APPENDIX E: CASE STUDIES

Site-Specific Water Quality Objectives and Water Quality Attainment Strategies for Copper and Nickel in South San Francisco Bay, South of the Dumbarton Bridge

Santa Clara River TMDL For Nitrogen Compounds

SITE-SPECIFIC WATER QUALITY OBJECTIVES AND WATER QUALITY ATTAINMENT STRATEGIES FOR COPPER AND NICKEL IN SOUTH SAN FRANCISCO BAY, SOUTH OF THE DUMBARTON BRIDGE

Waterbody Type:	Estuarine bay
Pollutants:	Copper and nickel
Designated Uses:	Recreation, fisheries, shellfish harvesting, habitat, preservation of rare and endangered species, industrial service supply, navigation
Size of Waterbody:	15-square-mile (mi^2) region of the San Francisco Bay estuary, south of the Dumbarton Bridge
Size of Watershed:	Approximately 800 mi^2
Site Specific Water Quality Objectives (SSOs):	Acute (10.8 µg/L) and chronic (6.9 µg/L) site-specific values for dissolved copper. Acute (62.4 µg/L) and chronic (11.9 µg/L) nickel site-specific objective values.
Indicators:	Toxicity tests to determine whether copper and nickel were negatively impacting resident aquatic life beneficial uses. Evaluation of numeric water quality objectives protective of aquatic life using USEPA-approved methods.
Analytical Approach:	Establishment of SSOs and implementation plan to maintain SSOs, including pollution prevention and source control actions to prevent increases in ambient concentrations of copper and nickel.

Introduction

This summary is based on information contained in the following reports written by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB):

- *Staff Report on Proposed Site-Specific Water Quality Objectives and Water Quality Attainment Strategies for Copper and Nickel for San Francisco Bay, South of the Dumbarton Bridge* (SFBRWQCB, 2002a)
- *Status Report on Copper and Nickel TMDLs and Impairment Assessments in San Francisco Bay* (Looker, 2001)
- *Overview of Proposed Basin Plan Amendment to Establish Site-Specific Water Quality Objectives and Water Quality Attainment Strategies for Copper and Nickel in South San Francisco Bay, South of Dumbarton Bridge—Status Report* (SFBRWQCB, 2002b)
- *Impairment Assessment Report for Copper and Nickel in Lower South San Francisco Bay* (Tetra Tech, 2000).

Lower South San Francisco (LSSF) Bay is in San Francisco Bay along the northern part of California's central coastline. LSSF Bay is approximately 15 mi^2 and is the region of the San Francisco Bay estuary south of the Dumbarton Bridge. LSSF Bay is bordered by the Silicon Valley, and in the 1960s the boom of the electronics industry spurred the fast growth of the region. The continued growth has caused agriculture to decline and increased the demand for residential development, service industries, and transportation networks. LSSF Bay is a physically unique part of the San Francisco Bay estuary. It receives less fresh water because its tributaries are small in number and size. It is characterized by higher, more uniform salinities and is shallow with the exception of a deep central channel. Immediately adjacent to LSSF Bay lies a network of tidal mudflats, tidal sloughs, coastal salt marshes, diked salt marshes, brackish water marshes, salt ponds, and freshwater marshes, each of which has unique hydrologic properties.

The LSSF Bay watershed is part of the approximately 800-mi^2 Santa Clara Basin. This watershed has a population of approximately 1.7 million and is mostly urbanized, with some agricultural uses in the rural upper watershed areas. It is one of the fastest growing regions in California.

Problem Identification and Impairment Analysis

SFBRWQCB's Basin Plan sets standards for surface waters and groundwater in the region. These standards consist of designated beneficial uses for surface and groundwater, numeric and narrative WQOs necessary to support beneficial uses, and the state's antidegradation policy. California's numeric WQOs for copper and nickel established in Basin Plans and statewide water quality control plans are based on USEPA's national water quality criteria to protect aquatic life. Despite significant reductions in waterwater loadings over the past decade, copper and nickel concentrations were not meeting WQOs on a consistent basis in LSSF Bay.

In 1998, the SFBRWQCB and U.S. Environmental Protection Agency (USEPA) updated the state's 303(d) list and identified copper and nickel as pollutants of concern in LSSF Bay. Despite significant reductions in wastewater loadings over the past decade, ambient concentrations of dissolved copper and nickel in LSSF Bay were still approaching or exceeding Basin Plan water quality objectives (WQOs) and USEPA national water quality criteria for the protection of aquatic life. However, further reductions in mass loading by wastewater dischargers could be difficult and costly, without providing corresponding water quality improvements. Other sources that are difficult to manage such as urban runoff, copper in brake pads, historical deposits of copper in bay sediments, and natural sources of copper and nickel are among the dominant contributions to current ambient water concentrations.

The listing required the SRBRWQCB to establish Total Maximum Daily Loads (TMDLs) for copper and nickel. The TMDL effort began in 1998 with a focus on assessing the impairment to determine whether levels of copper and nickel in LSSF Bay were negatively impacting aquatic life beneficial uses.

The results of the impairment assessment indicated that beneficial use impairment in LSSF Bay due to ambient copper and nickel concentrations was unlikely and that the WQOs could be relaxed while still fully protecting beneficial uses. Toxicity testing indicated that water column concentrations of dissolved copper did not exceed chronic toxicity values for the most sensitive species for copper toxicity. Copper toxicity in LSSF Bay is reduced by the presence of dissolved organic compounds that bind copper, making it less bioavailable, and by the presence of other metals that compete with copper for receptor sites on the organism. Similarly, site-specific studies in LSSF Bay demonstrated that nickel toxicity is lower in ambient site-water than predicted by the national water quality criteria, possibly because of the organic binding of nickel and the presence of other metals that compete with nickel for receptor sites on or in the organism.

Because it was determined that ambient concentrations of dissolved copper and nickel were not likely impairing LSSF Bay beneficial uses, a full TMDL with allocations and a margin of safety was not necessary. Rather, the project focused on developing scientifically justified site-specific objectives (SSOs) for copper and nickel that would protect beneficial uses.

Development of Site-Specific Water Quality Objectives

Because the impairment analysis indicated that WQOs could be relaxed and still protect beneficial uses, SSOs were developed for copper and nickel in LSSF Bay. SSOs may be developed where conditions warrant less stringent effluent limits than those based on promulgated water quality standards or objectives, without compromising the beneficial uses. SSOs may be appropriate where an existing objective cannot be met through reasonable treatment, source control, and pollution prevention measures.

Copper and nickel SSOs were selected by the Regional Board from ranges of possible objectives that were scientifically defensible and protective of beneficial uses in LSSF Bay. The following two USEPA-approved methods were used to identify SSOs for copper and nickel:

- Recalculation Procedure – The recalculation procedure allows modification of the national criterion by correcting, adding, or removing data from the national toxicity database. Toxicity databases are collections of laboratory-measured toxicity values for various species and form the basis of water quality criteria promulgated by USEPA. The goal of the Recalculation Procedure is to create an appropriate data set for deriving a site-specific criterion by modifying the national data set as follows:
    a. Correction of data that are in the national database;
    b. Addition of data to the national database; and/or
    c. Deletion of data from the national database (e.g. elimination of data for non-resident species).

- Indicator Species Procedure – This procedure allows modifications of the national criterion by using a site-specific multiplier, called a water effects ratio (WER), to account for ambient water quality characteristics affecting the bioavailability of metals like copper and nickel. A WER is the ratio of toxicity of a given pollutant in site water to toxicity in laboratory water, based on toxicity tests administered to an appropriately sensitive species. A WER accounts for the site-specific toxicity of a metal due to the effects of other constituents in the site water. If the value of the WER exceeds 1.0, the site water reduces the toxic effects of the pollutant being tested. For example, a waterbody with a WER of 2 suggests that the ambient water concentration could be double its laboratory water value while affording the same protection for aquatic organisms. The WER is multiplied by the USEPA water quality criteria values to develop adjusted acute and chronic criteria.

The Recalculation and Indicator Species procedures were applied to develop ranges of chronic SSOs for copper and nickel in the LSSF Bay. Because the chronic objectives are more restrictive, the most appropriate and scientifically defensible chronic value was chosen from the range and the corresponding acute values were chosen as acute SSOs.

The development of a range of SSOs for copper in the LSSF Bay involved combining the Recalculation Procedure and the Indicator Species Procedure. The range of 5-12 µg/L dissolved copper for the chronic

SSO resulted from using the different combinations of toxicity databases, acute-to-chronic ratios, and WERs. The selected chronic SSO for dissolved copper is 6.9 µg/L with the corresponding acute value of 10.8 µg/L. The single SSO values were determined to be the most appropriate and technically justifiable values within the range considering all calculation approaches.

The nickel SSO was developed using the Recalculation Procedure only. A new acute value and a new acute-to-chronic ratio were developed by adding laboratory toxicity data for additional species to the national database. Adding species to the database resulted in a range of nickel chronic SSOs between 11.9 and 24 µg/L. The lower value of the range was chosen as the chronic SSOs for nickel (11.9 µg/L) with a corresponding acute SSO of 62.4 µg/L.

Source Assessment

The TMDL effort included the quantification of major copper and nickel sources entering the LSSF Bay (wastewater discharges, tributary loads, atmospheric deposition, and sediment exchange). Loading estimates and the seasonal variation of these loadings were identified.

Three Santa Clara Valley advanced wastewater treatment plants discharge into LSSF Bay—San Jose/Santa Clara, Palo Alto, and Sunnyvale. The San Jose/Santa Clara Water Pollution Control Plant is the largest of the three publicly owned treatment works (POTWs) discharging an average dry weather (June-November) effluent flow of approximately 122 million gallons per day. The Sunnyvale plant discharged, on average, 14 million gallons per day over the same period. The Palo Alto treatment plant discharges an average dry weather flow of approximately 26 million gallons per day (1998-2000). Significant reductions in copper and nickel loading have been accomplished through the improved treatment technologies implemented at wastewater treatment facilities, industrial pre-treatment programs, and basin-wide pollution prevention efforts. More than 20 years ago, POTWs contributed approximately 30,000 kilograms per year (kg/y) of total copper to LSSF Bay. Today, the POTWs contribute 1,100 kg/y, or about 4 percent of the loadings of 20 years ago. Similarly for total nickel, over 20 years ago POTWs contributed approximately 12,000 kg/y to the LSSF Bay. Today, the POTWs contribute 1,500 kg/y total nickel, or about 12 percent of the loadings of 20 years ago. In the past 10 years alone, total copper and total nickel loads from POTWs have decreased by about 70 percent.

Stormwater runoff is another source of metals to the LSSF Bay. The Santa Clara Valley Urban Runoff Pollution Prevention Program is an association of 13 cities and towns in Santa Clara Valley, the County of Santa Clara, and the Santa Clara Valley Water District that share a common permit to discharge stormwater to LSSF Bay.

Other sources of metals to LSSF Bay are difficult to manage and include historical deposits of copper in bay sediments and natural sources of copper and nickel. Atmospheric deposition is most likely a small source of nickel and copper loading.

Linking Water Quality and Pollutant Sources

Sources of copper and nickel were characterized through the development of a model relating sources to levels of copper and nickel in LSSF Bay and the identification of pollution prevention and control actions. The information related to development of the conceptual model is included in the Conceptual Model Report (Tetra Tech, 1999) for copper and nickel behavior in the LSSF Bay. The Conceptual Model Report presents the information developed on loadings, sediment transport, copper and nickel cycling, the relative importance of various forcing functions, and the ecological effects of these metals. The current total and dissolved copper and nickel loading to LSSF Bay included in the Conceptual Model Report includes both internal and external loading. External loading includes sources originating on the land (e.g., POTW effluent, stormwater, etc.) and internal loading consists of loadings delivered to the water column from resuspension and diffusion from sediments. The model estimated how changing the copper and nickel loading from any particular source would influence both dissolved and total water column concentrations.

Internal metal loading can be influenced by sediments in the following two ways: diffusion of dissolved metal from the sediments to the water column (this contributes both dissolved and total metals loading) and re-suspension of sediments (this contributes total metals loading). Internal loading can also include "internal cycling" in which changes occur in the exchange rates of dissolved copper and nickel between water and suspended sediments. When this phenomenon occurs, metals bound to mineral or soil surfaces are liberated when sediments are churning and mixing. Metals can also bind to suspended sediment and phytoplankton surfaces during spring blooms resulting in a loss of dissolved metals from the water column. The magnitudes of internal cycling fluxes are similar. They represent a net dissolved metals *source* during the dry season and a net dissolved metals *sink* during the wet season.

Total copper and total nickel can also enter the bay from external pathways, including POTWs, tributaries, and atmospheric deposition. The following tables summarize the model results for copper and nickel loadings to LSSF Bay.

Summary of Estimated Copper Loading to LSSF Bay

Copper Source	Total Copper Loading			Dissolved Copper Loading		
	Dry season	Wet Season	Annual	Dry season	Wet Season	Annual
	kg/y	kg/y	kg/y	kg/y	kg/y	kg/y
POTWs	500	700	1,200	400	560	960
Tributaries (including stormwater runoff from tributary watersheds)	160	3,600	3,800	130	360	490
Atmospheric Deposition	60	60	120	0	0	0
Diffuse Flux from Sediments	110	110	220	110	110	220
Net Particulate Flux from Sediments	6,300-7,100	5,200-5,900	12,000-13,000	0	0	0
Internal Cycling (not a load)	0	0	0	540	-140	400

Summary of Estimated Nickel Loading to LSSF Bay

Nickel Source	Total Nickel Loading			Dissolved Nickel Loading		
	Dry season	Wet Season	Annual	Dry season	Wet Season	Annual
	kg/y	kg/y	kg/y	kg/y	kg/y	kg/y
POTWs	800	940	1700	640	750	1,300
Tributaries (including stormwater runoff from tributary watersheds)	40	6,000	6,000	32	600	632
Atmospheric Deposition	15	15	30	0	0	0
Diffuse Flux from Sediments	360	360	720	360	360	720
Net Particulate Flux from Sediments	16,000-18,000	15,000-16,000	31,000-34,000	0	0	0
Internal Cycling (not a load)	0	0	0	700	-590	110

Monitoring Plan

A monitoring plan for the LSSF Bay has been established to evaluate compliance with SSOs. The plan consists of the following specific programs:

- Receiving Water Monitoring Program: Twelve receiving water stations were selected based on historical monitoring programs and records in the LSSF Bay. Two upland stations (i.e., Guadalupe River and Coyote Creek) were included to continue to provide tributary data. Dissolved copper and nickel are measured monthly.

- Reporting Program: The results of the monitoring will be reported as part of the POTWs' self-monitoring program.

- Response Program: The implementation plan identifies receiving water "triggers" linked to additional control actions in such a way that exceedance of the triggers is clear evidence that a response or action is required.

In addition to evaluating compliance with SSOs, monitoring will also be used to evaluate ambient conditions compared to "trigger" levels. Trigger levels were determined through statistical analysis used to evaluate the expected performance of dissolved copper and dissolved nickel as monitoring indicators. The analyses identified the amount of reliable detection despite the inherent variability in concentrations. These amounts were established as triggers to be included in the implementation plan. For example, the Phase I copper trigger is 0.8 µg/L, meaning that if the average dry season dissolved copper concentration increases from 3.2 µg/L to 4.0 µg/L, the Phase I trigger is reached and the Phase I actions in the implementation plan will be conducted.

Implementation Plan

SSOs must be supported by an implementation plan. The proposed copper and nickel SSOs are currently being achieved and must therefore be maintained. For that reason, the implementation plan for copper and nickel in LSSF Bay is designed to prevent water quality degradation and to ensure the ongoing attainment of the SSOs. The implementation plan includes

- Current control measures to minimize copper and nickel discharges from municipal wastewater and urban runoff sources (NPDES permits and Municipal Urban Runoff Program);
- Statistically based water quality “triggers” and a receiving water monitoring program that would initiate additional control measures if the “triggers” are met;
- A proactive framework for addressing increases to copper and nickel concentrations if they occur in the future; and
- Metal translators that will be used to compute copper and nickel effluent limits for the municipal discharges to LSSF Bay.

The implementation plan also includes a time schedule for the actions to be taken to support the copper and nickel SSOs. The implementation actions will be coordinated by the RWQCB in cooperation with other parties. The principal mechanisms for implementation of the actions are NPDES permits for POTWs and Municipal Urban Runoff Programs.

The implementation actions are divided into the following three categories that are linked to the water quality triggers:

- Baseline Actions—These existing actions include 1) programmatic actions by public agencies, 2) tracking special studies that address specific technical areas of uncertainty identified in the impairment assessment and the conceptual model evaluation, 3) planning studies to track, evaluate, and/or develop additional indicators for use as future indicators and triggers (e.g., indicators for growth, development, or increased use or discharge of copper and nickel in the watershed, and water recycling efforts).
- Phase I Actions—These actions are implemented when the values of selected monitoring parameters exceed specified criterion values (referred to as the Phase I Trigger Levels). Exceedance of Phase I Trigger Levels indicates a negative water quality trend rather than actual impairment. Phase I actions consist of both specific remedial actions and the planning for the implementation of further actions if Phase II trigger levels are exceeded.
- Phase II Actions—These will be implemented when the value of selected monitoring parameters exceeds a second-level criterion value (referred to as the Phase II trigger levels). These actions are intended to reduce controllable sources further to maintain compliance with SSOs.

Public Participation

TMDL efforts for copper and nickel in LSSF Bay began in January 1998. The Santa Clara Basin Watershed Management Initiative formed the Copper and Nickel TMDL Work Group as a stakeholder forum to oversee and provide guidance for the development of the TMDLs. The TMDL Work Group included representatives from regulatory and resource agencies, environmental advocacy groups, industry, and municipalities. The TMDL Work Group oversaw the preparation and review of several technical reports including the Conceptual Model Report and the Impairment Assessment Report. These reports provided the basis for the findings and recommendations regarding the effects of ambient levels of copper and nickel on the beneficial uses of LSSF Bay. Facilitated public participation was key to acceptance and buy-in of the project results.

The Regional Board also submitted a request for external peer review of the technical basis of the Basin Plan amendments. Professors in the Department of Civil and Environmental Engineering at the University of California, Berkeley, performed the review.

On April 5, 2002, the SFBRWQCB sent a public hearing notice on the proposed amendment to the Water Quality Control Plan for the San Francisco Bay Basin. At this public hearing on May 22, 2002, the SFBRWQCB removed the LSSF Bay from the 303(d) list of impaired waters with respect to copper and nickel, and adopted the Basin Plan amendment establishing acute and chronic SSOs for dissolved concentrations of copper and nickel in LSSF Bay and incorporating anti-degradation actions for copper and nickel.

References

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SFBRWQCB (San Francisco Bay Regional Water Quality Control Board). 2002a. *Staff Report on Proposed Site-Specific Water Quality Objectives and Water Quality Attainment Strategy for Copper and Nickel for San Francisco Bay South of the Dumbarton Bridge*. Final Staff Report. California Regional Water Quality Control Board, San Francisco Bay Region, Oakland, CA. May 15, 2002.

SFBRWQCB (San Francisco Bay Regional Water Quality Control Board). 2002b. *Staff Summary Report Meeting. Overview of Proposed Basin Plan Amendment to Establish Site-Specific Water Quality Objectives and Water Quality Attainment Strategies for Copper and Nickel in South San Francisco Bay, South of the Dumbarton Bridge — Status Report.* California Regional Water Quality Control Board, San Francisco Bay Region, Oakland, CA. April 17, 2002.

Tetra Tech, 1999. (CMR) *Conceptual model report for copper and nickel in lower South San Francisco Bay (Final Report).*

Tetra Tech. 2000. *Impairment Assessment Report for Copper and Nickel in Lower South San Francisco Bay.* Report prepared for the City of San Jose, CA. June 2000.

SANTA CLARA RIVER TMDL FOR NITROGEN COMPOUNDS

Waterbody Type:	River
Pollutants:	Nitrogen Compounds (ammonia, nitrate and nitrite)
Designated Uses:	Municipal and domestic supply; groundwater recharge; agricultural and industrial supply; recreation; cold, warm, wild, rare, wetland freshwater and wildlife habitats
Size of Waterbody:	100 miles
Size of Watershed:	1,200 mi^2
Water Quality Standards:	Narrative and numeric standards
Indicators:	Elevated levels of ammonia cause toxicity to aquatic organisms; elevated levels of oxidized nitrogen cause eutrophic effects in freshwater systems
Analytical Approach:	Hydrodynamic and water quality modeling linkage analysis from documented nutrient sources to in-river nitrogen concentrations

Introduction

This summary was based on information obtained from the Santa Clara River TMDL for Nitrogen Compounds Staff Report (2003). This TMDL was written by the California Regional Water Quality Control Board, Los Angeles Region, and released on June 16, 2003. On August 7, 2003, the California Regional Water Quality Control Board (Regional Board) adopted the amendment to the Water Quality Control Plan (Basin Plan) for the Los Angeles Region to incorporate a TMDL to reduce nitrogen compounds loading to the Santa Clara River. The TMDL development process was a facilitated approach with significant stakeholder input and participation.

Santa Clara River is located in Los Angeles and Ventura Counties. The river drains from the east beginning in the Transverse Ranges and flows into the Pacific Ocean. It is the largest river system in the Los Angeles Region that remains in a relatively natural state. However, the watershed has been subjected to significant land use and flow modifications due to urbanization and agriculture. The endangered steelhead trout and stickleback reside in this river system.

Problem Identification

USEPA listed reaches of the Santa Clara River on its 1998 303(d) list of impaired waterbodies in California for elevated ammonia and oxidized nitrogen levels. In 2002, the State of California again proposed listing the Santa Clara River on the 2002 303(d) list as impaired as a result of nitrogen compound impairments. Discharge of wastes containing nitrite, nitrate, and ammonia to the Santa Clara River caused exceedances of the water quality objectives for ammonia, nitrate, and nitrite established in the Basin Plan.

Applicable Water Quality Standards and Numeric Water Quality Targets

States adopt water quality standards to protect public health and welfare, enhance water quality, and serve the purposes of the federal Clean Water Act (CWA). Water quality standards consist of the following elements 1) designated beneficial use(s) for a waterbody 2) the numeric and/or narrative objectives to protect these use(s), and 3) the prevention of water quality degradation through anti-degradation procedures. CWA Section 303 (c) requires states to adopt and modify, as appropriate, water quality standards for surface waters.

The California Water Quality Control Plan, Los Angeles Region (Basin Plan) sets standards for surface waters and groundwater in the region. These standards are comprised of designated beneficial uses for surface and groundwater, and numeric and narrative water quality objectives (WQOs) necessary to support beneficial uses, and the state's antidegradation policy. California's numerical WQOs established in Basin Plans and Statewide water quality control plans are based on USEPA's national water quality criteria to protect aquatic life.

The WQOs and Numeric Targets applicable to the impaired reaches of the Santa Clara River for Total Ammonia Nitrogen (mg/L Nitrogen) include:

Reach	WQO		Numeric Target	
	1-Hour Average	30-Day Average	1-Hour Average	30-Day Average
Reach 8	16.5	3.5	14.8	3.2
Reach 7 Above Valencia	5.5	2.2	4.8	2.0
Reach 7 Below Valencia	6.1	2.3	5.5	2.0
Reach 7 at County Line	3.8	1.3	3.4	1.2
Reach 3 above Santa Paula	2.7	2.1	2.4	1.9
Reach 3 at Santa Paula	2.7	2.1	2.4	1.9
Reach 3 below Santa Paula	2.4	1.9	2.2	1.7

The WQOs and Numeric Targets applicable to the impaired reaches of the Santa Clara River for Nitrate plus Nitrite as Nitrogen include:

Reach	WQO (30-Day Average)	Numeric Target (30-Day Average)
Reach 8	10	9.0
Reaches 3 and 7	5	4.5

Numeric targets and allocations for ammonia, nitrate and nitrite were set according to a model scenario, which attained water quality objectives with a 10 percent margin of safety.

Narrative objectives for biostimulatory substances and toxicity in the Basin Plan specify that "Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses…" The Basin Plan also states that "All waters shall be maintained free of toxic substances in concentrations that are toxic to, or produce detrimental physiological responses in human, plant and aquatic life…" The TMDL analysis indicates that achieving the numeric targets will also implement the narrative objectives. The Implementation Plan includes monitoring and special studies to verify that the TMDL will implement the narrative objectives.

Source Assessment

Nutrient sources were characterized based on data from the Regional Board permit programs, agencies responsible for reservoir releases and groundwater basin management, agricultural experts, municipalities, and water treatment agencies. Direct point sources were assessed by evaluating discharge monitoring reports and from other data supplied by major dischargers.

Sources of ammonia, nitrite and nitrate to the Santa Clara River were characterized in order of relative impact as:

- Point discharges from the Saugus and Valencia Water Reclamation Plants (WRPs) and the Fillmore and Santa Paula Publicly Owned Treatment Works (POTWs),
- Groundwater with nonpoint source loading, and other nonpoint sources. There was insufficient data to characterize nitrogen sources from groundwater, septic systems, and agricultural drainage and runoff. The nonpoint source load contribution was determined to be greater in wet years than dry years.

Loading Capacity-Linking Water Quality and Pollutant Sources

Hydrodynamic and water quality modeling was utilized to link the documented nutrient sources to the instream water quality. The primary purpose of the model was to calculate TMDLs for the water quality impaired river segments in the watershed.

The Watershed Analysis Risk Management Framework (WARMF) was used to model the hydrodynamic characteristics and water quality of the Santa Clara River. The model was run on a daily time step to accurately calibrate the model and include a variety of hydrologic conditions. The WARMF model provided the ability to predict chemical transformation of nutrient species with varying pH and dilution and to integrate large amounts of data and area. The analysis demonstrated that major point sources (WRPs and POTWs) were the primary contributors to instream ammonia and nitrate plus nitrite loads. Nonpoint sources and minor point sources contributed a much smaller fraction of these loads. Critical conditions were identified as occurring during low flows.

Allocations

This TMDL study evaluated a number of nitrogen allocations from point and nonpoint sources present in the reaches of the Santa Clara River. Allocations were established for major point sources, minor point sources, municipal separate stormwater sewer systems (MS4s) and stormwater sources, and nonpoint sources (e.g., septic systems, agricultural discharges).

Wasteload allocations were set through an analysis of different alternatives constructed using observed meteorological conditions from 1989 to 2000, based on the calibrated WARMF model. Because the major sources in the Santa Clara River affecting nitrogen compounds are several WRPs, the analysis considered four scenarios to evaluate the relative impacts of the point sources, their combined effects and the effects of planned WRP upgrades. The first alternative considered point source effluent concentrations at the numeric targets for the respective nutrients. Alternative 2 involved reducing the ammonia loading from the Saugus WRP, leaving all other effluent concentrations equal to targets.

Alternative 3 considered the expected performance of the two WRPs undergoing upgrades to include a Nitrification-Denitrification module. Based on the results of Alternative 3, an "Intermediate Scenario," Alternative 4, was constructed, with the goal of meeting the numeric targets and yet recognizing the feasibility of performance of the upgraded Nitrification-Denitrification processes at the WRPs (including lower nitrate+nitrite concentrations). Alternative 4 was the selected alternative since the action would:

- Be consistent with State and federal water quality regulations;
- Consider the expected performance of upgraded WRP;
- Facilitate development of appropriate waste load allocations to meet numeric targets and recognize the feasibility of performance of the upgraded NDN processes at the WRPs; and
- Improve the scientific basis upon which the waste load allocations are based.

Concentration-based wasteloads were allocated to the major point sources of ammonia and nitrate+nitrite. The Implementation Plan provides reconsideration of the WLAs by the Regional Board based on WER studies and updated data 5 years after the effective date of the TMDL.

Minor point sources and MS4s were considered to contribute minor loads of ammonia, nitrite or nitrate to the Santa Clara River. Since these sources can potentially have localized effects on water quality, they were allocated concentration-based wasteloads equivalent to the water quality objective.

Concentration-based load allocations for nonpoint sources were also set equivalent to the water quality objectives. Nonpoint source nitrite loading was found to be very low throughout the watershed. Monitoring is established in the TMDL Implementation Plan to verify the nitrogen nonpoint source contributions from agricultural and urban runoff and groundwater discharges.

Margin of Safety

An explicit margin of safety of 10 percent of the nitrogen loads was allocated to address uncertainty in the source and linkage analysis. In addition, an implicit margin of safety was incorporated through conservative model assumptions and statistical analysis.

Implementation and Monitoring Plan

The Implementation Plan was designed to meet water quality objectives for nitrate, nitrite, and ammonia and to ensure protection of beneficial uses in the Santa Clara River. The implementation plan includes special studies and monitoring to assess aquatic life and eutrophic impacts of the Santa Clara River. The plan will also evaluate the effectiveness of nitrogen reductions in implementing narrative objectives.

Ammonia, nitrite, and nitrate reductions will be regulated through effluent limits prescribed in POTWs and minor point source NPDES permits; management practices (MPs) required in NPDES MS4 permits; and State Water Resources Control Board (SWRCB) Management Measures for nonpoint source discharges. Monitoring of effluent and receiving water requirements will be developed for the POTWs to ensure compliance of narrative and numeric standards. Additional monitoring will be required during dry and wet weather discharges to refine point source loading estimates from minor sources and nonpoint sources (agricultural, urban and open space sources). Implementation and evaluation of agricultural MPs and groundwater conditions will be utilized.

The implementation plan also includes upgrades to the WRPs and POTWs discharging to the Santa Clara River for removal of ammonia, nitrate, and nitrite. To allow time for completion of the nitrification/denitrification facilities and/or modifications of existing nitrification/denitrification facilities which are integral to this TMDL, the amendment to the Basin Plan made by this TMDL allows for higher interim loads which the Regional Board can incorporate into NPDES permits as interim effluent limits for a period not to exceed five years from the effective date of the TMDL.

Implementation tasks, milestones, provisions, responsible parties, and completion dates have been identified in the implementation plan.

Reasonable Assurances

Reasonable assurances were not specifically addressed in the Santa Clara River TMDL for Nitrogen Compounds. However, compliance with the TMDL requirements will be attained through the existing NPDES program and the implementation plan to meet water quality objectives for nitrate, nitrite, and ammonia, and to ensure protection of beneficial uses in the Santa Clara River.

Public Participation

The stakeholder involvement process for the Santa Clara River Nutrient TMDL began in November 2001 with a kick-off meeting led by the Regional Board. Stakeholders included representatives of wastewater treatment plants, cities, counties, private property owners, agricultural organizations, and environmental groups with interests in the watershed.

A Steering Committee was formed to allow those stakeholders interested in taking a more active role in the TMDL technical work to guide and participate in the analysis. Steering committee meetings were held monthly, with quarterly stakeholder meetings for summary and update purposes. The Steering Committee members contracted outside experts to provide technical facilitation and modeling services in support of the TMDL analysis.

Efforts to solicit public review and comment on the TMDL included more than eighteen public workshops held between February 11, 2002 and June 13, 2003; public notification 45 days preceding the Board hearing; and responses from Regional Board staff to oral and written comments received from the public.

References

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