	152	1.2	1.2	1.2	1.2
1996	159	155	156	154	1.2	1.2	1.2	1.2
1997	153	155	154	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	162	160	158	1.4	1.2	1.2	1.2



R_S520a_matrix.xls -- Fig 3a

WILDERMUTH™ ENVIRONMENTAL INC.

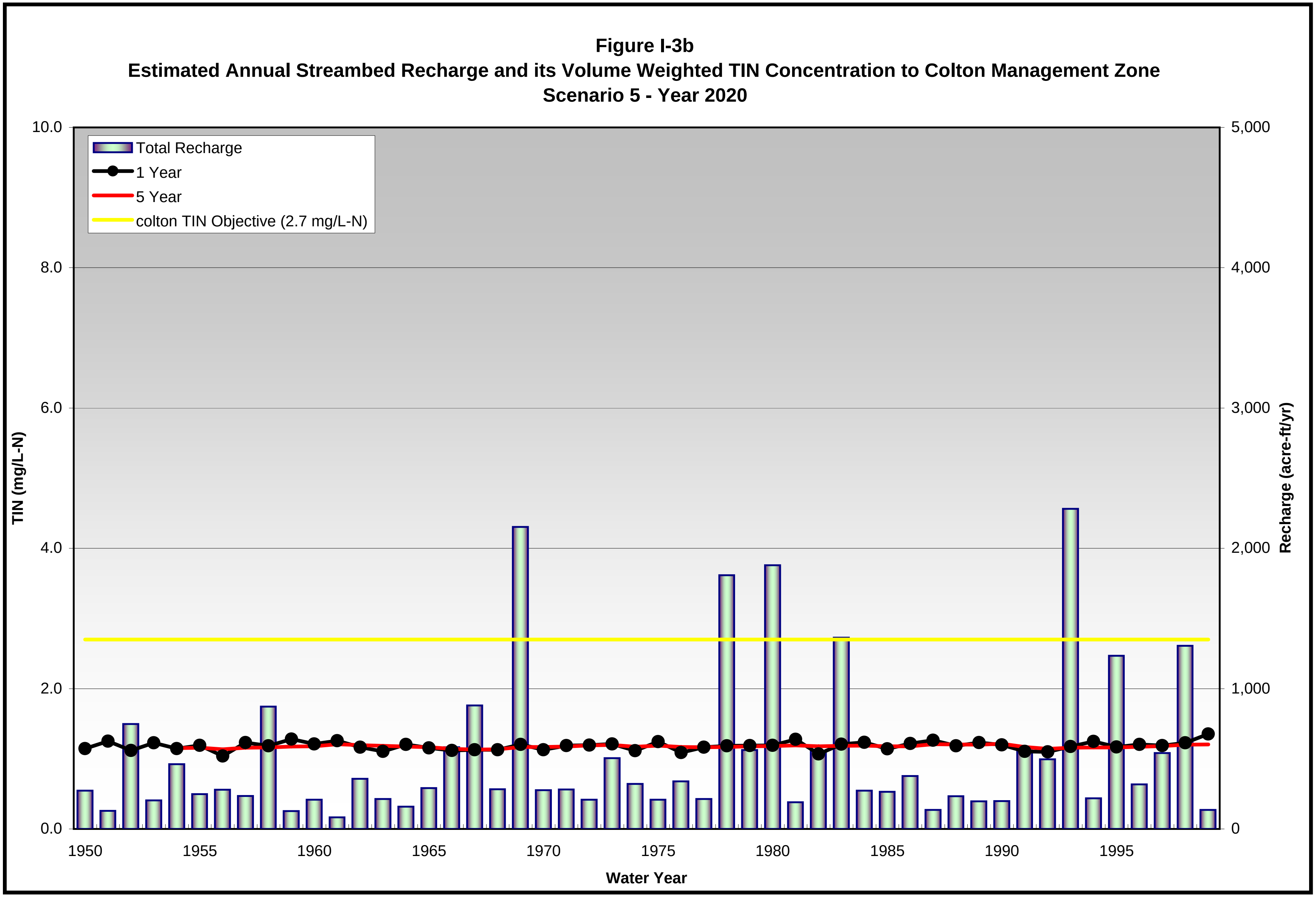
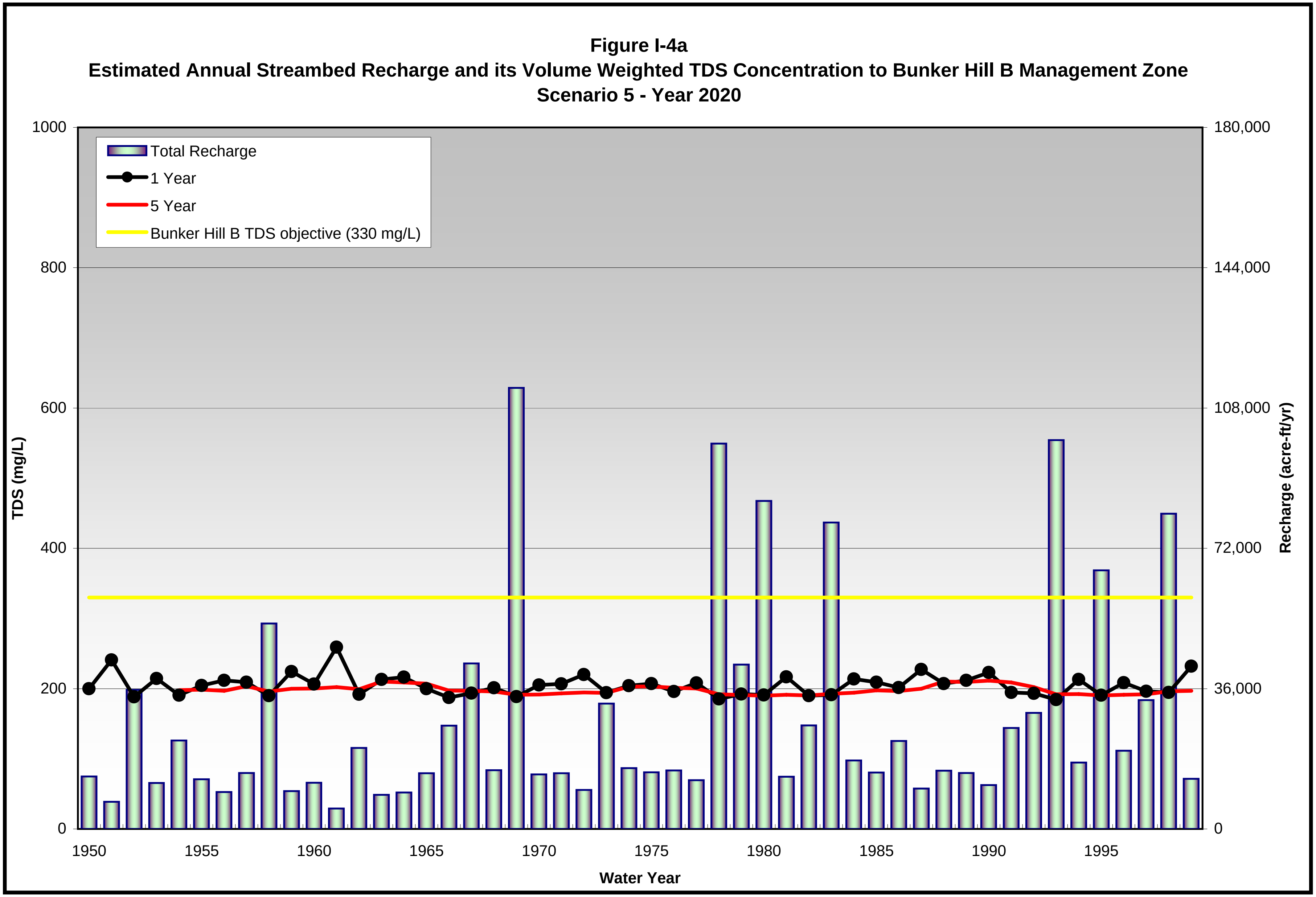


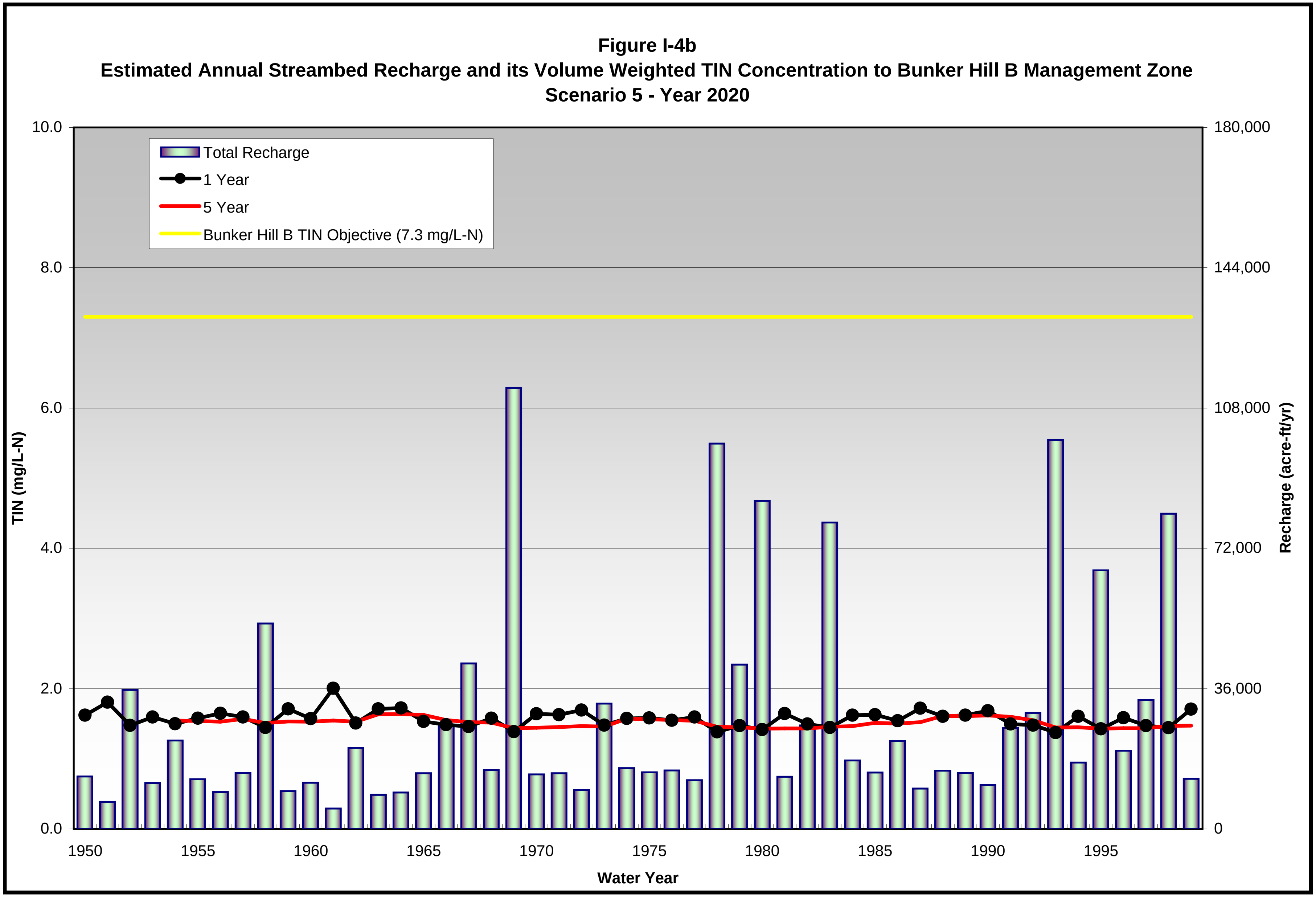
Figure I-3b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Colton Management Zone
Scenario 5 - Year 2020
Total Recharge
1 Year
5 Year
colton TIN Objective (2.7 mg/L-N)
TIN (mg/L-N)
Recharge (acre-ft/yr)
Water Year
10.0
8.0
6.0
4.0
2.0
0.0
5,000
4,000
3,000
2,000
1,000
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

Table I-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	200				1.6			
1951	241	214			1.8	1.7		
1952	188	197	197		1.5	1.5	1.6	
1953	214	195	201		1.6	1.5	1.5	
1954	191	199	193	198	1.5	1.5	1.5	1.5
1955	204	196	200	199	1.6	1.5	1.5	1.5
1956	212	208	199	197	1.6	1.6	1.6	1.5
1957	209	210	208	204	1.6	1.6	1.6	1.6
1958	190	194	196	196	1.4	1.5	1.5	1.5
1959	224	195	198	200	1.7	1.5	1.5	1.5
1960	207	215	197	200	1.6	1.6	1.5	1.5
1961	259	223	223	202	2.0	1.7	1.7	1.5
1962	192	206	206	199	1.5	1.6	1.6	1.5
1963	213	198	207	210	1.7	1.6	1.6	1.6
1964	217	215	203	209	1.7	1.7	1.6	1.6
1965	200	207	208	207	1.5	1.6	1.6	1.6
1966	187	192	196	197	1.5	1.5	1.5	1.6
1967	194	191	193	197	1.5	1.5	1.5	1.5
1968	201	196	193	196	1.6	1.5	1.5	1.5
1969	189	190	191	191	1.4	1.4	1.4	1.4
1970	205	190	192	192	1.6	1.4	1.4	1.4
1971	207	206	192	193	1.6	1.6	1.4	1.5
1972	220	212	210	195	1.7	1.7	1.6	1.5
1973	194	200	202	194	1.5	1.5	1.6	1.5
1974	204	197	201	203	1.6	1.5	1.5	1.6
1975	207	206	200	203	1.6	1.6	1.5	1.6
1976	196	201	202	201	1.6	1.6	1.6	1.6
1977	208	201	203	200	1.6	1.6	1.6	1.5
1978	185	188	189	192	1.4	1.4	1.4	1.5
1979	192	187	189	191	1.5	1.4	1.4	1.4
1980	191	191	189	190	1.4	1.4	1.4	1.4
1981	217	195	194	191	1.6	1.4	1.5	1.4
1982	190	199	194	190	1.5	1.5	1.5	1.4
1983	191	191	194	193	1.4	1.5	1.5	1.5
1984	214	195	194	194	1.6	1.5	1.5	1.5
1985	209	212	197	198	1.6	1.6	1.5	1.5
1986	201	204	207	197	1.5	1.6	1.6	1.5
1987	227	210	209	200	1.7	1.6	1.6	1.5
1988	207	215	209	210	1.6	1.7	1.6	1.6
1989	212	209	214	209	1.6	1.6	1.6	1.6
1990	223	217	213	212	1.7	1.6	1.6	1.6
1991	195	203	206	209	1.5	1.6	1.6	1.6
1992	193	194	199	202	1.5	1.5	1.5	1.5
1993	184	186	188	192	1.4	1.4	1.4	1.4
1994	213	189	190	192	1.6	1.4	1.4	1.4
1995	190	195	189	190	1.4	1.5	1.4	1.4
1996	208	195	198	191	1.6	1.5	1.5	1.4
1997	196	201	195	192	1.5	1.5	1.5	1.4
1998	194	195	197	196	1.4	1.5	1.5	1.5
1999	232	200	199	197	1.7	1.5	1.5	1.5



R_S520a_matrix.xls -- Fig 4a



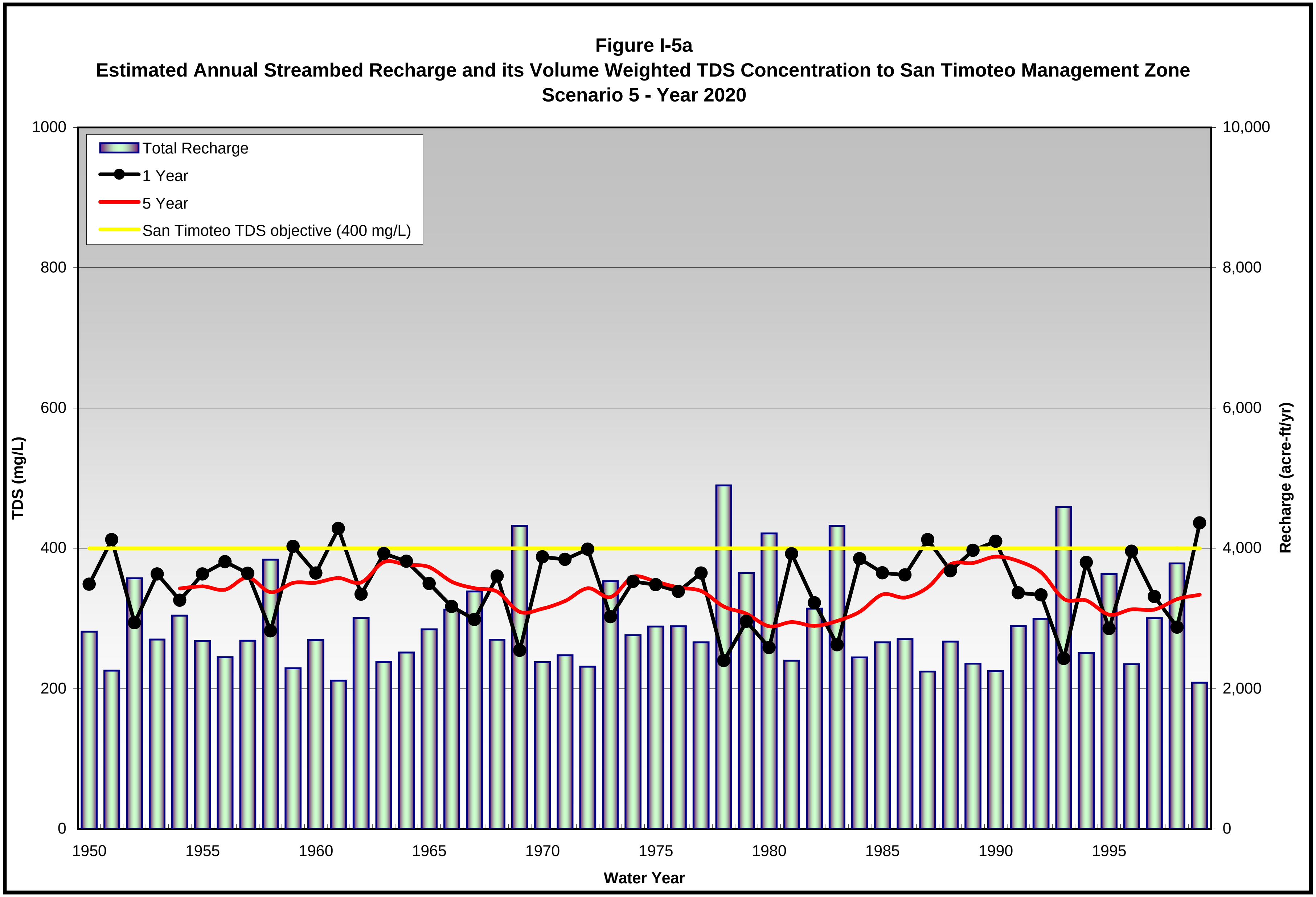
R_S520a_matrix.xls -- Fig 4b

WILDERMUTH™ ENVIRONMENTAL INC.

Table I-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	349				2.9			
1951	412	377			3.5	3.2		
1952	294	340	343		2.5	2.9	2.9	
1953	363	324	347		3.0	2.7	2.9	
1954	326	344	324	343	2.8	2.9	2.7	2.9
1955	363	343	350	346	3.0	2.9	2.9	2.9
1956	381	372	355	341	3.2	3.1	3.0	2.9
1957	364	372	369	358	3.1	3.1	3.1	3.0
1958	282	316	334	338	2.4	2.6	2.8	2.8
1959	403	327	339	351	3.4	2.8	2.8	2.9
1960	365	382	339	351	3.1	3.2	2.8	2.9
1961	428	393	396	358	3.6	3.3	3.3	3.0
1962	335	373	370	351	2.8	3.1	3.1	3.0
1963	392	360	379	380	3.3	3.0	3.2	3.2
1964	382	387	367	377	3.2	3.3	3.1	3.2
1965	350	365	373	373	2.9	3.1	3.1	3.1
1966	317	333	347	352	2.7	2.8	2.9	3.0
1967	298	307	320	343	2.5	2.6	2.7	2.9
1968	360	326	323	338	3.0	2.8	2.7	2.8
1969	255	295	296	310	2.2	2.5	2.5	2.6
1970	388	302	319	314	3.3	2.6	2.7	2.7
1971	384	386	324	325	3.2	3.3	2.7	2.7
1972	399	391	390	343	3.4	3.3	3.3	2.9
1973	302	341	354	331	2.5	2.9	3.0	2.8
1974	353	324	344	359	3.0	2.7	2.9	3.0
1975	348	350	332	352	2.9	2.9	2.8	3.0
1976	338	343	346	344	2.9	2.9	2.9	2.9
1977	365	351	350	339	3.1	3.0	2.9	2.8
1978	240	284	299	317	2.0	2.4	2.5	2.7
1979	296	264	288	307	2.5	2.2	2.4	2.6
1980	259	276	262	289	2.2	2.3	2.2	2.4
1981	392	307	303	295	3.3	2.6	2.5	2.5
1982	322	353	312	289	2.7	3.0	2.6	2.4
1983	262	288	313	297	2.2	2.4	2.6	2.5
1984	385	307	312	310	3.2	2.6	2.6	2.6
1985	365	375	323	334	3.1	3.1	2.7	2.8
1986	362	363	370	330	3.0	3.0	3.1	2.8
1987	412	385	378	344	3.5	3.2	3.2	2.9
1988	368	388	379	377	3.1	3.3	3.2	3.2
1989	397	382	391	379	3.3	3.2	3.3	3.2
1990	410	403	390	388	3.5	3.4	3.3	3.3
1991	337	369	378	382	2.8	3.1	3.2	3.2
1992	334	335	356	366	2.8	2.8	3.0	3.1
1993	243	279	295	328	2.1	2.4	2.5	2.8
1994	380	291	304	326	3.2	2.5	2.6	2.7
1995	286	324	289	306	2.4	2.7	2.4	2.6
1996	396	329	344	313	3.3	2.8	2.9	2.6
1997	331	360	330	313	2.8	3.0	2.8	2.6
1998	288	307	330	328	2.4	2.6	2.8	2.8
1999	436	340	337	334	3.7	2.9	2.8	2.8

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1!



R_S520a_matrix.xls -- Fig 5a

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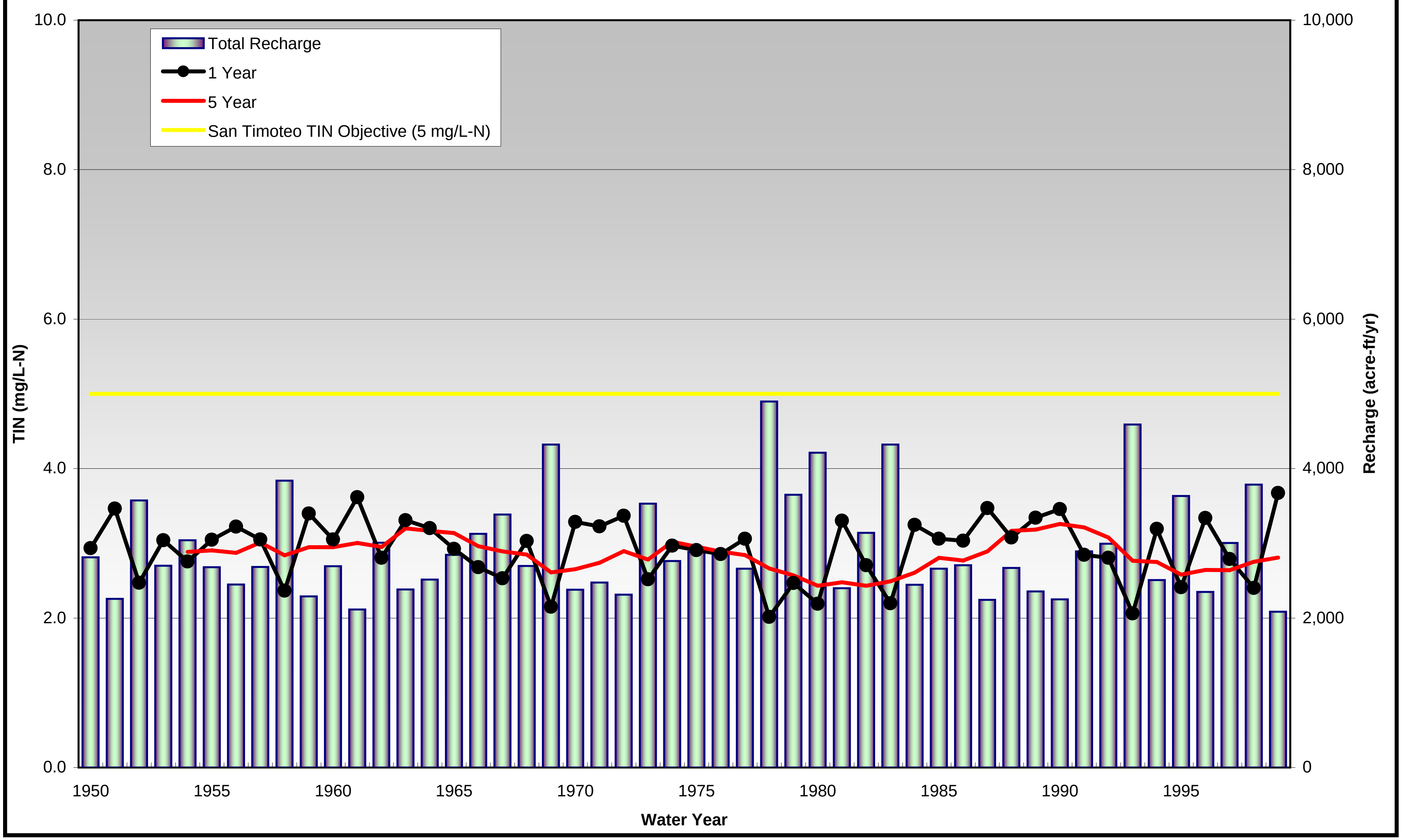
Figure I-5b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to San Timoteo Management Zone
Scenario 5 - Year 2020

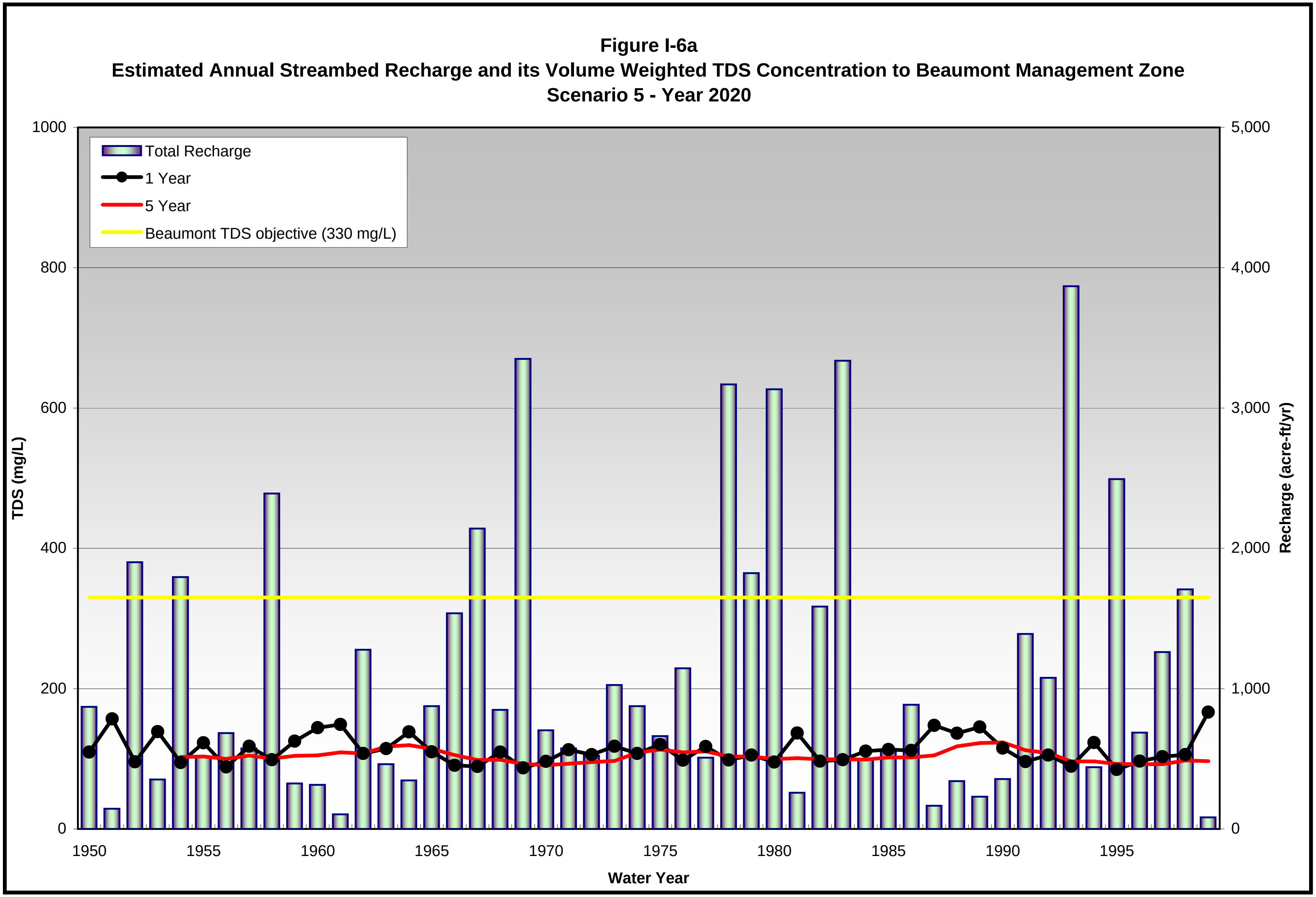


R_S520a_matrix.xls -- Fig 5b

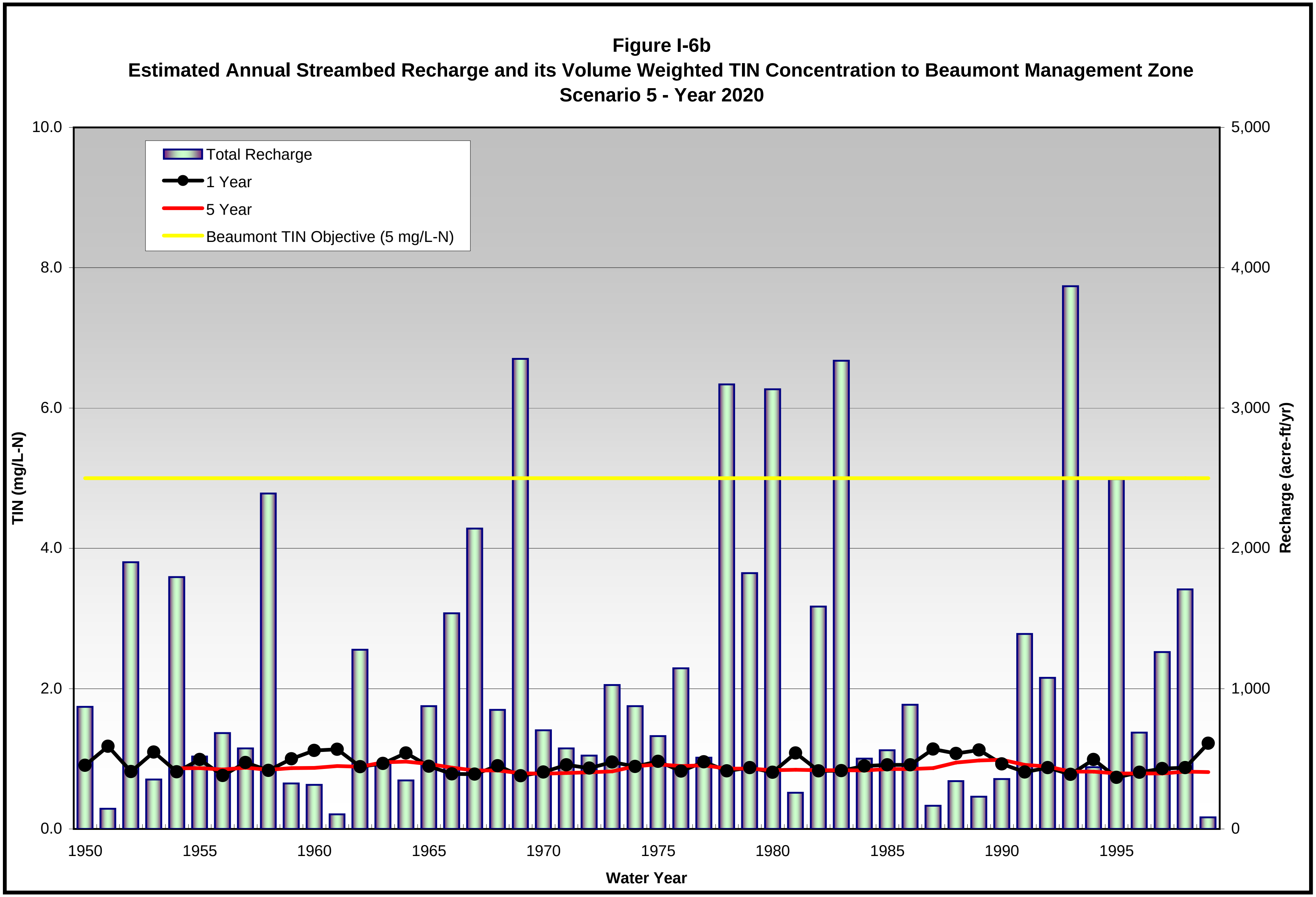
WILDERMUTH™ ENVIRONMENTAL INC.

Table I-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8



R_S520a_matrix.xls -- Fig 6a



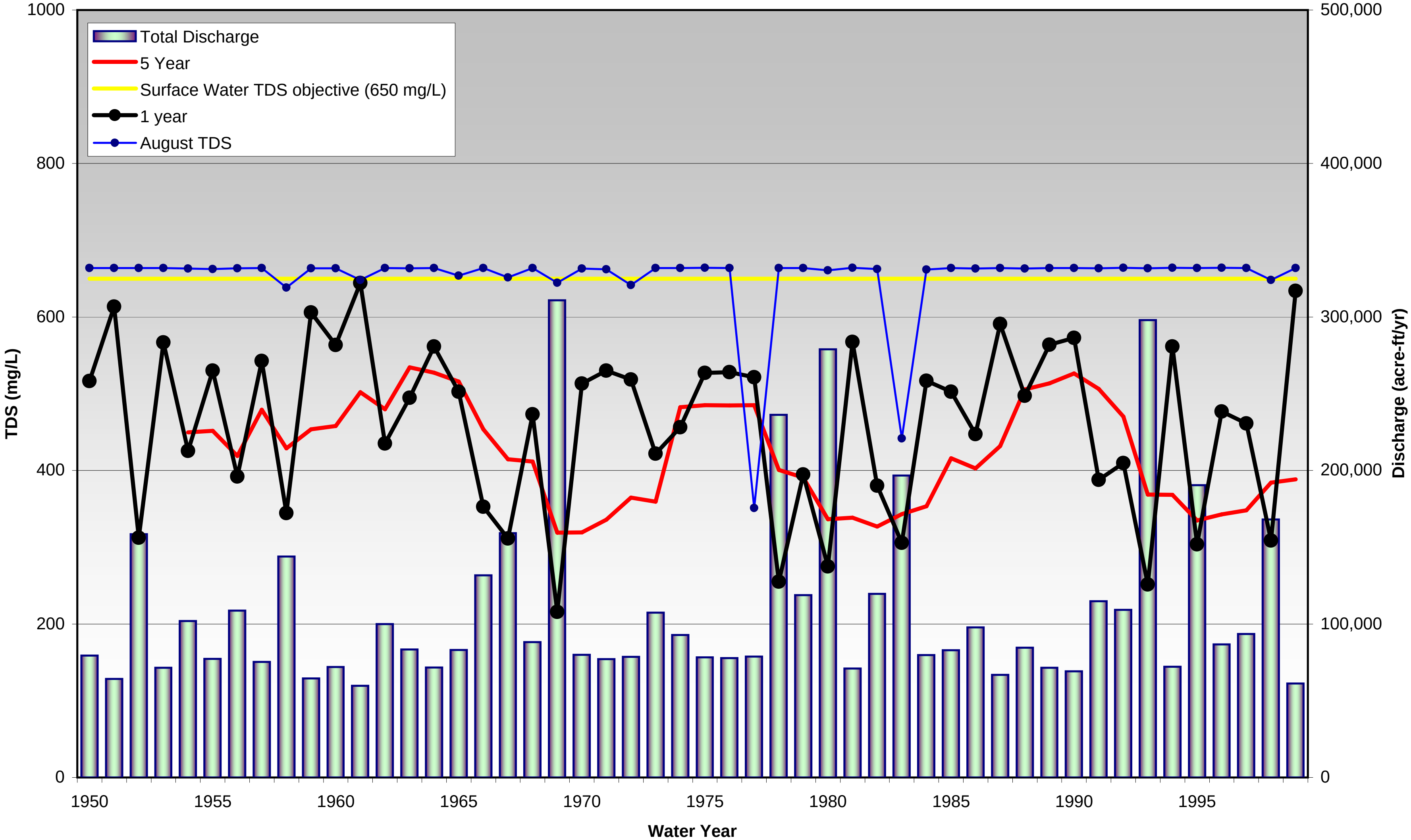
R_S520a_matrix.xls -- Fig 6b

WILDERMUTH ENVIRONMENTAL INC.

Table I-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 5 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	516				664	6.5				8.5
1951	614	560			664	7.8	7.1			8.5
1952	312	399	430		664	3.9	5.0	5.4		8.5
1953	567	391	440		664	7.1	4.9	5.5		8.5
1954	426	484	402	450	663	5.3	6.1	5.0	5.6	8.5
1955	530	471	498	452	663	6.7	5.9	6.3	5.7	8.5
1956	392	449	441	419	664	5.0	5.7	5.6	5.3	8.5
1957	543	454	476	479	664	6.8	5.7	6.0	6.0	8.5
1958	344	413	406	429	638	4.2	5.1	5.1	5.4	8.2
1959	606	425	457	454	664	7.7	5.3	5.7	5.7	8.5
1960	563	584	461	458	664	7.1	7.4	5.8	5.7	8.5
1961	644	600	602	502	648	8.2	7.6	7.6	6.3	8.3
1962	435	513	529	480	664	5.5	6.5	6.7	6.0	8.5
1963	495	462	507	534	663	6.2	5.8	6.4	6.7	8.5
1964	562	526	490	528	664	7.1	6.6	6.2	6.6	8.5
1965	503	530	518	516	654	6.3	6.7	6.5	6.5	8.4
1966	353	411	448	454	664	4.4	5.1	5.6	5.7	8.5
1967	312	330	369	415	652	3.8	4.1	4.6	5.2	8.3
1968	473	369	364	412	664	6.0	4.6	4.5	5.1	8.5
1969	216	273	284	319	645	2.5	3.3	3.4	3.9	8.2
1970	513	277	313	319	663	6.5	3.3	3.8	3.9	8.5
1971	530	522	318	336	662	6.7	6.6	3.9	4.1	8.5
1972	519	524	521	365	642	6.5	6.6	6.6	4.5	8.2
1973	422	463	483	359	664	5.2	5.8	6.0	4.4	8.5
1974	456	438	461	483	664	5.7	5.5	5.8	6.1	8.5
1975	527	489	463	485	664	6.6	6.1	5.8	6.1	8.5
1976	528	528	501	485	664	6.6	6.6	6.3	6.1	8.5
1977	521	525	526	485	351	6.6	6.6	6.6	6.1	4.3
1978	255	322	363	401	664	3.1	3.9	4.5	5.0	8.5
1979	395	302	342	391	664	4.9	3.7	4.2	4.8	8.5
1980	275	311	290	336	661	2.7	3.4	3.2	3.9	8.5
1981	567	334	350	338	664	7.1	3.6	3.9	3.9	8.5
1982	380	450	346	327	663	4.7	5.6	3.9	3.8	8.5
1983	306	334	377	343	442	3.4	3.9	4.5	3.9	5.5
1984	517	367	371	354	662	6.5	4.3	4.4	4.0	8.5
1985	503	510	398	416	664	6.3	6.4	4.8	5.1	8.5
1986	447	473	486	403	663	5.6	5.9	6.1	4.9	8.5
1987	591	506	505	432	664	7.5	6.4	6.3	5.3	8.5
1988	497	539	503	505	663	6.2	6.8	6.3	6.4	8.5
1989	564	528	547	514	664	7.1	6.6	6.9	6.5	8.5
1990	573	568	542	526	664	7.2	7.2	6.8	6.6	8.5
1991	388	457	487	506	664	4.8	5.7	6.1	6.4	8.5
1992	410	398	440	470	664	5.1	5.0	5.5	5.9	8.5
1993	252	294	315	368	664	2.6	3.3	3.6	4.4	8.5
1994	562	312	334	368	664	7.1	3.5	3.9	4.4	8.5
1995	304	375	309	335	664	3.5	4.5	3.5	3.9	8.5
1996	477	358	400	343	664	6.0	4.3	4.8	4.0	8.5
1997	461	469	384	348	664	5.7	5.9	4.6	4.1	8.5
1998	309	363	392	384	648	3.8	4.5	4.9	4.7	8.3
1999	634	396	415	389	664	8.0	4.9	5.2	4.8	8.5

Figure I-7a
Estimated Annual Discharge and its Volume Weighted TDS Concentration in Santa Ana River Flow at below Prado
Scenario 5 - Year 2020



R_S520a_matrix.xls -- Fig 7a

WILDERMUTH™
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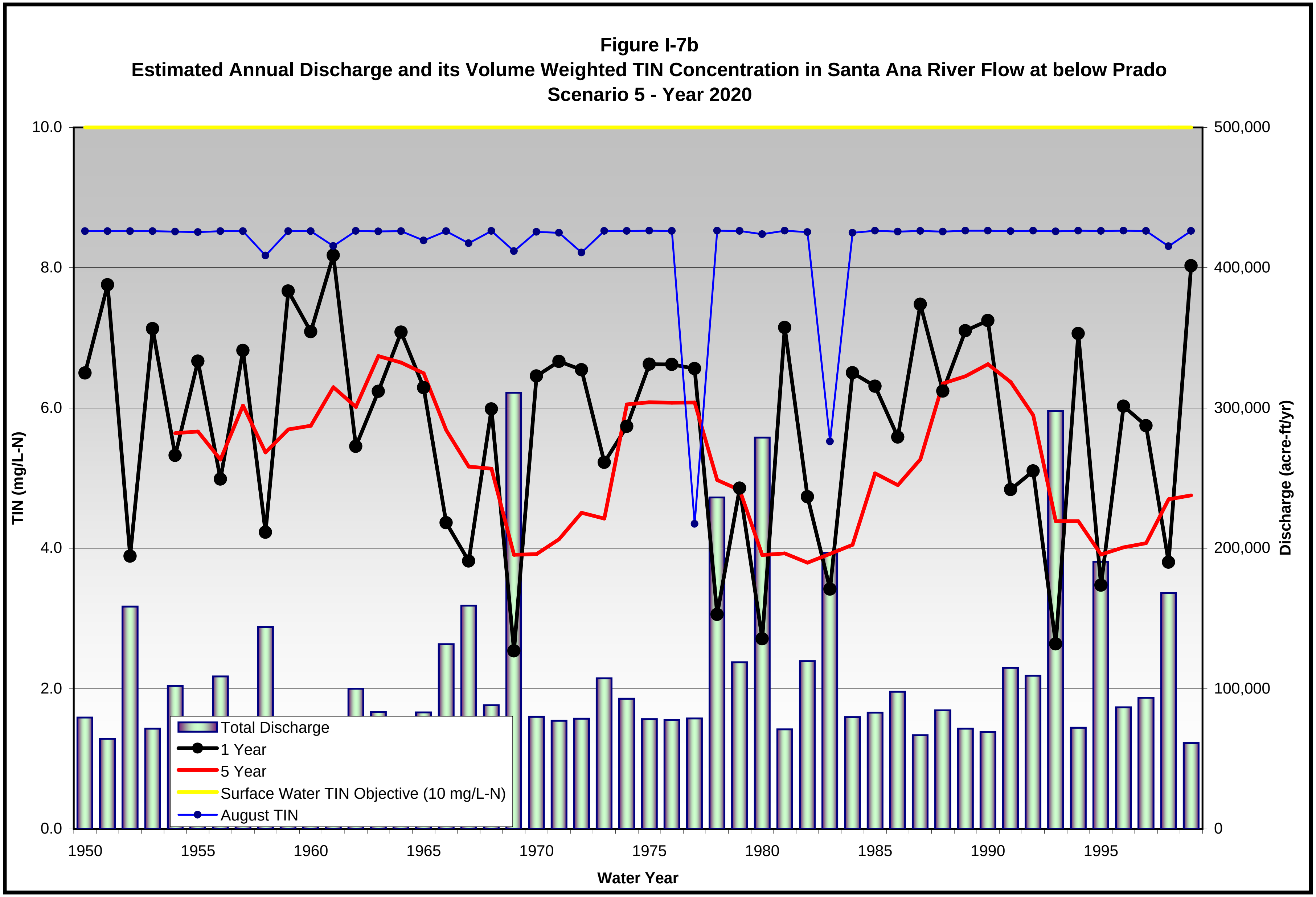


R_S520a_matrix.xls -- Fig 7b

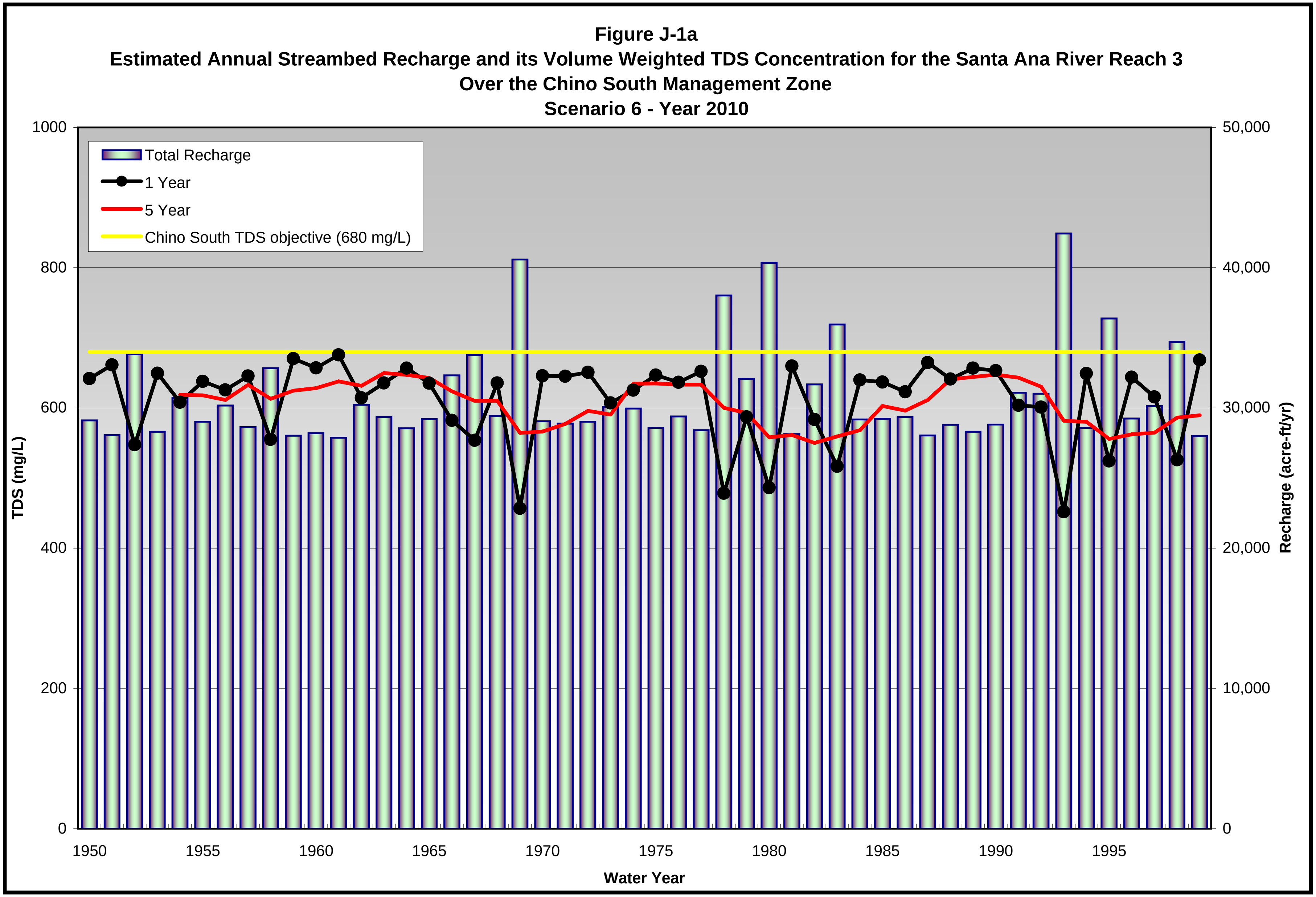
WILDERMUTH™ ENVIRONMENTAL INC.

Appendix J

Scenario 6, Year 2010 Simulation Results (Summary Matrices and Graphs)

Table J-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 6 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	642				4.7			
1951	661	651			4.9	4.8		
1952	548	599	613		4.0	4.4	4.5	
1953	649	594	615		4.8	4.4	4.5	
1954	608	628	599	619	4.5	4.6	4.4	4.5
1955	638	623	631	618	4.7	4.6	4.6	4.5
1956	626	632	624	612	4.6	4.6	4.6	4.5
1957	646	635	636	633	4.7	4.7	4.7	4.6
1958	555	597	607	613	4.0	4.4	4.4	4.5
1959	670	608	620	625	4.9	4.5	4.5	4.6
1960	657	664	624	628	4.8	4.9	4.6	4.6
1961	676	666	668	638	5.0	4.9	4.9	4.7
1962	614	644	648	632	4.5	4.7	4.8	4.6
1963	635	625	641	650	4.7	4.6	4.7	4.8
1964	657	646	635	647	4.8	4.7	4.7	4.8
1965	635	646	642	643	4.7	4.7	4.7	4.7
1966	582	607	623	624	4.2	4.4	4.6	4.6
1967	554	568	588	610	4.0	4.1	4.3	4.5
1968	636	592	589	610	4.7	4.3	4.3	4.5
1969	457	532	539	565	3.2	3.8	3.9	4.1
1970	646	536	565	566	4.7	3.8	4.1	4.1
1971	645	646	568	577	4.7	4.7	4.1	4.2
1972	651	648	647	596	4.8	4.8	4.8	4.3
1973	607	629	634	591	4.4	4.6	4.7	4.3
1974	625	616	628	635	4.6	4.5	4.6	4.7
1975	647	636	626	635	4.8	4.7	4.6	4.7
1976	637	642	636	633	4.7	4.7	4.7	4.6
1977	652	644	645	633	4.8	4.7	4.7	4.6
1978	478	553	578	600	3.4	4.0	4.2	4.4
1979	587	528	564	593	4.2	3.8	4.1	4.3
1980	486	531	513	558	3.3	3.7	3.6	4.0
1981	660	558	567	561	4.9	4.0	4.0	4.0
1982	584	619	566	550	4.3	4.5	4.1	3.9
1983	517	548	581	559	3.6	3.9	4.2	4.0
1984	640	572	576	568	4.7	4.1	4.2	4.1
1985	637	638	592	603	4.7	4.7	4.3	4.4
1986	623	630	633	596	4.6	4.6	4.7	4.3
1987	665	643	641	611	4.9	4.7	4.7	4.4
1988	641	653	643	641	4.7	4.8	4.7	4.7
1989	657	649	654	644	4.8	4.8	4.8	4.7
1990	653	655	650	648	4.8	4.8	4.8	4.8
1991	604	628	637	643	4.4	4.6	4.7	4.7
1992	601	603	619	630	4.4	4.4	4.5	4.6
1993	452	515	541	582	3.1	3.6	3.9	4.2
1994	649	531	553	580	4.8	3.8	4.0	4.2
1995	524	579	529	556	3.7	4.2	3.7	4.0
1996	644	578	599	562	4.7	4.1	4.3	4.0
1997	616	629	590	565	4.5	4.6	4.3	4.0
1998	526	568	591	586	3.8	4.1	4.3	4.3
1999	668	590	598	590	4.9	4.3	4.4	4.3



R_S610a_matrix.xls -- Fig 1a

WILDERMUTH ENVIRONMENTAL INC.

Figure J-1b

Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 3 Over the Chino South Management Zone

Scenario 6 - Year 2010

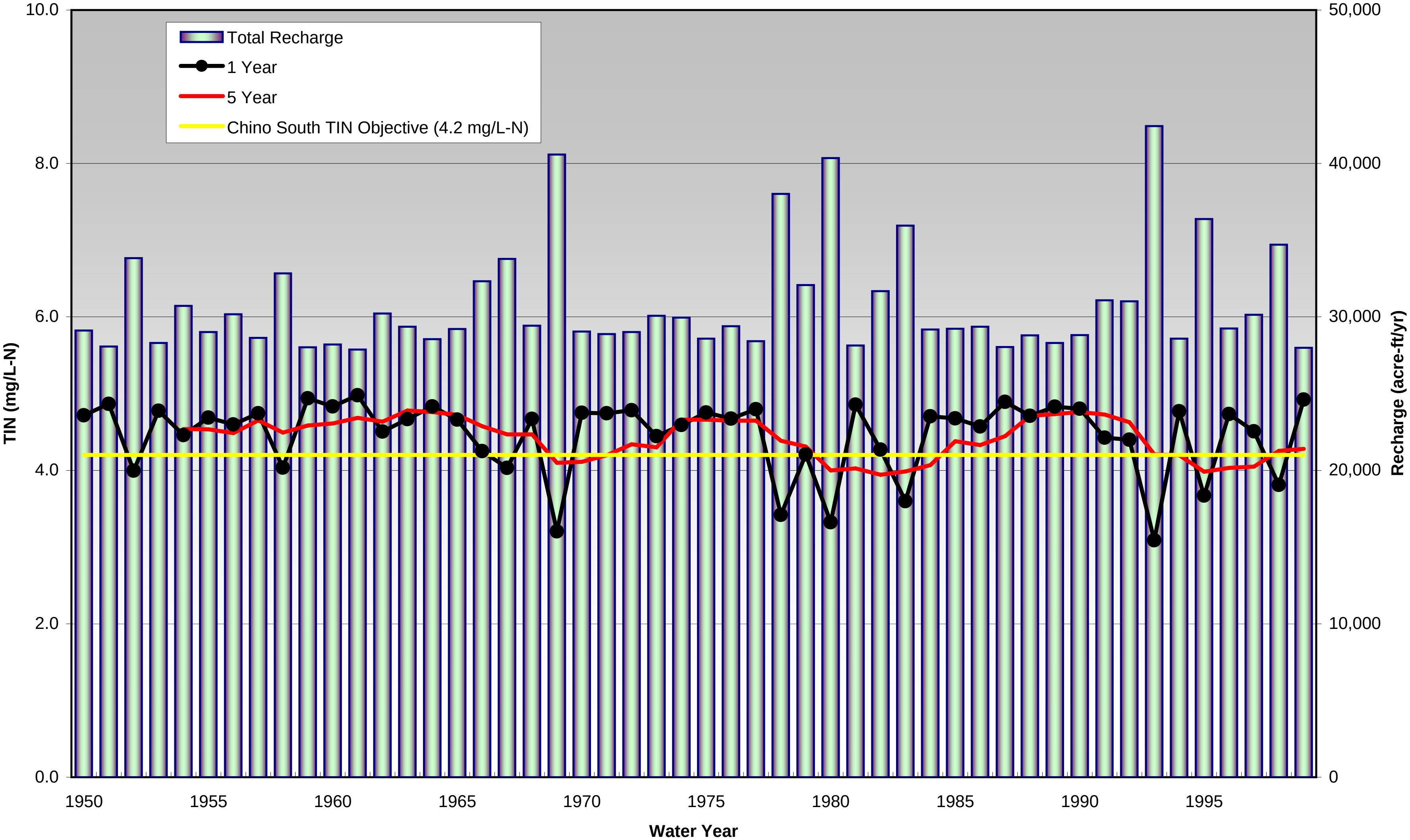
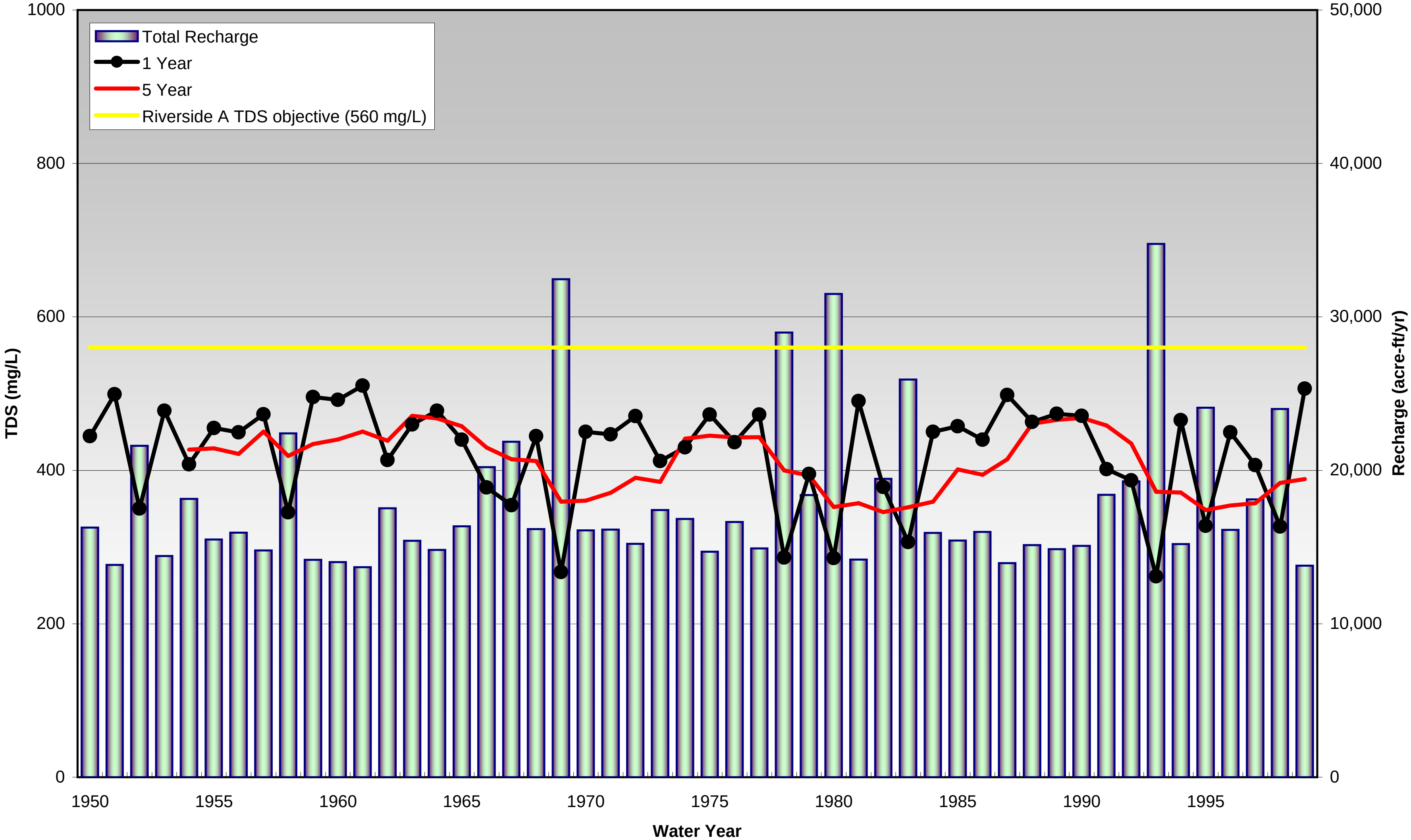


Table J-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 6 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	499	470			7.0	6.5		
1952	350	408	420		4.7	5.6	5.7	
1953	478	401	428		6.6	5.4	5.9	
1954	408	439	403	427	5.5	6.0	5.5	5.8
1955	455	429	444	429	6.3	5.9	6.1	5.9
1956	450	452	436	421	6.2	6.3	6.0	5.8
1957	473	461	459	451	6.5	6.4	6.3	6.2
1958	345	396	412	419	4.5	5.3	5.6	5.7
1959	495	403	423	434	6.9	5.4	5.7	5.9
1960	492	494	428	440	6.8	6.9	5.8	6.0
1961	510	501	499	451	7.1	7.0	7.0	6.2
1962	413	456	467	439	5.6	6.3	6.5	6.0
1963	460	435	457	471	6.4	6.0	6.3	6.5
1964	478	468	448	468	6.6	6.5	6.2	6.5
1965	440	458	458	457	6.0	6.3	6.3	6.3
1966	378	406	426	430	5.0	5.5	5.8	5.9
1967	355	366	386	414	4.7	4.9	5.2	5.6
1968	445	393	388	412	6.1	5.3	5.2	5.6
1969	267	326	335	359	3.1	4.1	4.3	4.7
1970	450	328	357	361	6.2	4.2	4.6	4.7
1971	447	449	358	371	6.1	6.2	4.7	4.9
1972	471	458	456	390	6.5	6.3	6.3	5.2
1973	412	440	442	385	5.6	6.0	6.1	5.1
1974	430	421	436	441	5.9	5.7	6.0	6.0
1975	473	450	437	445	6.5	6.2	6.0	6.1
1976	437	454	445	443	6.0	6.2	6.1	6.1
1977	473	454	460	443	6.5	6.3	6.3	6.1
1978	286	350	374	400	3.5	4.5	4.9	5.4
1979	395	329	363	393	5.3	4.2	4.7	5.2
1980	286	326	311	352	3.5	4.1	3.9	4.6
1981	490	349	362	357	6.8	4.5	4.7	4.6
1982	378	425	358	346	5.1	5.8	4.7	4.5
1983	306	337	374	352	3.9	4.4	5.0	4.6
1984	450	361	367	359	6.2	4.8	4.9	4.7
1985	457	454	387	401	6.3	6.2	5.2	5.4
1986	440	449	449	394	6.0	6.2	6.2	5.3
1987	498	467	464	415	6.9	6.4	6.4	5.6
1988	463	480	466	461	6.4	6.7	6.4	6.4
1989	474	468	478	466	6.6	6.5	6.6	6.4
1990	471	472	469	468	6.5	6.5	6.5	6.5
1991	401	433	445	458	5.4	5.9	6.1	6.3
1992	387	394	416	435	5.2	5.3	5.7	6.0
1993	262	306	331	372	3.1	3.8	4.2	4.9
1994	465	324	341	371	6.4	4.1	4.4	4.9
1995	328	381	325	348	4.2	5.1	4.1	4.5
1996	450	377	401	354	6.2	5.0	5.4	4.6
1997	407	427	386	357	5.5	5.8	5.1	4.7
1998	327	361	386	384	4.2	4.7	5.1	5.1
1999	506	392	397	389	7.1	5.2	5.3	5.2

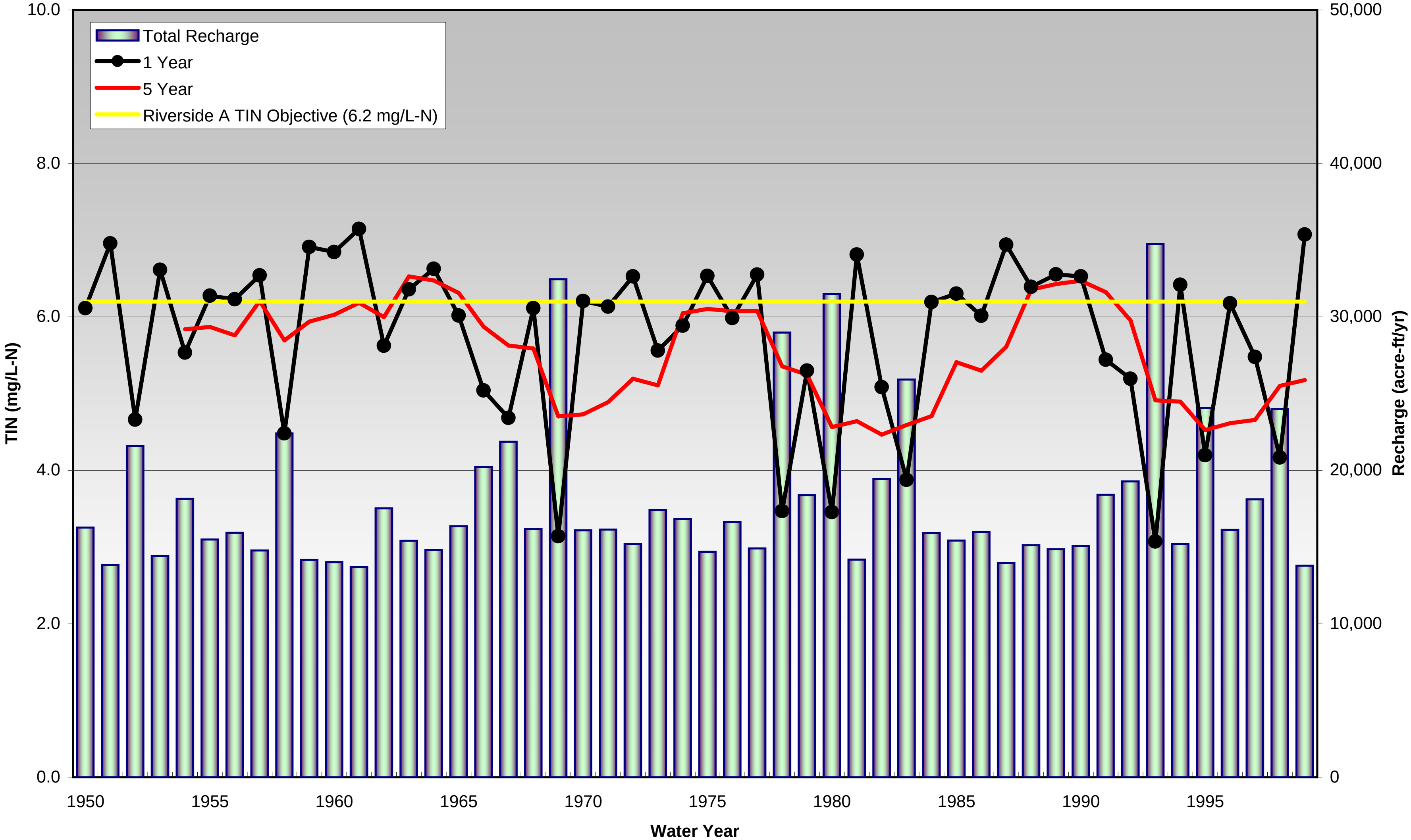
Figure J-2a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 4 Over the Riverside A Management Zone
Scenario 6 - Year 2010



R_S610a_matrix.xls -- Fig 2a

WILDERMUTH™ ENVIRONMENTAL INC.

Figure J-2b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 6 - Year 2010

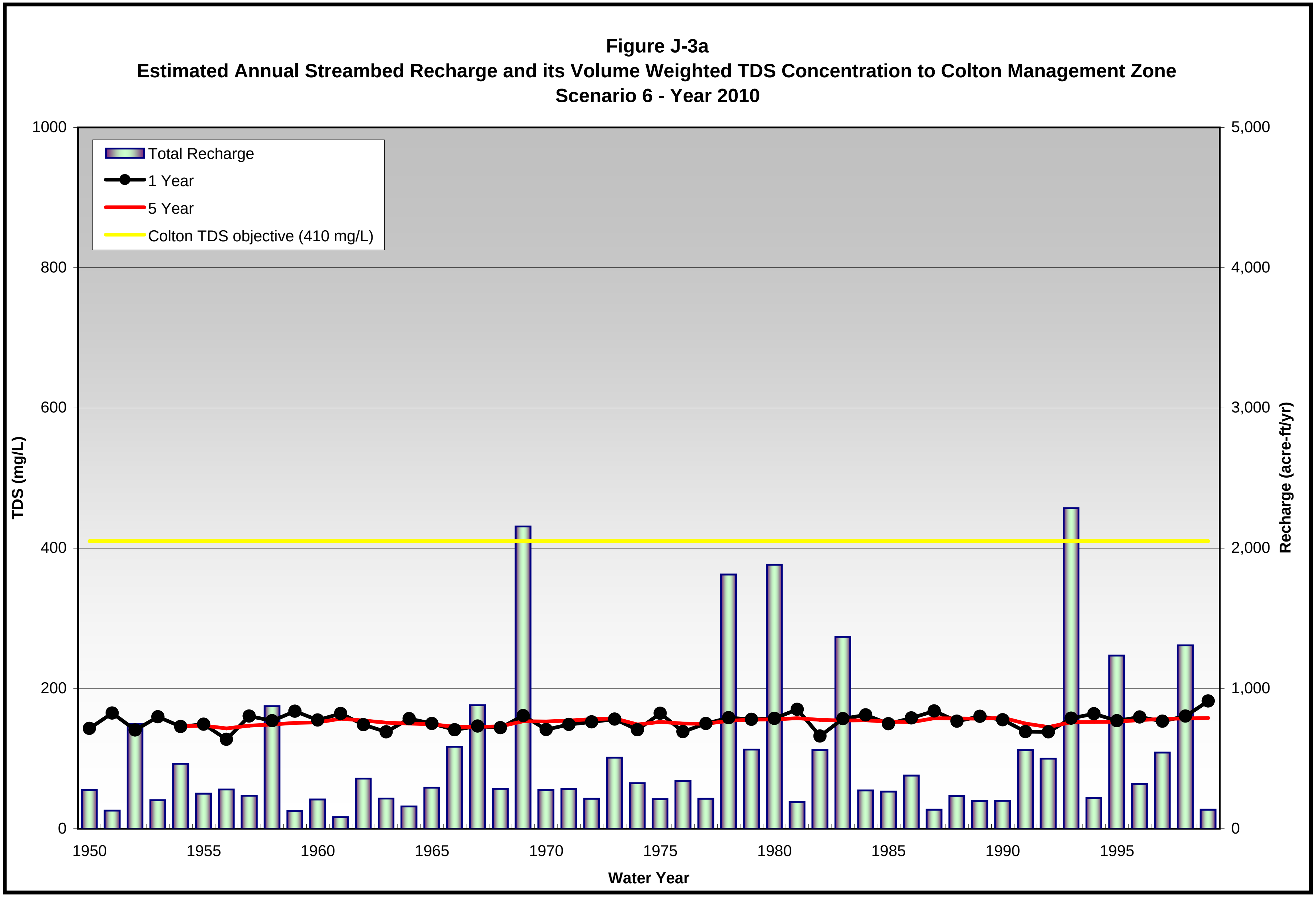


R_S610a_matrix.xls -- Fig 2b

WILDERMUTH ENVIRONMENTAL INC.

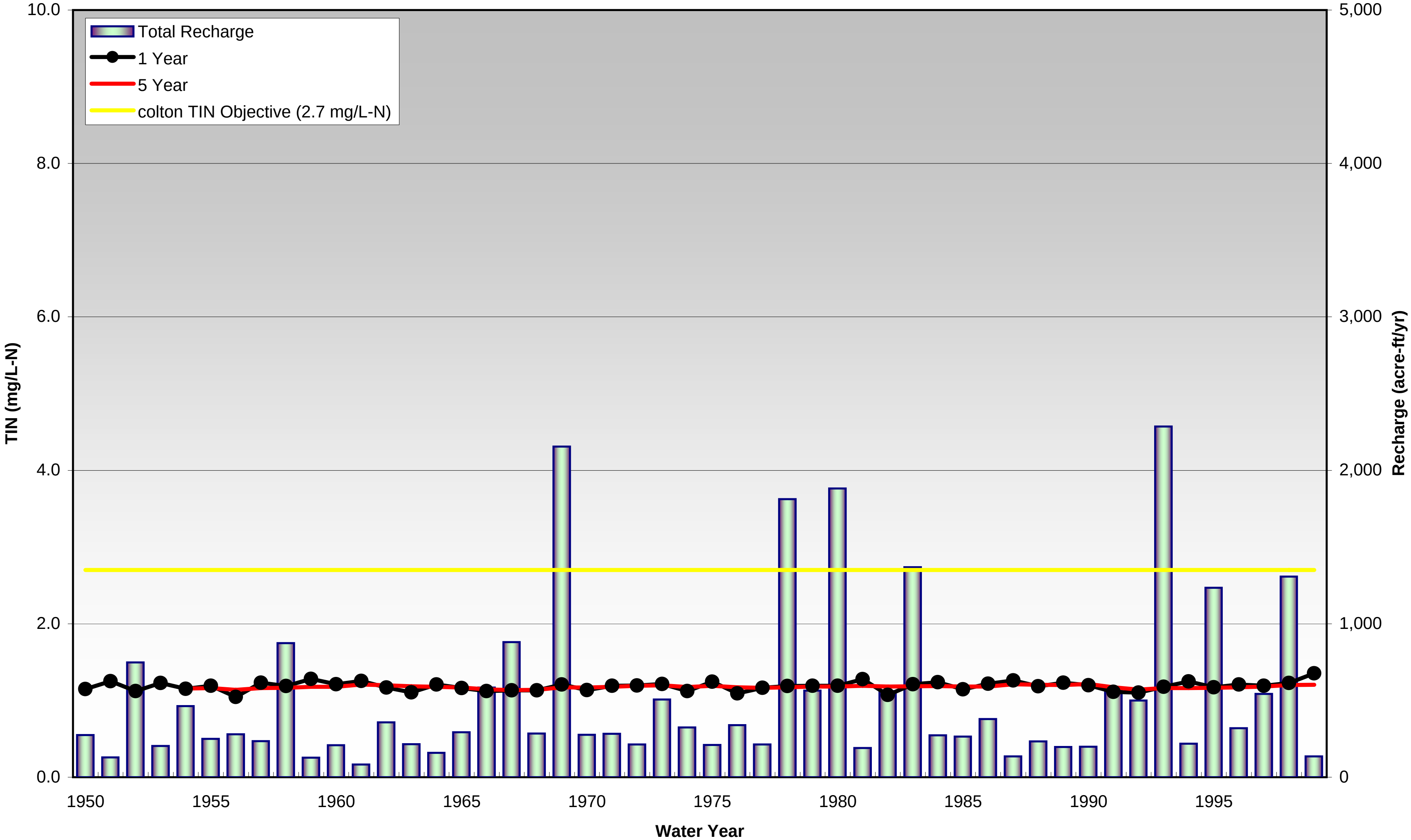
Table J-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 6 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	143				1.1			
1951	165	150			1.3	1.2		
1952	141	144	144		1.1	1.1	1.1	
1953	160	145	147		1.2	1.1	1.2	
1954	146	150	145	146	1.2	1.2	1.1	1.2
1955	149	147	150	147	1.2	1.2	1.2	1.2
1956	127	138	141	143	1.0	1.1	1.1	1.1
1957	160	142	145	147	1.2	1.1	1.1	1.2
1958	154	155	150	149	1.2	1.2	1.2	1.2
1959	168	156	157	151	1.3	1.2	1.2	1.2
1960	155	160	156	152	1.2	1.2	1.2	1.2
1961	164	158	161	157	1.3	1.2	1.2	1.2
1962	148	151	152	154	1.2	1.2	1.2	1.2
1963	138	144	147	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	150	152	148	149	1.2	1.2	1.2	1.2
1966	141	144	146	145	1.1	1.1	1.1	1.1
1967	146	144	145	145	1.1	1.1	1.1	1.1
1968	144	146	144	146	1.1	1.1	1.1	1.1
1969	161	159	156	153	1.2	1.2	1.2	1.2
1970	141	159	157	153	1.1	1.2	1.2	1.2
1971	149	145	158	154	1.2	1.2	1.2	1.2
1972	152	150	147	156	1.2	1.2	1.2	1.2
1973	156	155	153	157	1.2	1.2	1.2	1.2
1974	141	150	151	149	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	146	150	1.1	1.2	1.1	1.2
1977	150	143	149	150	1.2	1.1	1.2	1.2
1978	158	157	155	154	1.2	1.2	1.2	1.2
1979	156	158	157	156	1.2	1.2	1.2	1.2
1980	157	157	157	156	1.2	1.2	1.2	1.2
1981	170	158	158	158	1.3	1.2	1.2	1.2
1982	132	142	153	155	1.1	1.1	1.2	1.2
1983	157	150	152	154	1.2	1.2	1.2	1.2
1984	162	158	151	155	1.2	1.2	1.2	1.2
1985	150	156	157	152	1.1	1.2	1.2	1.2
1986	158	155	157	152	1.2	1.2	1.2	1.2
1987	168	161	157	158	1.3	1.2	1.2	1.2
1988	153	159	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	143	146	150	1.1	1.1	1.2	1.2
1992	138	138	141	145	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	155	152	1.2	1.2	1.2	1.2
1995	154	156	157	153	1.2	1.2	1.2	1.2
1996	159	155	156	155	1.2	1.2	1.2	1.2
1997	153	155	155	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	163	160	158	1.4	1.2	1.2	1.2



R_S610a_matrix.xls -- Fig 3a

Figure J-3b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Colton Management Zone
Scenario 6 - Year 2010



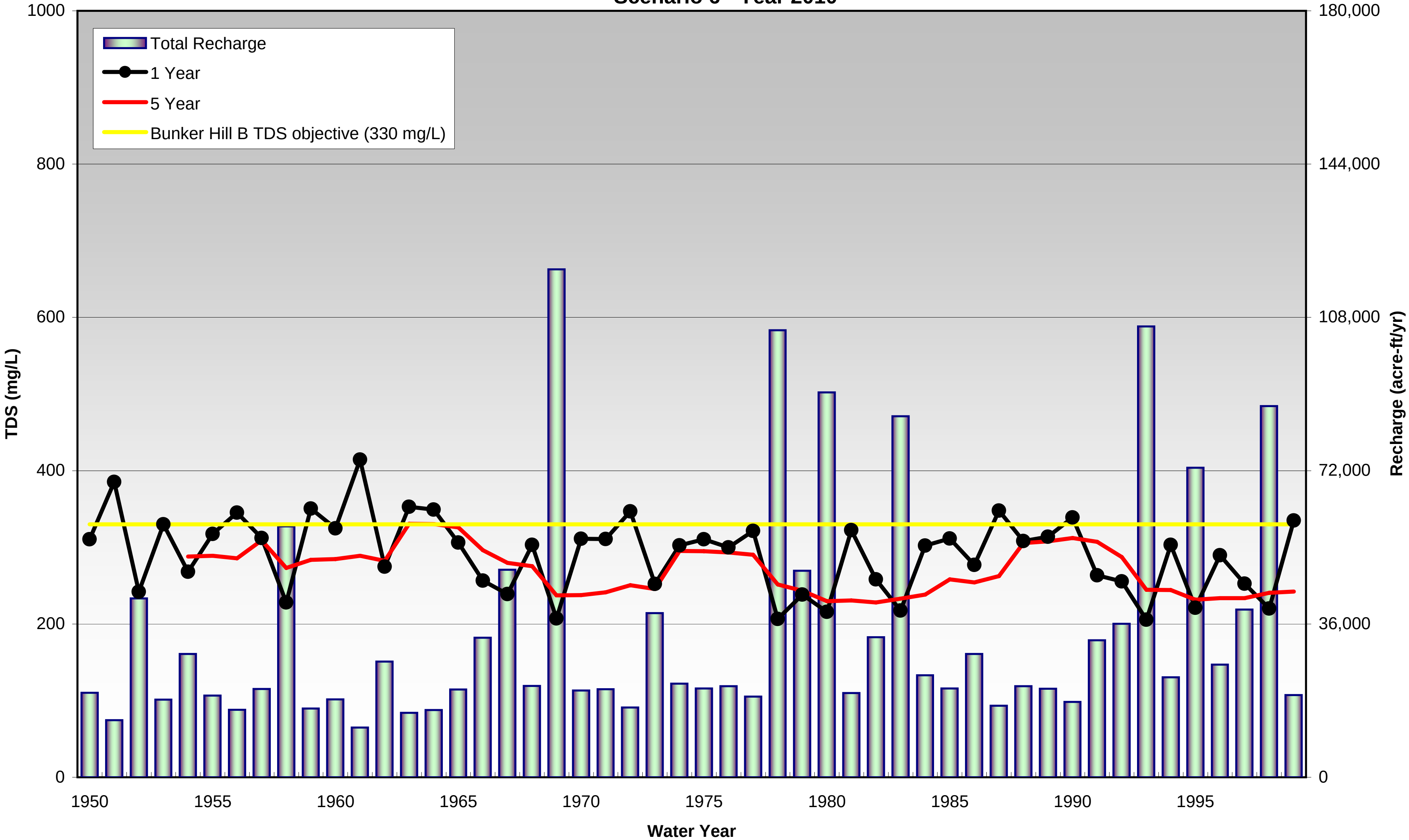
R_S610a_matrix.xls -- Fig 3b

WILDERMUTH™ ENVIRONMENTAL INC.

Table J-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 6 - Year 2010
(mg/L)

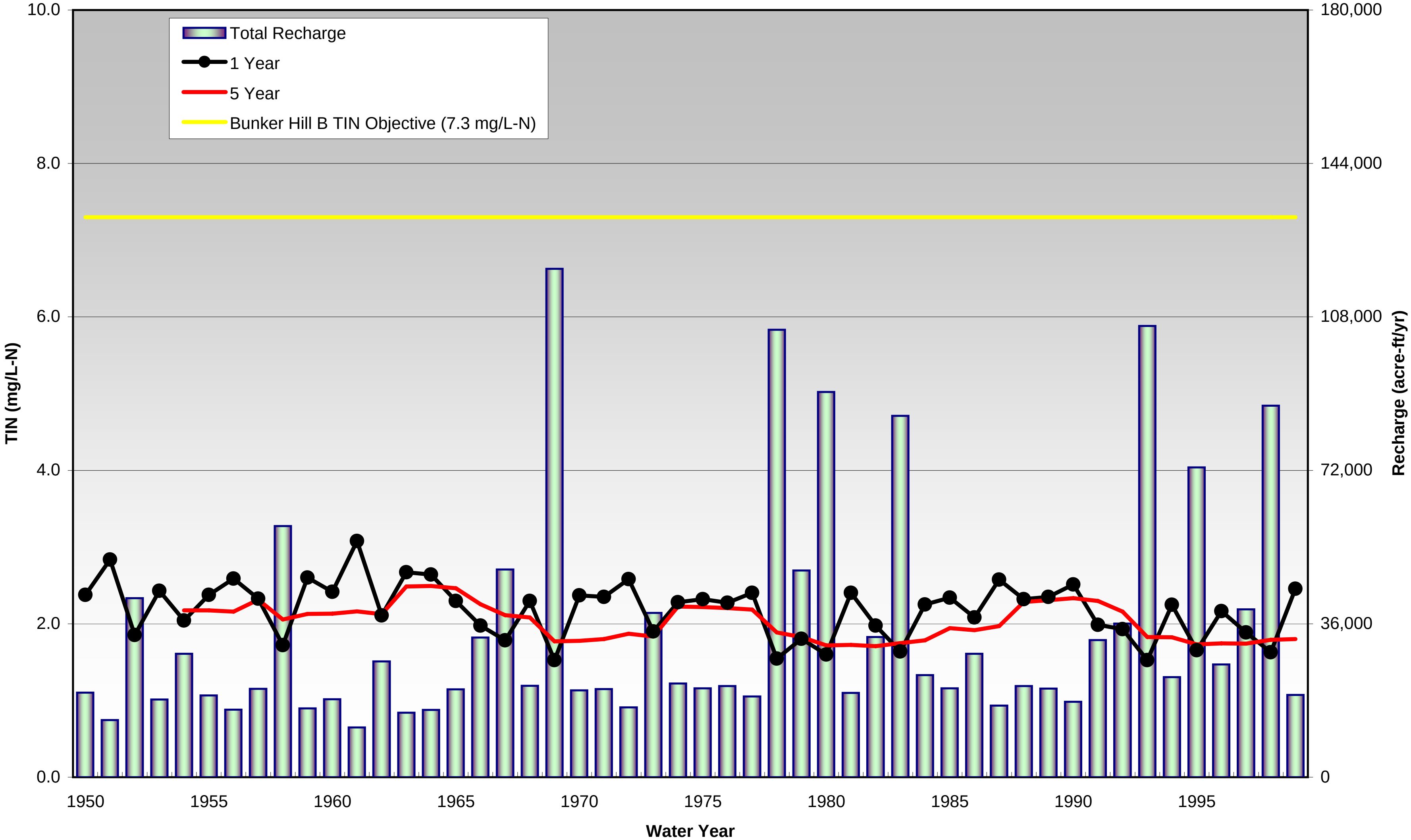
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	311				2.4			
1951	385	341			2.8	2.6		
1952	242	277	286		1.9	2.1	2.2	
1953	330	269	290		2.4	2.0	2.2	
1954	268	292	268	288	2.0	2.2	2.0	2.2
1955	318	288	299	289	2.4	2.2	2.2	2.2
1956	345	330	302	286	2.6	2.5	2.3	2.2
1957	312	327	323	309	2.3	2.4	2.4	2.3
1958	228	250	266	273	1.7	1.9	2.0	2.1
1959	351	254	267	284	2.6	1.9	2.0	2.1
1960	325	337	268	285	2.4	2.5	2.0	2.1
1961	415	360	357	289	3.1	2.7	2.6	2.2
1962	275	317	319	282	2.1	2.4	2.4	2.1
1963	353	303	327	331	2.7	2.3	2.5	2.5
1964	349	351	315	330	2.6	2.7	2.4	2.5
1965	306	325	333	326	2.3	2.4	2.5	2.5
1966	256	276	292	296	2.0	2.1	2.2	2.3
1967	239	246	258	280	1.8	1.9	1.9	2.1
1968	303	259	258	275	2.3	1.9	2.0	2.1
1969	207	222	226	237	1.5	1.6	1.7	1.8
1970	311	222	233	238	2.4	1.6	1.7	1.8
1971	311	311	234	241	2.4	2.4	1.7	1.8
1972	347	327	321	251	2.6	2.5	2.4	1.9
1973	252	280	289	246	1.9	2.1	2.2	1.8
1974	303	270	287	295	2.3	2.0	2.2	2.2
1975	310	306	281	295	2.3	2.3	2.1	2.2
1976	300	305	304	293	2.3	2.3	2.3	2.2
1977	321	310	310	290	2.4	2.3	2.3	2.2
1978	207	224	235	252	1.5	1.7	1.8	1.9
1979	238	217	228	243	1.8	1.6	1.7	1.8
1980	216	224	216	230	1.6	1.7	1.6	1.7
1981	322	235	236	231	2.4	1.7	1.8	1.7
1982	258	282	240	228	2.0	2.1	1.8	1.7
1983	218	229	242	233	1.6	1.7	1.8	1.7
1984	302	236	241	238	2.3	1.8	1.8	1.8
1985	312	307	248	258	2.3	2.3	1.9	1.9
1986	277	292	295	254	2.1	2.2	2.2	1.9
1987	348	303	306	263	2.6	2.3	2.3	2.0
1988	308	326	305	305	2.3	2.4	2.3	2.3
1989	314	311	321	308	2.3	2.3	2.4	2.3
1990	339	325	319	312	2.5	2.4	2.4	2.3
1991	264	290	297	307	2.0	2.2	2.2	2.3
1992	256	259	276	287	1.9	2.0	2.1	2.2
1993	206	218	227	244	1.5	1.6	1.7	1.8
1994	303	223	230	244	2.2	1.7	1.7	1.8
1995	221	241	223	232	1.7	1.8	1.7	1.7
1996	290	240	252	234	2.2	1.8	1.9	1.7
1997	253	268	243	234	1.9	2.0	1.8	1.7
1998	220	230	240	241	1.6	1.7	1.8	1.8
1999	335	241	244	242	2.5	1.8	1.8	1.8

Figure J-4a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Bunker Hill B Management Zone
Scenario 6 - Year 2010



WILDERMUTH™ ENVIRONMENTAL INC.

Figure J-4b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Bunker Hill B Management Zone
Scenario 6 - Year 2010



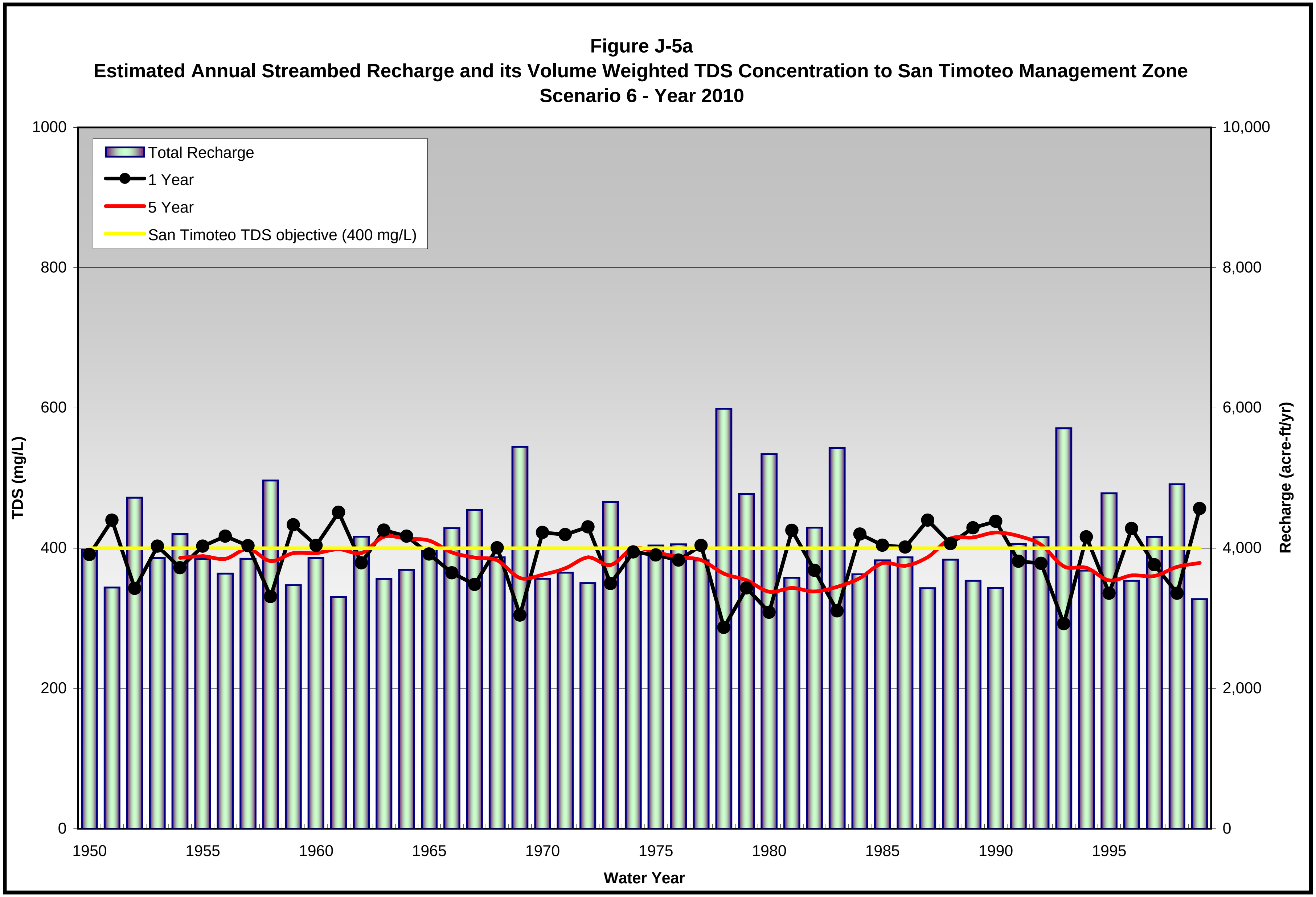
R_S610a_matrix.xls -- Fig 4b

WILDERMUTH™ ENVIRONMENTAL INC.

Table J-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 6 - Year 2010
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	391				3.3			
1951	440	414			3.7	3.5		
1952	343	384	386		2.9	3.2	3.3	
1953	403	370	390		3.4	3.1	3.3	
1954	372	387	370	386	3.2	3.3	3.1	3.3
1955	403	387	392	389	3.4	3.3	3.3	3.3
1956	417	410	396	385	3.5	3.5	3.4	3.3
1957	403	410	408	399	3.4	3.5	3.4	3.4
1958	331	363	379	382	2.8	3.1	3.2	3.2
1959	433	373	383	393	3.7	3.2	3.2	3.3
1960	404	418	383	393	3.4	3.5	3.2	3.3
1961	451	426	428	398	3.8	3.6	3.6	3.4
1962	379	411	408	393	3.2	3.5	3.4	3.3
1963	426	400	416	416	3.6	3.4	3.5	3.5
1964	417	421	406	413	3.5	3.6	3.4	3.5
1965	392	404	411	411	3.3	3.4	3.5	3.5
1966	365	378	390	394	3.1	3.2	3.3	3.3
1967	348	356	367	387	3.0	3.0	3.1	3.3
1968	401	372	370	383	3.4	3.2	3.1	3.2
1969	304	344	346	358	2.6	2.9	2.9	3.0
1970	422	351	366	362	3.6	3.0	3.1	3.1
1971	419	421	371	371	3.5	3.6	3.1	3.1
1972	430	425	424	387	3.6	3.6	3.6	3.3
1973	349	384	395	376	2.9	3.2	3.3	3.2
1974	395	370	388	400	3.3	3.1	3.3	3.4
1975	390	392	376	394	3.3	3.3	3.2	3.3
1976	383	387	389	387	3.2	3.3	3.3	3.3
1977	404	393	392	383	3.4	3.3	3.3	3.2
1978	287	333	347	364	2.4	2.8	2.9	3.1
1979	343	312	336	354	2.9	2.6	2.8	3.0
1980	309	325	311	338	2.6	2.7	2.6	2.9
1981	425	355	351	343	3.6	3.0	3.0	2.9
1982	369	394	360	338	3.1	3.3	3.0	2.9
1983	310	336	360	345	2.6	2.8	3.0	2.9
1984	420	354	359	358	3.6	3.0	3.0	3.0
1985	404	412	369	379	3.4	3.5	3.1	3.2
1986	402	403	408	375	3.4	3.4	3.4	3.2
1987	440	420	414	387	3.7	3.5	3.5	3.3
1988	406	422	415	414	3.4	3.6	3.5	3.5
1989	429	417	424	415	3.6	3.5	3.6	3.5
1990	438	434	424	422	3.7	3.7	3.6	3.6
1991	381	408	414	418	3.2	3.5	3.5	3.5
1992	378	380	397	405	3.2	3.2	3.4	3.4
1993	292	329	344	374	2.5	2.8	2.9	3.2
1994	416	341	352	372	3.5	2.9	3.0	3.2
1995	336	371	339	354	2.8	3.1	2.9	3.0
1996	428	375	388	361	3.6	3.2	3.3	3.1
1997	376	400	375	361	3.2	3.4	3.2	3.1
1998	336	354	375	373	2.8	3.0	3.2	3.2
1999	457	384	381	379	3.9	3.2	3.2	3.2

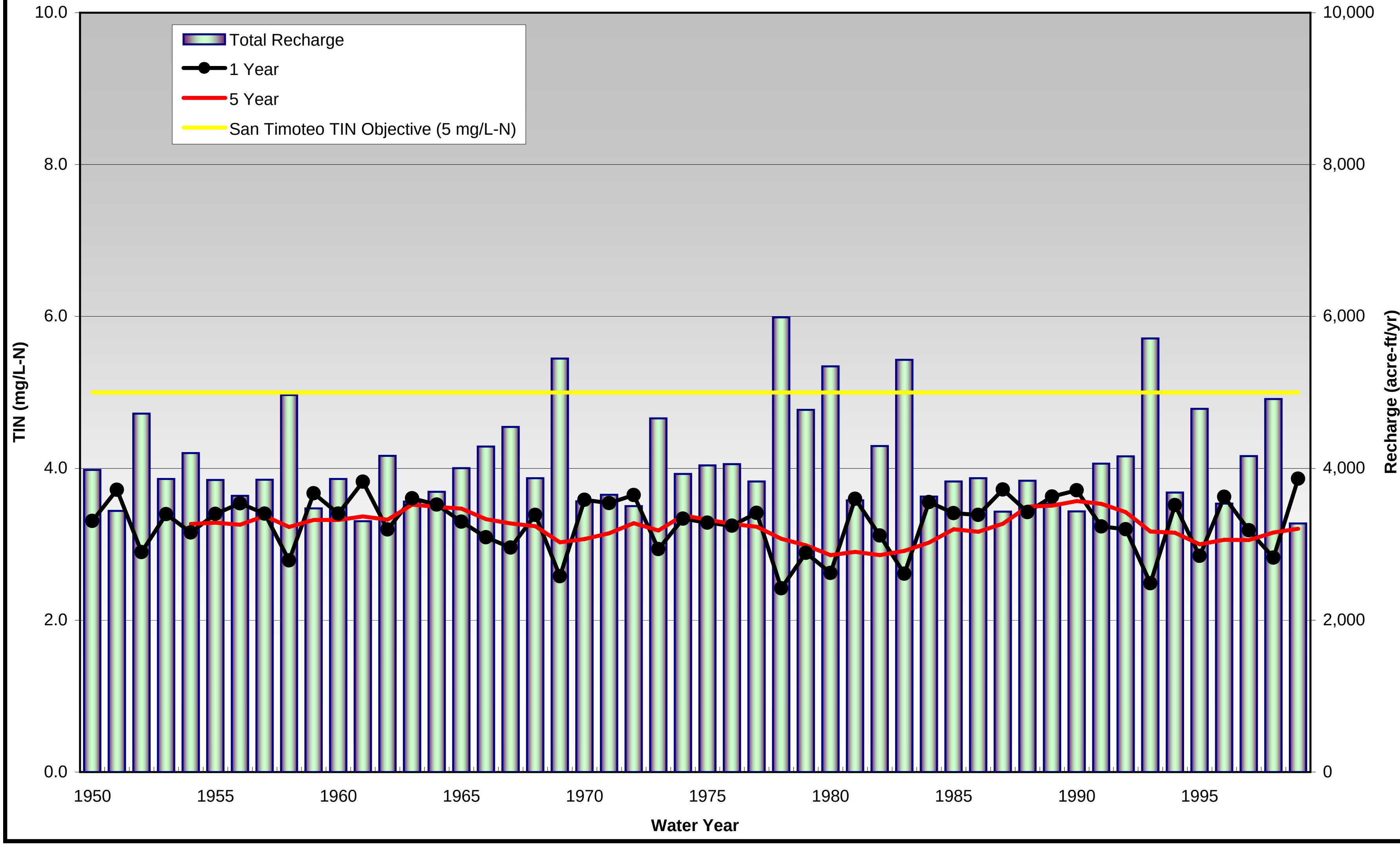
San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1995 Water Quality Control Plan



R_S610a_matrix.xls -- Fig 5a

WILDERMUTH™ ENVIRONMENTAL INC.

Figure J-5b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to San Timoteo Management Zone
Scenario 6 - Year 2010

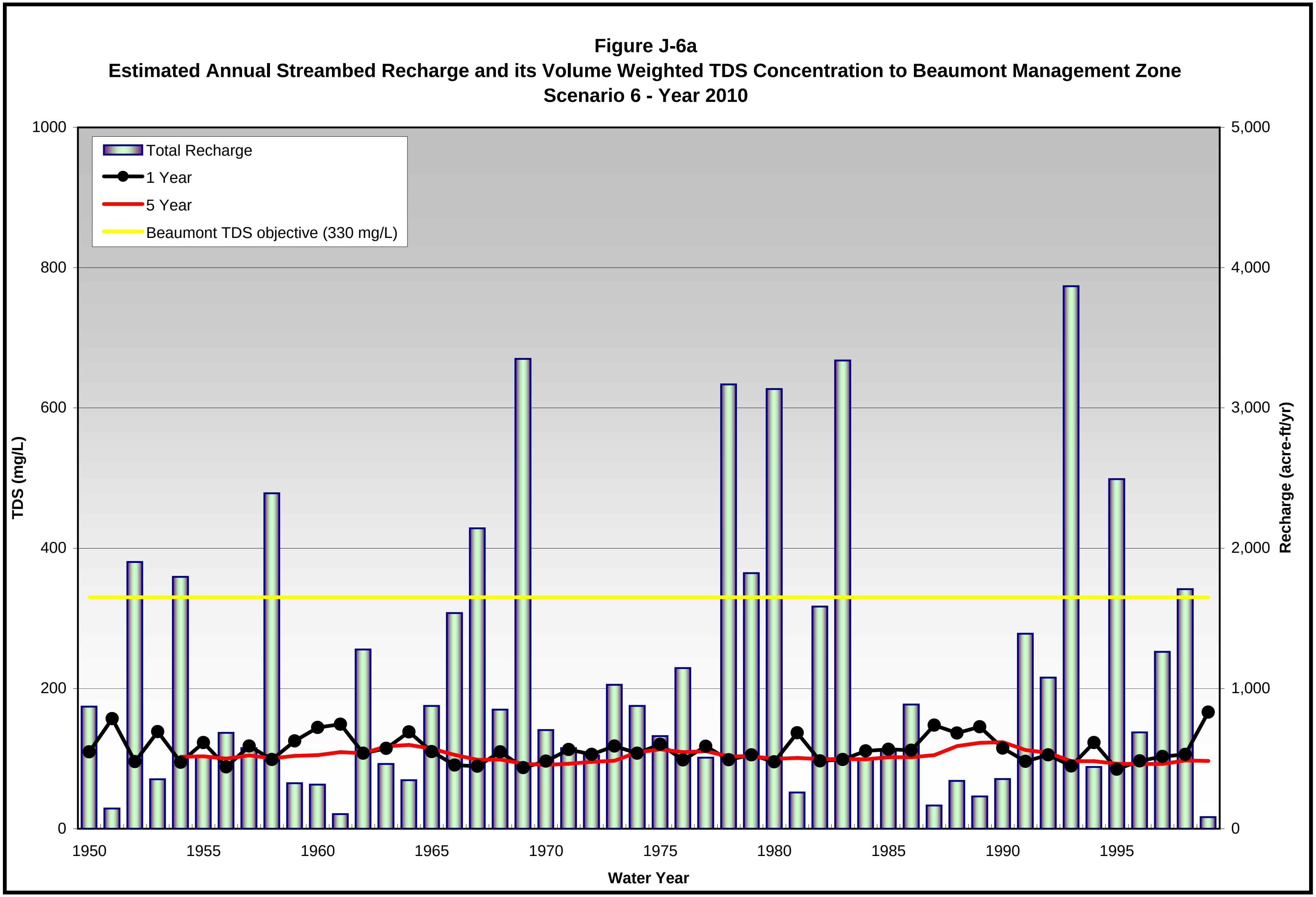


R_S610a_matrix.xls -- Fig 5b

WILDERMUTH ENVIRONMENTAL INC.

Table J-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 6 - Year 2010
(mg/L)

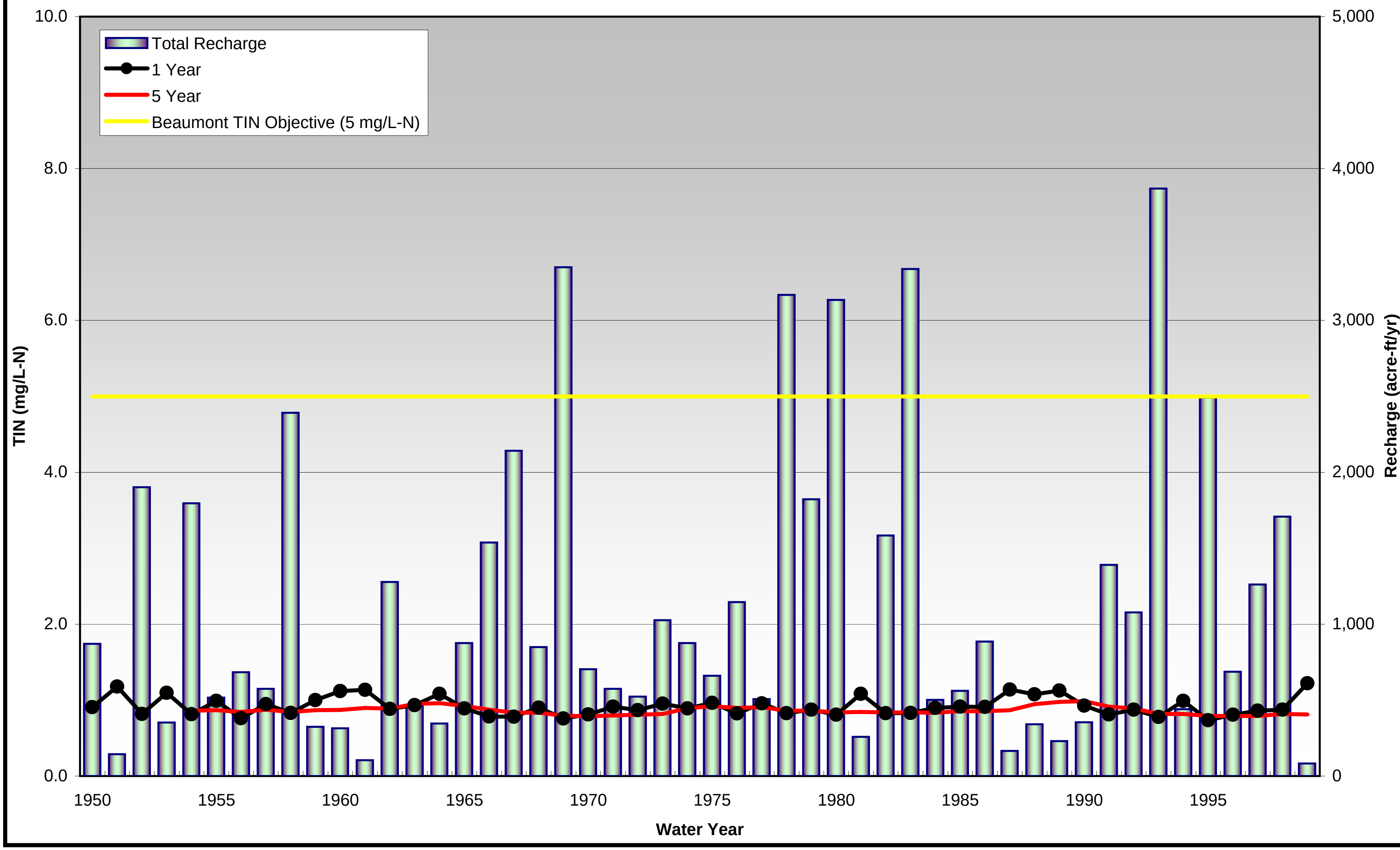
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8



R_S610a_matrix.xls -- Fig 6a

WILDERMUTH ENVIRONMENTAL INC.

Figure J-6b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Beaumont Management Zone
Scenario 6 - Year 2010



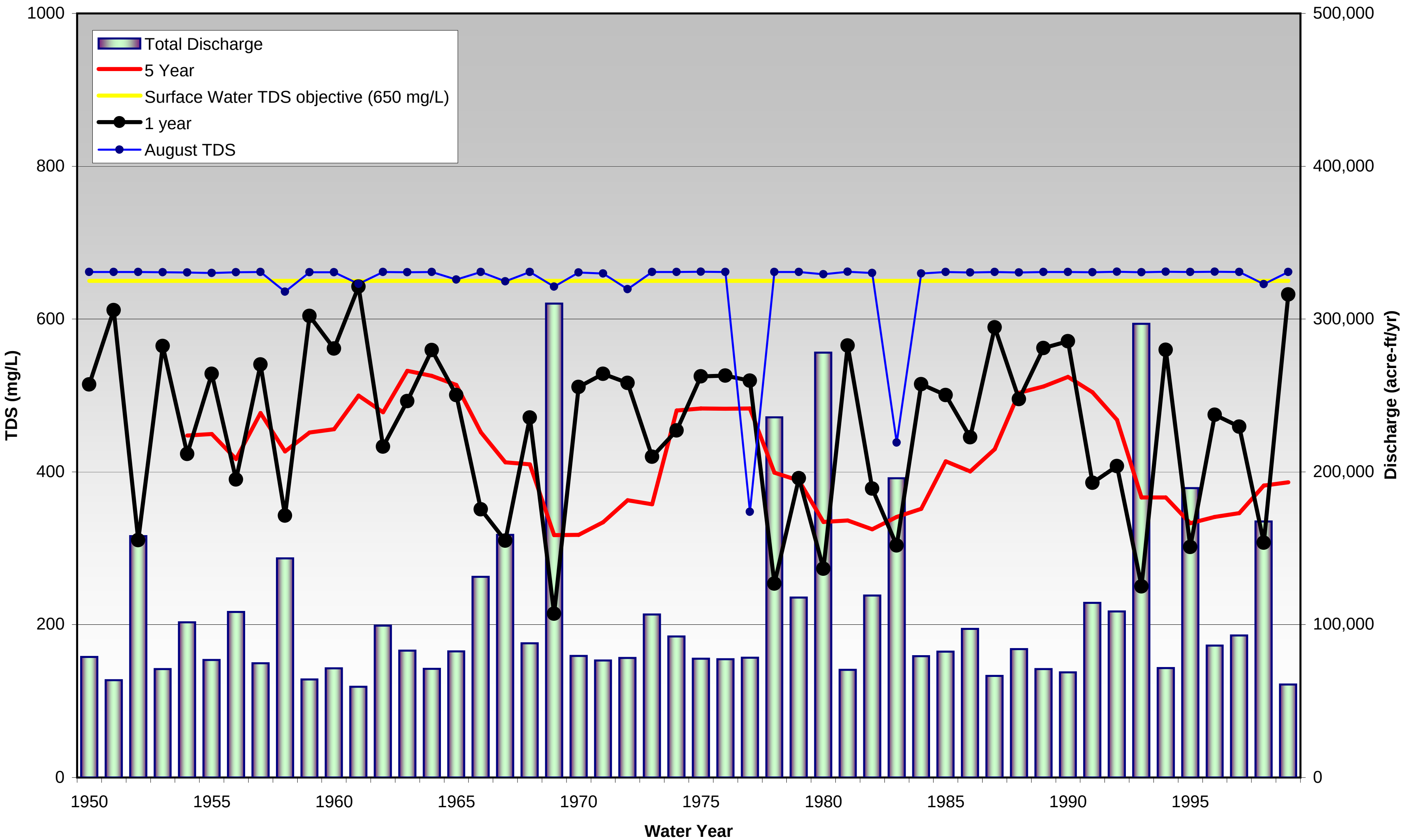
R_S610a_matrix.xls -- Fig 6b

WILDERMUTH™ ENVIRONMENTAL INC.

Table J-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 6 - Year 2010
(mg/L)

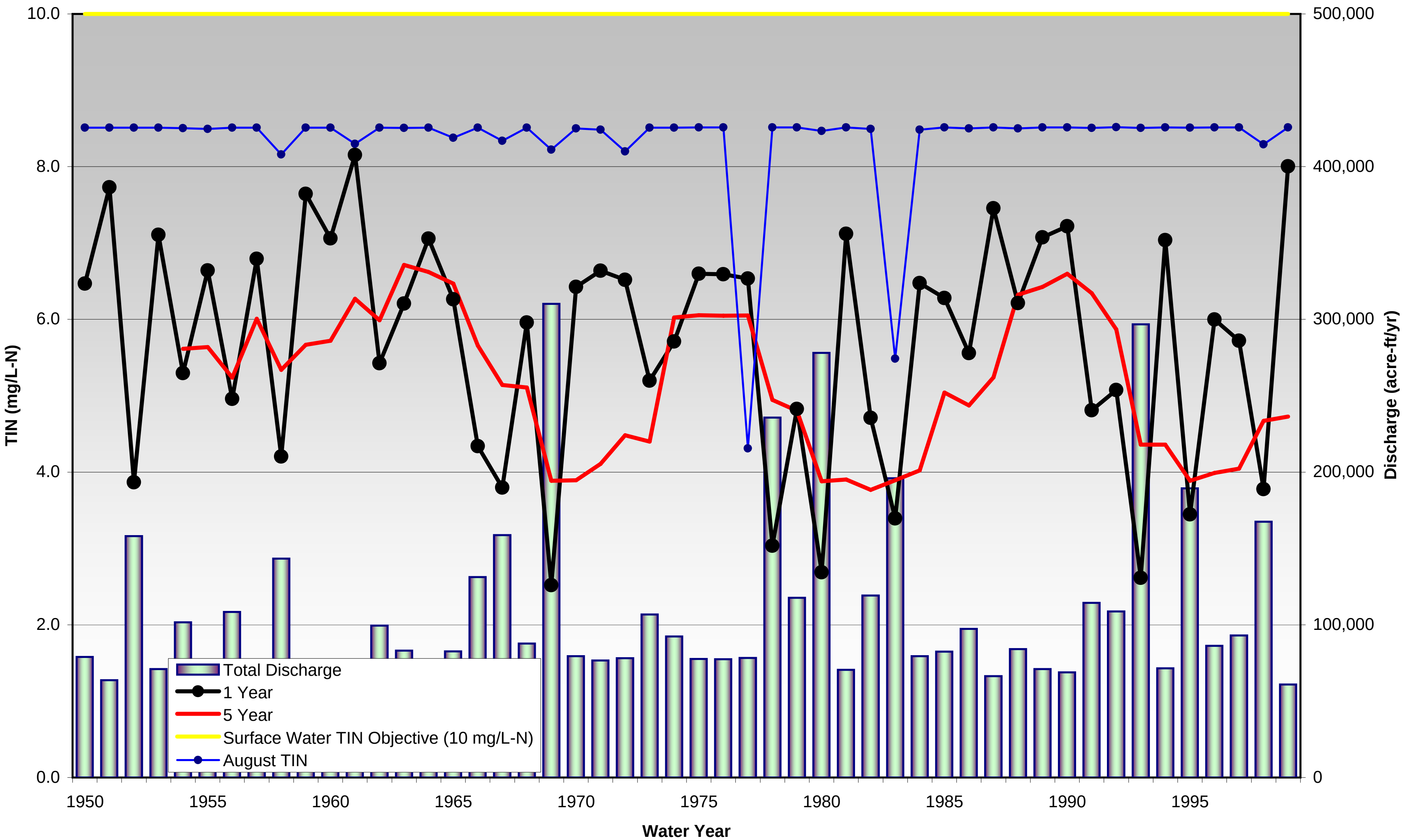
Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	514				661	6.5				8.5
1951	612	558			661	7.7	7.0			8.5
1952	311	397	428		662	3.9	5.0	5.4		8.5
1953	565	389	438		661	7.1	4.9	5.5		8.5
1954	423	482	400	447	661	5.3	6.0	5.0	5.6	8.5
1955	528	469	496	449	660	6.6	5.9	6.2	5.6	8.5
1956	390	447	439	417	661	5.0	5.7	5.5	5.2	8.5
1957	541	452	474	477	661	6.8	5.7	6.0	6.0	8.5
1958	343	411	404	427	636	4.2	5.1	5.0	5.3	8.2
1959	604	423	454	452	661	7.6	5.3	5.7	5.7	8.5
1960	561	582	459	456	661	7.1	7.3	5.7	5.7	8.5
1961	642	598	600	500	646	8.2	7.6	7.6	6.3	8.3
1962	433	511	527	478	662	5.4	6.4	6.6	6.0	8.5
1963	493	460	505	532	661	6.2	5.8	6.4	6.7	8.5
1964	560	523	488	526	662	7.1	6.6	6.1	6.6	8.5
1965	500	528	515	514	652	6.3	6.6	6.5	6.5	8.4
1966	351	409	446	452	662	4.3	5.1	5.6	5.7	8.5
1967	310	329	367	413	649	3.8	4.0	4.5	5.1	8.3
1968	471	367	362	410	661	6.0	4.6	4.5	5.1	8.5
1969	214	271	282	317	642	2.5	3.3	3.4	3.9	8.2
1970	511	275	311	318	661	6.4	3.3	3.8	3.9	8.5
1971	528	519	317	334	660	6.6	6.5	3.9	4.1	8.5
1972	516	522	518	363	639	6.5	6.6	6.5	4.5	8.2
1973	420	461	480	358	662	5.2	5.8	6.0	4.4	8.5
1974	454	436	459	480	662	5.7	5.4	5.7	6.0	8.5
1975	525	487	461	483	662	6.6	6.1	5.8	6.1	8.5
1976	526	525	499	483	662	6.6	6.6	6.3	6.0	8.5
1977	519	523	523	483	348	6.5	6.6	6.6	6.1	4.3
1978	254	320	361	399	662	3.0	3.9	4.4	4.9	8.5
1979	392	300	340	389	662	4.8	3.6	4.2	4.8	8.5
1980	273	309	288	334	659	2.7	3.3	3.2	3.9	8.5
1981	565	332	347	336	662	7.1	3.6	3.9	3.9	8.5
1982	378	448	344	325	660	4.7	5.6	3.9	3.8	8.5
1983	304	332	375	341	438	3.4	3.9	4.5	3.9	5.5
1984	515	365	369	352	659	6.5	4.3	4.4	4.0	8.5
1985	500	507	396	414	662	6.3	6.4	4.7	5.0	8.5
1986	445	471	484	401	661	5.6	5.9	6.1	4.9	8.5
1987	589	504	503	430	662	7.5	6.3	6.3	5.2	8.5
1988	495	537	501	503	661	6.2	6.8	6.3	6.3	8.5
1989	562	526	545	512	662	7.1	6.6	6.9	6.4	8.5
1990	571	566	540	524	662	7.2	7.1	6.8	6.6	8.5
1991	386	455	485	504	661	4.8	5.7	6.1	6.3	8.5
1992	408	396	437	468	662	5.1	4.9	5.5	5.9	8.5
1993	250	292	313	366	661	2.6	3.3	3.6	4.4	8.5
1994	560	310	332	366	662	7.0	3.5	3.8	4.4	8.5
1995	302	372	307	333	662	3.4	4.4	3.5	3.9	8.5
1996	475	356	398	341	662	6.0	4.2	4.8	4.0	8.5
1997	459	467	382	346	662	5.7	5.9	4.6	4.0	8.5
1998	307	361	390	382	646	3.8	4.5	4.9	4.7	8.3
1999	632	394	413	386	662	8.0	4.9	5.1	4.7	8.5

Figure J-7a
Estimated Annual Discharge and its Volume Weighted TDS Concentration in Santa Ana River Flow at below Prado
Scenario 6 - Year 2010



WILDERMUTH™ ENVIRONMENTAL INC.

Figure J-7b
Estimated Annual Discharge and its Volume Weighted TIN Concentration in Santa Ana River Flow at below Prado
Scenario 6 - Year 2010



R_S610a_matrix.xls -- Fig 7b

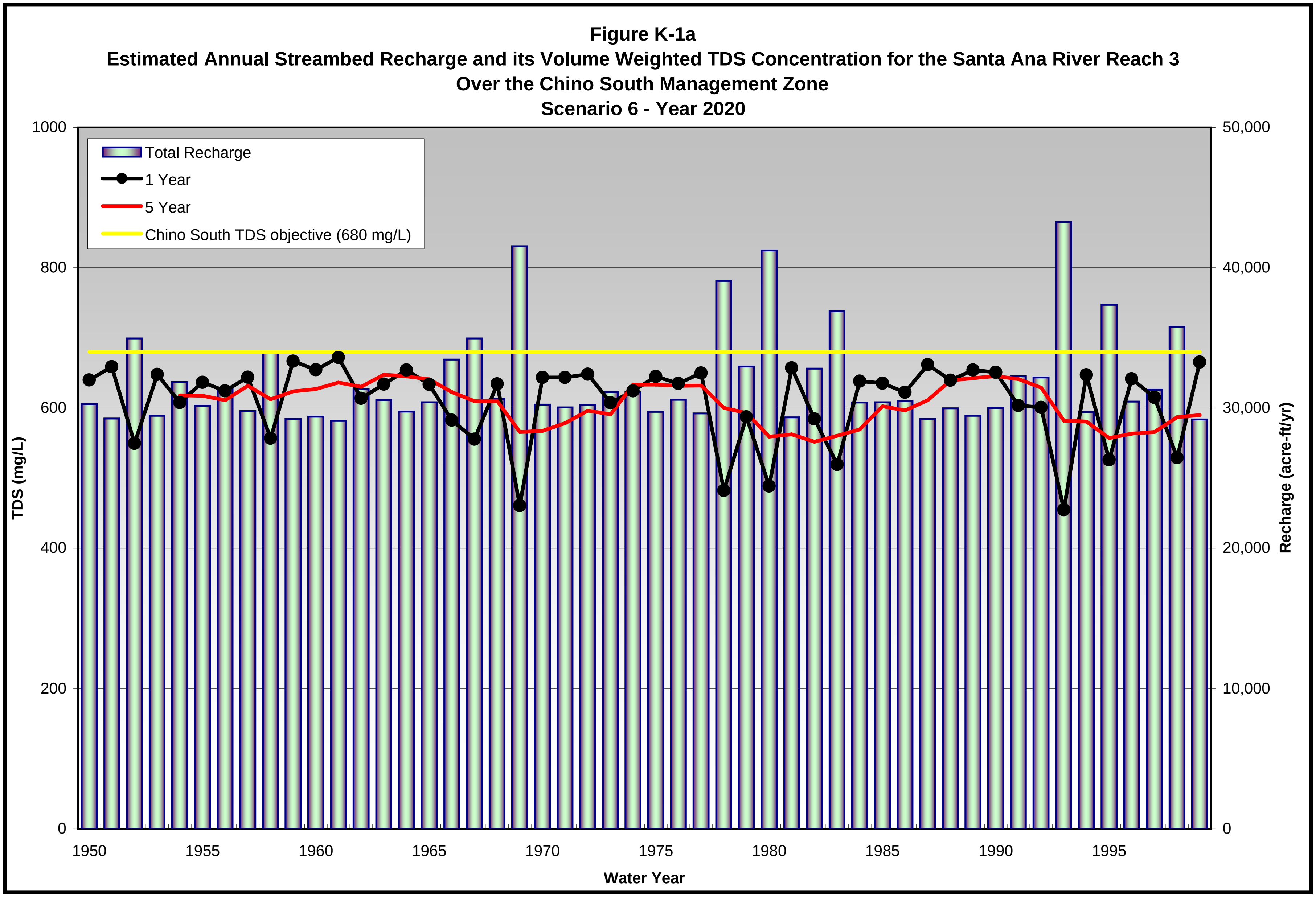
WILDERMUTH™ ENVIRONMENTAL INC.

Appendix K

Scenario 6, Year 2020 Simulation Results (Summary Matrices and Graphs)

Table K-1
TDS and TIN in Streambed Recharge to Chino South Management Zone
Scenario 6 - Year 2020
(mg/L)

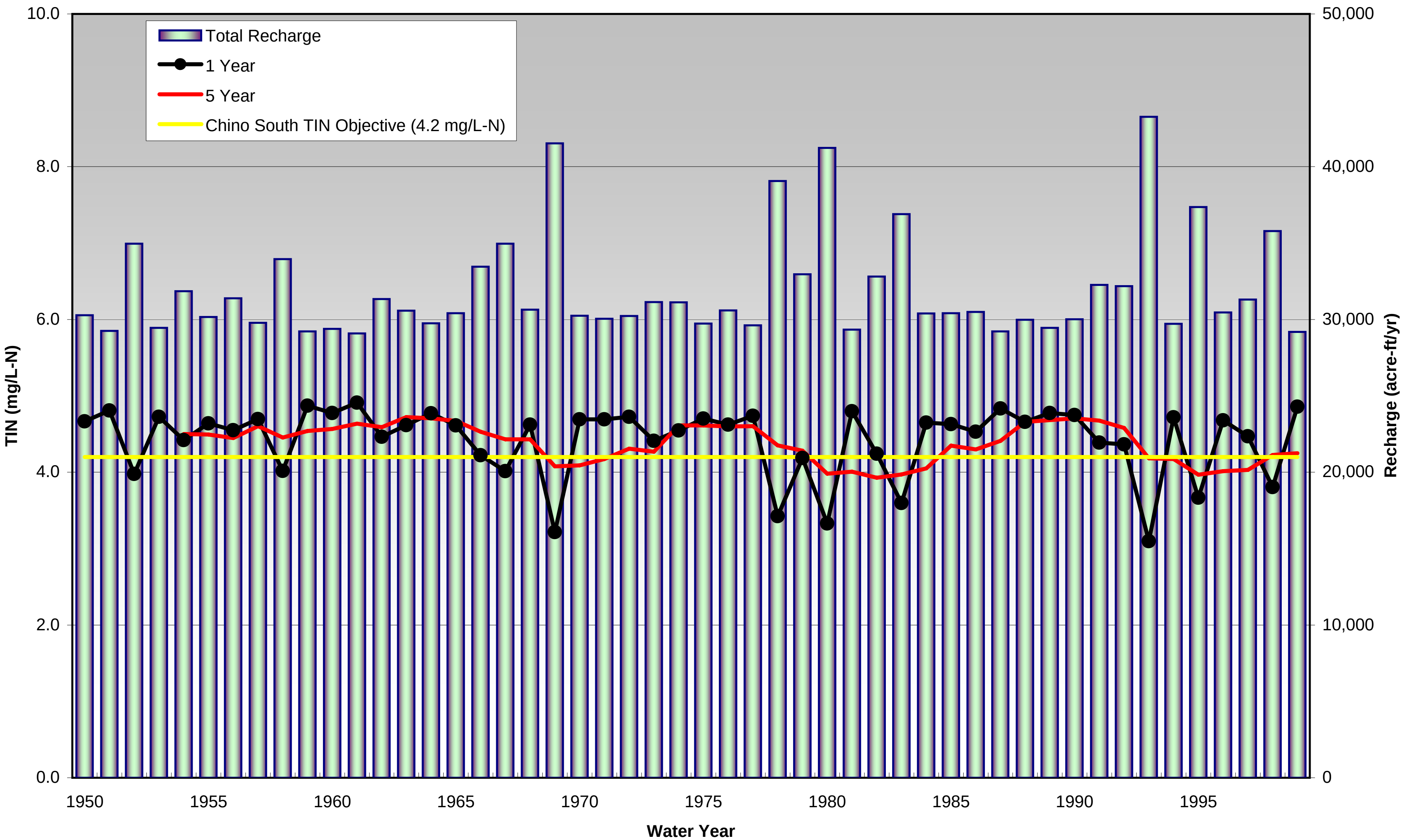
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	640				4.7			
1951	659	649			4.8	4.7		
1952	550	599	612		4.0	4.4	4.5	
1953	648	595	615		4.7	4.3	4.5	
1954	608	627	599	618	4.4	4.6	4.4	4.5
1955	637	622	630	618	4.6	4.5	4.6	4.5
1956	624	630	623	611	4.6	4.6	4.5	4.4
1957	644	634	635	632	4.7	4.6	4.6	4.6
1958	557	598	607	613	4.0	4.3	4.4	4.5
1959	667	608	619	624	4.9	4.4	4.5	4.5
1960	655	661	623	627	4.8	4.8	4.5	4.6
1961	672	663	665	636	4.9	4.8	4.9	4.6
1962	614	642	646	630	4.5	4.7	4.7	4.6
1963	634	624	639	648	4.6	4.5	4.7	4.7
1964	654	644	634	645	4.8	4.7	4.6	4.7
1965	634	644	640	641	4.6	4.7	4.7	4.7
1966	583	607	622	623	4.2	4.4	4.5	4.5
1967	556	569	589	610	4.0	4.1	4.3	4.4
1968	634	592	589	610	4.6	4.3	4.3	4.4
1969	461	535	541	566	3.2	3.8	3.9	4.1
1970	644	538	567	568	4.7	3.8	4.1	4.1
1971	644	644	569	578	4.7	4.7	4.1	4.2
1972	648	646	645	596	4.7	4.7	4.7	4.3
1973	607	628	633	591	4.4	4.6	4.6	4.3
1974	624	616	627	633	4.5	4.5	4.6	4.6
1975	645	635	625	634	4.7	4.6	4.6	4.6
1976	635	640	635	632	4.6	4.7	4.6	4.6
1977	650	642	643	632	4.7	4.7	4.7	4.6
1978	482	555	579	600	3.4	4.0	4.2	4.4
1979	587	530	565	593	4.2	3.8	4.1	4.3
1980	489	533	515	559	3.3	3.7	3.6	4.0
1981	657	559	568	563	4.8	3.9	4.0	4.0
1982	584	619	567	552	4.2	4.5	4.0	3.9
1983	519	550	582	561	3.6	3.9	4.2	4.0
1984	638	573	577	569	4.7	4.1	4.1	4.0
1985	635	637	592	603	4.6	4.6	4.2	4.3
1986	622	629	632	597	4.5	4.6	4.6	4.3
1987	662	642	640	611	4.8	4.7	4.7	4.4
1988	640	651	641	639	4.7	4.7	4.7	4.7
1989	654	647	652	642	4.8	4.7	4.8	4.7
1990	651	653	648	646	4.7	4.8	4.7	4.7
1991	603	626	635	641	4.4	4.6	4.6	4.7
1992	601	602	618	629	4.4	4.4	4.5	4.6
1993	455	517	543	582	3.1	3.6	3.9	4.2
1994	647	533	554	581	4.7	3.8	3.9	4.2
1995	526	580	531	557	3.7	4.1	3.7	4.0
1996	642	578	599	563	4.7	4.1	4.3	4.0
1997	615	628	590	566	4.5	4.6	4.2	4.0
1998	529	569	592	587	3.8	4.1	4.3	4.2
1999	665	590	598	590	4.9	4.3	4.3	4.2



R_S620a_matrix.xls -- Fig 1a

WILDERMUTH™ ENVIRONMENTAL INC.

Figure K-1b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 3
Over the Chino South Management Zone
Scenario 6 - Year 2020



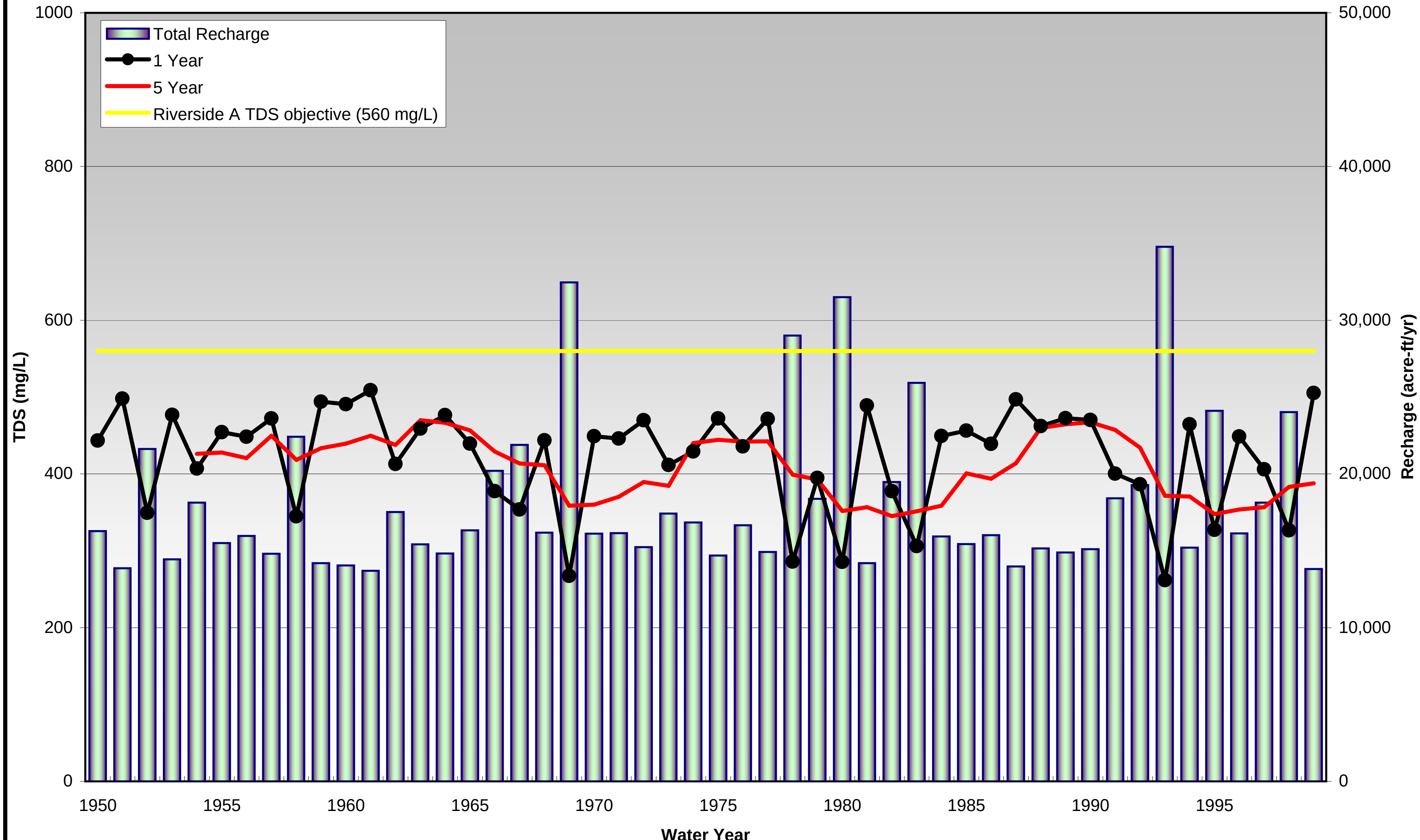
R_S620a_matrix.xls -- Fig 1b

WILDERMUTH™ ENVIRONMENTAL INC.

Table K-2
TDS and TIN in Streambed Recharge to Riverside A Management Zone
Scenario 6 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	444				6.1			
1951	498	469			7.0	6.5		
1952	350	408	419		4.7	5.6	5.7	
1953	477	400	428		6.6	5.4	5.9	
1954	407	438	403	426	5.5	6.0	5.5	5.8
1955	454	429	443	428	6.3	5.9	6.1	5.9
1956	448	451	435	421	6.2	6.3	6.0	5.8
1957	472	460	458	450	6.5	6.4	6.4	6.2
1958	345	396	411	418	4.5	5.3	5.6	5.7
1959	494	403	423	434	6.9	5.4	5.8	5.9
1960	491	492	427	440	6.8	6.9	5.8	6.0
1961	509	500	498	450	7.2	7.0	7.0	6.2
1962	413	455	466	438	5.6	6.3	6.5	6.0
1963	459	434	456	470	6.4	6.0	6.3	6.5
1964	477	468	448	467	6.6	6.5	6.2	6.5
1965	439	457	458	457	6.0	6.3	6.3	6.3
1966	377	405	426	429	5.1	5.5	5.8	5.9
1967	354	365	386	414	4.7	4.9	5.2	5.6
1968	444	392	387	411	6.1	5.3	5.2	5.6
1969	267	326	335	359	3.2	4.1	4.3	4.7
1970	449	328	357	360	6.2	4.2	4.7	4.7
1971	446	448	357	370	6.1	6.2	4.7	4.9
1972	470	458	455	390	6.5	6.3	6.3	5.2
1973	412	439	441	385	5.6	6.0	6.1	5.1
1974	429	420	435	440	5.9	5.7	6.0	6.1
1975	472	449	436	444	6.6	6.2	6.0	6.1
1976	436	453	445	442	6.0	6.3	6.1	6.1
1977	472	453	459	442	6.6	6.3	6.4	6.1
1978	286	349	373	399	3.5	4.5	4.9	5.4
1979	395	328	363	393	5.3	4.2	4.8	5.3
1980	286	326	311	352	3.5	4.1	3.9	4.6
1981	489	349	362	357	6.8	4.5	4.7	4.7
1982	378	425	357	345	5.1	5.8	4.7	4.5
1983	306	337	373	352	3.9	4.4	5.0	4.6
1984	449	361	366	359	6.2	4.8	4.9	4.7
1985	456	453	386	401	6.3	6.3	5.2	5.4
1986	439	448	448	394	6.0	6.2	6.2	5.3
1987	497	466	463	414	6.9	6.5	6.4	5.6
1988	462	479	465	460	6.4	6.7	6.4	6.4
1989	473	467	477	465	6.6	6.5	6.6	6.4
1990	470	471	468	467	6.5	6.5	6.5	6.5
1991	400	432	444	457	5.4	5.9	6.1	6.3
1992	387	393	415	434	5.2	5.3	5.7	6.0
1993	262	306	330	371	3.1	3.8	4.2	4.9
1994	464	323	341	371	6.4	4.1	4.4	4.9
1995	327	380	325	348	4.2	5.1	4.1	4.5
1996	449	376	400	354	6.2	5.0	5.4	4.6
1997	406	426	385	357	5.5	5.8	5.1	4.7
1998	327	361	385	383	4.2	4.7	5.1	5.1
1999	505	392	396	388	7.1	5.2	5.3	5.2

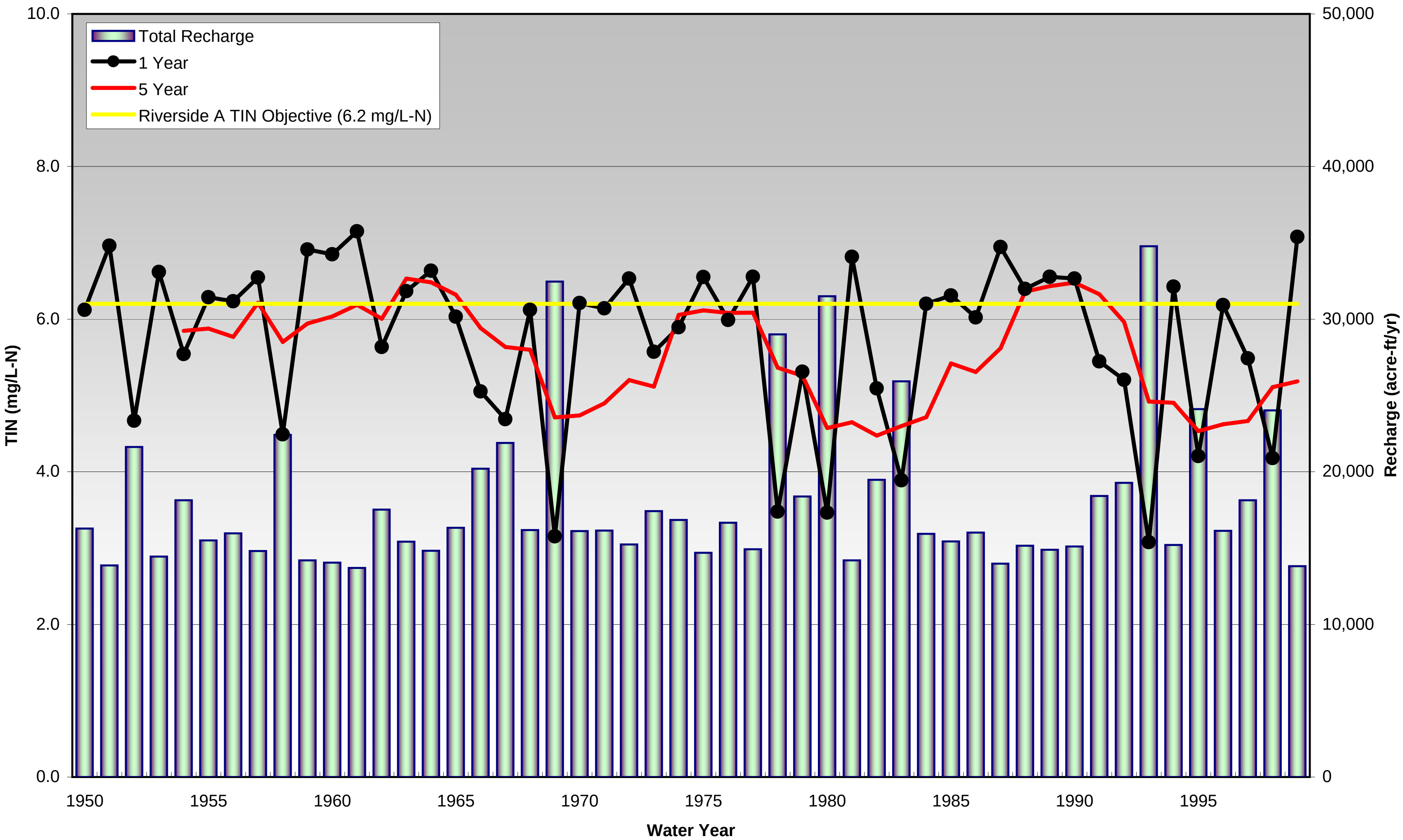
Figure K-2a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration for the Santa Ana River Reach 4
Over the Riverside A Management Zone
Scenario 6 - Year 2020



R_S620a_matrix.xls -- Fig 2a

WILDERMUTH™ ENVIRONMENTAL INC.

Figure K-2b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration for the Santa Ana River Reach 4 Over the Riverside A Management Zone
Scenario 6 - Year 2020



R_S620a_matrix.xls -- Fig 2b

WILDERMUTH ENVIRONMENTAL INC.

Table K-3
TDS and TIN in Streambed Recharge to Colton Management Zone
Scenario 6 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	142				1.1			
1951	165	150			1.3	1.2		
1952	140	143	143		1.1	1.1	1.1	
1953	160	144	146		1.2	1.1	1.2	
1954	144	149	144	145	1.1	1.2	1.1	1.2
1955	149	146	149	146	1.2	1.2	1.2	1.2
1956	127	137	141	142	1.0	1.1	1.1	1.1
1957	160	142	144	146	1.2	1.1	1.1	1.2
1958	153	155	149	148	1.2	1.2	1.2	1.2
1959	168	155	156	150	1.3	1.2	1.2	1.2
1960	155	160	155	151	1.2	1.2	1.2	1.2
1961	164	158	161	156	1.3	1.2	1.2	1.2
1962	147	151	152	154	1.2	1.2	1.2	1.2
1963	137	144	146	151	1.1	1.1	1.2	1.2
1964	157	146	147	150	1.2	1.1	1.2	1.2
1965	149	152	147	148	1.2	1.2	1.2	1.2
1966	140	143	145	145	1.1	1.1	1.1	1.1
1967	146	143	144	145	1.1	1.1	1.1	1.1
1968	143	145	143	145	1.1	1.1	1.1	1.1
1969	161	159	155	153	1.2	1.2	1.2	1.2
1970	141	159	157	152	1.1	1.2	1.2	1.2
1971	148	144	158	154	1.2	1.2	1.2	1.2
1972	152	150	146	156	1.2	1.2	1.2	1.2
1973	156	154	153	157	1.2	1.2	1.2	1.2
1974	140	150	150	148	1.1	1.2	1.2	1.2
1975	164	150	153	152	1.2	1.2	1.2	1.2
1976	138	148	145	149	1.1	1.1	1.1	1.2
1977	150	142	148	149	1.2	1.1	1.2	1.2
1978	158	157	154	153	1.2	1.2	1.2	1.2
1979	155	157	157	155	1.2	1.2	1.2	1.2
1980	157	156	157	155	1.2	1.2	1.2	1.2
1981	170	158	157	157	1.3	1.2	1.2	1.2
1982	131	141	152	155	1.1	1.1	1.2	1.2
1983	156	149	151	154	1.2	1.2	1.2	1.2
1984	162	157	151	154	1.2	1.2	1.2	1.2
1985	149	155	156	152	1.1	1.2	1.2	1.2
1986	158	154	156	151	1.2	1.2	1.2	1.2
1987	168	161	157	157	1.3	1.2	1.2	1.2
1988	153	158	158	157	1.2	1.2	1.2	1.2
1989	160	156	159	157	1.2	1.2	1.2	1.2
1990	155	158	156	158	1.2	1.2	1.2	1.2
1991	138	142	146	149	1.1	1.1	1.2	1.2
1992	137	137	140	144	1.1	1.1	1.1	1.1
1993	157	154	151	152	1.2	1.2	1.2	1.2
1994	164	158	154	152	1.2	1.2	1.2	1.2
1995	154	155	156	152	1.2	1.2	1.2	1.2
1996	159	155	156	154	1.2	1.2	1.2	1.2
1997	153	155	154	156	1.2	1.2	1.2	1.2
1998	160	158	158	157	1.2	1.2	1.2	1.2
1999	182	162	160	158	1.4	1.2	1.2	1.2

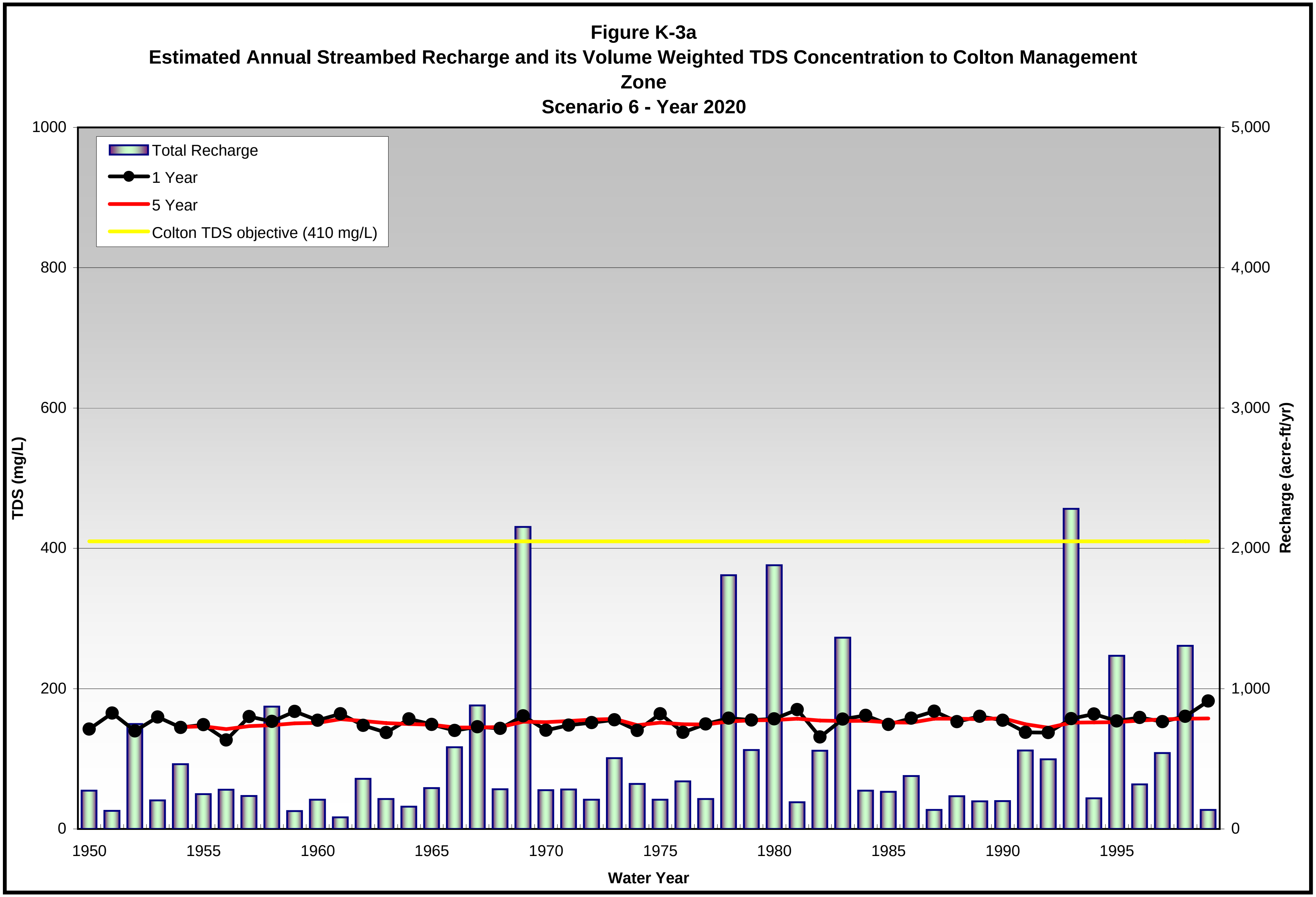
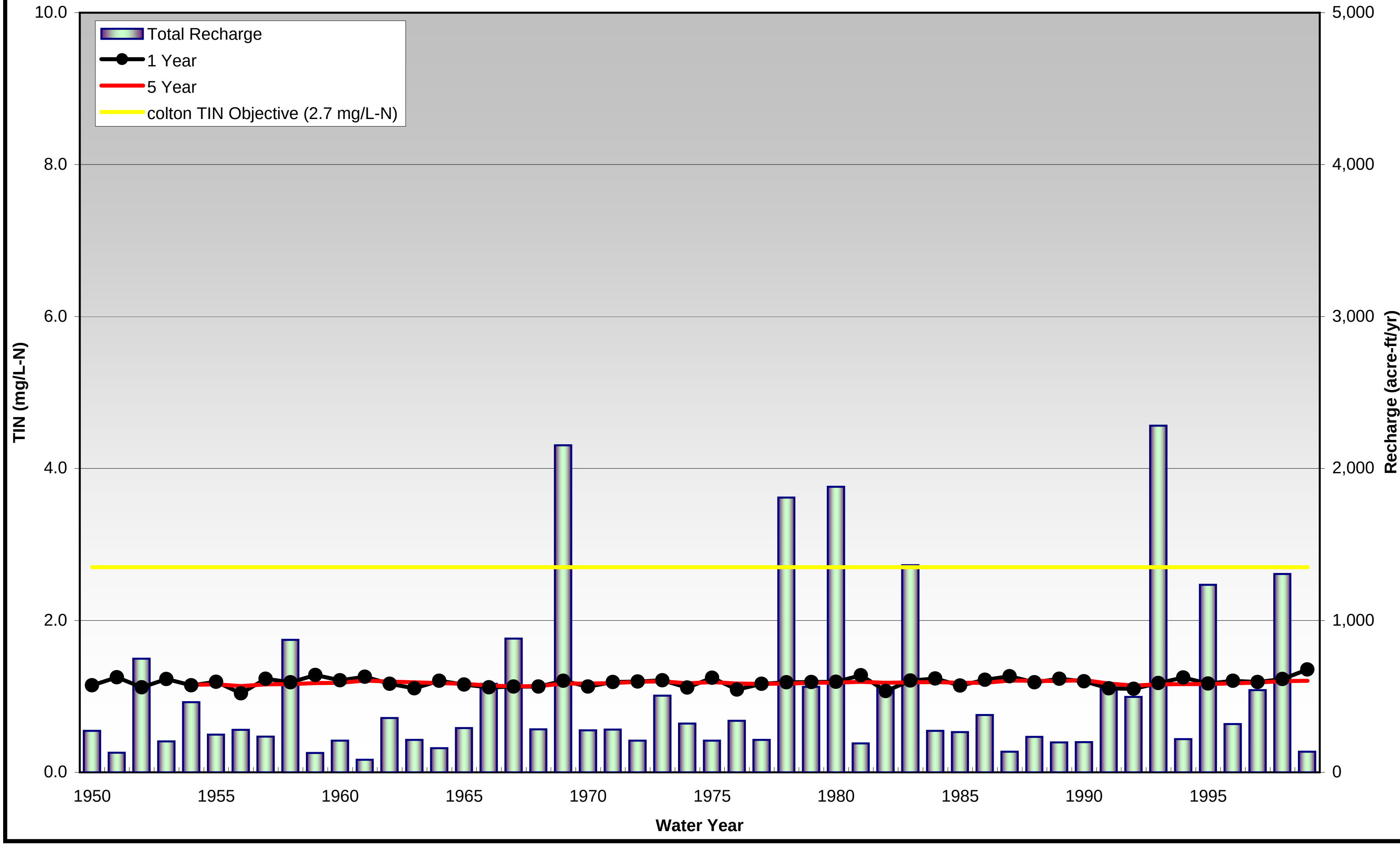


Figure K-3a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Colton Management Zone
Scenario 6 - Year 2020
Total Recharge
1 Year
5 Year
Colton TDS objective (410 mg/L)
TDS (mg/L)
Recharge (acre-ft/yr)
Water Year
1000
800
600
400
200
0
5,000
4,000
3,000
2,000
1,000
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

Figure K-3b
Estimated Annual Streambed Recharge and its Volume Weighted TIN Concentration to Colton Management Zone
Scenario 6 - Year 2020



R_S620a_matrix.xls -- Fig 3b

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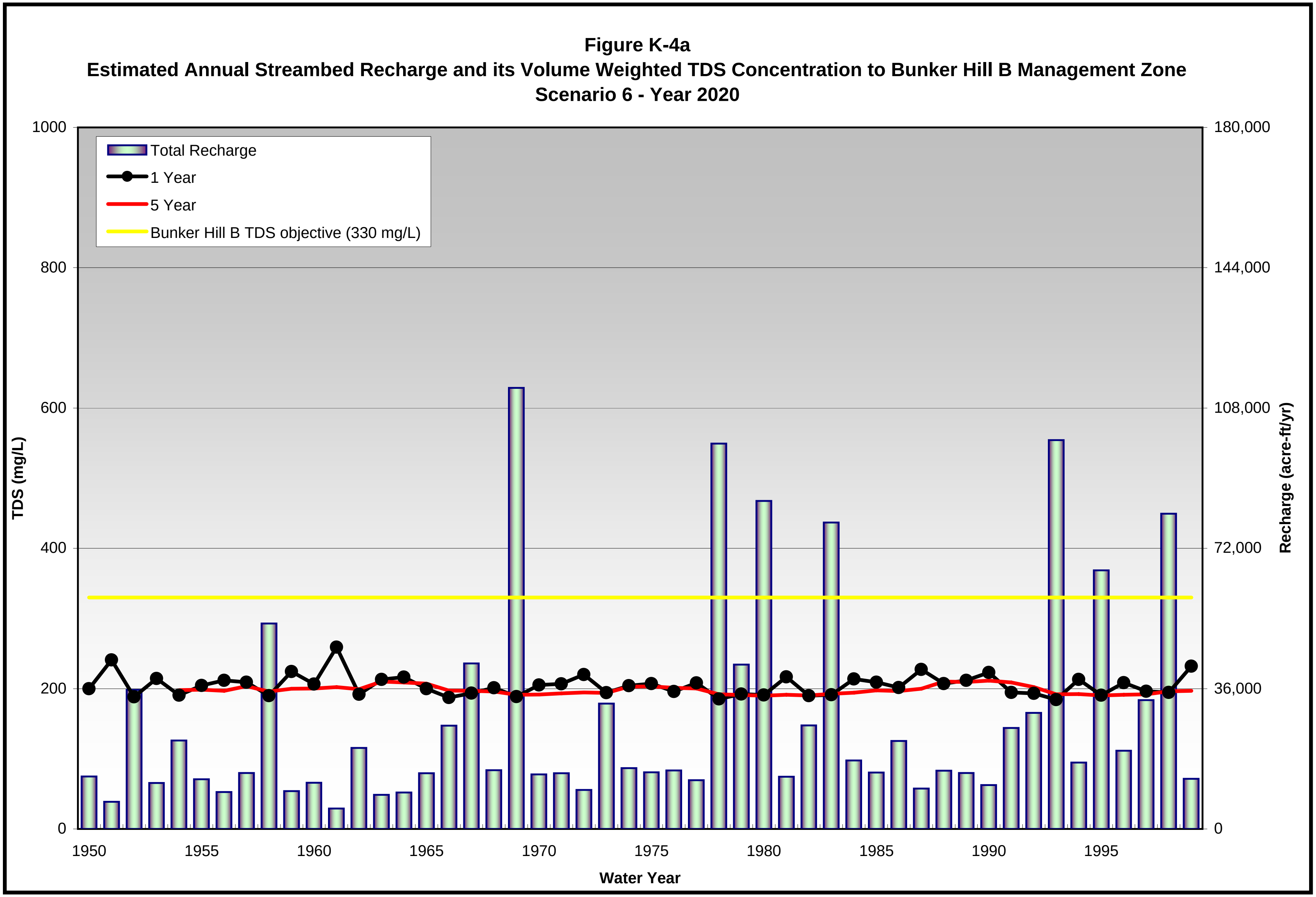
Table K-4
TDS and TIN in Streambed Recharge to Bunker Hill B Management Zone
Scenario 6 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	200				1.6			
1951	241	214			1.8	1.7		
1952	188	197	197		1.5	1.5	1.6	
1953	214	195	201		1.6	1.5	1.5	
1954	191	199	193	198	1.5	1.5	1.5	1.5
1955	204	196	200	199	1.6	1.5	1.5	1.5
1956	212	208	199	197	1.6	1.6	1.6	1.5
1957	209	210	208	204	1.6	1.6	1.6	1.6
1958	190	194	196	196	1.4	1.5	1.5	1.5
1959	224	195	198	200	1.7	1.5	1.5	1.5
1960	207	215	197	200	1.6	1.6	1.5	1.5
1961	259	223	223	202	2.0	1.7	1.7	1.5
1962	192	206	206	199	1.5	1.6	1.6	1.5
1963	213	198	207	210	1.7	1.6	1.6	1.6
1964	217	215	203	209	1.7	1.7	1.6	1.6
1965	200	207	208	207	1.5	1.6	1.6	1.6
1966	187	192	196	197	1.5	1.5	1.5	1.6
1967	194	191	193	197	1.5	1.5	1.5	1.5
1968	201	196	193	196	1.6	1.5	1.5	1.5
1969	189	190	191	191	1.4	1.4	1.4	1.4
1970	205	190	192	192	1.6	1.4	1.4	1.4
1971	207	206	192	193	1.6	1.6	1.4	1.5
1972	220	212	210	195	1.7	1.7	1.6	1.5
1973	194	200	202	194	1.5	1.5	1.6	1.5
1974	204	197	201	203	1.6	1.5	1.5	1.6
1975	207	206	200	203	1.6	1.6	1.5	1.6
1976	196	201	202	201	1.6	1.6	1.6	1.6
1977	208	201	203	200	1.6	1.6	1.6	1.5
1978	185	188	189	192	1.4	1.4	1.4	1.5
1979	192	187	189	191	1.5	1.4	1.4	1.4
1980	191	191	189	190	1.4	1.4	1.4	1.4
1981	217	195	194	191	1.6	1.4	1.5	1.4
1982	190	199	194	190	1.5	1.5	1.5	1.4
1983	191	191	194	193	1.4	1.5	1.5	1.5
1984	214	195	194	194	1.6	1.5	1.5	1.5
1985	209	212	197	198	1.6	1.6	1.5	1.5
1986	201	204	207	197	1.5	1.6	1.6	1.5
1987	227	210	209	200	1.7	1.6	1.6	1.5
1988	207	215	209	210	1.6	1.7	1.6	1.6
1989	212	209	214	209	1.6	1.6	1.6	1.6
1990	223	217	213	212	1.7	1.6	1.6	1.6
1991	195	203	206	209	1.5	1.6	1.6	1.6
1992	193	194	199	202	1.5	1.5	1.5	1.5
1993	184	186	188	192	1.4	1.4	1.4	1.4
1994	213	189	190	192	1.6	1.4	1.4	1.4
1995	190	195	189	190	1.4	1.5	1.4	1.4
1996	208	195	198	191	1.6	1.5	1.5	1.4
1997	196	201	195	192	1.5	1.5	1.5	1.4
1998	194	195	197	196	1.4	1.5	1.5	1.5
1999	232	200	199	197	1.7	1.5	1.5	1.5



R_S620a_matrix.xls -- Fig 4a

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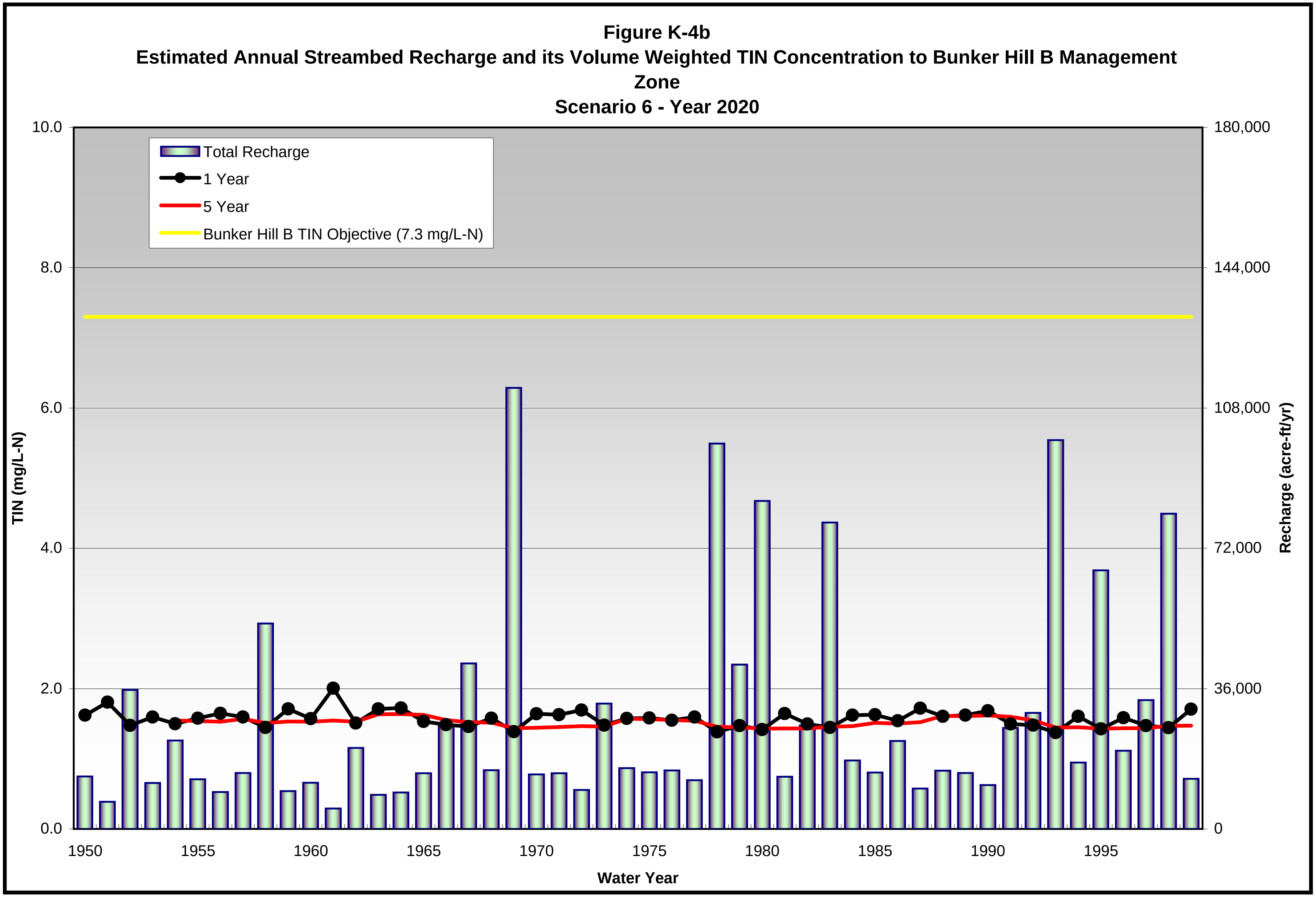


R_S620a_matrix.xls -- Fig 4b

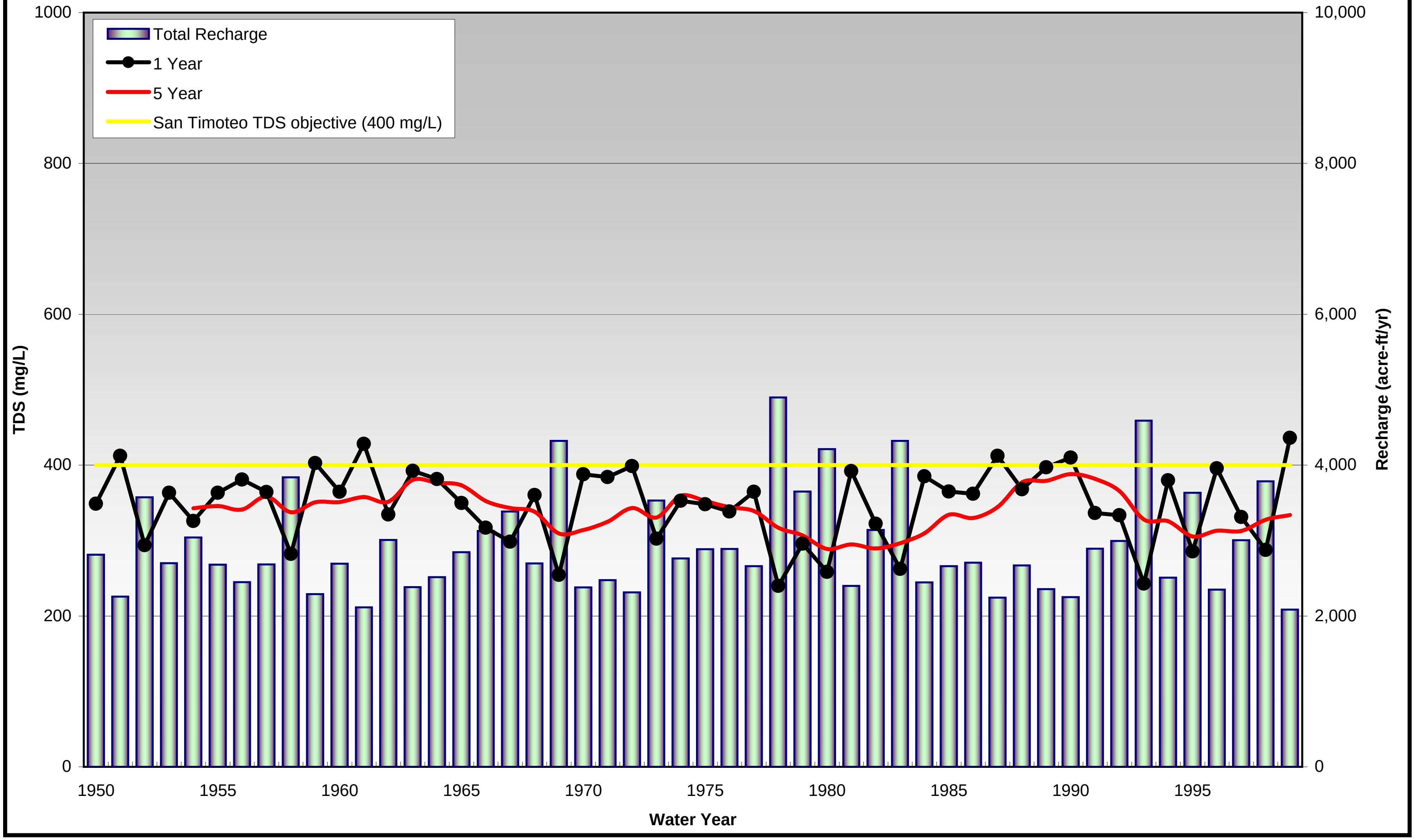
WILDERMUTH ENVIRONMENTAL INC.

Table K-5
TDS and TIN in Streambed Recharge to San Timoteo Management Zone
Scenario 6 - Year 2020
(mg/L)

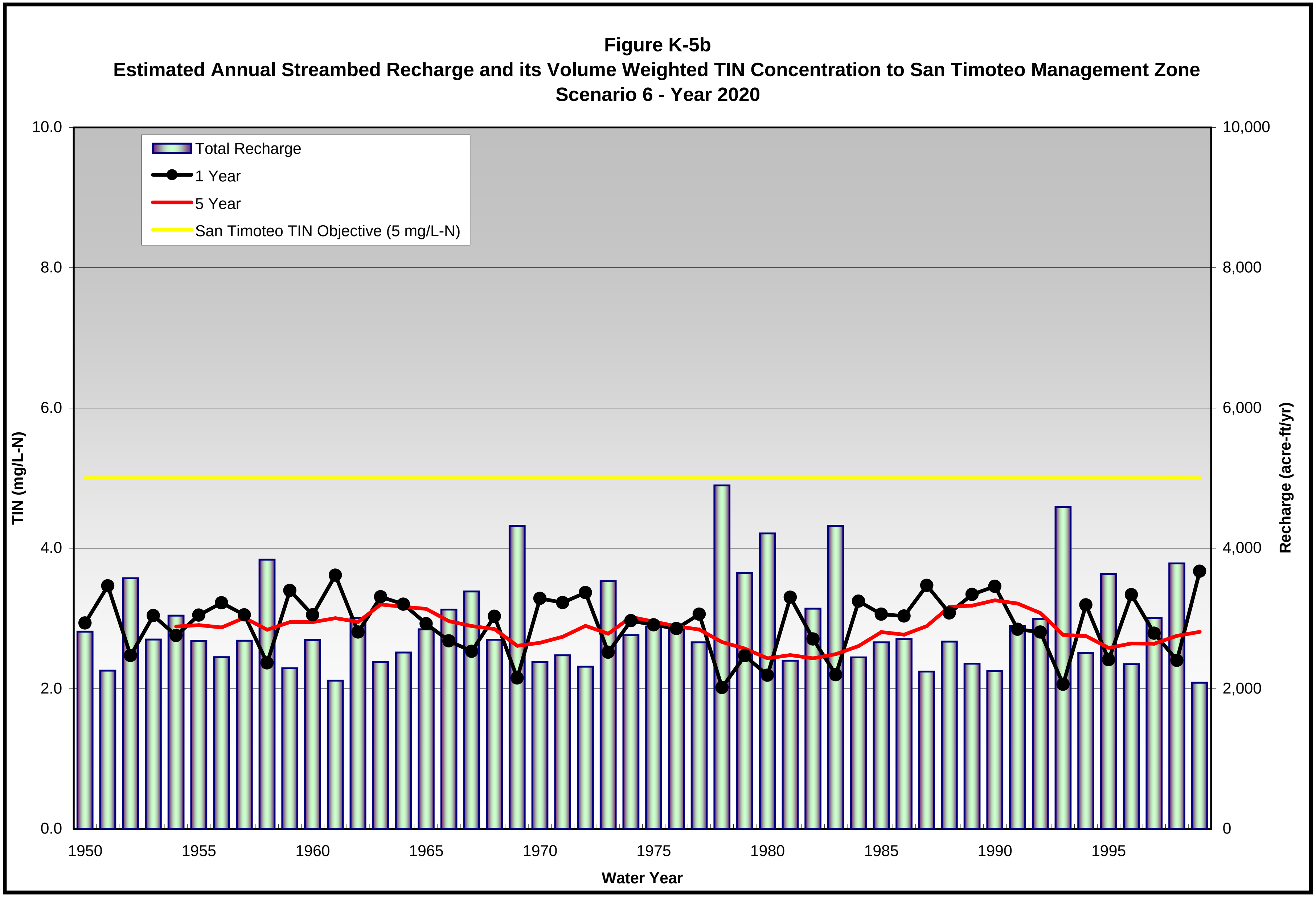
Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	349				2.9			
1951	412	377			3.5	3.2		
1952	294	340	343		2.5	2.9	2.9	
1953	363	324	347		3.0	2.7	2.9	
1954	326	344	324	343	2.8	2.9	2.7	2.9
1955	363	343	350	346	3.0	2.9	2.9	2.9
1956	381	372	355	341	3.2	3.1	3.0	2.9
1957	364	372	369	358	3.1	3.1	3.1	3.0
1958	282	316	334	338	2.4	2.6	2.8	2.8
1959	403	327	339	351	3.4	2.8	2.8	2.9
1960	365	382	339	351	3.1	3.2	2.8	2.9
1961	428	393	396	358	3.6	3.3	3.3	3.0
1962	335	373	370	351	2.8	3.1	3.1	3.0
1963	392	360	379	380	3.3	3.0	3.2	3.2
1964	382	387	367	377	3.2	3.3	3.1	3.2
1965	350	365	373	373	2.9	3.1	3.1	3.1
1966	317	333	347	352	2.7	2.8	2.9	3.0
1967	298	307	320	343	2.5	2.6	2.7	2.9
1968	360	326	323	338	3.0	2.8	2.7	2.8
1969	255	295	296	310	2.2	2.5	2.5	2.6
1970	388	302	319	314	3.3	2.6	2.7	2.7
1971	384	386	324	325	3.2	3.3	2.7	2.7
1972	399	391	390	343	3.4	3.3	3.3	2.9
1973	302	341	354	331	2.5	2.9	3.0	2.8
1974	353	324	344	359	3.0	2.7	2.9	3.0
1975	348	350	332	352	2.9	2.9	2.8	3.0
1976	338	343	346	344	2.9	2.9	2.9	2.9
1977	365	351	350	339	3.1	3.0	2.9	2.8
1978	240	284	299	317	2.0	2.4	2.5	2.7
1979	296	264	288	307	2.5	2.2	2.4	2.6
1980	259	276	262	289	2.2	2.3	2.2	2.4
1981	392	307	303	295	3.3	2.6	2.5	2.5
1982	322	353	312	289	2.7	3.0	2.6	2.4
1983	262	288	313	297	2.2	2.4	2.6	2.5
1984	385	307	312	310	3.2	2.6	2.6	2.6
1985	365	375	323	334	3.1	3.1	2.7	2.8
1986	362	363	370	330	3.0	3.0	3.1	2.8
1987	412	385	378	344	3.5	3.2	3.2	2.9
1988	368	388	379	377	3.1	3.3	3.2	3.2
1989	397	382	391	379	3.3	3.2	3.3	3.2
1990	410	403	390	388	3.5	3.4	3.3	3.3
1991	337	369	378	382	2.8	3.1	3.2	3.2
1992	334	335	356	366	2.8	2.8	3.0	3.1
1993	243	279	295	328	2.1	2.4	2.5	2.8
1994	380	291	304	326	3.2	2.5	2.6	2.7
1995	286	324	289	306	2.4	2.7	2.4	2.6
1996	396	329	344	313	3.3	2.8	2.9	2.6
1997	331	360	330	313	2.8	3.0	2.8	2.6
1998	288	307	330	328	2.4	2.6	2.8	2.8
1999	436	340	337	334	3.7	2.9	2.8	2.8

San Timoteo Reach 3 defined here is equivalent to San Temoteo Cr reaches 3 and 4 described in 1!

Figure K-5a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to San Timoteo Management Zone
Scenario 6 - Year 2020



R_S620a_matrix.xls -- Fig 5a



R_S620a_matrix.xls -- Fig 5b

Table K-6
TDS and TIN in Streambed Recharge to Beaumont Management Zone
Scenario 6 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average							
	TDS				TIN			
	1 year	2 Year	3 Year	5 Year	1 year	2 Year	3 Year	5 Year
1950	110				0.9			
1951	157	116			1.2	0.9		
1952	96	100	103		0.8	0.8	0.9	
1953	138	102	106		1.1	0.9	0.9	
1954	95	102	99	102	0.8	0.9	0.8	0.9
1955	123	101	106	103	1.0	0.9	0.9	0.9
1956	88	103	98	100	0.8	0.9	0.8	0.8
1957	118	102	108	105	0.9	0.8	0.9	0.9
1958	98	102	100	100	0.8	0.9	0.8	0.8
1959	125	102	104	104	1.0	0.9	0.9	0.9
1960	144	135	106	105	1.1	1.1	0.9	0.9
1961	149	145	137	109	1.1	1.1	1.1	0.9
1962	107	111	117	108	0.9	0.9	0.9	0.9
1963	115	109	112	118	0.9	0.9	0.9	0.9
1964	138	125	114	119	1.1	1.0	0.9	1.0
1965	110	118	117	114	0.9	0.9	0.9	0.9
1966	91	98	103	105	0.8	0.8	0.9	0.9
1967	89	90	94	98	0.8	0.8	0.8	0.8
1968	110	95	93	99	0.9	0.8	0.8	0.8
1969	87	92	91	93	0.8	0.8	0.8	0.8
1970	96	89	92	91	0.8	0.8	0.8	0.8
1971	113	104	92	93	0.9	0.9	0.8	0.8
1972	106	109	104	95	0.9	0.9	0.9	0.8
1973	118	114	113	97	1.0	0.9	0.9	0.8
1974	108	113	111	109	0.9	0.9	0.9	0.9
1975	121	113	115	113	1.0	0.9	0.9	0.9
1976	98	106	107	109	0.8	0.9	0.9	0.9
1977	118	104	109	111	1.0	0.9	0.9	0.9
1978	98	101	100	103	0.8	0.8	0.8	0.9
1979	105	101	102	103	0.9	0.8	0.9	0.9
1980	95	99	99	100	0.8	0.8	0.8	0.8
1981	137	98	101	101	1.1	0.8	0.8	0.8
1982	97	102	98	99	0.8	0.9	0.8	0.8
1983	99	98	100	99	0.8	0.8	0.8	0.8
1984	111	100	99	99	0.9	0.8	0.8	0.8
1985	113	112	102	102	0.9	0.9	0.8	0.9
1986	112	112	112	102	0.9	0.9	0.9	0.9
1987	147	118	116	105	1.1	0.9	0.9	0.9
1988	136	140	122	118	1.1	1.1	1.0	0.9
1989	145	140	142	122	1.1	1.1	1.1	1.0
1990	115	127	130	124	0.9	1.0	1.0	1.0
1991	96	100	105	112	0.8	0.8	0.9	0.9
1992	105	100	102	108	0.9	0.8	0.8	0.9
1993	89	93	94	96	0.8	0.8	0.8	0.8
1994	123	93	95	96	1.0	0.8	0.8	0.8
1995	85	90	90	93	0.7	0.8	0.8	0.8
1996	97	87	92	92	0.8	0.8	0.8	0.8
1997	103	101	92	92	0.9	0.8	0.8	0.8
1998	106	105	103	97	0.9	0.9	0.9	0.8
1999	166	109	106	97	1.2	0.9	0.9	0.8

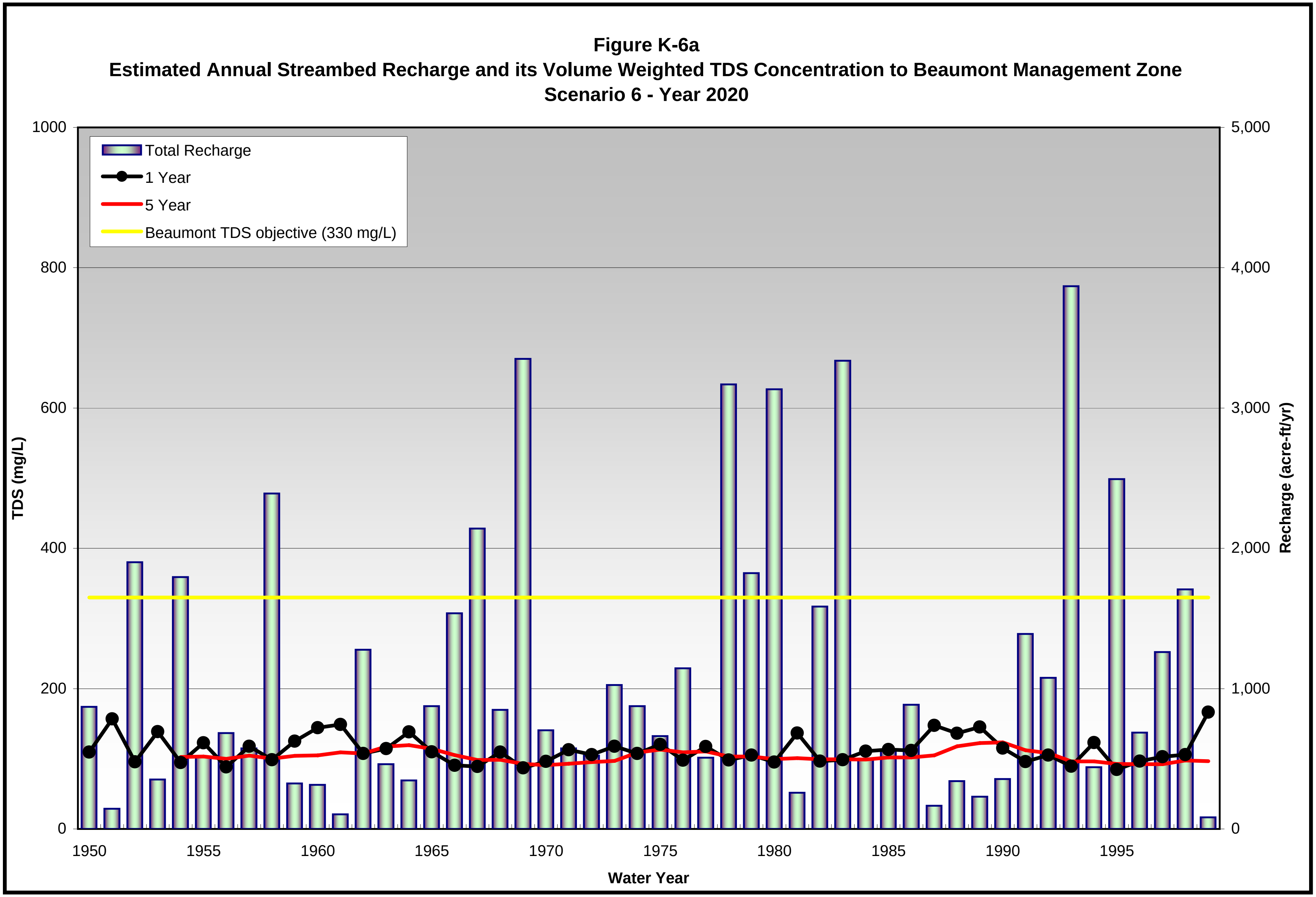
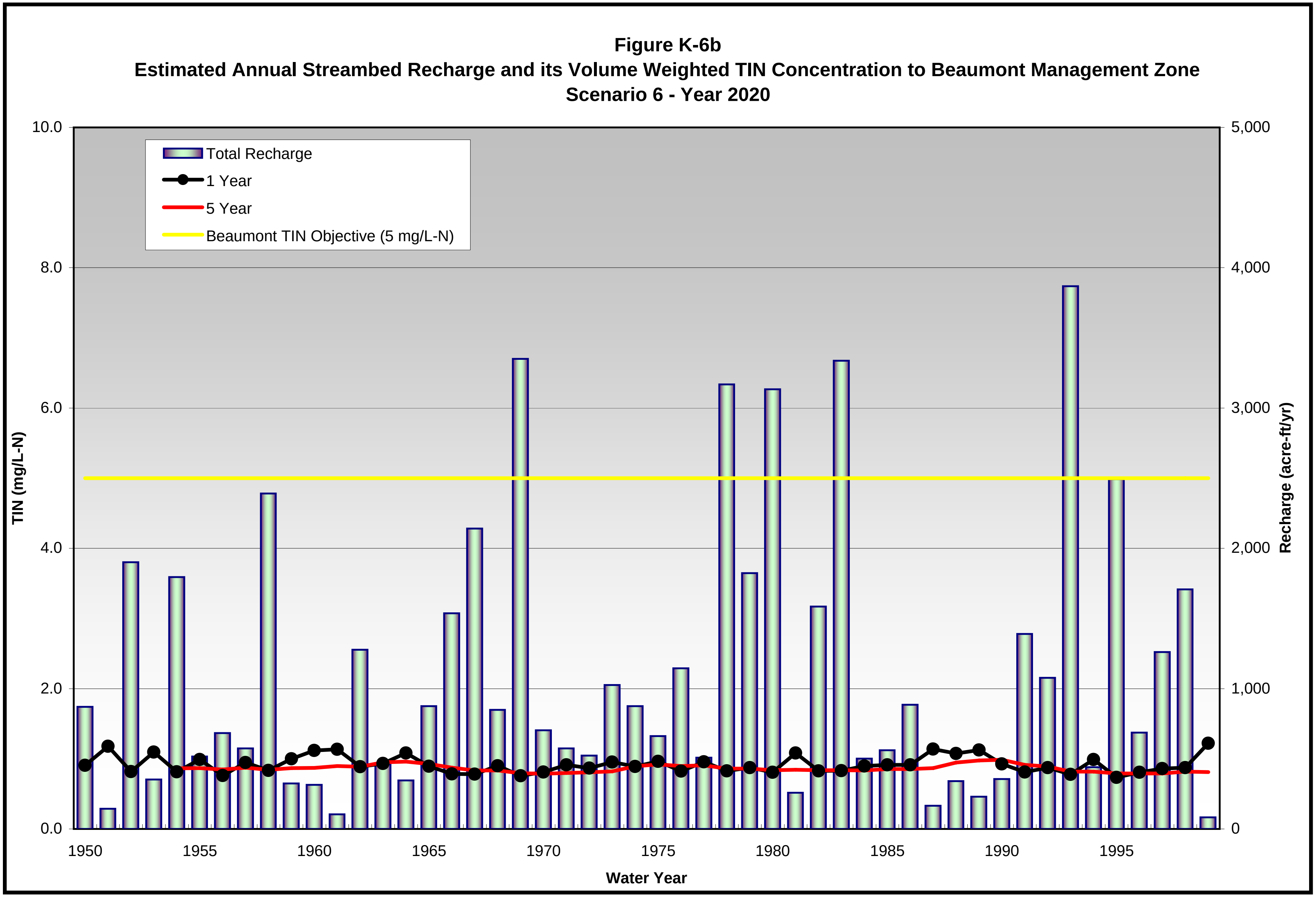


Figure K-6a
Estimated Annual Streambed Recharge and its Volume Weighted TDS Concentration to Beaumont Management Zone
Scenario 6 - Year 2020
Total Recharge
1 Year
5 Year
Beaumont TDS objective (330 mg/L)
TDS (mg/L)
Recharge (acre-ft/yr)
Water Year
0
200
400
600
800
1000
0
1,000
2,000
3,000
4,000
5,000
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995

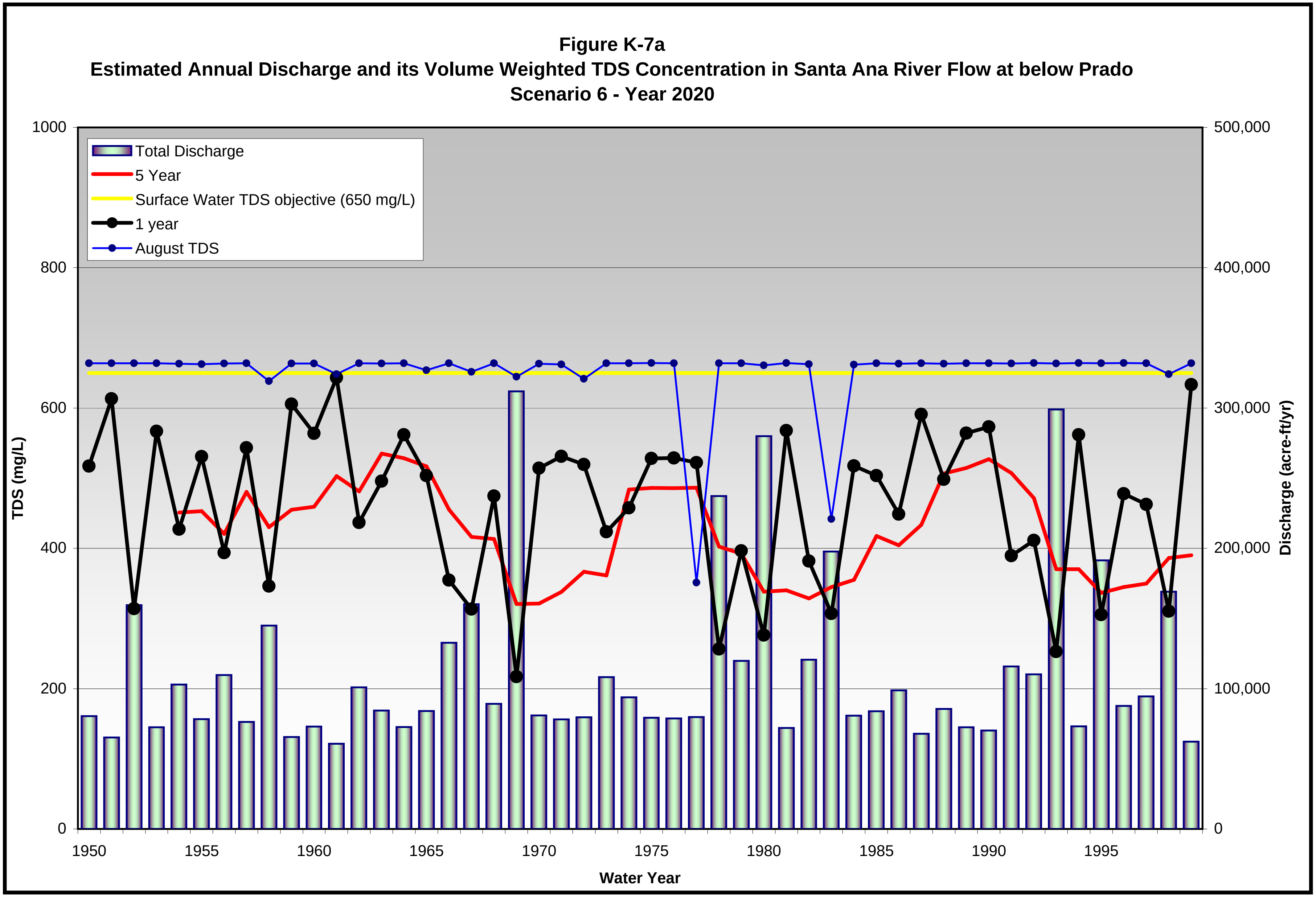


R_S620a_matrix.xls -- Fig 6b

WILDERMUTH ENVIRONMENTAL INC.

Table K-7
TDS and TIN in Santa Ana River Flow at below Prado
Scenario 6 - Year 2020
(mg/L)

Water Year	Volume-Weighted Average									
	TDS					TIN				
	1 year	2 Year	3 Year	5 Year	August TDS	1 year	2 Year	3 Year	5 Year	August TIN
1950	517				664	6.5				8.5
1951	613	560			664	7.7	7.0			8.5
1952	314	401	432		664	3.9	5.0	5.4		8.5
1953	567	393	441		664	7.1	4.9	5.5		8.5
1954	427	485	404	451	663	5.3	6.1	5.0	5.6	8.5
1955	531	472	499	453	663	6.7	5.9	6.2	5.7	8.5
1956	394	451	442	421	664	5.0	5.7	5.6	5.3	8.5
1957	543	455	478	480	664	6.8	5.7	6.0	6.0	8.5
1958	346	414	407	430	638	4.2	5.1	5.1	5.4	8.2
1959	606	427	458	455	664	7.6	5.3	5.7	5.7	8.5
1960	564	584	462	459	664	7.1	7.3	5.8	5.7	8.5
1961	643	600	602	503	648	8.1	7.6	7.6	6.3	8.3
1962	437	514	530	481	664	5.5	6.5	6.7	6.0	8.5
1963	496	464	508	535	663	6.2	5.8	6.4	6.7	8.5
1964	562	526	491	528	664	7.1	6.6	6.2	6.6	8.5
1965	504	531	518	517	654	6.3	6.6	6.5	6.5	8.4
1966	355	412	450	455	664	4.4	5.1	5.6	5.7	8.5
1967	313	332	370	416	652	3.8	4.1	4.6	5.2	8.3
1968	475	371	365	413	664	6.0	4.6	4.5	5.1	8.5
1969	217	274	285	321	645	2.5	3.3	3.5	3.9	8.2
1970	514	278	315	321	663	6.4	3.3	3.8	3.9	8.5
1971	531	522	320	338	662	6.7	6.5	3.9	4.1	8.5
1972	520	525	521	366	642	6.5	6.6	6.5	4.5	8.2
1973	423	464	484	361	664	5.2	5.8	6.0	4.4	8.5
1974	458	439	462	484	664	5.7	5.5	5.8	6.1	8.5
1975	528	490	464	486	664	6.6	6.1	5.8	6.1	8.5
1976	529	528	502	486	664	6.6	6.6	6.3	6.1	8.5
1977	522	525	526	486	351	6.6	6.6	6.6	6.1	4.3
1978	257	323	364	402	664	3.1	3.9	4.5	5.0	8.5
1979	397	304	343	393	664	4.9	3.7	4.2	4.8	8.5
1980	276	312	292	338	661	2.7	3.4	3.3	3.9	8.5
1981	568	336	351	340	664	7.1	3.6	3.9	3.9	8.5
1982	382	451	348	329	663	4.7	5.6	3.9	3.8	8.5
1983	307	335	378	345	442	3.4	3.9	4.5	3.9	5.5
1984	518	368	372	355	662	6.5	4.3	4.4	4.1	8.5
1985	504	510	400	417	664	6.3	6.4	4.8	5.1	8.5
1986	449	474	487	404	663	5.6	5.9	6.1	4.9	8.5
1987	591	507	506	433	664	7.5	6.3	6.3	5.3	8.5
1988	498	539	504	506	663	6.2	6.8	6.3	6.3	8.5
1989	564	529	547	515	664	7.1	6.6	6.9	6.4	8.5
1990	573	569	542	527	664	7.2	7.2	6.8	6.6	8.5
1991	390	459	488	507	664	4.8	5.7	6.1	6.4	8.5
1992	411	400	441	472	664	5.1	5.0	5.5	5.9	8.5
1993	253	296	316	370	664	2.6	3.3	3.6	4.4	8.5
1994	562	314	336	370	664	7.0	3.5	3.9	4.4	8.5
1995	306	376	311	336	664	3.5	4.5	3.5	3.9	8.5
1996	478	360	402	345	664	6.0	4.3	4.9	4.0	8.5
1997	463	470	386	350	664	5.7	5.9	4.7	4.1	8.5
1998	311	365	393	386	648	3.8	4.5	4.9	4.7	8.3
1999	633	397	416	390	664	8.0	4.9	5.2	4.8	8.5



R_S620a_matrix.xls -- Fig 7a

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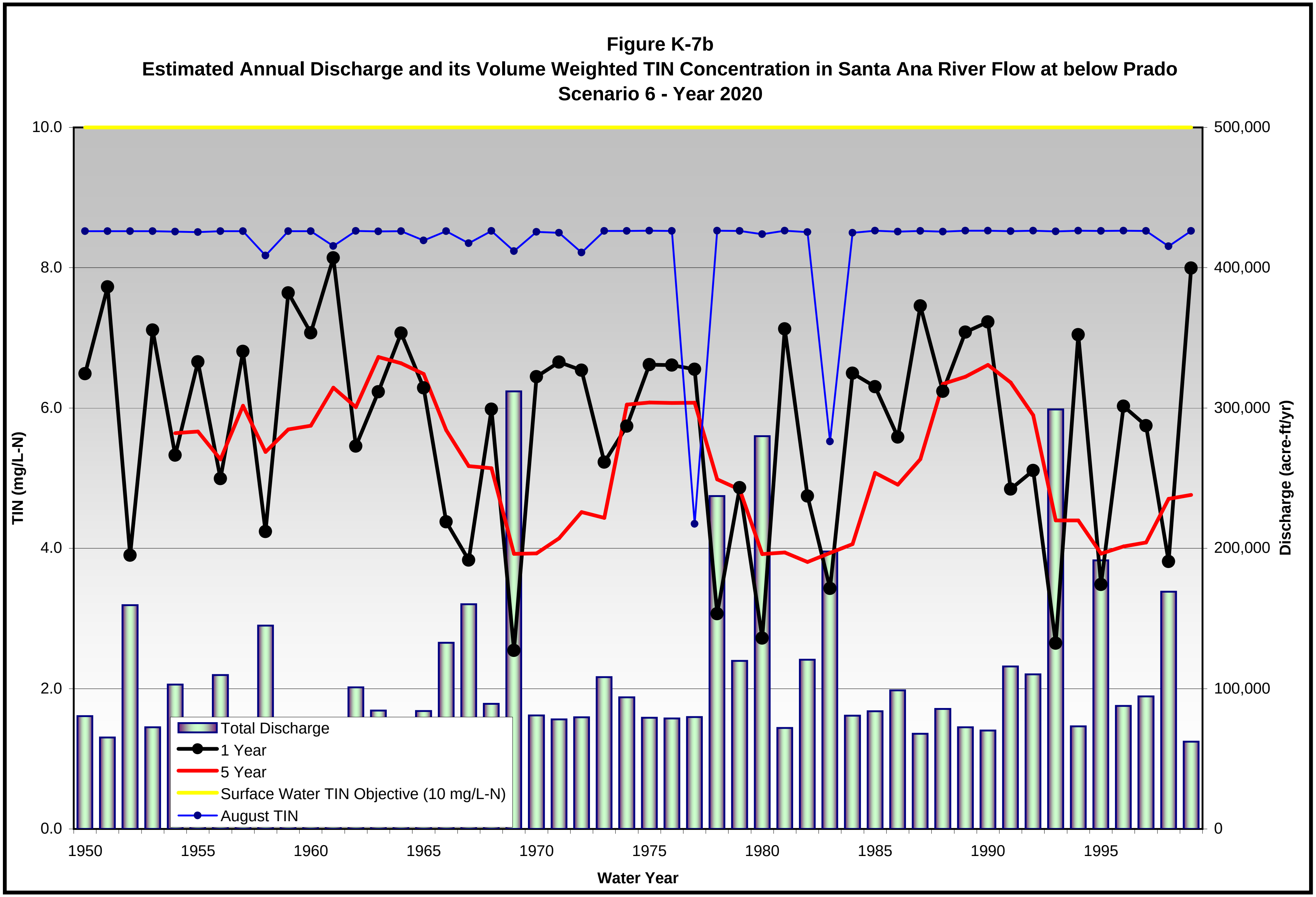

R_S620a_matrix.xls -- Fig 7b

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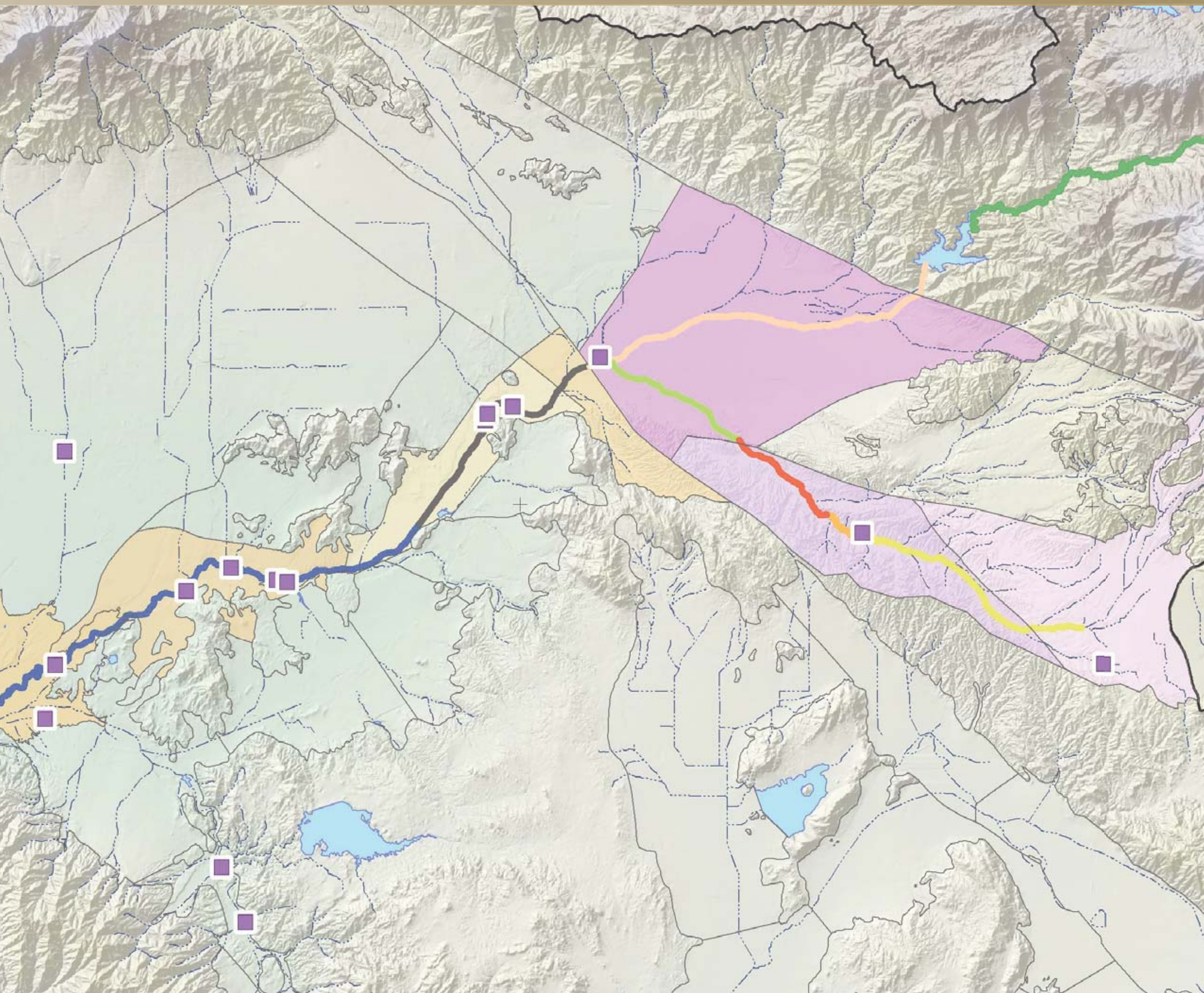

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