November, 2005

Attachment A to the Calleguas Creek Watershed
Metals and Selenium TMDL

Metals and Selenium Linkage Analysis for the Calleguas Creek Watershed
Interim Draft

Submitted to:
Calleguas Creek Watershed Management Plan

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INTRODUCTION

To assist the development of the Metals and Selenium TMDL for the Calleguas Creek Watershed (CCW), a numerical model is employed to estimate loading, movement, and effects of reductions of constituents thought to impose toxicity on the receiving waters in the watershed. As discussed in the modeling approach technical memorandum (LWA 2005a), the USEPA Hydrologic Simulation Program – Fortran (HSPF) will be used to simulate water quality in the CCW relevant to the Metals and Selenium TMDL. HSPF has been used develop a hydrologic model of the CCW (Aqua Terra, 2005). A discussion of the modifications performed to extend the HSPF CCW hydrologic model to include water quality is provided below.

REVIEW OF HSPF HYDROLOGIC MODEL

The comprehensive watershed hydrologic model of the Calleguas Creek Watershed was developed using HSPF for use as a tool for watershed planning, resource assessment, and ultimately, water quality management purposes. HSPF models watershed of hydrology and water quality, including both land surface and subsurface hydrologic, and water quality processes; linked and closely integrated with corresponding stream and reservoir processes. It is considered a premier, high-level model among those currently available for comprehensive watershed assessments. The CCW hydrologic model is described in Aqua Terra, 2005. Figure 1 is a plot of the discretization performed to represent the CCW in the HSPF model.

Precipitation and evaporation data were obtained and extended to allow model simulations up to 17 years. Topographic, soils, land use, and agricultural cropping information was used to develop the model segmentation and input, and detailed streamflow data were selected to allow calibration over a 9 year period (WY 1994 – WY 2002) and validation over a separate 6 year period (WY 1988 – WY1993). Both quantitative and qualitative comparisons were performed to support the model performance evaluation effort. Additional precipitation and evaporation data have been incorporated into the HSPF model to allow a second 2 year validation period (WY 2003 – WY 2004). The details of the extended model are described in LWA 2005b.

The conclusion of the model results presented and discussed in Aqua Terra, 2005, is that the current HSPF application to the Calleguas Creek Watershed has produced a sound, calibrated and validated hydrologic watershed model that provides a framework for watershed management analyses; and needs for flood assessments, water quality issues, and impact evaluation of mitigation alternatives. The calibration and validation results, based on the weight-of-evidence approach, demonstrate a good to very good representation of the observed hydrologic data. The outcome is from a wide range of graphical and statistical comparisons and measures of the model performance, performed at up to eight stream gage locations throughout the watershed, for annual runoff, daily and monthly streamflow, flow duration and frequency, water balance components, and hourly storm hydrographs. These comparisons demonstrate conclusively that the model is a very good representation of the water balance and hydrology of the watershed.

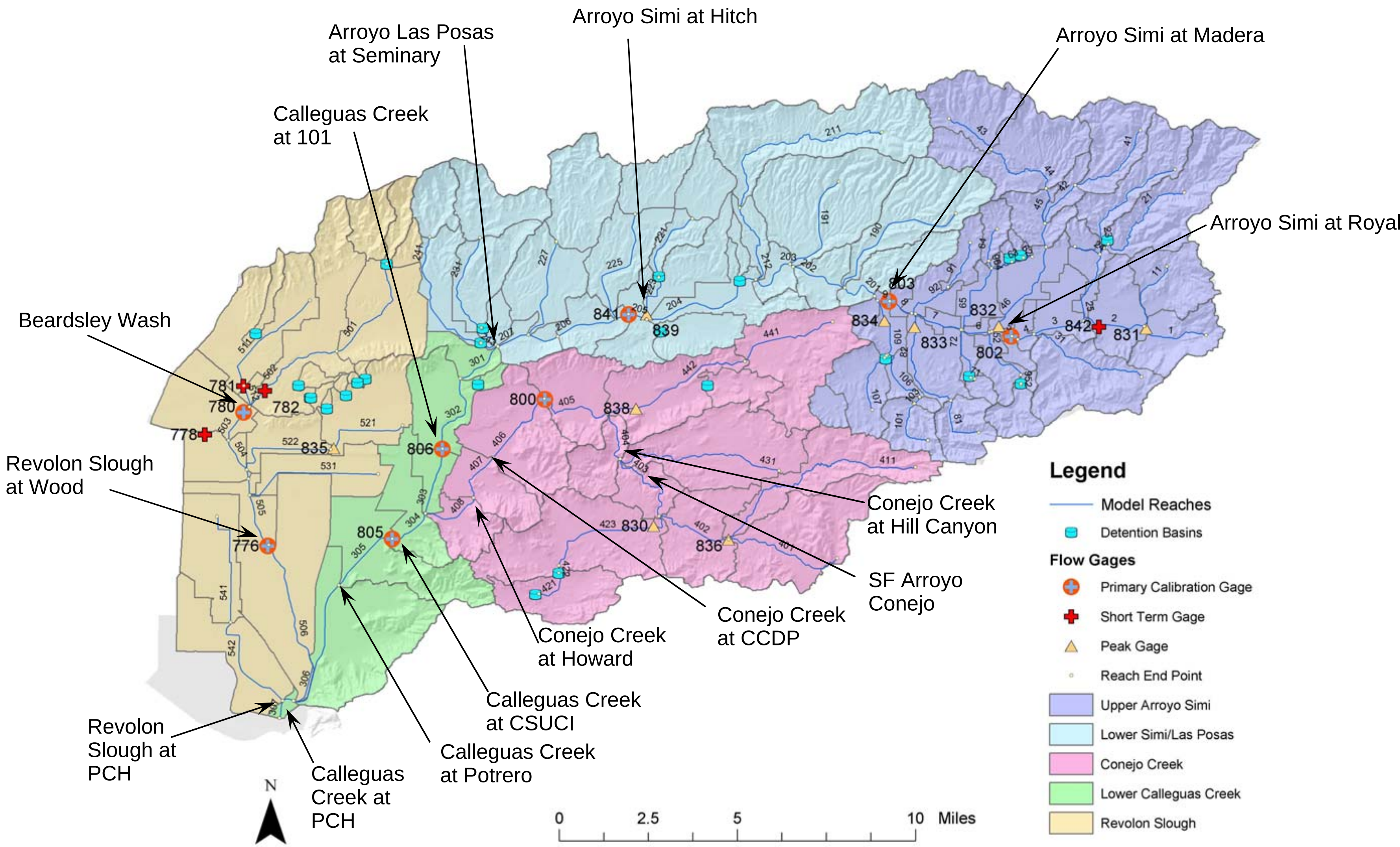

Figure 1: Calleguas Creek Watershed as represented in HSPF (adopted from Aqua Terra 2005).

APPROACH

The approach to developing the metals and selenium water quality model for the Calleguas Creek Watershed (CCWM) is to: 1) perform preliminary modifications to the HSPF hydrologic model, 2) activate water quality modules of HSPF, 3) import additional data for driving water quality, and 4) calibrate and validate the water quality calculations. The water quality parameters added to the CCWM include: temperature, total suspended solids (TSS), hardness, chloride, total and dissolved copper, total and dissolved mercury, and total and dissolved selenium.

Preliminary Modifications

The hydrologic HSPF model described in Aqua Terra (2005) is the basis of the CCW model (CCWM) for water quality. Modifications to the hydrologic model were made so the model would more accurately reflect the watershed conditions and allow proper simulation of flow and sediment past the Conejo Creek Diversion Project (CCDP). Modifications to the hydrologic model include:

- Moved discharge location of the Camarillo WRF form the confluence of Calleguas and Conejo Creeks to Conejo Creek at Howard Rd.
- Switched Camarillo WRF input from the total effluent rate to the amount actually discharged to the creek (i.e. total effluent flow minus reclaimed flow).
- Moved the Conejo Creek Diversion Project (CCDP) from Conejo Creek at Howard Rd. to Conejo Creek at Highway 101.
- Moved the Olsen Road WWTP discharge from the North Fork of Arroyo Conejo to the Arroyo Santa Rosa.
- Switched from internal model calculation of the CCDP diversion rate to specification of the diversion rate in the appropriate F-TABLE.

Relocation of point discharges to reflect watershed conditions are listed in LWA 2005b and changes made to the CCDP operation are detailed in LWA 2005c.

The hydrologic model is modified to activate the water quality components of HSPF. Model input and initial estimates of model parameters are generated through monitoring data, analysis of monitoring data, or review of literature values. A select set of monitoring data are used to calibrate the model parameters. An independent set of monitoring data are used to validate the model performance.

Water Quality Modifications

Modifications to the UCI file to allow modeling the water quality constituents are performed according to Bicknell, et al (2001). There are five major components to the UCI that require modification to enable water quality modeling. Specification of constituent loading from pervious areas and impervious areas are two sections of the UCI file that control non-point source loading to receiving waters. Specification of constituent transport, partitioning, and reaction in the receiving waters is a third section of the UCI requiring modification. The fourth section to be modified in the UCI specifies point source loading. The final section of the UCI specifies what output is desired. Along with the five major components, there are additional sections of the UCI file that require modification. All modifications are described below.

Modifications to the WDM file were performed largely through the use of the USGS programs ANNIE and IOWDM. ANNIE (Flynn, et al 1995) is used to interactively store, retrieve, list, plot, check, and update data in the WDM file. IOWDM is used to upload data from flat files into the WDM file. Both ANNIE and IOWDM can be automated using macros. Data describing constituent loading from point sources are loaded into WDM files for use in the HSPF model. As described above meteorological data in the WDM file are added to the HSPF Hydrologic model to extend the possible simulation period through December 31, 2004. The WDMUtil (Hummel, et al, 2001) is used to disaggregate monthly or daily time series meteorological data into hourly data.

Model Input

Values required for modeling water quality parameters are selected from monitoring data, analysis of monitoring data, or typical values from the literature. Where possible the monitoring data and analysis of monitoring data from the watershed are used for model parameterization to retain the site specific nature of the watershed in the model.

Calibration and Verification

In general available environmental data from October 1, 1987 through December 31, 2002 are used for calibration of model parameters, and latter data used for verification.

SCOPE OF THE CCWM

The National Research Council (NRC, 2001) provides some guidance for determining the appropriate level of complexity for modeling efforts in support of TMDL development. The time frame for model development is an important consideration for any modeling investigation. Water quality data are much more limited than receiving water flowrates, so calibration of the model will be sufficient to accurately reflect the relative loading of constituents from the sources present in the watershed. While the model calculations may not match water quality data to the extent of the hydrologic model, the results will be sufficient to aid in performing watershed management decisions.

Because of limited available data, grab and composite samples are treated in the analyses as being equivalent and equally representative of conditions in the CCW. Estimated and qualified data are used below in the analysis as normal detected values. Both uses of the data may introduce errors into the analysis, as grab samples may not be equivalent to composite samples and may not be representative of the source. Estimated values, while being a better estimate of the true sample value than the reporting limit, may not reflect the true value accurately.

HSPF MODIFICATIONS

There are two files that require modification to include water quality in the HSPF model for the CCW: i) the user control input (uci) file, and ii) the watershed data management (wdm) file. Both file names are descriptive of function as the uci file lists all the user selectable parameters for the model including: number and length of reaches, how reaches interconnect, area and type of land segments, which water quality parameters to model, etc. The wdm file contains all the input data (e.g. precipitation and evaporation) and is where the model writes output (e.g. time series of in-stream flowrate and concentrations of modeled constituents at locations specified in the uci file). A wdm file provides rudimentary database facilities and as such, the file must be set up to allocate space for writing before running the model.

UCI file Modifications

Essentially, the uci file is modified so that each applicable component of the HSPF model is aware that temperature is a desired calculation. Each section of the UCI requiring modification is separated into "blocks". The modifications of the blocks are described below.

FILES Block

The FILES block lists the input and output files for the HSPF runs. All water quality information will be stored in a WDM file separate from the hydrology. An entry is included specifying the use of WDM2.

PERLND Block

All aspects of pervious land uses are included in the PERLND block of the uci file. In the ACTIVITY block the ATEMP, SED, PST, PWG, and PQAL flags are set to 1, indicating air temperature should be used in the model, sediment is to be modeled, soil temperature should be calculated, water temperature calculations should be made and water quality parameters will be modeled, respectively. The PRINT-INFO and BINARY-INFO blocks controlling printed output summaries used as diagnostics were changed to match the printout frequency of the hydrologic simulation for ATEMP, PST, and PWG.

Temperature and sediment require specialized tables in the UCI file for simulation. Several Tables are required to specify water quality of hardness, chloride, copper, mercury, and selenium.. Table NQUAL specifies the number of water quality constituents, currently there are five. Table PQL-AD-FLAGS specifies if and how atmospheric deposition is handled for each of the water quality constituents. Table QUAL-PROPS sets the specific properties for each of the water quality constituents. Each table for each water quality parameter is briefly described below.

Temperature and Gases

The ATEMP-DAT block specifies the elevation change of the PERLND area from the MET station. The initial air temperature is also specified here. The adiabatic cooling is used to translate the air temperature from the monitoring station to the particular PERLND areas.

PSTEMP-PARM1 and PSTEMP-PARM2 tables are added to the UCI file to enable temperature simulation. PARM1 sets flags to allow temperature functions to vary by month. PARM2 sets default values for the functions and is required even though we are going to supply MON-ASLT and MON-BSLT the monthly values for the intercept and slope of the surface temperature functions, respectively. Figure 2 is a time series plot of the available air and soil daily average temperatures from the CIMIS station #152 located near Camarillo. Regression relations between the daily air and soil temperatures for each month are used to determine the values to enter into the MON-ASLT and MON-BSLT tables. The regression results are used to calculate modeled soil temperatures from the air temperatures and are plotted against the measured values in Figure 3. The MON-ULTP1 and MON-ULTP2 for the upper layer temperature function, MON-LGTP1 and MON-LGTP2 for the lower layer and groundwater temperature functions are also added to the model.

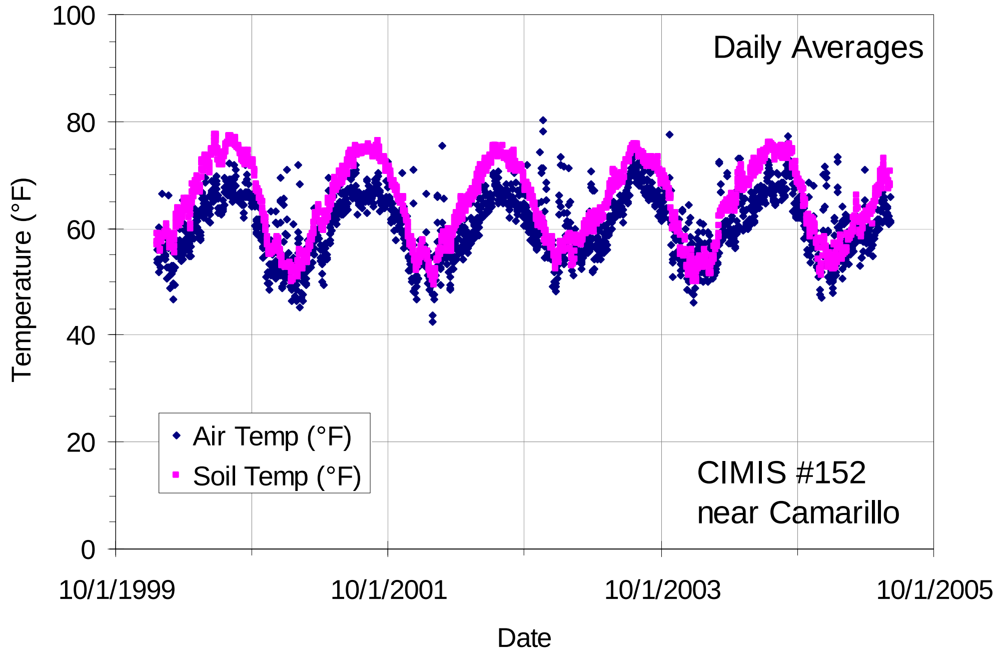

Figure 2: Daily Average Air and Surface Soil Temperature Data from CIMIS #152 near Camarillo. (Hourly Data are Incorporated into the CCWM).

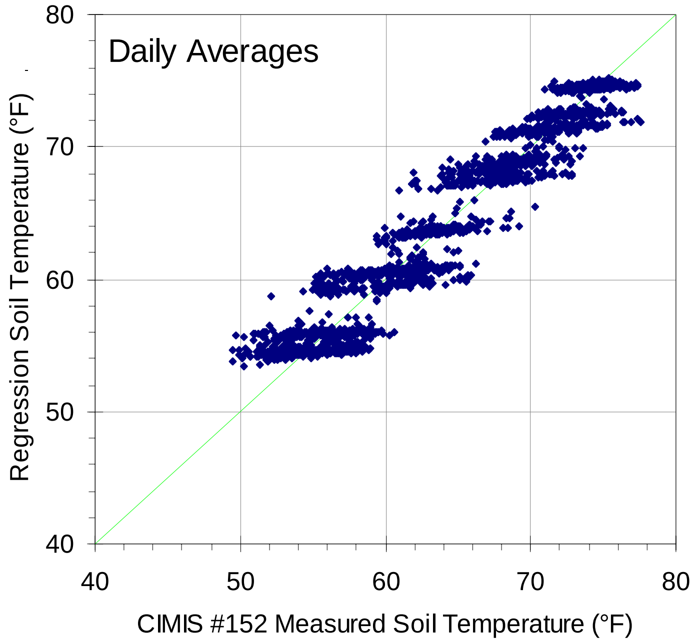

Figure 3: Modeled and Measured Surface Soil Temperatures near Camarillo.

Adding PWT-PARM1 and PWT-PARM2 tables to the UCI sets whether interflow and groundwater gas concentrations are allowed to vary through the year, and the initial values for the gas concentrations, respectively. Likewise, the monthly initial values for the interflow and groundwater gas concentration are initially left out, but may require input in the future. The default values for the excluded blocks is 0.0, but we are adding temperature here, so the gas values are okay to default as currently they are not being explicitly modeled. A PWT-TEMPS table for the initial soil, interflow, and active groundwater temperatures, and a PWT-GASES table for the initial soil, interflow, and active groundwater DO and CO_2 concentrations are added to the UCI file.

The data are projected backward to develop an estimated temperature time series from October 1, 1987 to December 31, 1999. None of the other water quality parameters of concern being modeled are sensitive to temperature, so the estimated temperatures will not affect model results.

Sediment Simulation

In table SED-PARM1 flags are set specifying the cover will vary monthly (CRV=1), vertical sediment input will not vary through the year (VSIV=0), and the newer, less dependent on time-step sediment removal algorithm SOSED2 will be used (SDOP=0).

Parameters indicating the availability and how easily sediment in the watershed is removed are listed in Table SED-PARM2. Specifically, the values for supporting management practice factor are set to 1.0 indicating no reduction in sediment (SMPF), soil detachment (KRER), exponent for soil detachment (JRER), daily reduction in sediment storage due to compaction (AFFIX), fraction of the land shielded from rainfall erosion, and the rate sediment is deposited from the atmosphere (NVSI). Each pervious land type used in the CCWM is set with the same set of parameters. The values were initially set equal to the values used in the HSPF model for metals in the Ballona Creek watershed (Ackerman, et al. 2004). Some entries are adjusted during calibration.

Table SED-PARM3 is used to specify the values for coefficient and exponent for the detached sediment washoff equation (KSER, and JSER) and the coefficient and exponent for the matrix scour equation (KGER, JGER). The values are equal to the values used in the HSPF model for metals in the Ballona Creek watershed (Ackerman, et al. 2004). The values in the SED-PARM3 Table are the primary calibration parameters for sediment loading.

Table MON-COVER is set of monthly fraction of area shielded from rain erosion for each pervious land segment. Currently open space is assigned 15% cover, residential areas see 70% cover, commercial and industrial areas have 50% cover, and agricultural areas see 60% cover. The table is included to facilitate future calibration in the event it is determined that the fraction covered is an important parameter.

Table SED-STOR is used to set the initial detached sediment storage. All pervious land segments are assigned 100 tons/ac.

The available TSS data are plotted by land use category in Figure 4 to Figure 7. The data were used to adjust the numbers from Ackerman, et al (2004) to reflect the conditions in the CCW.

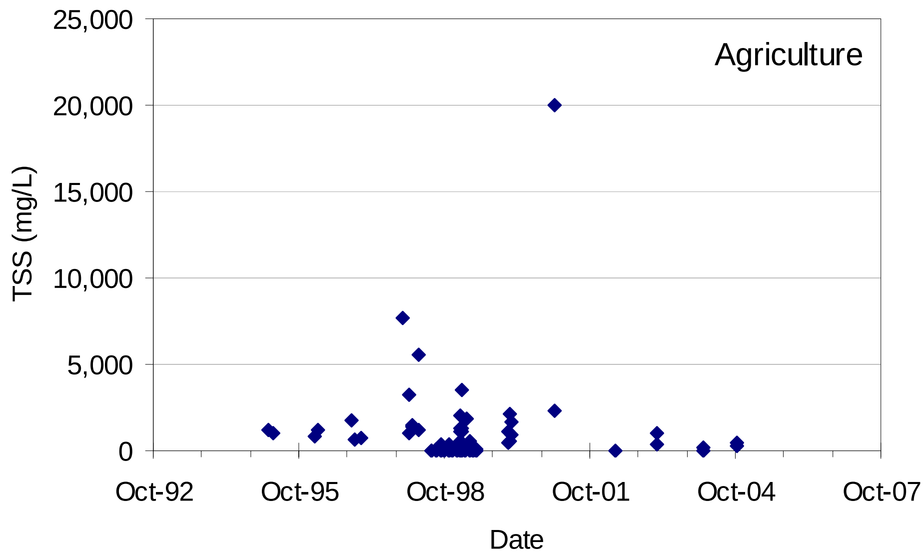

Figure 4: TSS Data for Agriculture Runoff.

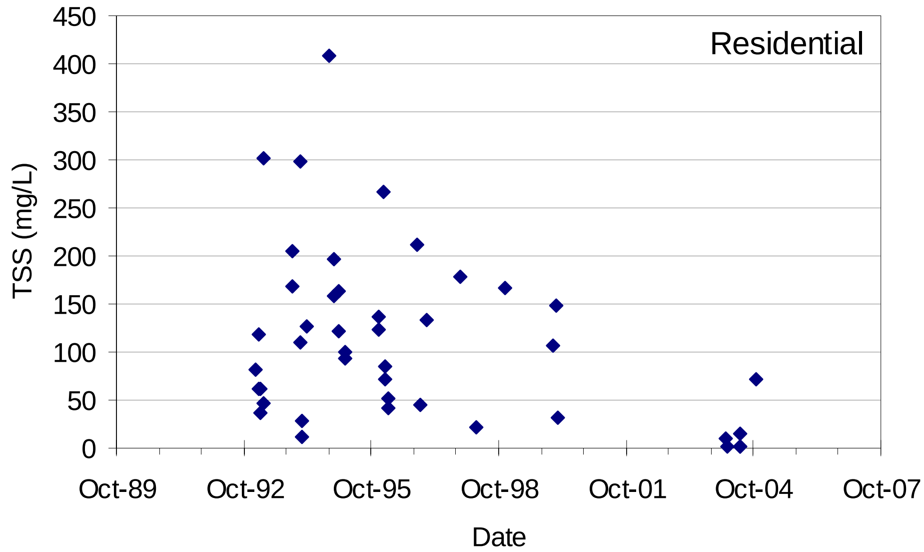

Figure 5: TSS Data for Residential and Urban Runoff.

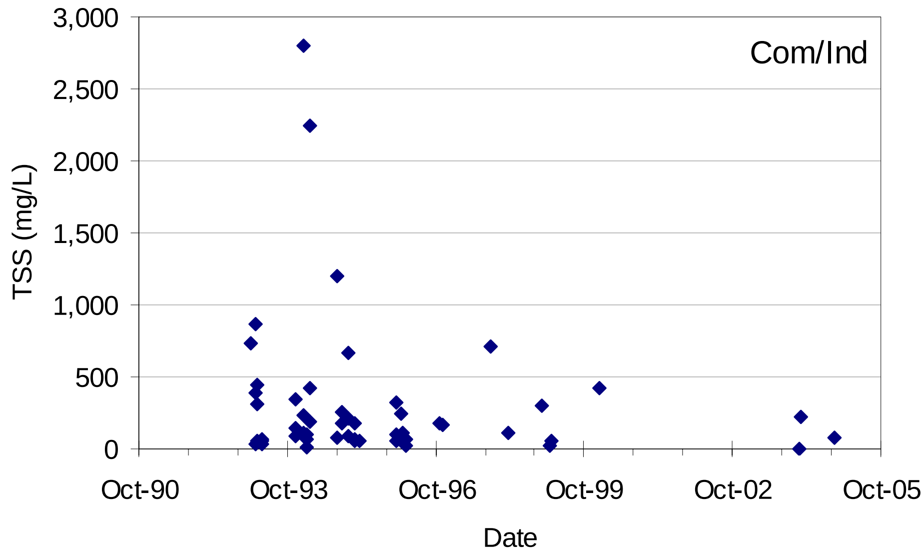

Figure 6: TSS Data from Commercial and Industrial Runoff.

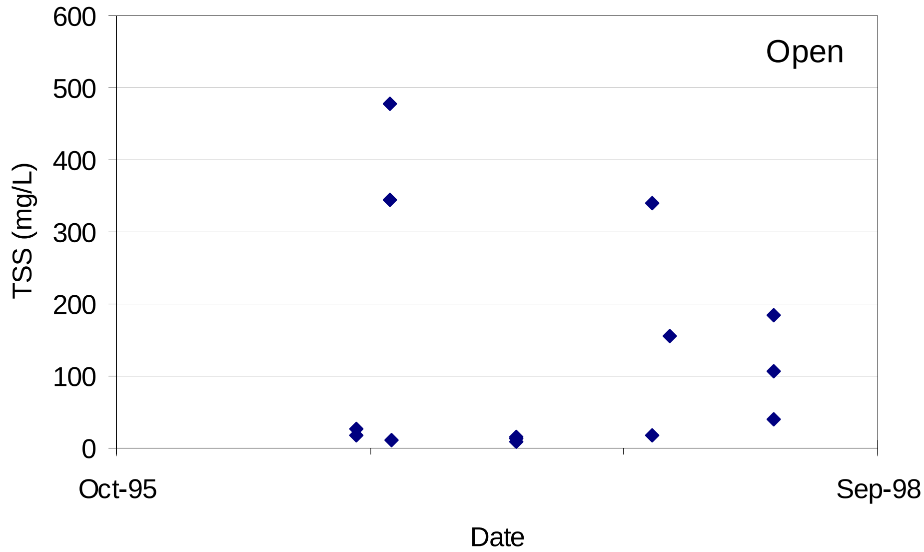

Figure 7: TSS Data for Open Space Runoff.

Hardness Simulation

Hardness is assumed to be associated with surface runoff, interflow, and groundwater baseflow. Hardness is not modeled as particle associated. Atmospheric deposition of hardness is assumed to be negligible and not included in the model (LWA 2004).

Initial values for surface runoff, interflow, and groundwater contributions of hardness per land use type are estimated through available data and the analyses performed for salt management in CCW (LWA 2004). Available hardness data by land use category are plotted in Figure 8 to Figure 11.

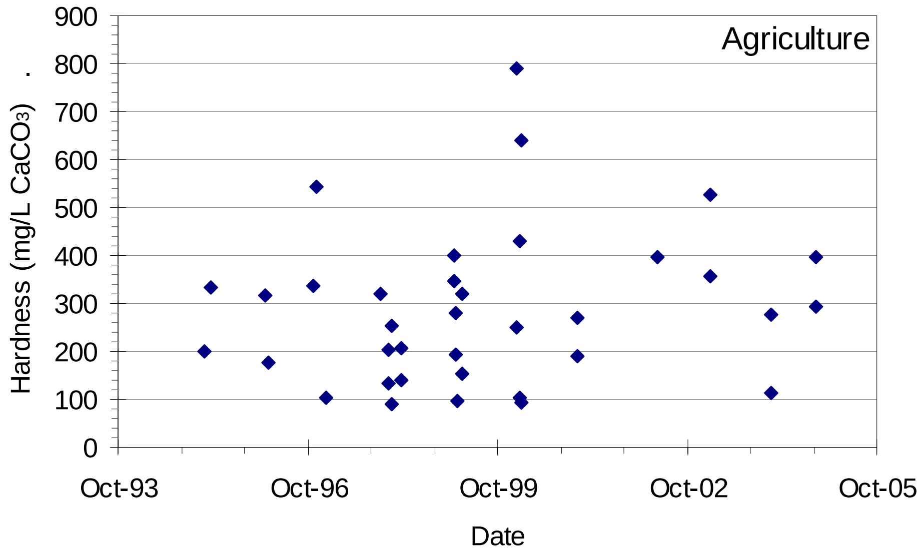

Figure 8: Hardness Data for Agricultural Runoff.

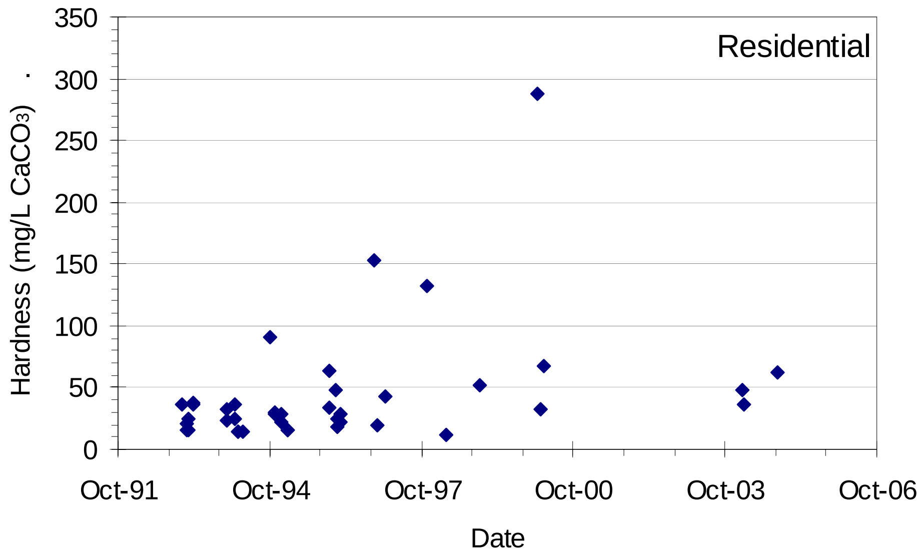

Figure 9: Hardness Data from Residential and Urban Runoff.

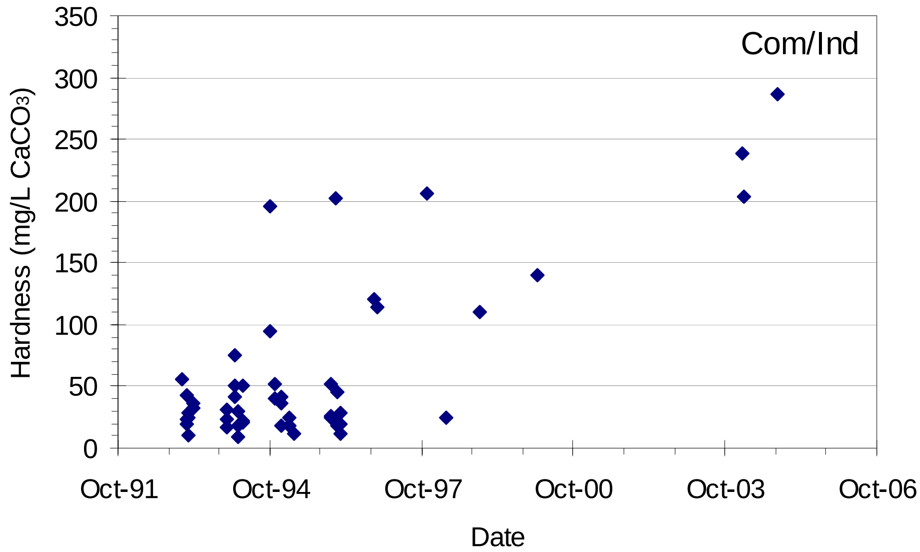

Figure 10: Hardness Data from Commercial and Industrial Runoff.

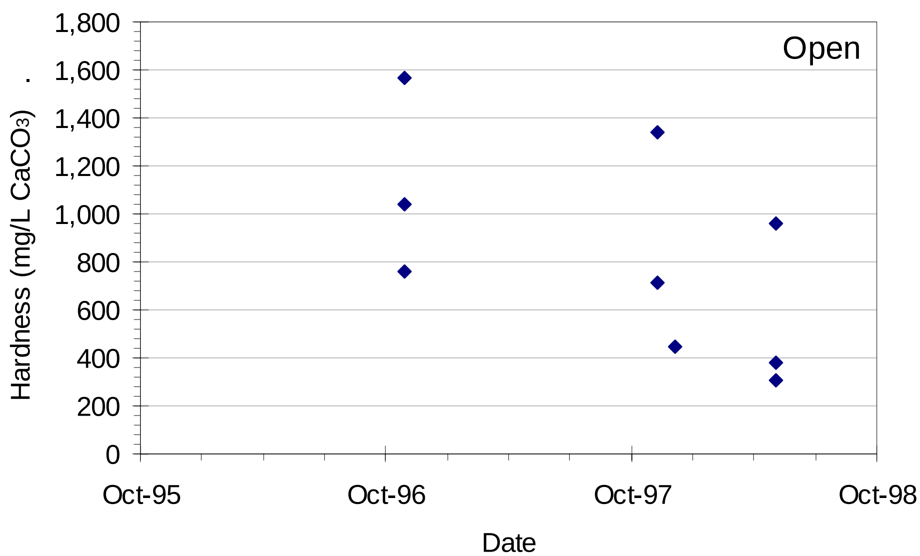

Figure 11: Hardness Data for Open Space Runoff.

Chloride Simulation

Chloride is assumed to be associated with surface runoff, interflow, and groundwater baseflow. Chloride is not modeled as particle associated. Atmospheric deposition of chloride is assumed to be negligible and not included in the model (LWA 2004).

Initial values for surface runoff, interflow, and groundwater contributions of chloride per land use type are estimated through available data and the analyses performed for salt management in

CCW (LWA 2004). Available chloride data by land use category are plotted in Figure 12 to Figure 15.

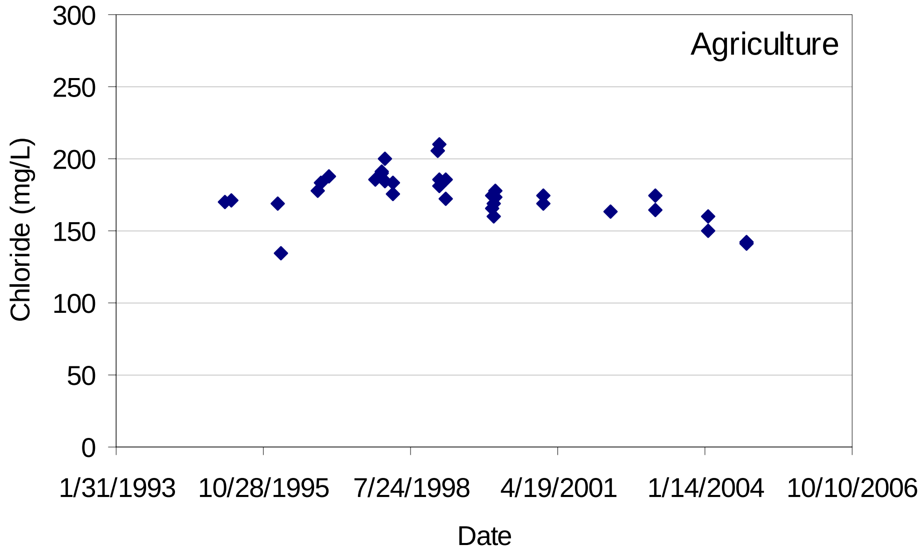

Figure 12: Chloride Data for Agricultural Runoff.

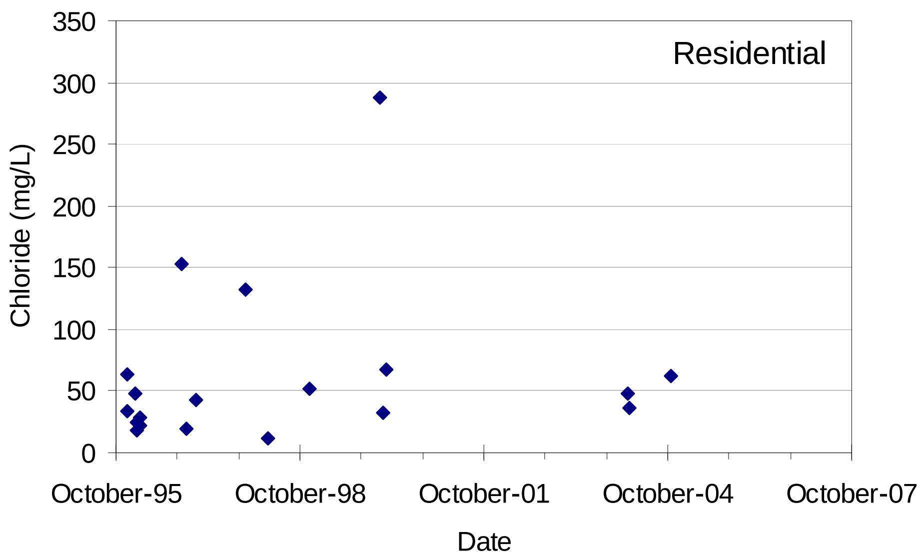

Figure 13: Chloride Data from Residential Runoff.

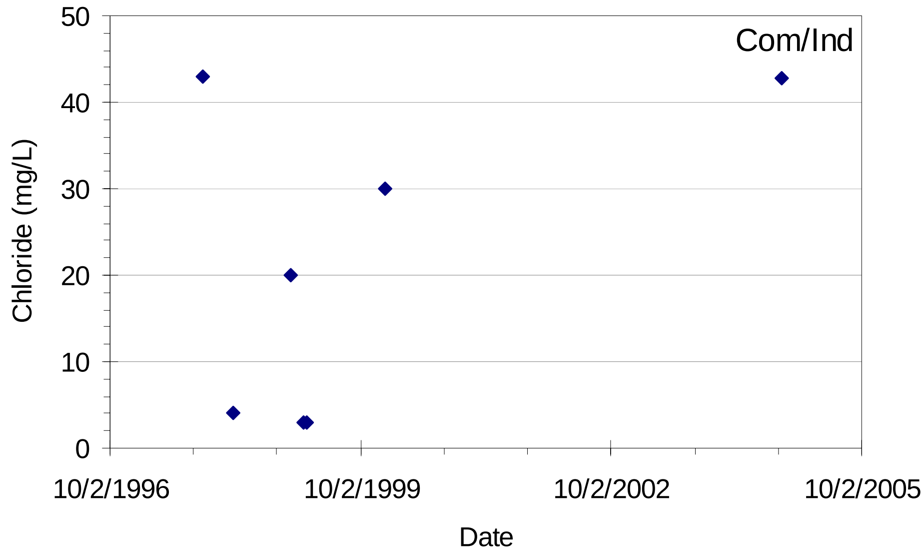

Figure 14: Chloride Data for Commercial and Industrial Runoff.

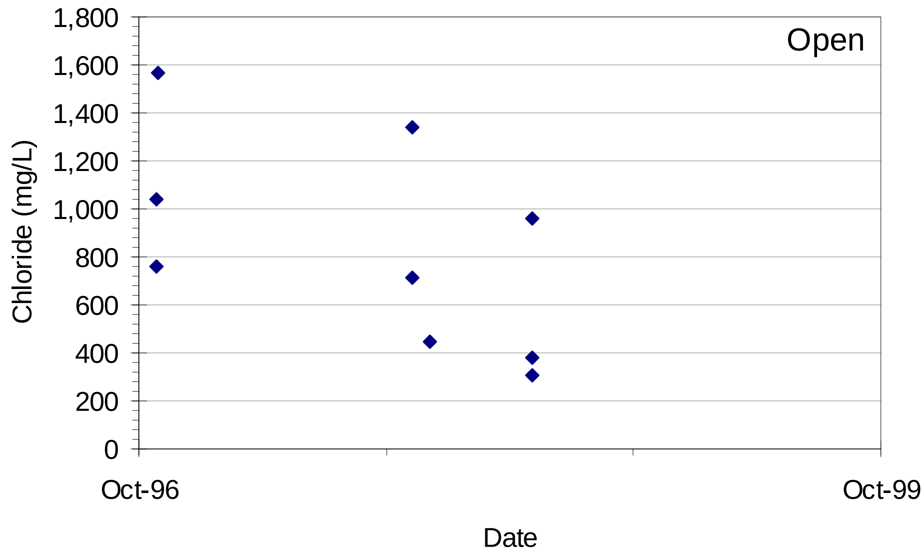

Figure 15: Chloride Data for Open Space Runoff.

Copper Simulation

Copper is modeled as both particulate and dissolved phase in surface overflow, and as dissolved phase in the interflow and groundwater baseflow. Atmospheric deposition of copper is estimated in the CCW Metals and Selenium TMDL (LWA 2005e) as dry deposition averaging 990 $\mu g/m^2 \cdot yr$ and wet deposition averaging 403 $\mu g/m^2 \cdot yr$.

Available copper data by land use category are plotted as Figure 16 to Figure 19. To determine the potency of sediment associated copper, the available receiving water data were analyzed to develop Figure 20. For the CCW, copper is approximately 0.17 lb/ton of suspended sediment from washoff (POTFW in Figure 20) and 0.06 lb/ton of scoured sediment (POTFS). The potency factors are adjusted during calibration.

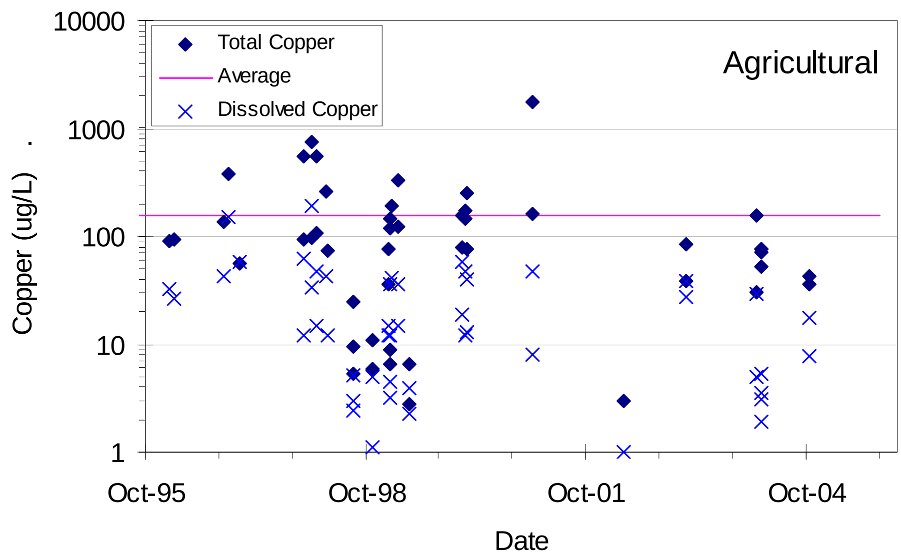

Figure 16: Copper Data for Agricultural Runoff.

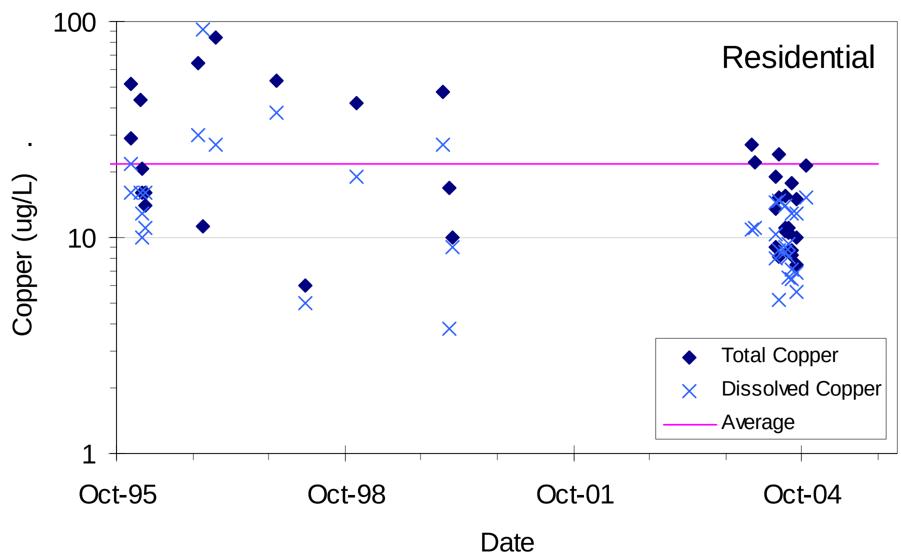

Figure 17: Copper Data for Residential and Urban Runoff.

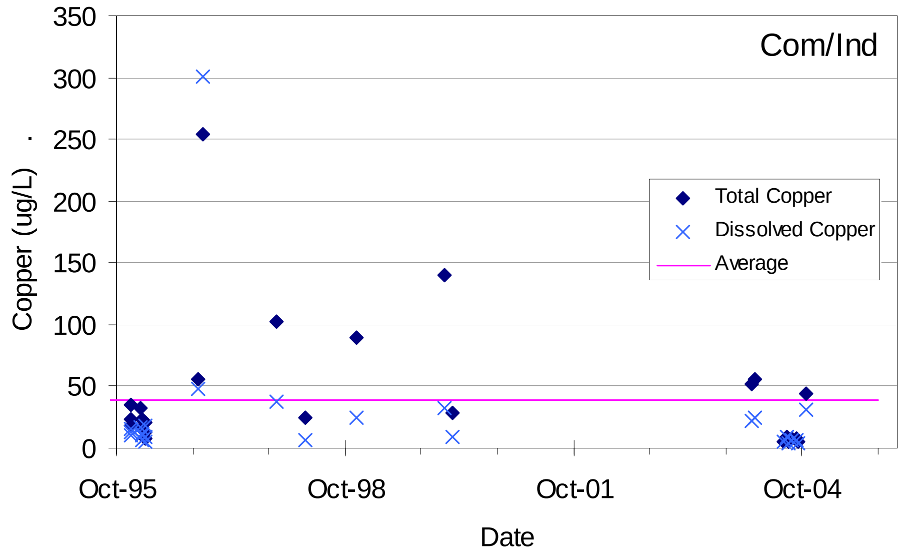

Figure 18: Copper Data for Commercial and Industrial Runoff.

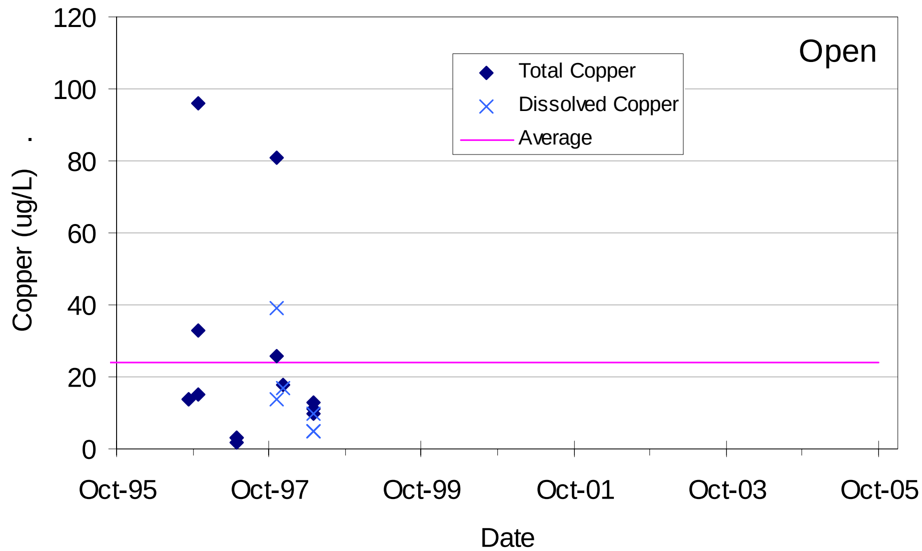

Figure 19: Copper Data for Open Space Runoff.

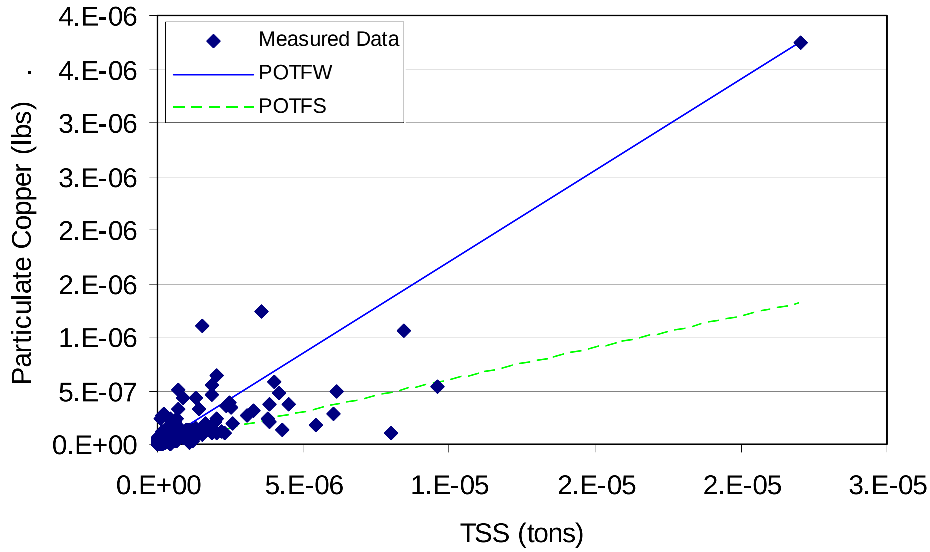

Figure 20: Potency Analysis for Copper in the CCW.

Nickel Simulation

Nickel is modeled as both particulate and dissolved phase in surface overflow, and as dissolved phase in the interflow and groundwater baseflow. Atmospheric deposition of nickel is estimated in the CCW Metals and Selenium TMDL (LWA 2005e) as dry deposition averaging 558 $\mu g/m^2 \cdot yr$ and wet deposition averaging 155 $\mu g/m^2 \cdot yr$.

Available nickel data by land use category are plotted as Figure 21 to Figure 25. To determine the potency of sediment associated copper, the available receiving water data were analyzed to develop Figure 20. For the CCW, nickel is approximately 0.06 lb/ton of suspended sediment from wash-off (POTFW in Figure 20) and 0.029 lb/ton of scoured sediment (POTFS). The potency factors are adjusted during calibration by land use and location.

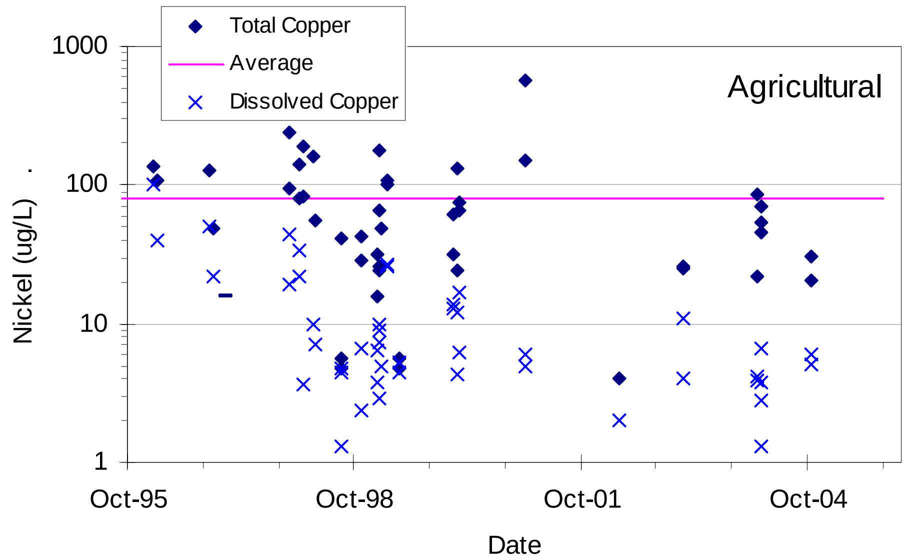

Figure 21: Nickel Data for Agricultural Runoff.

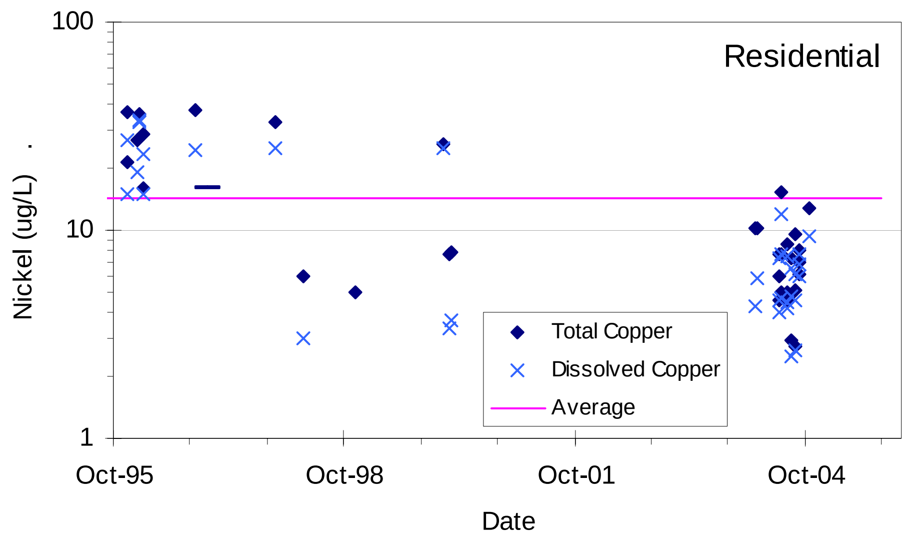

Figure 22: Nickel Data for Residential and Urban Runoff.

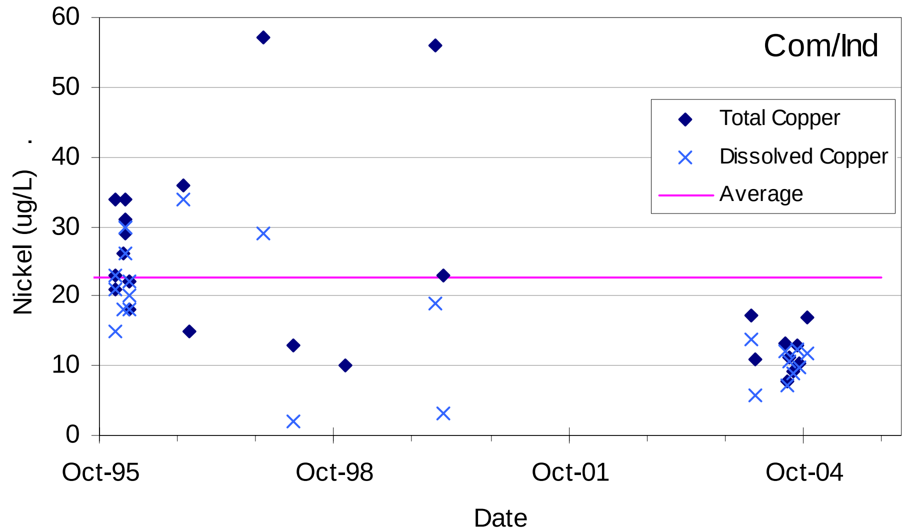

Figure 23: Nickel Data for Commercial and Industrial Runoff.

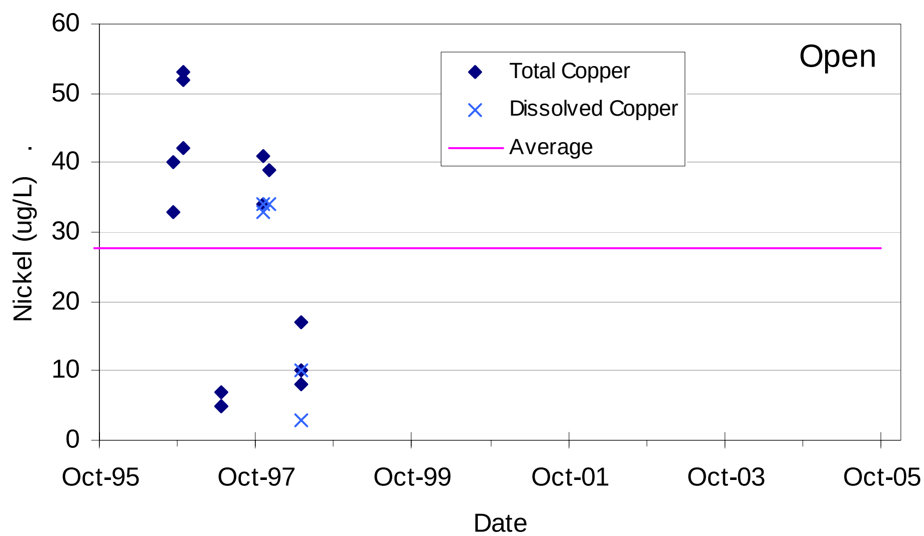

Figure 24: Nickel Data for Open Space Runoff.

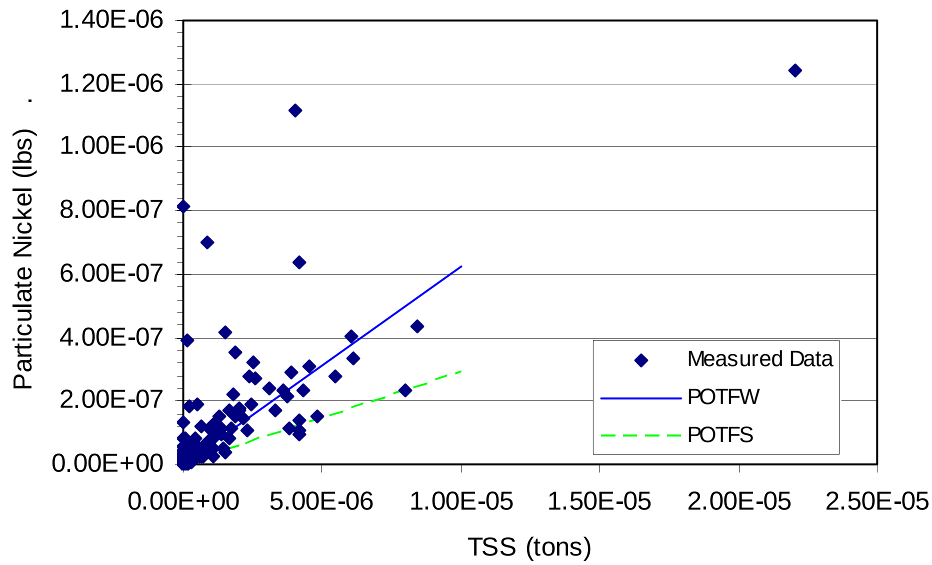

Figure 25: Potency Analysis for Nickel in the CCW.

Mercury Simulation

Mercury is modeled as in both particulate and dissolved phase in surface overflow, and as dissolved phase in the interflow and groundwater baseflow. Atmospheric deposition of mercury is estimated in the CCW Metals and Selenium TMDL (LWA 2005e) as dry deposition averaging 646 µg/m^2·yr and wet deposition averaging 19 µg/m^2·yr.

Available mercury data by land use category are plotted as Figure 26 to Figure 29. To determine the potency of sediment associated mercury, the available receiving water data were analyzed to develop Figure 30. For the CCW, mercury is approximately 0.0002 lb/ton of suspended sediment from washoff (POTFW in Figure 30) and 0.00006 lb/ton of scoured sediment (POTFS). Potency factors are adjusted during calibration.

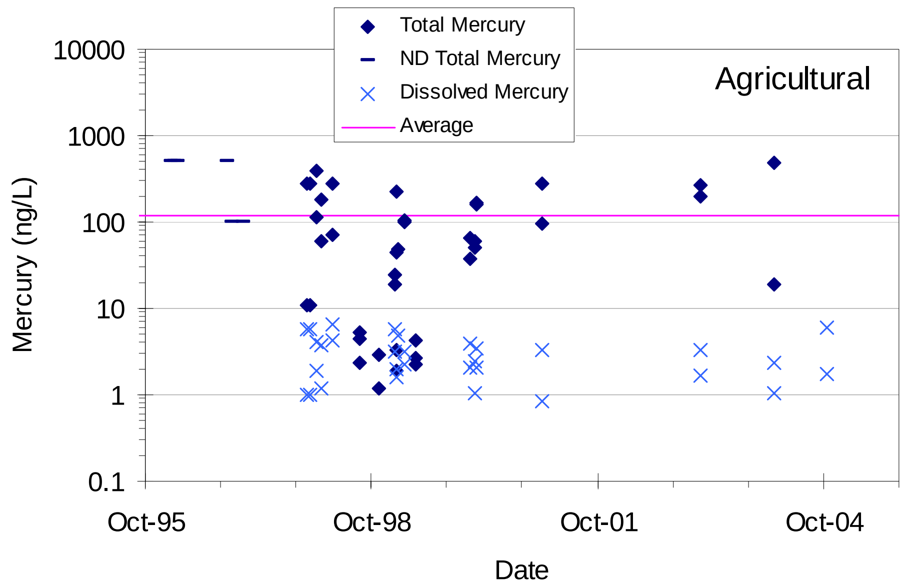

Figure 26: Mercury Data from Agricultural Runoff.

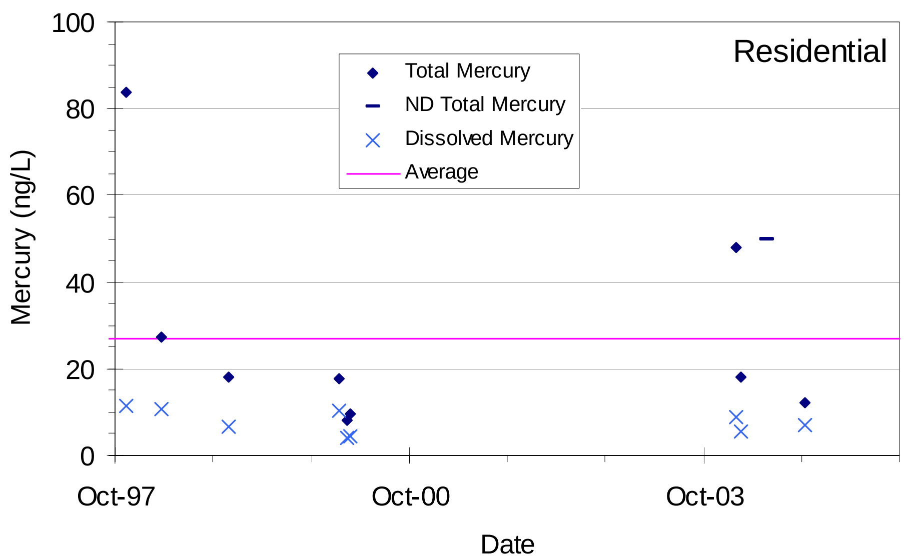

Figure 27: Mercury Data from Residential and Urban Runoff.

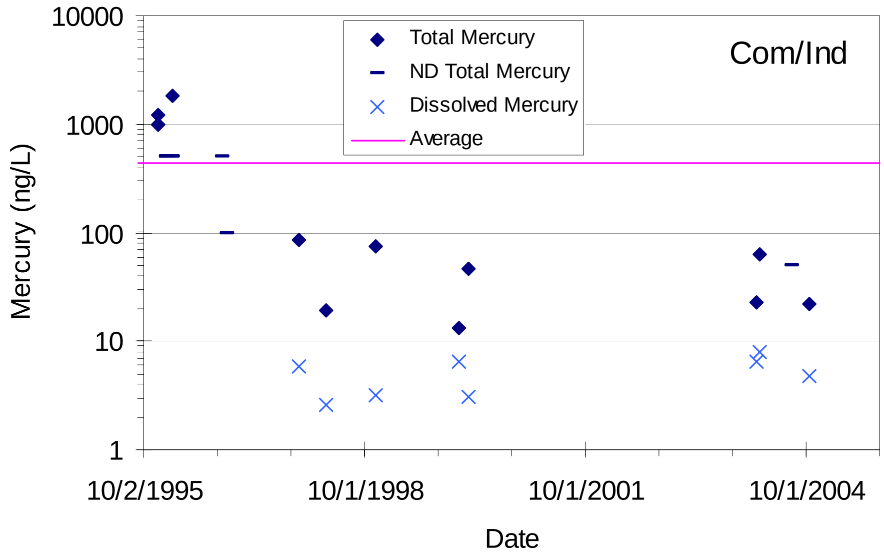

Figure 28: Mercury Data for Commercial and Industrial Runoff.

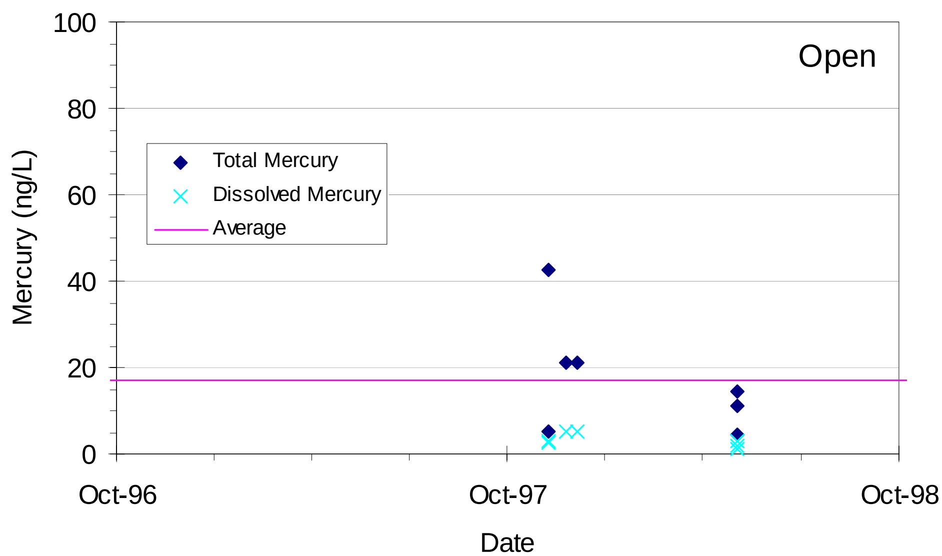

Figure 29: Mercury Data for Open Space Runoff.

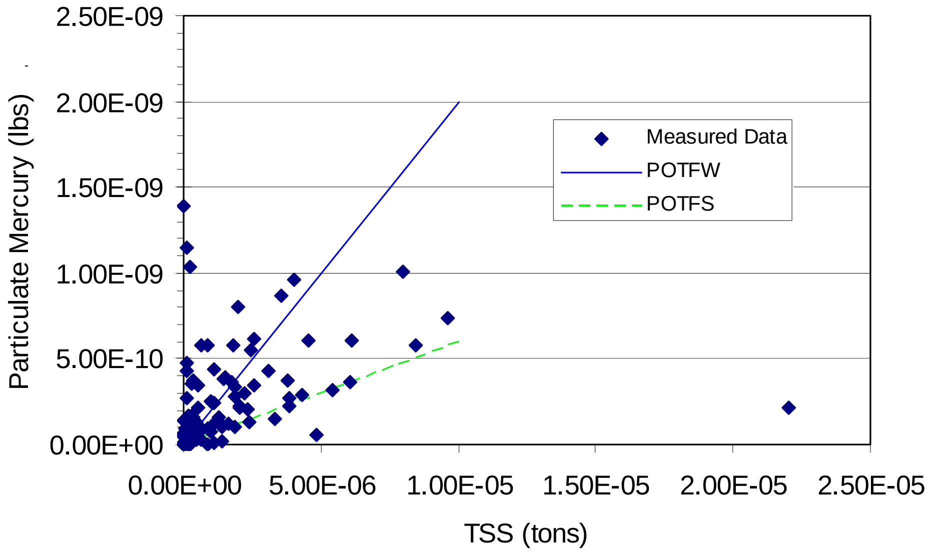

Figure 30: Potency Analysis for Mercury in the CCW.

Selenium Simulation

Selenium is modeled as in both particulate and dissolved phase in surface overflow, and as dissolved phase in the interflow and groundwater baseflow. Atmospheric deposition of selenium is estimated in the CCW Metals and Selenium TMDL (LWA 2005e) as dry deposition averaging 20 µg/m^2·yr and wet deposition averaging 320 µg/m^2·yr.

Available selenium data by land use category are plotted as Figure 26 to Figure 29. To determine the potency of sediment associated selenium, the available receiving water data were analyzed to develop Figure 30. For the CCW, selenium is approximately 0.0002 lb/ton of suspended sediment from washoff (POTFW in Figure 30) and 0.00006 lb/ton of scoured sediment (POTFS). Potency factors are adjusted during calibration.

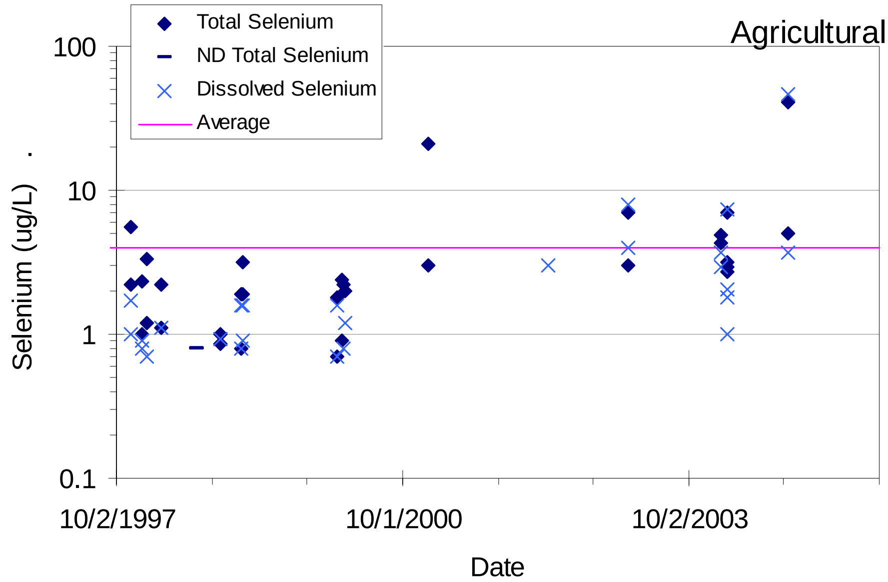

Figure 31: Selenium Data from Agricultural Runoff.

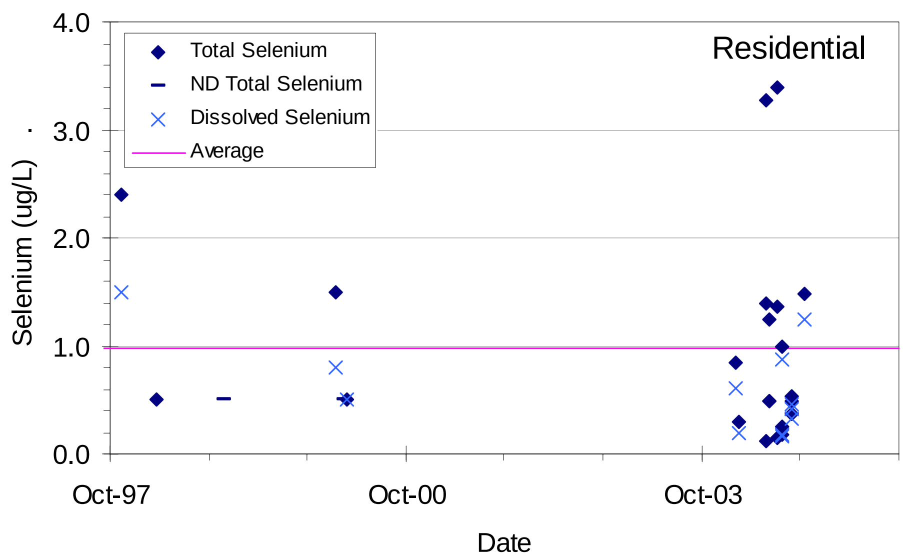

Figure 32: Selenium Data from Residential and Urban Runoff.

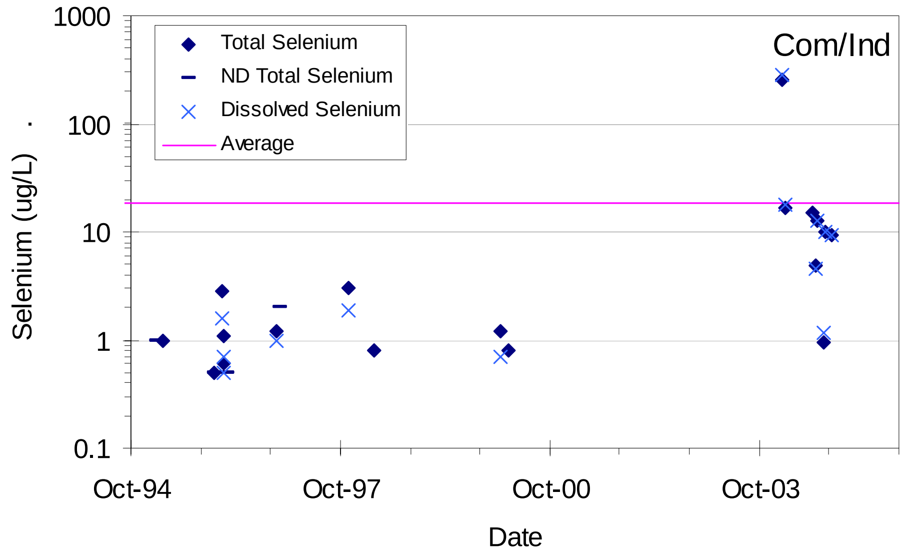

Figure 33: Selenium Data for Commercial and Industrial Runoff.

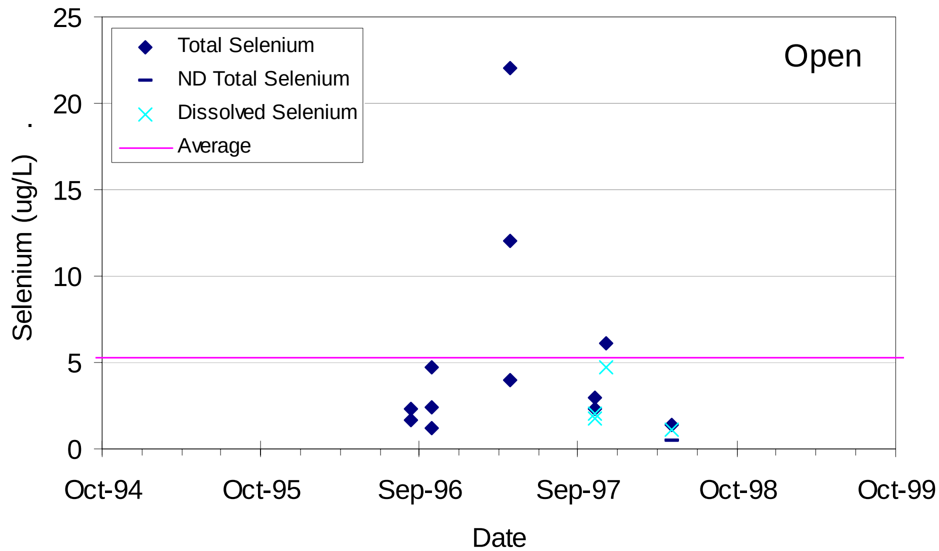

Figure 34: Selenium Data for Open Space Runoff.

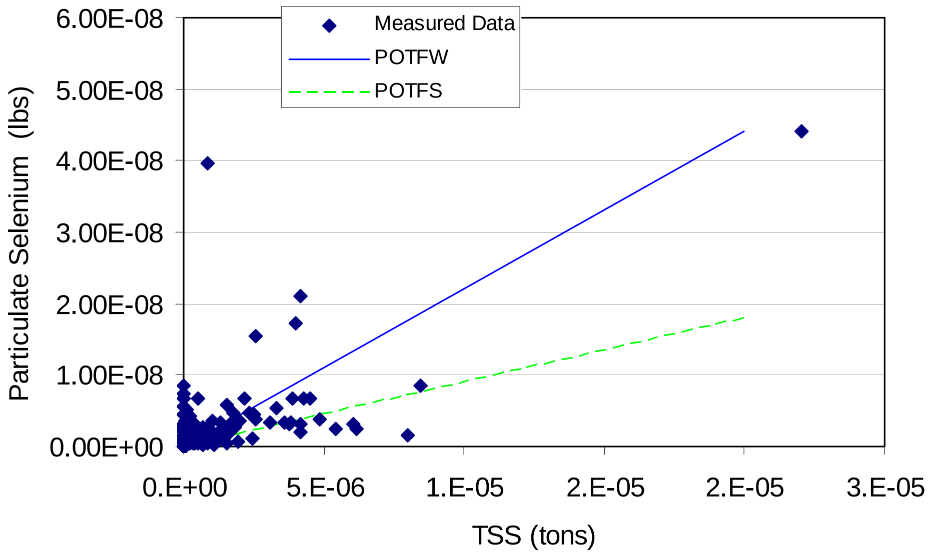

Figure 35: Potency Factor Analysis for Selenium in the CCW.

IMPLND Block

All aspects of the impervious land uses are included in the IMPLND block of the uci file. In the ACTIVITY block, the ATMP, and IWG flags were set to 1 indicating the air temperature and water temperature and gases should be calculated. The flag setting sediment simulation to active is the SLD = 1. The PRINT-INFO and BIN-INFO blocks were modified to print the temperature info on the same frequency as the hydrology. By definition impervious lad areas do not contribute to interflow or groundwater. The surface runoff of dissolved constituents and particle associated constituents are added to the receiving waters.

Temperature

ATEMP-DAT specifies the elevation of the implnd area and initial temperature so the adiabatic cooling can be calculated.

IWAT-PARM1 sets flags to not allow the water temperature regression to vary throughout the year and for no snow accumulation. IWAT-PARAM2 sets the slope and intercept of the water temperature regression.

Sediment Simulation

Table SLD-PARM1 sets flags to set the accumulation rate of solids to not vary throughout the year (VASD = 0), for the unit removal rate to not vary throughout the year (VRSD), and to use the sediment algorithm that is not quite so dependent on the time step (SDOP). If the accumulation or removal rates are allowed to vary through the year, tables MON-SACCUM and MON-REMOV will be required. The values were the best estimate of the values used in Ackerman, et al. (2004).

Table SLD-PARM2 sets the coefficient and exponent for the solids washoff (KEIM and JEIM), the accumulation rate (ACCSDP, e.g. via deposition), and the removal rate (REMSDP, e.g. via street sweeping). The values were the best estimate of the values used in Ackerman, et al. (2004).

Table SLD-STOR is the initial sediment storage on the impervious land. A value of 10.1 tons/ac is used for the CCWM.

Water Quality Constituents

The pervious area surface runoff and sediment associated hardness, chloride, copper, mercury, and selenium estimates are used as initial values for the impervious areas.

RCHRES Block

All aspects of the model reaches are included in the RCHRES block of the uci file. In the ACTIVITY block the ADFG, CNFG, HTFG, SDFG, and GQFG are set to 1 indicating that advection calculations, conservative constituents, heat transport, sediment transport, and general water quality constituents will be modeled in the simulation. The print flags are copied from the hydrology.

Temperature and Gases

HT-BED-FLAGS sets the model bed conduction, source of bed temperature, and how far in the future to use the current heat flux (only used in Jobson method which is not currently used). The flags are sets to use the single interface method and to use monthly bed temperature values.

HEAT-PARAM values are set to essentially the default values. Data in the HEAT-PARAM block include reach elevation, difference in elevation between the reach and MET station, fraction of surface exposed to sun, and factors for longwave radiation, conduction-convection heat transport and evaporation.

HT-BED-PARAM are the parameters for the single and double layer models. The parameters include the thickness of mud, temperature of ground, and heat conduction of the mud and ground.

MON-HT-TGRND is a list of the monthly ground temperatures for each reach. Currently, only default values are included in the uci file.

HEAT-INIT is the list of initial water temperature and air temperatures of and above the reaches. The simple defaults are currently in the uci.

Sediment Simulation

Table SANDFG is used to set the method for calculating sand load in the reaches. The SDFG is set to 3, user supplied option is used for CCWM, implying the use of the table SAND-PM.

Table SED_GENPARM is used to set the bed width, depth of sediments that should fire a warning, and bed porosity (volume voids/total volume). The main channels are set to 10 ft bed widths and 8 ft depth to fire warnings. The tribs have channel widths of 4 ft and 8 ft depth to fire warnings. Both main channels and tributaries use a 0.6 porosity.

Table SAND-PM sets the effective transport parameters for sand and the power function for SDFG=3. The effective diameter D is set to 0.005 in. W is the settling velocity in still water is set to 0.02 in/sec. Rho is the particle density 2.5 gm/cm3, and KSAND and EXPSND are the sand parameters initially set to 0.35 and 3.2 respectively. The values are from Ackerman, et al.

(2004). The values of KSAND and EXPSND are adjusted by reach as required during calibration to maintain a realistic bed depth of sand.

Table SILT-CLAY-PM is entered twice, first for silt and next for clay. The effective diameter, still water settling velocity, particle density, critical bed shear stress for deposition, critical bed shear stress for scour, and M is the erodibility coefficient. The default values selected for the CCWM are from Ackerman, et al. (2004). The values are adjusted by reach as required during calibration to maintain a realistic bed depth of sand.

Table SSED-INIT is used to set the initial concentrations of sand, silt, and clay. Each is set to relatively low values. Table BED-INIT is used to set the initial bed depth, and fraction of sand, silt, and clay in the benthic sediment.

Conservative Constituents

Hardness and chloride are modeled as conservative constituents in the CCWM. The only data required in the model are the initial water column concentration and units used. The hardness is set to 250 mg/L as $CaCO_3$ and chloride is set to 150 mg/L. The initial values have little to no impact after a few days of simulation.

Copper

As with the conservative constituents, the initial water column concentrations and units used are required. Because copper is modeled as particle associated, the partition coefficients, rate, and temperature dependence of the rate are required by the model. An estimate of the partition coefficient is determined by rearranging the partition equation to the form of a regression equation with a zero intercept.

$$C_d = \frac{C_T}{1 + \frac{K_D \cdot TSS}{10^6}}$$

$$\frac{C_T}{C_d} - 1 = \frac{K_D}{10^6} \cdot TSS$$

Where: C_d is the dissolved metal concentration
C_T is the total metal concentration
TSS is the total suspended solids concentration
K_D is the partition coefficient

Available receiving water monitoring data from the watershed are used to estimate the copper partition coefficient, K_D. The calculated copper K_D for the whole CCW are plotted in Figure 36 along with a line marking the best-fit value of 5,600 L/kg used as an initial estimate in the model. The rate of mass transfer between particulate and dissolved was set fast enough for equilibrium to be achieved quickly. The default temperature correction value is currently specified in the CCWM.

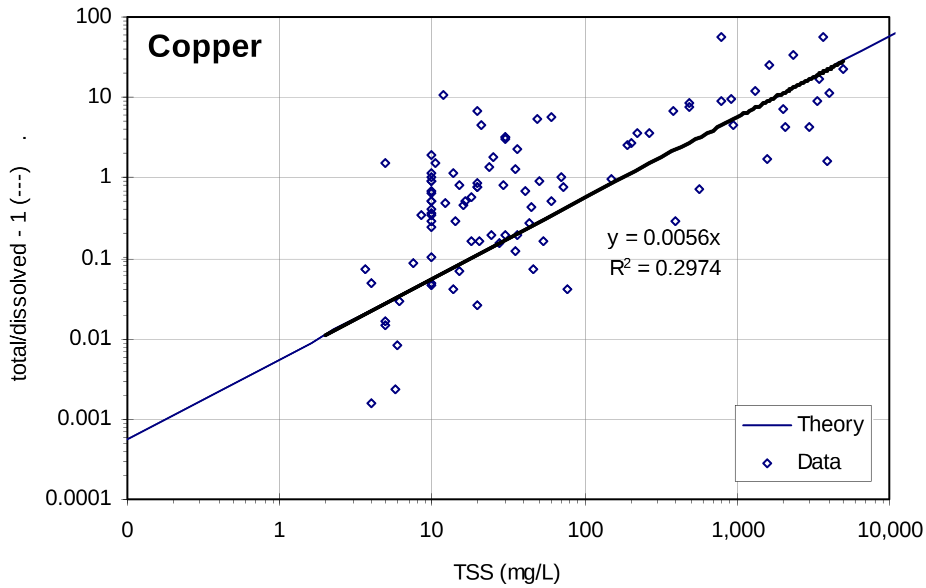

Figure 36: Copper K_D Values for the CCW.

Nickel

As with the conservative constituents, the initial water column concentrations and units used are required. Because ncikel is modeled as particle associated, the partition coefficients, rate, and temperature dependence of the rate are required by the model. As with copper, an estimate of the partition coefficient is determined by rearranging the partition equation to the form of a regression equation with a zero intercept.

Available receiving water monitoring data from the watershed are used to estimate the nickel partition coefficient, K_D. The calculated nickel K_D for the whole CCW are plotted in Figure 36 along with a line marking the best-fit value of 5,400 L/kg used as an initial estimate in the model. The rate of mass transfer between particulate and dissolved was set fast enough for equilibrium to be achieved quickly. The default temperature correction value is currently specified in the CCWM.

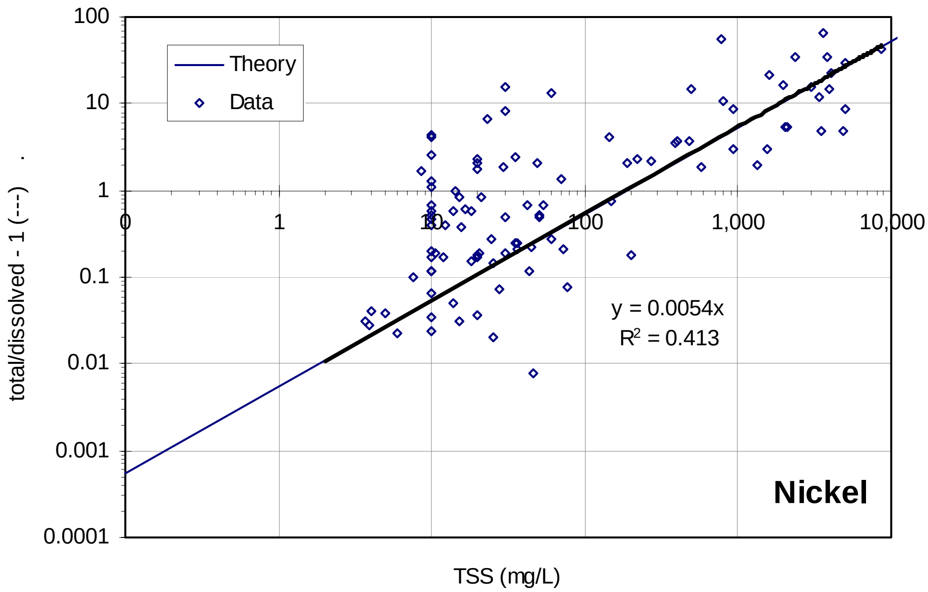

Figure 37: Nickel K_D Values for the CCW.

Mercury

As with the conservative constituents, the initial water column concentrations and units used are required. Because mercury is modeled as particle associated, the partition coefficients, rate, and temperature dependence of the rate are required by the model. Available monitoring data from the watershed are used to estimate the mercury partition coefficient, K_D. The best-fit mercury K_D for the whole CCW is plotted in Figure 38 as a slope of 32,300 L/kg used as an initial estimate in the model. The rate of mass transfer between particulate and dissolved was set fast enough for equilibrium to be achieved quickly. The default temperature correction value is currently specified in the CCWM.

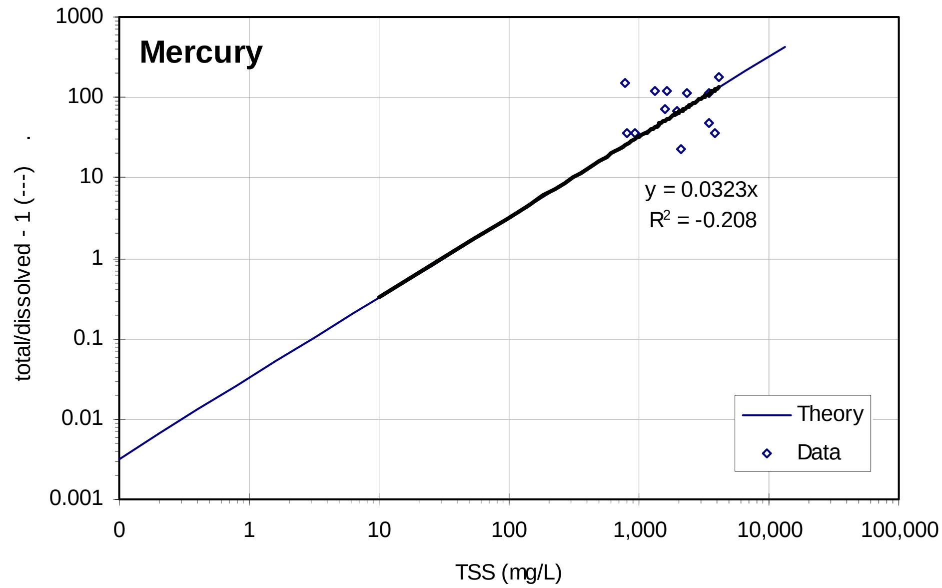

Figure 38: Mercury Partition Coefficient K_D for the CCW.

Selenium

As with the conservative constituents, the initial water column concentrations and units used are required. Because selenium is modeled as particle associated, the partition coefficients, rate, and temperature dependence of the rate are required by the model. Available monitoring data from the watershed are used to estimate the selenium partition coefficient, K_D. The calculated selenium K_D for the whole CCW are plotted in Figure 39 along with the regression line for the value of 420 L/kg used in the model. The rate of mass transfer between particulate and dissolved was set fast enough for equilibrium to be achieved quickly. The default temperature correction value is currently specified in the CCWM.

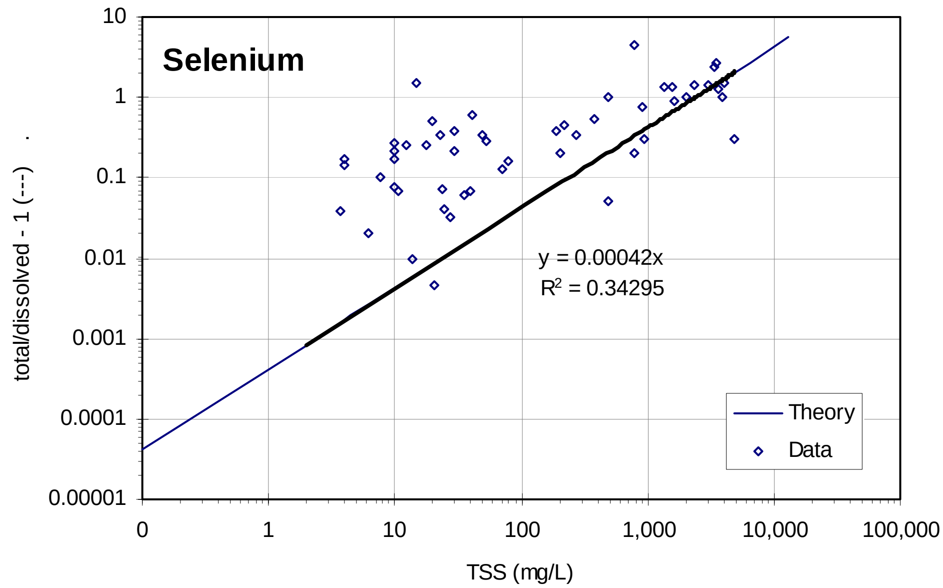

Figure 39: Selenium Partition Coefficient KD for the CCW.

SCHEMATIC Block

The SCHEMATIC block contains the global structure of the watershed, both land segment to reach and reach to reach. Each entry in the schematic refers to a MASS-LINK table where the detailed time series connections are specified. The SCHEMATIC specifies how the individual PERLND and IMPLND land areas are linked to specific RCHRES given the respective areas. No changes to the SCHEMATIC block are required to add water quality to the model.

The schematic block is also used to link the model calculations to the loadings by land use for the source analysis.

NETWORK Block

The network block is used to appropriately sum the loadings and inserting the results in the REPORT variables of HSPF. HSPF is set to generate load reports by constituent and land use category for the whole watershed and for selected subwatersheds.

MASS-LINK Block

Modifications to the MASS-LINK specify how the water quality constituents are linked into the model. The MASS-LINK block is used to specify how the model should link the flow of heat between model components. Entries are added to link the PERLND and IMPLND heat to RCHRES. Because the CCWM is relatively complicated, special attention is required to ensure the proper links are made connecting the land areas to the reaches and reach to reach.

EXT SOURCES Block

The EXT SOURCES lists a source of external data to a set of model segments. The details of the additional data sets of external data required for the temperature model are described below.

Entries in the EXT SOURCES block link air and dew point temperatures, solar radiation, and wind speed to PERLND, IMPLND, and RCHRES; and cloud cover is linked to the RCHRES.

The loads of constituents of interest carried by the point sources to the receiving waters (i.e. POTW and groundwater dewatering/treatment discharges) are specified in the EXT SOURCES block. Details of the calculations and specifications are described below.

EXT TARGETS Block

The EXT TARGETS block is a list linking model calculations to the output location in the appropriate wdm file. Entries are added linking the calculated water temperature to the new wdm file.

WDM file Modifications

Modification to the new wdm (calleg2.wdm) file are centered around adding air temperature, solar radiation, dew point temperature, wind speed, cloud cover, and POTW historic data and providing locations for model output.

New WDM file: calleg2.wdm

The new wdm file is created and modified using a combination of the USGS programs ANNIE and IOWDM. In general, annie is used to create and manipulate the datasets within the wdm; and iowdm is used for importing of csv flat data files into the wdm.

Meteorological Data

To run water temperature simulations, the air temperature, dew point temperature, wind speed, solar radiation, and cloud cover data are required for the entire watershed. As an initial run, only two MET stations will be used to cover the entire watershed. Air temperature, dew point temperature, wind speed, and solar radiation data from the CIMIS station 152, located near Camarillo are available from January 2000 to present. The data are simply repeated backward to create a synthetic data set for the initial scoping runs. Cloud cover data from the Camarillo air port are available from late 1999 to present and were repeated backward through time as with the CIMIS data to create a synthetic data set for scoping runs.

POTW Inflows

The DSN's corresponding to the POTW flowrates were imported from the original wdm (calleg1.wdm) to the new water quality wdm to allow for load calculations. All calculations necessary to develop the loads and heat contributions are performed using the USGS program ANNIE. The ability to transform the hourly air temperature values to average daily values, add and multiply constants to the data and multiply two data sets are utilized to create the heat load.

Temperature

The heat in the discharge relative to freezing added to the reach is required for the point sources. Daily temperature data for the Simi Valley WQCF effluent are available from January 1, 1991 to the present. The average daily temperature calculated from 1991 to 2001 data is used to synthesize the daily temperature record from October 1, 1987 to December 31, 1990. Both temperature data and estimated values are plotted in Figure 40. Where available, measured data are used in the CCWM, but the estimated values are used to fill in the temperature from the first several years of simulation. None of the other treatment plants has as extensive of a temperature record as Simi Valley. All treatment plant effluents in the watershed are assigned the temperature data for Simi Valley. The data available for the Hill Canyon and Camarillo treatment plants are superimposed on the Simi Valley values in Figure 41 and Figure 42, respectively. The temperature data for Hill Canyon and Camarillo match the Simi Valley data well.

As required by HSPF, the heat is calculated by multiplying the effluent temperature adjusted to convert to Celsius times the effluent flowrate (in MGD) and multiplied by 87,629.4 to convert to kcal/hr relative to freezing. The new DSN's are numbered 9xxx where xxx is the original DSN for treatment plant flow.

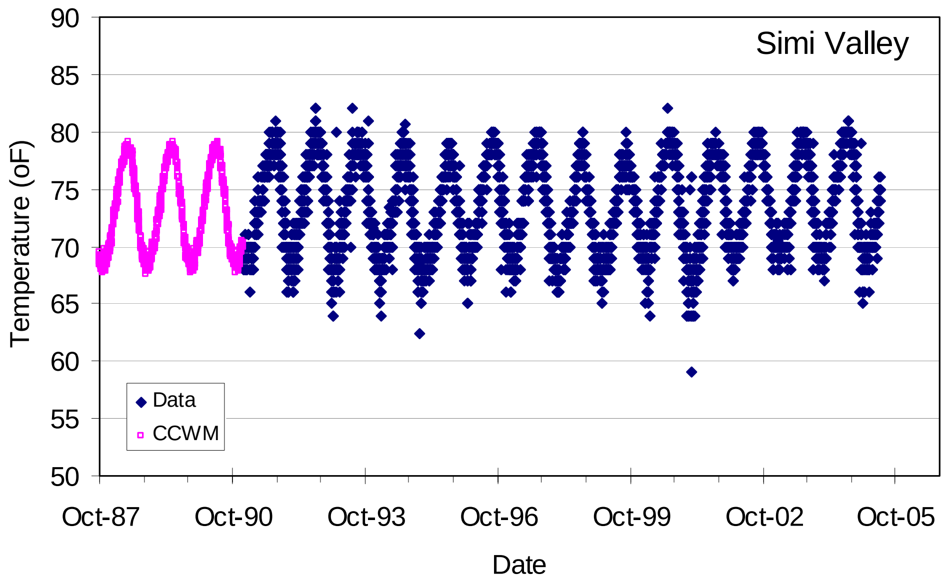

Figure 40: Temperature Data for Simi Valley Effluent.

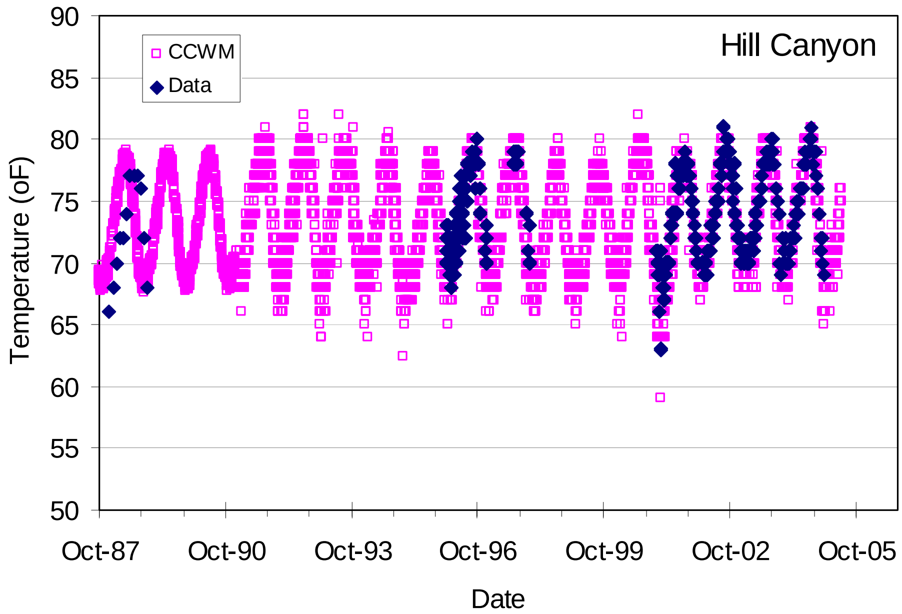

Figure 41: Temperature Data for Hill Canyon Effluent.

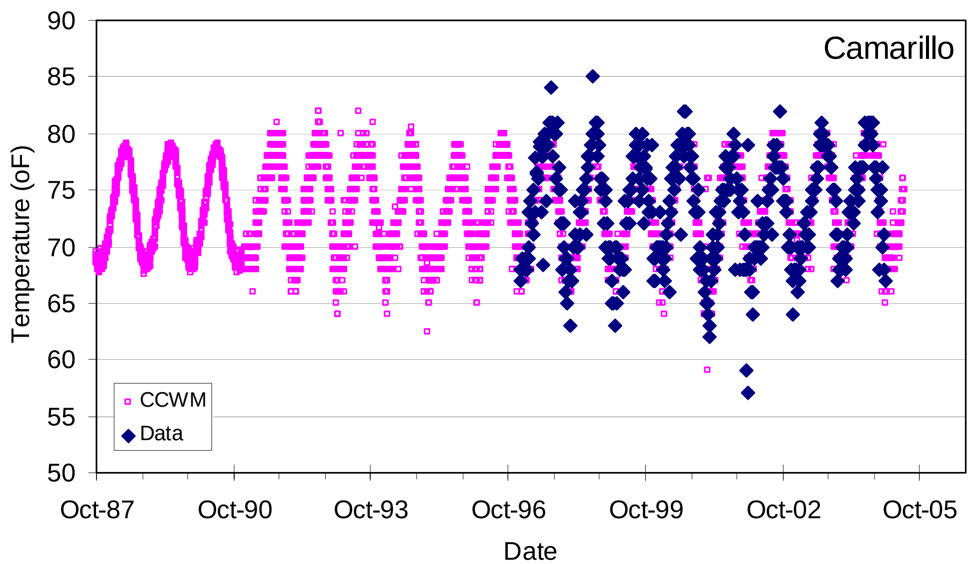

Figure 42: Temperature Data for Camarillo Effluent.

Sediment Simulation

The sediment input from treatment plants is required to be in units of tons/hr (hour because the time step is 1.0 hour). For the initial model, data for each treatment plant discharges a constant concentration of solids, of which 50% can be classified as silt and 50% can be classified as clay.

Available data from each of the major treatment plant along with the representative concentrations are plotted in Figure 43 to Figure 45. The input load data sets are built by simply multiplying the flow by the estimated concentration, to get numbers in the unconventional units of mg/L*MGD. The conversion multiplier and 0.5 fractionation, both combining to equal $0.87 \bullet 10^{-7}$, occurs in the EXT SOURCES block. The new DSN's are numbered 8xxx where xxx is the original DSN for treatment plant flow.

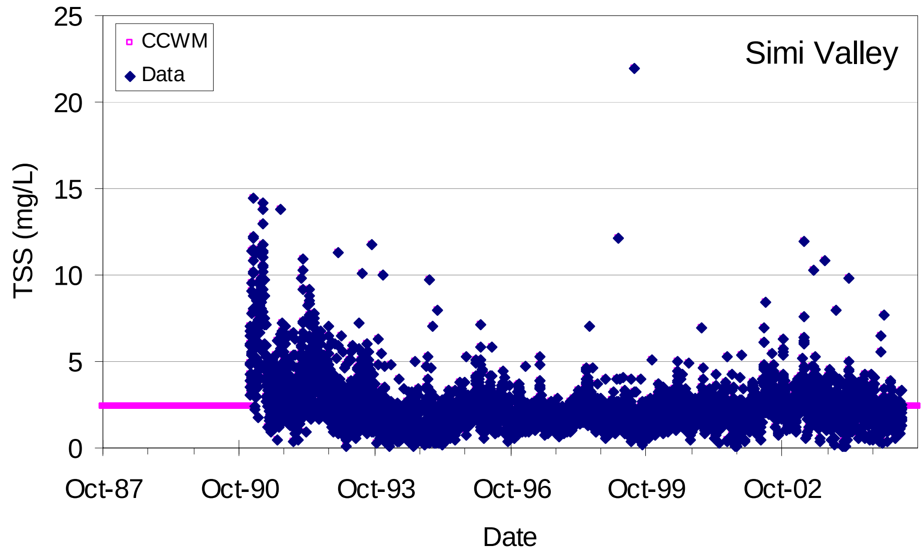

Figure 43: TSS Data in Simi Valley Effluent.

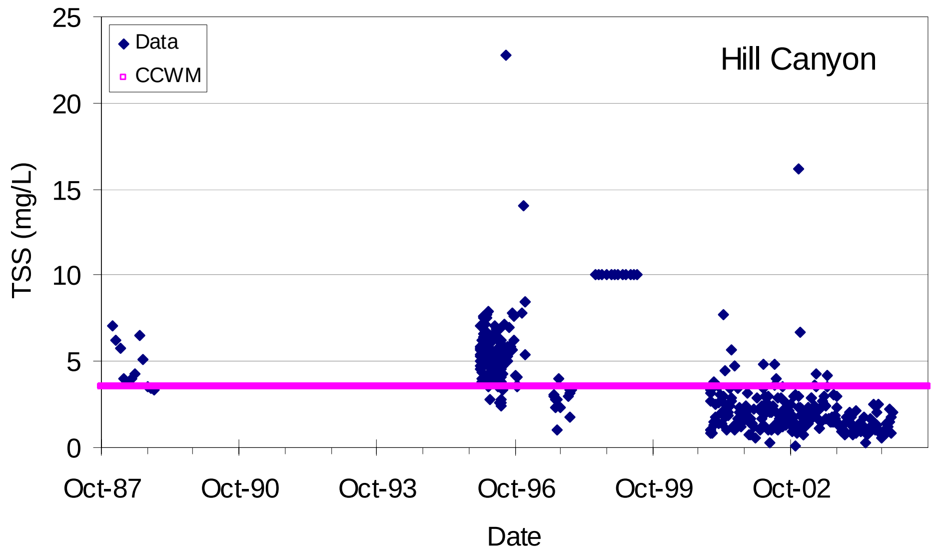

Figure 44: TSS Data for Hill Canyon Effluent

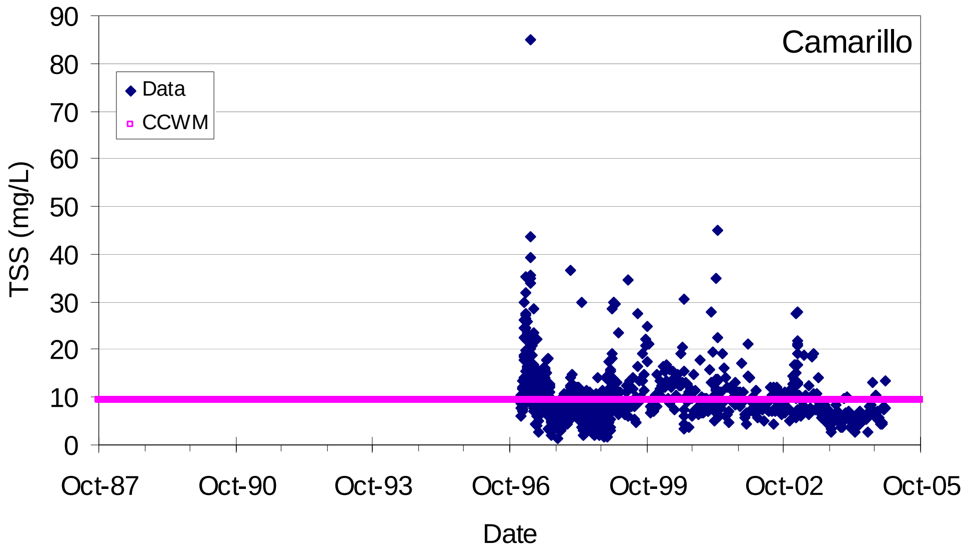

Figure 45: TSS Data for Camarillo Effluent.

Hardness

Because hardness data from the treatment plants are limited, and largely unavailable for the calibration time period. The average hardness for each treatment plant is used for input into the HSPF model. Available data and the value used in HSPF are plotted in Figure 46 to Figure 48.

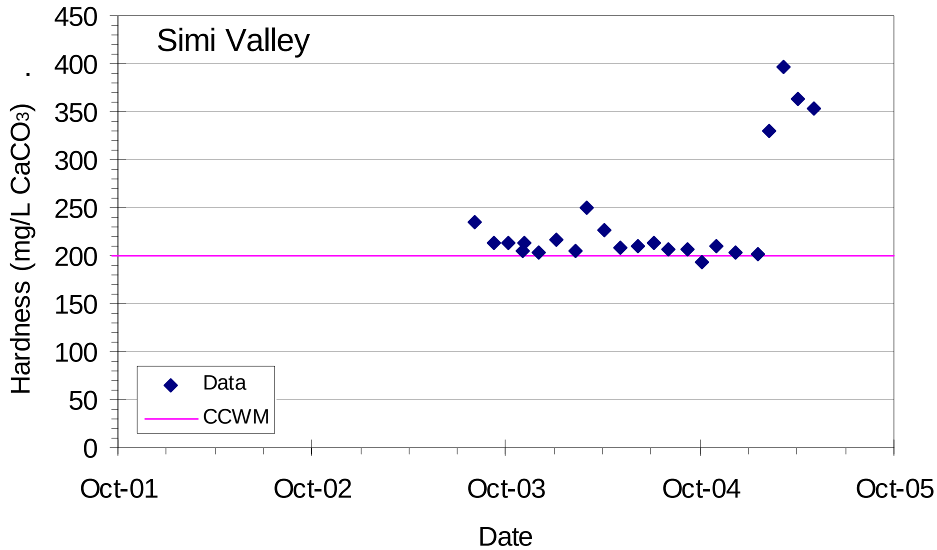

Figure 46: Hardness Data for Simi Valley Effluent.

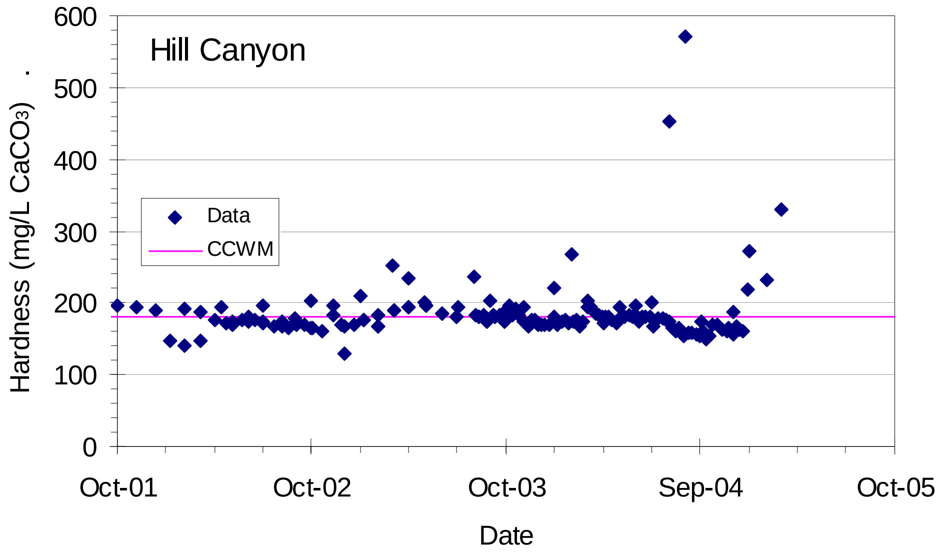

Figure 47: Hardness Data for Hill Canyon Effluent.

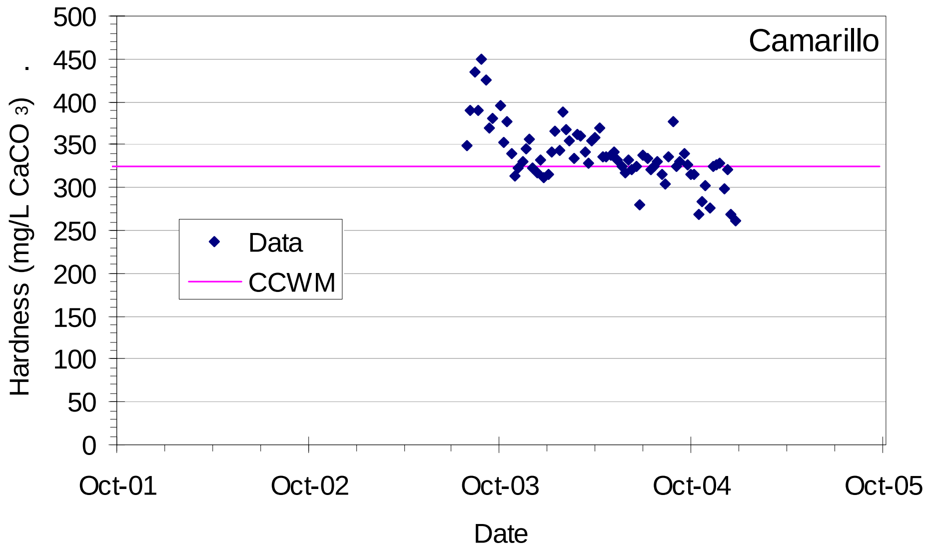

Figure 48: Hardness Data for Camarillo Effluent.

Chloride

Concentrations of chloride data for the major POTW effluents are plotted in Figure 49 to Figure 51. Because chloride in the POTW effluents have been studied extensively (LWA 2004) the results from the previous study are used as the input into the CCWM. The model developed for the salts investigations labeled the Dynamic Calleguas Creek Watershed Model (DCCWM) is described in (LWA 2004) and uses statistical representations of environmental conditions to calculate the chloride concentrations in the effluents of the CCW POTWs The DCCMS output is compared to the measured data in each of the Figures. Where measured data are available, they are used as input to HSPF and DCCMS output is used where data are not available.

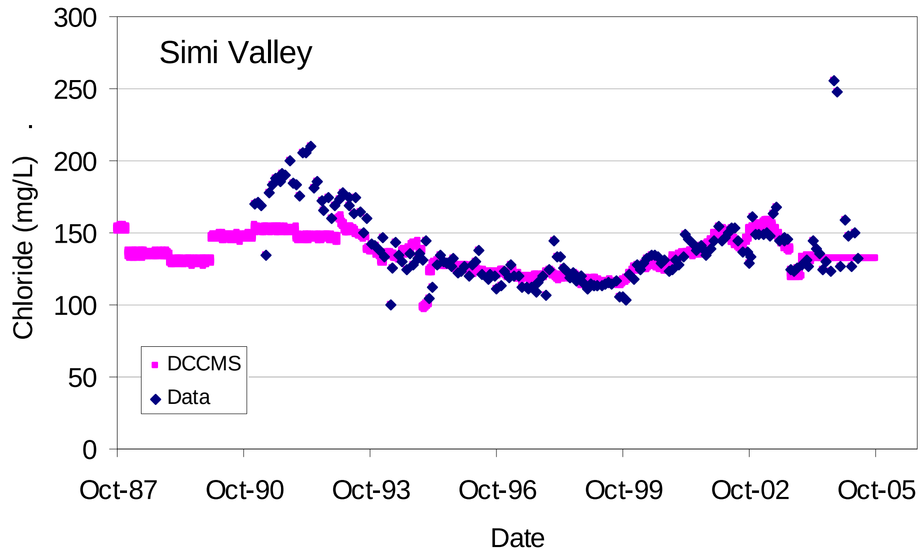

Figure 49: Chloride Data for Simi Valley Effluent

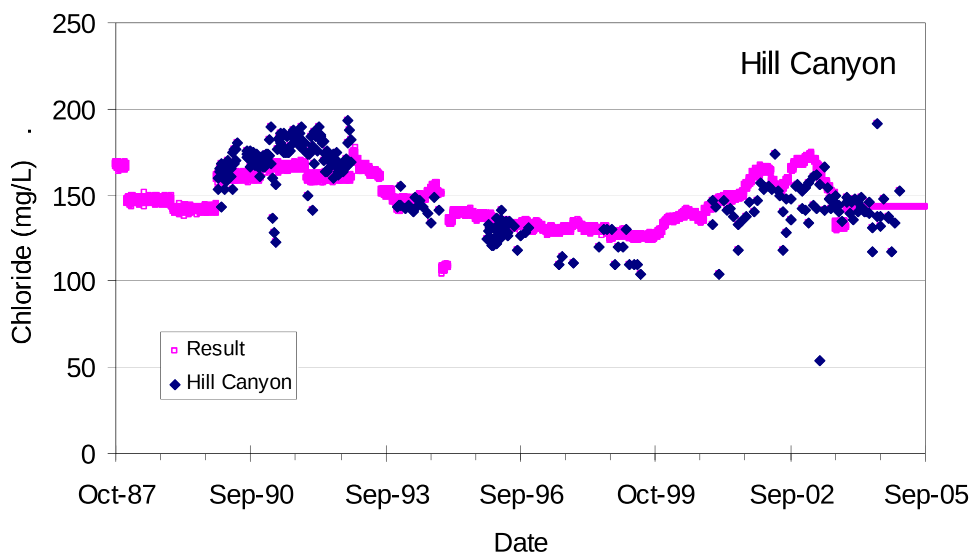

Figure 50: Chloride Data for Hill Canyon Effluent.

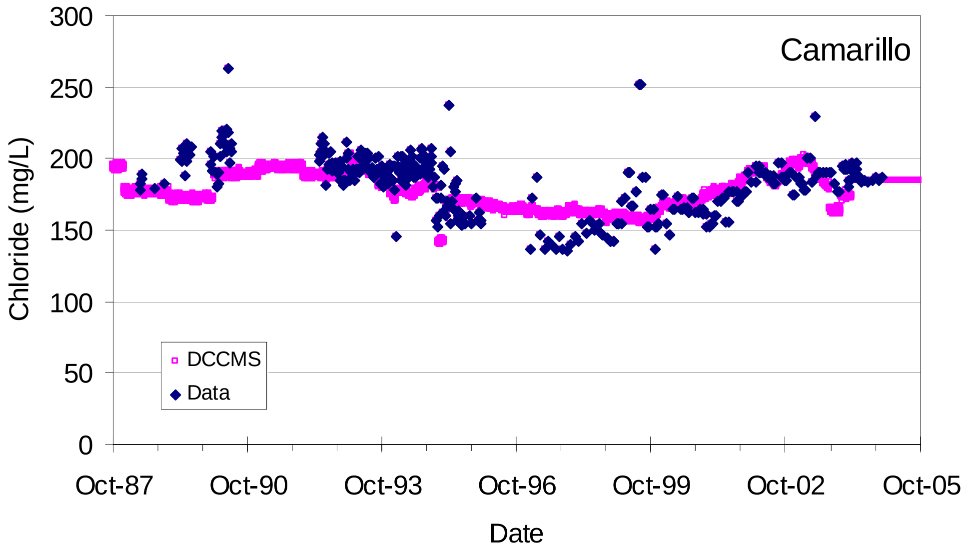

Figure 51: Chloride Data for Camarillo Effluent.

Copper

Available copper concentration data for the major POTWs in the CCW are plotted in Figure 52 to Figure 54. Because data are relatively limited, the average of the data is used to estimate effluent copper concentrations. The only dissolved copper data for POTW effluents were measured in the Calleguas Creek Characterization study performed in 1998. A review of the data indicates that most of the copper in POTW effluent is in the dissolved form. As a conservative assumption, the copper in each of the effluents is specified in the CCWM as being entirely in the dissolved fraction. Available data were analyzed via the regression on order statistics (ROS) method to determine a probability distribution for each treatment plant. The distribution is used with a random number generator to provide a synthetic daily discharge concentration. The daily values used in the model are plotted in the Figures.

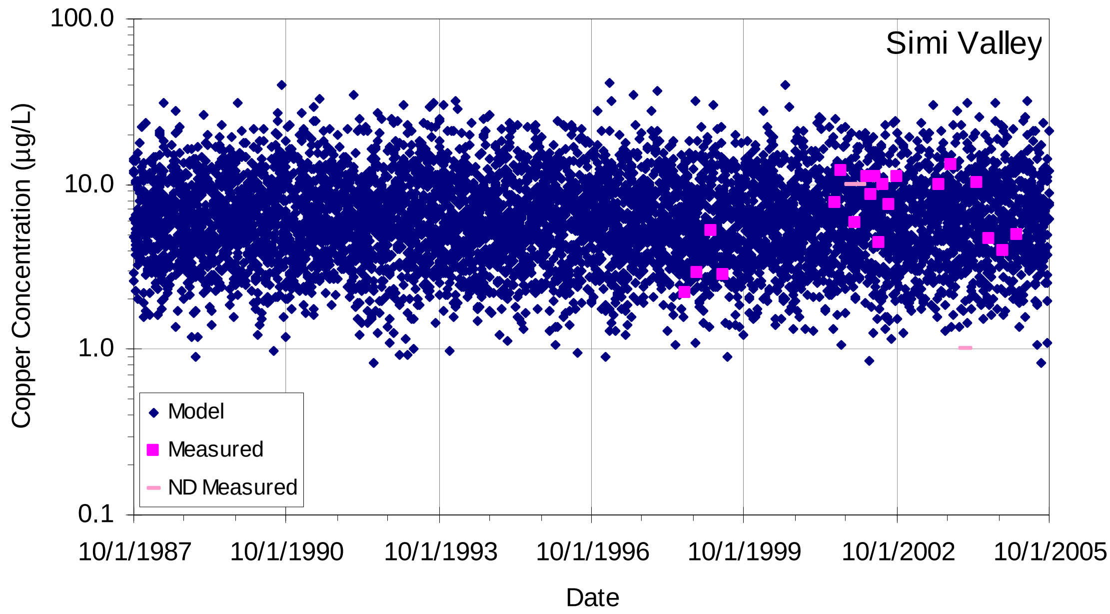

Figure 52: Total and Dissolved Copper Data for Simi Valley Effluent.

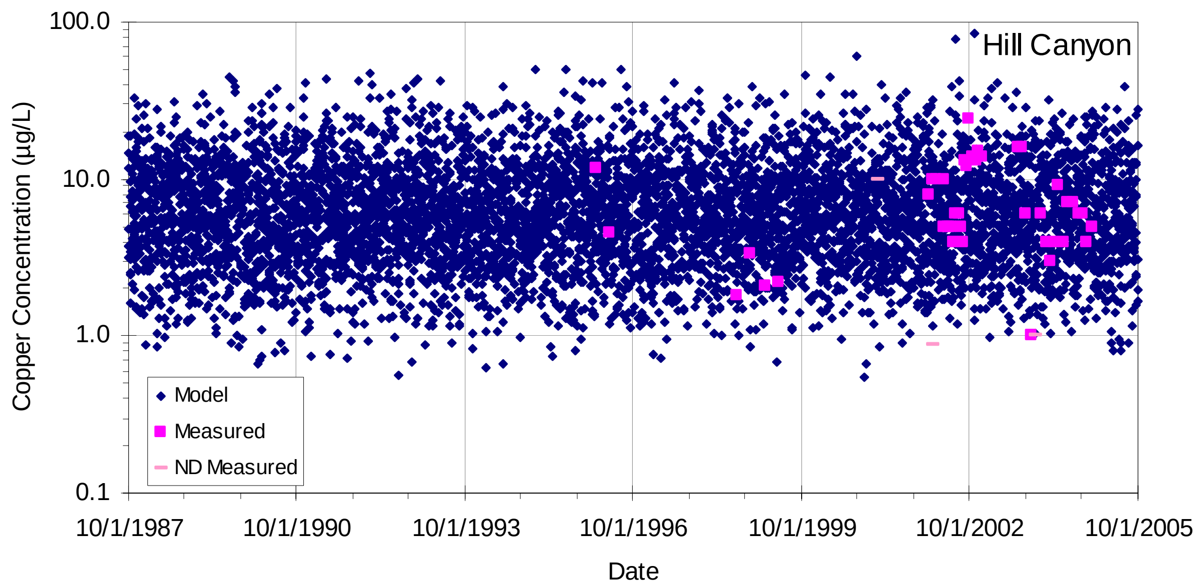

Figure 53: Copper Data for Hill Canyon Effluent.

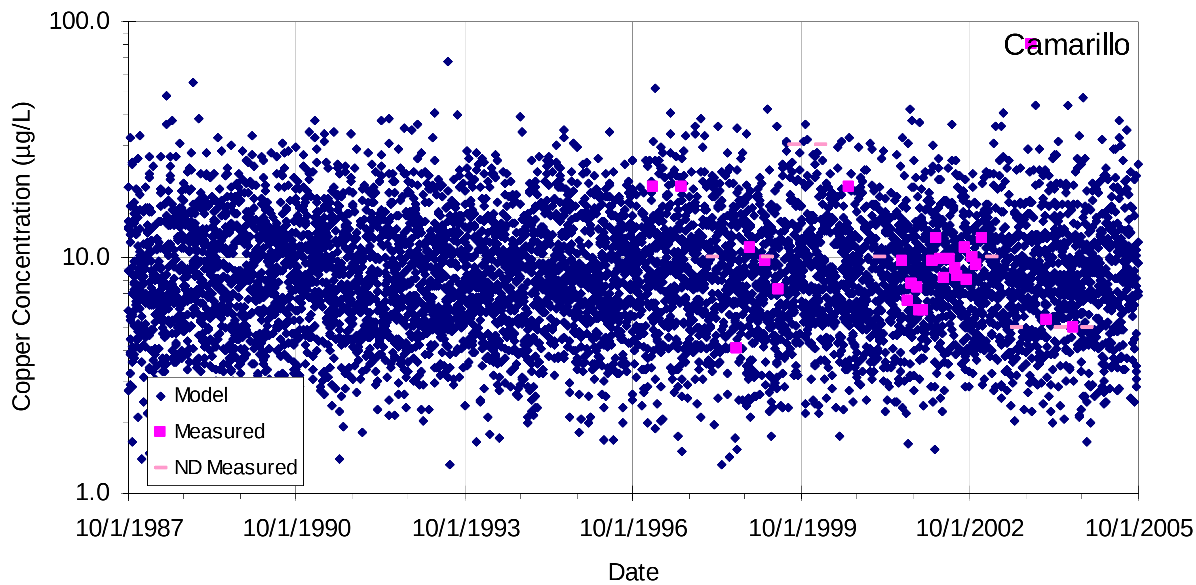

Figure 54: Copper Data for Camarillo Effluent.

Nickel

Available nickel concentration data for the major POTWs in the CCW are plotted in Figure 52 to Figure 54. Because data are relatively limited, the average of the data is used to estimate effluent nickel concentrations. The only dissolved nickel data for POTW effluents were measured in the Calleguas Creek Characterization study performed in 1998. A review of the data indicates that most of the nickel in POTW effluent is in the dissolved form. As a conservative assumption, the nickel in each of the effluents is specified in the CCWM as being entirely in the dissolved fraction. Available data were analyzed via the regression on order statistics (ROS) method to determine a probability distribution for each treatment plant. The distribution is used with a random number generator to provide a synthetic daily discharge concentration. The daily values used in the model are plotted in the Figures.

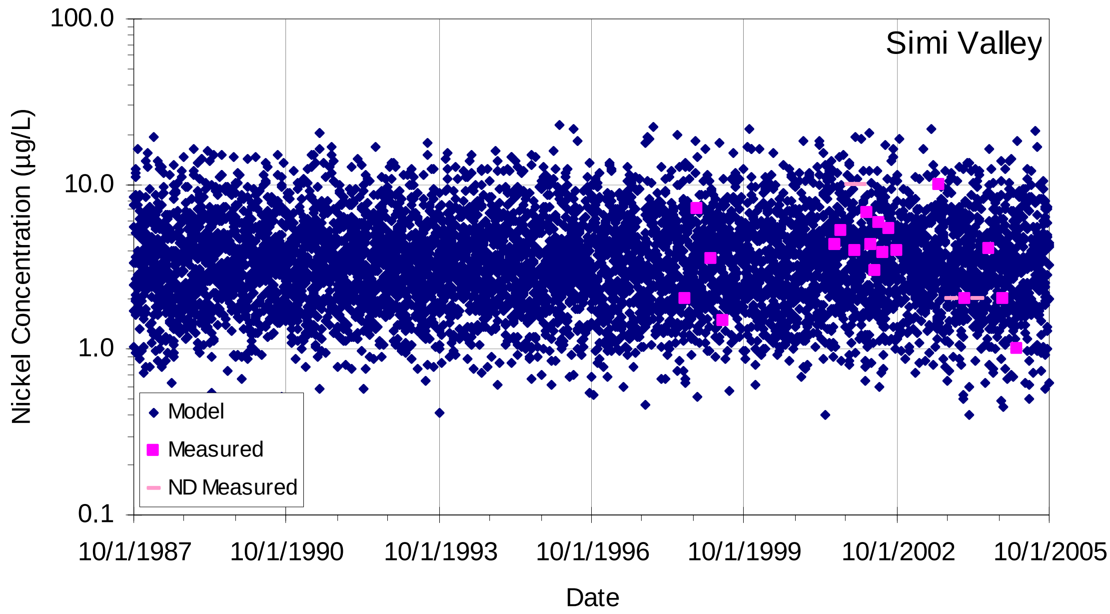

Figure 55: Nickel Data for Simi Valley Effluent.

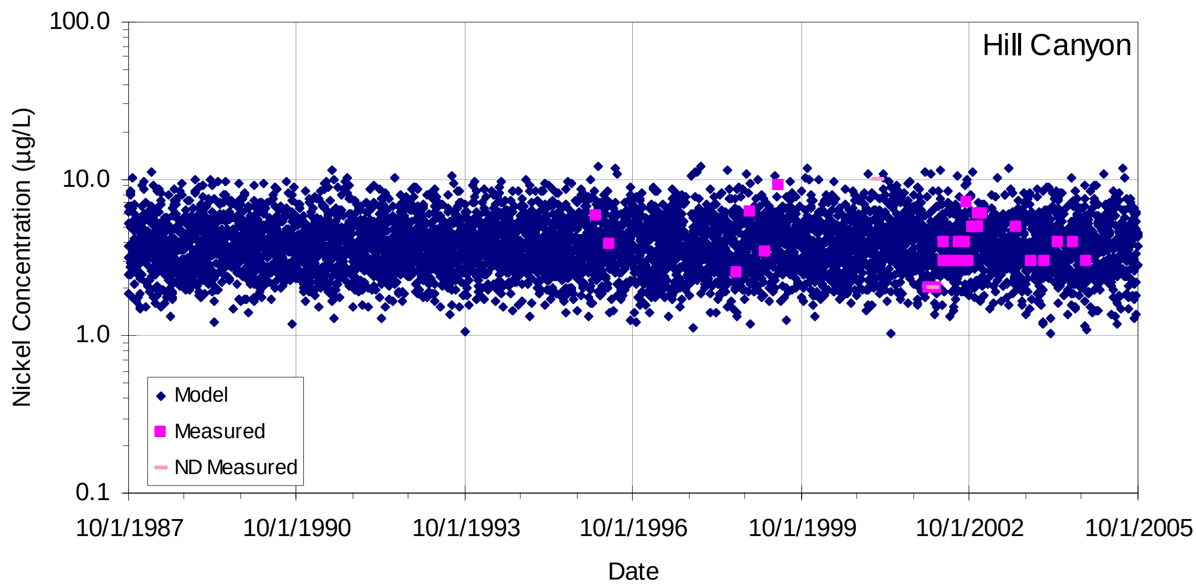

Figure 56: Nickel Data for Hill Canyon Effluent.

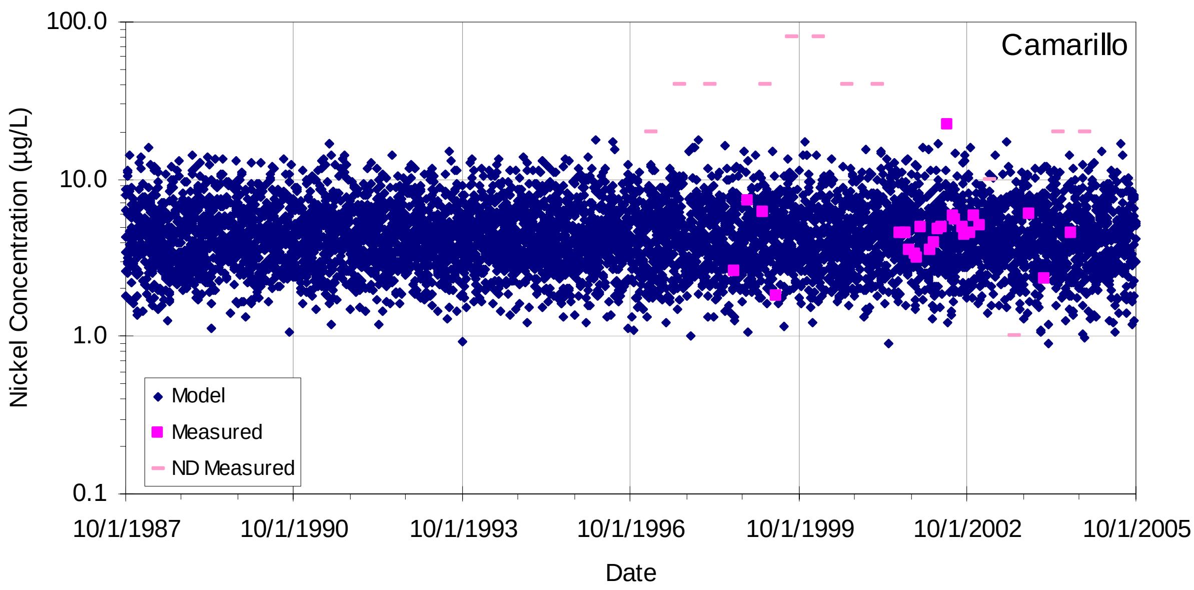

Figure 57: Nickel Data for Camarillo Effluent.

Mercury

Mercury data for the POTW effluents are plotted in Figure 58 to Figure 60. No dissolved mercury data are available for any of the POTW effluents. Average values for the concentrations are used in the HSPF due to limited available data. The mercury in POTW effluent is assumed to be entirely in the particulate phase.

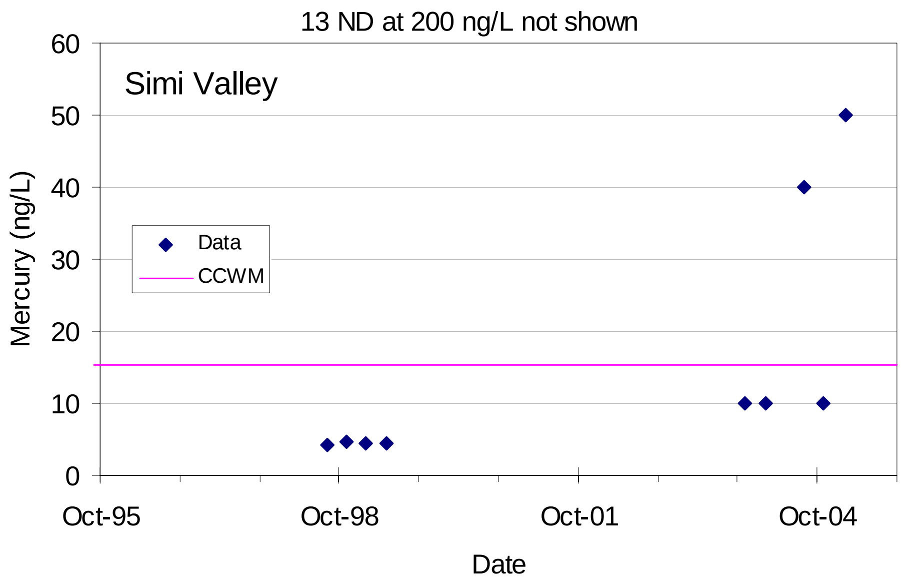

Figure 58: Mercury Data for Simi Valley Effluent.

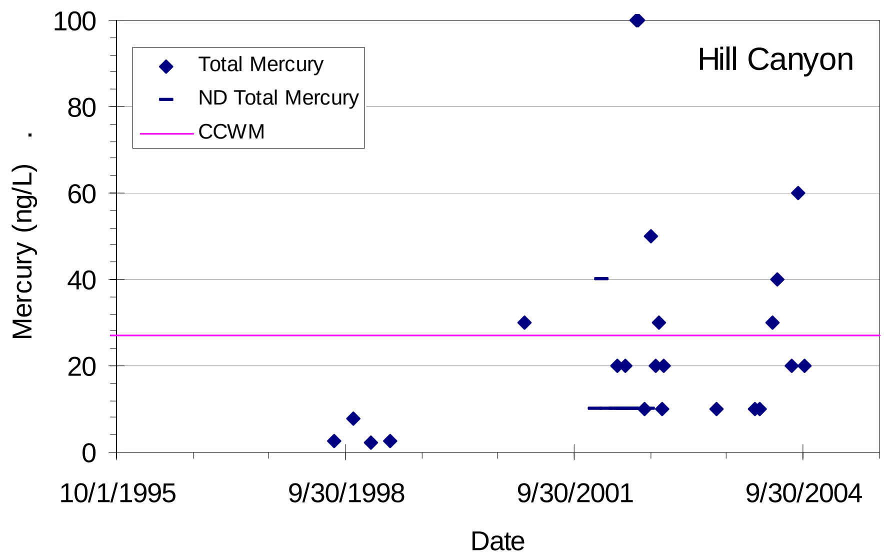

Figure 59: Mercury Data for Hill Canyon Effluent.

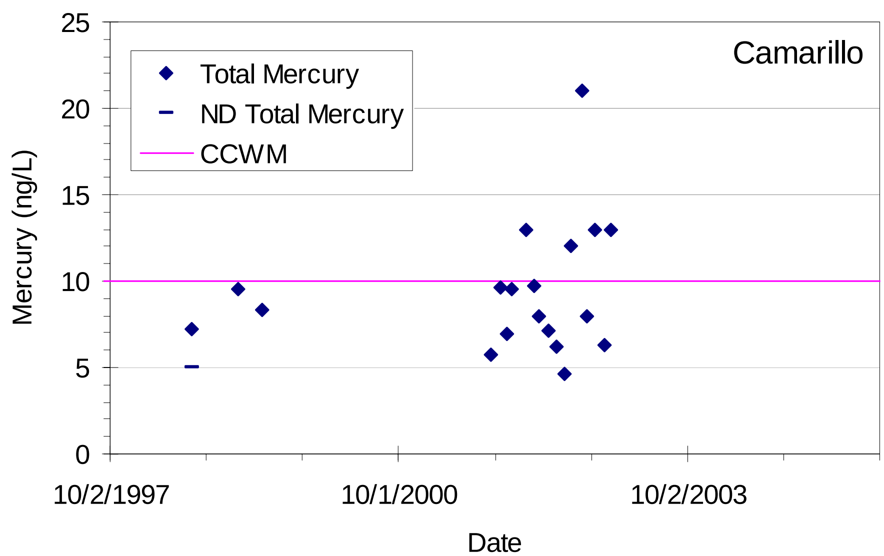

Figure 60: Mercury Data for Camarillo Effluent.

Selenium

Selenium data for the POTW effluents are plotted in Figure 61 to Figure 63. The average of the available data is used for input to the HSPF model. The selenium is assumed to be entirely in the particulate phase for the POTW effluents.

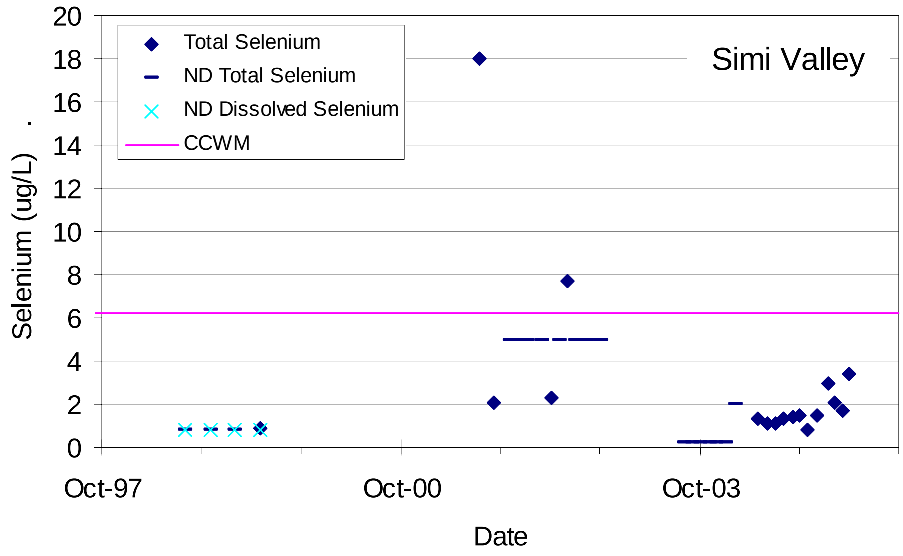

Figure 61: Selenium Data in Simi Valley Effluent.

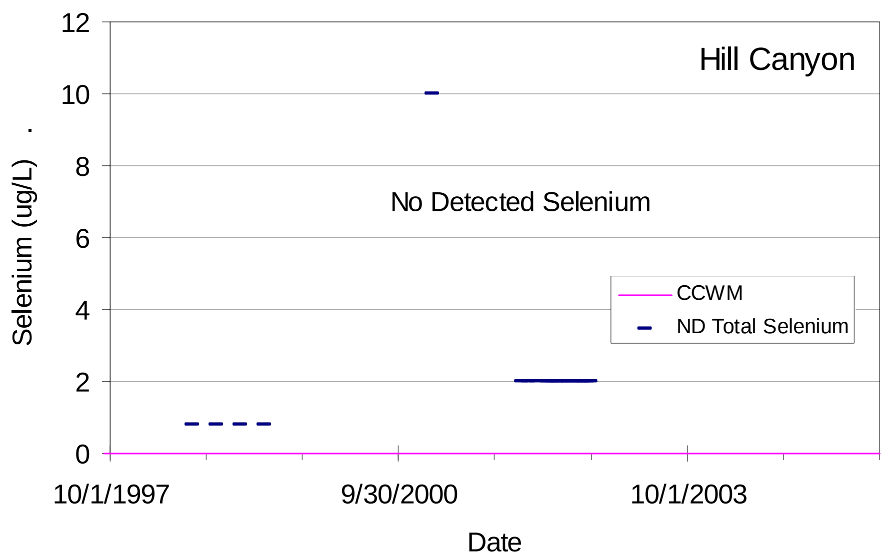

Figure 62: Selenium Data for Hill Canyon Effluent.

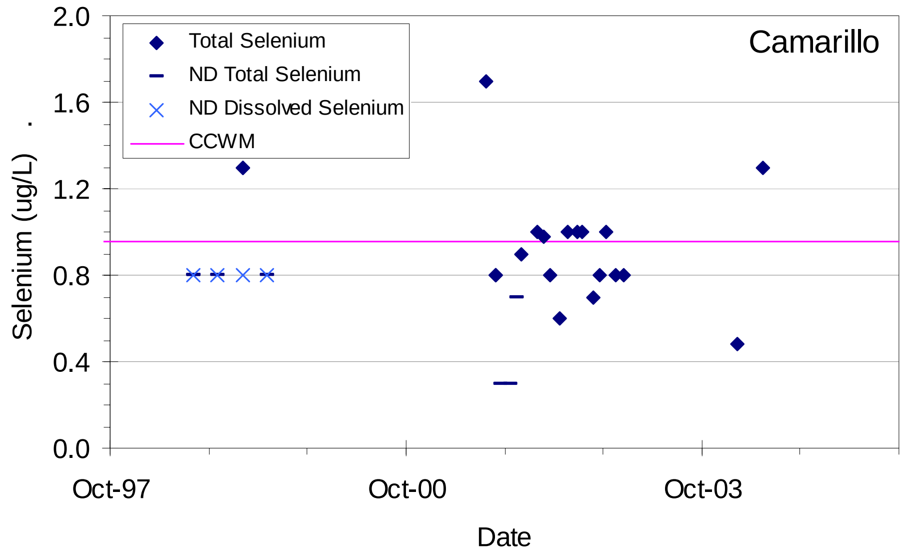

Figure 63: Selenium Data for Camarillo Effluent.

Pumped Groundwater Inflows

Heat contribution of pumped groundwater inflows are included in the model by performing an initial run saving the lower layer soil temperatures. The calculated temperatures were used to determine the heat load in the groundwater dewatering well discharge to the receiving waters.

Using the water quality information developed for the salts work in the watershed, the estimated concentration of chloride and hardness are applied as constants to the dewatering flowrates. Values selected from LWA, 2004 include: 131 mg/L chloride in Arroyo Simi; 180 mg/L as $CaCO_3$ hardness in Arroyo Simi; 195 mg/L in Conejo; and 227 mg/L in Calleguas.

Available TSS data for the Simi dewatering wells are plotted in Figure 64. A constant average value of 8 mg/L is used in the CCWM to estimate the solids loading to the receiving water by the dewatering activities.

Copper, nickel, mercury, and selenium data for the dewatering wells in Simi Valley are plotted in Figure 65 to Figure 68, respectively. Copper and nickel are applied as all dissolved phase at concentration randomly selected from the distribution generated by the ROS method. Mercury is applied as particulate associated at a concentration of 1.0 ng/L. Selenium is applied as particulate associated at a concentration of 1.7 µg/L.

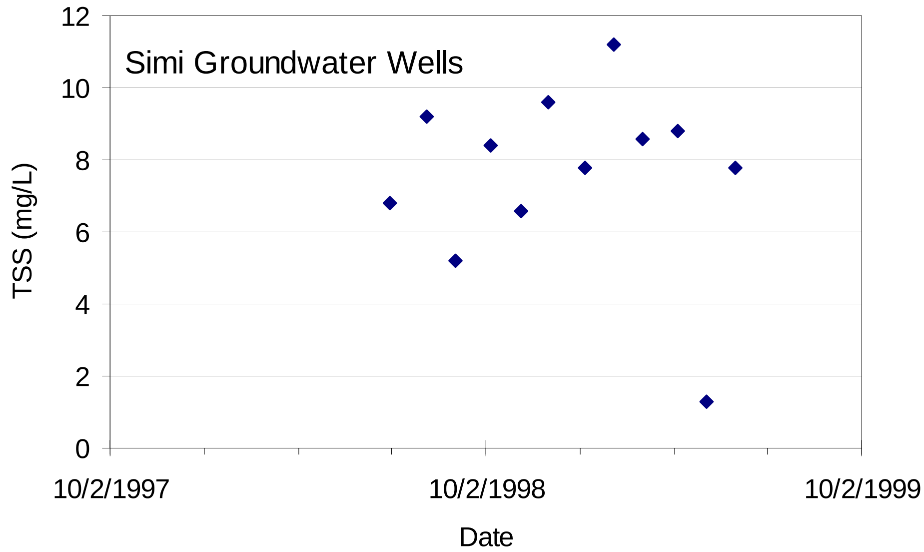

Figure 64: TSS Data for Simi Dewatering Wells.

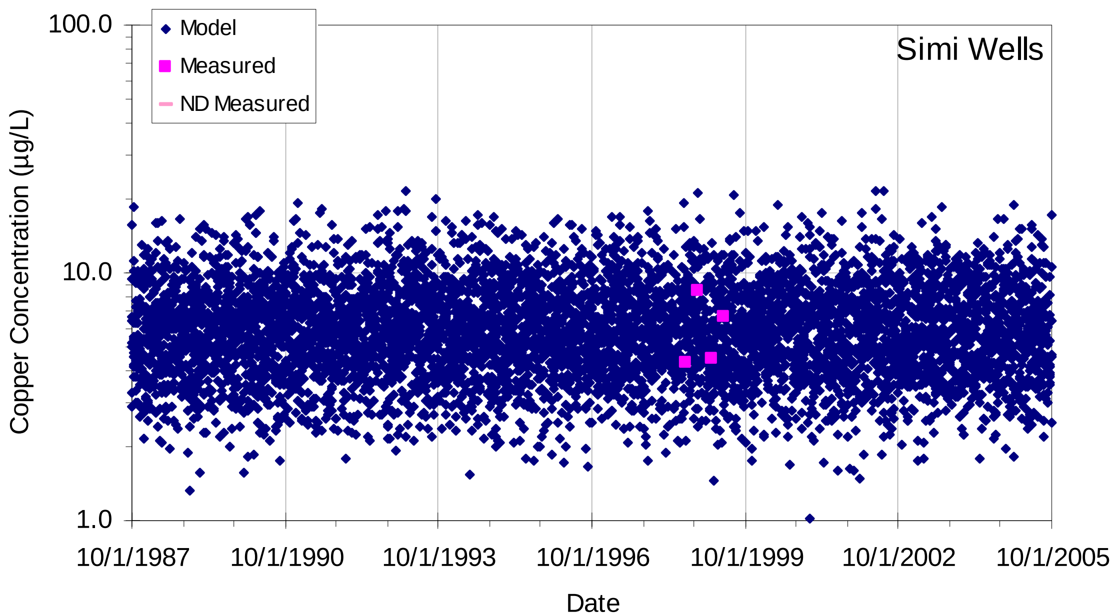

Figure 65: Copper Data from Simi Groundwater Dewatering Wells.

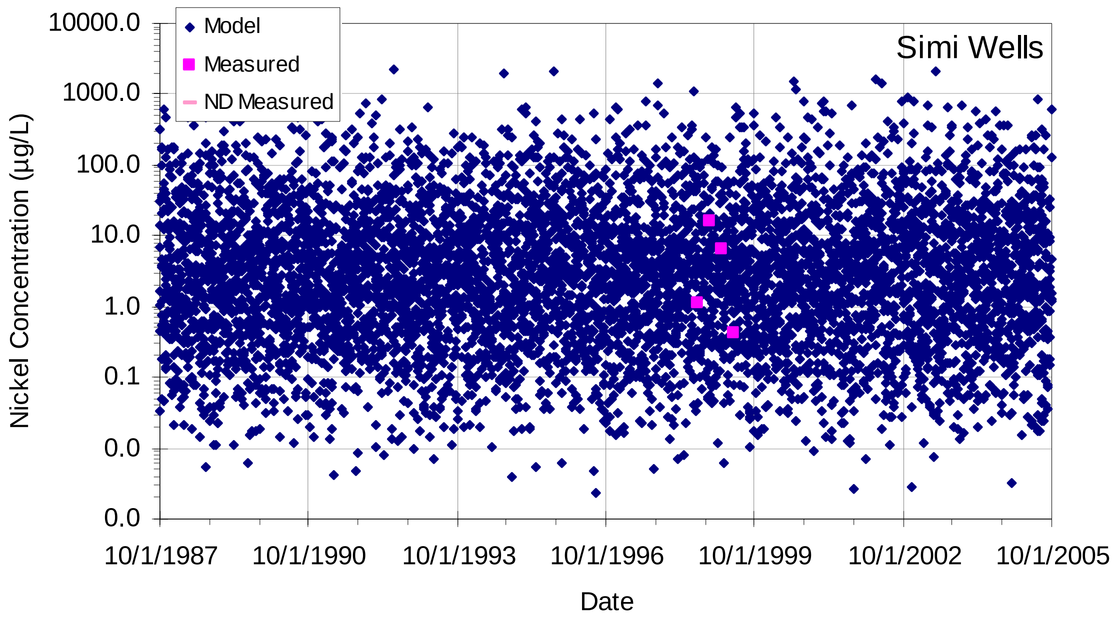

Figure 66: Nickel Data from Simi Dewatering Groundwater Wells.

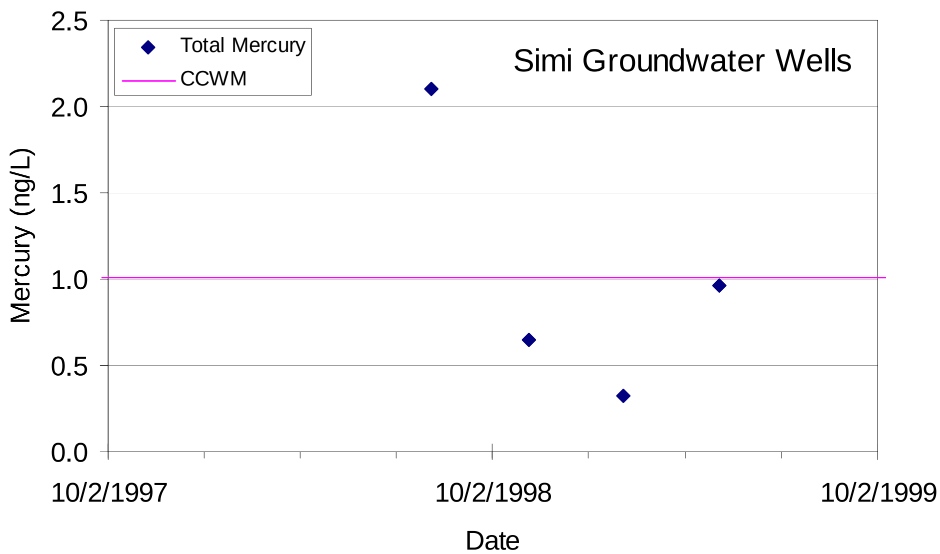

Figure 67: Mercury Data from Simi Dewatering Groundwater Wells.

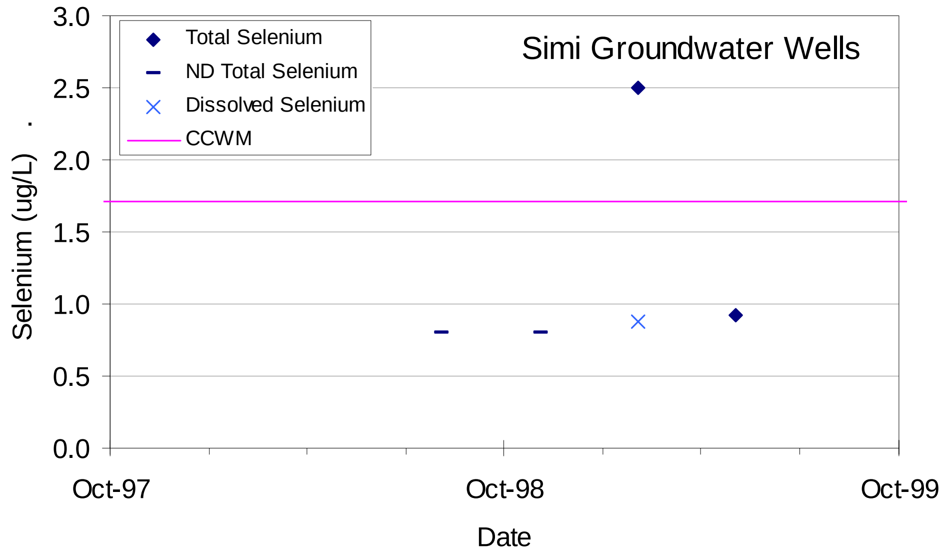

Figure 68: Selenium Data from Simi Dewatering Groundwater Wells.

New WDM file: calleg3.wdm

A wdm file to exclusively maintain the modeled and measured water quality is used for the extended HSPF model. A separate wdm file is used to allow the numbering of the data sets (DSN) to reflect the constituent and the location, thereby facilitating post processing of the information both manually and via the ANNIE scripting facility. Data sets contained in the wdm file are listed in the Appendix.

CALIBRATION AND VALIDATION

Calibration of the CCWM began with temperature and sediment. Calibration used available data up through December 2002, except metals and selenium where only data from January 1995 to December 2002 were used for calibration. Metals and selenium data prior to 1995 typically used detection limits an order of magnitude greater than expected concentrations, and are therefore not reliable. The calibration generally follows the methodology outlined in Donigian (2002). Sediment calibration followed recommendations of Donigian and Love (2003).

Validation data consisted of available data collected from January 2003 to December 2004.

Temperature

Measured and modeled temperature time series along with measured vs. modeled comparison plots are presented in Figure 69 to Figure 96.

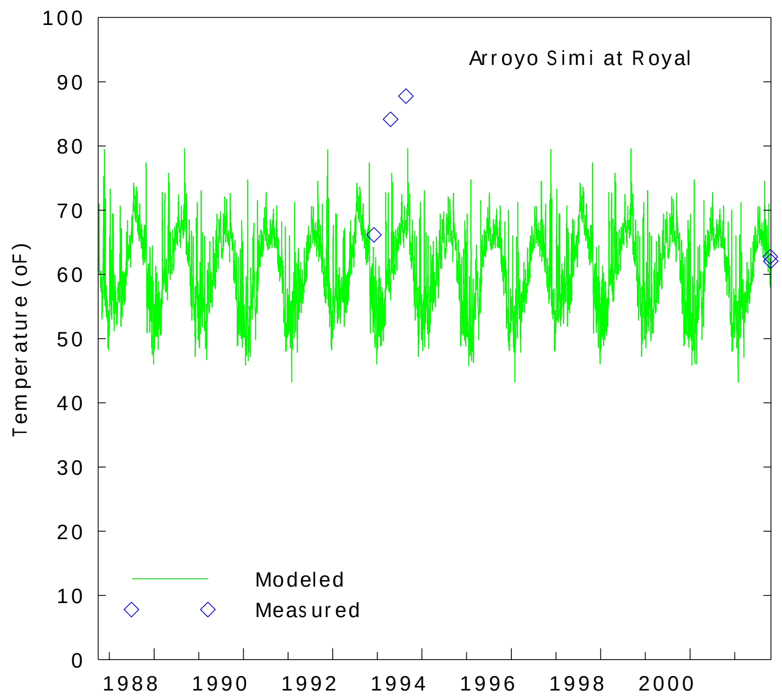

Figure 69: Modeled and Measured Temperature Time Series for Arroyo Simi at Royal.

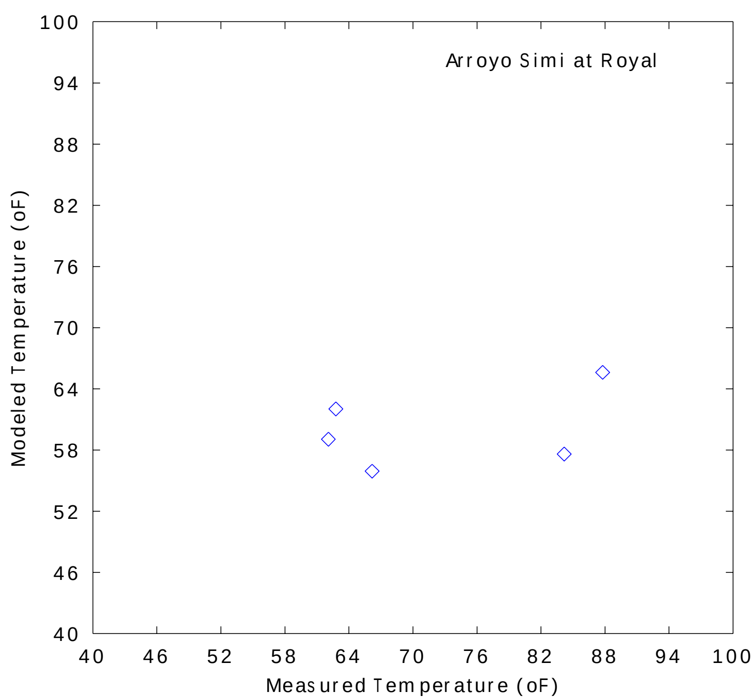

Figure 70: Measured vs. Modeled Temperature for Arroyo Simi at Royal.

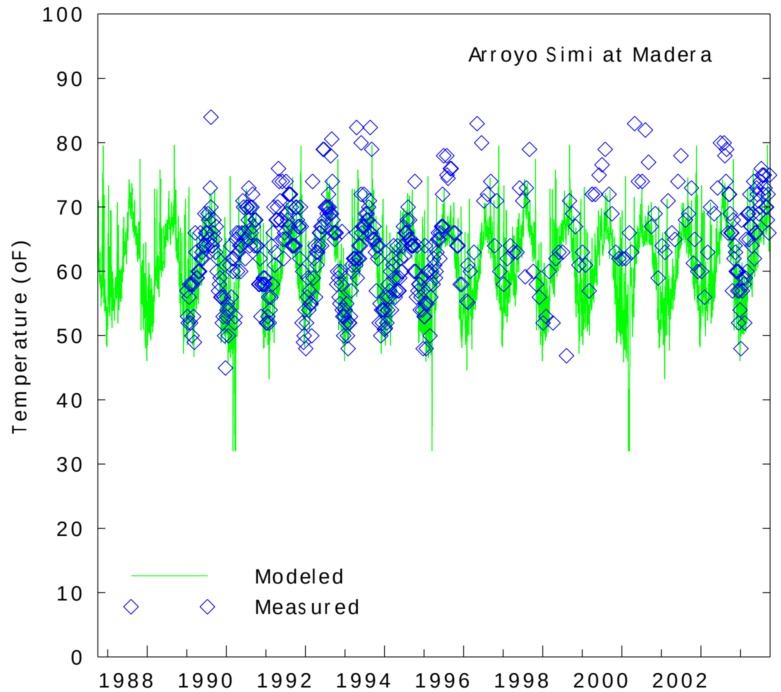

Figure 71: Measured and Modeled Temperature Time Series for Arroyo Simi at Madera.

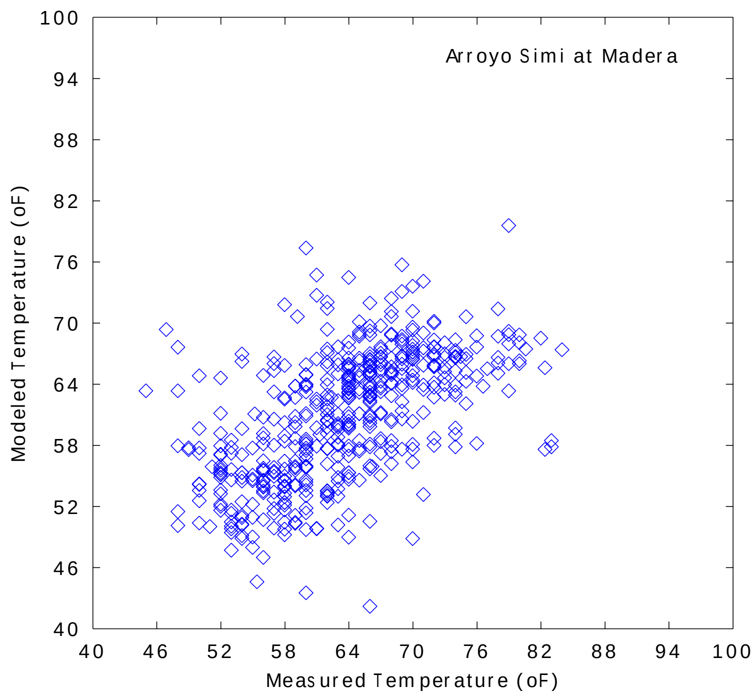

Figure 72: Measured vs. Modeled Temperature for Arroyo Simi at Madera.

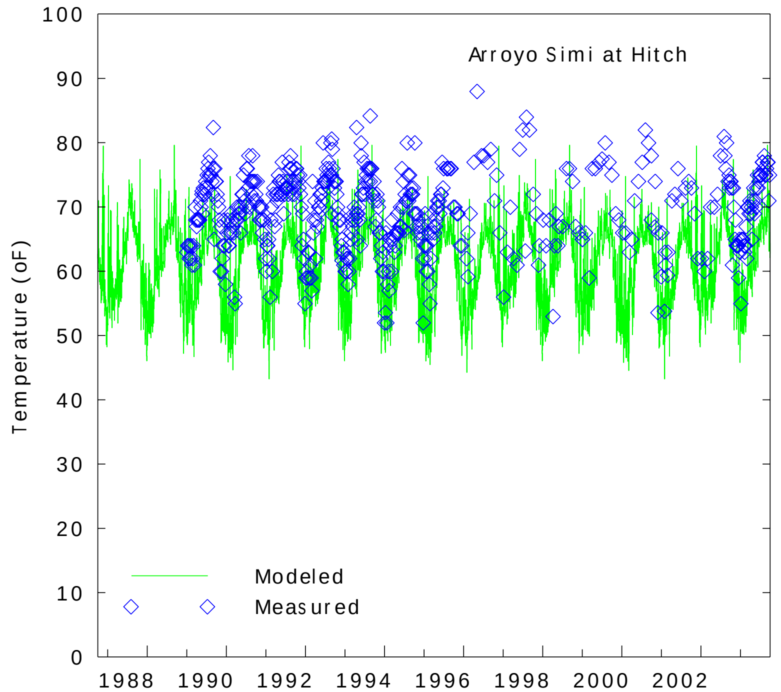

Figure 73: Measured and Modeled Temperature Time Series for Arroyo Simi at Hitch.

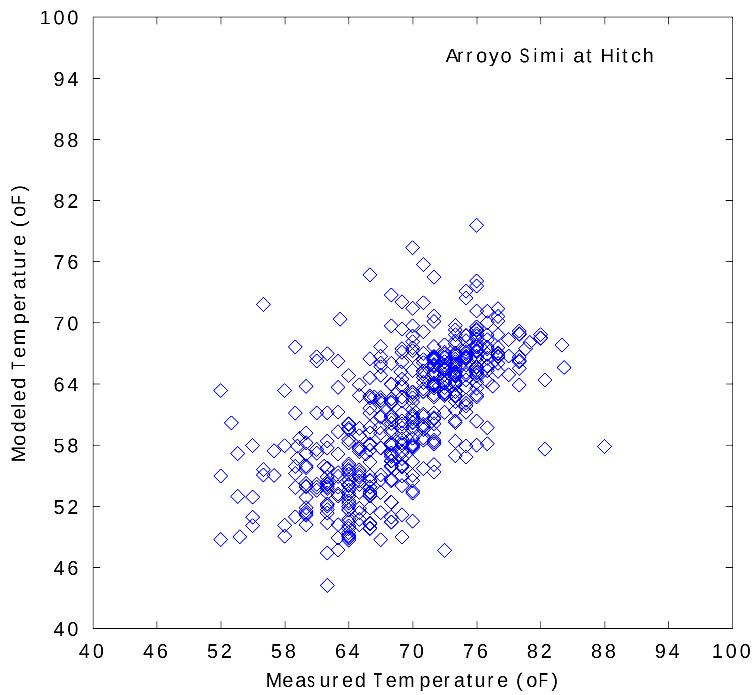

Figure 74: Measured vs. Modeled Temperature for Arroyo Simi at Hitch.

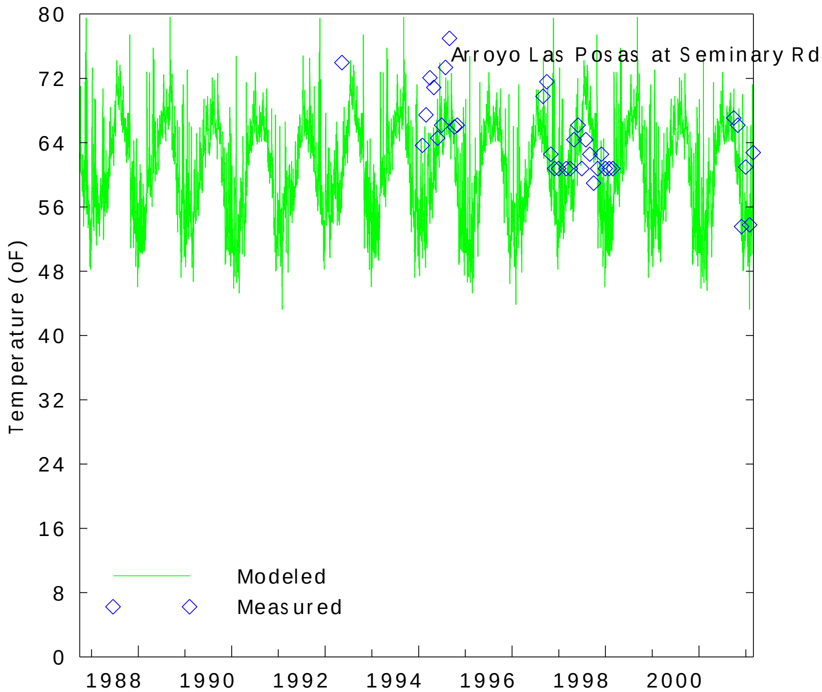

Figure 75: Measured and Modeled Temperature Time Series for Arroyo Las Posas at Seminary.

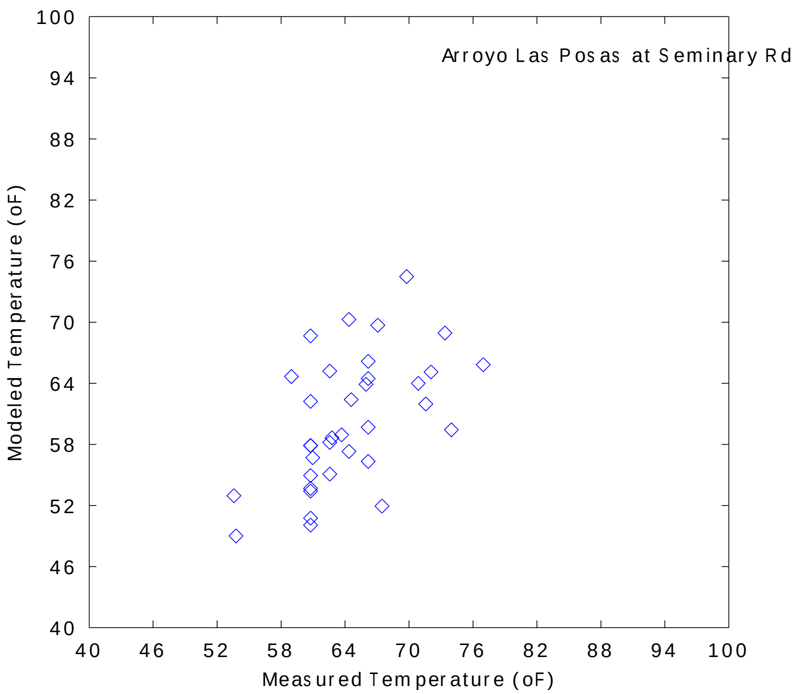

Figure 76: Measured vs. Modeled Temperature for Arroyo Las Posas at Seminary.

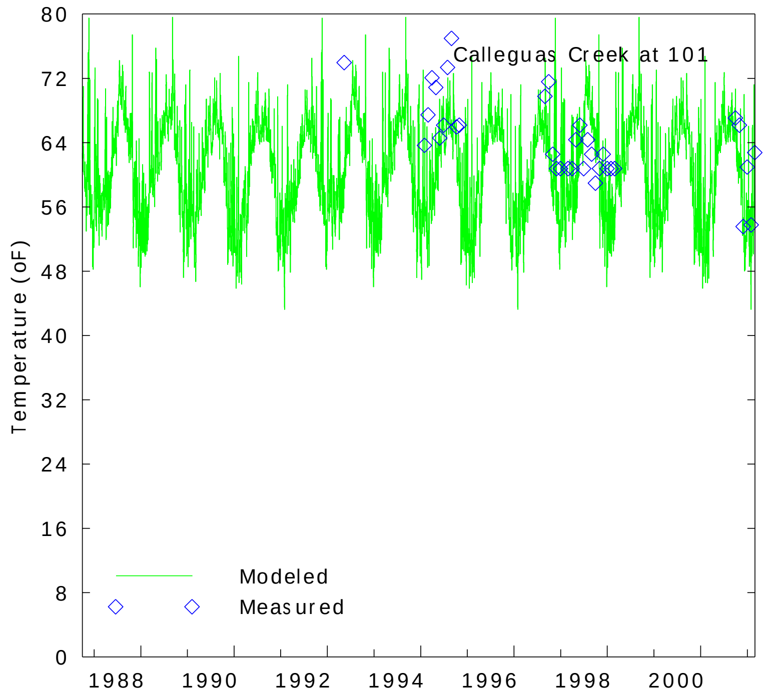

Figure 77: Measured and Modeled Temperature Time Series for Calleguas Creek at 101.

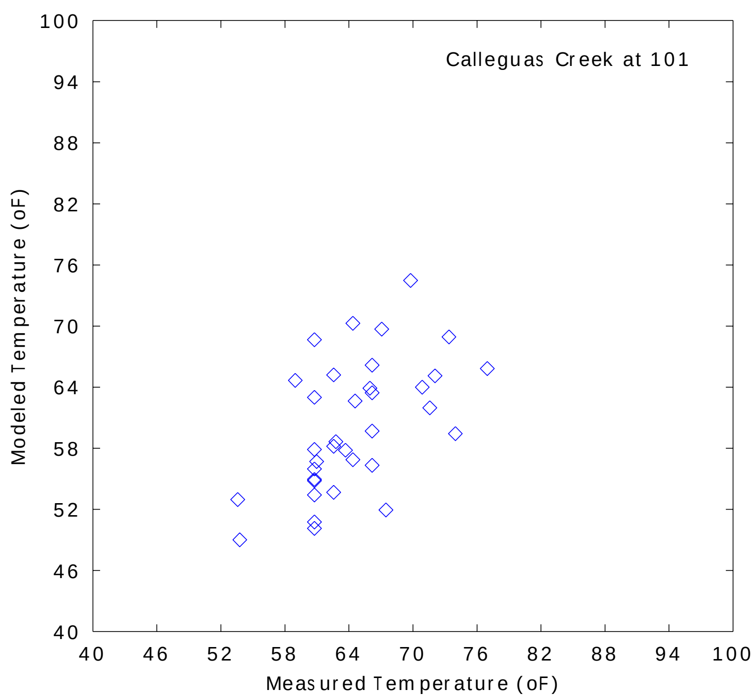

Figure 78: Measured vs. Modeled Temperature for Calleguas Creek at 101.

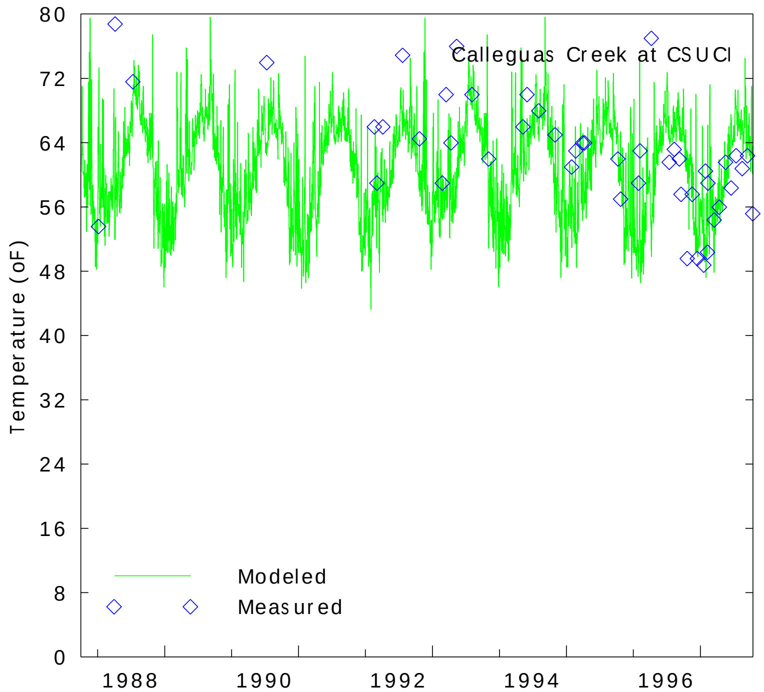

Figure 79: Measured and Modeled Temperature Time Series for Calleguas Creek at CSUCI.

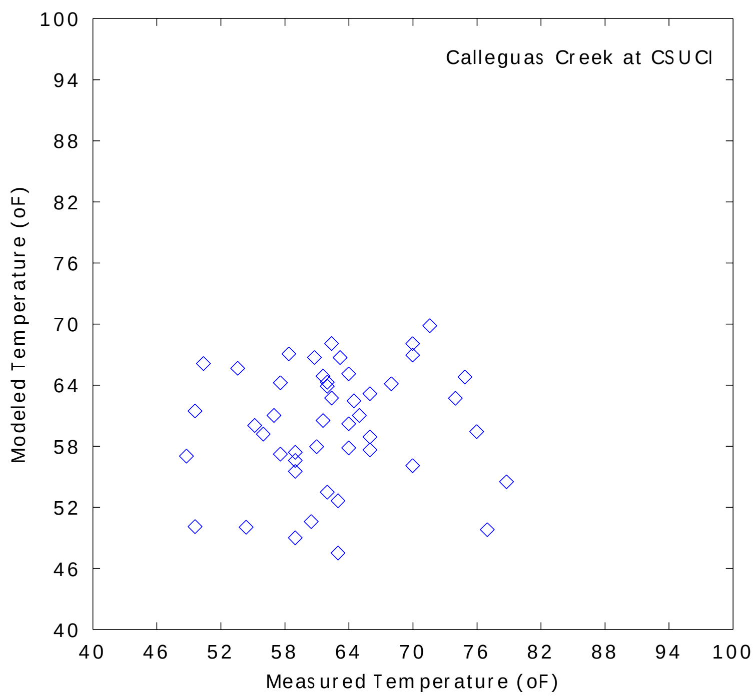

Figure 80: Measured vs. Modeled Temperature for Calleguas Creek at CSUCI.

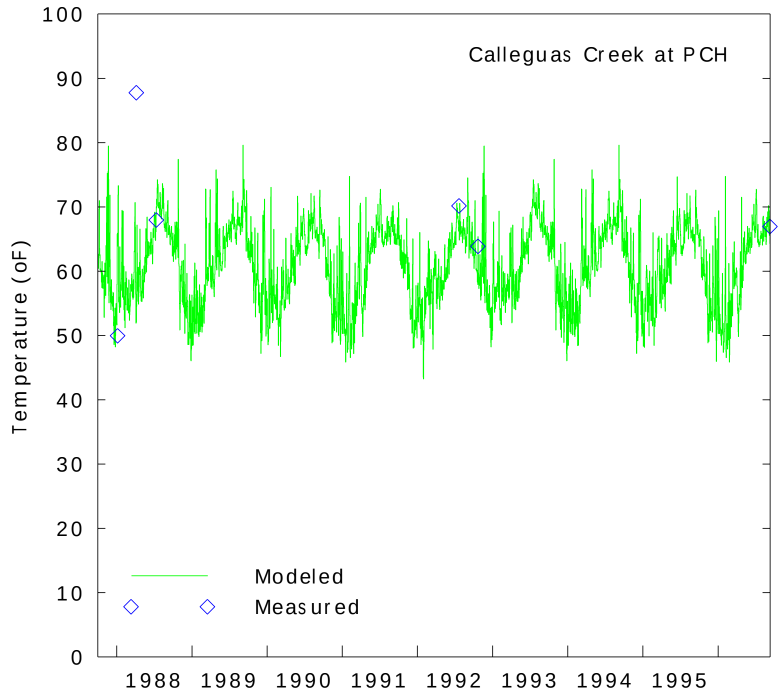

Figure 81: Measured and Modeled Temperature Time Series for Calleguas Creek at PCH.

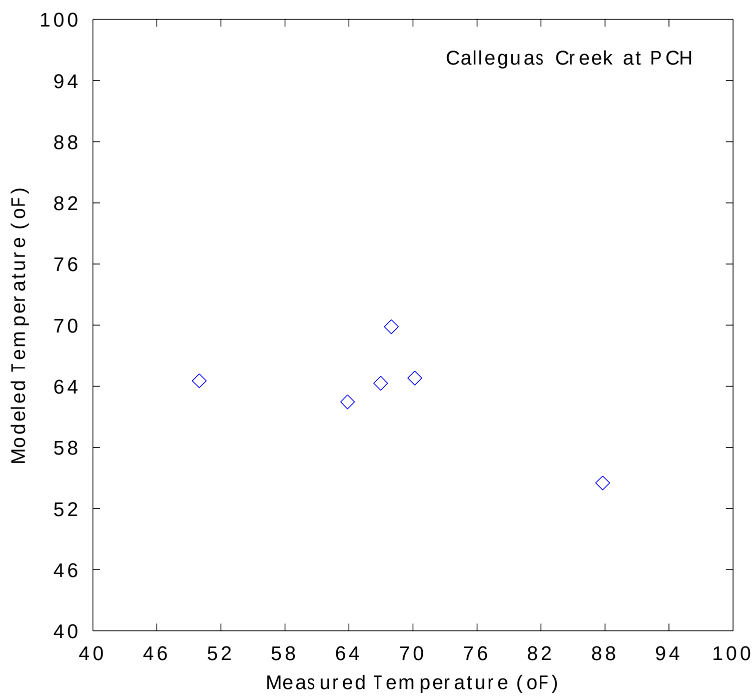

Figure 82: Measured vs. Modeled Temperature for Calleguas Creek at PCH.

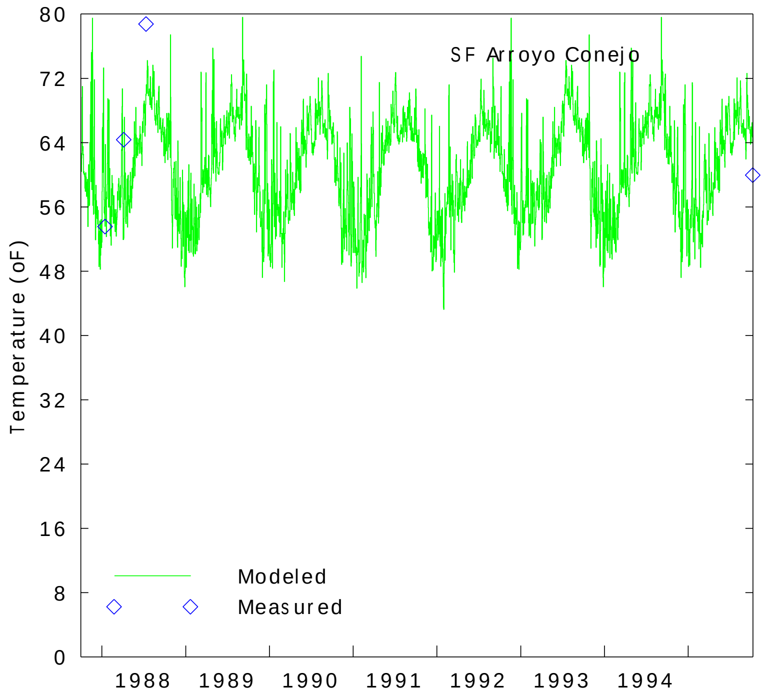

Figure 83: Measured and Modeled Temperature Time Series for South Fork of Arroyo Conejo.

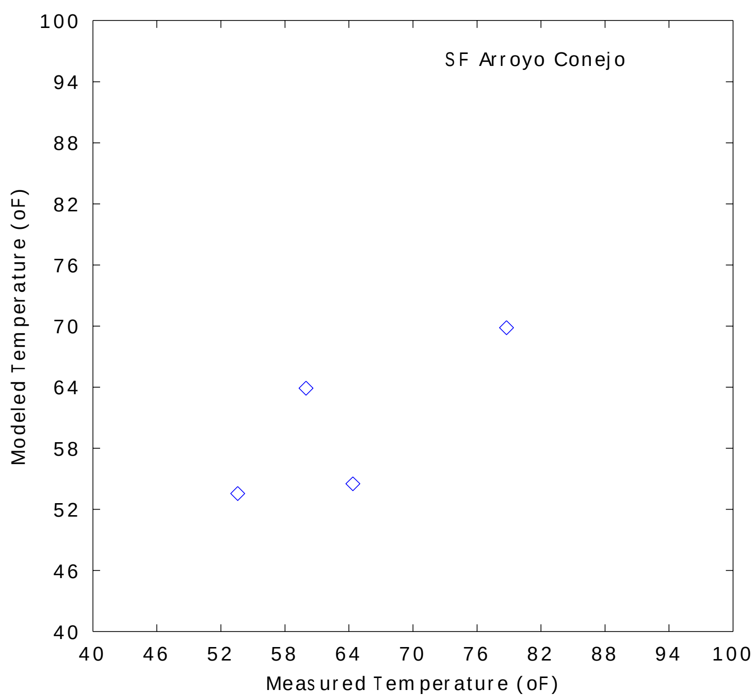

Figure 84: Measured vs. Modeled Temperature for South Fork of Arroyo Conejo.

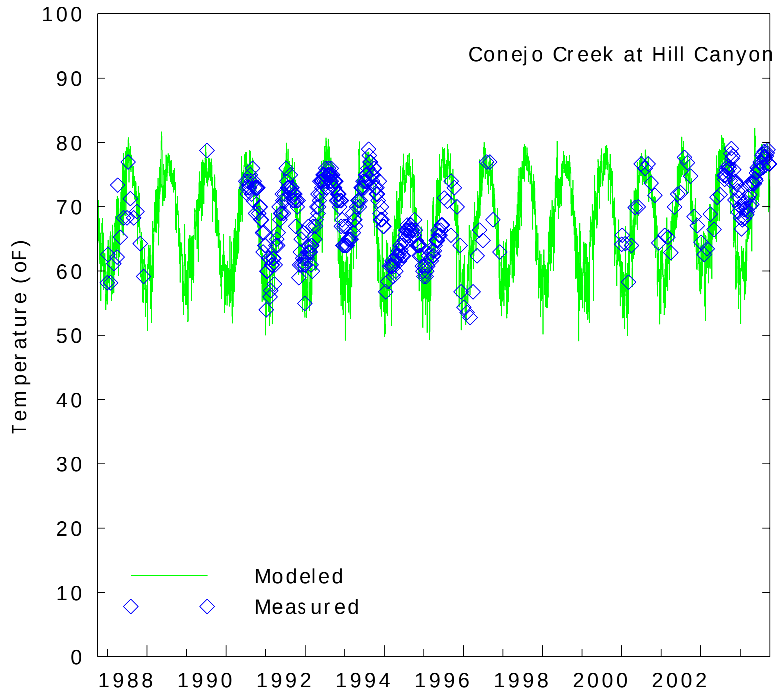

Figure 85: Measured and Modeled Temperature Time Series for Conejo Creek at Hill Canyon.

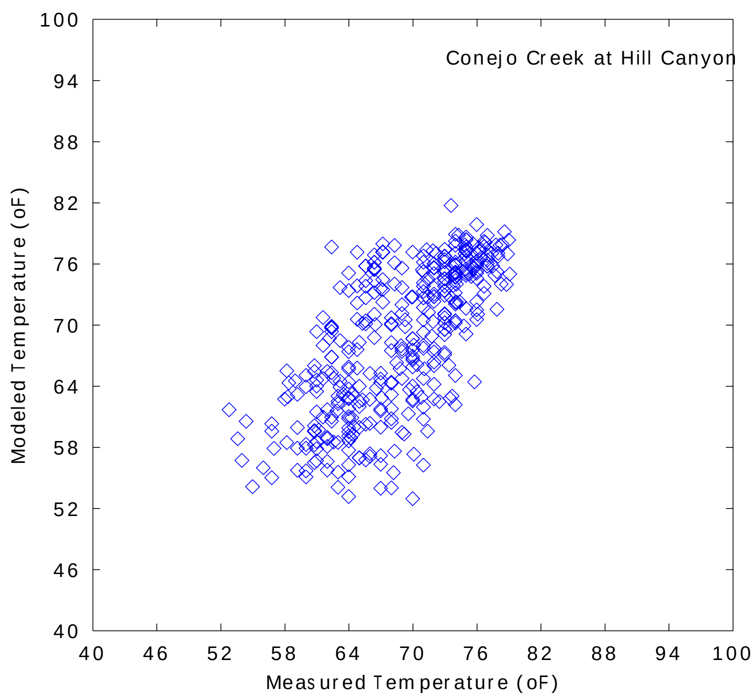

Figure 86: Measured vs. Modeled Temperature for Conejo Creek at Hill Canyon.

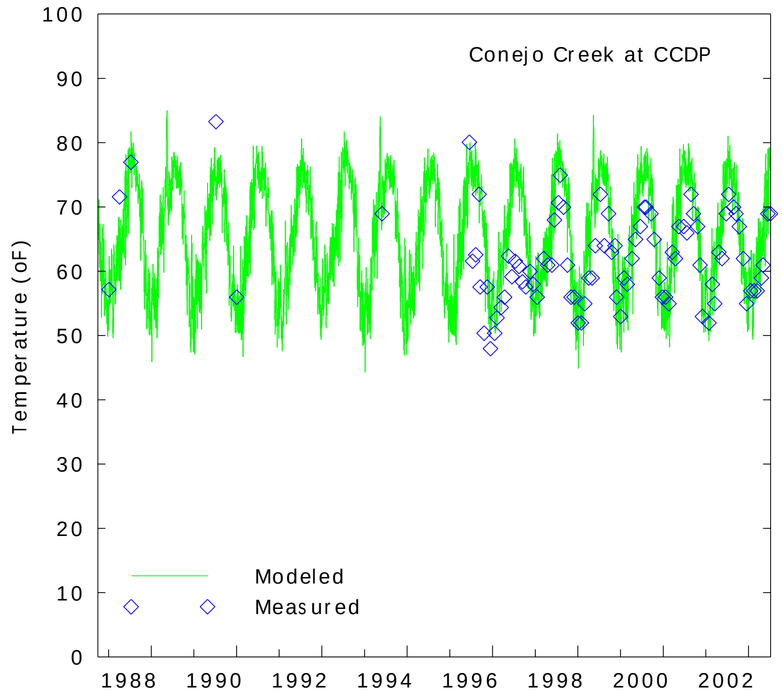

Figure 87: Measured and Modeled Temperature Time Series for Conejo Creek at CCDP.

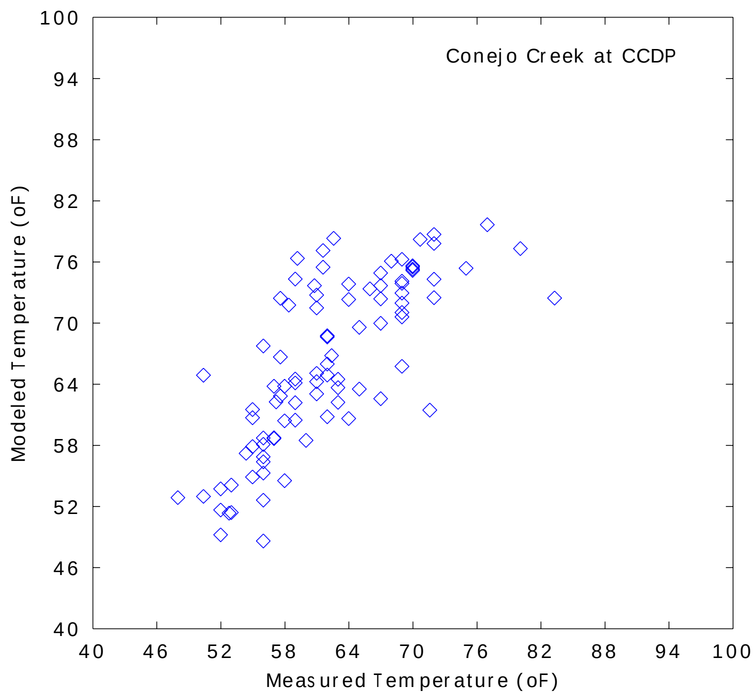

Figure 88: Measured vs. Modeled Temperature for Conejo Creek at CCDP.

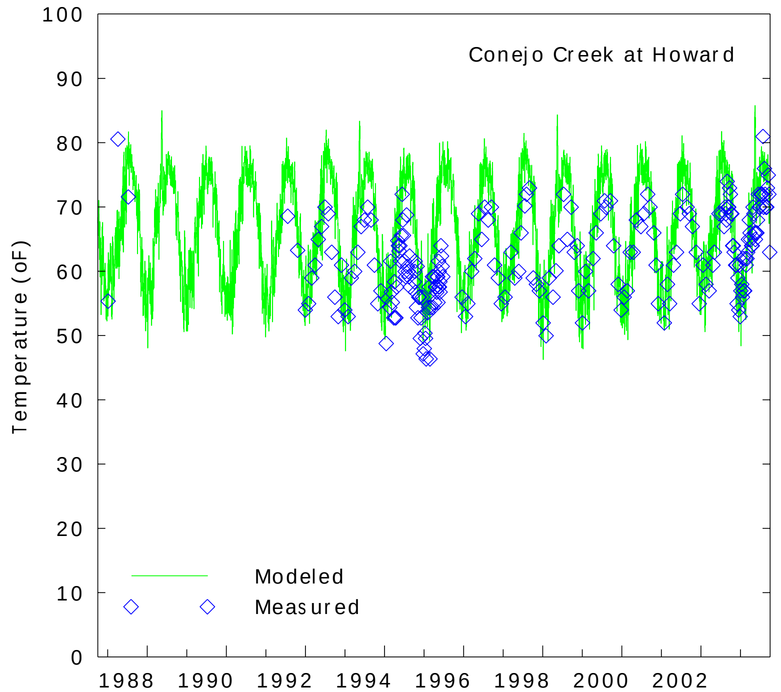

Figure 89: Measured and Modeled Temperature Time Series for Conejo Creek at Howard.

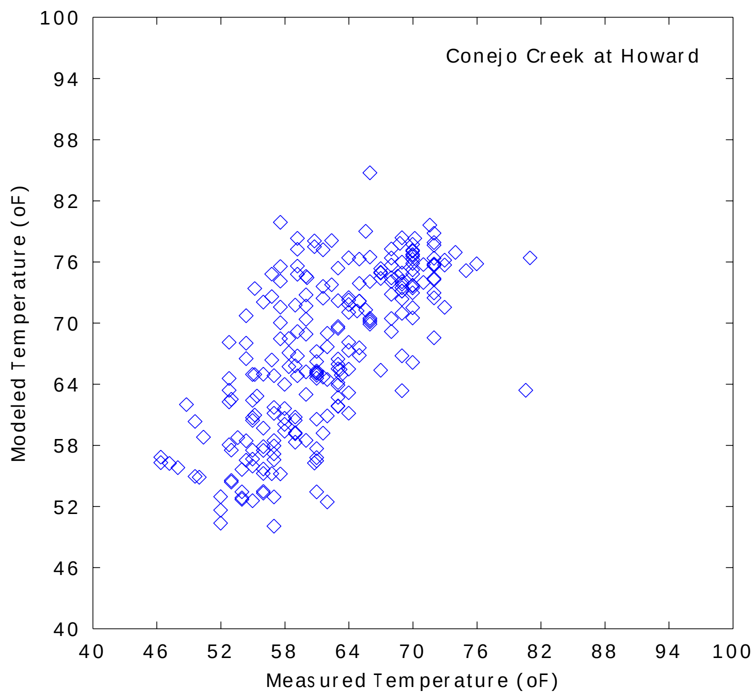

Figure 90: Measured vs. Modeled Temperature for Conejo Creek at Howard.

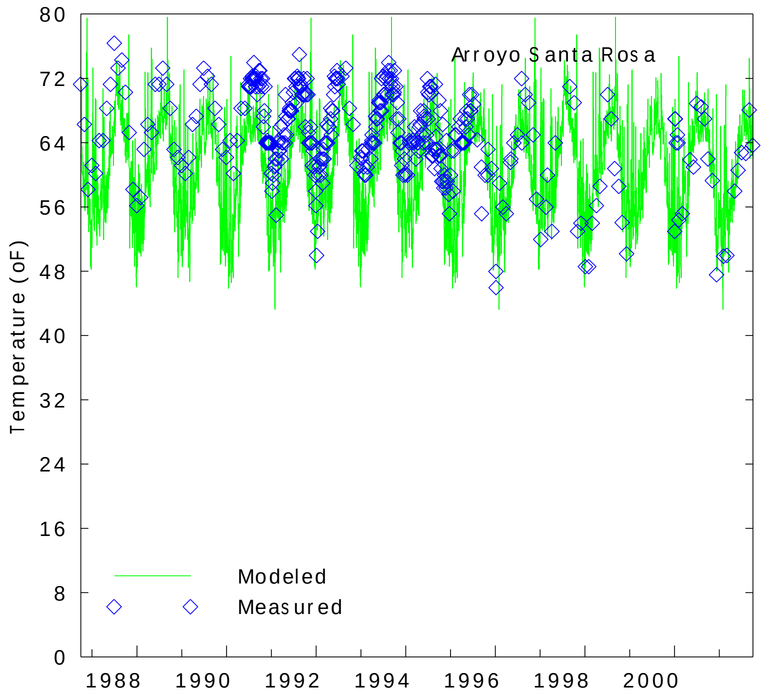

Figure 91: Measured and Modeled Temperature Time Series for Arroyo Santa Rosa.

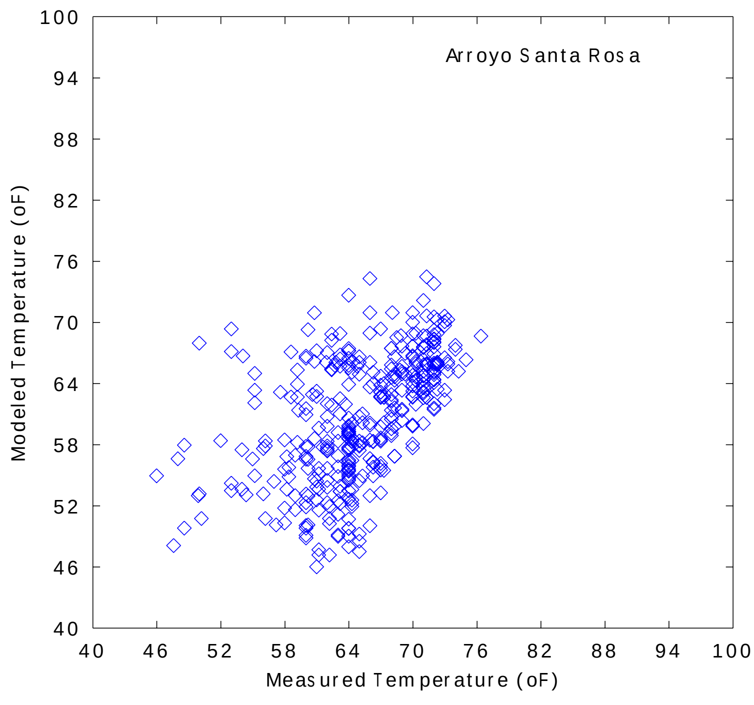

Figure 92: Measured vs. Modeled Temperature for Arroyo Santa Rosa.

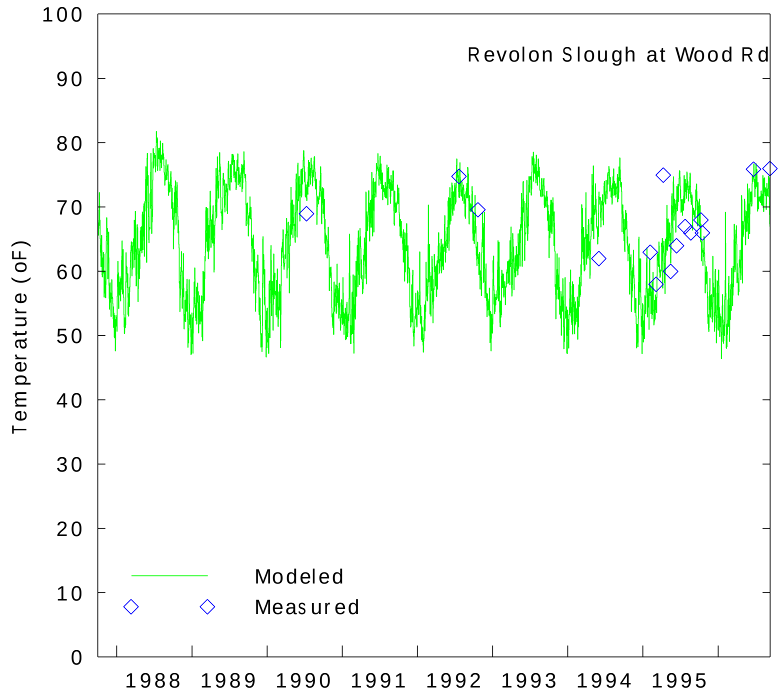

Figure 93: Measured and Modeled Temperature Time Series for Revolon Slough at Wood Rd.

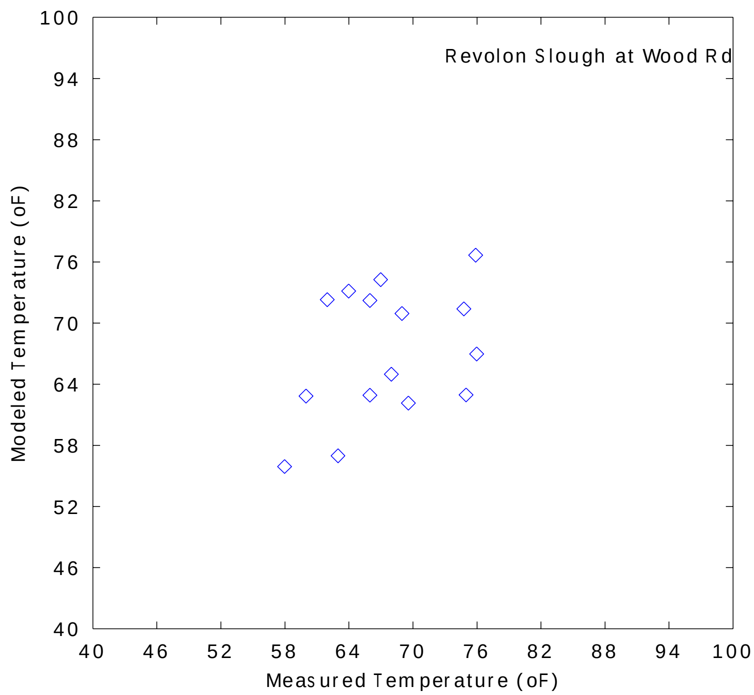

Figure 94: Measured vs. Modeled Temperature for Revolon Slough at Wood Rd.

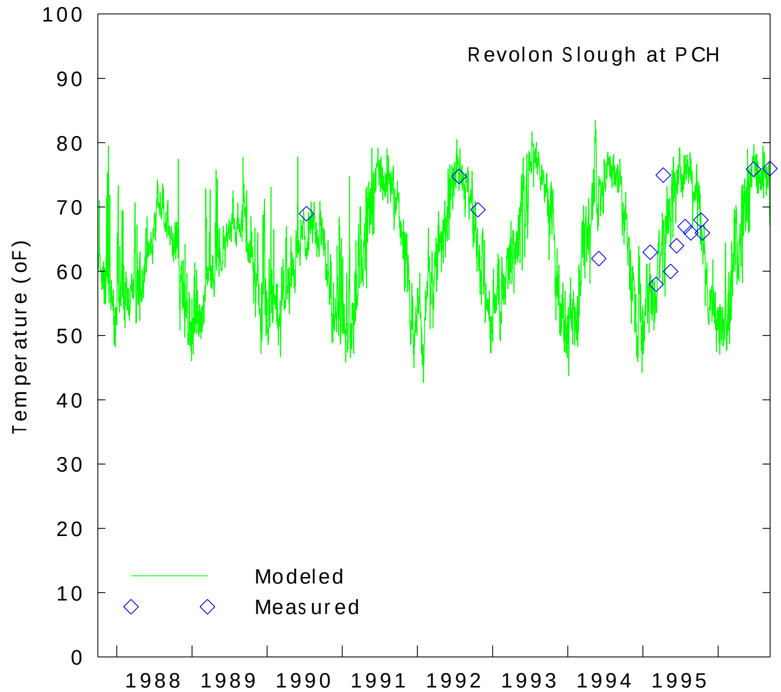

Figure 95: Measured and Modeled Temperature Time Series for Revolon Slough at PCH.

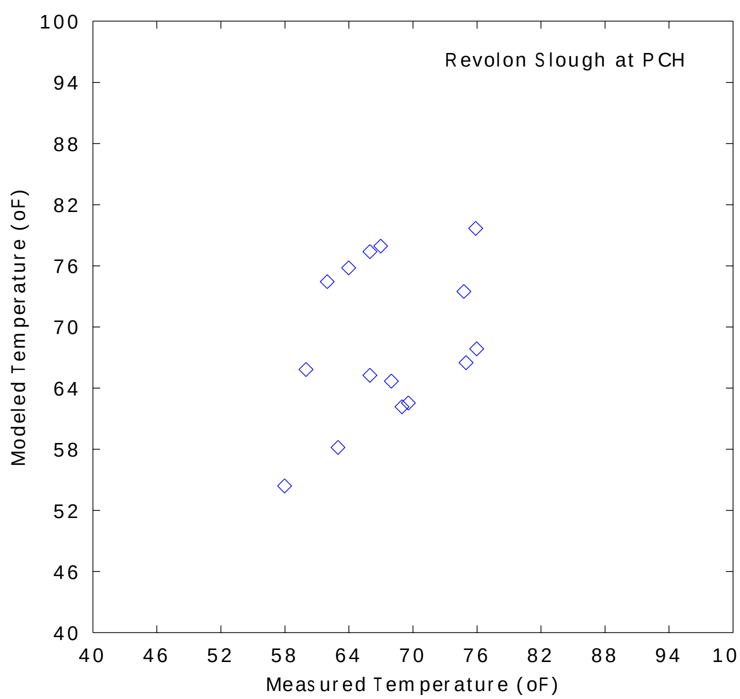

Figure 96: Measured vs. Modeled Temperature for Revolon Slough at PCH.

Sediment Simulation

The sediment calibration followed Donigian and Love (2003). Calibration involves matching the sediment yield of the watershed, maintaining a reasonable stream bed composition, and achieving comparable solids contractions.

Sediment Yield

Sediment yields calculated in Chang (2004) are compared to CCWM calculations for seven selected subwatershed in Figure 97 to Figure 103 and loading to Mugu Lagoon by Revolon Slough and Calleguas Creek in Figure 104 and Figure 105, respectively. The locations of the selected subwatersheds within the CCW are referenced to the HSPF reach number in Table 1. Estimates of sediment yield from each subwatershed considered are developed from Chang (2004). In the report data is presented indicating that the wash load (finer sediment) is slightly greater than bed load (coarser sediment) for the CCW. Estimates of total wash and bed load for the entire watershed calculated by the NRCS in conjunction with the SCS are 220,074 ton/yr and 192.031 ton/yr, respectively. The NRCS/SCS estimates include bank erosion and construction whereas Change does not. The bed load (coarser sediment) is estimated by Chang for the watershed.

The CCWM are consistent with the estimates of Chang (2004). There is significant variation of sediment yield between years because storm events are responsible for the majority of sediment transport.

Table 1: Cross-reference of Sediment Yield Subwatershed and Location within the HSPF Representation of the CCW.

Subwatershed	Sediment Yield	Region in Figure 1	Lowest Model Reach
Arroyo Simi Headwaters	Figure 97	Upper Arroyo Simi	2
Meier Canyon	Figure 98	Upper Arroyo Simi	31
Tapo Canyon	Figure 99	Upper Arroyo Simi	46
Sycamore Canyon	Figure 100	Upper Arroyo Simi	109
Happy Camp	Figure 101	Lower Simi/Las Posas	212
Fox Barranca	Figure 102	Lower Simi/Las Posas	243
Conejo Creek	Figure 103	Conejo Creek	408

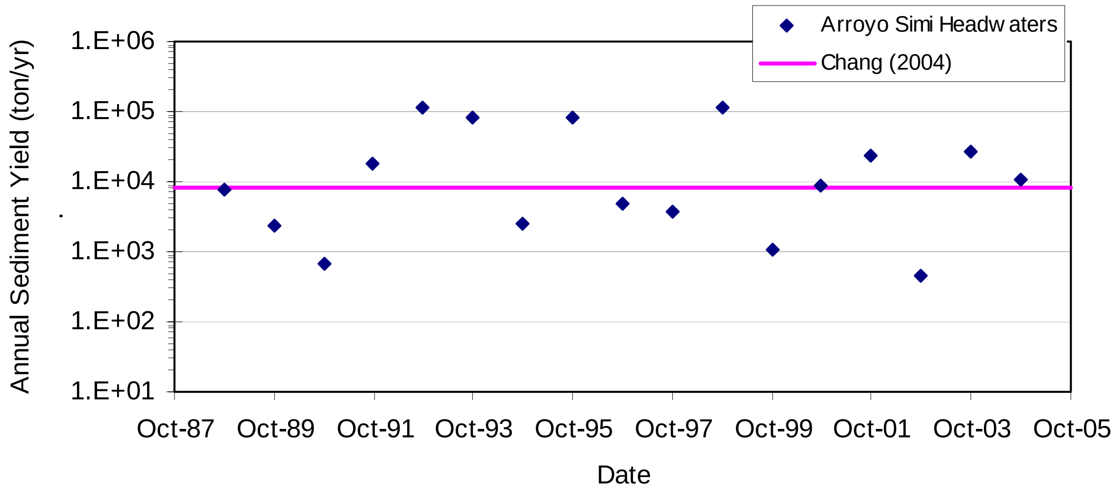

Figure 97: Annual Sediment Yield from the Arroyo Simi Headwaters Subwatershed.

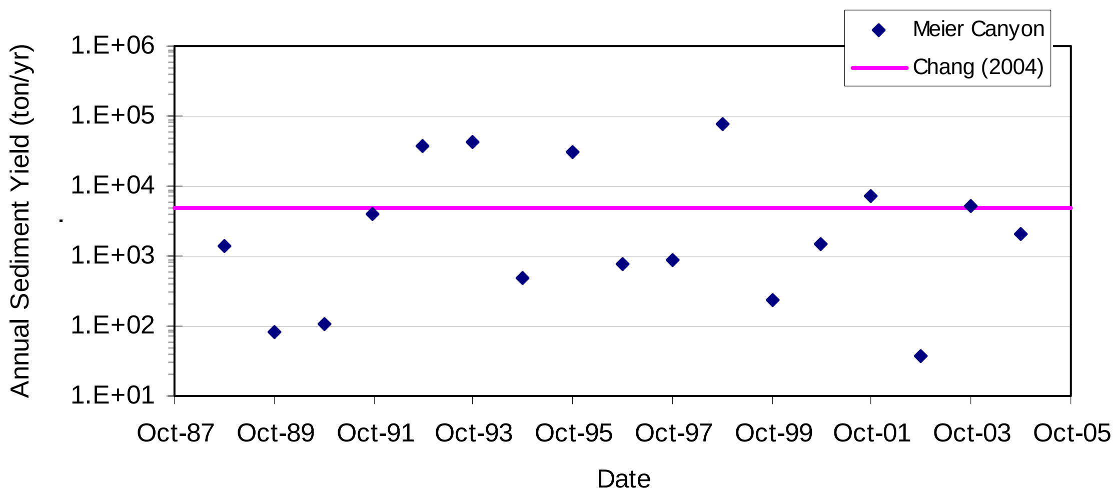

Figure 98: Annual Sediment Loading from Meier Canyon Subwatershed.

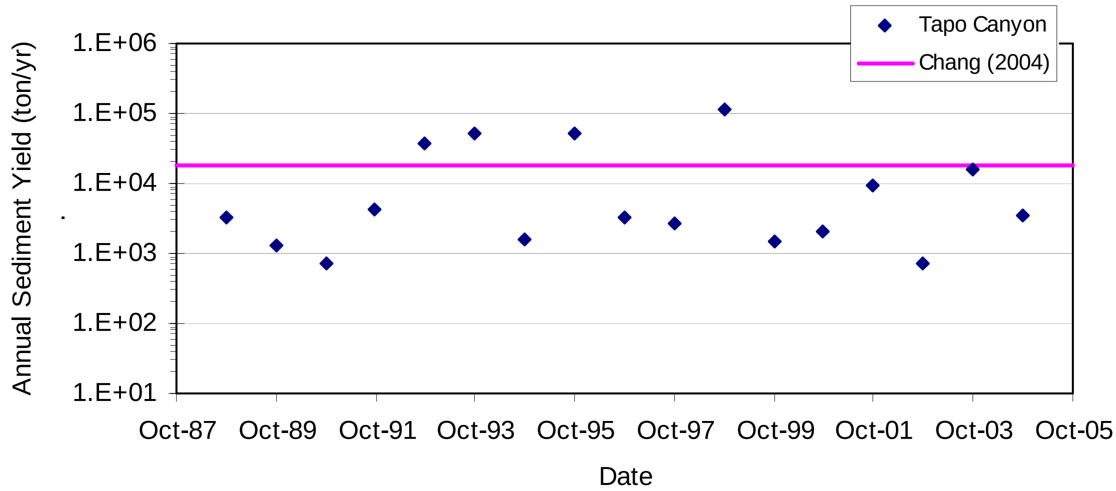

Figure 99: Annual Sediment Yield from the Tapo Canyon Subwatershed.

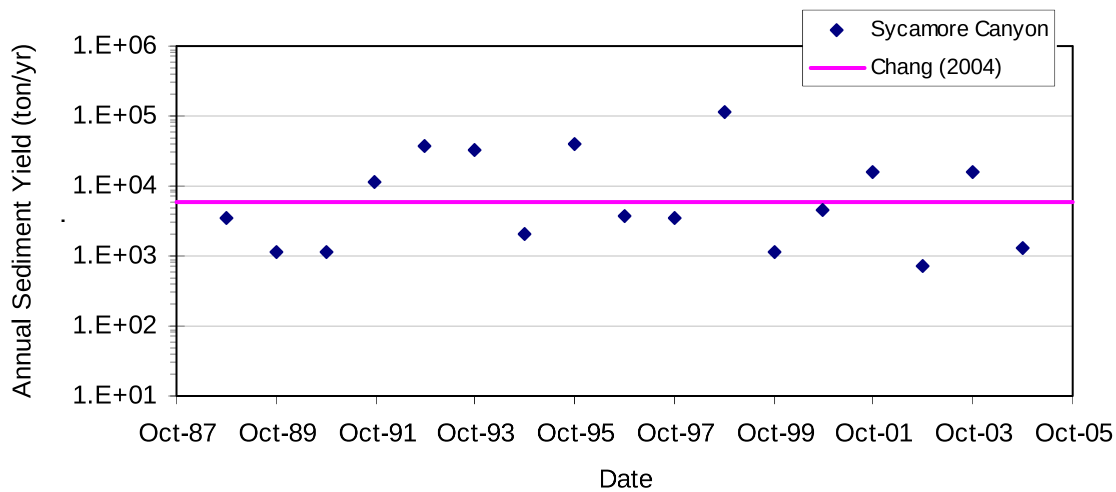

Figure 100: Annual Sediment Yield from the Sycamore Canyon Subwatershed.

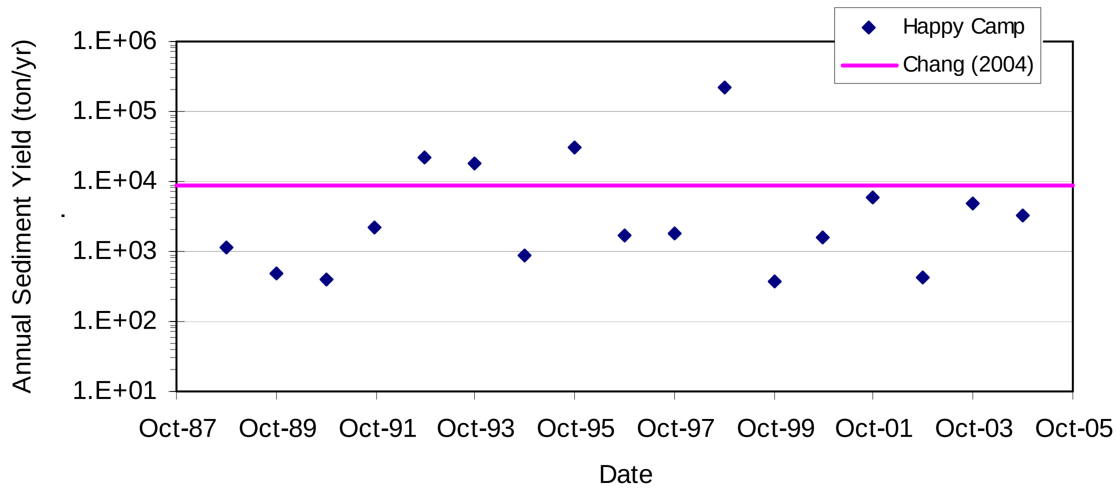

Figure 101: Annual Sediment Yield from Happy Camp Subwatershed.

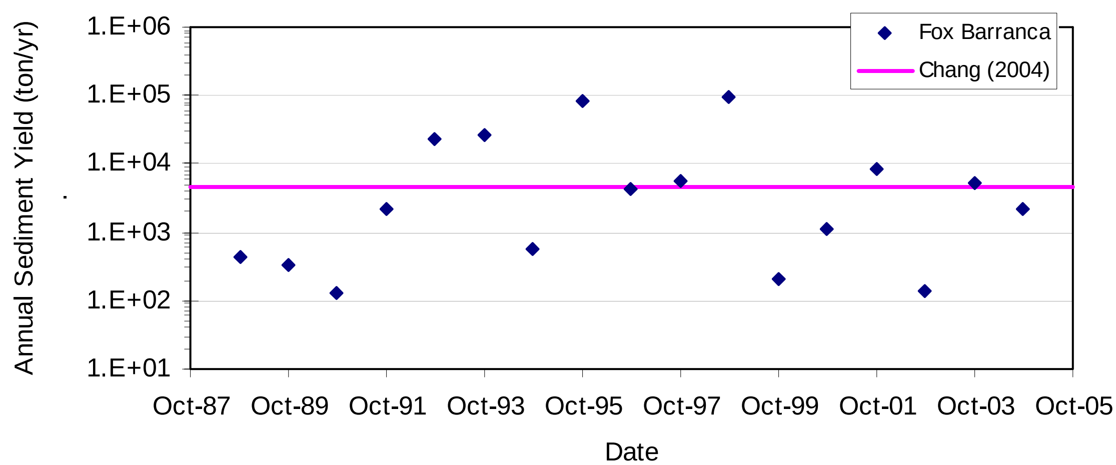

Figure 102: Annual Sediment Yield from Fox Barranca Subwatershed.

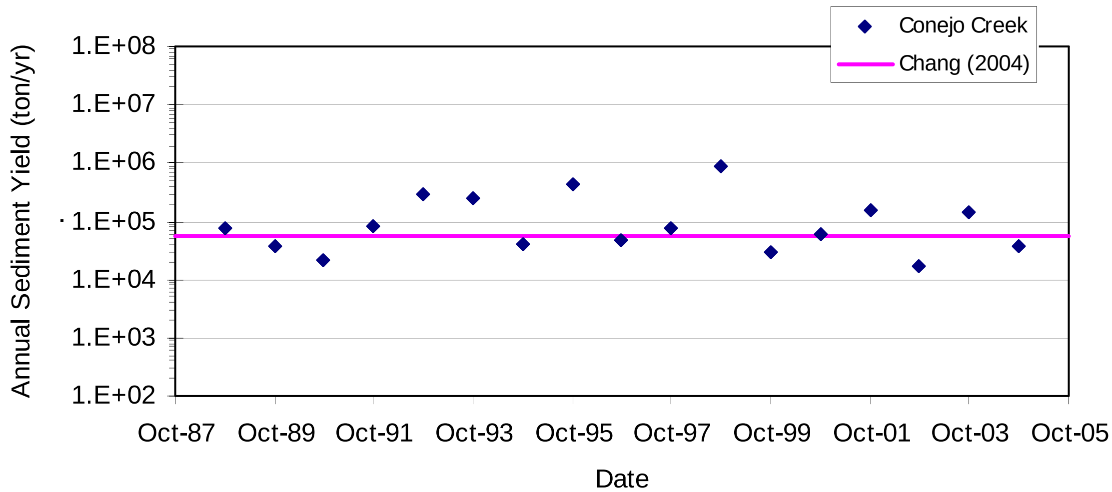

Figure 103: Annual Sediment Yield from the Conejo Creek Subwatershed.

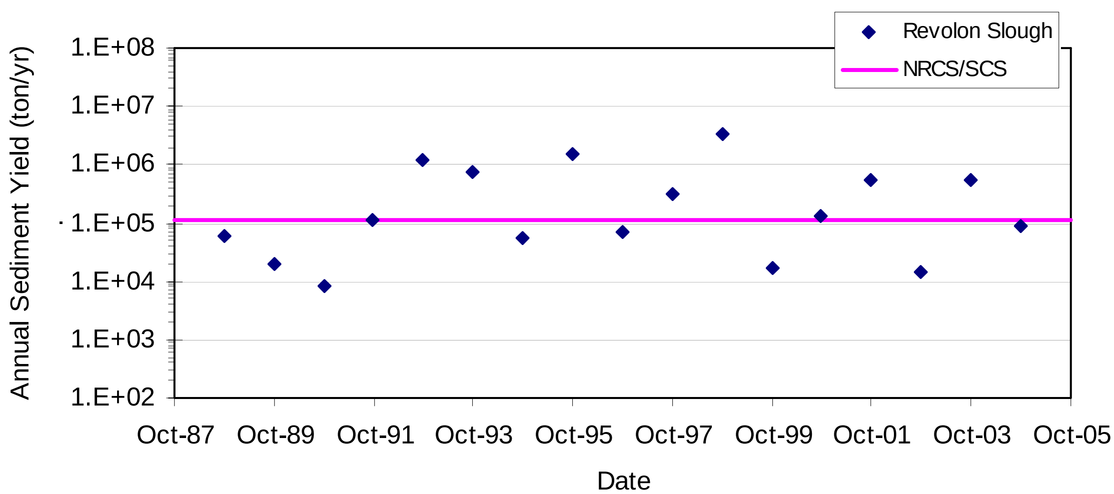

Figure 104: Annual Sediment Yield from Revolon Slough and Ag Drains to Mugu Lagoon.

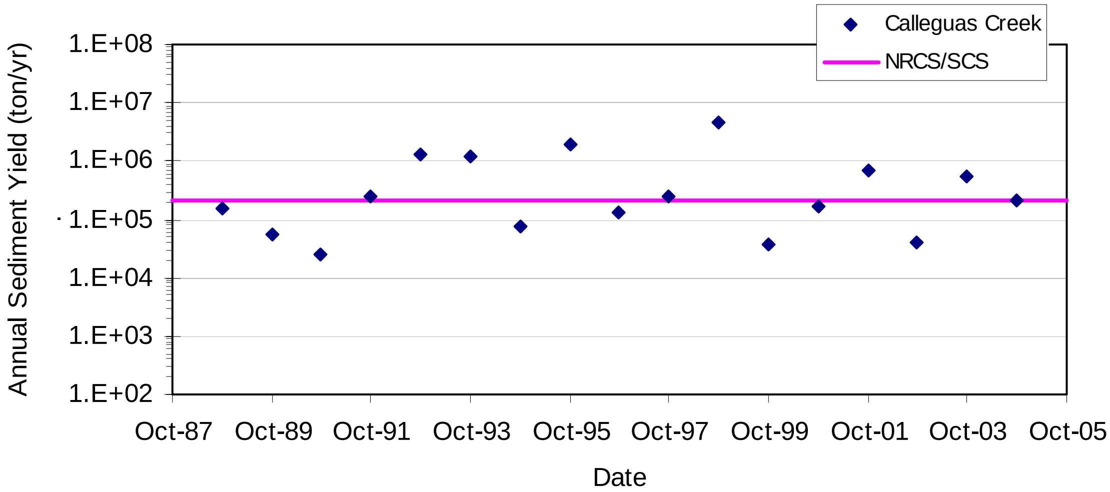

Figure 105: Annual Sediment Yield from Calleguas Creek to Mugu Lagoon.

Bed Composition

The calibration target for the bed composition is to maintain a pattern of total bed depth where depth increases gradually and is reduced during high flow events. The composition of sand, silt and clay is maintained to reflect observed watershed conditions.

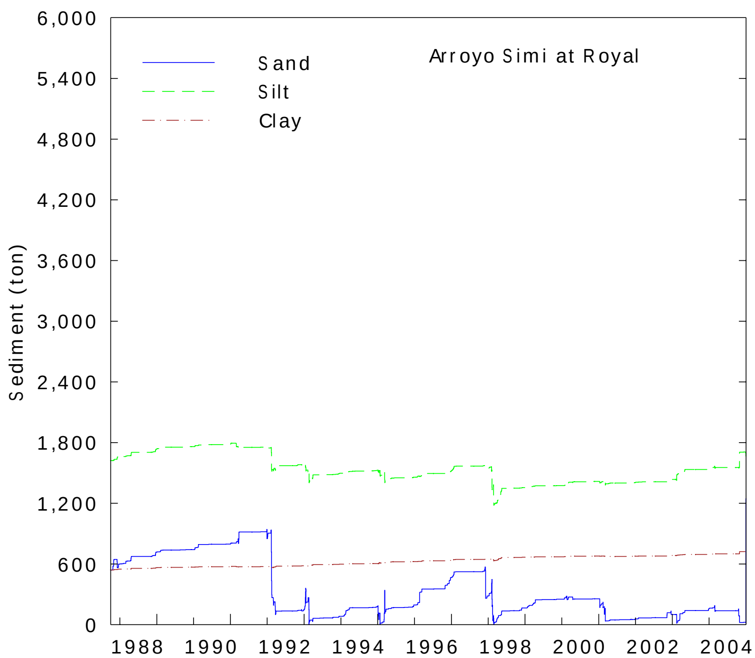

Figure 106: Bed Composition of Arroyo Simi at Royal.

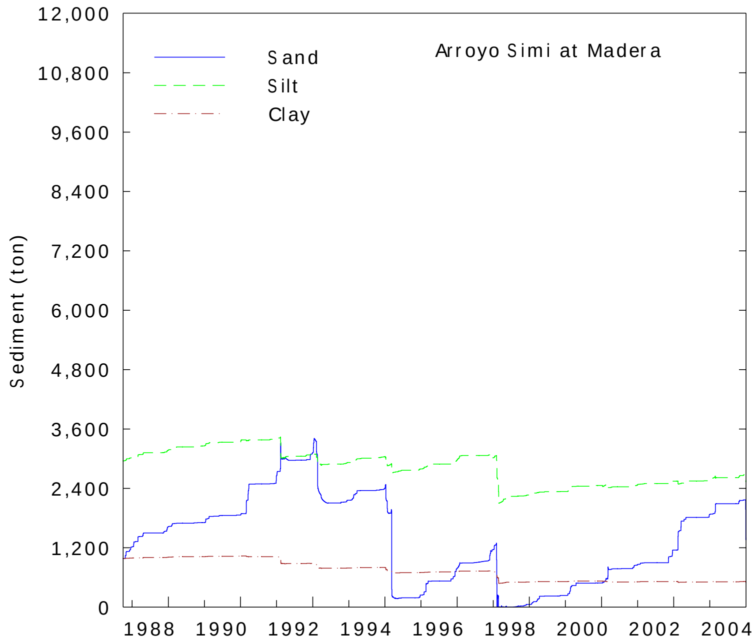

Figure 107: Bed Composition of Arroyo Simi at Madera.

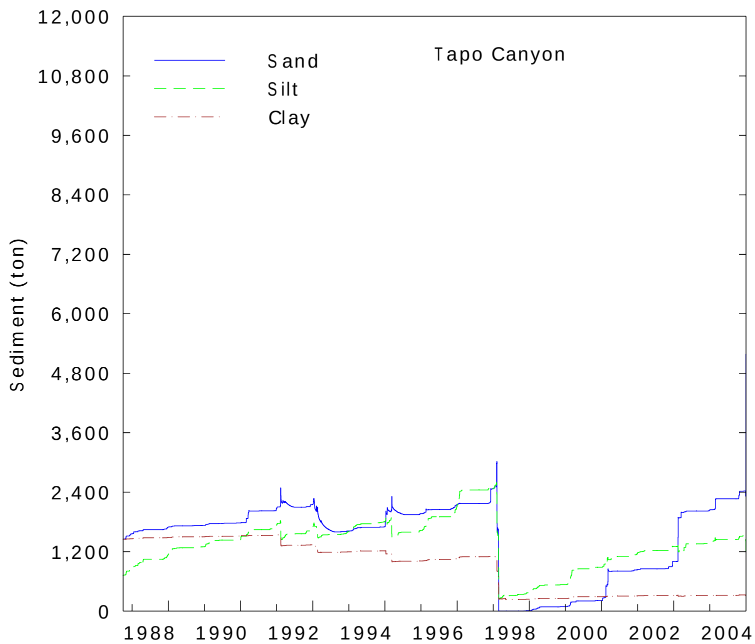

Figure 108: Bed Composition of Tapo Canyon.

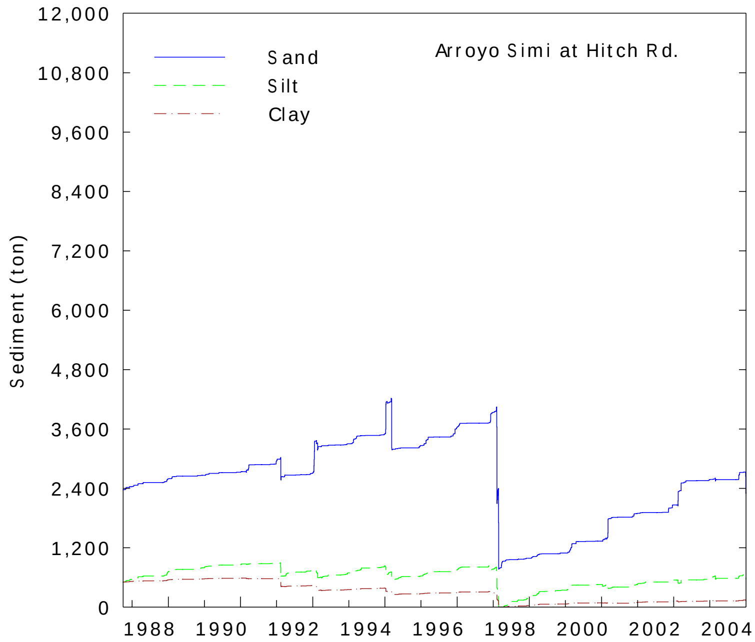

Figure 109: Bed Composition of Arroyo Simi at Hitch.

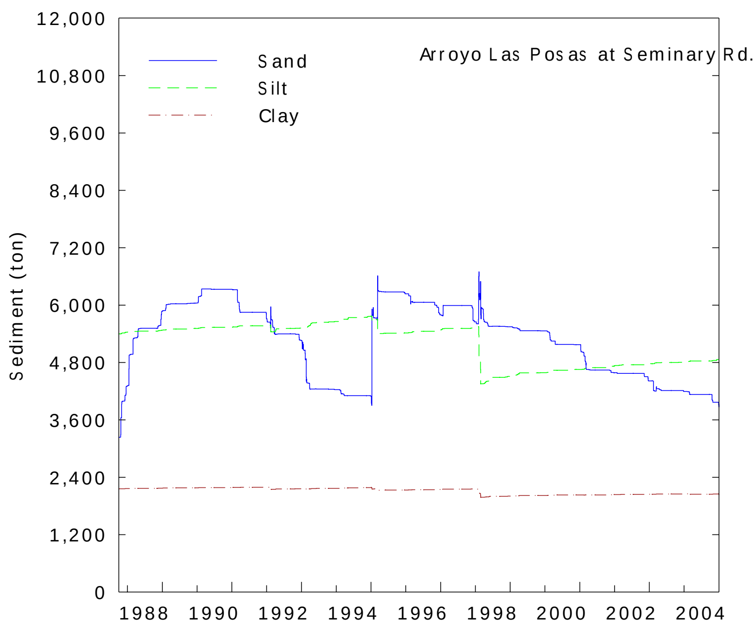

Figure 110: Bed Composition of Arroyo Las Posas at Seminary.

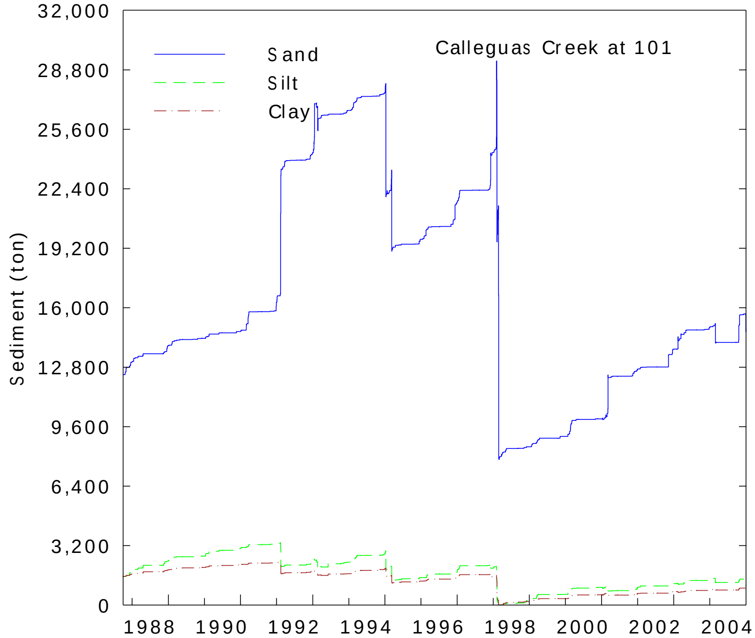

Figure 111: Bed Composition of Calleguas Creek at 101.

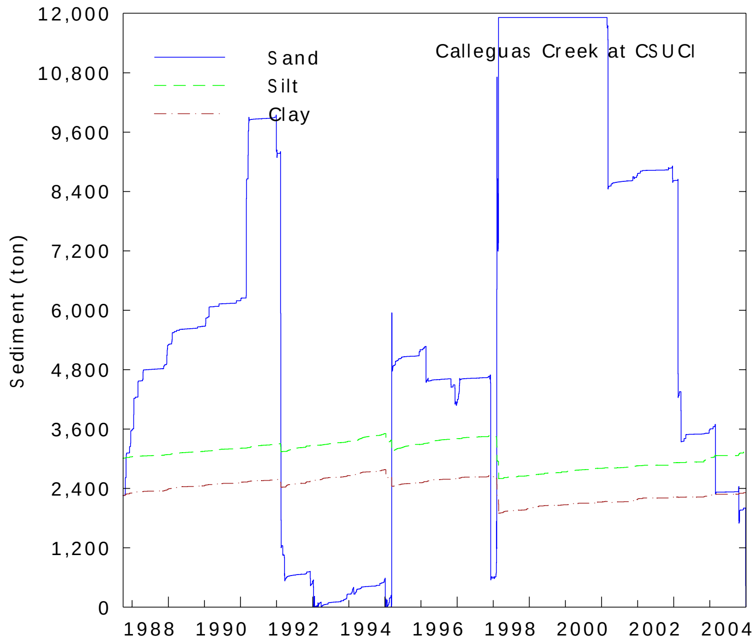

Figure 112: Bed Composition of Calleguas Creek at CSUCI.

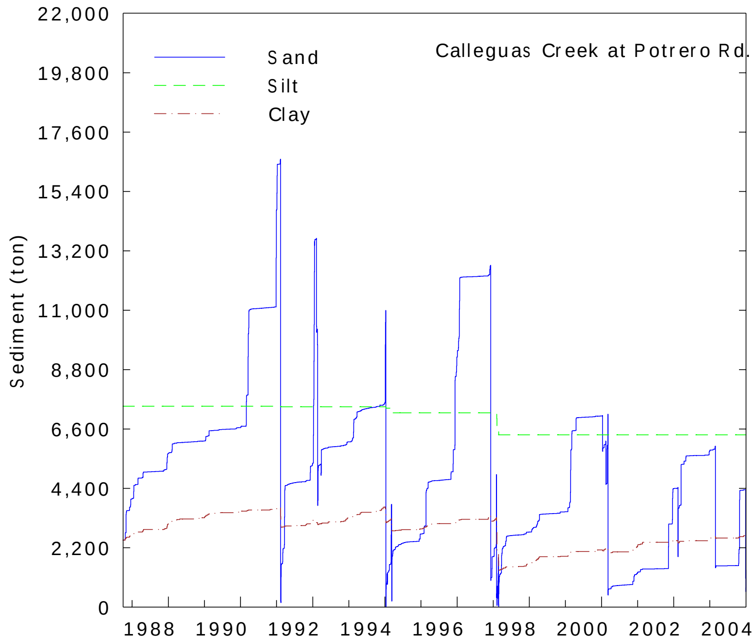

Figure 113: Bed Composition of Calleguas Creek at Potrero.

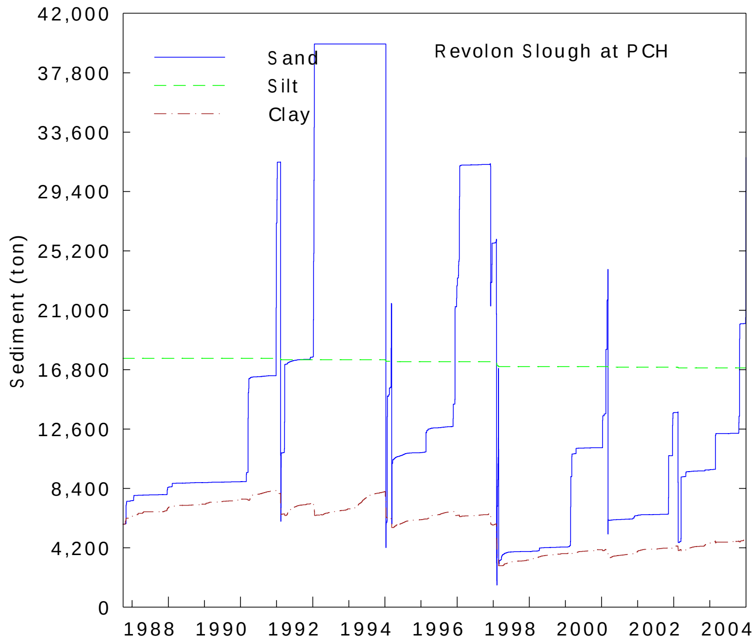

Figure 114: Bed Composition of Revolon Slough at PCH.

Total Suspended Solids

Total suspended solids (TSS) results comparing time series of measured and modeled and paired measure and modeled values are plotted in Figure 115 to Figure 137

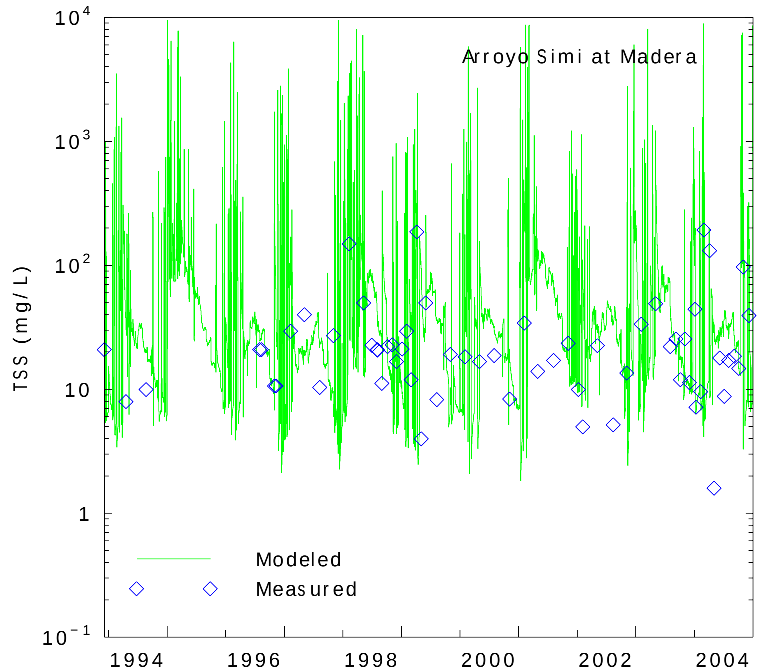

Figure 115: Measured and Modeled TSS Time Series for Arroyo Simi at Madera.

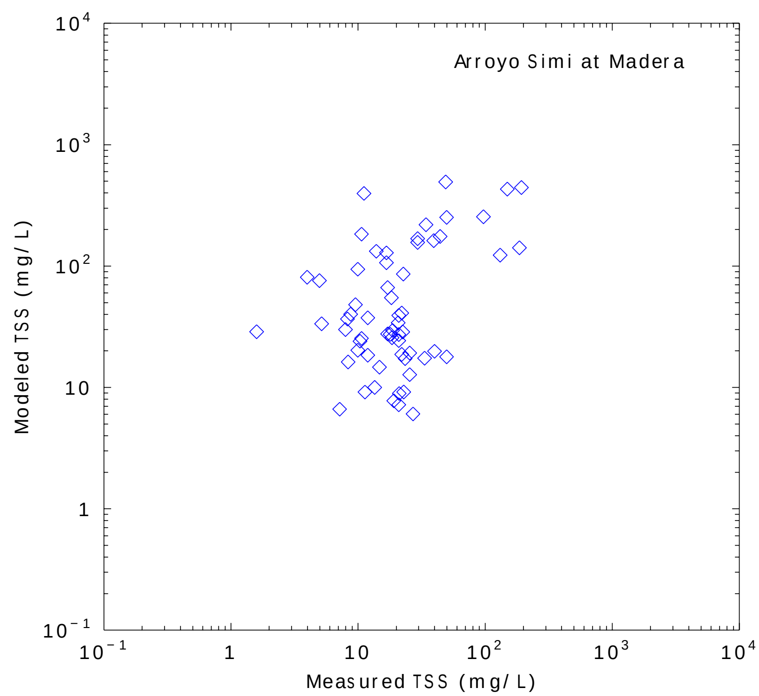

Figure 116: Measured vs. Modeled TSS for Arroyo Simi at Madera.

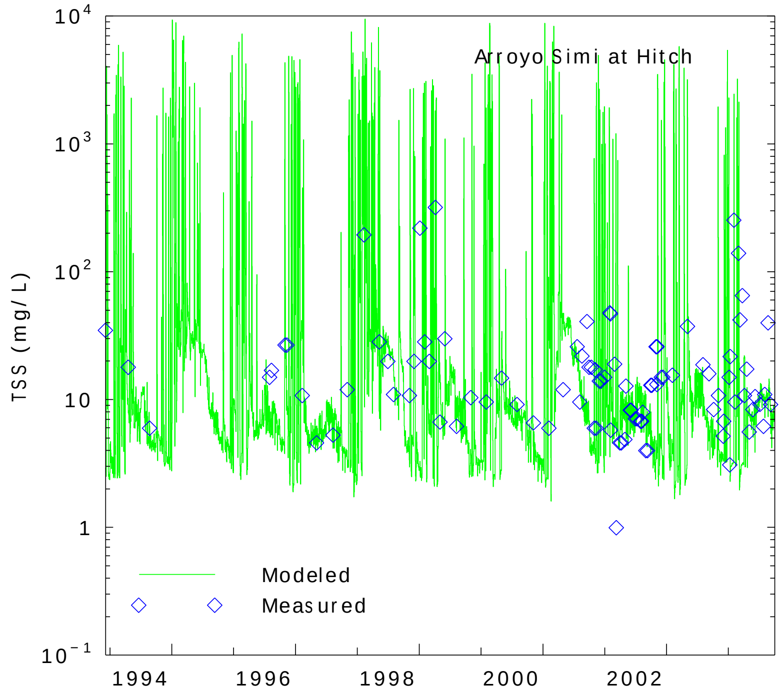

Figure 117: Measured and Modeled TSS Time Series for Arroyo Simi at Hitch.

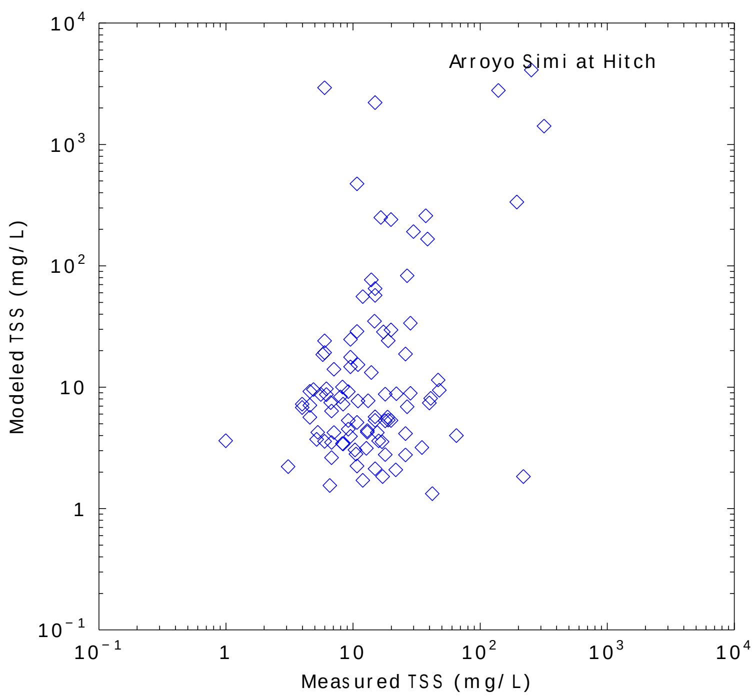

Figure 118: Measured vs. Modeled TSS for Arroyo Simi at Hitch.

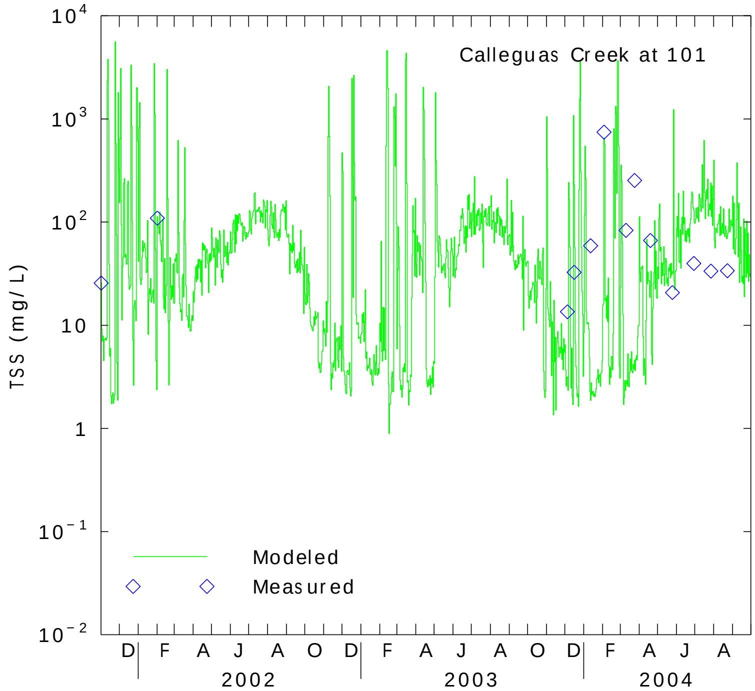

Figure 119: Measured and Modeled TSS Time Series for Calleguas Creek at 101.

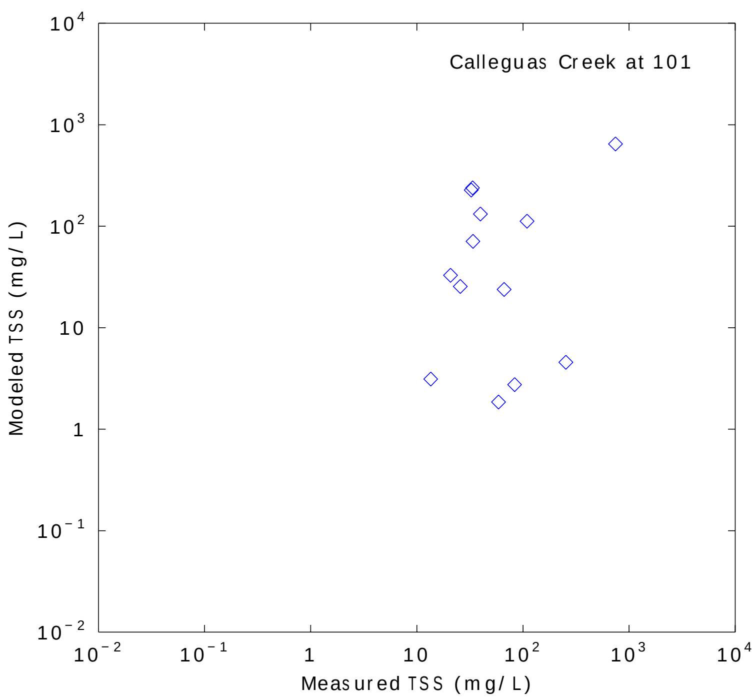

Figure 120: Measured vs. Modeled TSS for Calleguas Creek at 101.

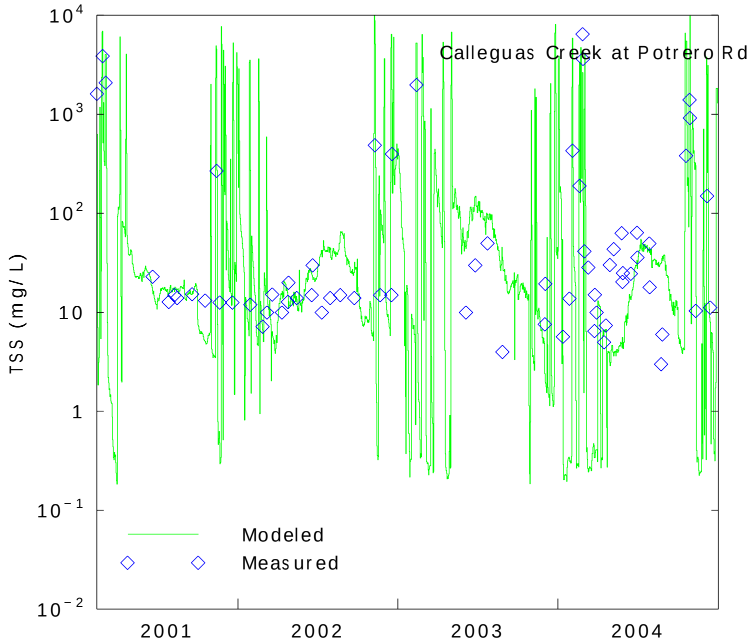

Figure 121: Measured and Modeled TSS Time Series for Calleguas Creek at Potrero.

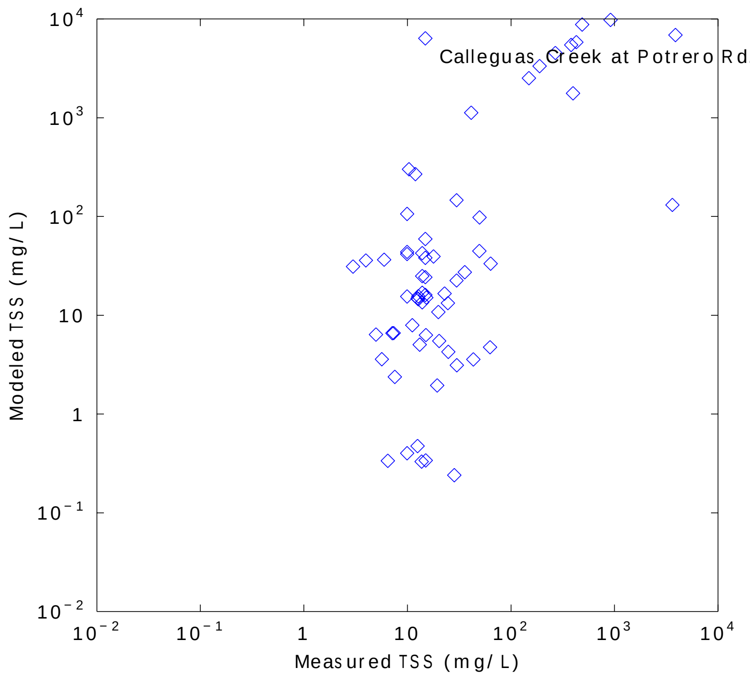

Figure 122: Measured vs. Modeled TSS for Calleguas Creek at Potrero.

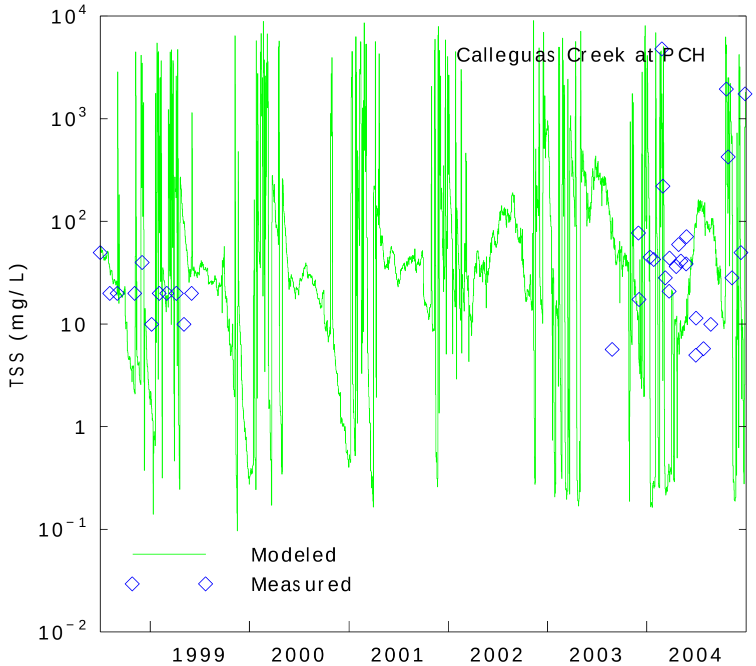

Figure 123: Measured and Modeled TSS Time Series for Calleguas Creek at PCH.

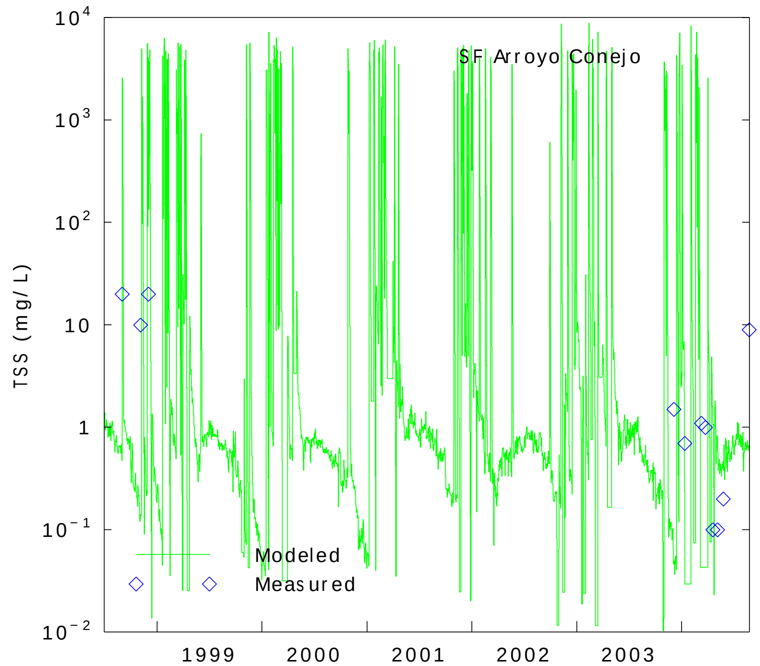

Figure 124: Measured and Modeled TSS Time Series for South Fork Arroyo Conejo.

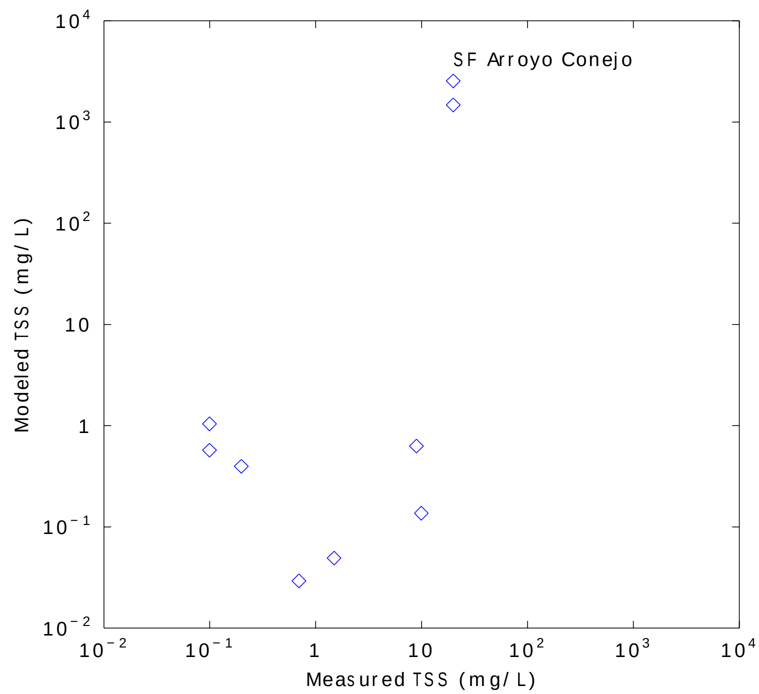

Figure 125: Measured vs. Modeled TSS for South Fork Arroyo Conejo.

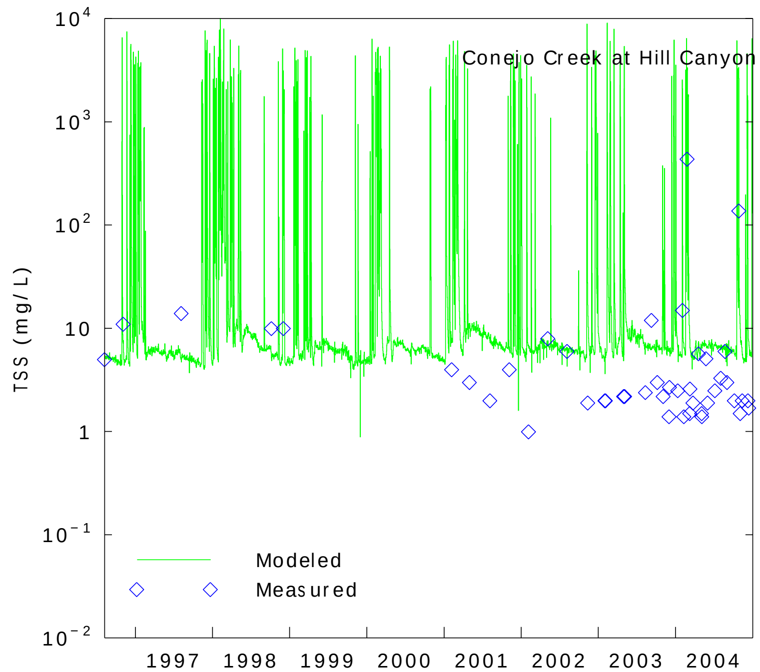

Figure 126: Measured and Modeled TSS Time Series for Conejo Creek at Hill Canyon.

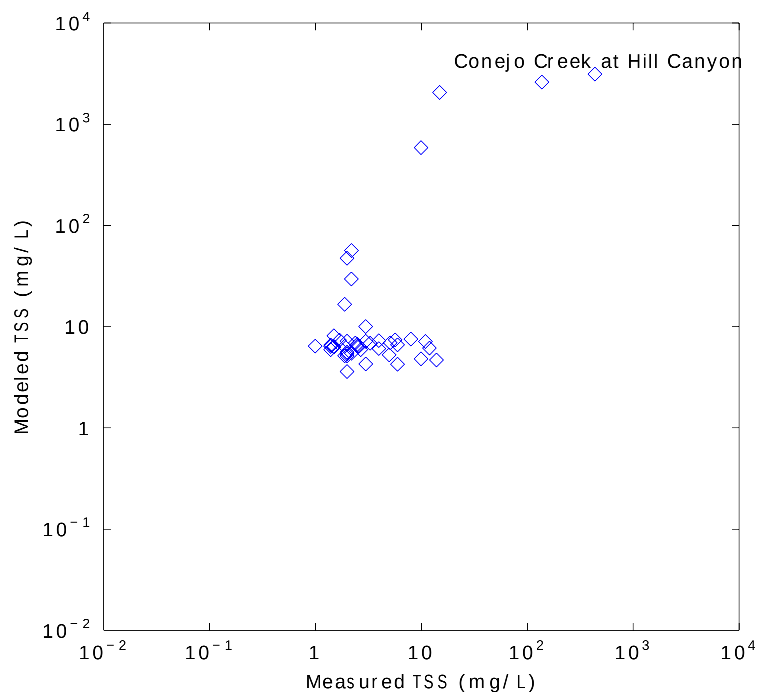

Figure 127: Measured vs. Modeled TSS for Conejo Creek at Hill Canyon.

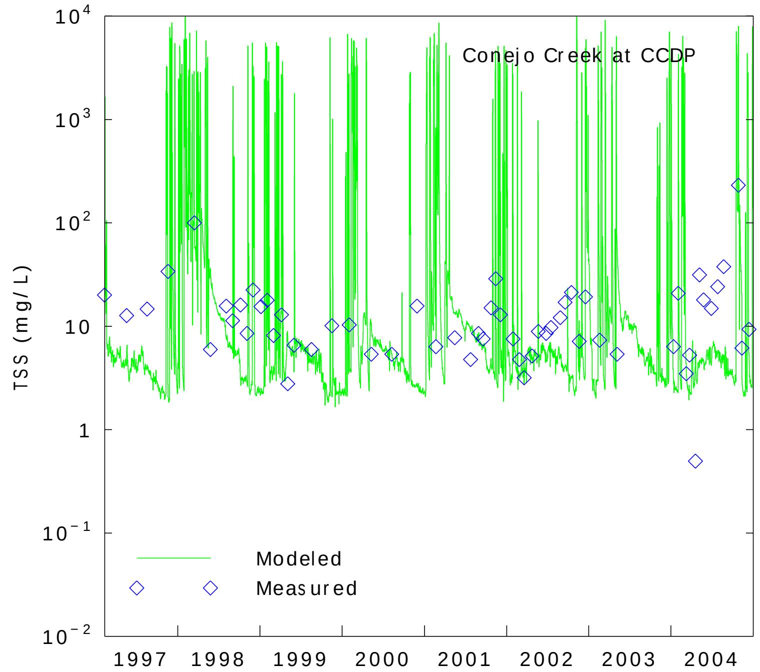

Figure 128: Measured and Modeled TSS Time Series for Conejo Creek at CCDP.

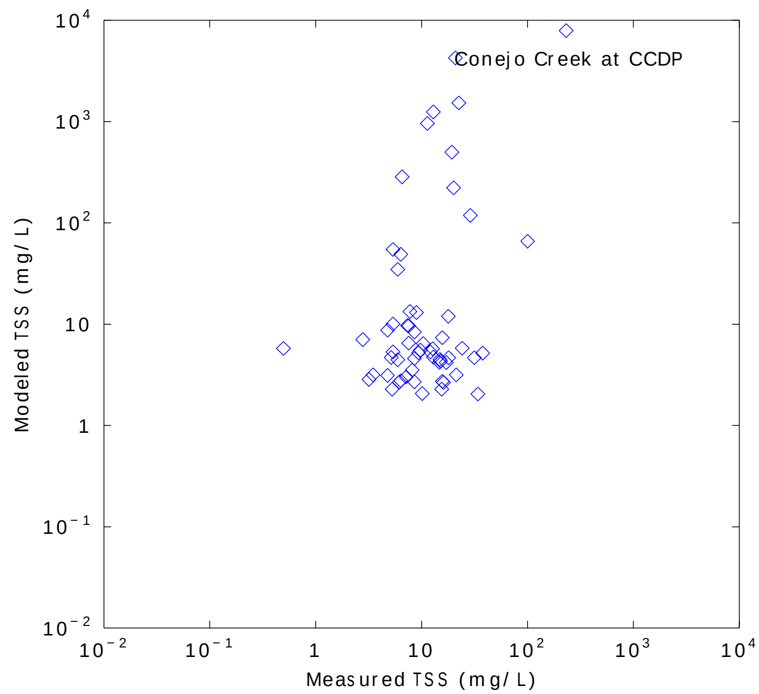

Figure 129: Measured vs. Modeled TSS for Conejo Creek at CCDP.

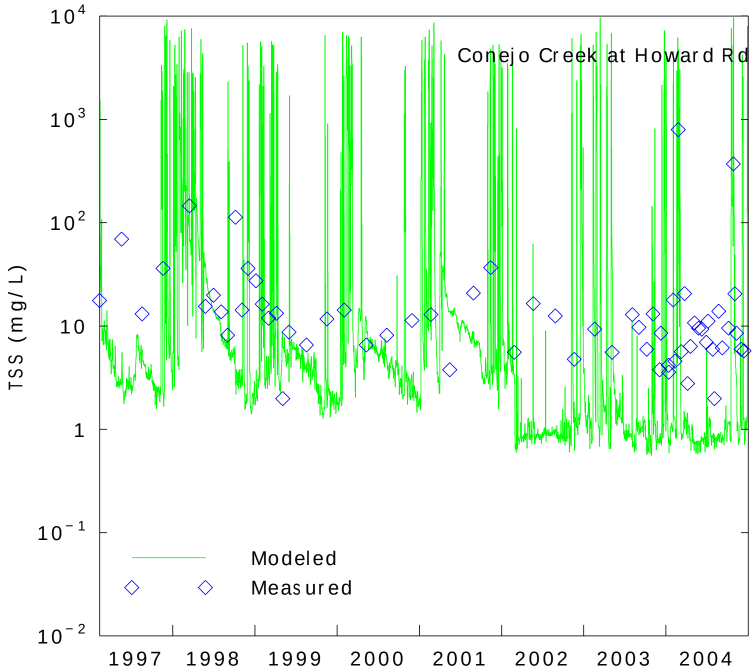

Figure 130: Measured and Modeled TSS Time Series for Conejo Creek at Howard.

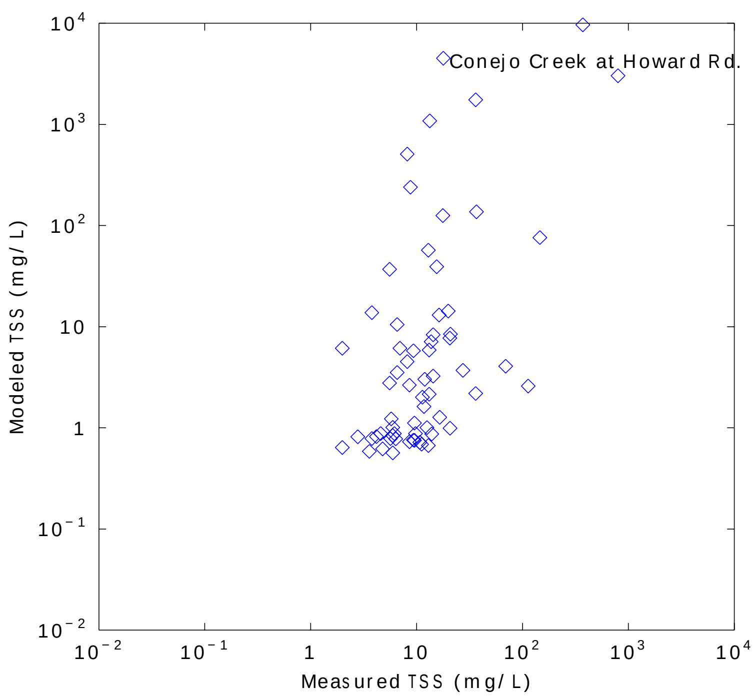

Figure 131: Measured vs. Modeled TSS for Conejo Creek at Howard.

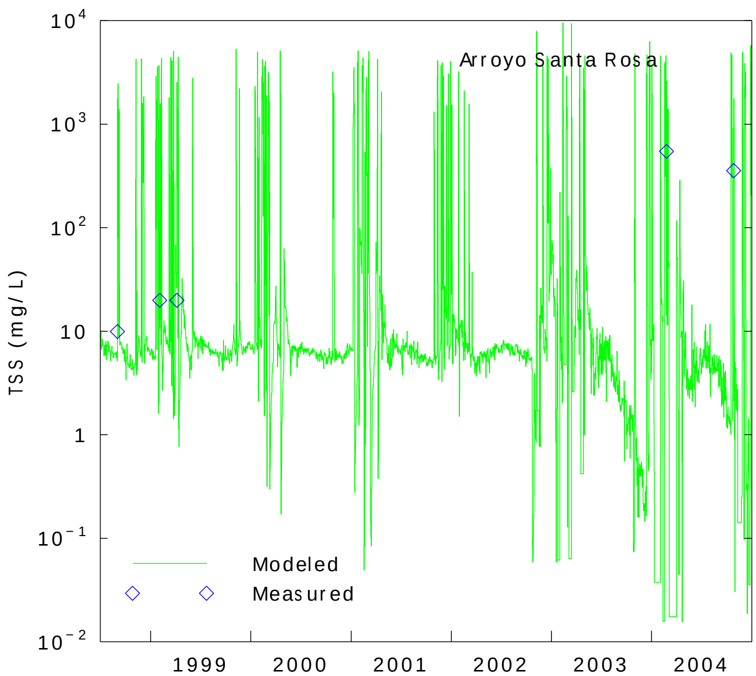

Figure 132: Measured and Modeled TSS Time Series for Arroyo Santa Rosa.

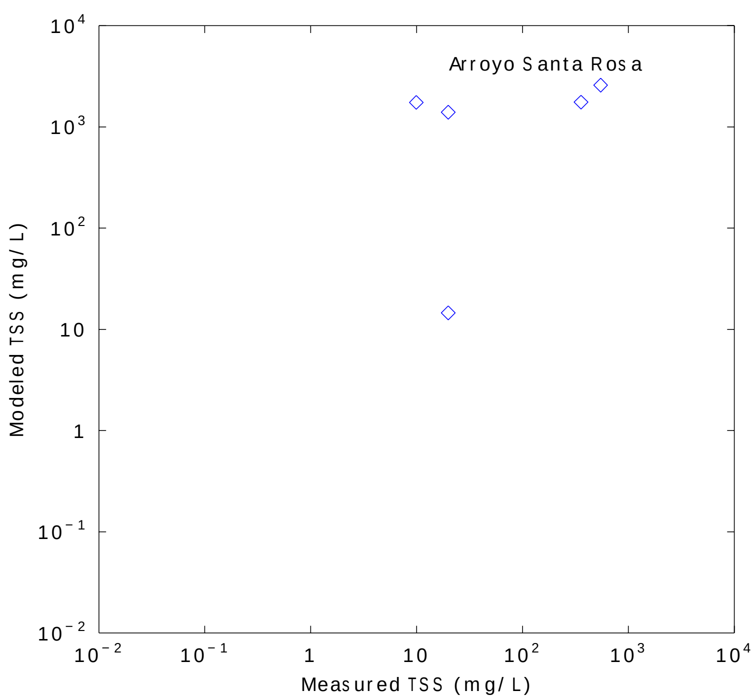

Figure 133: Measured vs. Modeled TSS for Arroyo Santa Rosa.

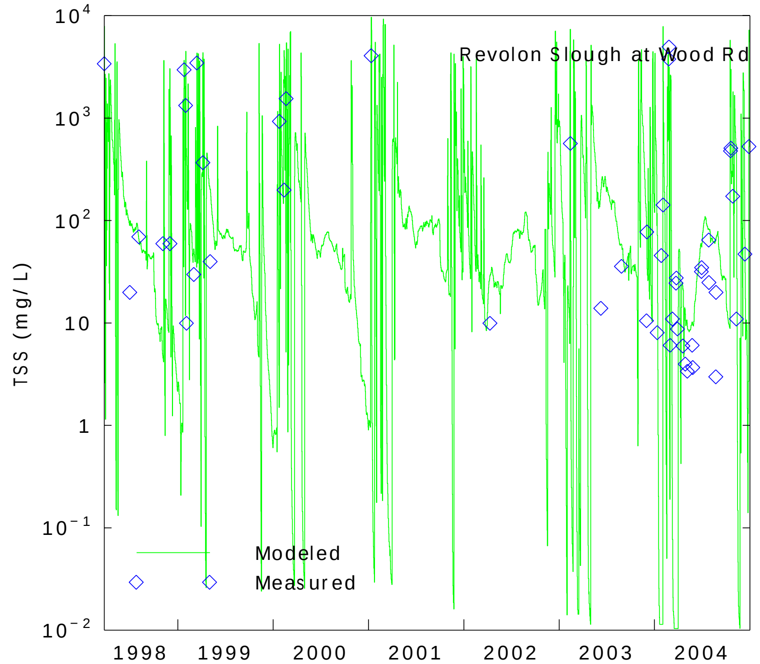

Figure 134: Measured and Modeled TSS Time Series for Revolon Slough at Wood.

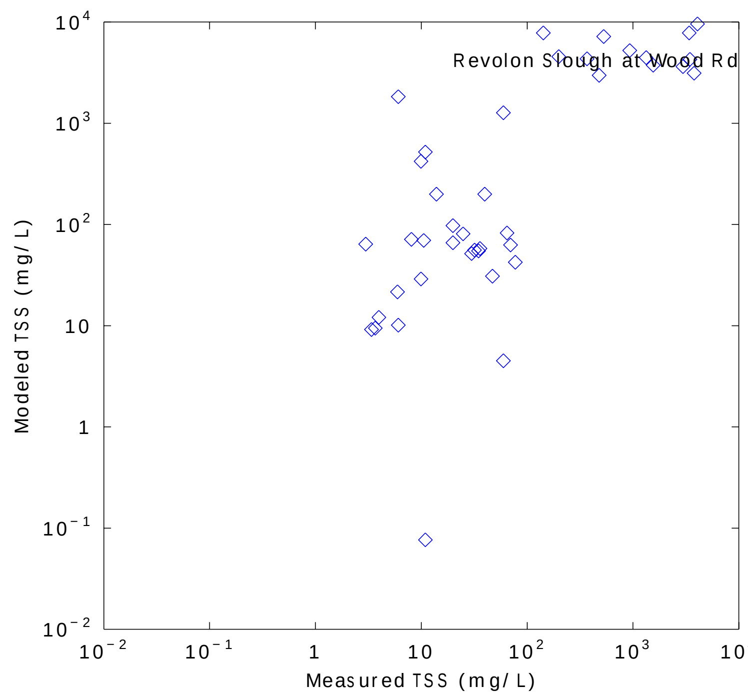

Figure 135: Measured vs. Modeled TSS for Revolon Slough at Wood.

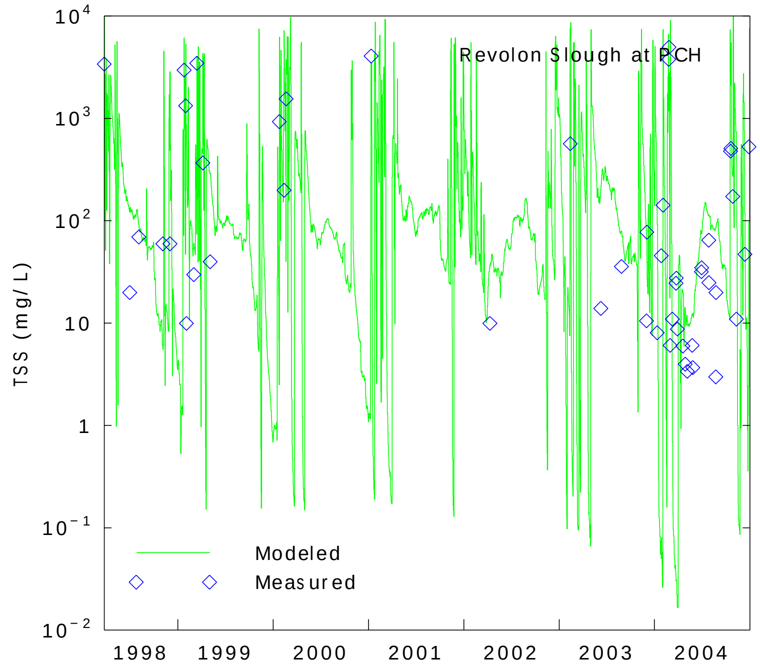

Figure 136: Measured and Modeled TSS Time Series for Revolon Slough at PCH.

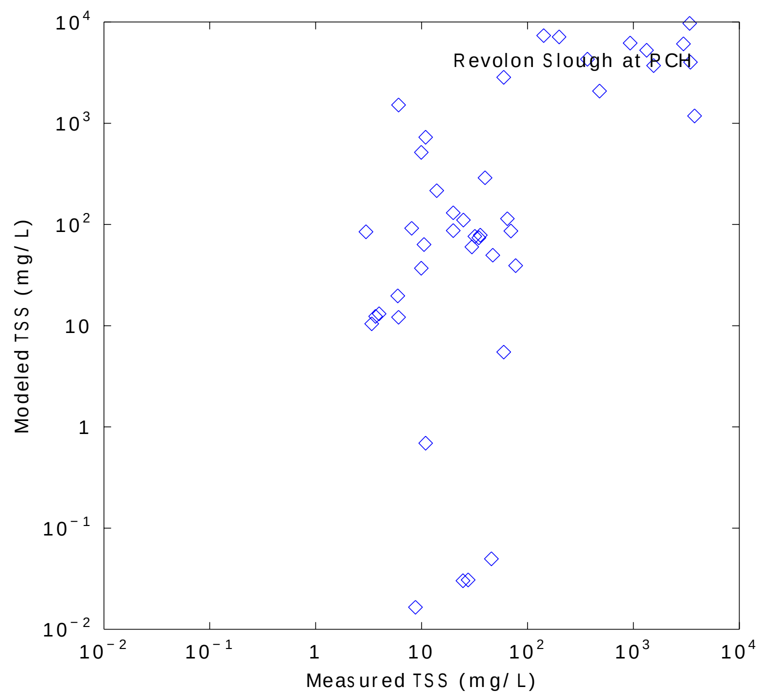

Figure 137: Measured vs. Modeled TSS for Revolon Slough at PCH.

Hardness

Hardness time series and model vs. measured values are plotted in Figure 138 to Figure 159.

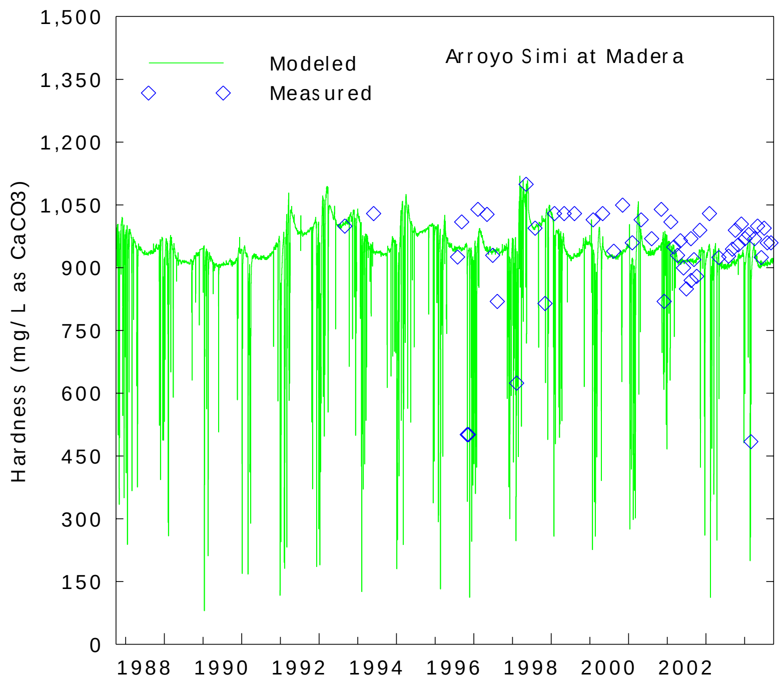

Figure 138: Measured and Modeled Hardness Time Series for Arroyo Simi at Madera.

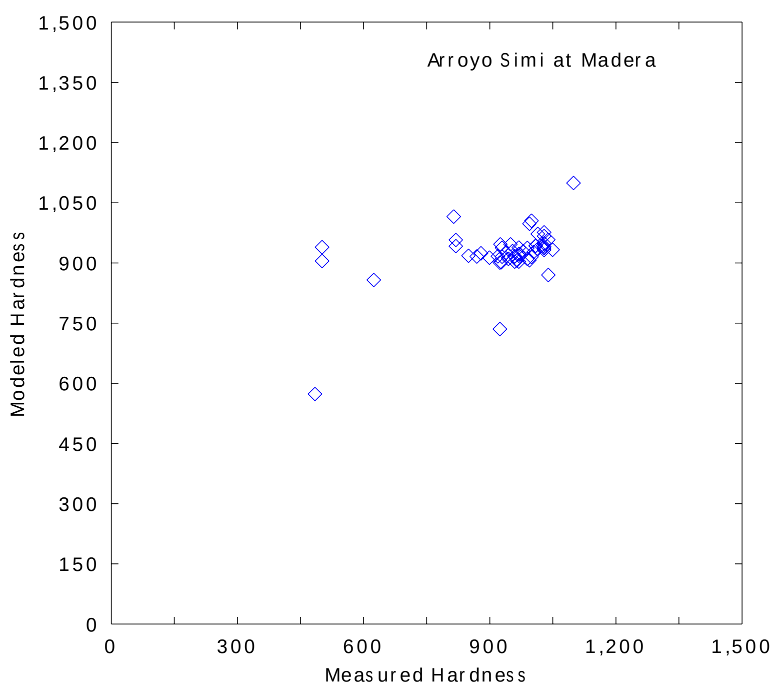

Figure 139: Measured vs. Modeled Hardness for Arroyo Simi at Madera.

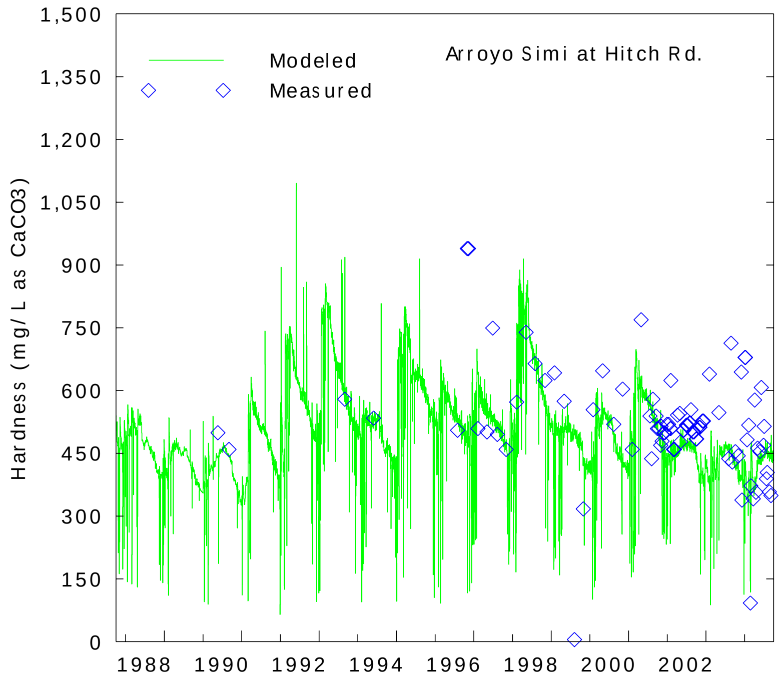

Figure 140: Measured and Modeled Hardness Time Series for Arroyo Simi at Hitch.

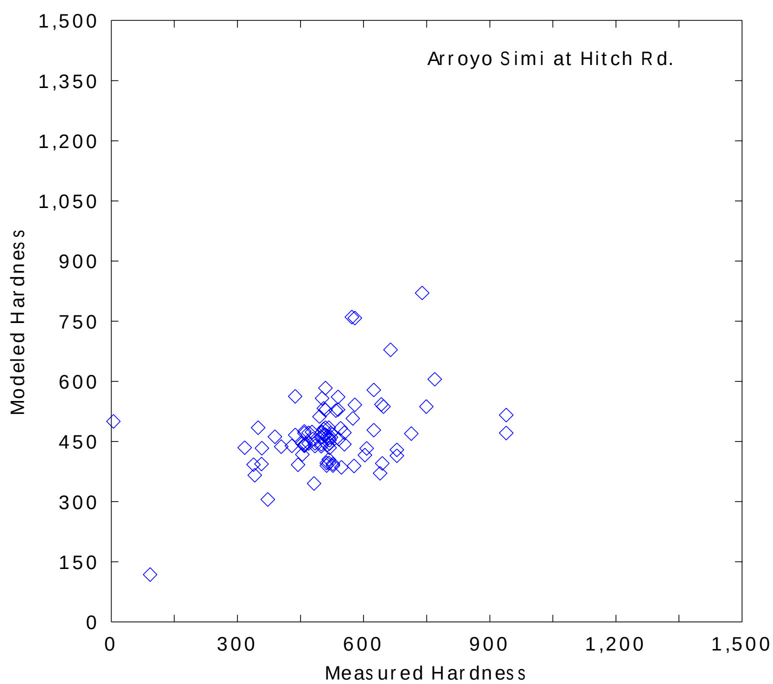

Figure 141: Measured vs. Modeled Hardness for Arroyo Simi at Hitch.

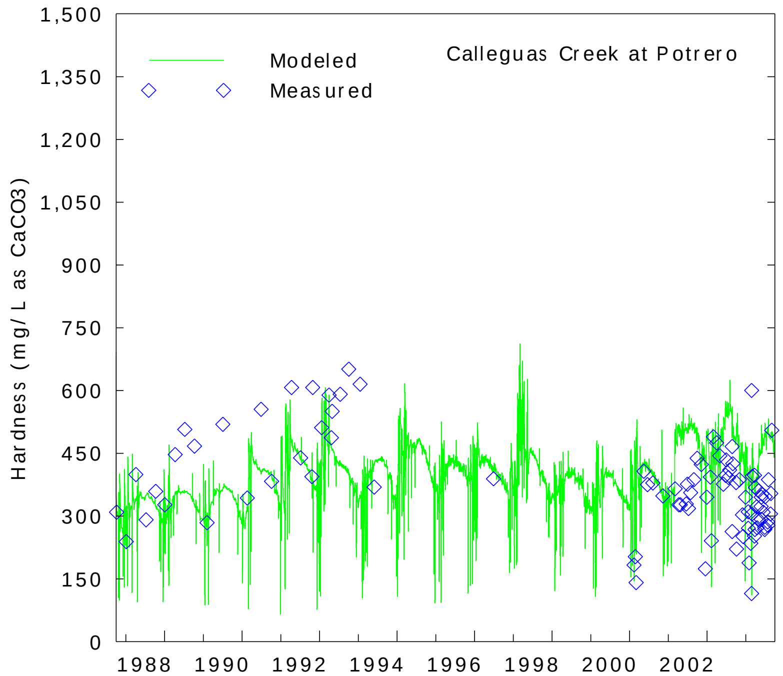

Figure 142: Measured and Modeled Hardness Time Series for Calleguas Creek at Potrero.

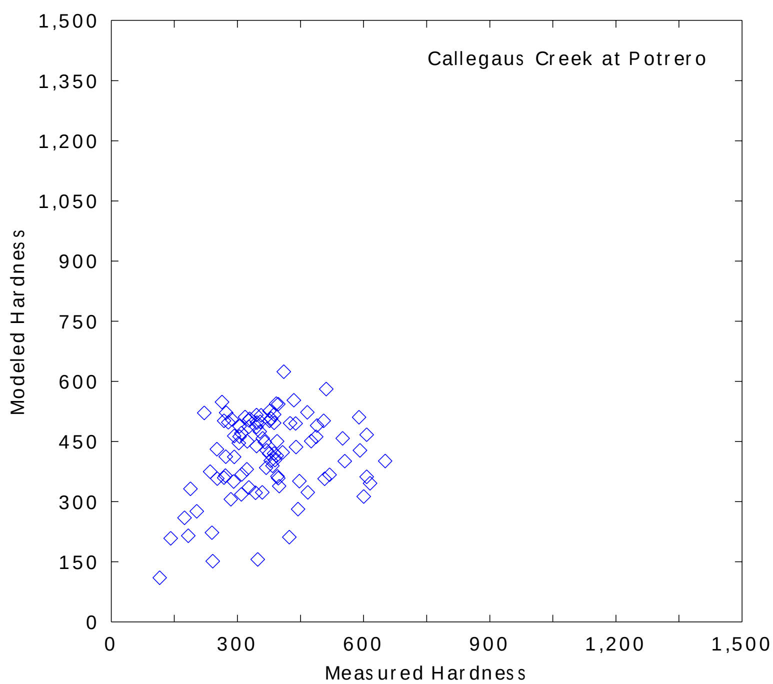

Figure 143: Measured vs. Modeled Hardness for Calleguas Creek at Potrero.

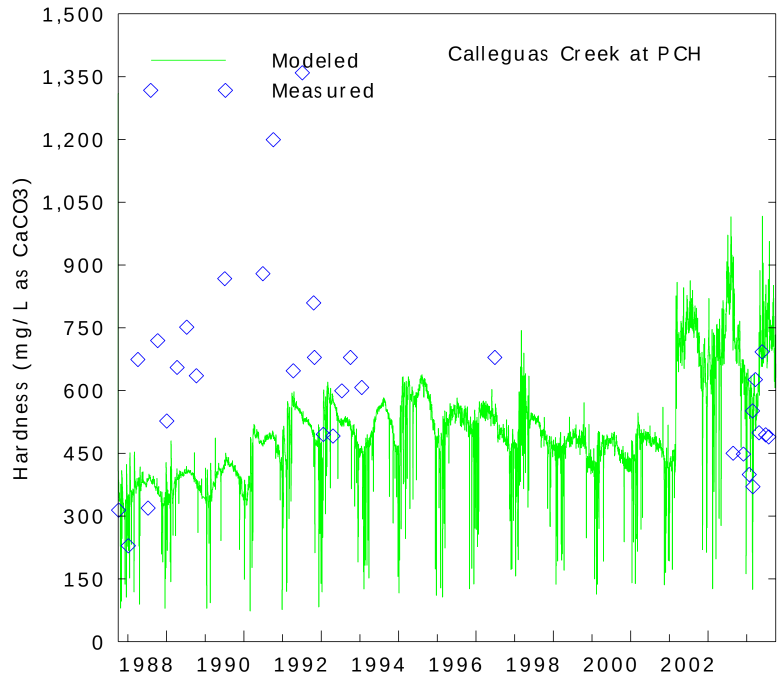

Figure 144: Measured and Modeled Hardness Time Series for Calleguas Creek at PCH.

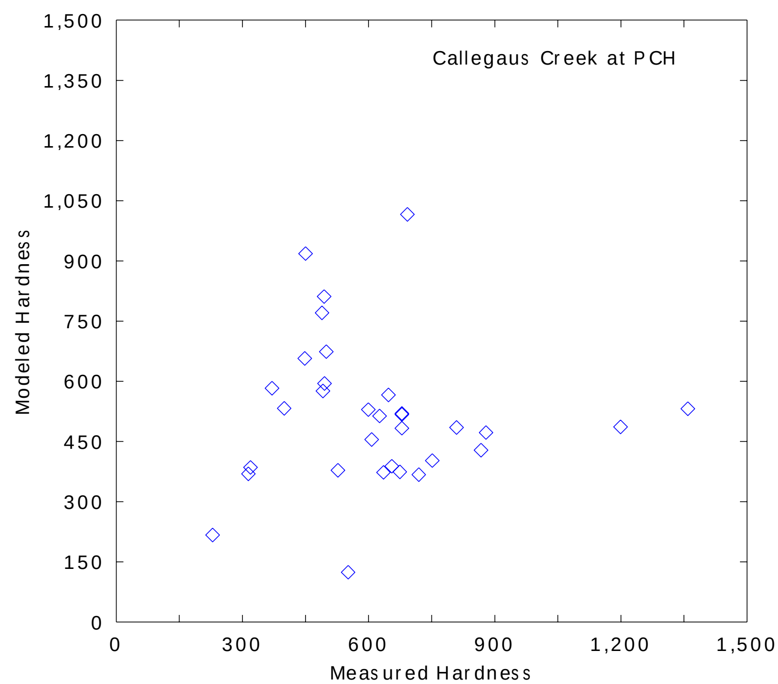

Figure 145: Measured vs. Modeled Hardness for Calleguas Creek at PCH.

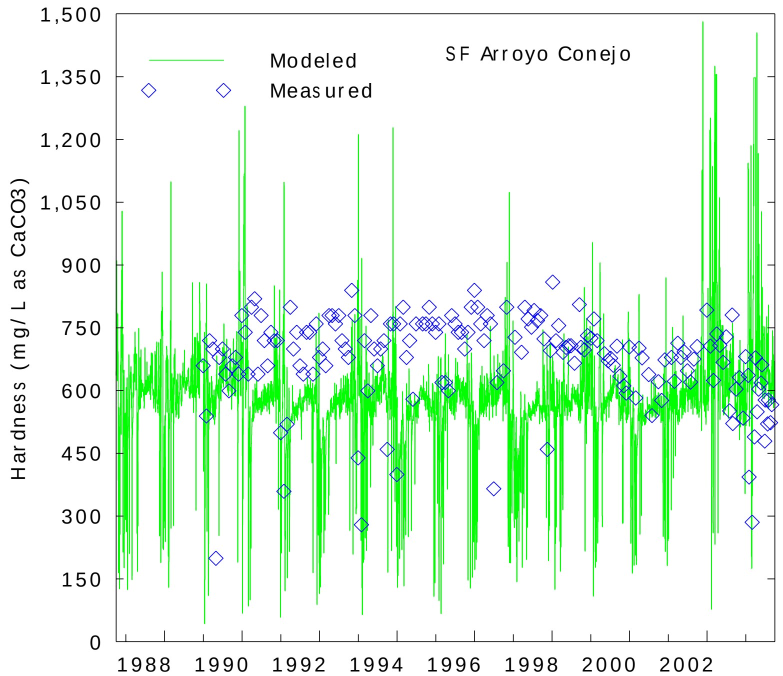

Figure 146: Measured and Modeled Hardness Time Series for South Fork Arroyo Conejo.

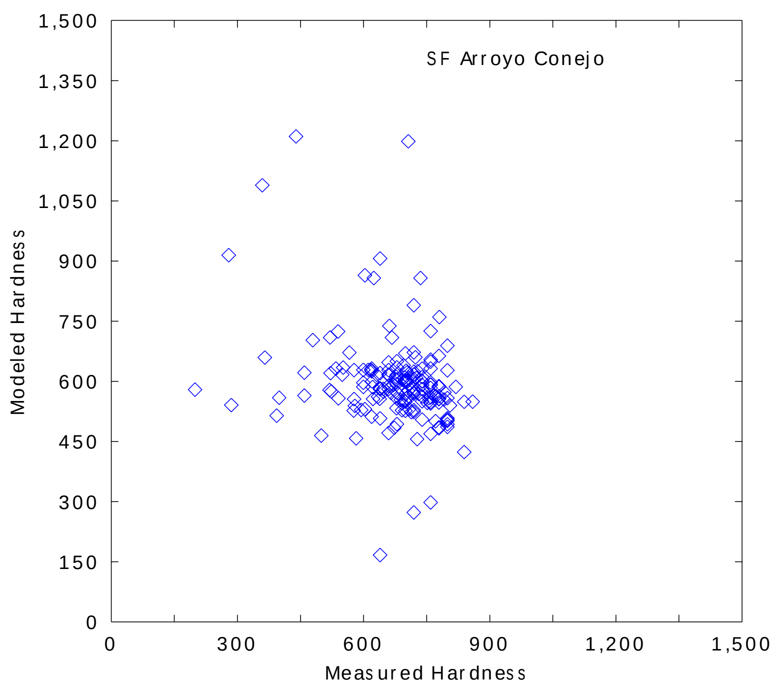

Figure 147: Measured vs. Modeled Hardness for South Fork Arroyo Conejo.

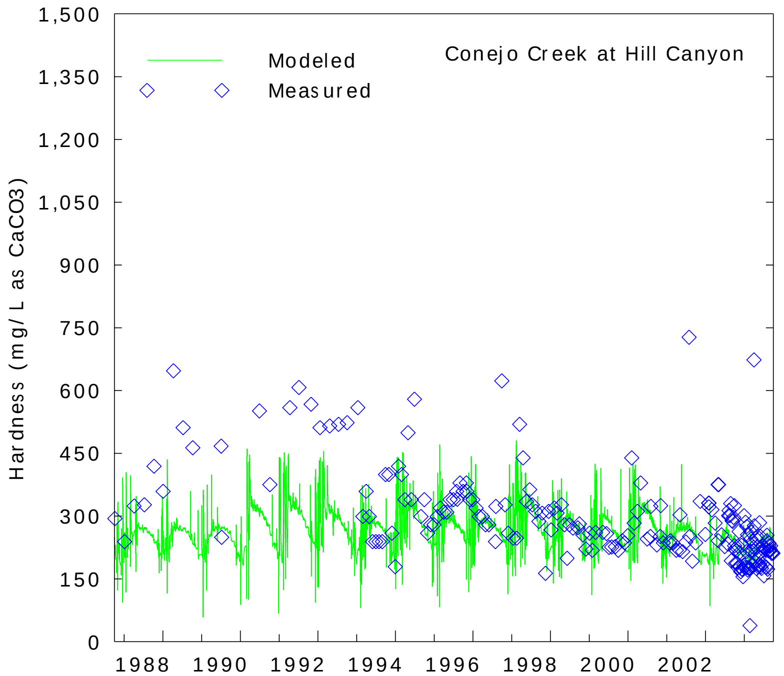

Figure 148: Measured and Modeled Hardness Time Series for Conejo Creek at Hill Canyon.

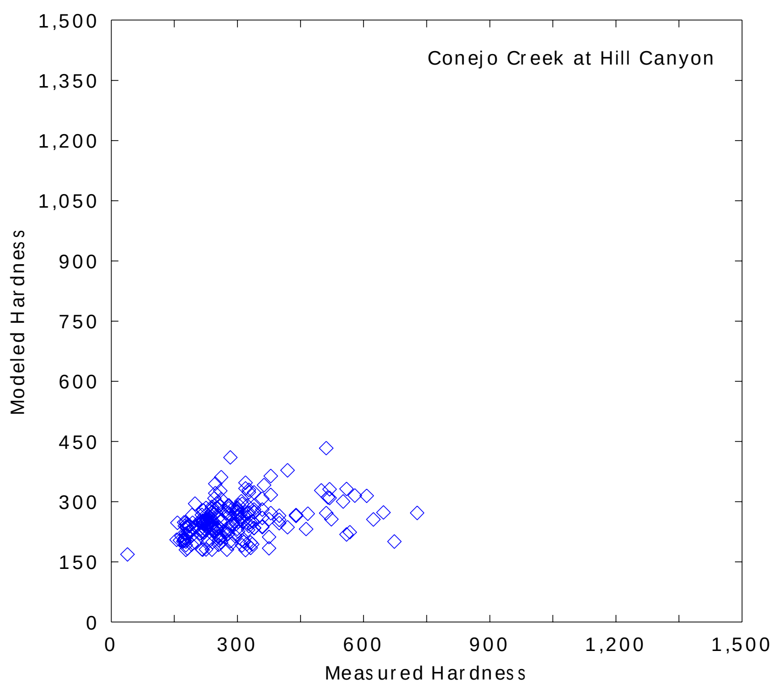

Figure 149: Measured vs. Modeled Hardness for Conejo Creek at Hill Canyon.

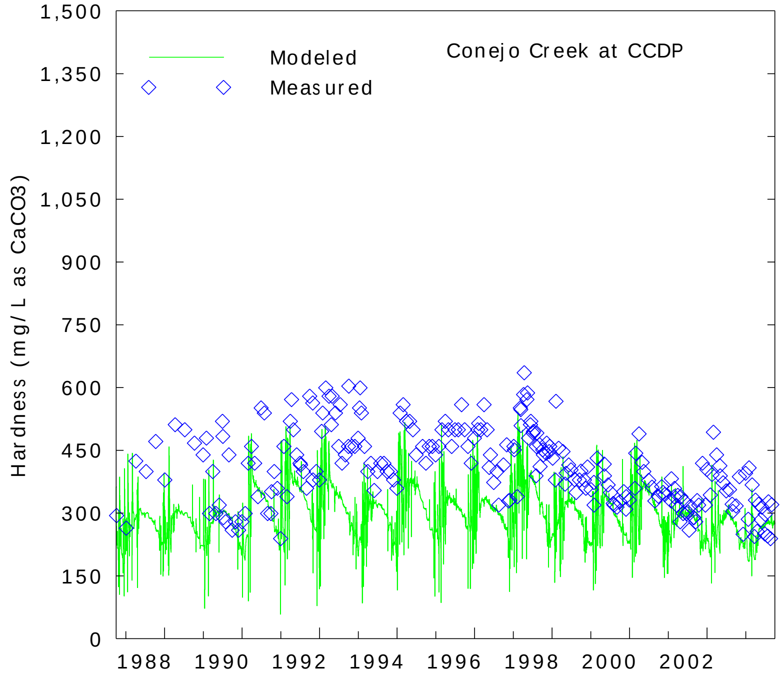

Figure 150: Measured and Modeled Hardness Time Series for Conejo Creek at CCDP.

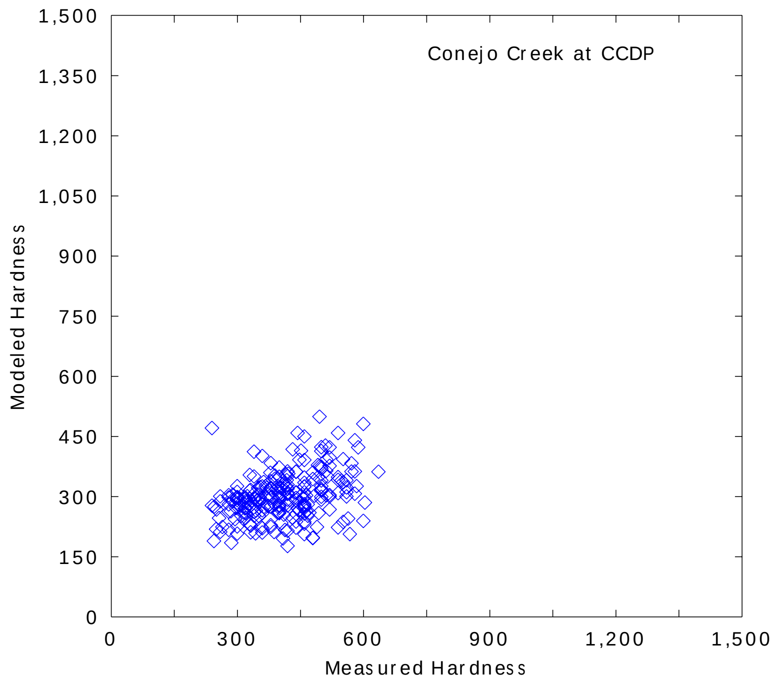

Figure 151: Measured vs. Modeled Hardness for Conejo Creek at CCDP.

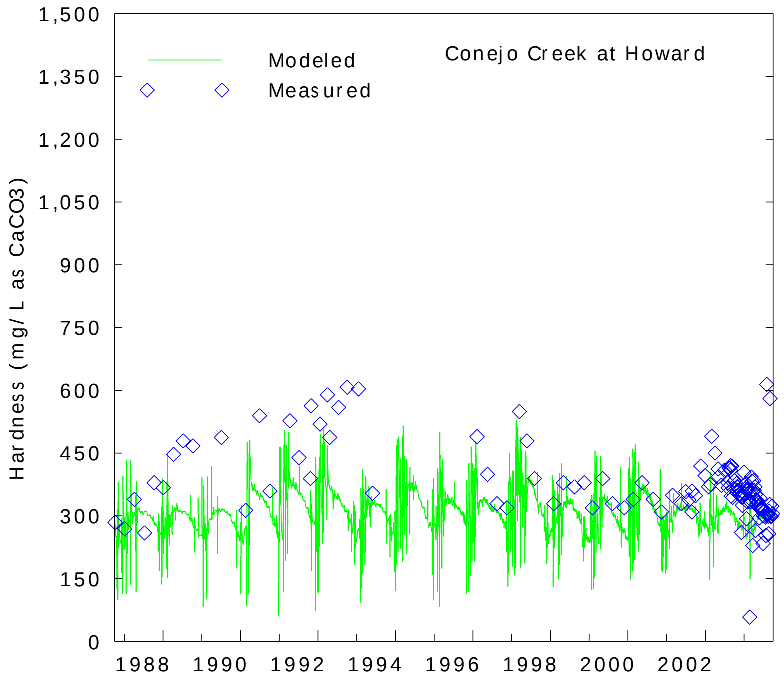

Figure 152: Measured and Modeled Hardness Time Series for Conejo Creek at Howard.

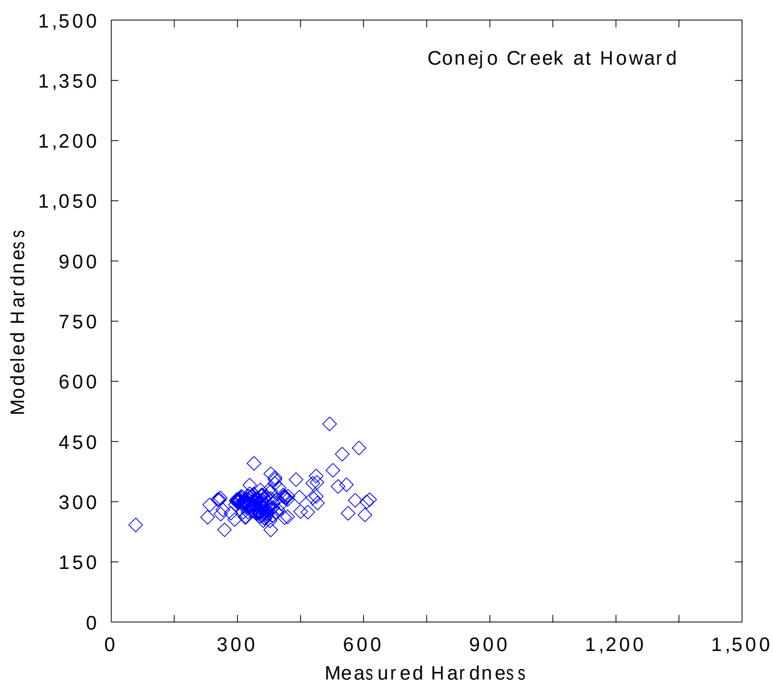

Figure 153: Measured vs. Modeled Hardness for Conejo Creek at Howard.

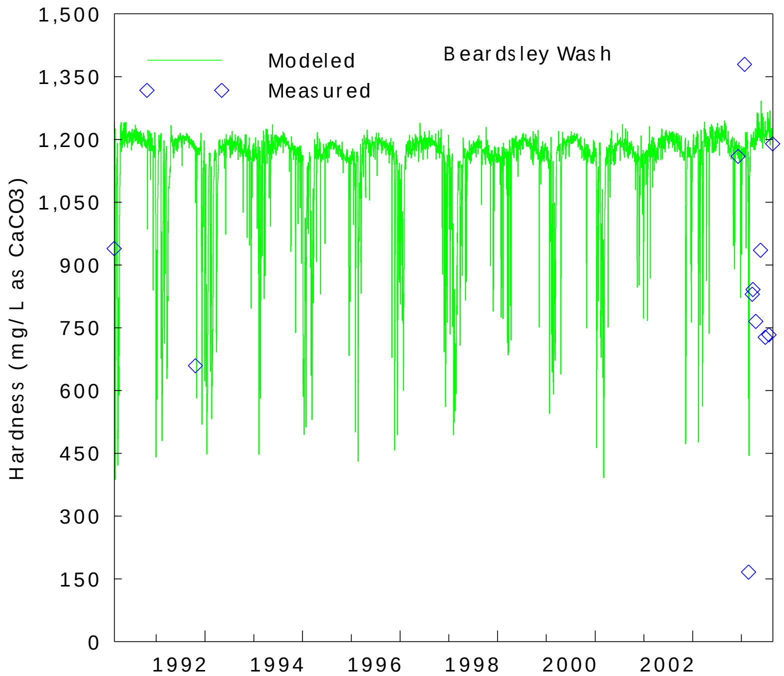

Figure 154: Measured and Modeled Hardness Time Series for Beardsley Wash.

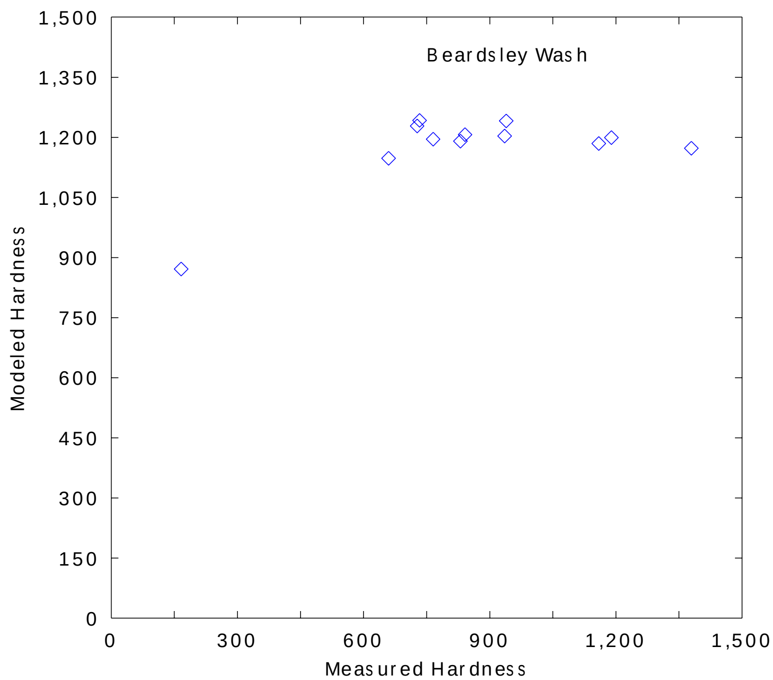

Figure 155: Measured vs. Modeled Hardness for Beardsley Wash.

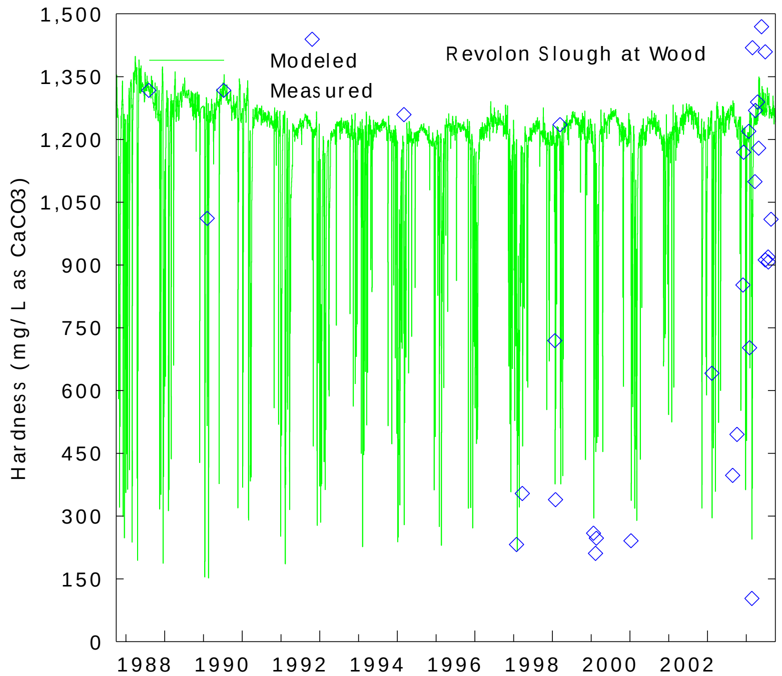

Figure 156: Measured and Modeled Hardness Time Series for Revolon Slough at Wood.

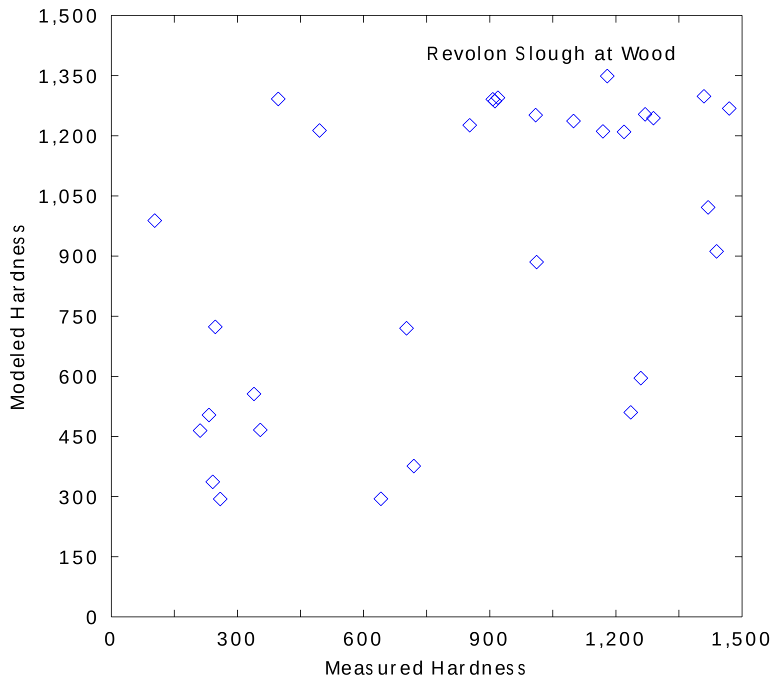

Figure 157: Measured vs. Modeled Hardness for Revolon Slough at Wood.

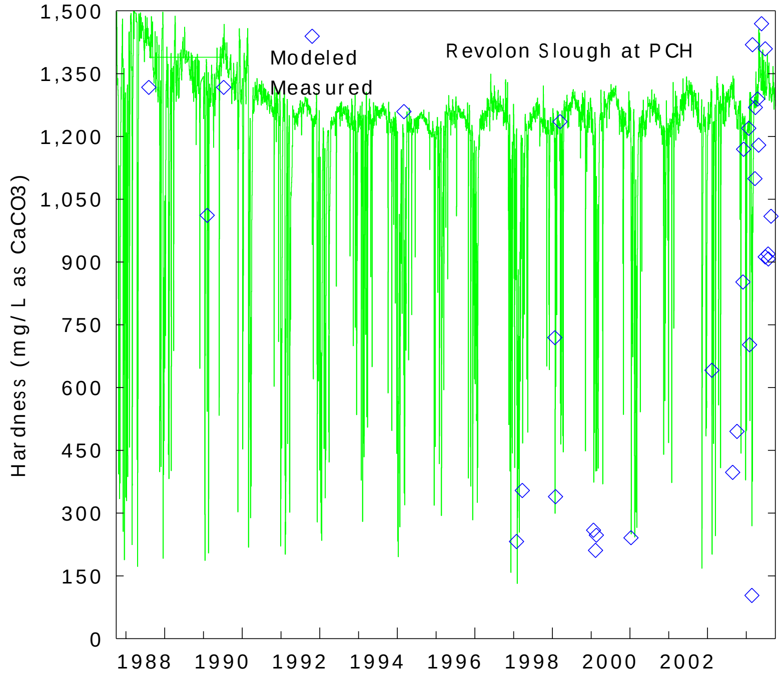

Figure 158: Measured and Modeled Hardness Time Series for Revolon Slough at PCH.

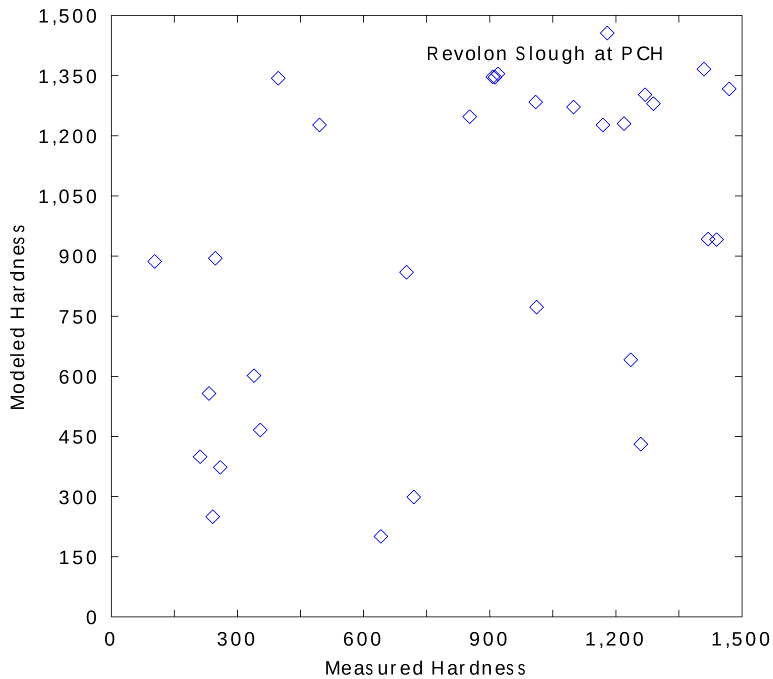

Figure 159: Measured vs. Modeled Hardness for Revolon Slough at PCH.

Chloride

Chloride time series of measured and modeled values along with paired comparisons of modeled vs. measured values are plotted in Figure 160 to Figure 181.

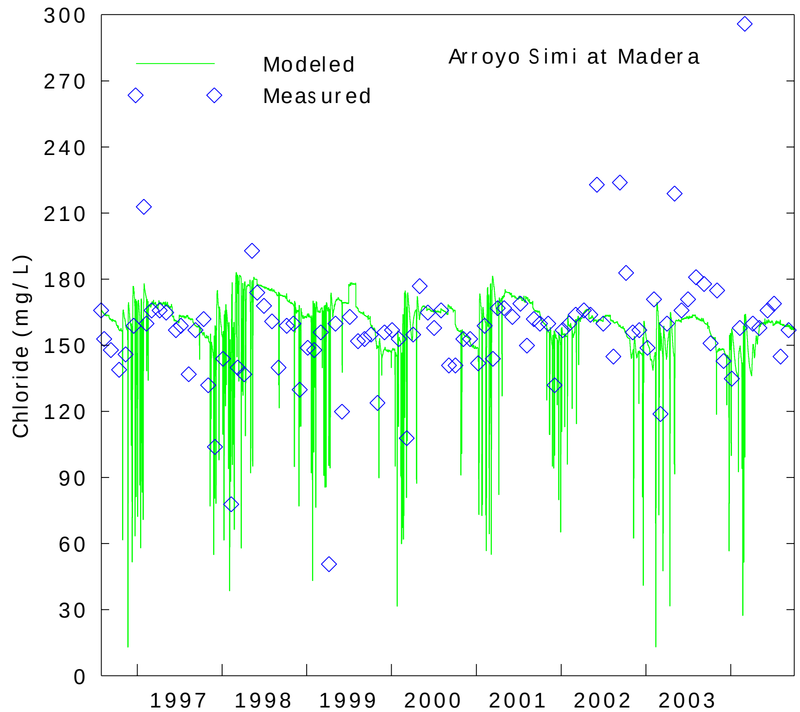

Figure 160: Measured and Modeled Chloride Time Series for Arroyo Simi at Madera.

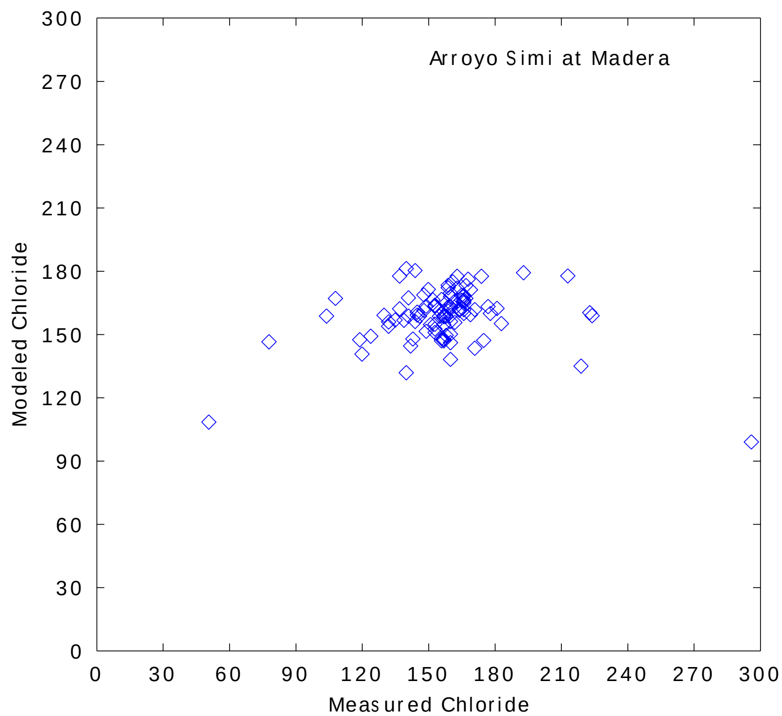

Figure 161: Measured vs. Modeled Chloride for Arroyo Simi at Madera.

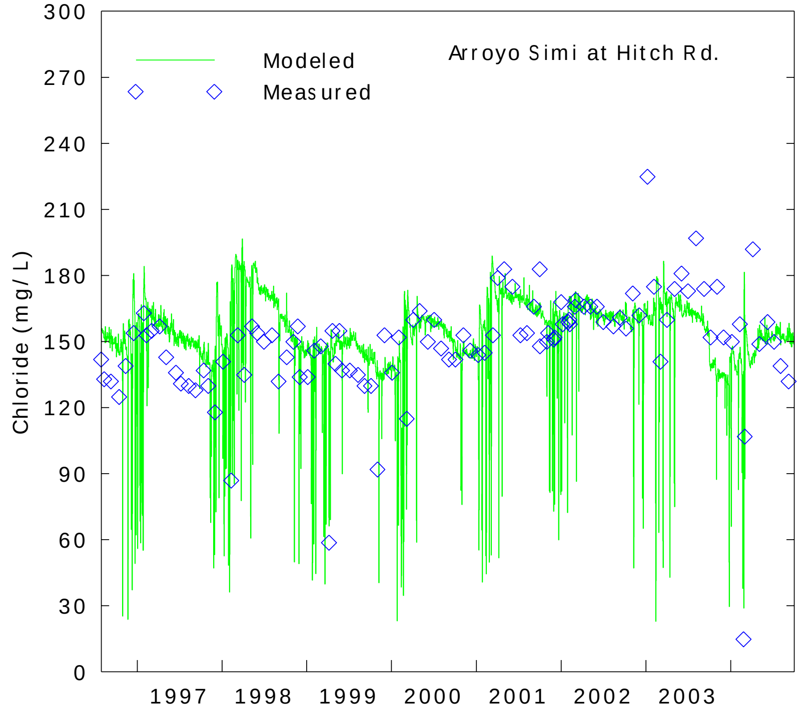

Figure 162: Measured and Modeled Chloride Time Series for Arroyo Simi at Hitch.

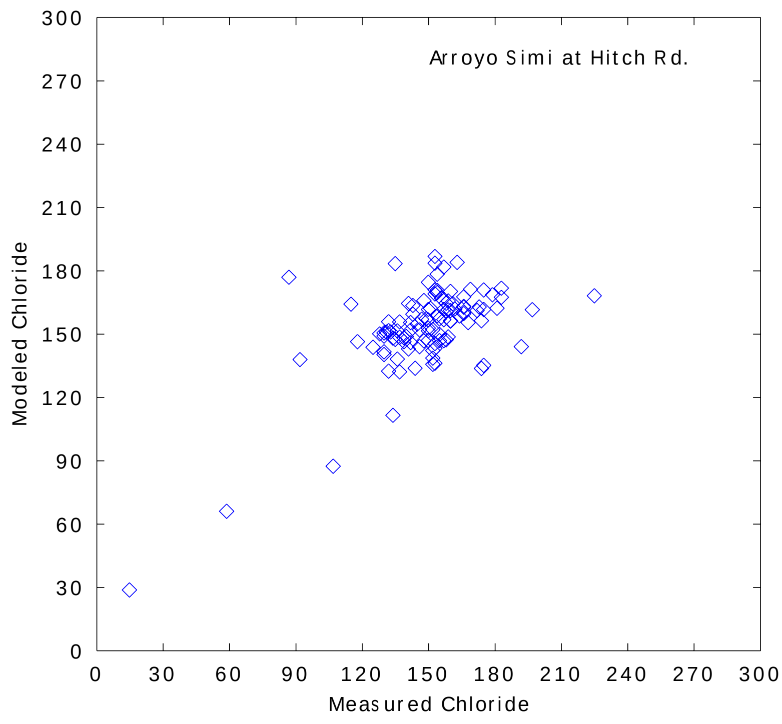

Figure 163: Measured vs. Modeled Chloride for Arroyo Simi at Hitch.

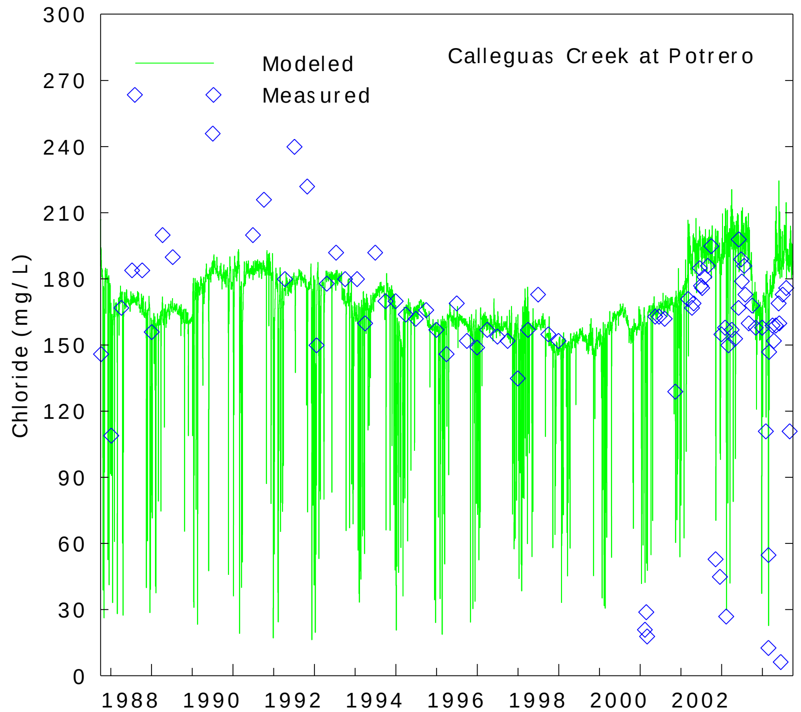

Figure 164: Measured and Modeled Chloride Time Series for Calleguas Creek at Potrero.

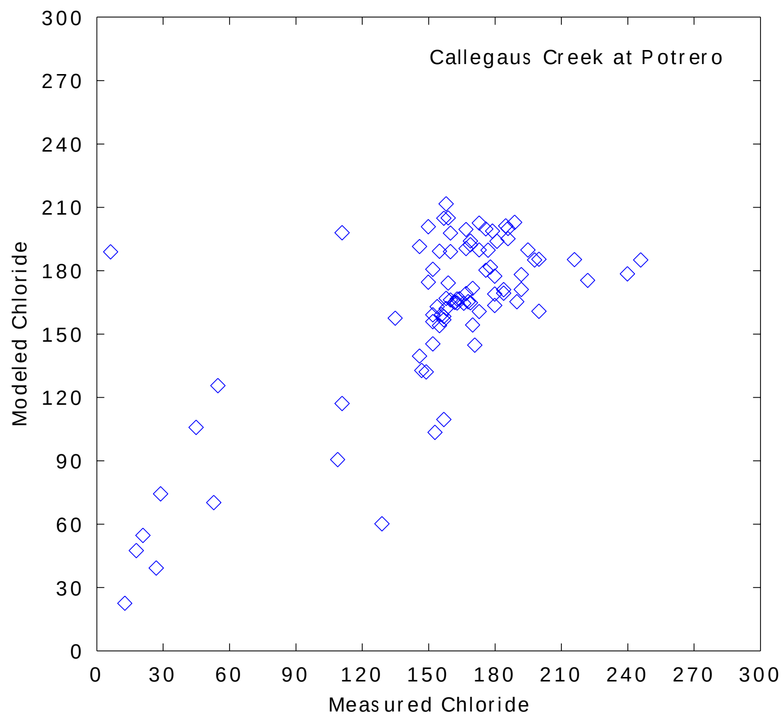

Figure 165: Measured vs. Modeled Chloride for Calleguas Creek at Potrero.

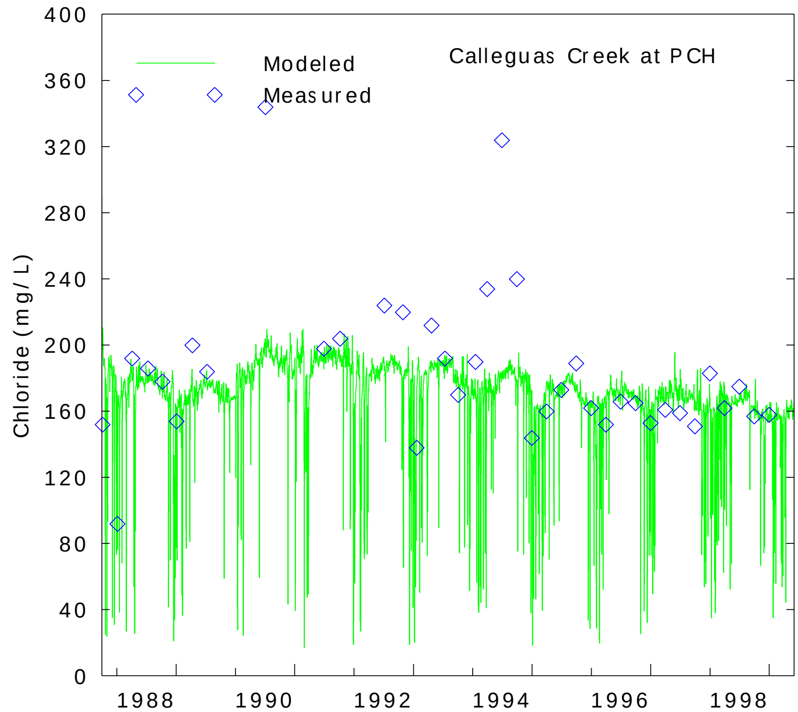

Figure 166: Measured and Modeled Chloride Time Series for Calleguas Creek at PCH.

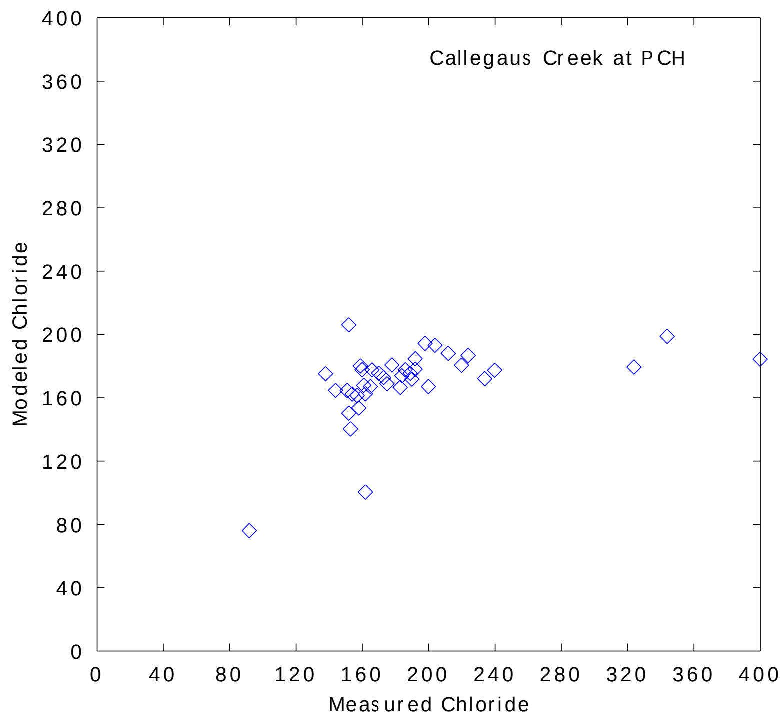

Figure 167: Measured vs. Modeled Chloride for Calleguas Creek at PCH.

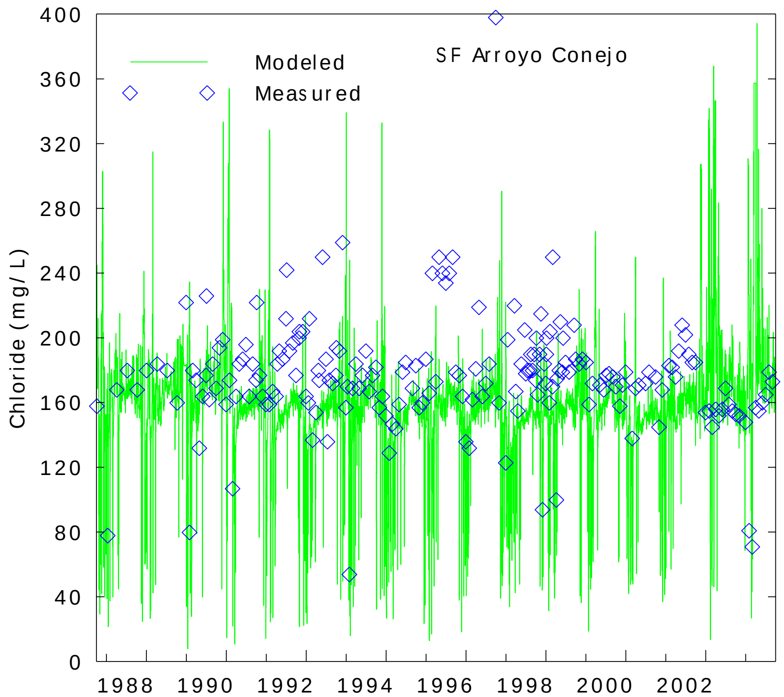

Figure 168: Measured and Modeled Chloride Time Series for South Fork Arroyo Conejo.

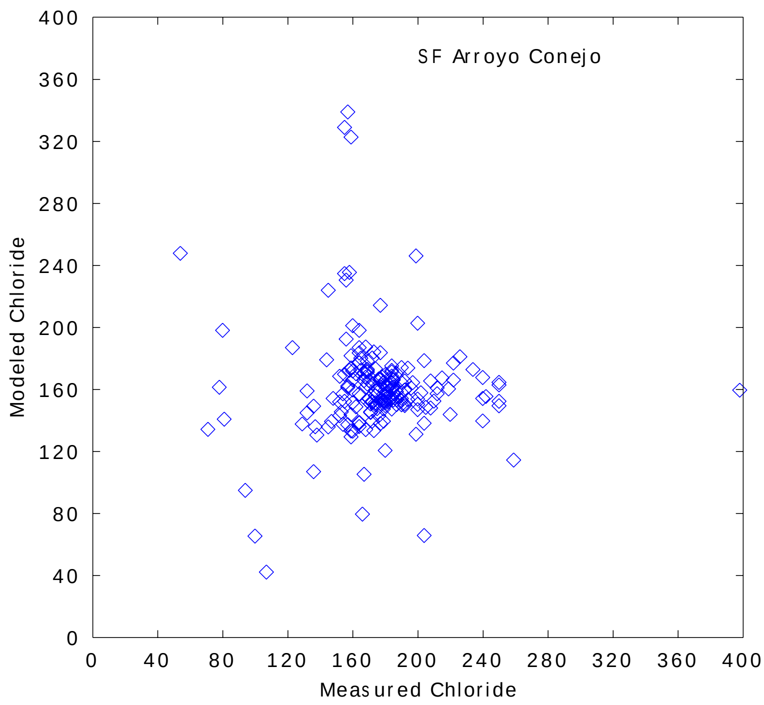

Figure 169: Measured vs. Modeled Chloride for South Fork Arroyo Conejo.

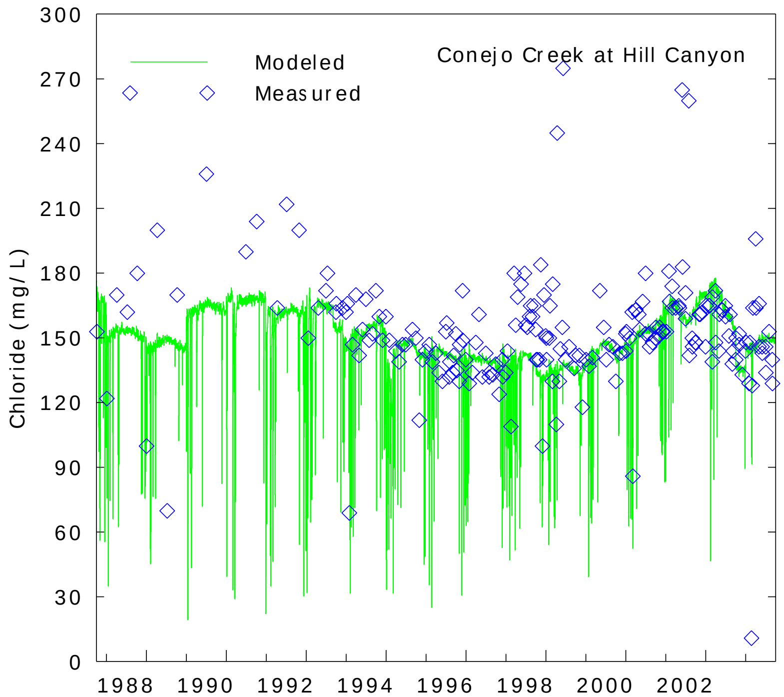

Figure 170: Measured and Modeled Chloride Time Series for Conejo Creek at Hill Canyon.

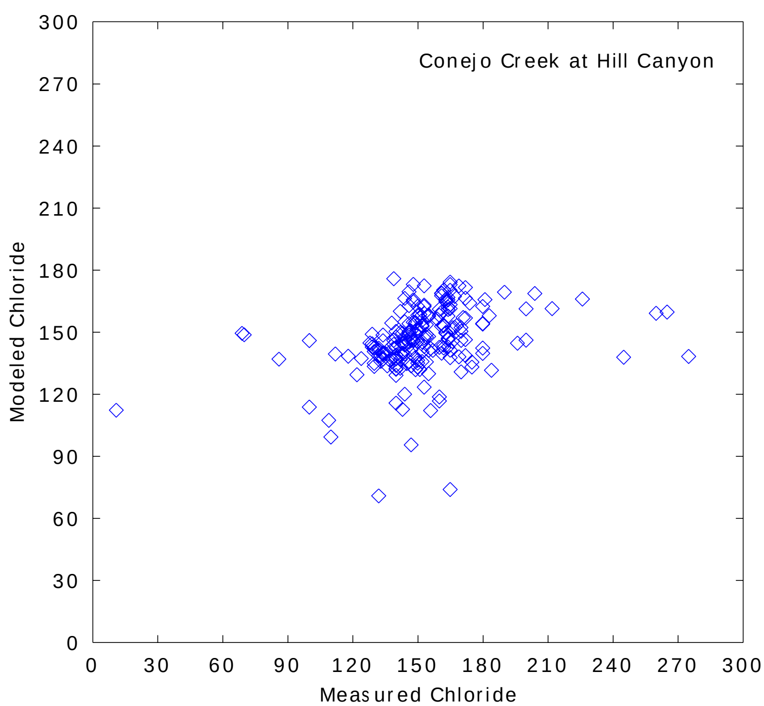

Figure 171: Measured vs. Modeled Chloride for Conejo Creek at Hill Canyon.

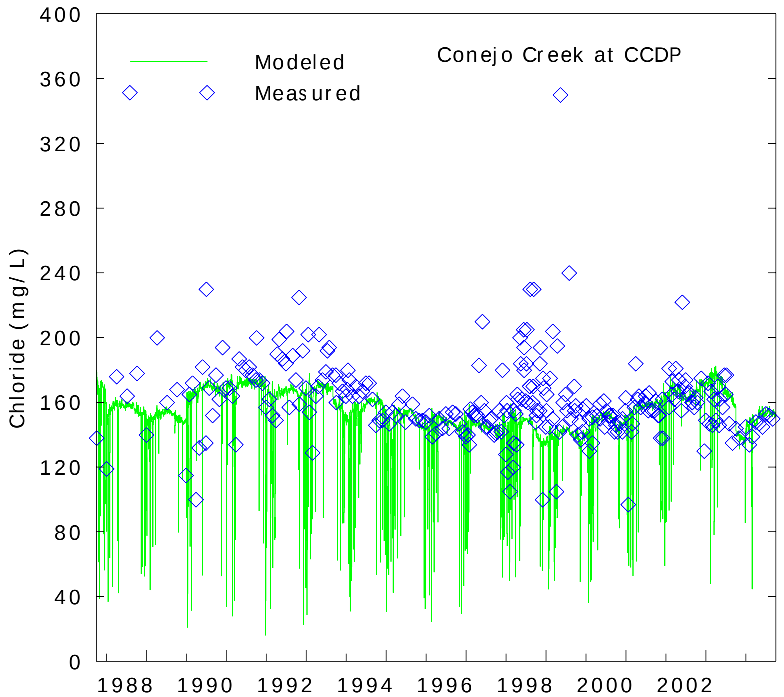

Figure 172: Measured and Modeled Chloride Time Series for Conejo Creek at CCDP.

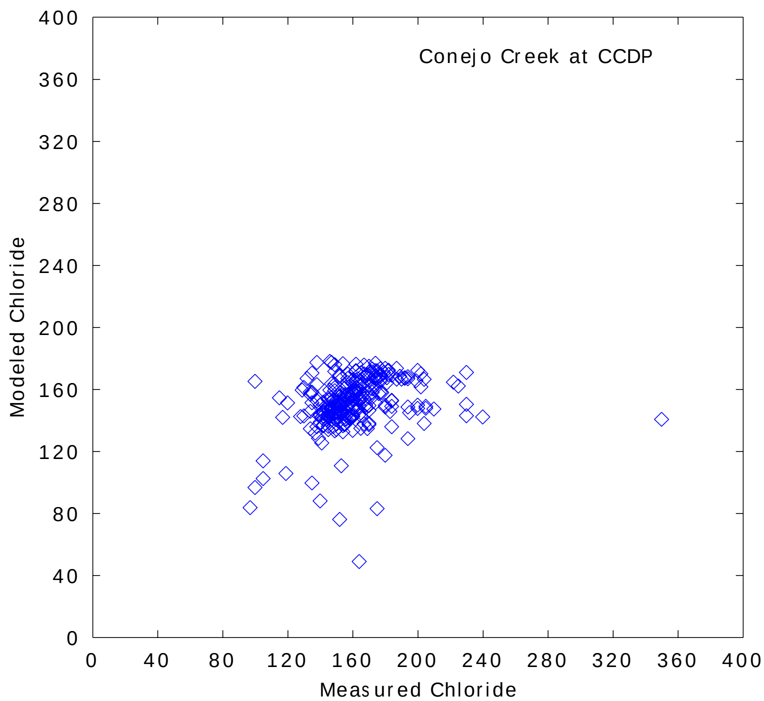

Figure 173: Measured vs. Modeled Chloride for Conejo Creek at CCDP.

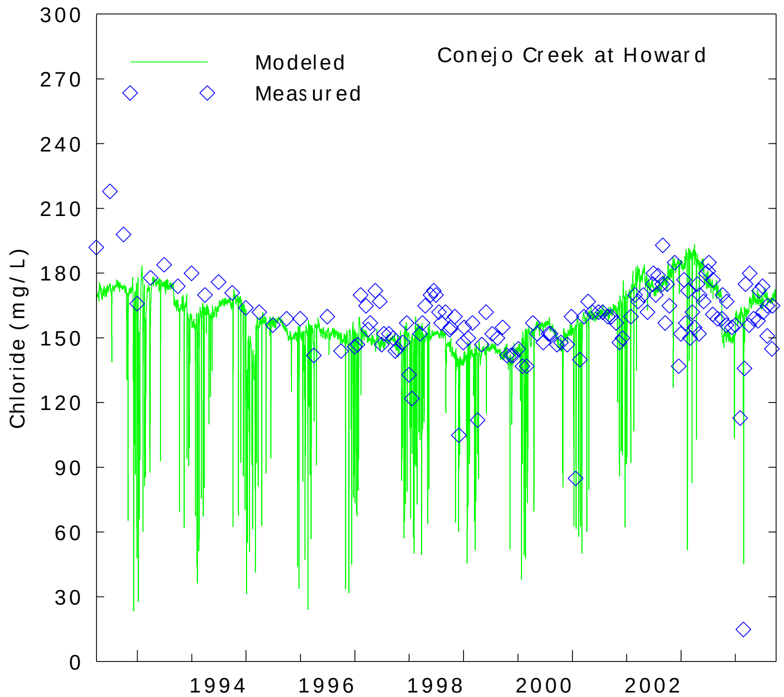

Figure 174: Measured and Modeled Chloride Time Series for Conejo Creek at Howard.

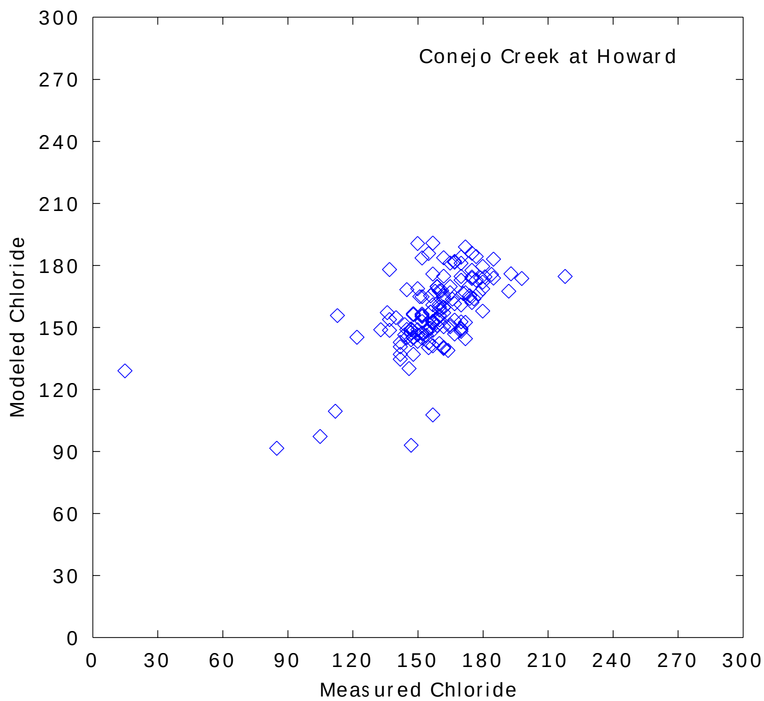

Figure 175: Measured vs. Modeled Chloride for Conejo Creek at Howard.

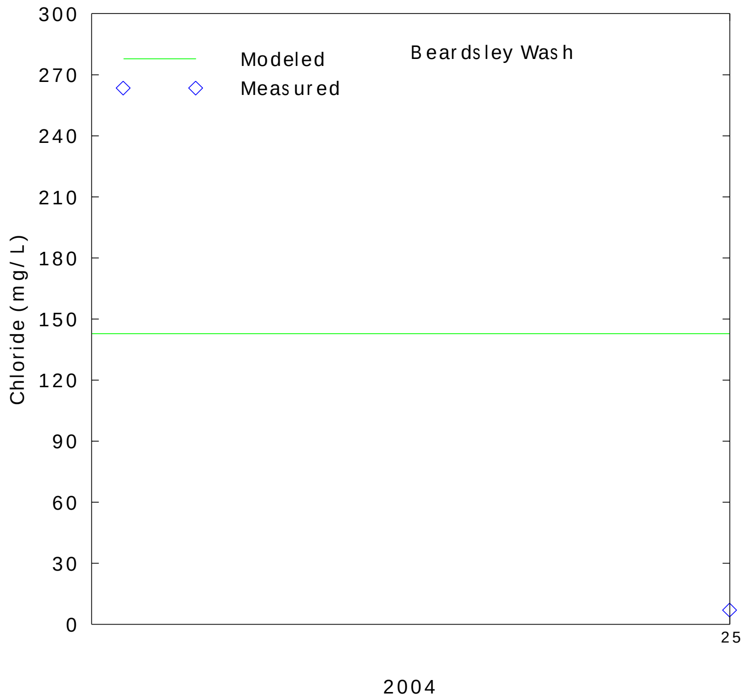

Figure 176: Measured and Modeled Chloride Time Series for Beardsley Wash.

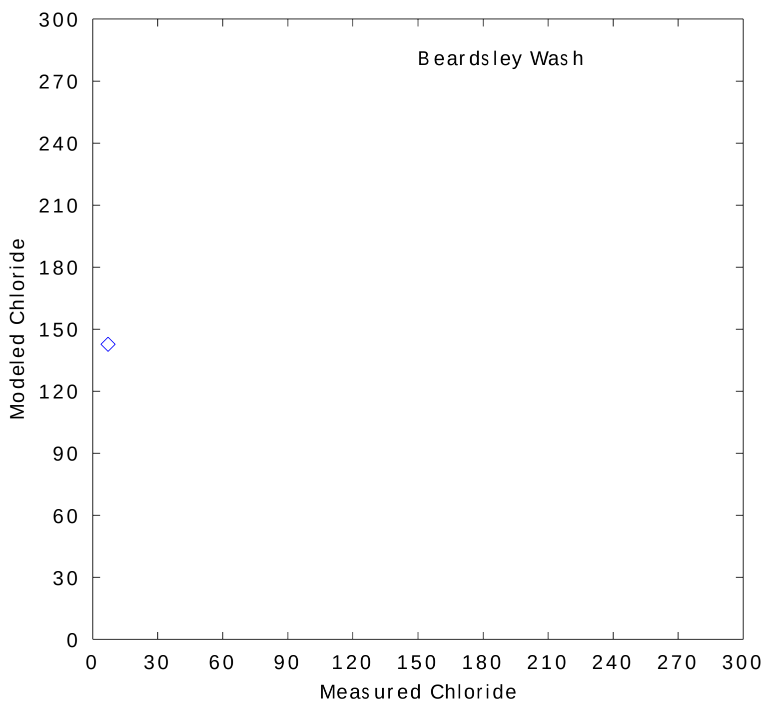

Figure 177: Measured vs. Modeled Chloride for Beardsley Wash.

Figure 178: Measured and Modeled Chloride Time Series for Revolon Slough at Wood.

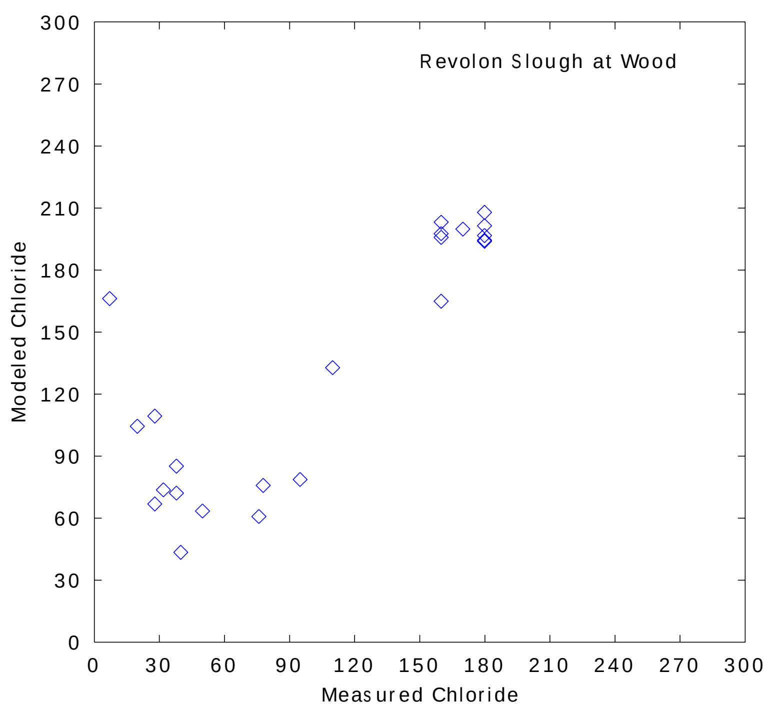

Figure 179: Measured vs. Modeled Chloride for Revolon Slough at Wood.

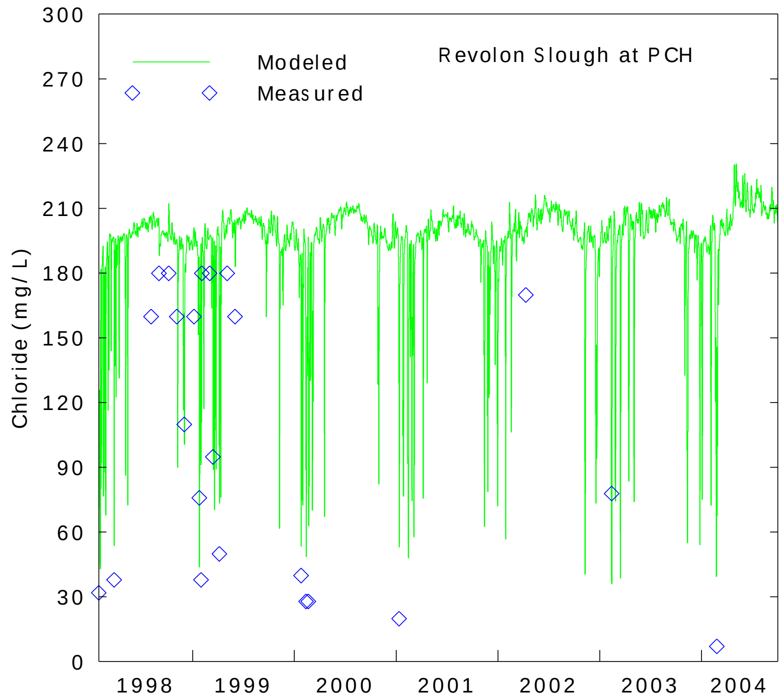

Figure 180: Measured and Modeled Chloride Time Series for Revolon Slough at PCH.

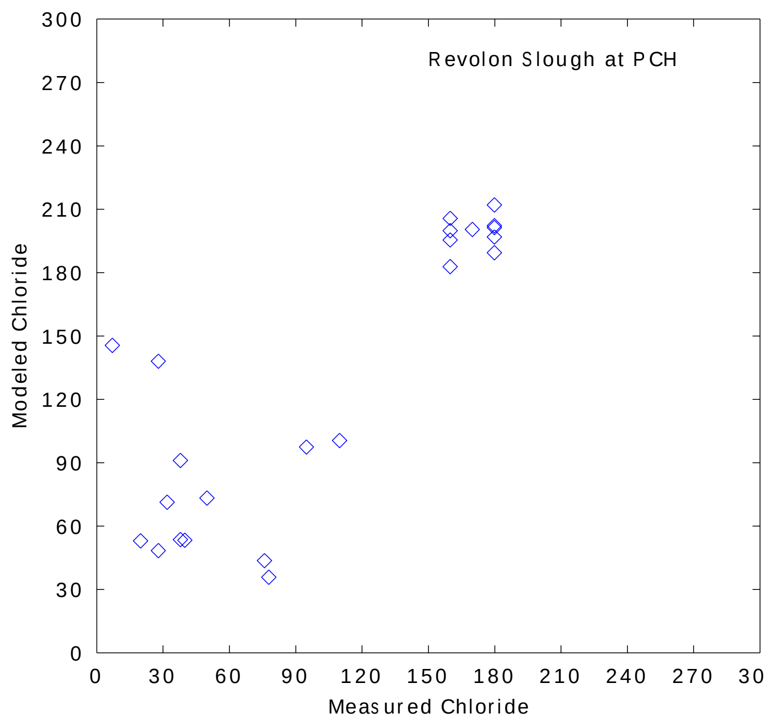

Figure 181: Measured vs. Modeled Chloride for Revolon Slough at PCH.

Copper

Total and dissolved copper calculations are compared to measured total copper in Figure 182 to Figure 201. The partitioning of copper is evaluated on a watershed-wide scale in Figure 202 to Figure 204.

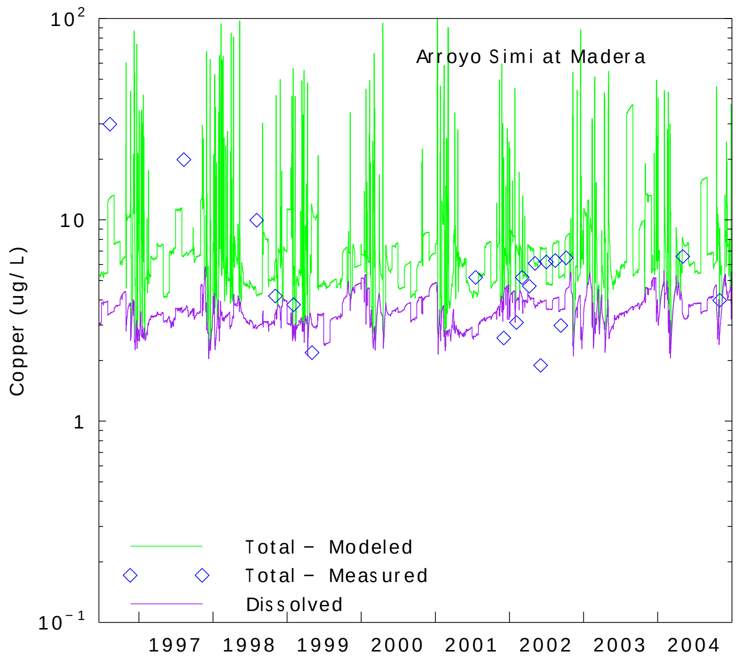

Figure 182: Measured and Modeled Copper Time Series for Arroyo Simi at Madera.

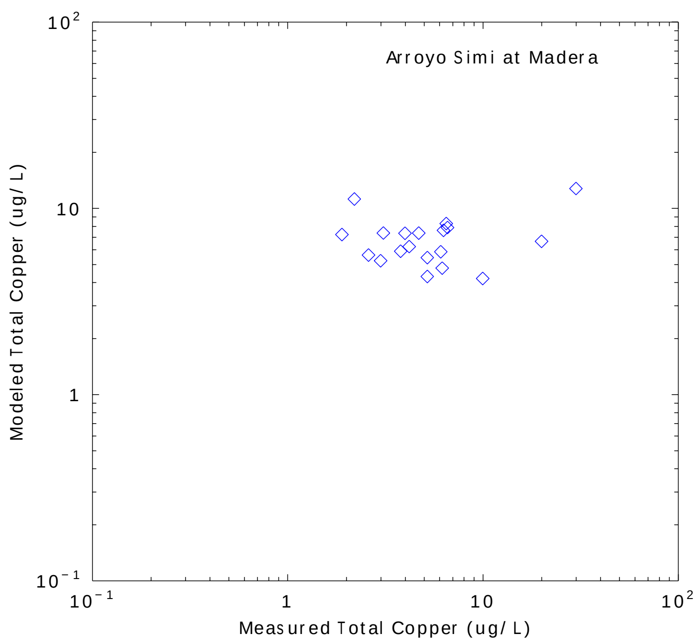

Figure 183: Measured vs. Modeled Copper for Arroyo Simi at Madera.

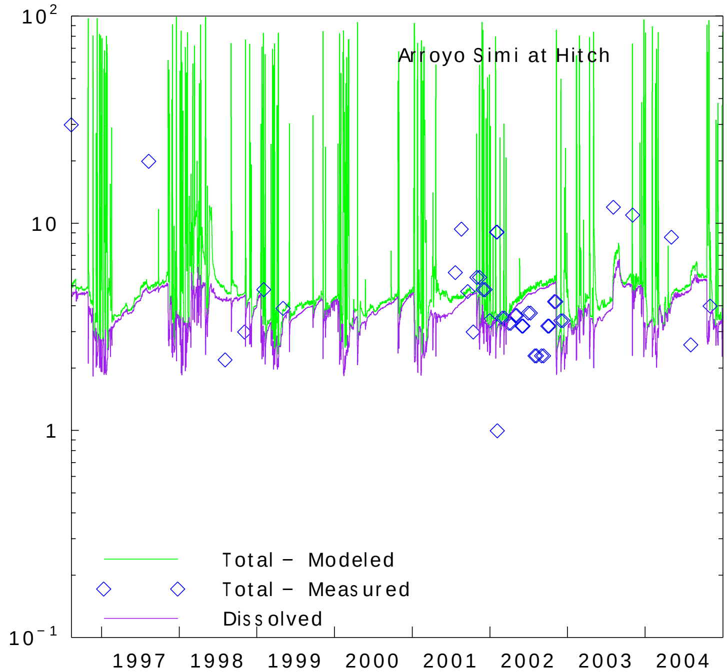

Figure 184: Measured and Modeled Copper Time Series for Arroyo Simi at Hitch.

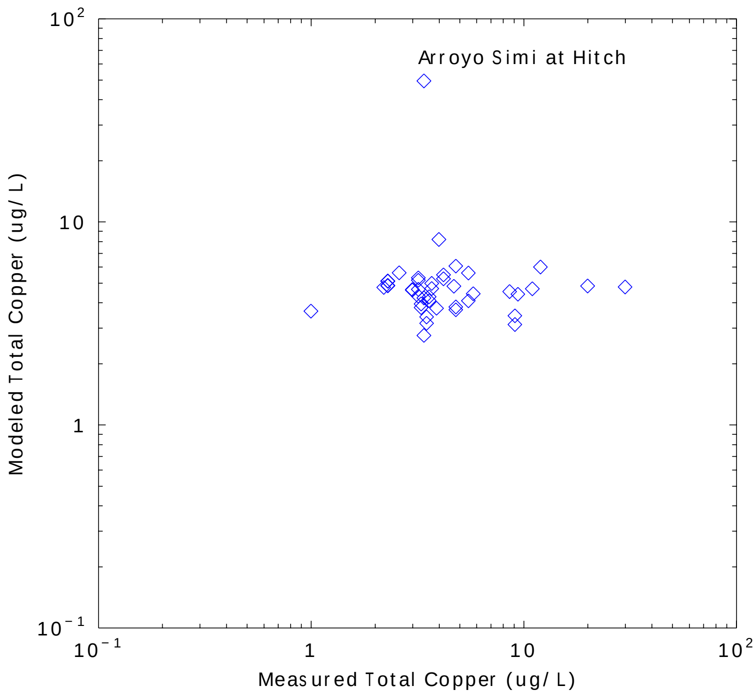

Figure 185: Measured vs. Modeled Copper for Arroyo Simi at Hitch.

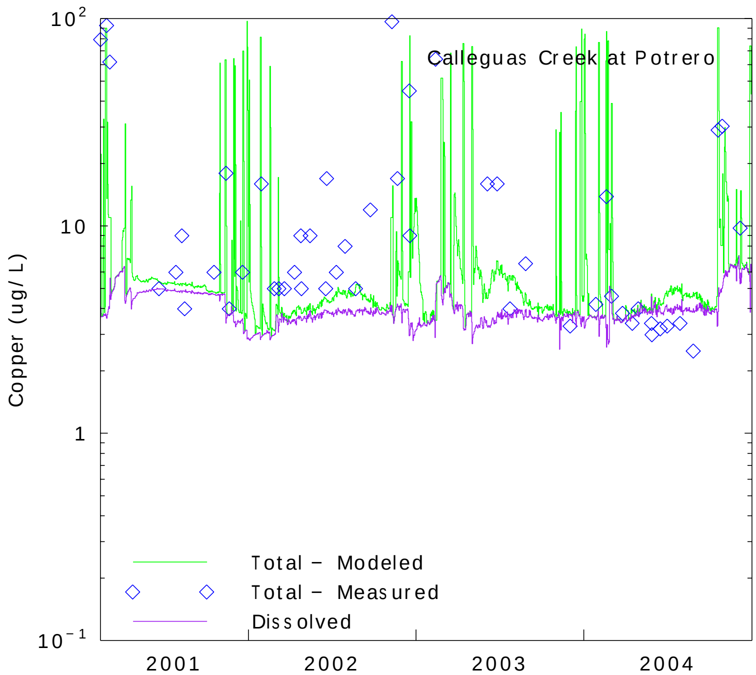

Figure 186: Measured and Modeled Copper Time Series for Calleguas Creek at Potrero.

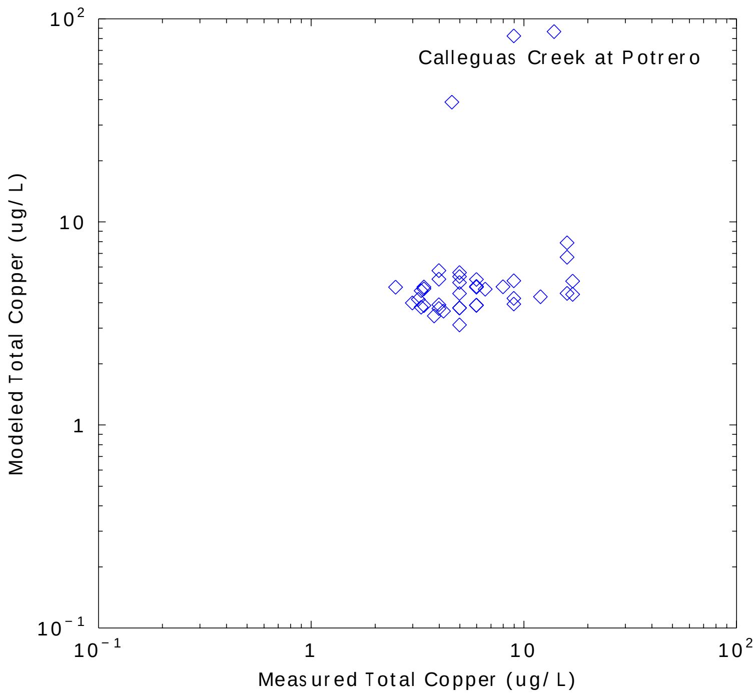

Figure 187: Measured vs. Modeled Copper for Calleguas Creek at Potrero.

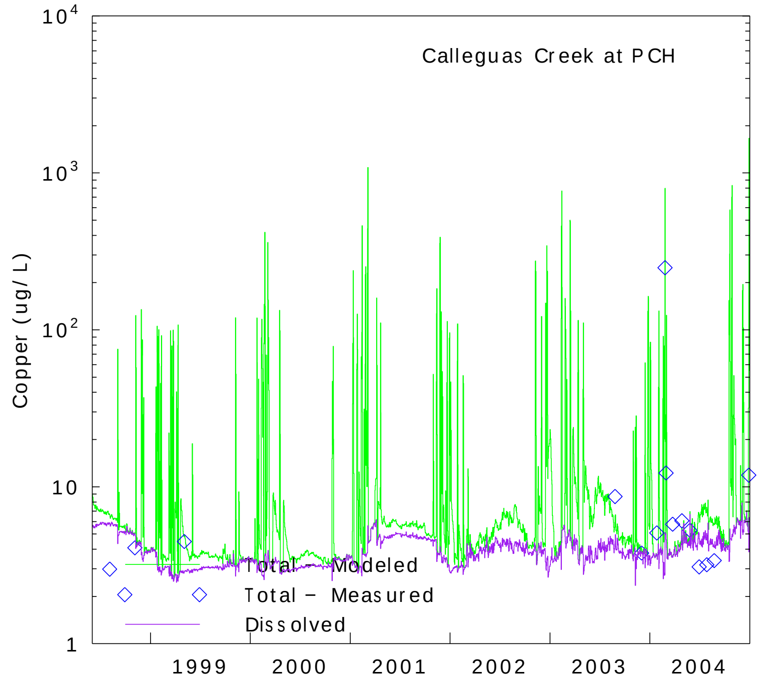

Figure 188: Measured and Modeled Copper Time Series for Calleguas Creek at PCH.

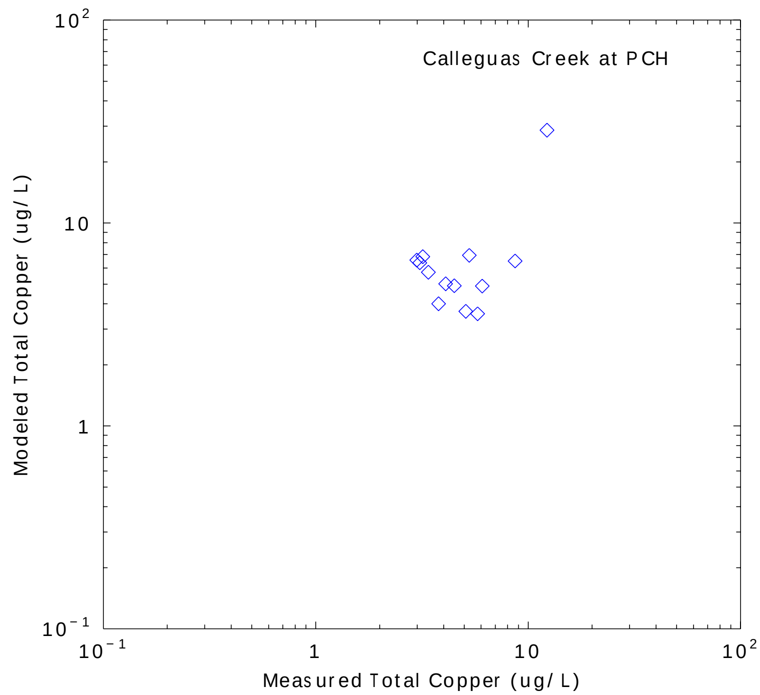

Figure 189: Measured vs. Modeled Copper for Calleguas Creek at PCH.

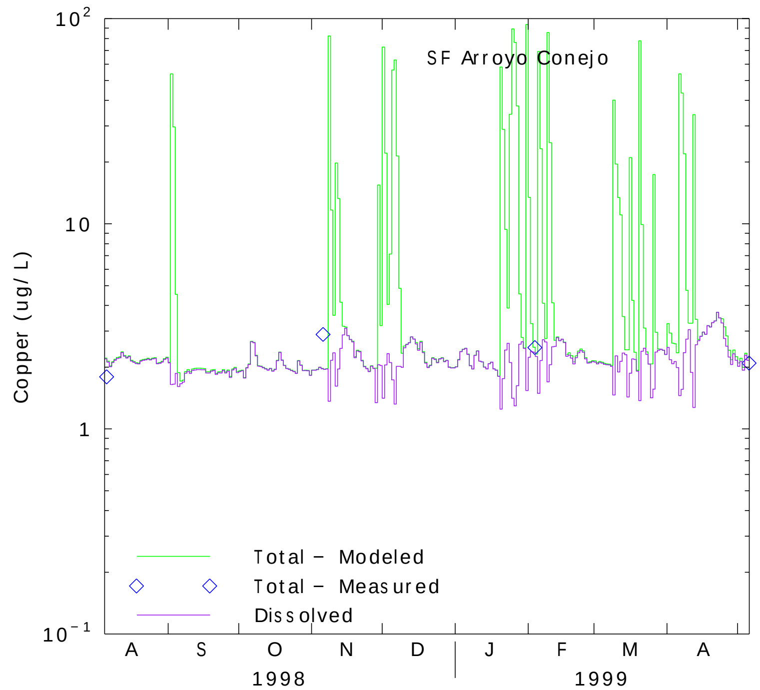

Figure 190: Measured and Modeled Copper Time Series for South Fork of Arroyo Conejo.

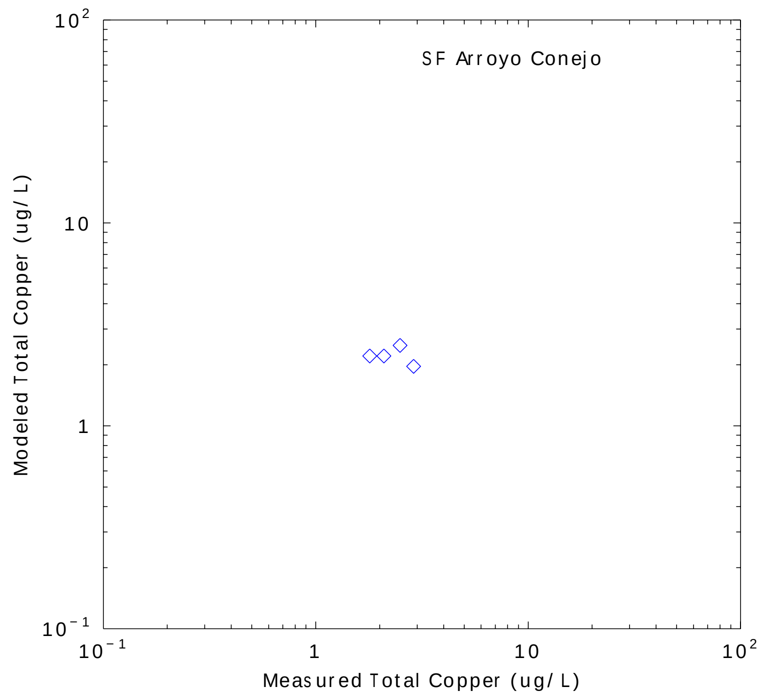

Figure 191: Measured vs. Modeled Copper for South Fork Arroyo Conejo.

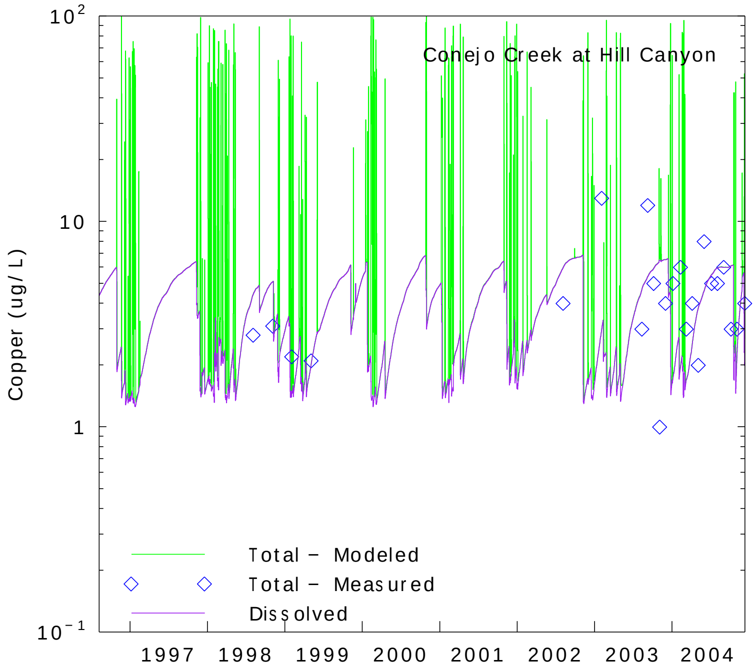

Figure 192: Measured and Modeled Copper Time Series for Conejo Creek at Hill Canyon.

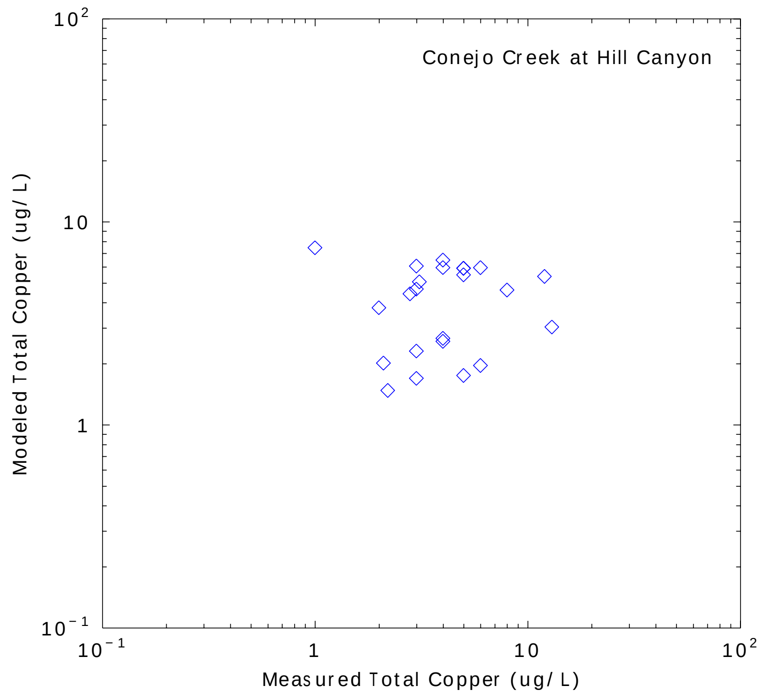

Figure 193: Measured vs. Modeled Copper for Conejo Creek at Hill Canyon.

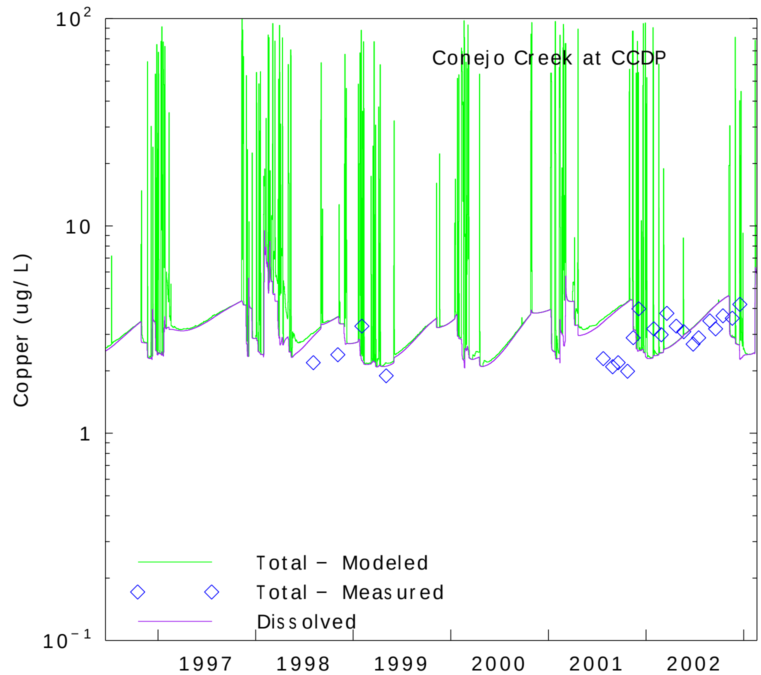

Figure 194: Measured and Modeled Copper Time Series for Conejo Creek at CCDP.

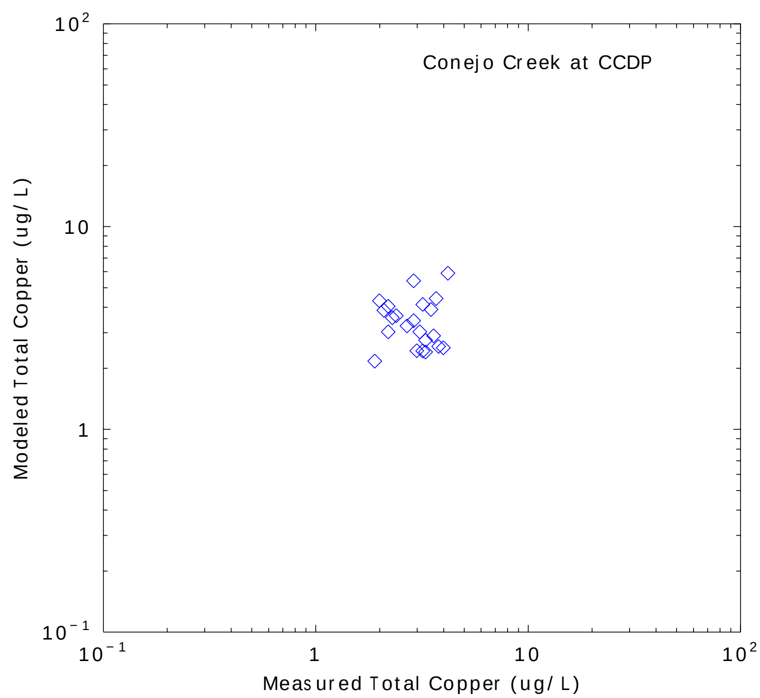

Figure 195: Measured vs. Modeled Copper for Conejo Creek at CCDP.

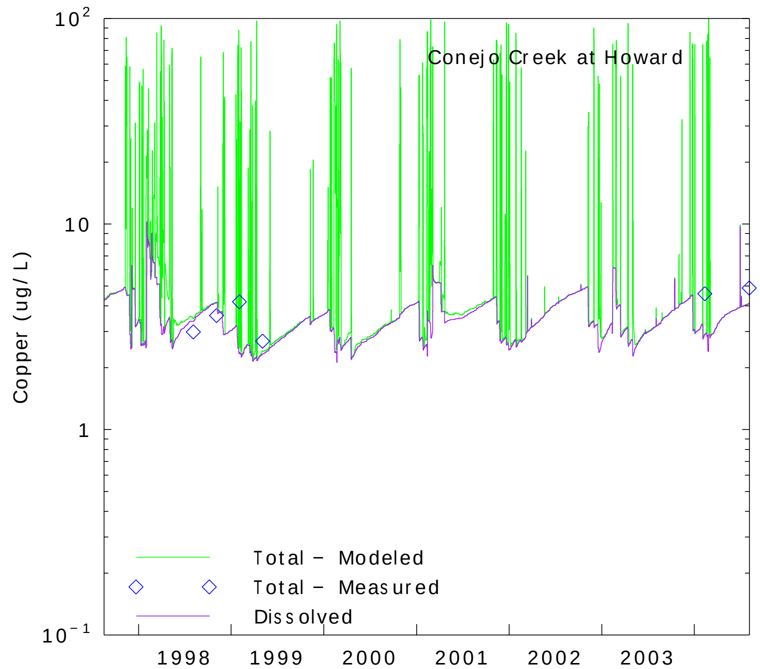

Figure 196: Measured and Modeled Copper Time Series for Conejo Creek at Howard.

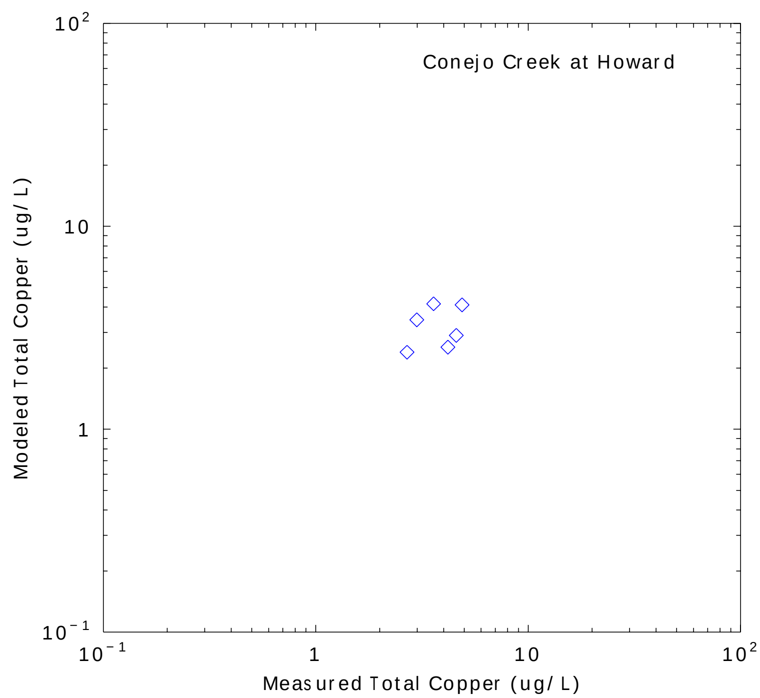

Figure 197: Measured vs. Modeled Copper for Conejo Creek at Howard.

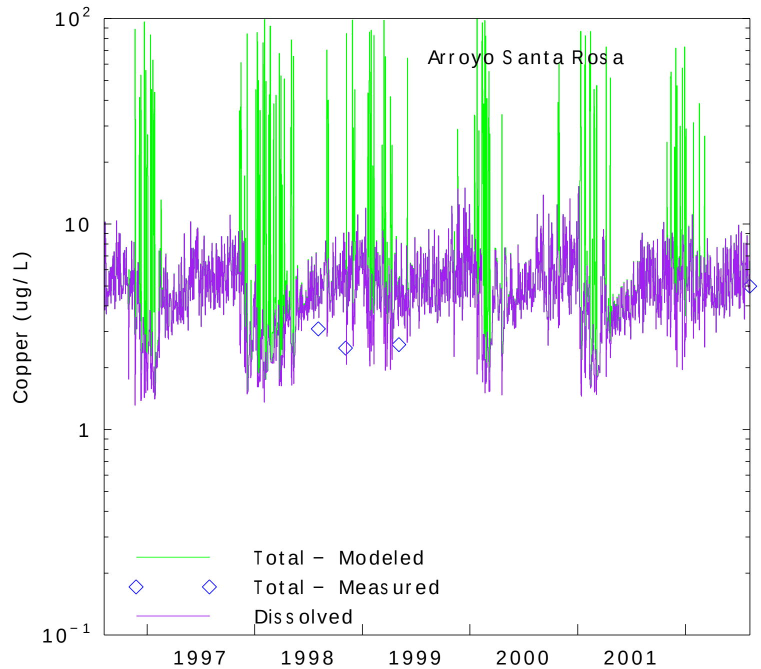

Figure 198: Measured and Modeled Copper Time Series for Arroyo Santa Rosa.

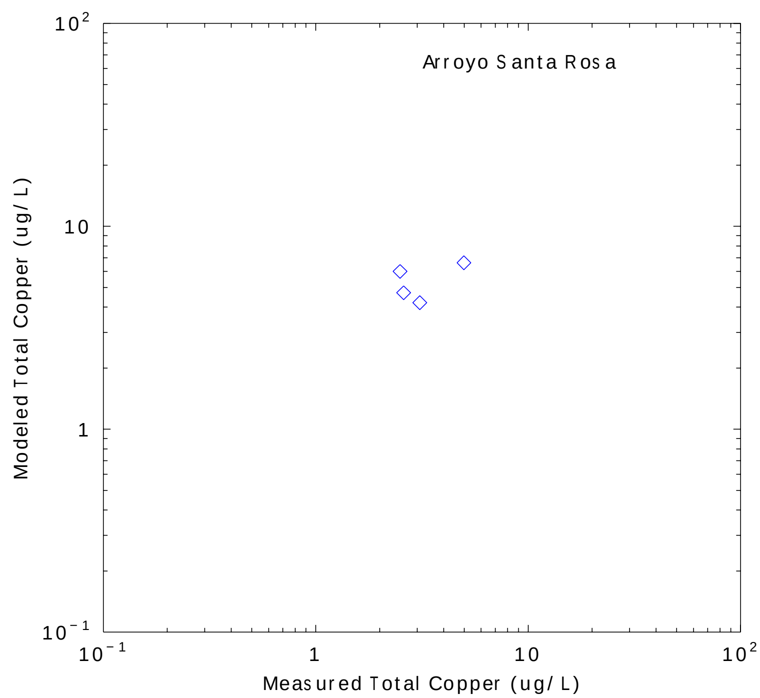

Figure 199: Measured vs. Modeled Copper for Arroyo Santa Rosa.

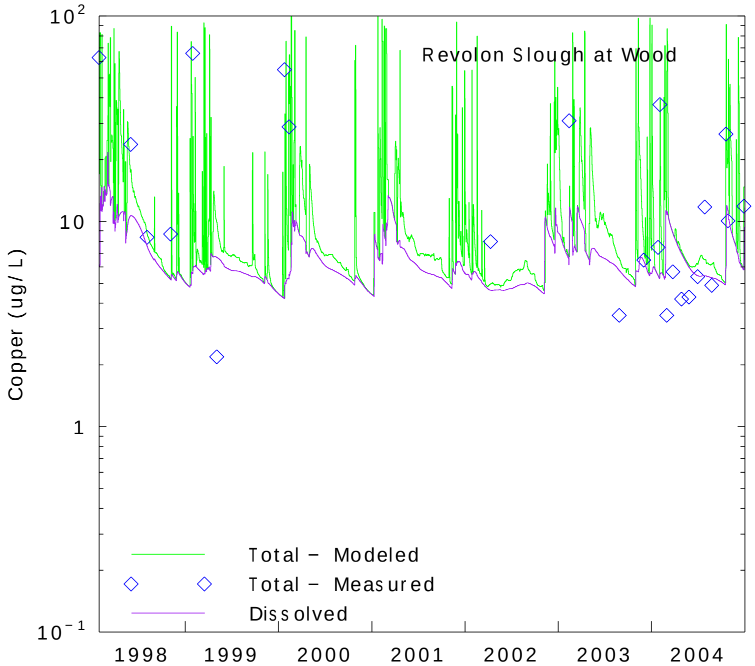

Figure 200: Measured and Modeled Copper Time Series for Revolon Slough at Wood.

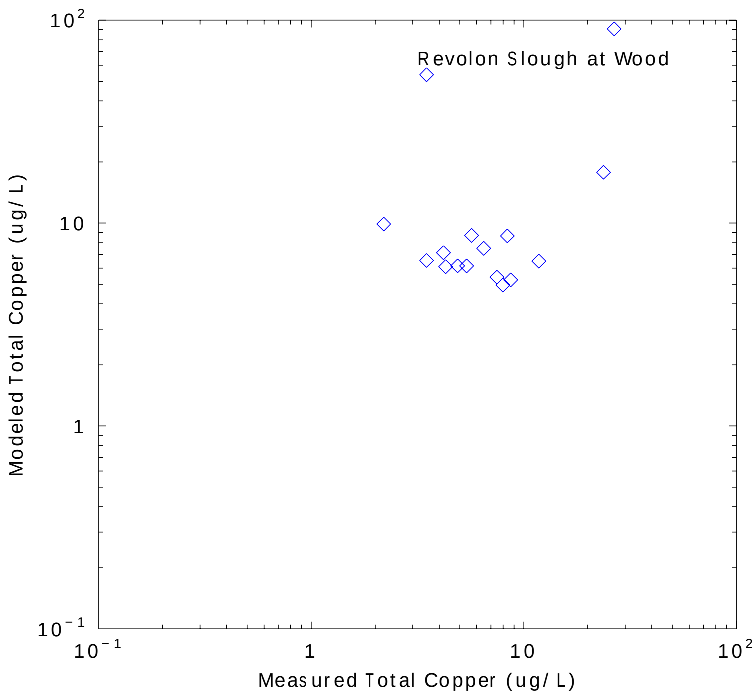

Figure 201: Measured vs. Modeled Copper for Revolon Slough at Wood.

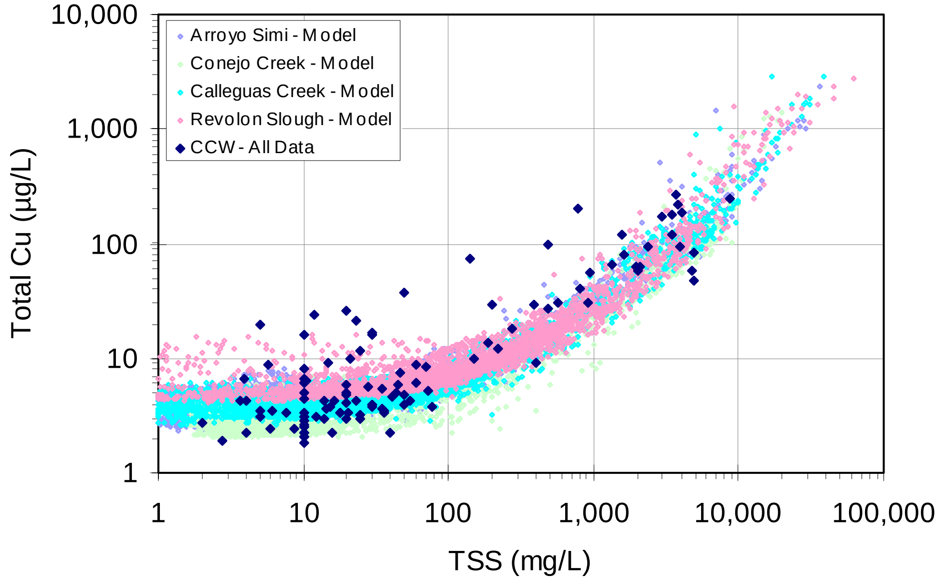

Figure 202: Total Copper as a Function of TSS for the Entire CCW.

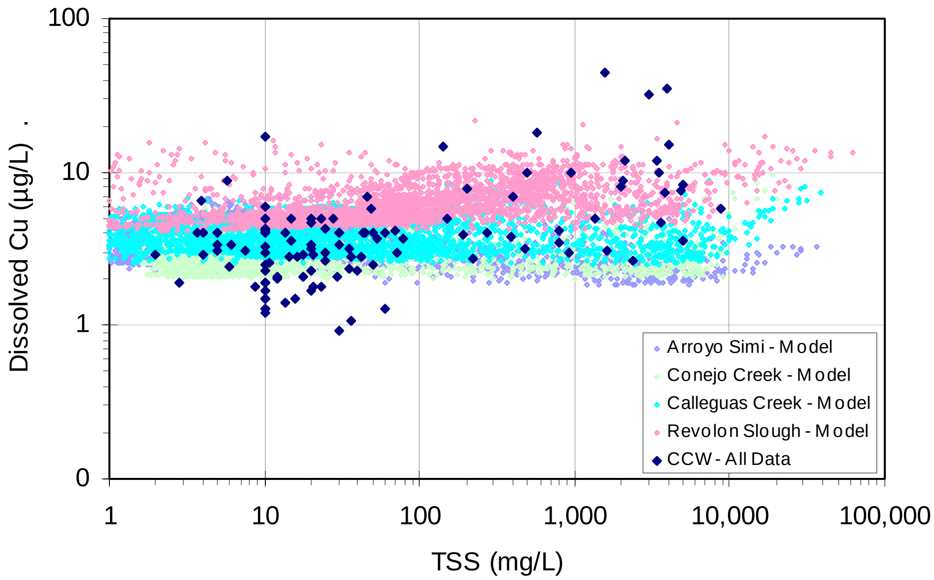

Figure 203: Dissolved Copper as a Function of TSS for the Entire CCW.

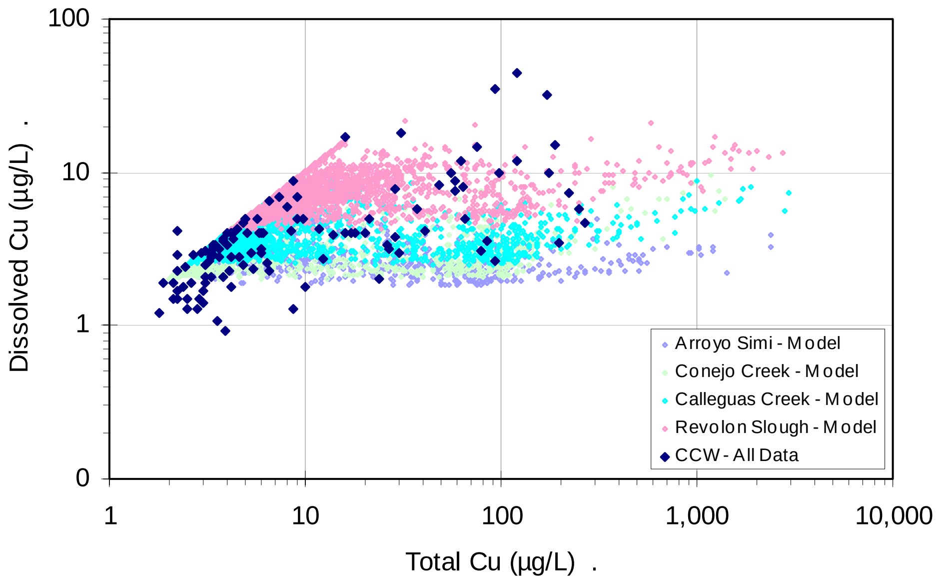

Figure 204: Dissolved Copper as a Function of Total Copper for the Entire CCW.

Nickel

Total and dissolved nickel calculations are compared to measured total nickel in Figure 182 to Figure 201. The partitioning of nickel is evaluated on a watershed-wide scale in Figure 225 to Figure 227.

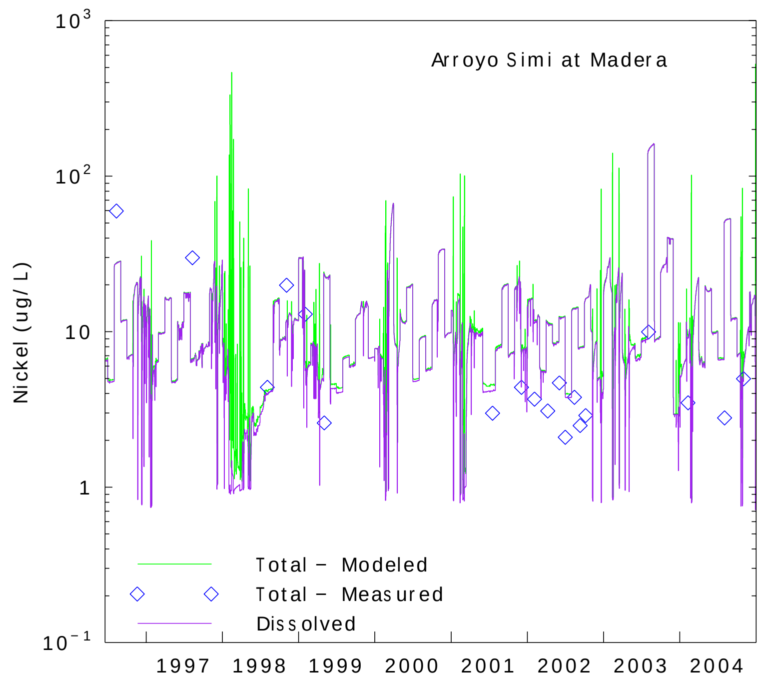

Figure 205: Measured and Modeled Nickel Time Series for Arroyo Simi at Madera.

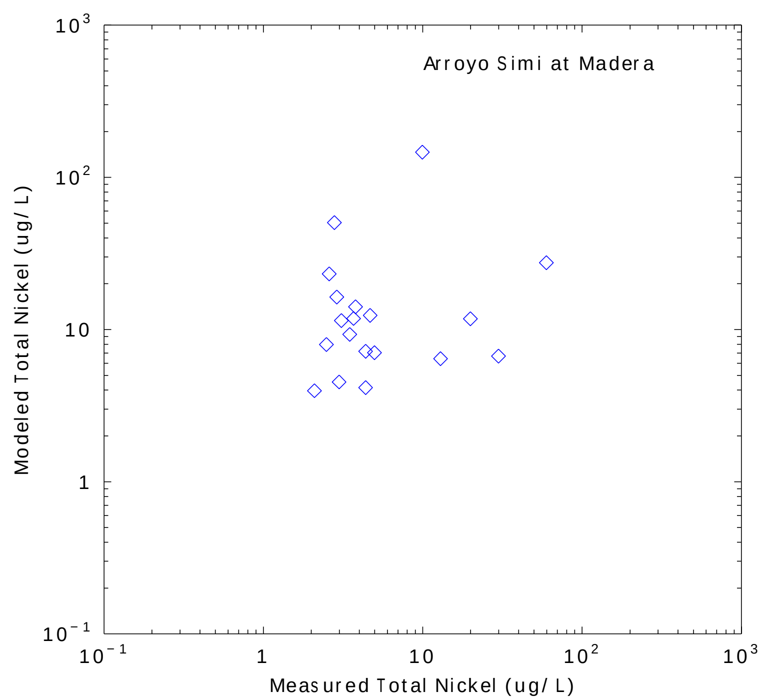

Figure 206: Measured vs. Modeled Nickel for Arroyo Simi at Madera.

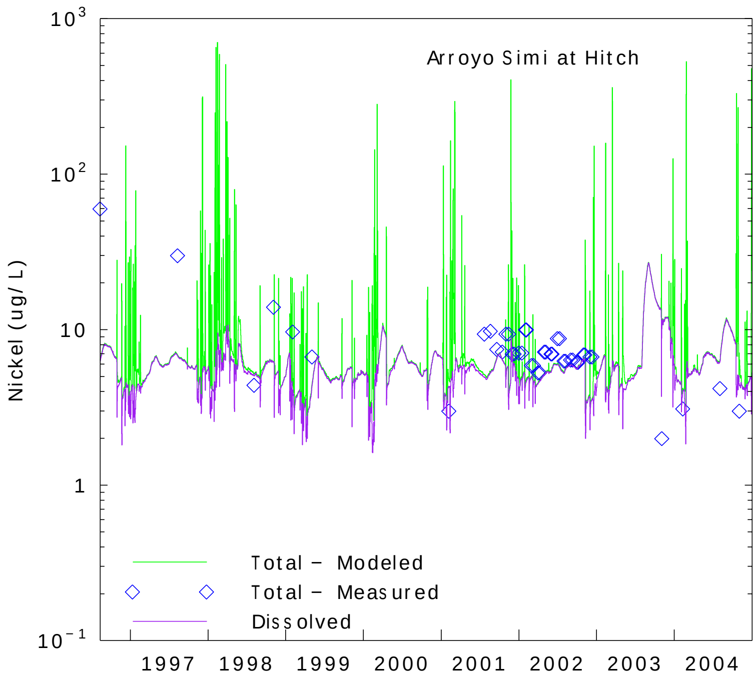

Figure 207: Measured and Modeled Nickel Time Series for Arroyo Simi at Hitch.

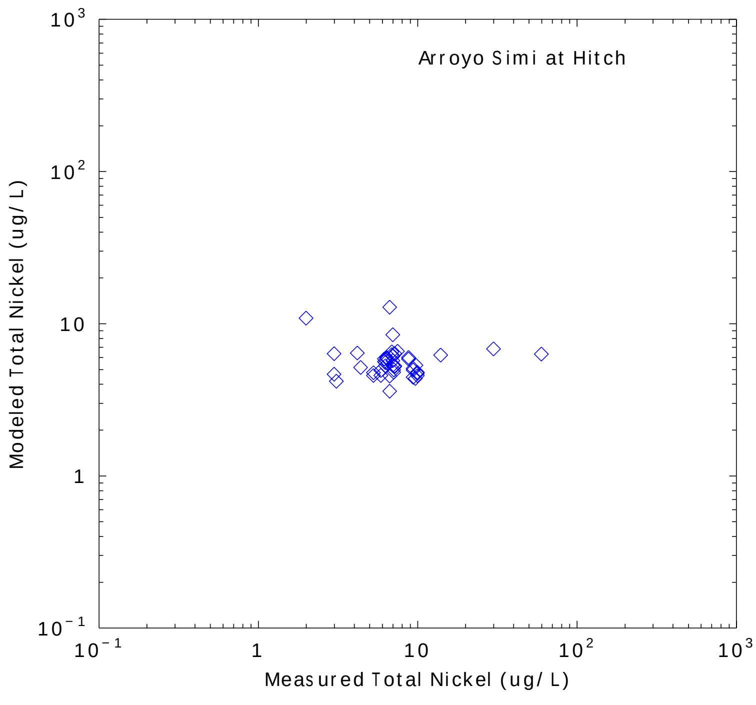

Figure 208: Measured vs. Modeled Nickel for Arroyo Simi at Hitch.

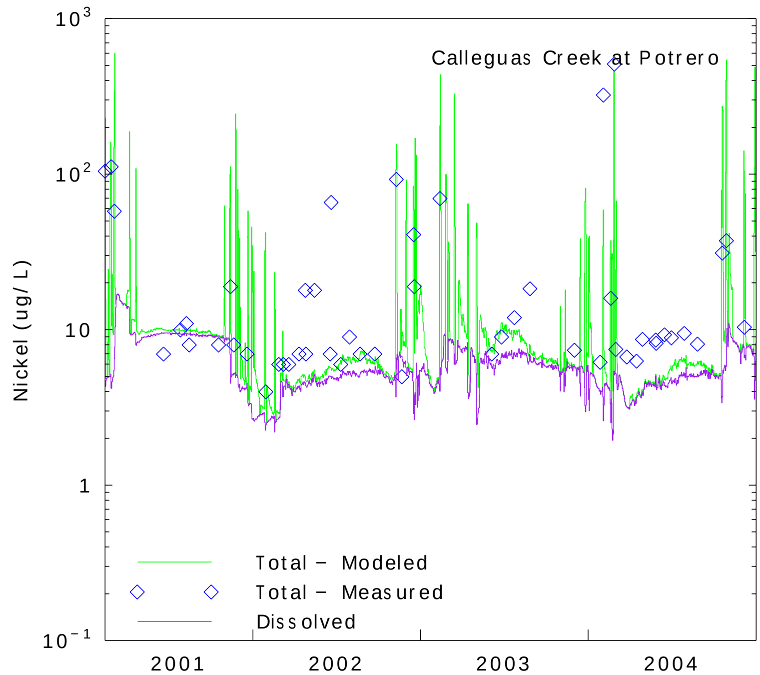

Figure 209: Measured and Modeled Nickel Time Series for Calleguas Creek at Potrero.

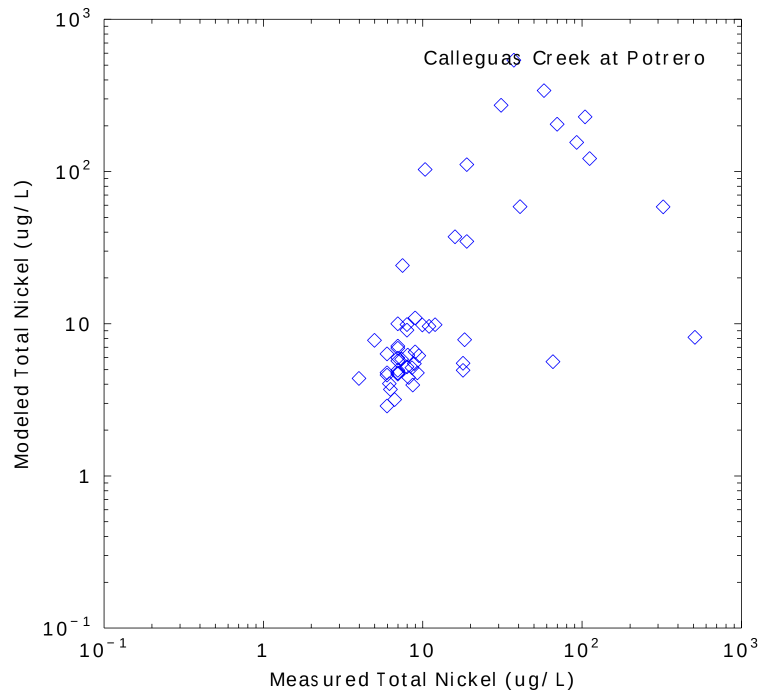

Figure 210: Measured vs. Modeled Nickel for Calleguas Creek at Potrero.

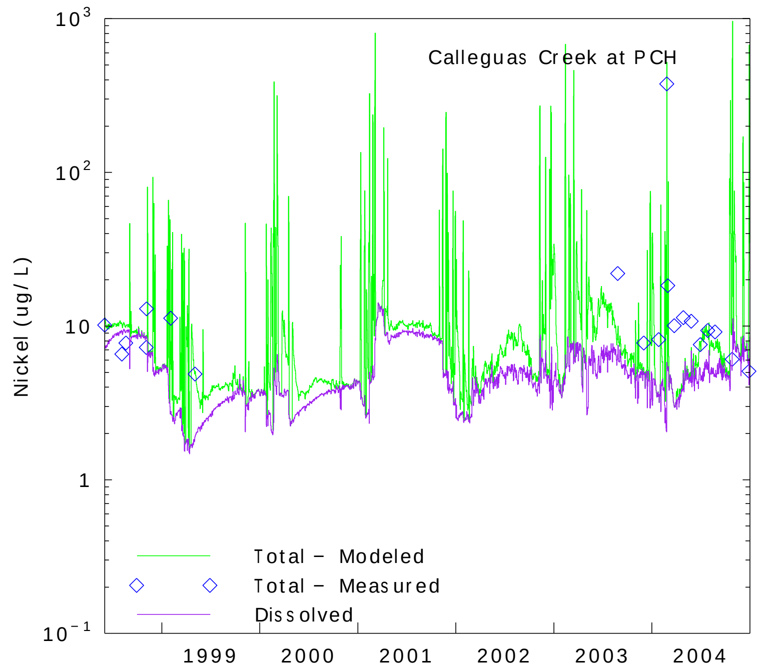

Figure 211: Measured and Modeled Nickel Time Series for Calleguas Creek at PCH.

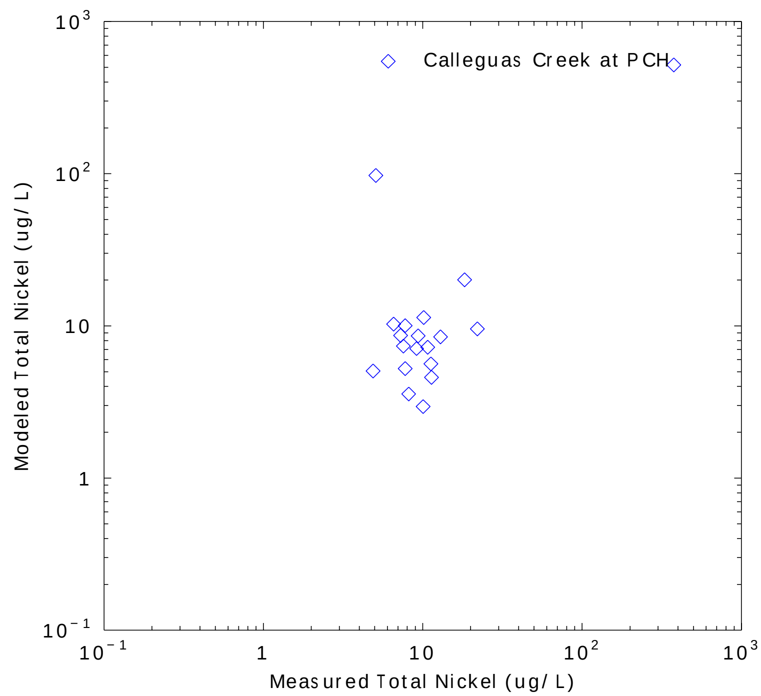

Figure 212: Measured vs. Modeled Nickel for Calleguas Creek at PCH.

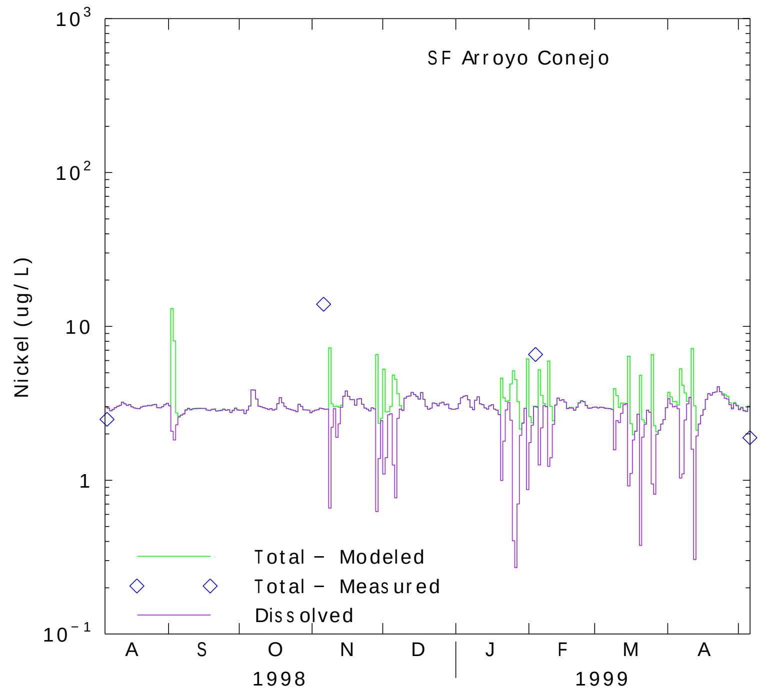

Figure 213: Measured and Modeled Nickel Time Series for South Fork of Arroyo Conejo.

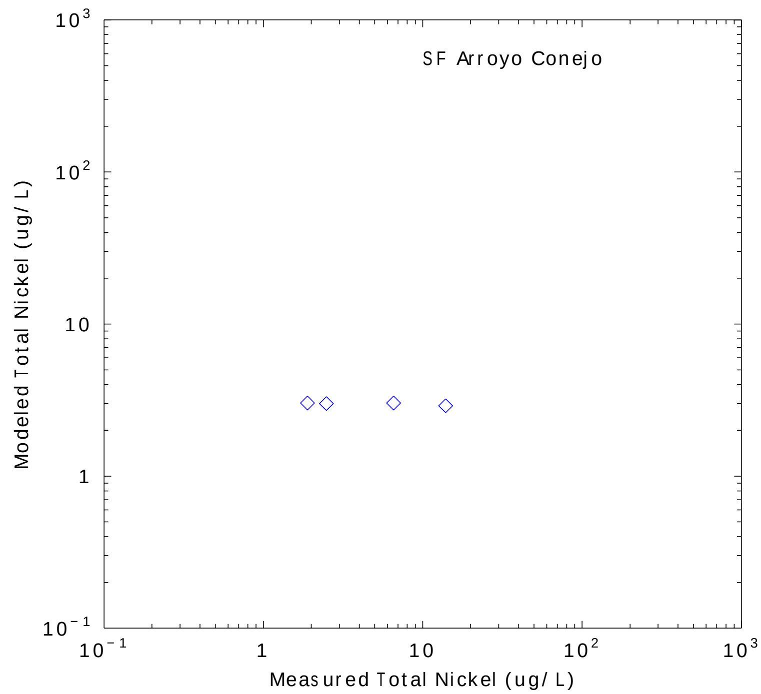

Figure 214: Measured vs. Modeled Nickel for South Fork Arroyo Conejo.

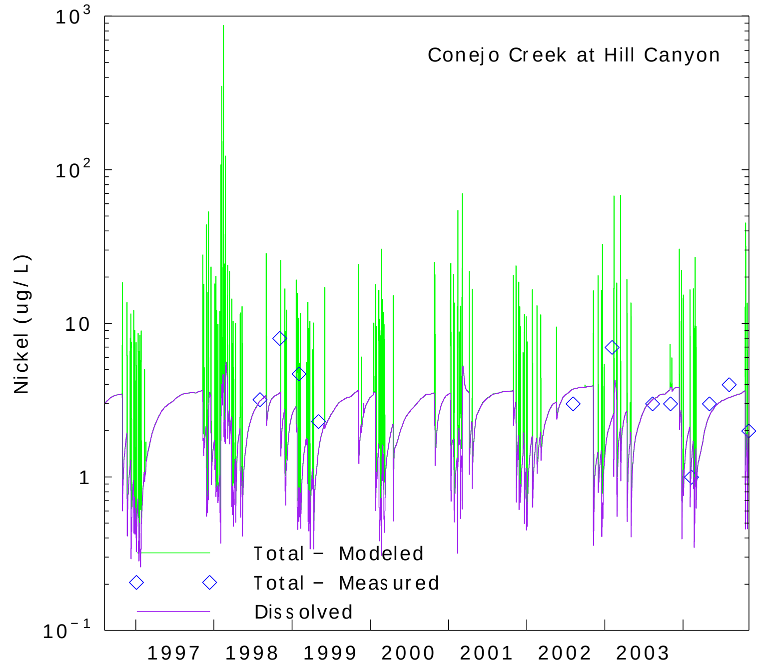

Figure 215: Measured and Modeled Nickel Time Series for Conejo Creek at Hill Canyon.

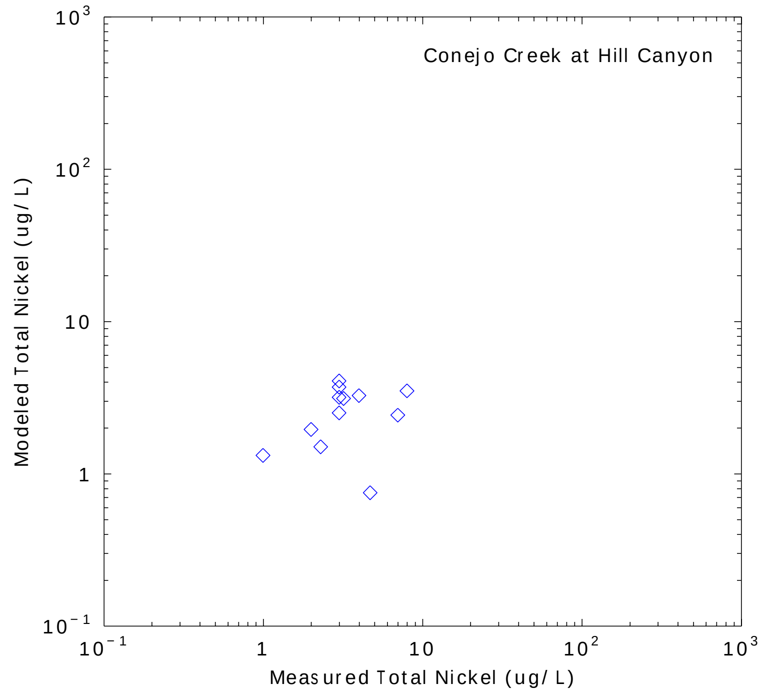

Figure 216: Measured vs. Modeled Nickel for Conejo Creek at Hill Canyon.

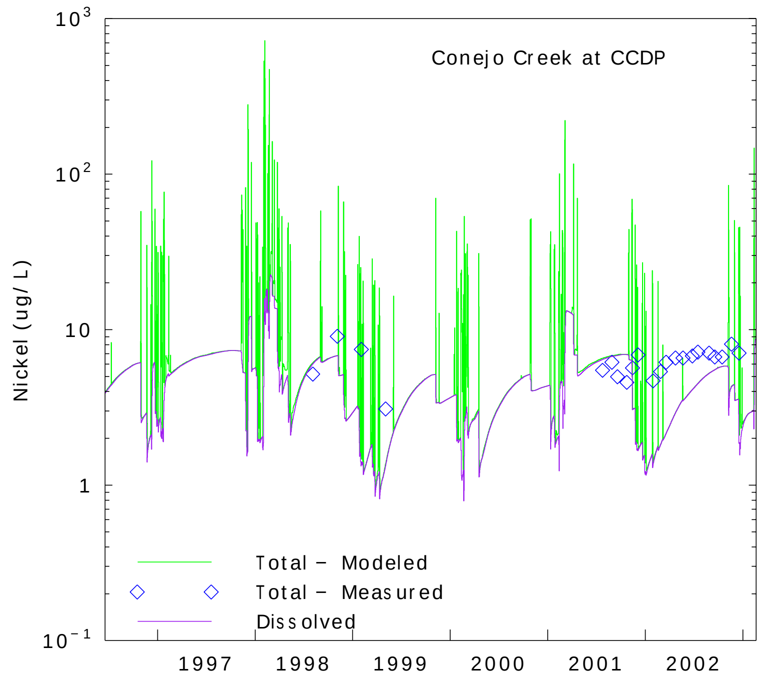

Figure 217: Measured and Modeled Nickel Time Series for Conejo Creek at CCDP.

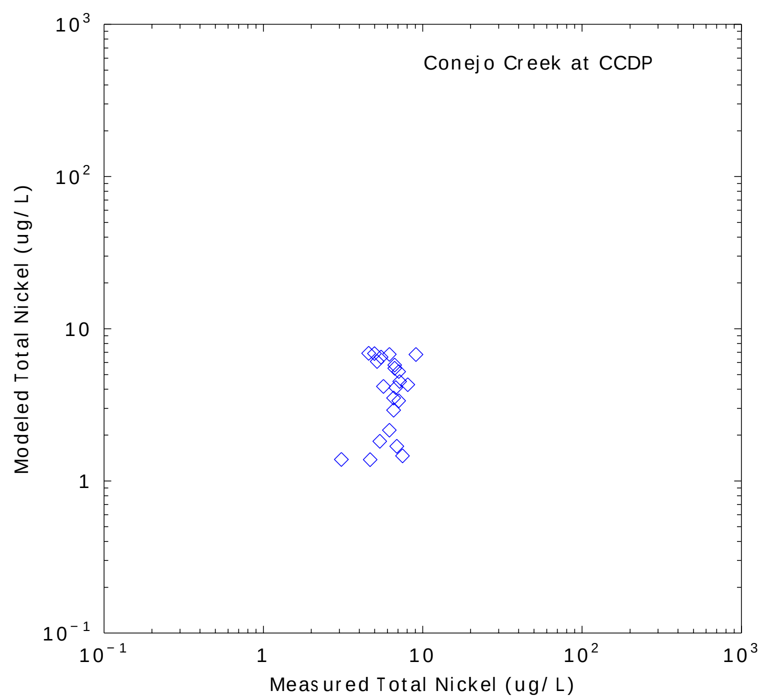

Figure 218: Measured vs. Modeled Nickel for Conejo Creek at CCDP.

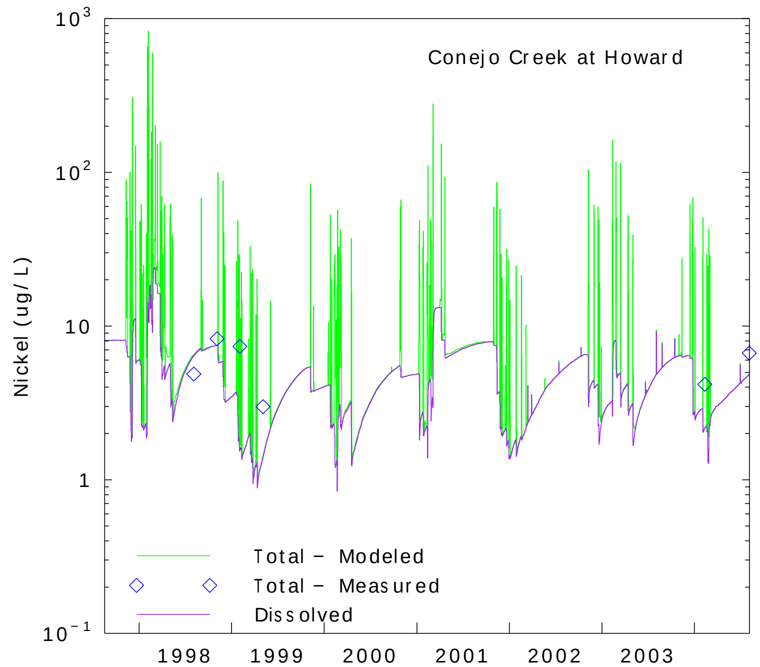

Figure 219: Measured and Modeled Nickel Time Series for Conejo Creek at Howard.

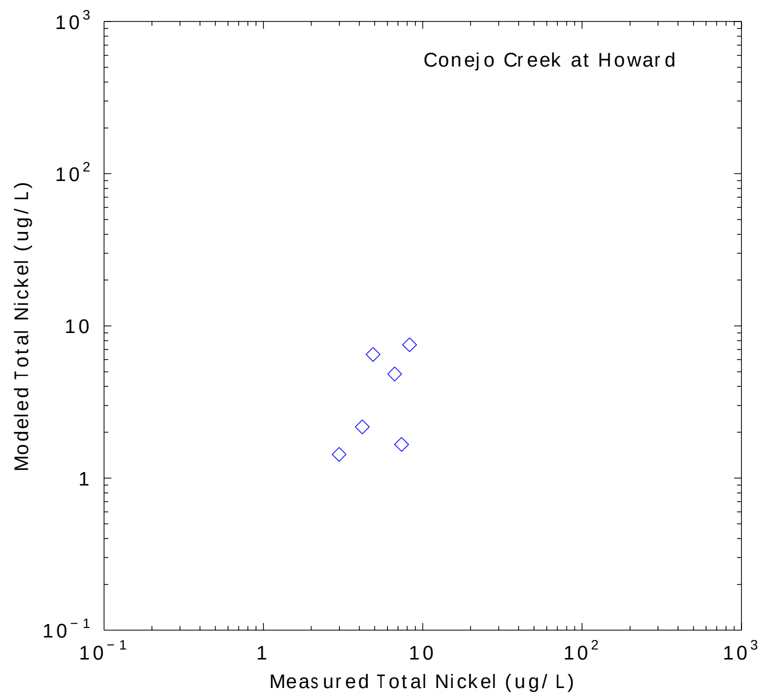

Figure 220: Measured vs. Modeled Nickel for Conejo Creek at Howard.

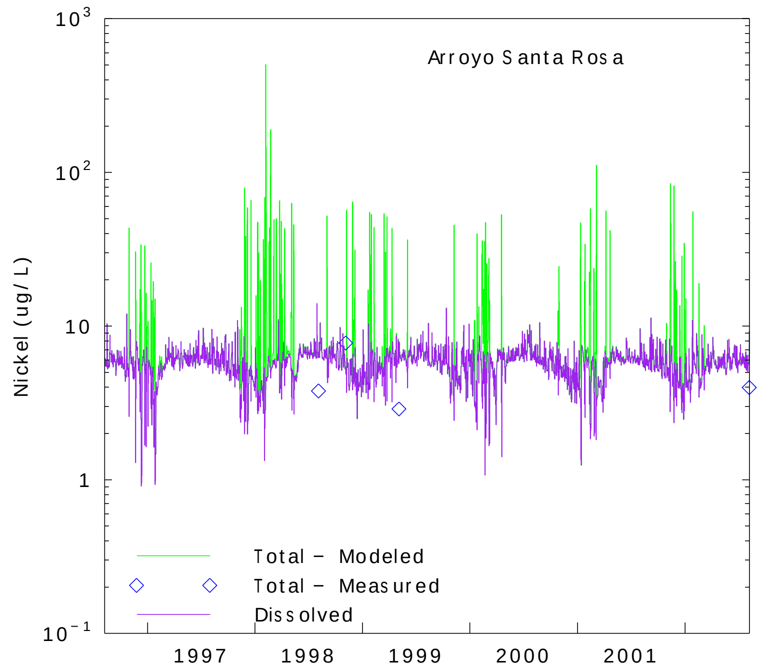

Figure 221: Measured and Modeled Nickel Time Series for Arroyo Santa Rosa.

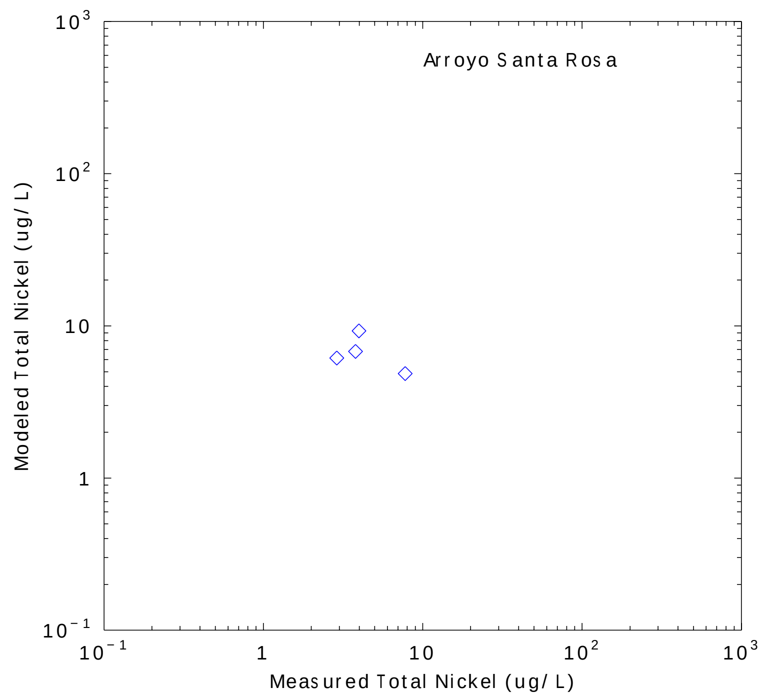

Figure 222: Measured vs. Modeled Nickel for Arroyo Santa Rosa.

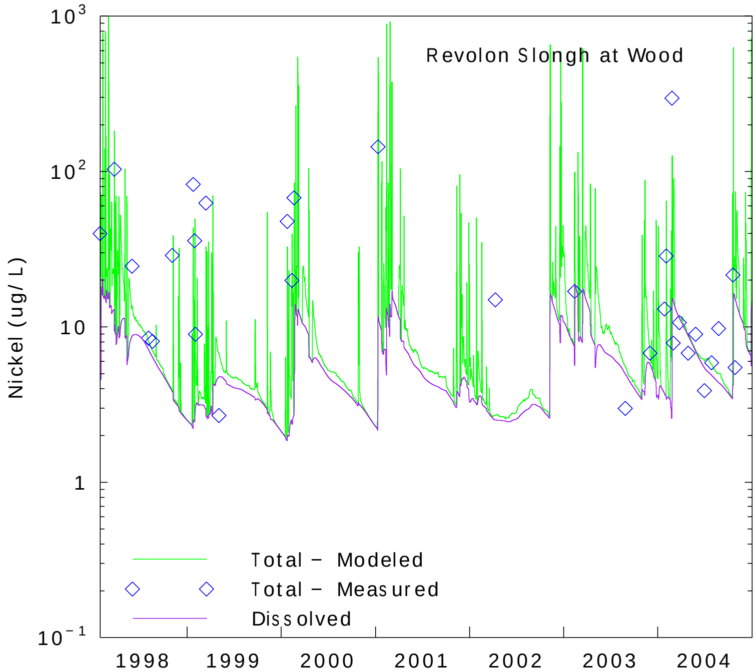

Figure 223: Measured and Modeled Nickel Time Series for Revolon Slough at Wood.

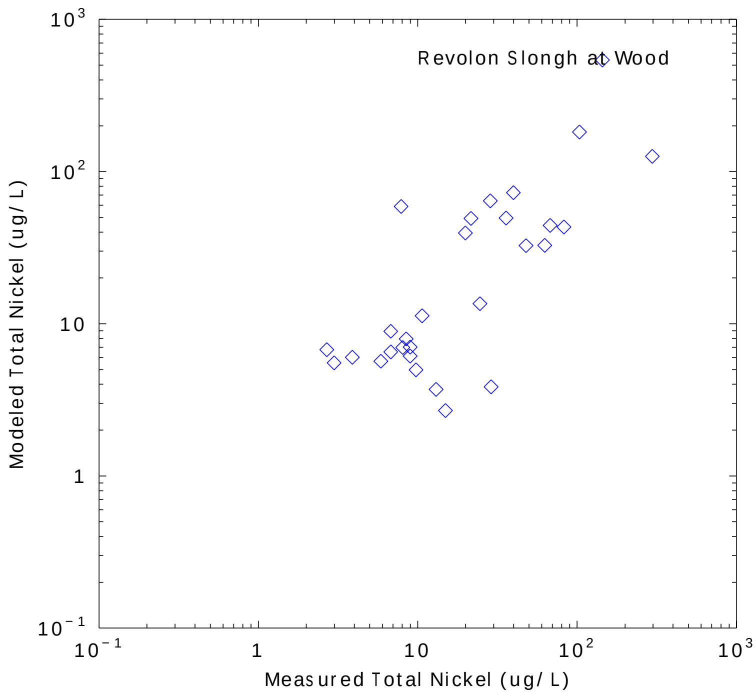

Figure 224: Measured vs. Modeled Nickel for Revolon Slough at Wood.

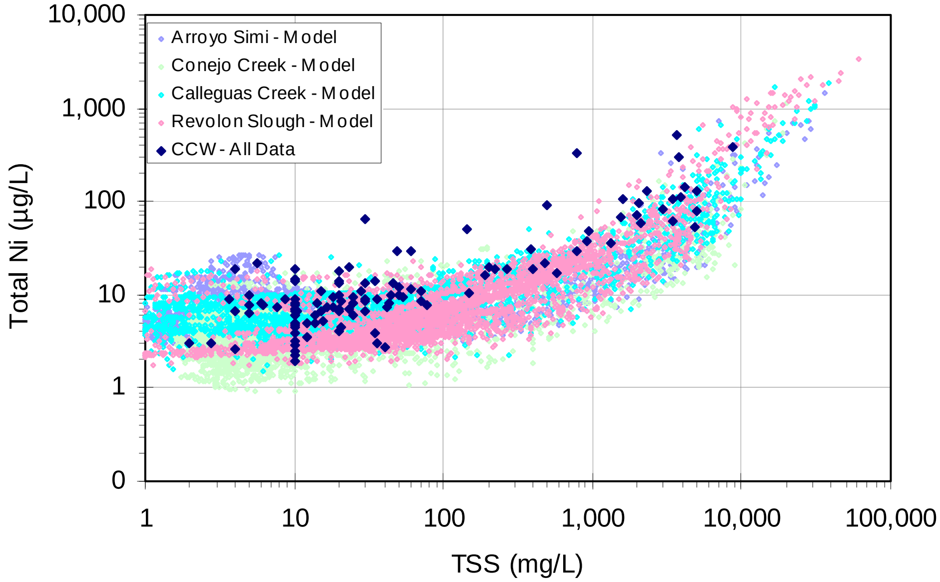

Figure 225: Total Nickel as a Function of TSS for the Entire CCW.

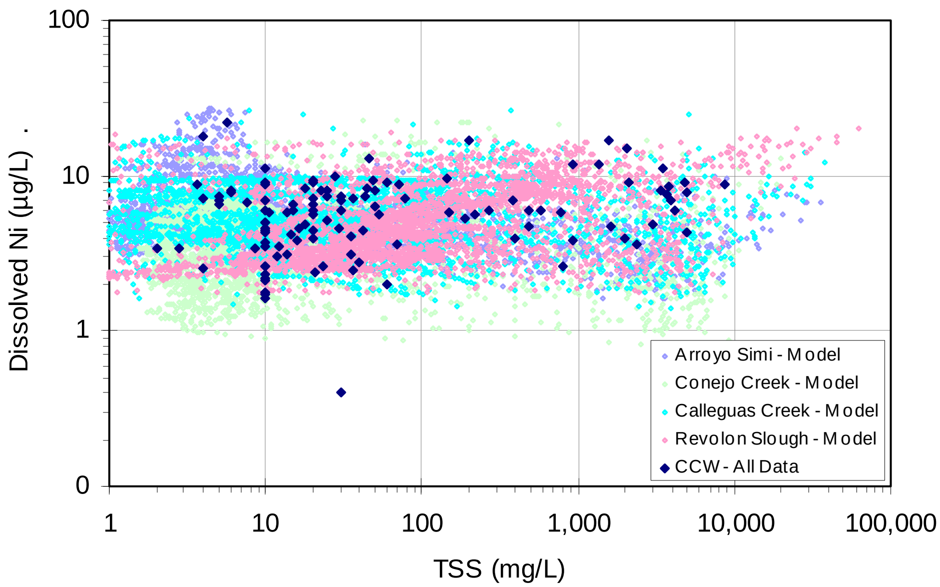

Figure 226: Dissolved Nickel as a Function of TSS for the Entire CCW.

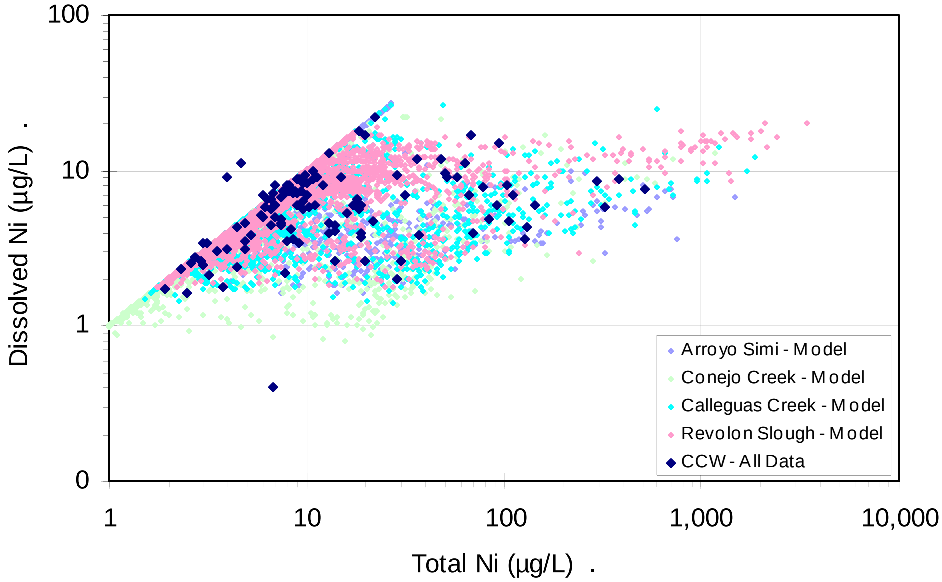

Figure 227: Dissolved Nickel as a Function of Total Nickel for the Entire CCW.

Mercury

Total and dissolved mercury calculations are compared as time series and as paired values to measured total mercury concentrations in Figure 228 to Figure 247. The partitioning of mercury is evaluated on a watershed-wide scale in Figure 248 to Figure 250.

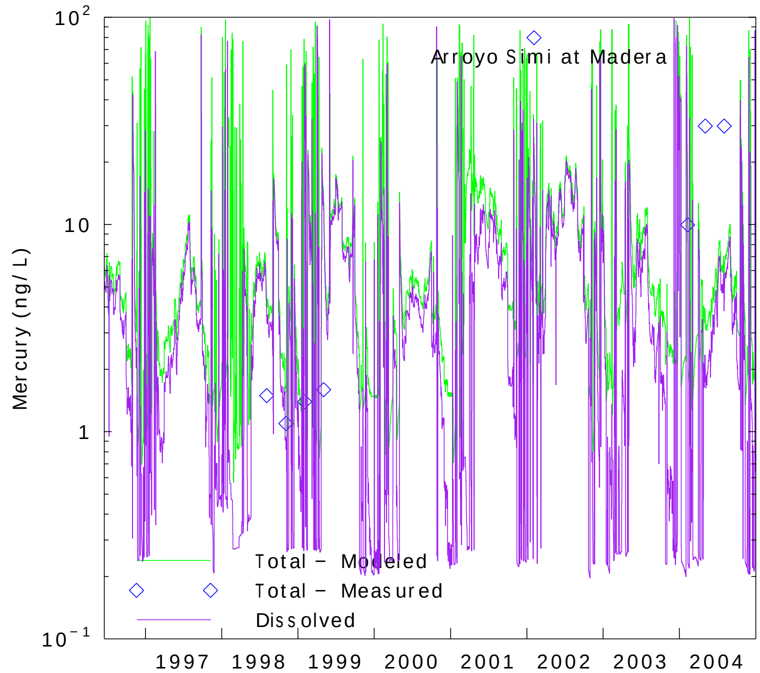

Figure 228: Measured and Modeled Mercury Time Series for Arroyo Simi at Madera.

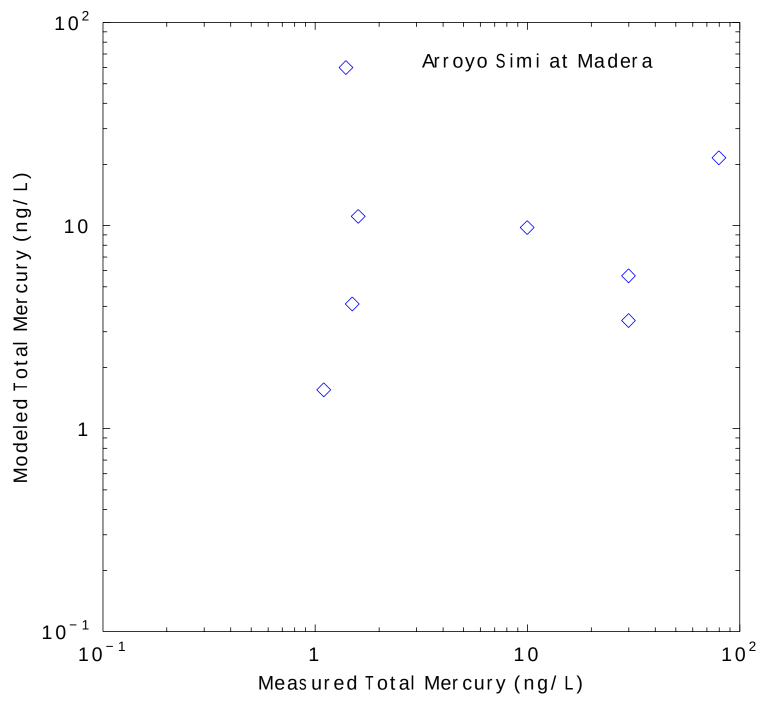

Figure 229: Measured vs. Modeled Mercury for Arroyo Simi at Madera.

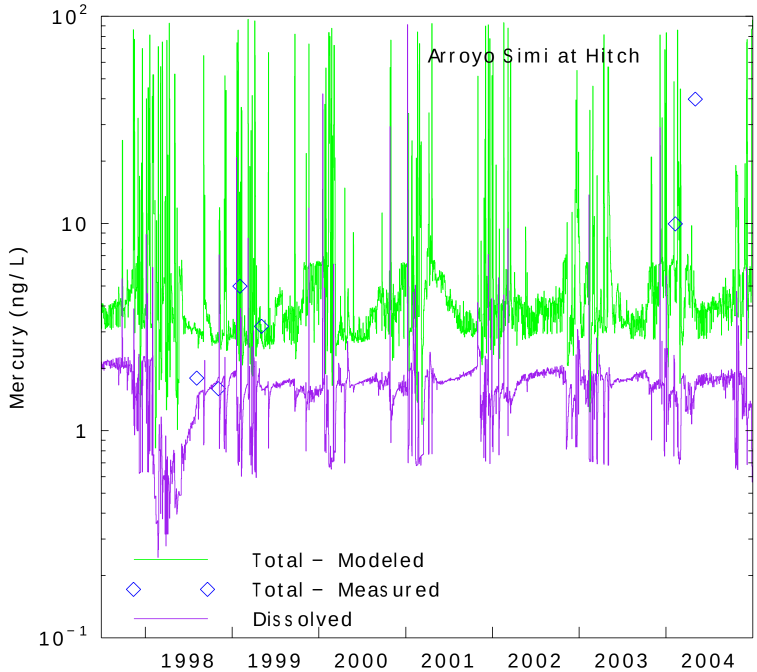

Figure 230: Measured and Modeled Mercury Time Series for Arroyo Simi at Hitch.

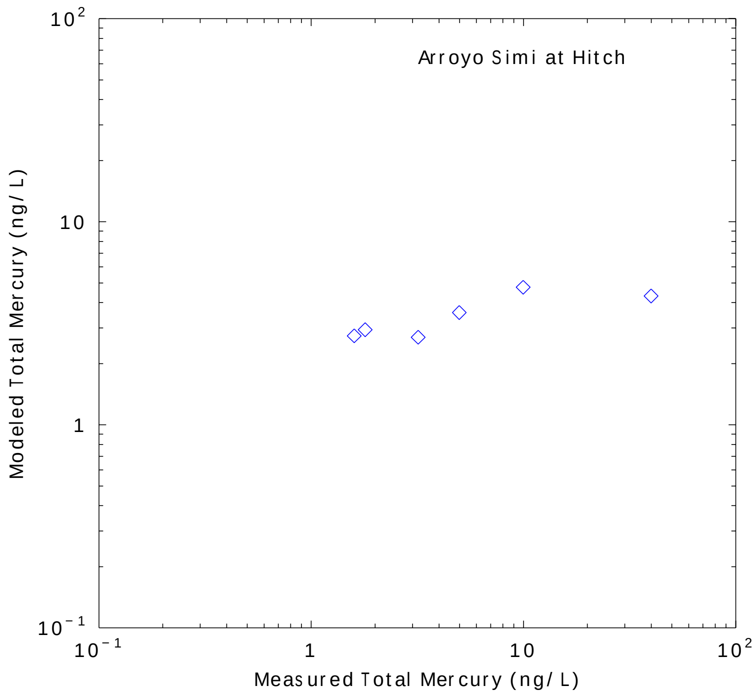

Figure 231: Measured vs. Modeled Mercury for Arroyo Simi at Hitch.

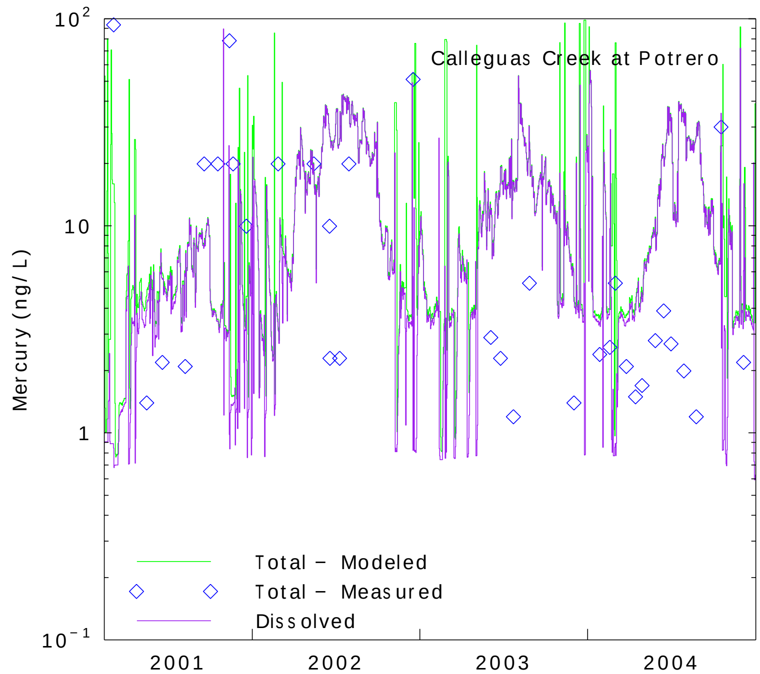

Figure 232: Measured and Modeled Mercury Time Series for Calleguas Creek at Potrero.

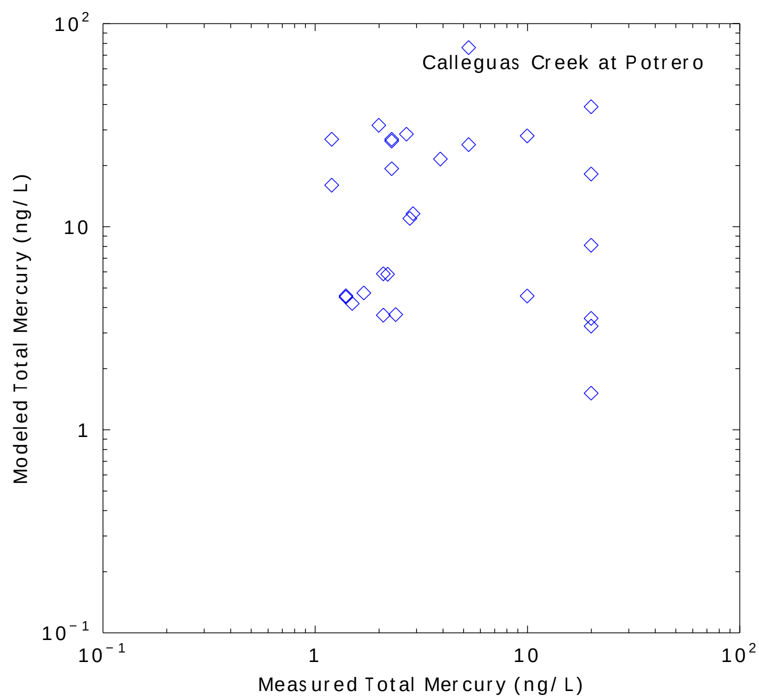

Figure 233: Measured vs. Modeled Mercury for Calleguas Creek at Potrero.

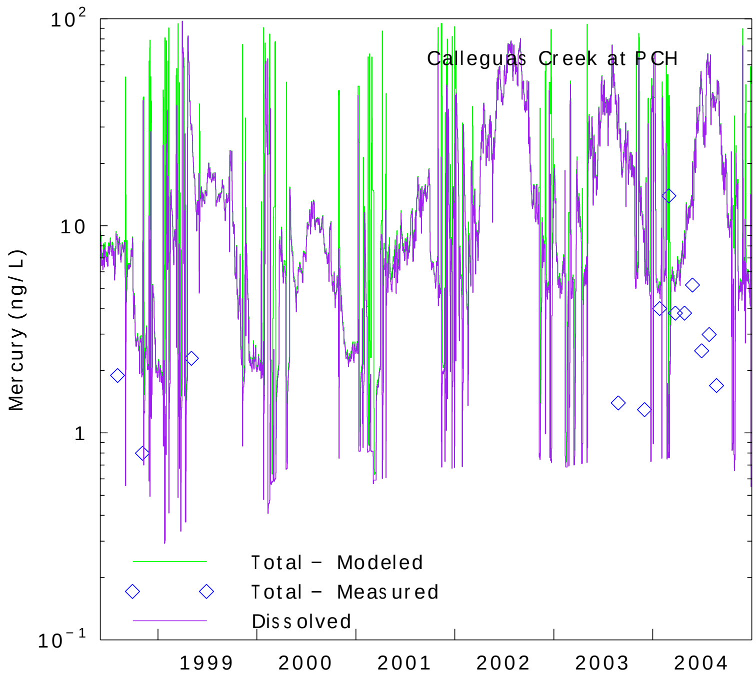

Figure 234: Measured and Modeled Mercury Time Series for Calleguas Creek at PCH.

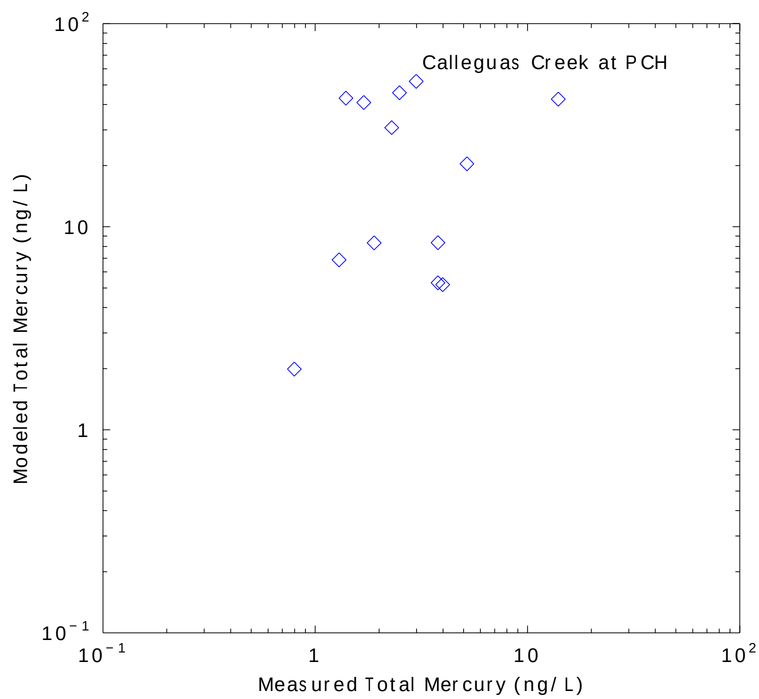

Figure 235: Measured vs. Modeled Mercury for Calleguas Creek at PCH.

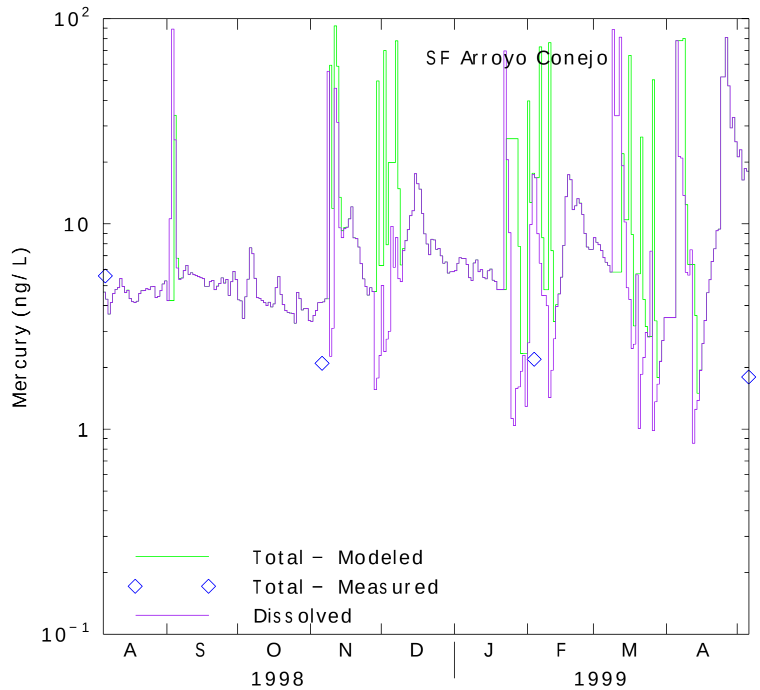

Figure 236: Measured and Modeled Mercury Time Series for South Fork Arroyo Conejo.

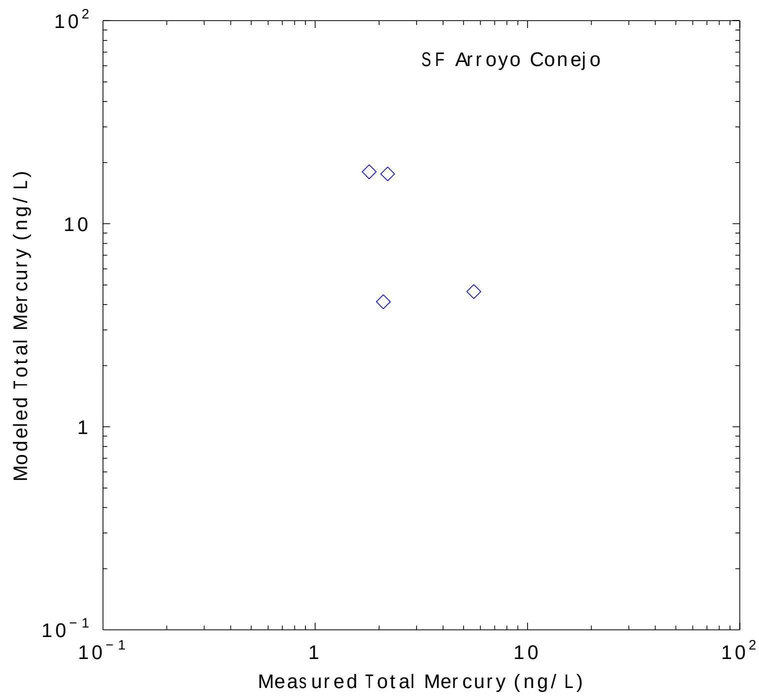

Figure 237: Measured vs. Modeled Mercury for South Fork Arroyo Conejo.

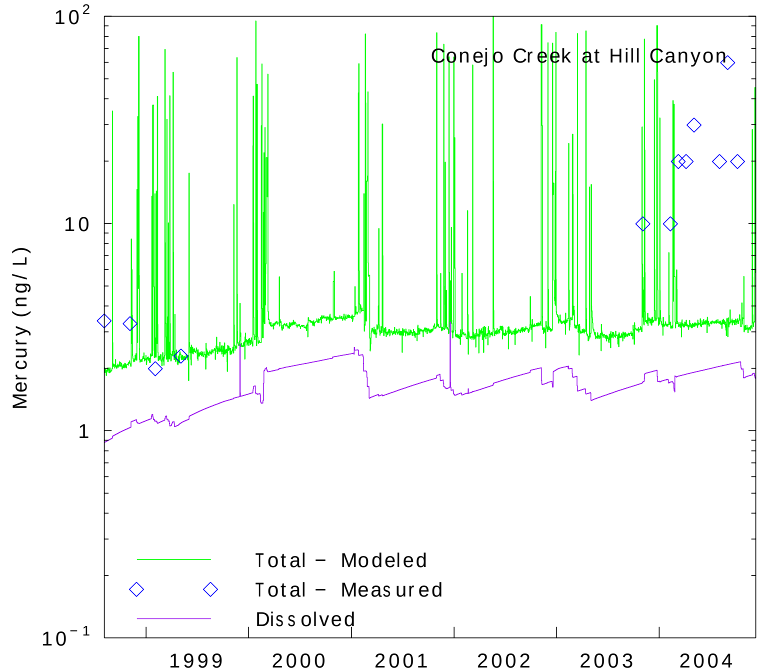

Figure 238: Measured and Modeled Mercury Time Series for Conejo Creek at Hill Canyon.

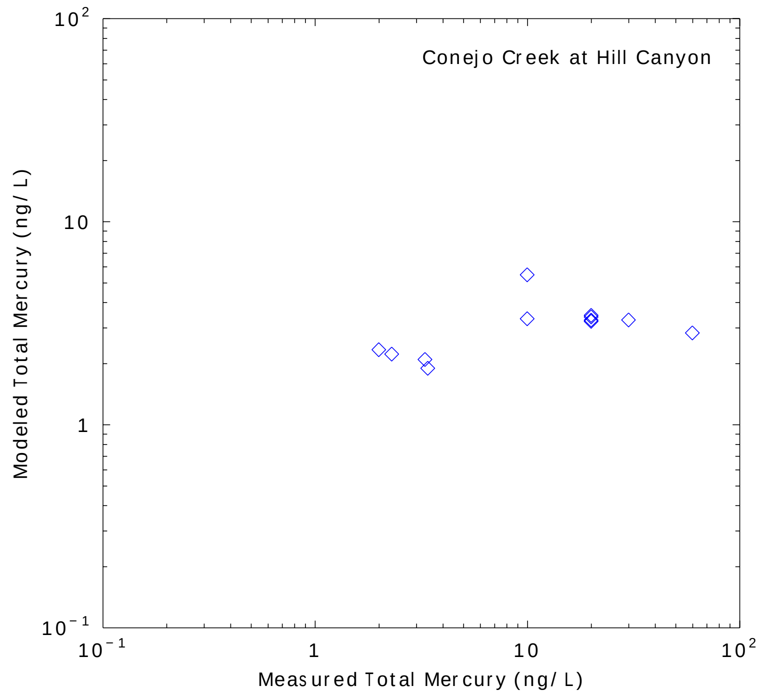

Figure 239: Measured vs. Modeled Mercury for Conejo Creek at Hill Canyon.

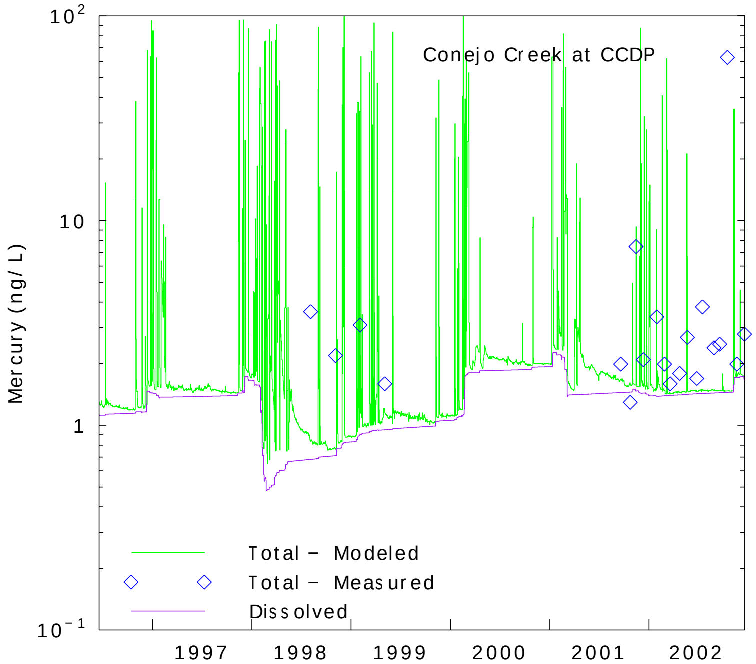

Figure 240: Measured and Modeled Mercury Time Series for Conejo Creek at CCDP.

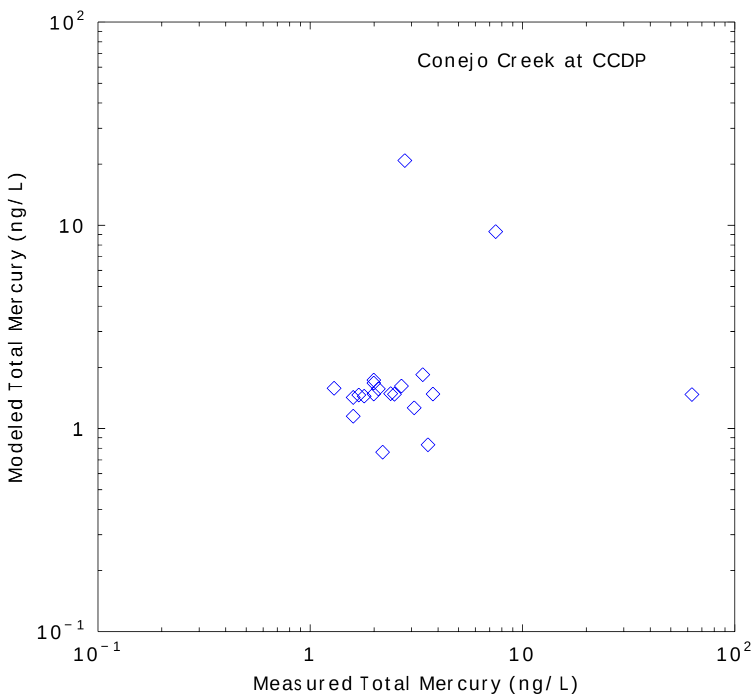

Figure 241: Measured vs. Modeled Mercury for Conejo Creek at CCDP.

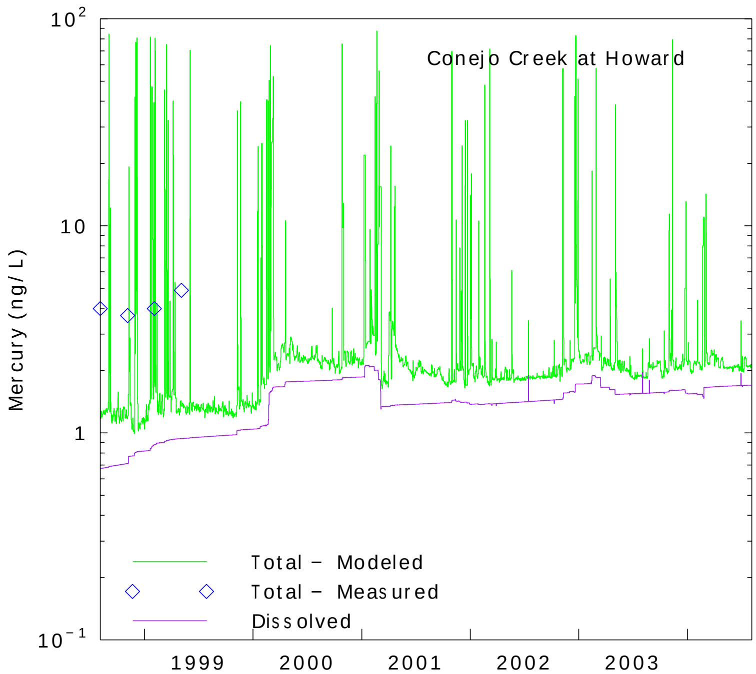

Figure 242: Measured and Modeled Mercury Time Series for Conejo Creek at Howard.

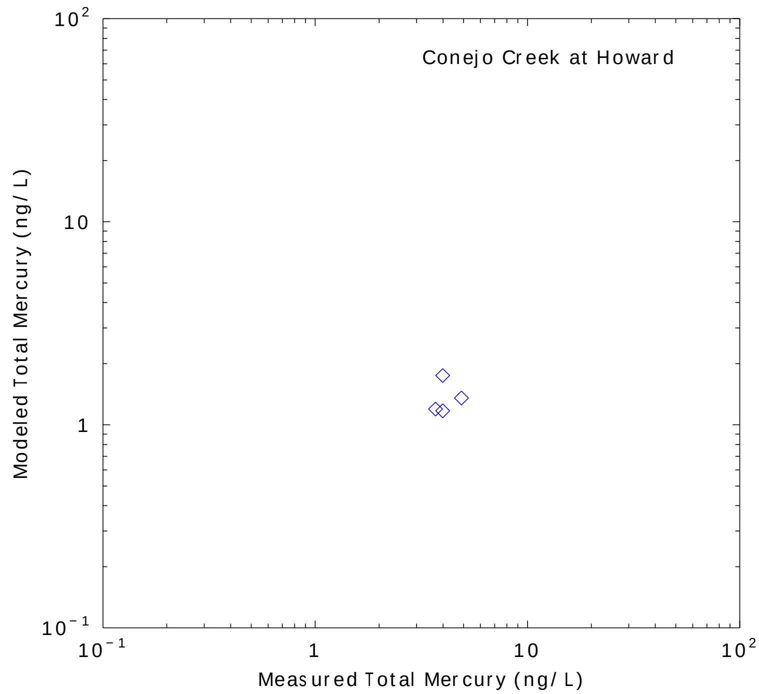

Figure 243: Measured vs. Modeled Mercury for Conejo Creek at Howard.

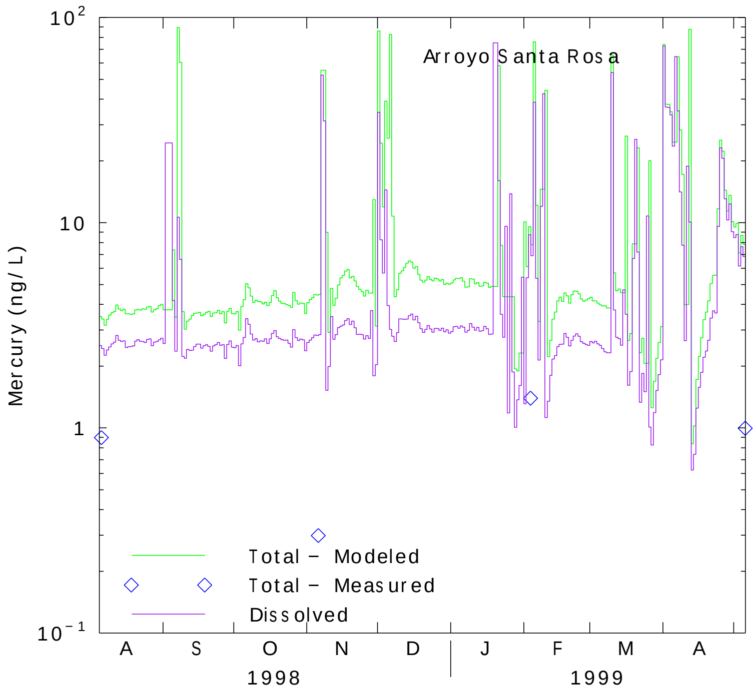

Figure 244: Measured and Modeled Mercury Time Series for Arroyo Santa Rosa.

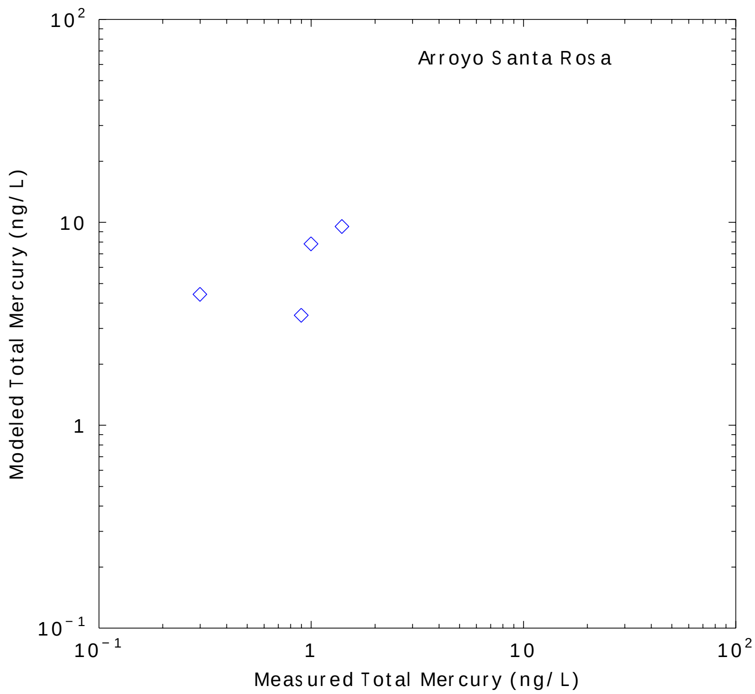

Figure 245: Measured vs. Modeled Mercury for Arroyo Santa Rosa.

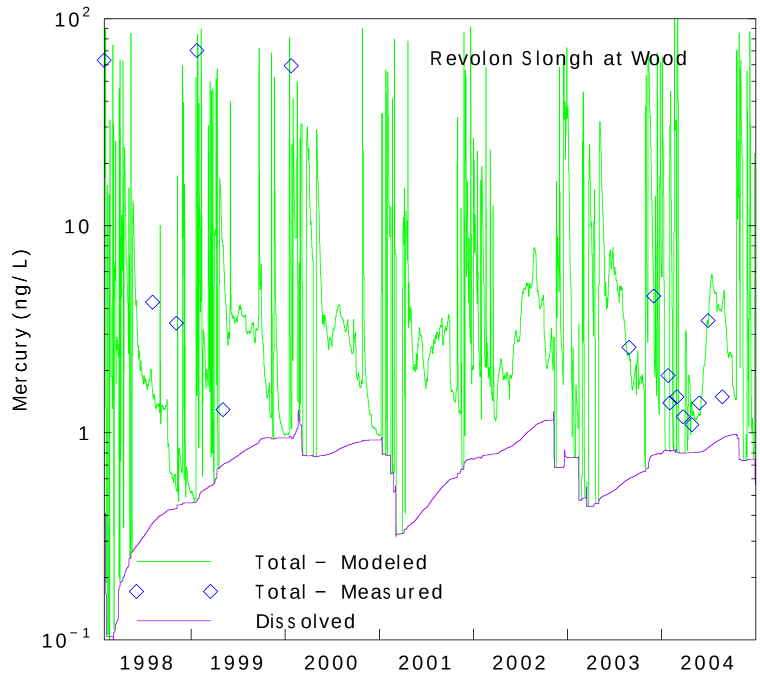

Figure 246: Measured and Modeled Mercury Time Series for Revolon Slough at Wood.

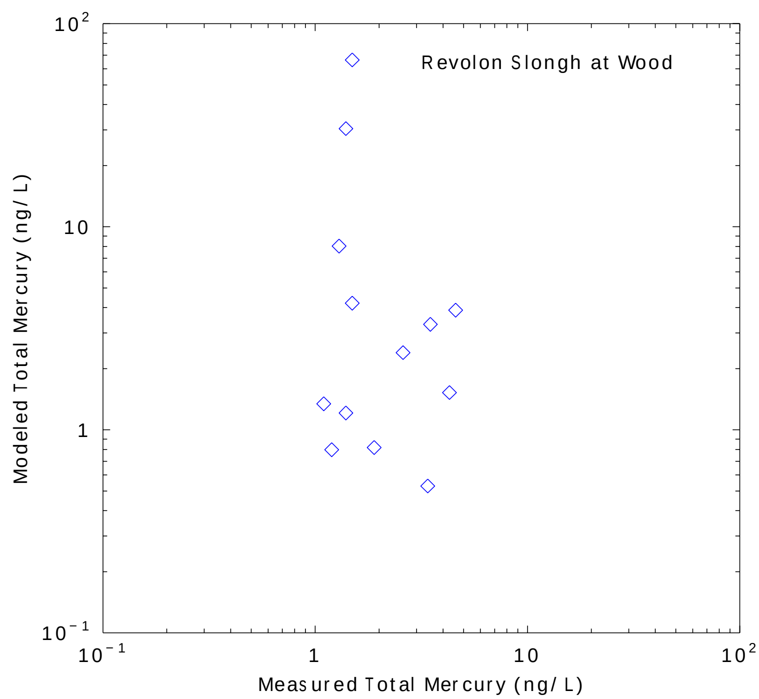

Figure 247: Measured vs. Modeled Mercury for Revolon Slough at Wood.

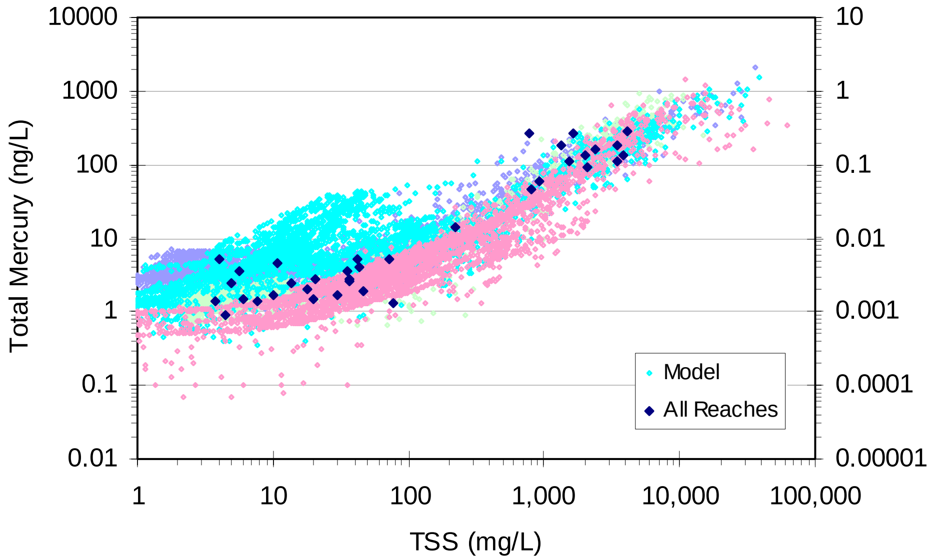

Figure 248: Total Mercury as a Function of the TSS for the Entire CCW.

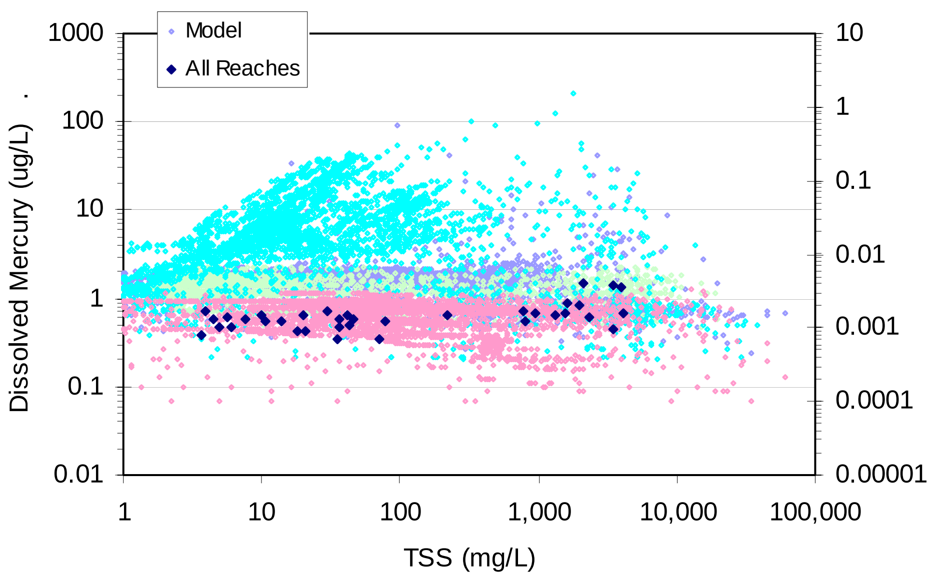

Figure 249: Dissolved Mercury as a Function of the TSS for the Entire CCW.

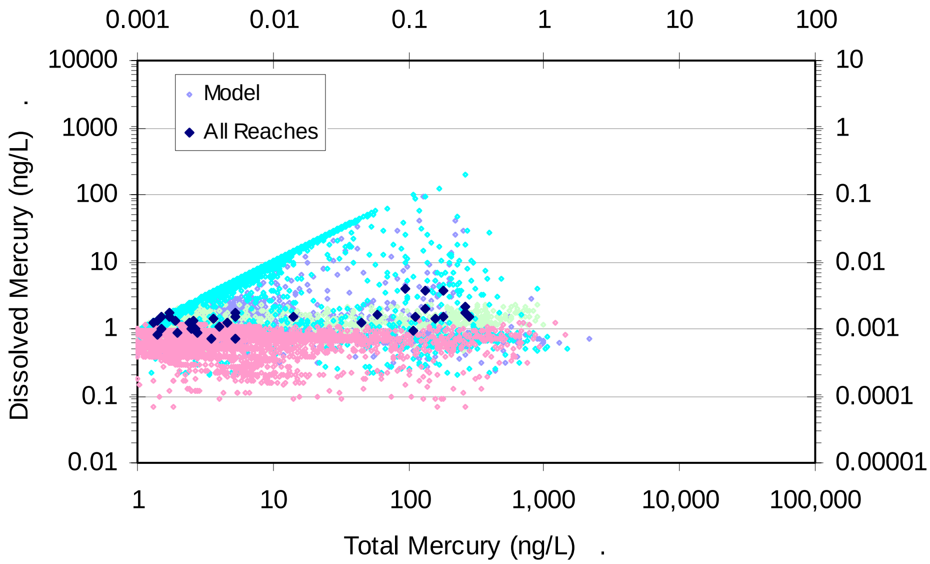

Figure 250: Dissolved Mercury as a Function of Total Mercury for the Entire CCW.

Selenium

Calculated total and dissolved selenium concentration time series and paired values are compared in Figure 251 to Figure 270. The partitioning of selenium is evaluated on a watershed-wide scale in Figure 271 to Figure 273.

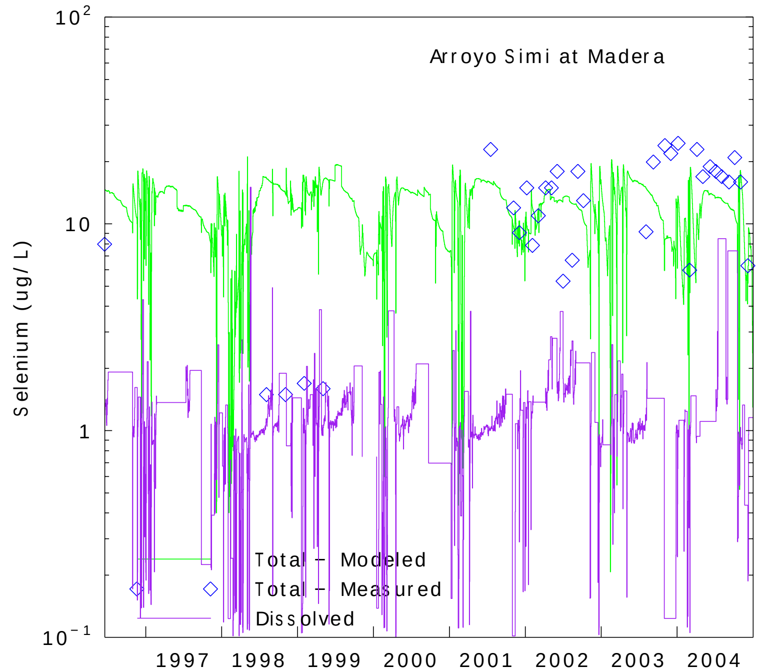

Figure 251: Measured and Modeled Selenium Time Series for Arroyo Simi at Madera.

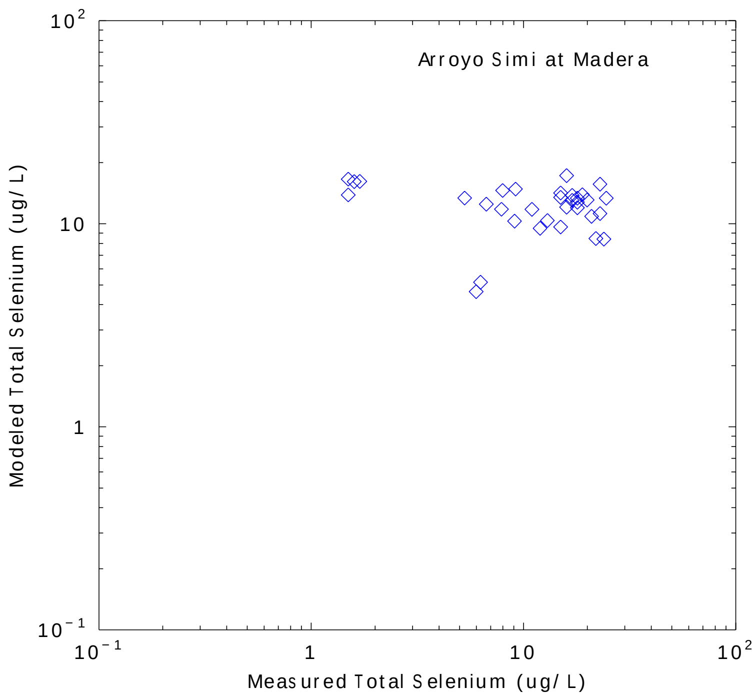

Figure 252: Measured vs. Modeled Selenium for Arroyo Simi at Madera.

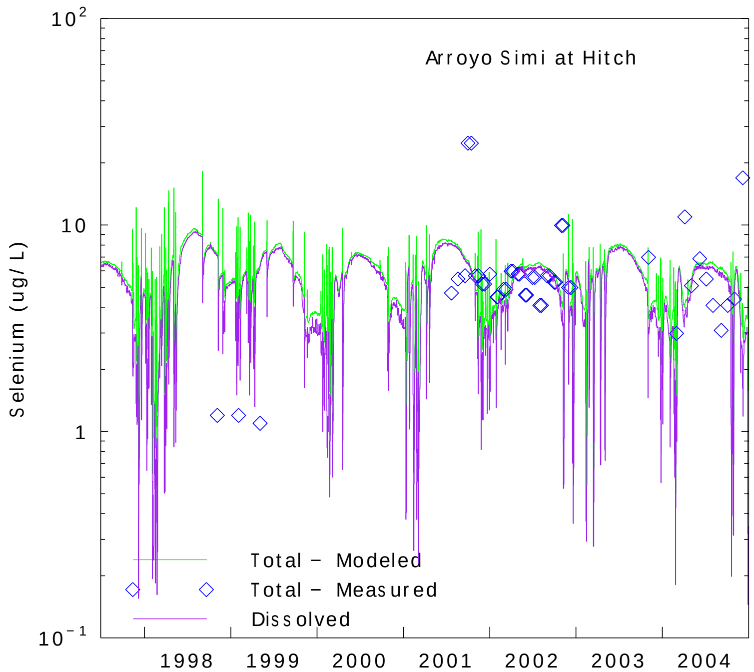

Figure 253: Measured and Modeled Selenium Time Series for Arroyo Simi at Hitch.

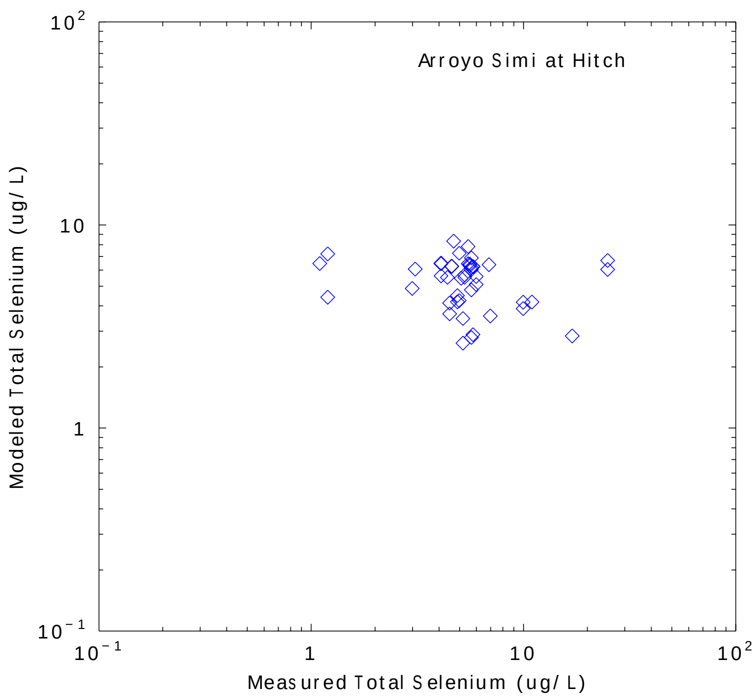

Figure 254: Measured vs. Modeled Selenium for Arroyo Simi at Hitch.

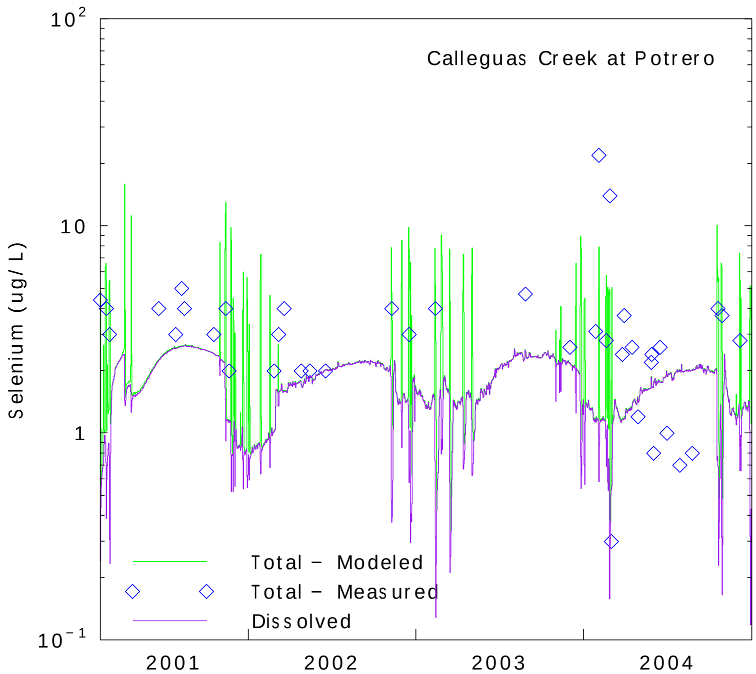

Figure 255: Measured and Modeled Selenium Time Series for Calleguas Creek at Potrero.

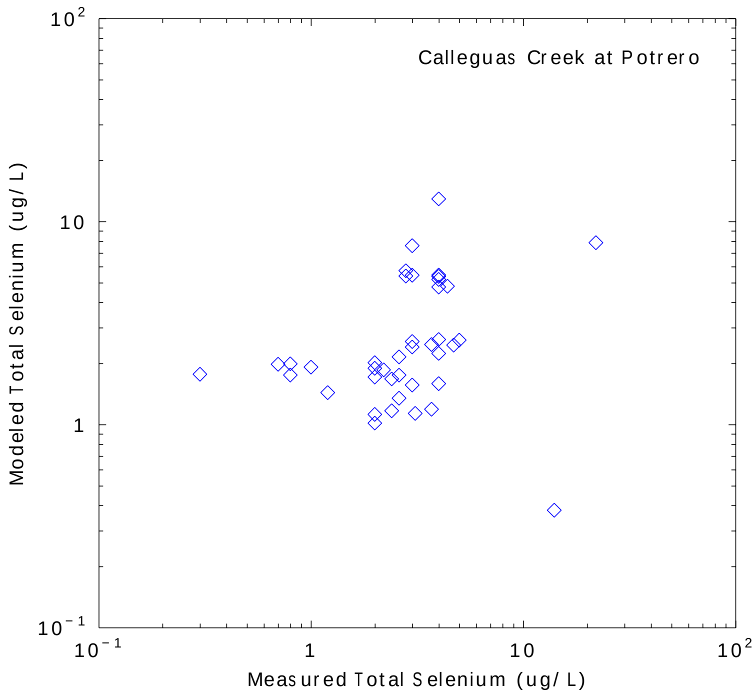

Figure 256: Measured vs. Modeled Selenium for Calleguas Creek at Potrero.

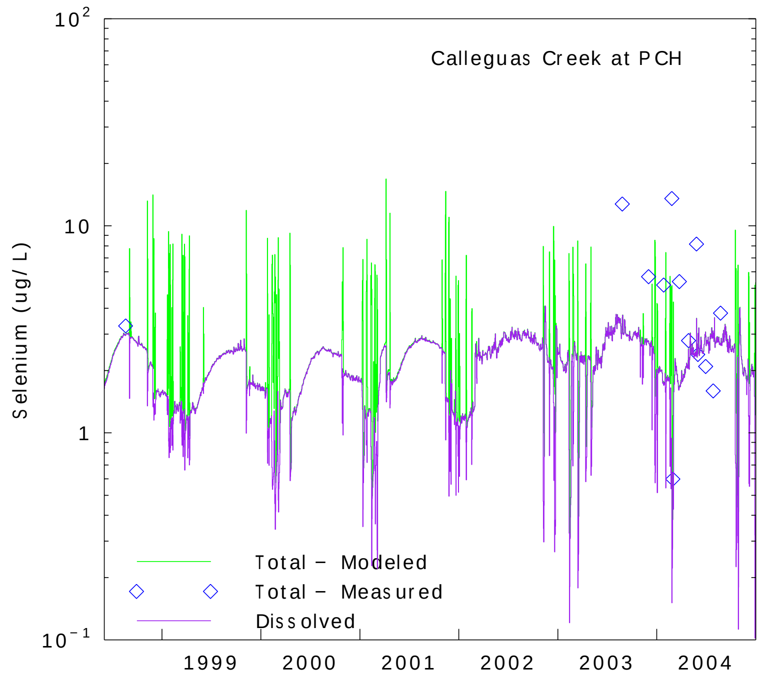

Figure 257: Measured and Modeled Selenium Time Series for Calleguas Creek at PCH.

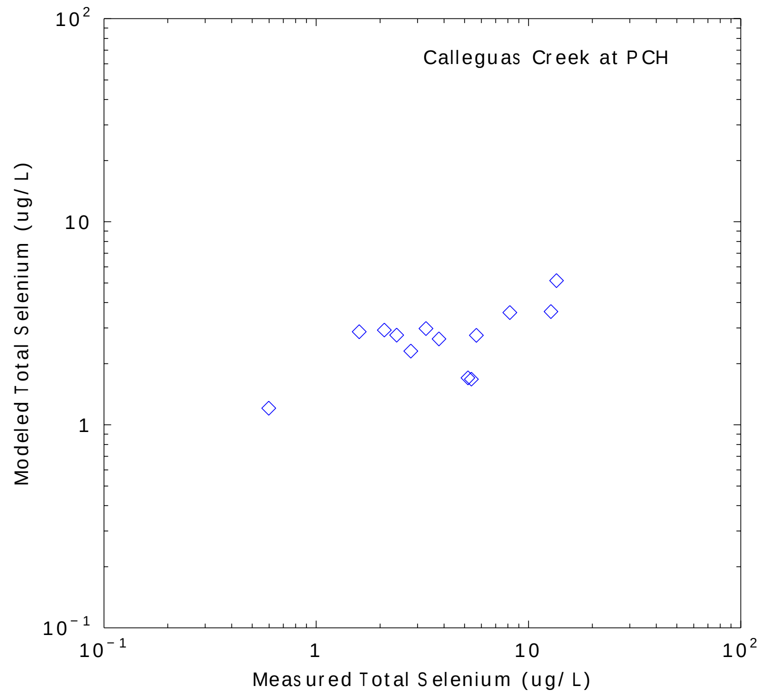

Figure 258: Measured vs. Modeled Selenium for Calleguas Creek at PCH.

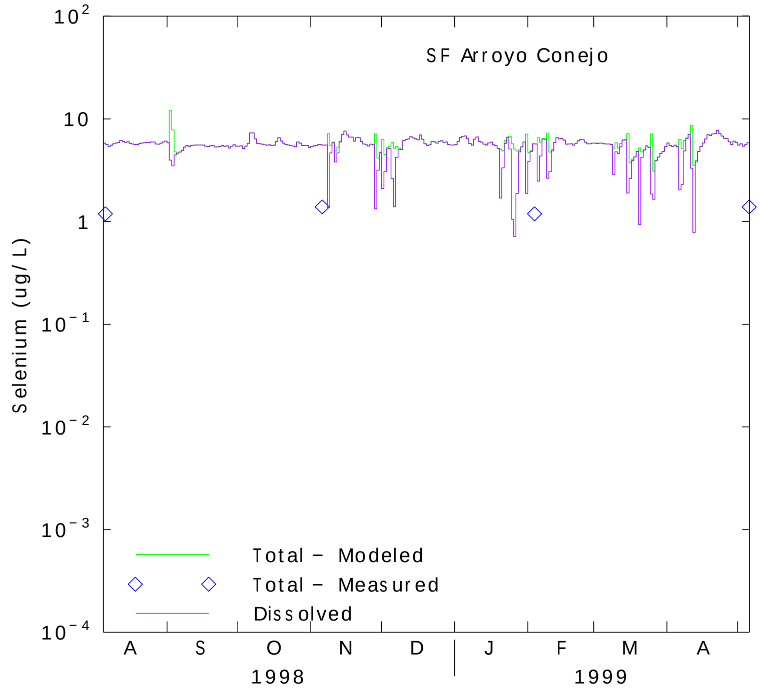

Figure 259: Measured and Modeled Selenium Time Series for South Fork Arroyo Conejo.

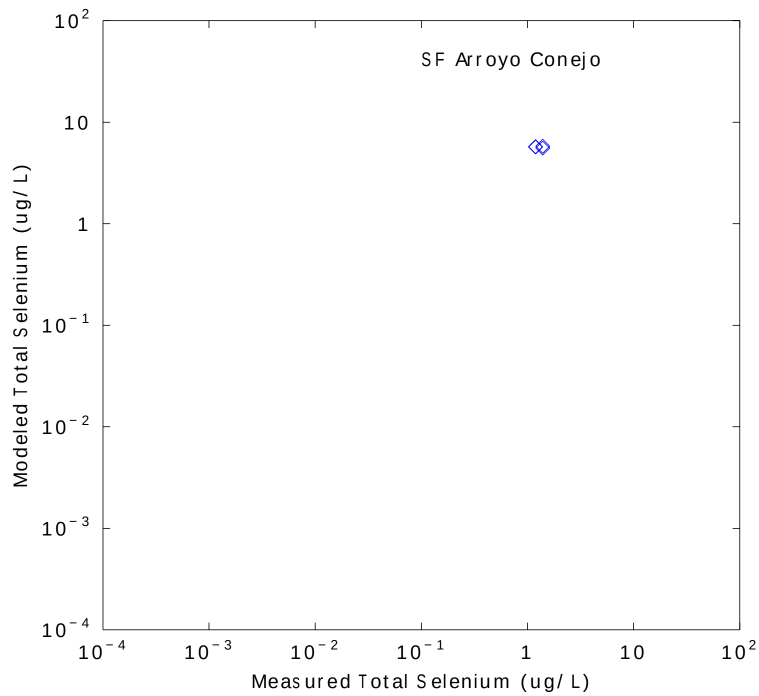

Figure 260: Measured vs. Modeled Selenium for South Fork Arroyo Conejo.

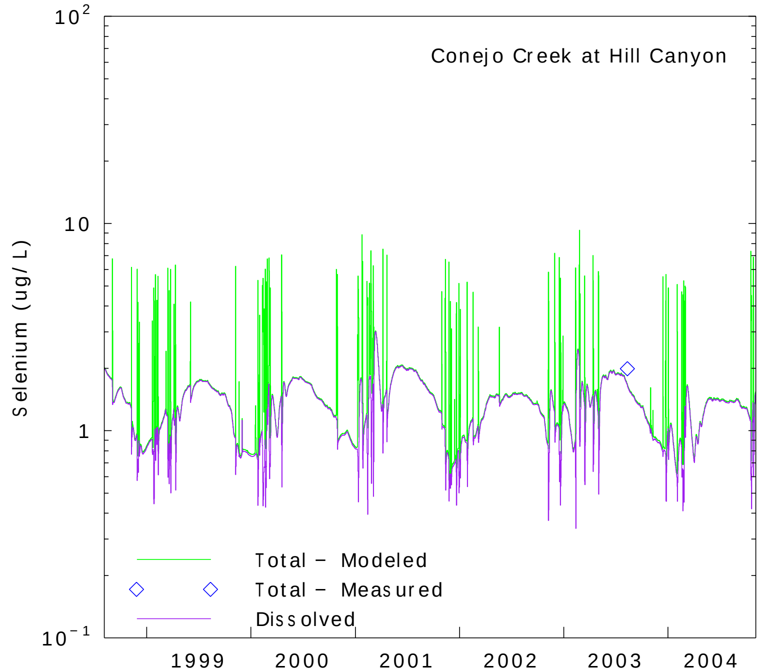

Figure 261: Measured and Modeled Selenium Time Series for Conejo Creek at Hill Canyon.

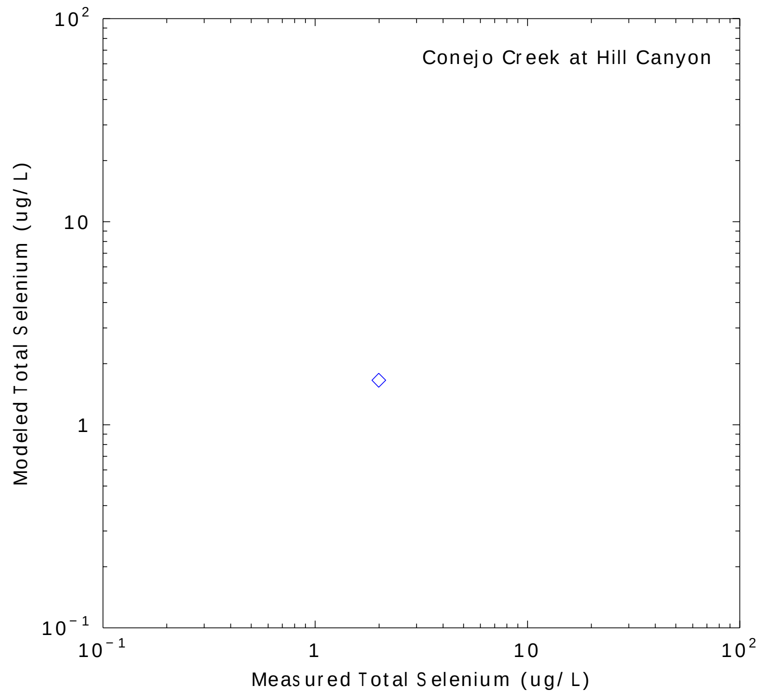

Figure 262: Measured vs. Modeled Selenium for Conejo Creek at Hill Canyon.

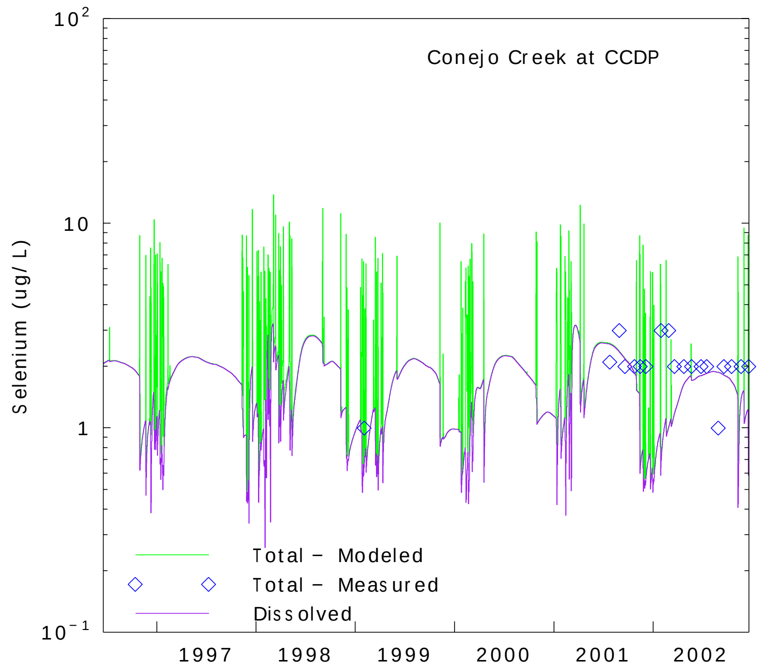

Figure 263: Measured and Modeled Selenium Time Series for Conejo Creek at CCDP.

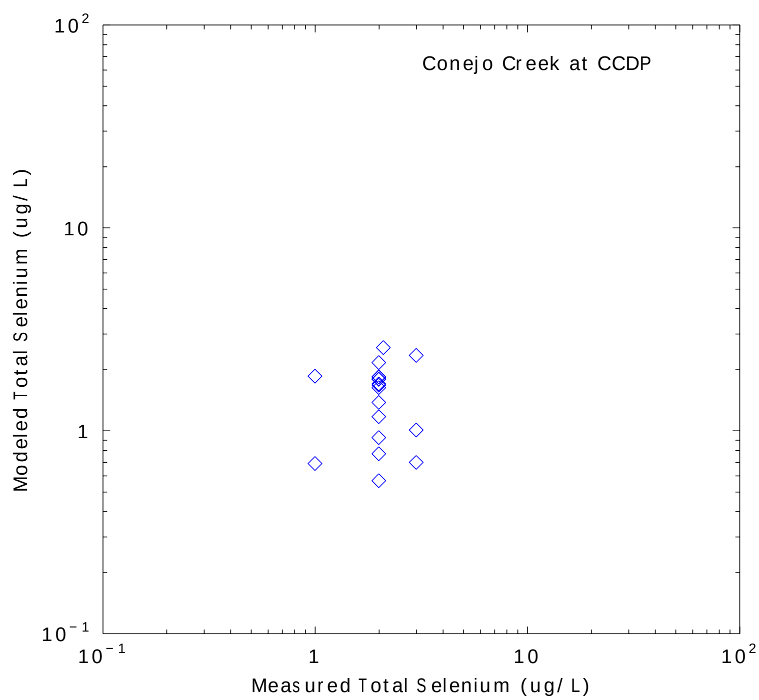

Figure 264: Measured vs. Modeled Selenium for Conejo Creek at CCDP.

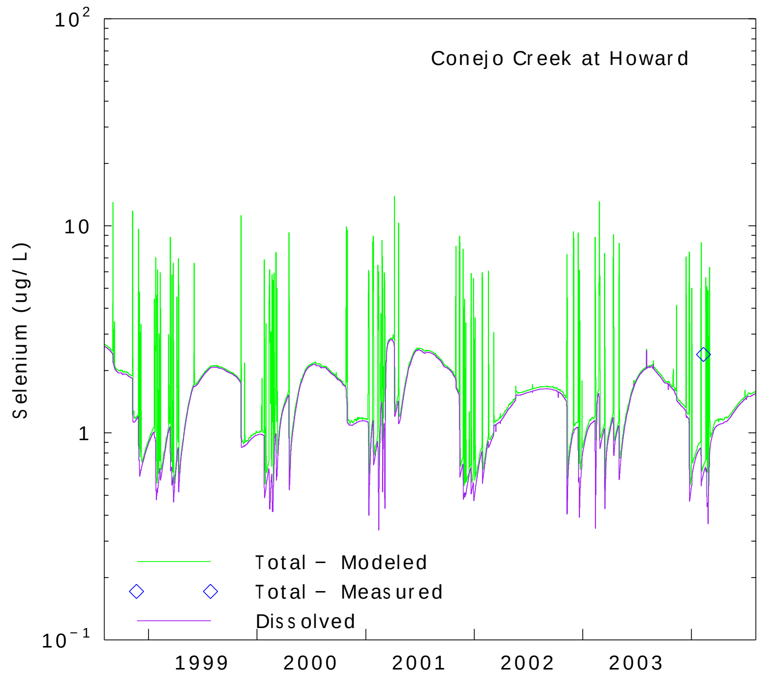

Figure 265: Measured and Modeled Selenium Time Series for Conejo Creek at Howard.

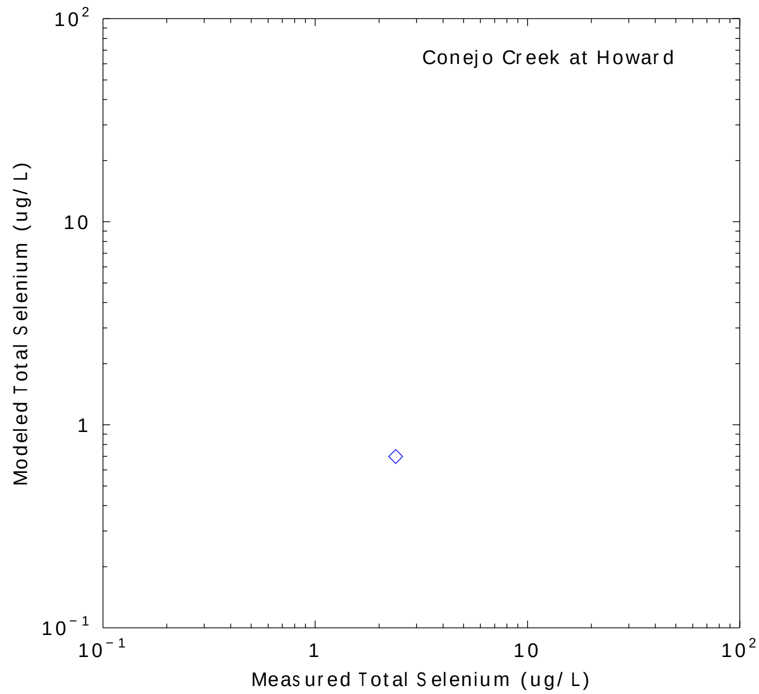

Figure 266: Measured vs. Modeled Selenium for Conejo Creek at Howard.

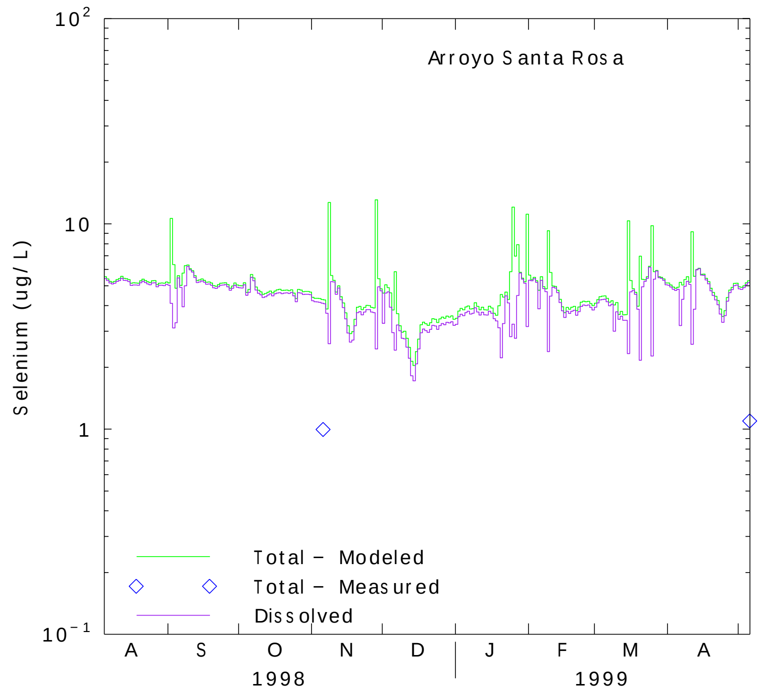

Figure 267: Measured and Modeled Selenium Time Series for Arroyo Santa Rosa.

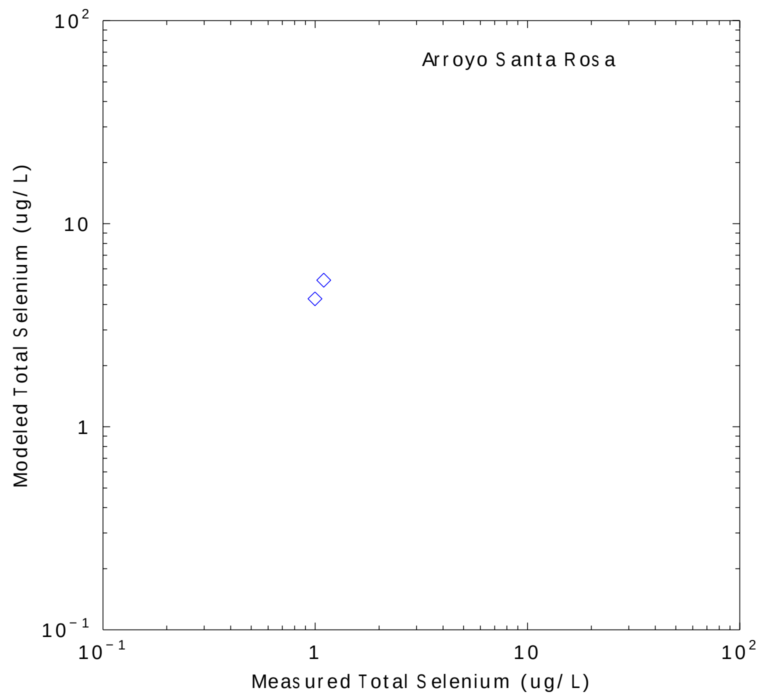

Figure 268: Measured vs. Modeled Selenium for Arroyo Santa Rosa.

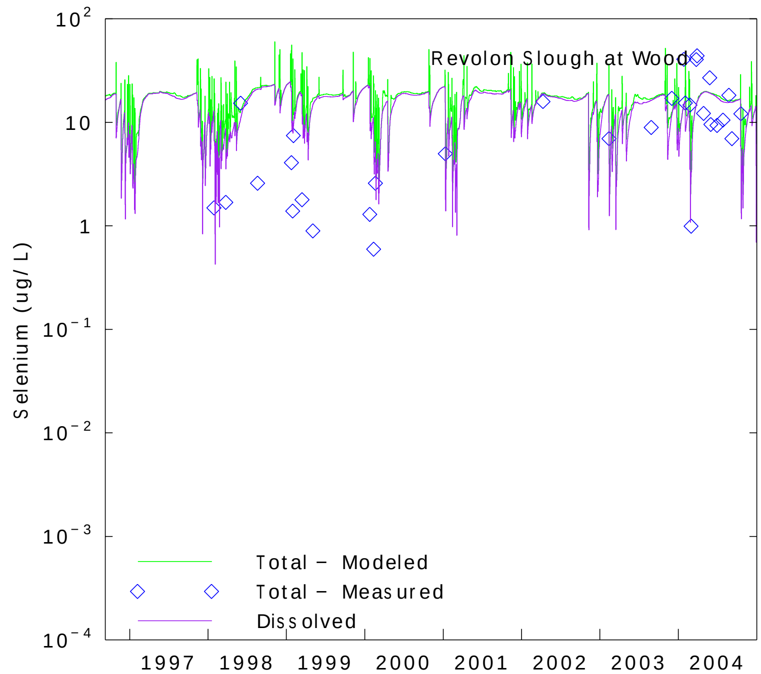

Figure 269: Measured and Modeled Selenium Time Series for Revolon Slough at Wood.

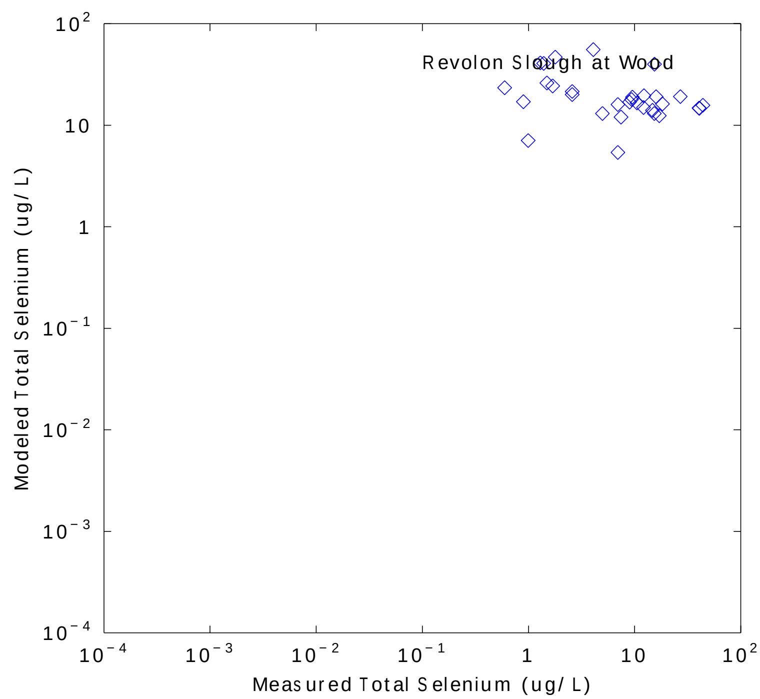

Figure 270: Measured vs. Modeled Selenium for Revolon Slough at Wood.

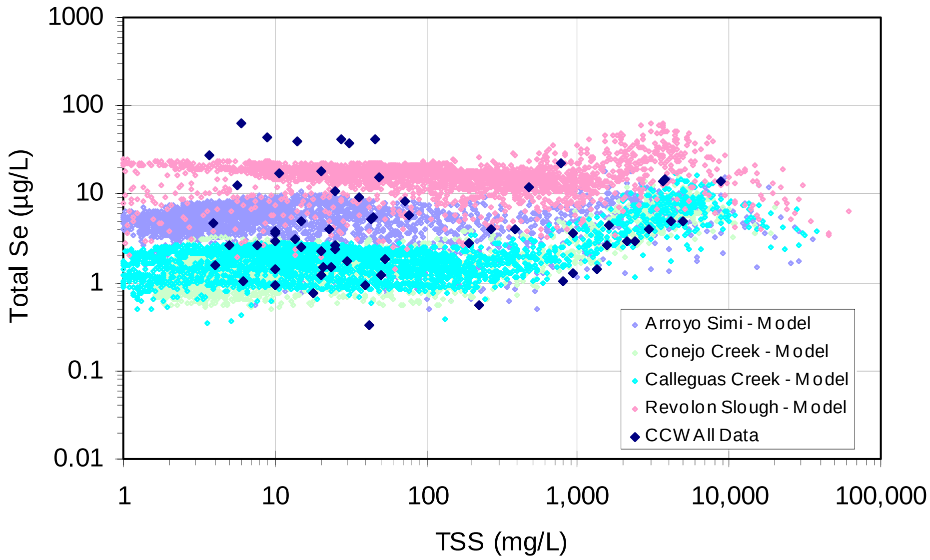

Figure 271: Total Selenium as a Function of TSS for the Entire CCW.

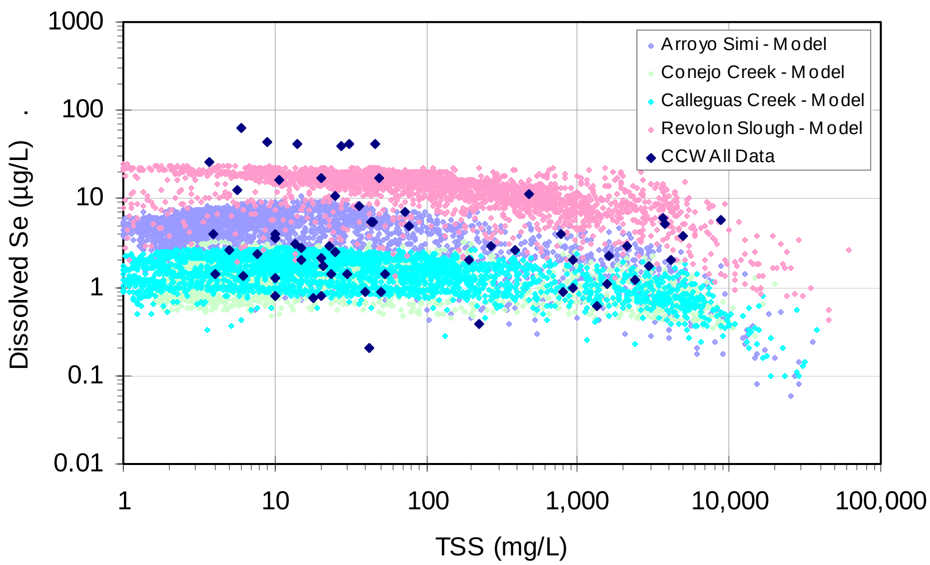

Figure 272: Dissolved Selenium as a Function of TSS for the Entire CCW.

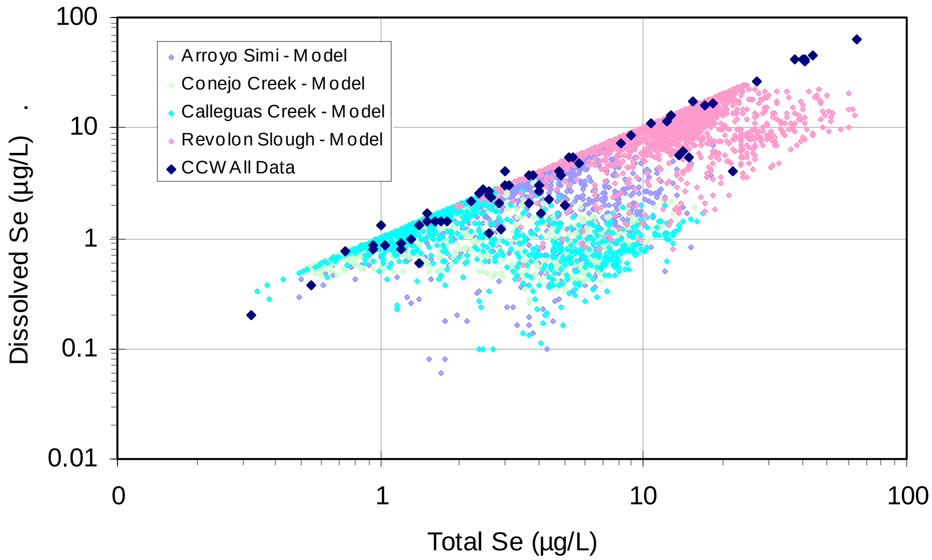

Figure 273: Dissolved Selenium as a Function of the Total Selenium for the Entire CCW.

CONCLUSIONS

The water quality calculations of the CCWM match the watershed observations well. For each of copper, nickel, mercury, and selenium the partitioning between dissolved and solid phases is well represented by the CCWM. The model will allow investigation of the effects of modifying total loading from the watershed on the dissolved concentrations in the receiving waters. The CCWM is ideally suited to perform decision support for the Calleguas Creek Metals and Selenium TMDL.

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CATALOG

calleg2.wdm

The additional time series inputs necessary to drive the water quality component of the CCWM are included in the file calleg2.wdm. The data set catalog for the calleg2 file are as follows.

DSN	Time	TSTYPE	Units	Description
152	h	ATMP	°F	Air Temperature for Camarillo CIMIS #152
153	h	SOLR	ly/day	Solar Radiation for Camarillo CIMIS #152
154	h	DEWP	°F	Dew Point for Camarillo CIMIS #152
155	h	WIND	mi/hr	Wind Speed for Camarillo CIMIS #152
156	h	CLDC	tenths	Cloud Cover for Camarillo Airport
301	d	FLOW	MGD	Camrosa WRF Q
335	m	FLOW	MGD	Camrosa WRF Q to ponds
10335	d	FLOW	MGD	Camrosa WRF Q to ponds (diaggregated time step)
302	d	FLOW	MGD	Hill Canyon Q
303	d	FLOW	MGD	Camarillo Q
304	d	FLOW	MGD	Moorpark Q
325	d	FLOW	MGD	Moorpark Q to ponds
305	d	FLOW	MGD	Olsen Rd. Q
307	m	FLOW	MGD	Simi Valley Q
10307	d	FLOW	MGD	Simi Valley Q (diaggregated time step)
311		FLOW		
312		FLOW		
313		FLOW		

321		FLOW		
322		FLOW		
323		FLOW		
324		FLOW		
403	m	PUMP	cfs	Dewatering Well Q
404	m	PUMP	cfs	Dewatering Well Q
405	m	PUMP	cfs	Dewatering Well Q
406	m	PUMP	cfs	Dewatering Well Q
407	m	PUMP	cfs	Dewatering Well Q
1403	d	HEAT	kcal/hr	Dewatering Well Heat
1404	d	HEAT	kcal/hr	Dewatering Well Heat
1405	d	HEAT	kcal/hr	Dewatering Well Heat
1406	d	HEAT	kcal/hr	Dewatering Well Heat
1407	d	HEAT	kcal/hr	Dewatering Well Heat
3301	d	HARD	mg/L*MGD	Camrosa WRF hardness
3335	d	HARD	mg/L*MGD	Camrosa WRF hardness to ponds (diaggregated time step)
3302	d	HARD	mg/L*MGD	Hill Canyon hardness
3303	d	HARD	mg/L*MGD	Camarillo hardness
3304	d	HARD	mg/L*MGD	Moorpark hardness
3325	d	HARD	mg/L*MGD	Moorpark hardness to ponds
3305	d	HARD	mg/L*MGD	Olsen Rd. hardness
3307	d	HARD	mg/L*MGD	Simi Valley hardness (diaggregated time step)
3403	d	HARD	mg/L*cfs	Dewatering Well Hardness
3404	d	HARD	mg/L*cfs	Dewatering Well Hardness
3405	d	HARD	mg/L*cfs	Dewatering Well Hardness
3406	d	HARD	mg/L*cfs	Dewatering Well Hardness
3407	d	HARD	mg/L*cfs	Dewatering Well Hardness
4301	d	CHLR	mg/L*MGD	Camrosa WRF chloride
4335	d	CHLR	mg/L*MGD	Camrosa WRF chloride to ponds (diaggregated time step)
4302	d	CHLR	mg/L*MGD	Hill Canyon chloride
4303	d	CHLR	mg/L*MGD	Camarillo chloride
4304	d	CHLR	mg/L*MGD	Moorpark chloride
4325	d	CHLR	mg/L*MGD	Moorpark chloride to ponds
4305	d	CHLR	mg/L*MGD	Olsen Rd. chloride
4307	d	CHLR	mg/L*MGD	Simi Valley chloride (diaggregated time step)
5301	d	DSEC	mg/L*MGD	Camrosa WRF selenium
5335	d	DSEC	mg/L*MGD	Camrosa WRF selenium to ponds (diaggregated time step)
5302	d	DSEC	mg/L*MGD	Hill Canyon selenium
5303	d	DSEC	mg/L*MGD	Camarillo selenium
5304	d	DSEC	mg/L*MGD	Moorpark selenium
5325	d	DSEC	mg/L*MGD	Moorpark selenium to ponds
5305	d	DSEC	mg/L*MGD	Olsen Rd. selenium
5307	d	DSEC	mg/L*MGD	Simi Valley selenium (diaggregated time step)
5403	d	DSEC	mg/L*cfs	Dewatering Well selenium
5404	d	DSEC	mg/L*cfs	Dewatering Well selenium
5405	d	DSEC	mg/L*cfs	Dewatering Well selenium
5406	d	DSEC	mg/L*cfs	Dewatering Well selenium
5407	d	DSEC	mg/L*cfs	Dewatering Well selenium
6301	d	DCUC	mg/L*MGD	Camrosa WRF copper
6335	d	DCUC	mg/L*MGD	Camrosa WRF copper to ponds (diaggregated time step)
6302	d	DCUC	mg/L*MGD	Hill Canyon copper
6303	d	DCUC	mg/L*MGD	Camarillo copper
6304	d	DCUC	mg/L*MGD	Moorpark copper
6325	d	DCUC	mg/L*MGD	Moorpark copper to ponds

6305	d	DCUC	mg/L*MGD	Olsen Rd. copper
6307	d	DCUC	mg/L*MGD	Simi Valley copper (diaggregated time step)
6403	d	DCUC	mg/L*cfs	Dewatering Well copper
6404	d	DCUC	mg/L*cfs	Dewatering Well copper
6405	d	DCUC	mg/L*cfs	Dewatering Well copper
6406	d	DCUC	mg/L*cfs	Dewatering Well copper
6407	d	DCUC	mg/L*cfs	Dewatering Well copper
7301	d	DHGC	mg/L*MGD	Camrosa WRF mercury
7335	d	DHGC	mg/L*MGD	Camrosa WRF mercury to ponds (diaggregated time step)
7302	d	DHGC	mg/L*MGD	Hill Canyon mercury
7303	d	DHGC	mg/L*MGD	Camarillo mercury
7304	d	DHGC	mg/L*MGD	Moorpark mercury
7325	d	DHGC	mg/L*MGD	Moorpark mercury to ponds
7305	d	DHGC	mg/L*MGD	Olsen Rd. mercury
7307	d	DHGC	mg/L*MGD	Simi Valley mercury (diaggregated time step)
7403	d	DHGC	mg/L*cfs	Dewatering Well mercury
7404	d	DHGC	mg/L*cfs	Dewatering Well mercury
7405	d	DHGC	mg/L*cfs	Dewatering Well mercury
7406	d	DHGC	mg/L*cfs	Dewatering Well mercury
7407	d	DHGC	mg/L*cfs	Dewatering Well mercury
8301	d	SEDC	mg/L*MGD	Camrosa WRF solids
8335	d	SEDC	mg/L*MGD	Camrosa WRF solids to ponds (diaggregated time step)
8302	d	SEDC	mg/L*MGD	Hill Canyon solids
8303	d	SEDC	mg/L*MGD	Camarillo solids
8304	d	SEDC	mg/L*MGD	Moorpark solids
8325	d	SEDC	mg/L*MGD	Moorpark solids to ponds
8305	d	SEDC	mg/L*MGD	Olsen Rd. solids
8307	d	SEDC	mg/L*MGD	Simi Valley solids (diaggregated time step)
9301	d	HEAT	kcal/hr	Camrosa WRF heat
9335	d	HEAT	kcal/hr	Camrosa WRF heat to ponds (diaggregated time step)
9302	d	HEAT	kcal/hr	Hill Canyon heat
9303	d	HEAT	kcal/hr	Camarillo heat
9304	d	HEAT	kcal/hr	Moorpark heat
9325	d	HEAT	kcal/hr	Moorpark heat to ponds
9305	d	HEAT	kcal/hr	Olsen Rd. heat
9307	d	HEAT	kcal/hr	Simi Valley heat (diaggregated time step)
10998	h	---	---	intermediate (air temp + 5 -32)
10999	h	---	---	(DSN10998)*87,629.4 conversion factor
11000	d	---	---	DSN10999 aggregated into daily timestep.

calleg3.wdm

DSN	Time	TSTYPE	Units	Description
004	d	FLOW	cfs	Modeled flow Arroyo Simi at Royal
008	d	FLOW	cfs	Modeled flow Arroyo Simi at Madera
205	d	FLOW	cfs	Modeled flow Arroyo Simi at Hitch Rd.
207	d	FLOW	cfs	Modeled flow Las Posas at Seminary Rd.
302	d	FLOW	cfs	Modeled flow Calleguas Creek at 101
304	d	FLOW	cfs	Modeled flow Calleguas Creek at CSUCI
305	d	FLOW	cfs	Modeled flow Calleguas Creek at Potrero Rd.
306	d	FLOW	cfs	Modeled flow Calleguas Creek at PCH

403	d	FLOW	cfs	Modeled flow SF Arroyo Conejo
404	d	FLOW	cfs	Modeled flow Conejo Creek at Hill Canyon
407	d	FLOW	cfs	Modeled flow Conejo Creek at CCDP
408	d	FLOW	cfs	Modeled flow Conejo Creek at Howard Rd.
431	d	FLOW	cfs	Modeled flow NF Arroyo Conejo
442	d	FLOW	cfs	Modeled flow Arroyo Santa Rosa
503	d	FLOW	cfs	Modeled flow Beardsley Wash
505	d	FLOW	cfs	Modeled flow Revolon Slough at Wood Rd.
506	d	FLOW	cfs	Modeled flow Revolon Slough at PCH
1004	d	WTEM	ºF	Modeled temperature Arroyo Simi at Royal
1008	d	WTEM	ºF	Modeled temperature Arroyo Simi at Madera
1046	d	WTEM	ºF	Modeled temperature Tapo Canyon
1205	d	WTEM	ºF	Modeled temperature Arroyo Simi at Hitch Rd.
1207	d	WTEM	ºF	Modeled temperature Las Posas at Seminary Rd.
1302	d	WTEM	ºF	Modeled temperature Calleguas Creek at 101
1304	d	WTEM	ºF	Modeled temperature Calleguas Creek at CSUCI
1305	d	WTEM	ºF	Modeled temperature Calleguas Creek at Potrero Rd.
1306	d	WTEM	ºF	Modeled temperature Calleguas Creek at PCH
1403	d	WTEM	ºF	Modeled temperature SF Arroyo Conejo
1404	d	WTEM	ºF	Modeled temperature Conejo Creek at Hill Canyon
1407	d	WTEM	ºF	Modeled temperature Conejo Creek at CCDP
1408	d	WTEM	ºF	Modeled temperature Conejo Creek at Howard Rd.
1431	d	WTEM	ºF	Modeled temperature NF Arroyo Conejo
1442	d	WTEM	ºF	Modeled temperature Arroyo Santa Rosa
1503	d	WTEM	ºF	Modeled temperature Beardsley Wash
1505	d	WTEM	ºF	Modeled temperature Revolon Slough at Wood Rd.
1506	d	WTEM	ºF	Modeled temperature Revolon Slough at PCH
2004	d	SEDC	mg/L	Modeled TSS Arroyo Simi at Royal
2008	d	SEDC	mg/L	Modeled TSS Arroyo Simi at Madera
2046	d	SEDC	mg/L	Modeled TSS Tapo Canyon
2205	d	SEDC	mg/L	Modeled TSS Arroyo Simi at Hitch Rd.
2207	d	SEDC	mg/L	Modeled TSS Las Posas at Seminary Rd.
2302	d	SEDC	mg/L	Modeled TSS Calleguas Creek at 101
2304	d	SEDC	mg/L	Modeled TSS Calleguas Creek at CSUCI
2305	d	SEDC	mg/L	Modeled TSS Calleguas Creek at Potrero Rd.
2306	d	SEDC	mg/L	Modeled TSS Calleguas Creek at PCH
2403	d	SEDC	mg/L	Modeled TSS SF Arroyo Conejo
2404	d	SEDC	mg/L	Modeled TSS Conejo Creek at Hill Canyon
2407	d	SEDC	mg/L	Modeled TSS Conejo Creek at CCDP
2408	d	SEDC	mg/L	Modeled TSS Conejo Creek at Howard Rd.
2431	d	SEDC	mg/L	Modeled TSS NF Arroyo Conejo
2442	d	SEDC	mg/L	Modeled TSS Arroyo Santa Rosa
2503	d	SEDC	mg/L	Modeled TSS Beardsley Wash
2505	d	SEDC	mg/L	Modeled TSS Revolon Slough at Wood Rd.
2506	d	SEDC	mg/L	Modeled TSS Revolon Slough at PCH
2600	d	SEDC	mg/L	Modeled TSS load Arroyo Simi at Royal
2617	d	SEDY	ton/d	Modeled sediment yield Fox Barranca
2618	d	SEDY	ton/d	Modeled sediment yield Happy Camp
2619	d	SEDY	ton/d	Modeled sediment yield Tapo Canyon
2620	d	SEDY	ton/d	Modeled sediment yield Arroyo Simi Headwaters
2621	d	SEDY	ton/d	Modeled sediment yield Meier Canyon
2622	d	SEDY	ton/d	Modeled sediment yield Sycamore Canyon
2623	d	SEDY	ton/d	Modeled sediment yield Conejo Creek Subwatershed
3004	d	HARD	mg/L as $CaCO_3$	Modeled hardness Arroyo Simi at Royal
3008	d	HARD	mg/L as $CaCO_3$	Modeled hardness Arroyo Simi at Madera
3046	d	HARD	mg/L as $CaCO_3$	Modeled hardness Tapo Canyon

3205	d	HARD	mg/L as $CaCO_3$	Modeled hardness Arroyo Simi at Hitch Rd.
3207	d	HARD	mg/L as $CaCO_3$	Modeled hardness Las Posas at Seminary Rd.
3302	d	HARD	mg/L as $CaCO_3$	Modeled hardness Calleguas Creek at 101
3304	d	HARD	mg/L as $CaCO_3$	Modeled hardness Calleguas Creek at CSUCI
3305	d	HARD	mg/L as $CaCO_3$	Modeled hardness Calleguas Creek at Potrero Rd.
3306	d	HARD	mg/L as $CaCO_3$	Modeled hardness Calleguas Creek at PCH
3403	d	HARD	mg/L as $CaCO_3$	Modeled hardness SF Arroyo Conejo
3404	d	HARD	mg/L as $CaCO_3$	Modeled hardness Conejo Creek at Hill Canyon
3407	d	HARD	mg/L as $CaCO_3$	Modeled hardness Conejo Creek at CCDP
3408	d	HARD	mg/L as $CaCO_3$	Modeled hardness Conejo Creek at Howard Rd.
3431	d	HARD	mg/L as $CaCO_3$	Modeled hardness NF Arroyo Conejo
3442	d	HARD	mg/L as $CaCO_3$	Modeled hardness Arroyo Santa Rosa
3503	d	HARD	mg/L as $CaCO_3$	Modeled hardness Beardsley Wash
3505	d	HARD	mg/L as $CaCO_3$	Modeled hardness Revolon Slough at Wood Rd.
3506	d	HARD	mg/L as $CaCO_3$	Modeled hardness Revolon Slough at PCH
4004	d	CHLR	mg/L	Modeled chloride Arroyo Simi at Royal
4008	d	CHLR	mg/L	Modeled chloride Arroyo Simi at Madera
4046	d	CHLR	mg/L	Modeled chloride Tapo Canyon
4205	d	CHLR	mg/L	Modeled chloride Arroyo Simi at Hitch Rd.
4207	d	CHLR	mg/L	Modeled chloride Las Posas at Seminary Rd.
4302	d	CHLR	mg/L	Modeled chloride Calleguas Creek at 101
4304	d	CHLR	mg/L	Modeled chloride Calleguas Creek at CSUCI
4305	d	CHLR	mg/L	Modeled chloride Calleguas Creek at Potrero Rd.
4306	d	CHLR	mg/L	Modeled chloride Calleguas Creek at PCH
4403	d	CHLR	mg/L	Modeled chloride SF Arroyo Conejo
4404	d	CHLR	mg/L	Modeled chloride Conejo Creek at Hill Canyon
4407	d	CHLR	mg/L	Modeled chloride Conejo Creek at CCDP
4408	d	CHLR	mg/L	Modeled chloride Conejo Creek at Howard Rd.
4431	d	CHLR	mg/L	Modeled chloride NF Arroyo Conejo
4442	d	CHLR	mg/L	Modeled chloride Arroyo Santa Rosa
4503	d	CHLR	mg/L	Modeled chloride Beardsley Wash
4505	d	CHLR	mg/L	Modeled chloride Revolon Slough at Wood Rd.
4506	d	CHLR	mg/L	Modeled chloride Revolon Slough at PCH
9999	d	CHLL	lbs/d	Modeled chloride load Conejo Creek u/s of CCDP
5004	d	TCU	lbs/ft^3	Modeled particulate copper load;Arroyo Simi at Royal
5008	d	TCU	lbs/ft^3	Modeled particulate copper load; Arroyo Simi at Madera
5046	d	TCU	lbs/ft^3	Modeled particulate copper load; Tapo Canyon
5205	d	TCU	lbs/ft^3	Modeled particulate copper load; Arroyo Simi at Hitch Rd.
5207	d	TCU	lbs/ft^3	Modeled particulate copper load; Las Posas at Seminary
5302	d	TCU	lbs/ft^3	Modeled particulate copper load; Calleguas at 101
5304	d	TCU	lbs/ft^3	Modeled particulate copper load; Calleguas CSUCI
5305	d	TCU	lbs/ft^3	Modeled particulate copper load; Calleguas at Potrero Rd.
5306	d	TCU	lbs/ft^3	Modeled particulate copper load; Calleguas Creek at PCH
5403	d	TCU	lbs/ft^3	Modeled particulate copper load; SF Arroyo Conejo
5404	d	TCU	lbs/ft^3	Modeled particulate copper load; Conejo at Hill Canyon
5407	d	TCU	lbs/ft^3	Modeled particulate copper load; Conejo Creek at CCDP
5408	d	TCU	lbs/ft^3	Modeled particulate copper load; Conejo at Howard Rd.
5431	d	TCU	lbs/ft^3	Modeled particulate copper load; NF Arroyo Conejo
5442	d	TCU	lbs/ft^3	Modeled particulate copper load; Arroyo Santa Rosa
5503	d	TCU	lbs/ft^3	Modeled particulate copper load; Beardsley Wash
5505	d	TCU	lbs/ft^3	Modeled particulate copper load; Revolon Slough at Wood
5506	d	TCU	lbs/ft^3	Modeled particulate copper load; Revolon Slough at PCH
6004	d	DCU	µg/L	Modeled dissolved copper Arroyo Simi at Royal
6008	d	DCU	µg/L	Modeled dissolved copper Arroyo Simi at Madera
6046	d	DCU	µg/L	Modeled dissolved copper Tapo Canyon
6205	d	DCU	µg/L	Modeled dissolved copper Arroyo Simi at Hitch Rd.

6207	d	DCU	µg/L	Modeled dissolved copper Las Posas at Seminary Rd.
6302	d	DCU	µg/L	Modeled dissolved copper Calleguas Creek at 101
6304	d	DCU	µg/L	Modeled dissolved copper Calleguas Creek at CSUCI
6305	d	DCU	µg/L	Modeled dissolved copper Calleguas Creek at Potrero Rd.
6306	d	DCU	µg/L	Modeled dissolved copper Calleguas Creek at PCH
6403	d	DCU	µg/L	Modeled dissolved copper SF Arroyo Conejo
6404	d	DCU	µg/L	Modeled dissolved copper Conejo Creek at Hill Canyon
6407	d	DCU	µg/L	Modeled dissolved copper Conejo Creek at CCDP
6408	d	DCU	µg/L	Modeled dissolved copper Conejo Creek at Howard Rd.
6431	d	DCU	µg/L	Modeled dissolved copper NF Arroyo Conejo
6442	d	DCU	µg/L	Modeled dissolved copper Arroyo Santa Rosa
6503	d	DCU	µg/L	Modeled dissolved copper Beardsley Wash
6505	d	DCU	µg/L	Modeled dissolved copper Revolon Slough at Wood Rd.
6506	d	DCU	µg/L	Modeled dissolved copper Revolon Slough at PCH
7004	d	TSE	lbs/ft^3	Modeled particulate selenium load; Arroyo Simi at Royal
7008	d	TSE	lbs/ft^3	Modeled particulate selenium load; Arroyo Simi at Madera
7046	d	TSE	lbs/ft^3	Modeled particulate selenium load; Tapo Canyon
7205	d	TSE	lbs/ft^3	Modeled particulate selenium load; Arroyo Simi at Hitch
7207	d	TSE	lbs/ft^3	Modeled particulate selenium load; Las Posas at Seminary
7302	d	TSE	lbs/ft^3	Modeled particulate selenium load; Calleguas at 101
7304	d	TSE	lbs/ft^3	Modeled particulate selenium load; Calleguas CSUCI
7305	d	TSE	lbs/ft^3	Modeled particulate selenium load; Calleguas at Potrero
7306	d	TSE	lbs/ft^3	Modeled particulate selenium load; Calleguas Creek at PCH
7403	d	TSE	lbs/ft^3	Modeled particulate selenium load; SF Arroyo Conejo
7404	d	TSE	lbs/ft^3	Modeled particulate selenium load; Conejo at Hill Canyon
7407	d	TSE	lbs/ft^3	Modeled particulate selenium load; Conejo Creek at CCDP
7408	d	TSE	lbs/ft^3	Modeled particulate selenium load; Conejo at Howard Rd.
7431	d	TSE	lbs/ft^3	Modeled particulate selenium load; NF Arroyo Conejo
7442	d	TSE	lbs/ft^3	Modeled particulate selenium load; Arroyo Santa Rosa
7503	d	TSE	lbs/ft^3	Modeled particulate selenium load; Beardsley Wash
7505	d	TSE	lbs/ft^3	Modeled particulate selenium load; Revolon Slough at Wood
7506	d	TSE	lbs/ft^3	Modeled particulate selenium load; Revolon Slough at PCH
7601	d	DSE	µg/L	Modeled dissolved selenium Arroyo Simi at Royal
7600	d	DSE	µg/L	Modeled dissolved selenium Arroyo Simi at Madera
7602	d	DSE	µg/L	Modeled dissolved selenium Tapo Canyon.
7609	d	DSE	µg/L	Modeled dissolved selenium Arroyo Simi at Hitch Rd.
7617	d	DSE	µg/L	Modeled dissolved selenium Las Posas at Seminary Rd.
7608	d	DSE	µg/L	Modeled dissolved selenium Calleguas Creek at 101
7603	d	DSE	µg/L	Modeled dissolved selenium Calleguas Creek at CSUCI
7604	d	DSE	µg/L	Modeled dissolved selenium Calleguas Creek at Potrero.
7605	d	DSE	µg/L	Modeled dissolved selenium Calleguas Creek at PCH
7615	d	DSE	µg/L	Modeled dissolved selenium SF Arroyo Conejo
7612	d	DSE	µg/L	Modeled dissolved selenium Conejo Creek at Hill Canyon
7611	d	DSE	µg/L	Modeled dissolved selenium Conejo Creek at CCDP
7610	d	DSE	µg/L	Modeled dissolved selenium Conejo Creek at Howard Rd.
7614	d	DSE	µg/L	Modeled dissolved selenium NF Arroyo Conejo
7613	d	DSE	µg/L	Modeled dissolved selenium Arroyo Santa Rosa
7607	d	DSE	µg/L	Modeled dissolved selenium Beardsley Wash
7616	d	DSE	µg/L	Modeled dissolved selenium Revolon Slough at Wood Rd.
7606	d	DSE	µg/L	Modeled dissolved selenium Revolon Slough at PCH
7701	d	THG	lbs/ft^3	Modeled particulate mercury load; Arroyo Simi at Royal
7700	d	THG	lbs/ft^3	Modeled particulate mercury load; Arroyo Simi at Madera
7702	d	THG	lbs/ft^3	Modeled particulate mercury load; Tapo Canyon
7709	d	THG	lbs/ft^3	Modeled particulate mercury load; Arroyo Simi at Hitch
7717	d	THG	lbs/ft^3	Modeled particulate mercury load; Las Posas at Seminary
7708	d	THG	lbs/ft^3	Modeled particulate mercury load; Calleguas at 101

7703	d	THG	lbs/ft^3	Modeled particulate mercury load; Calleguas CSUCI
7704	d	THG	lbs/ft^3	Modeled particulate mercury load; Calleguas at Potrero
7705	d	THG	lbs/ft^3	Modeled particulate mercury load; Calleguas Creek at PCH
7715	d	THG	lbs/ft^3	Modeled particulate mercury load; SF Arroyo Conejo
7712	d	THG	lbs/ft^3	Modeled particulate mercury load; Conejo at Hill Canyon
7711	d	THG	lbs/ft^3	Modeled particulate mercury load; Conejo Creek at CCDP
7710	d	THG	lbs/ft^3	Modeled particulate mercury load; Conejo at Howard Rd.
7714	d	THG	lbs/ft^3	Modeled particulate mercury load; NF Arroyo Conejo
7713	d	THG	lbs/ft^3	Modeled particulate mercury load; Arroyo Santa Rosa
7707	d	THG	lbs/ft^3	Modeled particulate mercury load; Beardsley Wash
7716	d	THG	lbs/ft^3	Modeled particulate mercury load; Revolon Slough at Wood
7706	d	THG	lbs/ft^3	Modeled particulate mercury load; Revolon Slough at PCH
7801	d	DHG	µg/L	Modeled dissolved mercury Arroyo Simi at Royal
7800	d	DHG	µg/L	Modeled dissolved mercury Arroyo Simi at Madera
7802	d	DHG	µg/L	Modeled dissolved mercury Tapo Canyon.
7809	d	DHG	µg/L	Modeled dissolved mercury Arroyo Simi at Hitch Rd.
7817	d	DHG	µg/L	Modeled dissolved mercury Las Posas at Seminary Rd.
7808	d	DHG	µg/L	Modeled dissolved mercury Calleguas Creek at 101
7803	d	DHG	µg/L	Modeled dissolved mercury Calleguas Creek at CSUCI
7804	d	DHG	µg/L	Modeled dissolved mercury Calleguas Creek at Potrero.
7805	d	DHG	µg/L	Modeled dissolved mercury Calleguas Creek at PCH
7815	d	DHG	µg/L	Modeled dissolved mercury SF Arroyo Conejo
7812	d	DHG	µg/L	Modeled dissolved mercury Conejo Creek at Hill Canyon
7811	d	DHG	µg/L	Modeled dissolved mercury Conejo Creek at CCDP
7810	d	DHG	µg/L	Modeled dissolved mercury Conejo Creek at Howard Rd.
7814	d	DHG	µg/L	Modeled dissolved mercury NF Arroyo Conejo
7813	d	DHG	µg/L	Modeled dissolved mercury Arroyo Santa Rosa
7807	d	DHG	µg/L	Modeled dissolved mercury Beardsley Wash
7816	d	DHG	µg/L	Modeled dissolved mercury Revolon Slough at Wood Rd.
7806	d	DHG	µg/L	Modeled dissolved mercury Revolon Slough at PCH
8004	d	BTAU	lb/ft^2	Modeled bed shear stress Arroyo Simi at Royal
8008	d	BTAU	lb/ft^2	Modeled bed shear stress Arroyo Simi at Madera
8046	d	BTAU	lb/ft^2	Modeled bed shear stress Tapo Canyon
8205	d	BTAU	lb/ft^2	Modeled bed shear stress Arroyo Simi at Hitch Rd.
8207	d	BTAU	lb/ft^2	Modeled bed shear stress Las Posas at Seminary Rd.
8302	d	BTAU	lb/ft^2	Modeled bed shear stress Calleguas Creek at 101
8304	d	BTAU	lb/ft^2	Modeled bed shear stress Calleguas Creek at CSUCI
8305	d	BTAU	lb/ft^2	Modeled bed shear stress Calleguas Creek at Potrero Rd.
8306	d	BTAU	lb/ft^2	Modeled bed shear stress Calleguas Creek at PCH
8403	d	BTAU	lb/ft^2	Modeled bed shear stress SF Arroyo Conejo
8404	d	BTAU	lb/ft^2	Modeled bed shear stress Conejo Creek at Hill Canyon
8407	d	BTAU	lb/ft^2	Modeled bed shear stress Conejo Creek at CCDP
8408	d	BTAU	lb/ft^2	Modeled bed shear stress Conejo Creek at Howard Rd.
8431	d	BTAU	lb/ft^2	Modeled bed shear stress NF Arroyo Conejo
8442	d	BTAU	lb/ft^2	Modeled bed shear stress Arroyo Santa Rosa
8503	d	BTAU	lb/ft^2	Modeled bed shear stress Beardsley Wash
8505	d	BTAU	lb/ft^2	Modeled bed shear stress Revolon Slough at Wood Rd.
8506	d	BTAU	lb/ft^2	Modeled bed shear stress Revolon Slough at PCH
9004	d	BEDD	ft	Modeled bed depth Arroyo Simi at Royal
9008	d	BEDD	ft	Modeled bed depth Arroyo Simi at Madera
9046	d	BEDD	ft	Modeled bed depth Tapo Canyon
9205	d	BEDD	ft	Modeled bed depth Arroyo Simi at Hitch Rd.
9207	d	BEDD	ft	Modeled bed depth Las Posas at Seminary Rd.
9302	d	BEDD	ft	Modeled bed depth Calleguas Creek at 101
9304	d	BEDD	ft	Modeled bed depth Calleguas Creek at CSUCI
9305	d	BEDD	ft	Modeled bed depth Calleguas Creek at Potrero Rd.

9306	d	BEDD	ft	Modeled bed depth Calleguas Creek at PCH
9403	d	BEDD	ft	Modeled bed depth SF Arroyo Conejo
9404	d	BEDD	ft	Modeled bed depth Conejo Creek at Hill Canyon
9407	d	BEDD	ft	Modeled bed depth Conejo Creek at CCDP
9408	d	BEDD	ft	Modeled bed depth Conejo Creek at Howard Rd.
9431	d	BEDD	ft	Modeled bed depth NF Arroyo Conejo
9442	d	BEDD	ft	Modeled bed depth Arroyo Santa Rosa
9503	d	BEDD	ft	Modeled bed depth Beardsley Wash
9505	d	BEDD	ft	Modeled bed depth Revolon Slough at Wood Rd.
9506	d	BEDD	ft	Modeled bed depth Revolon Slough at PCH
9210	d	SNDB	ton	Modeled bed sand storage Las Posas at Seninary
9211	d	SILB	ton	Modeled bed silt storage Las Posas at Seninary
9212	d	CLAB	ton	Modeled bed clay storage Las Posas at Seninary
9213	d	SNDC	mg/L	Modeled water sand Las Posas at Seninary
9214	d	SILC	mg/L	Modeled water silt Las Posas at Seninary
9215	d	CLAC	mg/L	Modeled water clay Las Posas at Seninary
9800	d	SNDB	ton	Modeled bed sand storage Arroyo Simi at Royal
9801	d	SILB	ton	Modeled bed silt storage Arroyo Simi at Royal
9802	d	CLAB	ton	Modeled bed clay storage Arroyo Simi at Royal
9803	d	SNDC	mg/L	Modeled water sand Arroyo Simi at Royal
9804	d	SILC	mg/L	Modeled water silt Arroyo Simi at Royal
9805	d	CLAC	mg/L	Modeled water clay Arroyo Simi at Royal
9806	d	SNDB	ton	Modeled bed sand storage Arroyo Simi at Madera
9807	d	SILB	ton	Modeled bed silt storage Arroyo Simi at Madera
9808	d	CLAB	ton	Modeled bed clay storage Arroyo Simi at Madera
9809	d	SNDC	mg/L	Modeled water sand Arroyo Simi at Madera
9810	d	SILC	mg/L	Modeled water silt Arroyo Simi at Madera
9811	d	CLAC	mg/L	Modeled water clay Arroyo Simi at Madera
9812	d	SNDB	ton	Modeled bed sand storage Tapo Canyon
9813	d	SILB	ton	Modeled bed silt storage Tapo Canyon
9814	d	CLAB	ton	Modeled bed clay storage Tapo Canyon
9815	d	SNDC	mg/L	Modeled water sand Tapo Canyon
9816	d	SILC	mg/L	Modeled water silt Tapo Canyon
9817	d	CLAC	mg/L	Modeled water clay Tapo Canyon
9818	d	SNDB	ton	Modeled bed sand storage Arroyo Simi at Hitch
9819	d	SILB	ton	Modeled bed silt storage Arroyo Simi at Hitch
9820	d	CLAB	ton	Modeled bed clay storage Arroyo Simi at Hitch
9821	d	SNDC	mg/L	Modeled water sand Arroyo Simi at Hitch
9822	d	SILC	mg/L	Modeled water silt Arroyo Simi at Hitch
9823	d	CLAC	mg/L	Modeled water clay Arroyo Simi at Hitch
9824	d	SNDB	ton	Modeled bed sand storage Calleguas Creek at 101
9825	d	SILB	ton	Modeled bed silt storage Calleguas Creek at 101
9826	d	CLAB	ton	Modeled bed clay storage Calleguas Creek at 101
9827	d	SNDC	mg/L	Modeled water sand Calleguas Creek at 101
9828	d	SILC	mg/L	Modeled water silt Calleguas Creek at 101
9829	d	CLAC	mg/L	Modeled water clay Calleguas Creek at 101
9830	d	SNDB	ton	Modeled bed sand storage Calleguas Creek at CSUCI
9831	d	SILB	ton	Modeled bed silt storage Calleguas Creek at CSUCI
9832	d	CLAB	ton	Modeled bed clay storage Calleguas Creek at CSUCI
9833	d	SNDC	mg/L	Modeled water sand Calleguas Creek at CSUCI
9834	d	SILC	mg/L	Modeled water silt Calleguas Creek at CSUCI
9835	d	CLAC	mg/L	Modeled water clay Calleguas Creek at CSUCI
9836	d	SNDB	ton	Modeled bed sand storage Calleguas Creek at Potrero
9837	d	SILB	ton	Modeled bed silt storage Calleguas Creek at Potrero
9838	d	CLAB	ton	Modeled bed clay storage Calleguas Creek at Potrero
9839	d	SNDC	mg/L	Modeled water sand Calleguas Creek at Potrero

9840	d	SILC	mg/L	Modeled water silt Calleguas Creek at Potrero
9841	d	CLAC	mg/L	Modeled water clay Calleguas Creek at Potrero
9842	d	SNDB	ton	Modeled bed sand storage Calleguas Creek at PCH
9843	d	SILB	ton	Modeled bed silt storage Calleguas Creek at PCH
9844	d	CLAB	ton	Modeled bed clay storage Calleguas Creek at PCH
9845	d	SNDC	mg/L	Modeled water sand Calleguas Creek at PCH
9846	d	SILC	mg/L	Modeled water silt Calleguas Creek at PCH
9847	d	CLAC	mg/L	Modeled water clay Calleguas Creek at PCH
9848	d	SNDB	ton	Modeled bed sand storage SF Arroyo Conejo
9849	d	SILB	ton	Modeled bed silt storage SF Arroyo Conejo
9850	d	CLAB	ton	Modeled bed clay storage SF Arroyo Conejo
9851	d	SNDC	mg/L	Modeled water sand SF Arroyo Conejo
9852	d	SILC	mg/L	Modeled water silt SF Arroyo Conejo
9853	d	CLAC	mg/L	Modeled water clay SF Arroyo Conejo
9854	d	SNDB	ton	Modeled bed sand storage Conejo Creek at Hill Canyon
9855	d	SILB	ton	Modeled bed silt storage Conejo Creek at Hill Canyon
9856	d	CLAB	ton	Modeled bed clay storage Conejo Creek at Hill Canyon
9857	d	SNDC	mg/L	Modeled water sand Conejo Creek at Hill Canyon
9858	d	SILC	mg/L	Modeled water silt Conejo Creek at Hill Canyon
9859	d	CLAC	mg/L	Modeled water clay Conejo Creek at Hill Canyon
9860	d	SNDB	ton	Modeled bed sand storage Conejo Creek at CCDP
9861	d	SILB	ton	Modeled bed silt storage Conejo Creek at CCDP
9862	d	CLAB	ton	Modeled bed clay storage Conejo Creek at CCDP
9863	d	SNDC	mg/L	Modeled water sand Conejo Creek at CCDP
9864	d	SILC	mg/L	Modeled water silt Conejo Creek at CCDP
9865	d	CLAC	mg/L	Modeled water clay Conejo Creek at CCDP
9866	d	SNDB	ton	Modeled bed sand storage Conejo Creek at Howard
9867	d	SILB	ton	Modeled bed silt storage Conejo Creek at Howard
9868	d	CLAB	ton	Modeled bed clay storage Conejo Creek at Howard
9869	d	SNDC	mg/L	Modeled water sand Conejo Creek at Howard
9870	d	SILC	mg/L	Modeled water silt Conejo Creek at Howard
9871	d	CLAC	mg/L	Modeled water clay Conejo Creek at Howard
9872	d	SNDB	ton	Modeled bed sand storage NF Arroyo Conejo
9873	d	SILB	ton	Modeled bed silt storage NF Arroyo Conejo
9874	d	CLAB	ton	Modeled bed clay storage NF Arroyo Conejo
9875	d	SNDC	mg/L	Modeled water sand NF Arroyo Conejo
9876	d	SILC	mg/L	Modeled water silt NF Arroyo Conejo
9877	d	CLAC	mg/L	Modeled water clay NF Arroyo Conejo
9878	d	SNDB	ton	Modeled bed sand storage Arroyo Santa Rosa
9879	d	SILB	ton	Modeled bed silt storage Arroyo Santa Rosa
9880	d	CLAB	ton	Modeled bed clay storage Arroyo Santa Rosa
9881	d	SNDC	mg/L	Modeled water sand Arroyo Santa Rosa
9882	d	SILC	mg/L	Modeled water silt Arroyo Santa Rosa
9883	d	CLAC	mg/L	Modeled water clay Arroyo Santa Rosa
9884	d	SNDB	ton	Modeled bed sand storage Beardsley Wash
9885	d	SILB	ton	Modeled bed silt storage Beardsley Wash
9886	d	CLAB	ton	Modeled bed clay storage Beardsley Wash
9887	d	SNDC	mg/L	Modeled water sand Beardsley Wash
9888	d	SILC	mg/L	Modeled water silt Beardsley Wash
9889	d	CLAC	mg/L	Modeled water clay Beardsley Wash
9890	d	SNDB	ton	Modeled bed sand storage Revolon Slough at Wood
9891	d	SILB	ton	Modeled bed silt storage Revolon Slough at Wood
9892	d	CLAB	ton	Modeled bed clay storage Revolon Slough at Wood
9893	d	SNDC	mg/L	Modeled water sand Revolon Slough at Wood
9894	d	SILC	mg/L	Modeled water silt Revolon Slough at Wood
9895	d	CLAC	mg/L	Modeled water clay Revolon Slough at Wood

9896	d	SNDB	ton	Modeled bed sand storage Revolon Slough at PCH
9897	d	SILB	ton	Modeled bed silt storage Revolon Slough at PCH
9898	d	CLAB	ton	Modeled bed clay storage Revolon Slough at PCH
9899	d	SNDC	mg/L	Modeled water sand Revolon Slough at PCH
9900	d	SILC	mg/L	Modeled water silt Revolon Slough at PCH
9901	d	CLAC	mg/L	Modeled water clay Revolon Slough at PCH
21004	d	WTEM	ºF	Measured temperature Arroyo Simi at Royal.
21008	d	WTEM	ºF	Measured temperature Arroyo Simi at Madera.
21205	d	WTEM	ºF	Measured temperature Arroyo Simi at Hitch.
21302	d	WTEM	ºF	Measured temperature Calleguas Creek at 101
21305	d	WTEM	ºF	Measured temperature Calleguas Creek at CSUCI
21306	d	WTEM	ºF	Measured temperature Calleguas Creek at PCH
21403	d	WTEM	ºF	Measured temperature SF Arroyo Conejo
21404	d	WTEM	ºF	Measured temperature Conejo Creek at Hill Canyon
21407	d	WTEM	ºF	Measured temperature Conejo Creek at CCDP
21408	d	WTEM	ºF	Measured temperature Conejo Creek at Howard Rd.
21431	d	WTEM	ºF	Measured temperature NF Arroyo Conejo
21442	d	WTEM	ºF	Measured temperature Arroyo Santa Rosa
21503	d	WTEM	ºF	Measured temperature Beardsley Wash
21506	d	WTEM	ºF	Measured temperature Revolon Slough at PCH
22004	d	SEDC	mg/L	Measured TSS Arroyo Simi at Royal.
22008	d	SEDC	mg/L	Measured TSS Arroyo Simi at Madera.
22205	d	SEDC	mg/L	Measured TSS Arroyo Simi at Hitch Rd.
22207	d	SEDC	mg/L	Measured TSS Las Posas at Seminary Rd.
22302	d	SEDC	mg/L	Measured TSS Calleguas Creek at 101
22305	d	SEDC	mg/L	Measured TSS Calleguas Creek at CSUCI
22306	d	SEDC	mg/L	Measured TSS Calleguas Creek at PCH
22403	d	SEDC	mg/L	Measured TSS SF Arroyo Conejo
22404	d	SEDC	mg/L	Measured TSS Conejo Creek at Hill Canyon
22406	d	SEDC	mg/L	Measured TSS Conejo Creek at CCDP
22407	d	SEDC	mg/L	Measured TSS Conejo Creek at Howard Rd.
22431	d	SEDC	mg/L	Measured TSS NF Arroyo Conejo d/s HC
22432	d	SEDC	mg/L	Measured TSS NF Arroyo Conejo u/s HC
22442	d	SEDC	mg/L	Measured TSS Arroyo Santa Rosa
22503	d	SEDC	mg/L	Measured TSS Beardsley Wash
22506	d	SEDC	mg/L	Measured TSS Revolon Slough at PCH
23004	d	HARD	mg/L as $CaCO_3$	Measured hardness Arroyo Simi at Royal
23008	d	HARD	mg/L as $CaCO_3$	Measured hardness Arroyo Simi at Madera
23205	d	HARD	mg/L as $CaCO_3$	Measured hardness Arroyo Simi at Hitch Rd.
23207	d	HARD	mg/L as $CaCO_3$	Measured hardness Las Posas at Seminary Rd.
23303	d	HARD	mg/L as $CaCO_3$	Measured hardness Calleguas Creek at 101
23305	d	HARD	mg/L as $CaCO_3$	Measured hardness Calleguas Creek at CSUCI
23306	d	HARD	mg/L as $CaCO_3$	Measured hardness Calleguas Creek at PCH
23403	d	HARD	mg/L as $CaCO_3$	Measured hardness SF Arroyo Conejo
23404	d	HARD	mg/L as $CaCO_3$	Measured hardness Conejo Creek at Hill Canyon
23407	d	HARD	mg/L as $CaCO_3$	Measured hardness Conejo Creek at CCDP
23408	d	HARD	mg/L as $CaCO_3$	Measured hardness Conejo Creek at Howard Rd.
23431	d	HARD	mg/L as $CaCO_3$	Measured hardness NF Arroyo Conejo
23442	d	HARD	mg/L as $CaCO_3$	Measured hardness Arroyo Santa Rosa
23503	d	HARD	mg/L as $CaCO_3$	Measured hardness Beardsley Wash
23506	d	HARD	mg/L as $CaCO_3$	Measured hardness Revolon Slough at PCH
24004	d	CHLR	mg/L	Measured chloride Arroyo Simi at Royal
24008	d	CHLR	mg/L	Measured chloride Arroyo Simi at Madera
24205	d	CHLR	mg/L	Measured chloride Arroyo Simi at Hitch Rd.
24303	d	CHLR	mg/L	Measured chloride Calleguas Creek at 101
24305	d	CHLR	mg/L	Measured chloride Calleguas Creek at CSUCI

24306	d	CHLR	mg/L	Measured chloride Calleguas Creek at PCH
24403	d	CHLR	mg/L	Measured chloride SF Arroyo Conejo
24404	d	CHLR	mg/L	Measured chloride Conejo Creek at Hill Canyon
24407	d	CHLR	mg/L	Measured chloride Conejo Creek at CCDP
24408	d	CHLR	mg/L	Measured chloride Conejo Creek at Howard Rd.
24431	d	CHLR	mg/L	Measured chloride NF Arroyo Conejo
24442	d	CHLR	mg/L	Measured chloride Arroyo Santa Rosa
24503	d	CHLR	mg/L	Measured chloride Beardsley Wash
24506	d	CHLR	mg/L	Measured chloride Revolon Slough at PCH
25008	d	TCUC	µg/L	Measured total copper: Arroyo Simi at Madera
25205	d	TCUC	µg/L	Measured total copper: Arroyo Simi at Hitch
25303	d	TCUC	µg/L	Measured total copper: Calleguas Creek at 101
25305	d	TCUC	µg/L	Measured total copper: Calleguas Creek at CSUCI
25306	d	TCUC	µg/L	Measured total copper: Calleguas Creek at PCH
25403	d	TCUC	µg/L	Measured total copper: SF Arroyo Conejo
25404	d	TCUC	µg/L	Measured total copper: Conejo Creek at Hill Canyon
25407	d	TCUC	µg/L	Measured total copper: Conejo Creek at 101
25408	d	TCUC	µg/L	Measured total copper: Conejo Creek at Howard
25431	d	TCUC	µg/L	Measured total copper: NF Arroyo Conejo d/s HC
25432	d	TCUC	µg/L	Measured total copper: NF Arroyo Conejo u/s HC
25442	d	TCUC	µg/L	Measured total copper: Arroyo Santa Rosa
25506	d	TCUC	µg/L	Measured total copper: Revolon Slough at PCH
26008	d	TSEC	µg/L	Measured total selenium: Arroyo Simi at Madera
26205	d	TSEC	µg/L	Measured total selenium: Arroyo Simi at Hitch
26303	d	TSEC	µg/L	Measured total selenium: Calleguas Creek at 101
26305	d	TSEC	µg/L	Measured total selenium: Calleguas Creek at CSUCI
26306	d	TSEC	µg/L	Measured total selenium: Calleguas Creek at PCH
26403	d	TSEC	µg/L	Measured total selenium: SF Arroyo Conejo
26404	d	TSEC	µg/L	Measured total selenium: Conejo Creek at Hill Canyon
26407	d	TSEC	µg/L	Measured total selenium: Conejo Creek at CCDP
26408	d	TSEC	µg/L	Measured total selenium: Conejo Creek at Howard
26432	d	TSEC	µg/L	Measured total selenium: NF Arroyo Conejo u/s HC
26442	d	TSEC	µg/L	Measured total selenium: Arroyo Santa Rosa
26506	d	TSEC	µg/L	Measured total selenium: Revolon Slough at PCH
27700	d	THGC	ng/L	Measured total mercury: Arroyo Simi at Madera
27704	d	THGC	ng/L	Measured total mercury: Calleguas Creek at CSUCI
27705	d	THGC	ng/L	Measured total mercury: Calleguas Creek at PCH
27706	d	THGC	ng/L	Measured total mercury: Revolon Slough at PCH
27709	d	THGC	ng/L	Measured total mercury: Arroyo Simi at Hitch
27710	d	THGC	ng/L	Measured total mercury: Conejo Creek at Howard
27711	d	THGC	ng/L	Measured total mercury: Conejo Creek at 101
27712	d	THGC	ng/L	Measured total mercury: Conejo Creek at HC
27713	d	THGC	ng/L	Measured total mercury: Arroyo Santa Rosa
27715	d	THGC	ng/L	Measured total mercury: SF Arroyo Conejo
27718	d	THGC	ng/L	Measured total mercury: NF Arroyo Conejo u/s HC