CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD SAN DIEGO REGION

RESOLUTION NO. R9-2007-0043

A RESOLUTION ADOPTING AN AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SAN DIEGO BASIN (9) TO INCORPORATE TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD, AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY,

AND TO REVISE THE TOXIC POLLUTANTS SECTION OF CHAPTER 3 TO REFERENCE THE CALIFORNIA TOXICS RULE

WHEREAS, The San Diego Regional Water Quality Control Board (hereinafter, San Diego Water Board), finds that:

1. **BASIN PLAN AMENDMENT**: Total Maximum Daily Loads (TMDLs) and allocations for pollutants that exceed water quality objectives in waterbodies that do not meet water quality standards under the conditions set forth in section 303(d) of the Clean Water Act [33 U.S.C. 1250, *et seq*., at 1313(d)] ("Water Quality Limited Segments") should be incorporated into the *Water Quality Control Plan for the San Diego Basin (9)* (Basin Plan) pursuant to Article 3, commencing with section 13240, of Chapter 4 of the Porter-Cologne Water Quality Control Act, as amended, codified in Division 7, commencing with section 13000, of the Water Code.

2. **CLEAN WATER ACT SECTION 303(d)**: The lowest 1.2 miles of Chollas Creek (from the mouth of Chollas Creek at San Diego Bay to 1.2 miles inland) were placed on the List of Water Quality Limited Segments in 1996 due to levels of dissolved copper, lead, and zinc (metals) in the water column that exceeded numeric water quality objectives for copper, lead, and zinc, and narrative water quality objectives for toxicity, as required by Clean Water Act (CWA) section 303(d).

3. **BENEFICIAL USE IMPAIRMENTS**: Two beneficial uses exist in Chollas Creek that are sensitive to, and subject to impairment by elevated concentrations of dissolved metals in the water column. Warm Freshwater Habitat (WARM) and Wildlife Habitat (WILD) require water quality suitable for the protection of aquatic life and aquatic dependent wildlife. Dissolved metals are toxic to aquatic life and aquatic dependent wildlife at relatively low concentrations. Concentrations of dissolved metals in Chollas Creek exceed the water quality necessary to support the WARM and WILD beneficial uses of Chollas Creek.

4. **NECESSITY STANDARD** [Government Code section 11353(b)]: Amendment of the Basin Plan to establish and implement TMDLs for Chollas Creek is necessary because the existing water quality in the lowest 1.2 miles of Chollas Creek does not meet applicable water quality objectives for copper, lead, zinc, or toxicity. CWA section 303(d) requires the establishment and implementation of TMDLs under the conditions that exist in Chollas

Creek. TMDLs for copper, lead, and zinc are necessary to ensure attainment of applicable water quality objectives and restoration of water quality needed to support the beneficial uses designated for Chollas Creek.

5. **WATER QUALITY OBJECTIVES**: The United States Environmental Protection Agency (USEPA) has established numeric criteria for toxic pollutants which are applicable water quality objectives for dissolved copper, lead, and zinc in the inland surface waters, enclosed bays, and estuaries of California through promulgation of the California Toxics Rule (CTR). [40 CFR 131.38]. These water quality criteria, presented below, are applicable to Chollas Creek.

Water Quality Criteria for dissolved metals in Chollas Creek.

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Continuous Concentration
Copper	(1) * (0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(1) * (0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(1) * (0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

Hardness is expressed as milligrams per liter.
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)].
The natural log and exponential functions are represented as “ln” and “e,” respectively.

In addition, the Basin Plan establishes the following narrative water quality objective for “toxicity” to ensure the protection of the WARM and WILD beneficial uses.

> **Toxicity Objective**: *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the San Diego Water Board.*
>
> *The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water factors, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with requirements specified in USEPA, State Water Resources Control Board (State Board) or other protocol authorized by the San Diego Water Board. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.*
>
> *In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of*

toxic substances will be encouraged.

6. **NUMERIC TARGETS**: Numeric targets are established for the purposes of calculating TMDLs. Since the numeric targets are equal to the water quality criteria in the CTR for dissolved copper, lead, and zinc cited in finding 5, attainment of TMDLs will ensure attainment of these water quality criteria.

7. **SOURCES OF DISSOLVED METALS**: Many land uses and activities associated with urbanization are sources of copper, lead, and zinc to Chollas Creek. Freeways and commercial/ industrial land uses are major contributors. Automobiles are a significant source of all three metals. Water supply systems, pesticides, industrial metal recyclers and other industrial activities also contribute to levels of copper, lead, and zinc in excess of water quality criteria for Chollas Creek. Metals released to the environment by different land uses and activities are washed off of the land surface by urban runoff and storm flows and conveyed to Chollas Creek through municipal separate storm sewer systems. Quantification of bacteria loading in all watersheds is necessary to calculate the load reductions required to meet TMDLs.

8. **WATER QUALITY OBJECTIVE VIOLATIONS**: Concentrations of dissolved copper, lead, and zinc have frequently exceeded numeric water quality criteria contained in the CTR. Furthermore, in a Toxicity Identification Evaluation performed in 1999, Chollas Creek stormwater concentrations of zinc and to a lesser extent copper, were identified as causing or contributing to reduced fertility in the purple sea urchin.

9. **ADVERSE EFFECTS OF COPPER, LEAD, AND ZINC**: Concentrations of copper, lead, and zinc in excess of CTR criteria entail increased risk of adverse toxic effects in aquatic organisms exposed to them. Copper, lead, and zinc may bioaccumulate within lower organisms, however they do not biomagnify up the food chain. Of these three metals, copper is considered the most potent toxin at environmentally relevant aqueous concentrations.

10. **TOTAL MAXIMUM DAILY LOADS AND ALLOCTIONS**: TMDLs for dissolved copper, lead, and zinc are equal to the total assimilative or loading capacity of Chollas Creek for dissolved copper, lead, and zinc. The loading capacities are defined as the maximum amount of each dissolved metal that Chollas Creek can assimilate and still attain water quality criteria needed for the protection of designated beneficial uses. Each TMDLS must accommodate all known sources of a pollutant, whether from natural background, nonpoint sources, or point sources, and must include a margin of safety (MOS) to preclude pollutant loading from exceeding the actual assimilative capacities of Chollas Creek. The TMDL calculations also account for seasonal variations and critical conditions and were developed in a manner consistent with guidelines published by the USEPA. The TMDLs are concentration based, therefore, the allocations are not additive. The TMDLs for dissolved copper, lead, and zinc are equal to the Waste Load Allocations (WLAs) which are 90 percent of the CTR Criteria Continuous Concentration (CCC) and Criteria Maximum Concentration (CMC) equations. Discharges of dissolved copper, lead, and zinc require significant reductions from current levels to meet the allocations.

11. **IMPLEMENTATION PLAN**: The technical report entitled *Total Maximum Daily Loads for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay* dated June 13, 2007, presents a summary of measures that, if adopted by the San Diego Water Board, the State Water Resources Control Board (State Water Board), and local governmental agencies, will promote attainment of the load reductions needed to keep discharges of metals at or below the TMDLs calculated for Chollas Creek. Section 303 of the CWA and the federal National Pollutant Discharge Elimination System (NPDES) regulations direct the USEPA and authorized states to impose requirements consistent with TMDLs for point source discharges to "impaired" waterbodies. When the San Diego Water Board and the State Water Board re-issue or revise NPDES requirements for municipal, construction, and industrial stormwater discharges, and groundwater extraction discharges in the Chollas Creek watershed, including discharges of "small MS4s," they will have to include requirements that will implement all TMDLs applicable to waters affected by the regulated discharges.

12. **COMPLIANCE MONITORING**: Water quality monitoring will be necessary to assess progress in achieving WLAs and compliance in Chollas Creek with the water quality objectives for dissolved copper, lead, and zinc.

13. **COMPLIANCE SCHEDULE**: Full implementation of the TMDLs for dissolved copper, lead, and zinc shall be completed within 20 years from the effective date of the Basin Plan amendment. The compliance schedule for implementing the wasteload reductions required under these TMDLs is structured in a phased manner, with 80 percent of reductions required in 10 years, and 100 percent of reductions required within 20 years. The 20-year compliance schedule is contingent upon the dischargers implementing integrated controls to achieve required copper, lead, zinc, indicator bacteria, diazinon, and trash reductions.

14. **SCIENTIFIC PEER REVIEW**: The scientific basis of this TMDL has undergone external peer review pursuant to Health and Safety Code section 57004. The San Diego Water Board has considered and responded to all comments submitted by the peer review panel and has enhanced the Technical Report appropriately. No change to the fundamental approach to TMDL calculations was necessary as a result of this process.

15. **STAKEHOLDER AND PUBLIC PARTICIPATION**: Interested persons and the public have had reasonable opportunity to participate in review of the proposed TMDL. Efforts to solicit public review and comment included five public workshops held between April 1999 and April 2005, including a CEQA scoping meeting held on March 21, 2003; a public review and comment period of 45 days preceding the San Diego Water Board public hearing in May 2005; a two week extension of the comment period after the public hearing in May 2005; a second public review and comment period of 45 days commencing in July 2006; a third public review and comment period of 45 days commencing on March 9, 2007; and a public hearing on April 25, 2007. Notices for all meetings were sent to interested parties including cities and San Diego County with jurisdiction in Chollas Creek. All of the written comments submitted to the San Diego Water Board during the review and comment periods have been considered, and written responses provided in Appendix M to the Technical Report.

16. **CEQA REQUIREMENTS:** Pursuant to Public Resources Code section 21080.5, the Resources Agency has approved the Regional Water Boards' basin planning process as a "certified regulatory program" that adequately satisfies the California Environmental Quality Act (CEQA) (Public Resources Code, section 21000 et seq.) requirements for preparing environmental documents. [14 CCR section 15251(g); 23 CCR section 3782] As such, the San Diego Water Board's basin planning documents together with an Environmental Checklist are the "substitute documents" that contain the required environmental documentation under CEQA. [23 CCR section 3777] The substitute documents for this project include the Environmental Checklist, the detailed technical report entitled Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay, responses to comments raised during the development of the TMDL, and this resolution. The project itself is the establishment of TMDLs for toxic metals in Chollas Creek where water quality has been listed as "impaired" by the State Water Board pursuant to section 303(d) of the CWA, as required by that section. While the San Diego Water Board has no discretion to not establish a TMDL (the TMDL is required by federal law) the San Diego Water Board does exercise discretion in assigning wasteload allocations, determining the program of implementation, and setting various milestones in achieving the water quality objectives for Chollas Creek.

17. **PROJECT IMPACTS:** The accompanying CEQA substitute documents satisfy the requirements of substitute documents for a Tier 1 environmental review under CEQA, pursuant to Public Resources Code section 21159 and CCR Title 14, section 15187. Nearly all of the compliance obligations anticipated to be necessary to implement the TMDLs for copper, lead, and zinc in Chollas Creek will be undertaken by public agencies that will have their own obligations under CEQA for implementation projects that could have significant environmental impacts (*e.g.*, installation and operation of structural best management practices). Project level impacts will need to be considered in any subsequent environmental analysis performed by other public agencies pursuant to Public Resources Code section 21159.2.

    If not properly mitigated at the project level, implementation and compliance measures undertaken could have significant adverse environmental impacts. The substitute documents for this TMDL, and in particular the environmental checklist and responses to comments, identify broad mitigation approaches that should be considered at the project level. The San Diego Water Board does not engage in speculation or conjecture regarding the projects that may be used to implement the TMDLs and only considers the reasonably foreseeable alternative methods of compliance, the reasonably foreseeable feasible environmental impacts of the these methods of compliance, and the reasonably foreseeable mitigation measures which would avoid or eliminate the identified impacts, all from a broad general perspective consistent with the uncertainty regarding how the TMDLs, ultimately, will be implemented. The lengthy implementation period allowed by the TMDLs will allow persons responsible for compliance with wasteload allocations to develop and pursue many compliance approaches and mitigation measures.

18. **PROJECT MITIGATION:** The proposed amendment to the Basin Plan to establish TMDLs for copper, lead, and zinc in Chollas Creek could have a significant adverse effect on the environment. However, there are feasible alternatives, feasible mitigation measures, or both, that would substantially lessen any significant adverse impact. The public agencies responsible for implementation measures needed to comply with the TMDLs can and should incorporate such alternatives and mitigation into any projects or project approvals that they undertake for the impaired creek. Possible alternatives and mitigation are described in the CEQA substitute documents, specifically the Technical Report and the environmental checklist. To the extent the alternatives, mitigation measures, or both, are not deemed feasible by those agencies, the necessity of implementing the TMDLs that is mandated by the federal Clean Water Act and removing the copper, lead, and zinc impairments in Chollas Creek (an action required to achieve the express, national policy of the Clean Water Act) outweigh the unavoidable adverse environmental effects identified in the substitute documents.

19. **ECONOMIC ANALYSIS**: The San Diego Water Board has considered the costs of the reasonably foreseeable methods of compliance with the wasteload reductions specified in these TMDLs. The most reasonably foreseeable methods of compliance involve implementation of structural and non-structural controls. Surface water monitoring to evaluate the effectiveness of these controls will be necessary.

20. **NO ADVERSE ENVIRONMENTAL EFFECTS**: This Basin Plan amendment will result in no adverse effect, either individually or cumulatively, on wildlife.

21. **REVISION TO BASIN PLAN**: The USEPA promulgated a final rule prescribing water quality criteria for toxic pollutants in inland surface waters, enclosed bays, and estuaries in California in 2000 (The California Toxics Rule or "CTR;" [40 CFR 131.38]). CTR criteria constitute applicable water quality objectives in California. In addition to the CTR, certain criteria for toxic pollutants in the National Toxics Rule [40 CFR 131.36] constitute applicable water quality objectives in California as well. The section in Chapter 3 of the Basin Plan titled "Toxic Pollutants" should be revised to be consistent with the current federal rules. The subsection entitled "Water Quality Objectives for Toxic Pollutants" in Chapter 3 of the Basin Plan needs to be deleted. This subsection is redundant since the CTR and certain NTR criteria constitute applicable water quality objectives in California.

NOW, THEREFORE, BE IT RESOLVED that

1. **AMENDMENT ADOPTION**: The San Diego Water Board hereby adopts the amendment to the Basin Plan to incorporate the TMDLs for dissolved copper, lead, and zinc in Chollas Creek and to revise the Basin Plan to reference the California Toxics Rule as set forth in Attachment A hereto.

2. **TECHNICAL REPORT APPROVAL**: The San Diego Water Board hereby approves the Technical Report entitled *Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay*, dated May 30, 2007.

3. **CERTIFICATE OF FEE EXEMPTION**: The Executive Officer is authorized to sign a Certificate of Fee Exemption.

4. **AGENCY APPROVALS**: The Executive Officer is directed to submit this Basin Plan amendment to the State Water Board for approval in accordance with Water Code section 13245.

5. **NON-SUBSTANTIVE CORRECTIONS**: If, during the approval process for this amendment, the State Water Board, San Diego Water Board, or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or consistency, the Executive Officer may make such changes, and shall inform the San Diego Water Board of any such changes.

6. **ENVIRONMENTAL DOCUMENT CERTIFICATION**: The substitute environmental documents prepared pursuant to Public Resources Code section 21080.5 are hereby certified, and the Executive Officer is directed to file a Notice of Decision with the Resources Agency after State Water Board and OAL approval of the Basin Plan Amendment, in accordance with section 21080.5(d)(2)(E) of the Public Resources Code and the California Code of Regulations, title 23, section 3781.

I, John H. Robertus, Executive Officer, do hereby certify the foregoing is a full, true and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, San Diego Region, on June 13, 2007.

JOHN H. ROBERTUS
EXECUTIVE OFFICER

ATTACHMENT A
TO RESOLUTION NO. R9-2007-0043

AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SAN DIEGO BASIN (9) TO INCORPORATE TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD, AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY,

AND TO REVISE THE TOXIC POLLUTANTS SECTION OF CHAPTER 3 TO REFERENCE THE CALIFORNIA TOXICS RULE

This Basin Plan amendment establishes a Total Maximum Daily Load (TMDL) and associated load and wasteload allocations for copper, lead and zinc in Chollas Creek, and revises the Toxic Pollutants section of Chapter 3 to reference the California Toxics Rule. This amendment includes a program to implement the TMDL and monitor its effectiveness. Chapters 2, 3, and 4 of the Basin Plan are amended as follows:

Chapter 2, Beneficial Uses
Table 2-2. *Beneficial Uses of Inland Surface Waters*

Add the following footnote 3 to Chollas Creek

> [3]Chollas Creek is designated as an impaired water body for copper, lead and zinc pursuant to Clean Water Act section 303(d). A Total Maximum Daily Load (TMDL) has been adopted to address this impairment. See Chapter 3, Water Quality Objectives for Toxicity and Toxic Pollutants and Chapter 4, Total Maximum Daily Loads.

Chapter 3, Water Quality Objectives
Inland Surface Waters, Enclosed Bays and Estuaries, Coastal Lagoons, and Ground Waters

Water Quality Objectives for Toxicity:
Add a fifth paragraph as follows:

> Chollas Creek is designated as a water quality limited segment for dissolved copper, lead, and zinc pursuant to Clean Water Act section 303(d). Total Maximum Daily Loads have been adopted to address these impairments. See Chapters 2, Table 2-2, *Beneficial Uses of Inland Surface Waters, Footnote 3* and Chapter 4, Total Maximum Daily Loads.

TOXIC POLLUTANTS:
Revise as follows:

> The USEPA promulgated a final rule prescribing water quality criteria for toxic pollutants in inland surface waters, enclosed bays, and estuaries in California on May 18, 2000 (The California Toxics Rule or "CTR;" [40 CFR 131.38]). CTR criteria constitute applicable water quality criteria in California. In addition to the CTR,

certain criteria for toxic pollutants in the National Toxics Rule [40 CFR 131.36] constitute applicable water quality criteria in California as well.

Chollas Creek is designated as a water quality limited segment for dissolved copper, lead, and zinc pursuant to Clean Water Act section 303(d). Total Maximum Daily Loads have been adopted to address these impairments. See Chapters 2, Table 2-2, *Beneficial Uses of Inland Surface Waters*, *Footnote 3* and Chapter 4, Total Maximum Daily Loads.

~~Federal Register, Volume 57, Number 246 amended Title 40, Code of Federal Regulations, Part 131.36 (40 CFR 131.36) and established numeric criteria for a limited number of priority toxic pollutant for inland surface waters and estuaries in California. USEPA promulgated these criteria on December 22, 1992, to bring California into full compliance with section 303(c)(2)(B) of the Clean Water Act. California is not currently in full compliance with this section of the Clean Water Act due to the invalidation of the Water Quality Control Plan for Inland Surface Waters of California and the Water Quality Control Plan for Bays and Estuaries of California. However, the criteria established in 57 FR 60848 (December 22, 1992) (specifically pages 60920-60921) are still applicable to surface waters in the Region.~~

~~Water Quality Objectives for Toxic Pollutants:~~

~~Inland surface waters, enclosed bays, and estuaries shall not contain toxic pollutants in excess of the numerical objectives applicable to California specified in 40 CFR 131.36 (§131.36 revised at 57 FR 60848, December 22, 1992).~~

Chapter 4, Implementation

After the subsection on the TMDL for Dissolved Copper, Shelter Island Yacht Basin, San Diego Bay add the following subsection:

Total Maximum Daily Loads for Copper, Lead, and Zinc in Chollas Creek

On *June 13, 2007,* the Regional Board adopted Resolution No. R9-2007-0043, *Amendment to the Water Quality Control Plan for the San Diego Region to Incorporate Total Maximum Daily Loads for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay*. The TMDL Basin Plan Amendment was subsequently approved by the State Water Resources Control Board on *[Insert Date]*, the Office of Administrative Law on *[Insert Date]*, and the USEPA on *[Insert Date]*.

Problem Statement

Dissolved copper, lead and zinc concentrations in Chollas Creek violate numeric water quality criteria for copper, lead, and zinc promulgated in the California Toxics Rule, and the narrative objective for toxicity. Concentrations of these metals in Chollas Creek threaten and impair the designated beneficial uses of warm freshwater habitat (WARM), and wildlife habitat (WILD).

Numeric Targets

The TMDL numeric targets for copper, lead, and zinc are set equal to the numeric water quality criteria as defined in the California Toxics Rule (CTR) and shown below. Because the concentration of a dissolved metal causing a toxic effect varies significantly with hardness, the water quality criteria are expressed in the CTR as hardness based equations. The numeric targets are equal to the loading capacity of these metals in Chollas Creek.

Table 4 *[insert number]* Water Quality Criteria /Numeric Targets for dissolved metals in Chollas Creek.

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Continuous Concentration
Copper	(1) * (0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(1) * (0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(1) * (0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

Hardness is expressed as milligrams per liter.
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)].
The natural log and exponential functions are represented as "ln" and "e," respectively.

Source Analysis

The vast majority of metals loading to Chollas Creek are believed to come through the storm water conveyance system. An analysis of source contributions reveals many land uses and activities associated with urbanization to be potential sources of copper, lead and zinc to Chollas Creek. Modeling efforts point toward freeways and commercial/industrial land uses as the major contributors

Total Maximum Daily Loads

The TMDLs for dissolved copper, lead and zinc in Chollas Creek are concentration-based and set equal to 90 percent of the numeric targets/loading capacity.

Margin of Safety

The TMDL includes an explicit margin of safety (MOS). Ten percent of the loading capacity was reserved as an explicit MOS.

Allocations and Reductions

The source analysis showed that nonpoint sources and background concentrations of metals are insignificant, and thus, were set equal to zero in the TMDL calculations. The wasteload allocations are set equal to 90 percent of the numeric targets/loading capacity. Concentrations of dissolved copper, lead and zinc require significant reductions from current concentrations to meet the loading capacity.

TMDL Implementation Plan

Persons whose point source discharges contribute to exceedance of Water Quality Criteria (WQC) for copper, lead, and zinc in Chollas Creek will be required to meet the WLA hardness dependant concentrations in their urban runoff discharges before it is discharged to Chollas Creek. Actions to meet the WLAs in discharges to Chollas Creek will be required in WDRs that regulate MS4 discharges, industrial facility and construction activity stormwater discharges, and groundwater extraction discharges in the Chollas Creek watershed. The following orders may be reissued or revised by the Regional Board to include requirements to meet the WLAs. Alternatively, the Regional Board may issue new WDRs to meet the WLAs.

Order No. 2007-0001, NPDES No. CAS0108758, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, or subsequent superceding NPDES renewal orders.

Order No. 2000-90, NPDES No. CAG19001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or other Conveyance Systems Tributary Thereto*, or subsequent superceding NPDES renewal orders.

Order No. 2001-96, NPDES No. CAG 919002, *General Waste Discharge Requirements for Groundwater Extraction Waste Discharges from Construction, Remediation and Permanent Groundwater Extraction Projects to Surface Waters within the San Diego Region Except for San Diego Bay* or subsequent superceding NPDES renewal orders.

Order No. 97-11, *General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Nonhazardous Waste Landfills within the San Diego Region* or subsequent superceding NPDES renewal orders.

The Regional Board shall request the State Water Resources Control Board amend the following statewide orders:

Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal orders.

Order No. 97-03-DWQ, NPDES No. CAS 000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities*, or subsequent superceding NPDES renewal orders.

Order No. 2003-0005-DWQ, NPDES No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*, or subsequent superceding NPDES renewal orders.

Order No. 99-08-DWQ, NPDES No. CAS000002, *General Permit for Storm Water Discharges Associated with Construction Activity*, or subsequent superceding NPDES renewal orders.

The Regional Board shall require the U.S. Navy to submit a Notice of Intent to enroll the Naval Base San Diego facility under statewide Order No. 2003-005-DWQ or subsequent superseding NPDES renewal orders .

Implementation Monitoring Plan

The dischargers will be required to monitor Chollas Creek and provide monitoring reports to the Regional Board for the purpose of assessing the effectiveness of the management practices implemented to meet the TMDL allocations. The Regional Board shall amend the following order to include a requirement that the cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego, the San Diego Unified Port District, and CalTrans investigate excessive levels of metals in Chollas Creek and feasible management strategies to reduce metal loadings in Chollas Creek, and conduct additional monitoring to collect the data necessary to refine the watershed wash-off model to provide a more accurate estimate of the mass loads of copper, lead and zinc leaving Chollas Creek each year.

Order No. R9-2004-0277, *California Department of Transportation and San Diego Municipal Separate Storm Sewer System Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California*.

Schedule of Compliance

Concentrations of metals in urban runoff shall only be allowed to exceed the WLAs by a certain percentage for the first nineteen years after initiation of this TMDL. Allowable concentrations shall decrease as shown in Table 4 *[insert number]*. For example, if the measured hardness in year ten dictates the WLA for copper in urban runoff is 10 µg/l, the maximum allowable measured copper concentration would be 12.0 µg/L. By the end of the twentieth year of this TMDL, the WLAs of this TMDL shall be met. This will ensure that copper, lead and zinc water quality objectives are being met at all locations in the creek during all times of the year.

Table 4 *[insert number*] Interim goals for achieving Wasteload Allocations

	Allowable Exceedance of the WLAs (allowable percentage above)		
Compliance Year	**Copper**	**Lead**	**Zinc**
1	100%	100%	100%
10	20%	20%	20%
20	0%	0%	0%

Compliance with the interim goals in this schedule can be assessed by showing that dissolved metals concentrations in the receiving water exceed the WQC for copper, lead, and zinc by no more than the allowable exceedances for WLAs shown in the table above. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges.

The compliance schedule for implementation of the TMDLs shall be as follows in Table 4 *[insert number]*.

Table 4 *[insert number]* Compliance Schedule

Item	Implementation Action	Responsible Parties	Date
1	Effective date of Chollas Creek Metals TMDL Waste Load Allocations.	San Diego Water Board, Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	October 22, 2008[1]
2	Recommend High Priority for grant funds.	San Diego Water Board	Immediately after effective date
3	Submit annual Progress Report to San Diego Water Board due January 1 of each year.	Municipal Dischargers	Annually after reissue of NPDES WDRs.
4	Submit annual Progress Report to San Diego Water Board due April 1 of each year.	Caltrans	Annually after reissue of NPDES WDRs.
5	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Industrial Stormwater Dischargers	Annually after reissue of NPDES WDRs.
6	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Construction Stormwater Dischargers	Annually after reissue of NPDES WDRs.
7	Municipal NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
8	Caltrans NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
9	Construction NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
10	Industrial NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date

[1] Upon approval of by Office of Administrative Law.

Item	Implementation Action	Responsible Parties	Date
11	Amend Orders No. 2000-90, and No. 2001-96 (or superseding renewal orders) which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
12	Municipal and Navy WDR Order No. R9-2004-0277 shall amended to require additional monitoring for metals and hardness.	San Diego Water Board	Within 5 years of effective date
13	Landfill NPDES WDR Order No. 97-11 (or superseding renewal orders) shall be issued, reissued, or revised to monitor for metals and hardness.	San Diego Water Board	Within 5 years of effective date
14	Navy and all other Phase II small MS4 permittees in the Chollas Creek watershed shall be enrolled in Order No. 2003-0005-DWQ (or superseding renewal orders).	San Diego Water Board	Immediately after effective date.
15	Take enforcement actions	San Diego Water Board	As needed after effective date.
16	Meet 80% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	10 years after effective date.
17	Meet 100% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	20 years after effective date.

California Regional Water Quality Control Board
San Diego Region

Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay

Chollas Creek Watershed

Technical Report
May 30, 2007

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
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To request copies of the Basin Plan Amendment and Technical Report for Copper, Lead, and Zinc Total Maximum Daily Loads for Chollas Creek, Tributary to San Diego Bay, please contact Benjamin Tobler, Water Resources Control Engineer at (858) 467 – 2736, btobler@waterboards.ca.gov.

Documents also are available at: http://www.waterboards.ca.gov/sandiego.

TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD, AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY

Technical Report

Adopted by the
California Regional Water Quality Control Board
San Diego Region
on June 17, 2007
Approved by the
State Water Resources Control Board
on July 15, 2008
and the
Office of Administrative Law
on October 22, 2008
and the
United States Environmental Protection Agency
on December 18, 2008

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LIST OF ACRONYMS AND ABBREVIATIONS

ACQOP	Daily pollutant accumulation rate
ALERT	Automatic Local Evaluation in Real Time
BMPs	Best Management Practices
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
Basin Plan	Water Quality Control Plan for the San Diego Basin – Region 9
BIOL	Preservation of biological habitats of special significance
BLM	Biotic Ligand Model
$CaCO_3$	Calcium carbonate
Caltrans	California Department of Transportation
CCC	Criteria continuous concentration
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CF	Conversion factor
CFR	Code of Federal Regulations
Cfs	Cubic feet per second
CIMIS	California Irrigation Management Information System
CMC	Criteria maximum concentration
COMM	Commercial and sport fishing
CTR	California Toxics Rule
CWA	Clean Water Act
CWC	California Water Code
DEEPFR	Fraction of infiltrating water lost to inactive groundwater
DEM	Digital Elevation Model
DPR	California Department of Pesticide Regulation
EIR	Environmental Impact Report
EMC	Event mean concentration
EST	Estuarine habitat
GIS	Geographic Information System
HSPF	Hydrological Simulation Program - FORTRAN
IND	Industrial service supply
IMPLND	Impervious land
INFILT	Index to mean soil infiltration rate
IQUAL	Simulation of quality constituents for impervious land segments
IWATER	Water simulation for impervious land segments
LA	Load allocations
LACDPW	Los Angeles County Department of Public Works
LSPC	Load Simulation Program written in C++
LZETP	Lower zone evapotranspiration
LZSN	Lower zone nominal soil moisture storage
MAR	Marine habitat
METCMP	Computation of Meterological Time Series
MIGR	Migration of aquatic organisms
MOS	Margin of safety
MS4	Municipal Separate Storm Sewer Systems

Municipal Dischargers	Cities of San Diego, Lemon Grove, and La Mesa, County of San Diego, and the San Diego Unified Port District
NAV	Navigation
Navy	U.S. Navy
NCDC	National Climatic Data Center
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge and Elimination System
NTR	National Toxics Rule
OAL	Office of Administrative Law
PEC	Probable Effects Concentration
PEL	Probable Effects Level
PERLND	Pervious land
Port	San Diego Unified Port District
PQUAL	Simulation of quality constituents for pervious land segments
PWATER	Water simulation for pervious land segments
RARE	Rare, threatened, or endangered species
RCHRES	Stream reach
REC1	Water contact recreation
REC2	Non-contact water recreation
ROWD	Report of Waste Discharge
SANDAG	San Diego Association of Governments
San Diego Water Board	California Regional Water Quality Control Board, San Diego Region
SCCWRP	Southern California Coastal Water Research Project
SHELL	Shellfish harvesting
SIYB	Shelter Island Yacht Basin
SQOLIM	Maximum storage level parameter
SSO	Site-specific objective
STATSGO	Natural Resources Conservation Services State Soil Geographic
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
USDA	U.S. Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
WARM	Warm fresh water habitat
WDR	Waste discharge requirements
WER	Water effects ratio
WILD	Wildlife habitat
WLA	Wasteload allocation
WSQOP	Rate of surface runoff that will remove 90 percent of the stored constituent per hour
WQO	Water quality objective
WQS	Water quality standard

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EXECUTIVE SUMMARY

Chollas Creek[1] is an urban coastal stream in southern San Diego County, tributary to San Diego Bay. Chollas Creek was placed on the Clean Water Act (CWA) section 303(d) List of Water Quality Limited Segments (List of Water Quality Limited Segments) in 1996 for the metals copper, lead, and zinc. Storm water samples from Chollas Creek collected between 1994 and 2003 periodically exceeded California Toxics Rule (CTR) water quality criteria for copper, lead, and zinc. The existing and potential beneficial uses of Chollas Creek and San Diego Bay described in the Water Quality Control Plan for the San Diego Basin (9) (Basin Plan) are adversely affected by these exceedances. Additionally, toxicity tests show that water quality objectives (WQOs) for toxicity are also violated.

E.1. Problem Statement

While only the lowest 3.5 miles of Chollas Creek comprise the actual listed segment of the water body, all upstream tributaries to this section are considered in this TMDL project. The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) has established Total Maximum Daily Loads (TMDLs) for copper, lead, and zinc as required by the CWA for water quality limited segments.

Chollas Creek is also listed as impaired for the metal cadmium. The available data suggest that concentrations of dissolved cadmium in Chollas Creek exceed neither acute nor chronic CTR water quality criteria. Consequently, the San Diego Water Board has recommended Chollas Creek for delisting with respect to cadmium to the State Water Resources Control Board (State Water Board). The State Water Board is preparing the latest update of the List of Water Quality Limited Segments.

The purpose of this TMDL project is to attain WQOs for copper, lead, and zinc, and restore and protect the beneficial uses of Chollas Creek. TMDLs represent a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. A TMDL is defined as the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background [40 CFR section 130.2] such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded. In order to achieve the TMDLs, an Implementation Action Plan is also developed that describes the pollutant reduction actions that must be taken by various responsible persons to meet the wasteload and load allocations. The Implementation Action Plan includes a time schedule for meeting the required allocations and requirements for monitoring to assess the effectiveness of the load reduction activities in attaining water quality objectives and restoring beneficial uses.

Once established, the regulatory provisions of this TMDL project are incorporated into the Basin Plan. Additional requirements of the Basin Plan amendment process also include an evaluation of environmental and economic considerations. As with any Basin

[1] The Chollas Creek Watershed comprises Hydrologic Unit number 908.22.

Plan amendment involving surface waters, a TMDL project will not take effect until it has undergone subsequent agency approvals by the State Water Board, and the Office of Administrative Law (OAL). The U.S. Environmental Protection Agency (USEPA) must also approve the TMDL.

E.2. Numeric Targets

When calculating TMDLs, numeric targets are established to ensure that WQOs are met and beneficial uses are protected. The CTR is the basis of the numeric targets. Specifically, the numeric targets for the Chollas Creek TMDLs were set equal to the CTR's WQOs, which are comprised of hardness-based equations for dissolved copper, lead, and zinc. Equations, rather than numbers comprise the WQOs because the toxicity of dissolved copper, lead, and zinc varies significantly depending on hardness.[2] The CTR was chosen as the basis for these numeric targets because it has the most current, defendable WQOs for dissolved copper, lead, and zinc concentrations in fresh water (USEPA, 2000a). Additionally, the CTR is legally applicable in inland surface waters (e.g., Chollas Creek), enclosed bays and estuaries of California for all purposes and programs under the CWA (USEPA, 2000a).

E.3. Source Analysis

For Chollas Creek, essentially all metals sources (point and nonpoint) are discharged through municipal separate storm sewer systems (MS4) that are regulated under waste discharge requirements (WDRs) prescribed in Order No. R9-2007-0001.[3] Metals sources are thus collectively considered point sources due to their release from channelized, discrete conveyance pipe systems and outfalls. Known point source discharges to the MS4s include stormwater discharges from industrial facilities, construction sites, underground utility vaults, and groundwater discharges from de-watering sites. These discharges are regulated under different statewide and San Diego Water Board orders prescribing general WDRs. Because there are no other known point sources, urban runoff is considered the most significant source of metals to Chollas Creek.

Watershed models were developed by Tetra Tech, Inc. to estimate the magnitude of land uses that generate existing annual metal loadings to the Chollas Creek Watershed during both wet and dry weather conditions of a typical year. Modeling results based on land use category parameters, hydrological characteristics and observed metal concentrations provided estimates of the magnitude of metal loadings. The top two land use categories in Chollas Creek, freeways and commercial/institutional, contribute over 75 percent of the total load for each metal. Significant sources of all three metals to urban runoff are thought to include automobile operation (especially brake pads and tires) and industries with practices that may expose metals to stormwater. Water supply infrastructure

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[2] As hardness increases, it competes with metals for binding sites on animals and effectively reduces the toxicity of metals. Therefore, as hardness increases the CTR metals criteria also increase to maintain the same allowable amount of toxicity.

[3] Order No. R9- 2007-0001, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, NPDES No. CAS0108758 or subsequent superseding NPDES renewal Orders.

corrosion, and pesticide application are also among the identified potential sources. Additionally, another potential source of metals in urban runoff from activities outside and inside of the Chollas Creek Watershed boundaries is atmospheric deposition.

Nonpoint sources are washed into and conveyed to Chollas Creek through the MS4 systems and thus, are accounted for in the point source MS4 discharges. Because of this, and the lack of data to prove otherwise, any nonpoint source that discharges directly into Chollas Creek is assumed to be comparatively insignificant.

E.4. Linkage Analysis

The TMDL technical report must estimate total assimilative capacity (loading capacity) of Chollas Creek for the metals and describe the relationship between Numeric Targets and identified metal sources. Collectively, these requirements are termed the linkage analysis and provide the necessary quantitative link between the TMDL and attainment of water quality standards.

The total assimilative capacity, or loading capacity, is the maximum amount of pollutant that a water body can assimilate while maintaining WQSs. The loading capacity is also a function of different hydrodynamic processes that affect the environmental fate and transport of dissolved metals as they move through the system. At Chollas Creek, the loading capacity for each metal is estimated to be equal to its respective Numeric Target. The Numeric Targets are to be protective of aquatic life and are thus conservatively considered the total loading capacity for Chollas Creek. These loading capacities will attain WQSs because they are set equal to the CTR equations that are protective of aquatic life. Table E.1 presents the loading capacities for metals copper, lead, and zinc.

TABLE E.1 Dissolved metals loading capacities for acute and chronic conditions.

Metal	Loading Capacity for Acute Conditions – One-Hour Average[1]	Loading Capacity for Chronic Conditions – Four-Day Average[1]
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

The natural log and exponential functions are represented as "ln" and "e", respectively.
[1] Loading capacities equal numeric targets that equal the CTR WQOs.

These loading capacities, which are equal to the Numeric Targets, will apply to the entirety of Chollas Creek and during all times of the year. Regulated discharges from each of the land uses identified in the Source Analysis portion of this TMDL will not be allowed to have dissolved metals concentrations that causes in-stream waters to exceed the loading capacities. Furthermore, all other sources of copper, lead, and zinc to Chollas

Creek will be expected to not cause the creek to exceed these loading capacities. Once these capacities are achieved, Chollas Creek copper, lead, and zinc concentrations will be protective of the creek's beneficial uses.

A concentration-based approach was chosen to link the Numeric Targets with the largest identified metal source -- urban runoff. This approach is considered more appropriate than a mass-based approach, because not only does it take into account the dynamic nature of urban runoff, which is greatly affected by stormwater, but it also accommodates the dynamic nature of freshwater systems that have a myriad of flow and hardness conditions.

In addition, a mass-based approach would be more sensitive to concerns of accumulated bottom sediment in fresh water bodies and down stream sediment toxicity. However, sediment is not considered a source of metals due to the nature of Chollas Creek and due to low sediment toxicity results. In addition, downstream sediment toxicity is to be addressed in a separate TMDL for San Diego Bay at the mouth of Chollas Creek once adequate data are collected and applicable models are developed for the Chollas Creek Watershed.

E.5. Margin of Safety

The TMDLs must contain a margin of safety (MOS) to account for uncertainty in the analysis. The MOS for Chollas Creek is explicit as well as implicit. The explicit MOS was incorporated by setting the wasteload allocations equal to 90 percent of the total loading capacity as generated from the CTR equations, using the sampled hardness concentrations. The use of actual hardness values in the CTR equation in order to calculate TMDLs established an implicit MOS.

E.6. TMDLs and Allocations

The TMDLs must be less than or equal to the loading capacities after taking into account allocations to all sources. A TMDL is the combination of a total wasteload allocation (WLA) that allocates loadings for point sources, a total load allocation (LA) that allocates loadings for nonpoint sources and background sources and a MOS that may either explicitly reserve an allocation for or implicitly account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. In this TMDL, 10 percent of the load is reserved for an MOS, or not allocated to sources, in order to account for identified uncertainties in the TMDL in addition to conservative assumptions made in the TMDL analysis (Margin of Safety Section).

In TMDL development, allowable WLA and LA from pollutant sources that cumulatively amount to no more than the TMDL must be established; this provides the basis to establish water quality-based controls. For Chollas Creek, the WLAs and LAs and consequently the TMDLs, are expressed as concentrations derived from the CTR acute and chronic WQO equations for dissolved copper, lead, and zinc. In addition, the concentration-based TMDLs will account for any future point or nonpoint sources, because any future sources will also be required to be below the same concentration.

Mass-based TMDLs typically are described by the following equation:

$$TMDL_{mass} = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

However, in concentration-based TMDLs, the allocations are not additive. Additionally, the allocation concentrations for point sources (WLAs), and nonpoint and background sources (LAs) will be equivalent for each metal. Thus, only one term is needed in the equation for the allocations. Because significant nonpoint sources and background sources were not identified in the Chollas Creek watershed, the WLA term was retained in the equation and the LA term dropped. The MOS also is not additive in concentration-based TMDLs. As described previously, the MOS is incorporated into the WLAs, rather than added to them. This reduces the equation to:

$$TMDLs_{conc} = WLAs$$

The explicit MOS reserves 10 percent of the allocation and is incorporated into the WLAs by setting them equal to 90 percent of the loading capacity. Because the loading capacities are equal to the numeric targets, which are equal to the CTR WQOs, the TMDLs are equal to 90 percent of the CTR WQO concentrations. In other words:

CTR WQOs = Numeric Targets
Numeric Targets = Loading Capacities
WLAs = Loading Capacities * 0.9

Substituting CTR WQOs for Loading Capacity results in:

$$TMDLs = WLAs = CTR\ WQOs * 0.9$$

The hardness-based equations for calculating TMDL concentrations are shown in Table E.3.

If all copper, lead, and zinc concentrations in urban runoff to Chollas Creek meet their respective TMDL concentrations, the loading capacity of the creek should not be exceeded.

TABLE E.2 Dissolved metals loading capacities for acute and chronic conditions, as determined by sampling requirements in TABLE 4.2.

Metal	Loading Capacity for Acute Conditions – One-Hour Average	Loading Capacity for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

The natural log and exponential functions are represented as "ln" and "e", respectively.

TABLE E.3 Total Maximum Daily Loads for dissolved copper, lead, and zinc for acute and chronic conditions

Metal	TMDL for Acute Conditions – One-Hour Average	TMDL for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

The natural log and exponential functions are represented as "ln" and "e", respectively.

E.7. Wasteload Allocations

The Chollas Creek metals WLAs are expressed as concentrations equal to 90 percent of the loading capacities for the three metals. Federal regulations require TMDLs to include individual WLAs for each point source discharge. The point source discharges that could affect Chollas Creek are the MS4 discharges, stormwater discharges from industrial sites, and discharges of extracted groundwater. All point source discharges to Chollas Creek will be required to achieve this WLA.

Modeling results demonstrate the possible land use specific and sub-watershed specific contributions of copper, lead, and zinc. However because this WLA is concentration-based it will apply to each land use and each sub-watershed at all times and will not be specific to any land use or sub-watershed. Therefore, the model predictions of the relative metal contribution from each category will be useful in targeting problem areas during implementation.

E.8. Load Allocations

The LAs are assigned to nonpoint sources and natural background sources in the watershed. Background sources can include air deposition of metals in the watershed and any groundwater contributions. Because of the regulatory definition of the MS4 system, all source (point and nonpoint sources) contributions of metals to Chollas Creek come via the MS4s and are therefore accounted for when an allocation is made for the MS4. The only other possible sources that may end up directly in Chollas Creek would be direct air deposition and groundwater, which may or may not include anthropogenic sources. These two sources are not considered significant at this time. These sources may be re-evaluated at a future date if any additional data become available. Currently, the point sources not already accounted for in the WLAs to the MS4s are considered to be relatively insignificant. Thus, the LAs are equal to zero in these TMDLs, and the TMDL calculations are equal to the WLAs.

E.9. Seasonal Variations and Critical Conditions

In accordance with federal regulations, a TMDL must consider seasonal variations and critical conditions (e.g. stream flows, pollutant loadings and other water quality parameters). A flow-based approach was used for the Chollas Creek Metals TMDL, and defines critical conditions solely based on freshwater flow rates regardless of season. No matter the time of year or situation, toxicity allocations that are based on the CTR equations will be required throughout all segments of Chollas Creek and therefore, by definition, will always be protective of aquatic life.

Furthermore, the flow-based approach is appropriate because the main sources of metal accumulation in the Chollas Creek Watershed are non-seasonal (e.g. automobile wear, exhaust emissions, industry contributions). Urban runoff, which is the main mechanism by which these accumulated metals reach Chollas Creek, can occur in both dry and wet weather.

The allowable concentrations will be determined with hardness values measured at the time of compliance. These data will provide a direct measure of any seasonal variations and/or critical conditions effects on hardness. Since hardness is an essential component of the WLAs, seasonal variations and/or critical conditions will be covered by this TMDL. This method of using sampled hardness as the variable instead of an estimated hardness, will account for these effects because it is an absolute representation of current conditions and thus will account for any effects that may be caused by seasonal variations or extreme conditions. Other stream chemistry, which may or may not be a function of seasonal variations and critical conditions, were not taken into consideration as an implicit MOS and will therefore not have a bearing, with respect to seasonal variations and critical conditions, on the TMDL.

E.10. Implementation Plan

Following TMDL project initiation, the San Diego Water Board is required to incorporate the regulatory provisions of the TMDL into all applicable orders prescribing WDRs, or other regulatory mechanisms. Water quality based effluent limitations (WQBELs) for the impairing pollutant in the subject watershed must be added to the appropriate WDRs to implement and make the TMDL enforceable. WQBELs can be either numeric or non-numeric. Non-numeric effluent limitations typically are a program of expanded or better-tailored BMPs. The CWA requires that WDRs that implement federal NPDES regulations be consistent with all applicable TMDLs. The San Diego Water Board can issue new NPDES WDRs for all discharges in the Chollas Creek watershed, can issue new NPDES WDRs in a region-wide TMDL order, or reissue or revise existing NPDES WDRs.

The purpose of these TMDLs is to attain and maintain the applicable WQOs in Chollas Creek through mandated wasteload reductions of pollutants in point sources discharging to the creek. The TMDL requires dischargers to improve water quality conditions in the Chollas Creek receiving water by achieving wasteload reductions in their discharges. The copper, lead, and zinc TMDLs shall be implemented with a monitoring component to determine the effectiveness of each phase and guide the selection of BMPs.

Concentrations of metals in urban runoff shall only be allowed to exceed the WLAs by a certain percentage for the first nineteen years after adoption of this TMDL. Allowable concentrations shall decrease to the amounts indicated below (Table E.4). For example, if the measured hardness ten years after initiation of this TMDL project dictates the WLA for copper in urban runoff is 10 µg/l, the maximum allowable measured copper concentration would be 12.0 µg/L. The phases require loading reductions in steps through the use of expanded or better tailored BMPs to achieve the ultimate goal of attaining and maintaining compliance with copper, lead, and zinc water quality objectives. By the end of the twentieth year after initiation of this TMDL, the WLAs of this TMDL shall be met. This will ensure that copper, lead, and zinc water quality objectives are being met at all locations in the creek during all times of the year.

Compliance with the interim goal~~s~~ in this schedule can be assessed by showing that dissolved metals concentrations in the receiving water exceed the WQOs for copper, lead, and zinc by no more than the allowable exceedances for WLAs shown in Table E.4. The first ten years will require the bulk of the metal load reduction, while the remaining ten years provide for adequate construction and implementation time for potential structural BMPs, to achieve the full (100 percent) metal load reduction. As described in Appendix I section 8.4, this compliance schedule of 20 years requires comprehensive BMP planning for all pollutants impairing Chollas Creek, including coordination with all TMDLs and all other water quality project requirements within the Chollas Creek watershed.

The cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego and the San Diego Unified Port District (Municipal Dischargers) are all in the Chollas Creek

Watershed and should be involved in addressing water quality concerns for the MS4 in the Chollas Creek Watershed. Specifically, the San Diego Water Board shall issue new WDRs or amend Order No. R9-2007-0001 to require that MS4 discharges to Chollas Creek not exceed the WLAs for copper, lead, and zinc as established in this TMDL in accordance with a 20-year time schedule to reduce metal concentrations in urban runoff to achieve the WLAs. The San Diego Water Board shall also issue new WDRs or amend Order No. R9-2004-0277, pursuant to CWC section 13383, requiring the Municipal Dischargers and the California Department of Transportation (Caltrans) to investigate excessive levels of metals in Chollas Creek and feasible management strategies to reduce metal loadings in Chollas Creek. Annual reporting on the progress and efficacy of implementation elements will be required.

Caltrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, including the portion of the Interstate Highway System within the state's boundaries. The roads and highways operated by Caltrans are legally defined as MS4s and discharges of pollutants from Caltrans MS4s to waters of the U.S., such as Chollas Creek, constitute a point source discharge that is subject to regulation under WDRs implementing federal NPDES regulations. Discharges of storm water from the Caltrans owned right-of-ways, properties, facilities, and activities, including stormwater management activities in construction, maintenance, and operation of state-owned highways are regulated under Order No. 99-06-DWQ.[4] Caltrans is responsible, under the terms and conditions of these WDRs, for ensuring that their operations do not contribute to violations of water quality objectives in Chollas Creek. The San Diego Water Board can issue new WDRs to Caltrans, or request that the State Water Board amend Order No. 99-06-DWQ to implement the WLA and other requirements established in this TMDL project, including the requirement to submit annual reports on Caltrans' progress in achieving the WLAs in discharges from its MS4s.

The U.S. Navy (Navy) generates urban runoff at Naval Station San Diego near the mouth of Chollas Creek Watershed. Upon submittal of a complete Report of Waste Discharge (ROWD), these MS4 discharges can be regulated by the State Water Board via their general order prescribing WDRs for small MS4s.[5] These WDRs regulate MS4 discharges not covered by the San Diego Water Board's Order No. R9-2007-0001, including those from MS4s on military bases. The San Diego Water Board will require the Navy to submit a ROWD.

Stormwater from certain industrial sites and construction sites can contribute metals to Chollas Creek. The San Diego Water Board shall request the State Water Board amend Order No. 97-03-DWQ, the statewide general WDRs that regulate stormwater discharges from industrial sites, and Order No. 97-03-DWQ, the statewide general WDRs that regulate stormwater discharges from construction sites to implement the WLAs.

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[4] Order No. 99-06-DWQ *National Pollutant Discharge Elimination System Permit, Statewide Storm Water Permit, and Waste Discharge Requirements for the State of California, Department of Transportation (Caltrans)* or subsequent superseding NPDES renewal orders.
[5] State Water Resources Control Board Water Quality Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems* or subsequent superseding NPDES renewal Orders.

The San Diego Water Board will amend Orders No. 2000-90,[6] and No. 2001-96[7] which regulate temporary groundwater extraction discharges to San Diego Bay and its tributaries, and to surface waters throughout the region. The existing effluent limitations for copper, lead, and zinc for extracted groundwater discharges to MS4s in the Chollas Creek watershed, and directly to Chollas Creek, shall be revised to equal the WLAs of this TMDL. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No compliance schedule to meet interim and final goals will be allowed in the case of groundwater discharges.

There is only one landfill in the Chollas Creek Watershed and it was closed in 1981. Order No. 97-11[8] and Addendum No. 4 require monitoring of groundwater below and near the South Chollas Landfill. The San Diego Water Board will revise this WDR to re-institute analysis for metals and begin analysis for hardness as part of the monitoring requirements. Furthermore, if the data indicate that metal concentrations are in excess of the WLAs of this TMDL, the San Diego Water Board may require additional actions. Since the landfill is down gradient from Chollas Reservoir and is up gradient from Chollas Creek, the possibility exists that groundwater recharge from the reservoir may be transporting landfill pollutants to the creek. The WDR may be revised or the San Diego Water Board may issue an investigative order (under the authority of the California Water Code section 13267) to require a technical report examining this potential metals pathway to Chollas Creek.

The first few years after initiation of this TMDL project are not likely to realize a reduction from current concentrations of all three metals. These years will provide the dischargers time to develop plans, and implement enhanced and expanded Best Management Practices (BMPs) that should result in immediate decreases of metal concentrations in the Chollas Creek water column. Year ten will see a maximum of 20 percent in the allowable percentage exceedance of the water quality objectives for copper, lead, and zinc. Finally, at year twenty, dischargers will be expected to meet the WLAs in their effluent discharges and WQOs for metals in Chollas Creek.

The Compliance Schedule, which includes the implementation actions of the San Diego Water Board and the dischargers, the due dates, and the interim and final allowable exceedances of the WLAs is shown in Table E. 4.

TABLE E.4 Compliance Schedule.

[6] Order No. 2000-90, NPDES Permit No. CAG919001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or Other Conveyance Systems Tributary Thereto* or subsequent superseding NPDES renewal orders.
[7] Order No. 2001-96, NPDES Permit No. CAG919002, *General Waste Discharge Requirements for Groundwater Extraction Waste Discharges from Construction, Remediation and Permanent Groundwater Extractioi Projects to Surface Waters within the San Diego Region Except for San Diego Bay* or subsequent superseding NPDES renewal orders.
[8] Order No. R9-97-11, *General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Nonhazardous Waste Landfills within the San Diego Region* or subsequent superseding NPDES renewal orders.

Item	Implementation Action	Responsible Parties	Date
1	Effective date of Chollas Creek Metals TMDL Waste Load Allocations.	San Diego Water Board, Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	October 22, 2008[9]
2	Recommend High Priority for grant funds.	San Diego Water Board	Immediately after effective date
3	Submit annual Progress Report to San Diego Water Board due January 1 of each year.	Municipal Dischargers	Annually after reissue of NPDES WDRs.
4	Submit annual Progress Report to San Diego Water Board due April 1 of each year.	Caltrans	Annually after reissue of NPDES WDRs.
5	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Industrial Stormwater Dischargers	Annually after reissue of NPDES WDRs.
6	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Construction Stormwater Dischargers	Annually after reissue of NPDES WDRs.
7	Municipal NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
8	Caltrans NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
9	Construction NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
10	Industrial NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
11	Amend Orders No. 2000-90, and No. 2001-96 (or superseding renewal orders) which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
12	Municipal and Navy WDR Order No. R9-2004-0277 shall amended to require additional monitoring for metals and hardness.	San Diego Water Board	Within 5 years of effective date
13	Landfill NPDES WDR Order No. 97-11 (or superseding renewal orders) shall be issued, reissued, or revised to monitor for metals and hardness.	San Diego Water Board	Within 5 years of effective date

[9] Upon approval of by OAL.

Item	Implementation Action	Responsible Parties	Date
14	Navy and all other Phase II small MS4 permittees in the Chollas Creek watershed shall be enrolled in Order No. 2003-0005-DWQ (or superseding renewal orders).	San Diego Water Board	Immediately after effective date.
15	Take enforcement actions	San Diego Water Board	As needed after effective date.
16	Meet 80% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	10 years after effective date.
17	Meet 100% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	20 years after effective date.

E.11. Implementation Monitoring Plan

Compliance monitoring will be required in the creek itself to measure the progress of BMP implementation effectiveness and finally to ensure that the water quality objectives for copper, lead, and zinc are being achieved. Order No. R9-2004-0277 (the Chollas Creek Investigation Order for Diazinon and Metals) will be reviewed by the San Diego Water Board, and if needed, amended to require the dischargers to collect the data necessary to refine the watershed model so that mass loads of copper, lead, and zinc leaving the Chollas Creek watershed can be more accurately estimated. This information will be used to refine the TMDLs and in the development of the TMDL for Metals in San Diego Bay at the mouth of Chollas Creek. The San Diego Water Board has considered the costs of the reasonably foreseeable methods of compliance with the load and wasteload reductions specified in this TMDL.

E.12. Environmental Review and Economic Analysis

The San Diego Water Board is the lead agency for evaluating the environmental impacts of this Basin Plan amendment pursuant to the California Environmental Quality Act (CEQA). The Basin Planning process has been certified as functionally equivalent to CEQA requirements for preparing environmental documents and is, therefore, exempt from those requirements (Public Resources Code section 21000 et seq.). The required environmental documentation (Basin Plan amendment, Technical Report, and Environmental Checklist) has been prepared. The San Diego Water Board has identified environmental impacts, reasonable alternatives, and mitigation measures to minimize any significant adverse environmental impacts of the proposed Basin Plan amendment.

Attainment of the WLAs will be achieved through discharger implementation of structural and nonstructural BMPs designed to reduce metals concentrations in urban runoff and stormwater. The environmental analysis contains examples of BMPs that might reasonably be implemented by the dischargers to comply with the TMDLs. Nonstructural BMPs identified included, among others, education and outreach, road and street maintenance, elimination of illicit discharges, and inspections of commercial and industrial facilities. Structural BMPs included, among others, construction of vegetated swales and buffer strips, bioretention, detention basins, retention ponds, sand filters, and diversion systems.

The CEQA checklist identified potential adverse environmental impacts that might result from implementation of the identified BMPs unless mitigation is incorporated into the projects. Potential adverse impacts to the environment were identified for earth, air, water, plant life, animal life, transportation/circulation, public services, human health, aesthetics, recreation, archeological, overall potential to degrade, cumulative impacts, and substantial adverse impacts categories of the CEQA checklist. The environmental analysis included discussion regarding mitigation measures that could be implemented to minimize these potential impacts.

The San Diego Water Board must also consider the economic costs of the reasonably foreseeable methods of compliance with this Basin Plan amendment to reduce copper, lead, and zinc loads to surface waters through implementation of BMPs. The economic analysis discloses the costs of implementing typical stormwater BMPs for reduction of metals. Monitoring and reporting costs are not disclosed in this report since monitoring and reporting is a requirement of existing orders and the need for additional monitoring is unknown at this time.

The specific BMPs to be implemented will be chosen by the dischargers after adoption of this TMDL project. All costs are preliminary estimates only, since particular elements of a BMP, such as type, size, and location, would need to be developed to provide a basis for more accurate cost estimations. Typical costs of conventional stormwater BMPs are provided in the following two tables (Tables E.5 and E.6). Costs for structural BMPs were estimated for treatment of ten percent of urbanized watershed area (approximately 1,370 acres) with the exception of diversion structures, which are costs per unit.

TABLE E.5: Summary of Cost Estimates for Non-Structural BMPs

Non-Structural BMPs	Estimated Cost*	Estimated Cost Adjusted For Inflation 2006 Dollars**
Education and Outreach	$1,000 - $200,000 per program	$1,210 - $242,000 per program
Street Sweeping	$ 60,000 - $180,000 per unit	$ 72,600 - $218,000 per unit
Illicit Discharges	$0 to $1,750	$0 to $2,120

*The costs were obtained from USEPA, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. (EPA-821-R-99-012). August 1999.
** Sahr, R.C. 2007. Consumer Price Index (CPI) Conversion Factors 1800 to Estimated 2016 to Convert to Dollars of 2006. Oregon State University, Political Science Department, Corvallis, OR. Revised January 18, 2006.

TABLE E.6: Summary of Cost Estimates for Structural BMPs

Structural BMPs	Estimated Cost to treat 10% of Urbanized Area (ECUA 10%)	ECUA 10% Adjusted For Inflation 2006 Dollars*****	Estimated Yearly Maintenance Cost (EYMC)	EYMC Adjusted For Inflation 2006 Dollars*****
Vegetated Swale	$960,000*	$1.2 million	$67,000	$81,000
Vegetated Buffer Strip	$1.2 million*	$1.45 million	$120,000	$145,000
Infiltration Trench	$60 Million	$64 Million	$5.8 Million	$6.2 Million
Bioretention	$16.4 million*	$19.9 million	$1.1 million	$1.3 million
Detention Basins and Retention Ponds	$2.7million*	$3.3 million	$27,000	$33,000
Sand Filters	$15 million*	$18.2 million	$2 million	$2.4 million
Austin Sand Filters	$119 million**	$127 million	$6.4 Million	$6.8 Million
Porous Pavement	$490 Million***	$593 Million	$274,000	$332,000
Diversion	$1 million****	$1.03 million	$10,000	$10,300

* Based on USEPA, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. [EPA-821-R-99-012. August 1999].
** Based on Caltrans, 2004. Report ID CTSW-RT-01-050.
*** Based on USEPA, 1999 Storm Water Technology Fact Sheet Porous Pavement [EPA 823-F-023]
**** Cost per unit. Based on personal communication with Ruth Kolb, City of San Diego, March 14, 2005.
***** Sahr, R.C. 2007. Consumer Price Index (CPI) Conversion Factors 1800 to Estimated 2016 to Convert to Dollars of 2006. Oregon State University, Political Science Department, Corvallis, OR. Revised January 18, 2006.

E.13. Peer Review

The scientific basis of this TMDL has undergone external peer review pursuant to Health and Safety Code section 57-004. The San Diego Water Board has considered and responded to all comments submitted by the peer review panel. Interested persons and the public have had reasonable opportunity to participate in review of the amendment to the Basin Plan. Efforts to solicit public review and comment include five public workshops held between April 1999 and April 2005; a public review and comment period of 45 days preceding the San Diego Water Board public hearing; and written responses from the San Diego Water Board to oral and written comments received from the public. The San Diego Water Board has notified all known interested parties and the public of its intent to consider adoption of this Basin Plan amendment in accordance with CWC section 13244.

TECHNICAL ANALYSIS

1 Background

Chollas Creek[10] is an urban coastal stream in southern San Diego County, and a tributary to San Diego Bay. Portions of the cities of San Diego, Lemon Grove, and La Mesa are located within the Chollas Creek Watershed. Chollas Creek was placed on the Clean Water Act (CWA) section 303(d) List of Water Quality Limited Segments (List of Water Quality Limited Segments) in 1996 for the metals cadmium,[11] copper, lead, and zinc. The San Diego Water Board has established Total Maximum Daily Loads (TMDLs) for copper, lead, and zinc as required by the CWA for water quality limited segments.

Chollas Creek is an urban creek with highly variable flows. The highest flow rates are associated with storm events. Extended periods with no surface flows occur during dry weather, although pools of standing water may be present. Much of the creek has been channelized and concrete lined, but some sections of earthen creek bed remain. The mouth of the creek is located on the eastern shoreline of the central portion of San Diego Bay. San Diego Bay at the mouth of Chollas Creek is also on the List of Water Quality Limited Segments; being impaired for sediment toxicity and degraded benthic community.

The watershed of Chollas Creek encompasses 16,273 acres. The area of the north fork of the watershed (9,276 acres) is larger than that of the south fork (6,997 acres) (URS Greiner Woodward Clyde 1999). Land use is predominantly residential, with some commercial/institutional and industrial use. A significant portion of the remainder of the watershed consists of roadways, while the rest is open space. Portions of the cities of San Diego, Lemon Grove, and La Mesa are located within the watershed. A small portion of the watershed consists of "tidelands" immediately adjacent to San Diego Bay. Some of this tideland area is under the jurisdiction of the San Diego Unified Port District (Port); the remainder is under the jurisdiction of the U.S. Navy (Navy). San Diego County also holds jurisdiction over a small portion of the watershed.

The Introduction section of this report describes the TMDL process in general. Sections 3 through 9 comprise the seven required components of a TMDL technical report.

[10] The Chollas Creek Watershed comprises Hydrologic Unit number 908.22.
[11] Cadmium was delisted in 2006. See Appendix B.

2 Introduction

Section 303(d)(1)(A) of the CWA requires that "Each state shall identify those waters within its boundaries for which the effluent limitations…are not stringent enough to implement any water quality standard (WQS) applicable to such waters." The CWA also requires states to establish a priority ranking of Water Quality Limited Segments and to establish TMDLs for such waters.

The purpose of a TMDL is to attain water quality objectives (WQOs) and restore and protect the beneficial uses of an impaired waterbody. TMDLs represent a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. A TMDL is defined as the sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background [40 CFR 130.2] such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded.

The TMDL process begins with the development of a technical report which includes the following 7 components: (1) a **Problem Statement** describing which WQOs are not being attained and which beneficial uses are impaired; (2) identification of **Numeric Targets** which will result in attainment of the WQOs and protection of beneficial uses; (3) a **Source Analysis** to identify all of the point and nonpoint sources of the impairing pollutant in the watershed and to estimate the current pollutant loading for each source; (4) a **Linkage Analysis** to calculate the **Loading Capacity** of the waterbody for the pollutant; which is the maximum amount of the pollutant that may be discharged to the waterbody without causing exceedances of WQOs and impairment of beneficial uses; (5) a **Margin of Safety** (MOS) to account for uncertainties in the analysis; (6) the division and **Allocation** of the TMDL among each of the contributing sources in the watershed, WLAs for point sources and LAs for nonpoint and background sources; and (7) a description of how **Seasonal Variation and Critical Conditions** are accounted for in the TMDL determination. A document, like this report, containing the above components is generally referred to as the technical report.

The report also includes an **Implementation Plan** that describes the pollutant reduction actions that must be taken by various persons accountable for taking actions to meet the allocations specified in the technical report. A time schedule for meeting the required pollutant allocations is included in the Implementation Plan. In addition, the Implementation Plan also includes requirements for an Implementation Monitoring Plan that must be implemented to assess the effectiveness of the load reduction activities in attaining allocations and WQOs in Chollas Creek and restoring beneficial uses. Public participation is a key element of the TMDL process and stakeholder involvement is encouraged and required.

Once established, the regulatory provisions of the TMDL, Implementation Plan and Implementation Monitoring Plan are incorporated into the Water Quality Control Plan for the San Diego Basin (9) (Basin Plan; San Diego Water Board, 1994). The San Diego Water Board, following a public comment period and hearing process, adopts a resolution that amends the Basin Plan to incorporate the TMDL. Additional requirements of the

Basin Plan amendment process also include an evaluation of economic and environmental considerations. As with any Basin Plan amendment involving surface waters, a TMDL amendment will not take effect until it has undergone subsequent agency approvals by the State Water Resources Control Board (State Water Board), the Office of Administrative Law (OAL). The United States Environmental Protection Agency (USEPA) must also approve the Amendment; however, it will take effect following approval by OAL.

Following these approvals, the San Diego Water Board is required to incorporate the regulatory provisions of the TMDL into all applicable orders prescribing waste discharge requirements (WDRs), or other regulatory mechanisms. Water Quality Based Effluent Limits (WQBELs) for the impairing pollutant in the subject watershed are incorporated in the appropriate WDRs to implement and make the TMDL enforceable. WQBELs can consist of either numeric effluent limitations, or an iterative Best Management Practice (BMP) approach of expanded or better tailored BMPs. The CWA requires that WDRs issued pursuant to the National Pollutant Discharge Elimination System (NPDES) provisions of the CWA be consistent with all applicable TMDLs.

The final and most important step in the process is the implementation of the TMDL by dischargers. Per the governing WDR order (or other regulatory mechanism), each discharger must reduce its current loading of the pollutant to its assigned allocation of the pollutant in accordance with the time schedule specified in the technical report (and implementing WDR order). When each responsible party has achieved its required load reduction, water quality standards for the impairing pollutants are expected to be restored in the receiving water.

3 Problem Statement

The lowest 1.2 miles of Chollas Creek were placed on the List of Water Quality Limited Segments in 1996 for stormwater toxicity, coliform[12] and the metals cadmium[13] copper, lead, and zinc. While only the lowest 3.5 miles of Chollas Creek comprise the actual impaired and listed segment of the water body, all upstream tributaries to this section are considered in this TMDL because they deliver metals loads to the lower segments. Samples collected at station SD8(1) (Figure 3.1) pursuant to Order No. R9-2001-01,[14] repeatedly showed toxicity to the water flea, *Ceriodaphnia dubia*. A subsequent Toxicity Identification Evaluation (SCCWRP, 1999) for three storm events identified copper and the pesticide diazinon[15] as the principal causes of toxicity to *C. dubia* and zinc as the cause of toxicity to the purple sea urchin, *Strongylocentrotus purpuratus*.

Since 1994, stormwater samples from Chollas Creek have frequently exceeded both chronic and acute water quality criteria established in the National Toxics Rule (NTR) in federal regulations [40 CFR 131.36 (d)(10)(ii)] for copper, lead, zinc and cadmium. In the NTR, both 1-hour acute and 4-day chronic water quality criteria are calculated as a function of hardness and the criteria are then compared against measured event mean concentrations (EMC). The EMC is defined as the total pollutant load divided by the total runoff volume. If the measured EMC was equal to or greater than acute or chronic criteria, the result was considered to exceed water quality criteria. Comparisons against NTR criteria were partially responsible for the original listing of Chollas Creek in 1996 for cadmium, copper, lead, and zinc.

In April 2000, the USEPA promulgated the California Toxics Rule (CTR) [40 CFR 131.38] that established new water quality criteria for waters in California, including water quality criteria for copper, lead, zinc and cadmium. As in the NTR, both 1-hour acute and 4-day chronic water quality criteria are calculated as a function of hardness.

The criteria are compared against measured concentrations of the dissolved metal (NTR assessed total metal concentration). Storm water samples from Chollas Creek collected between 1994 and 2003 periodically exceeded CTR water quality criteria for only copper, lead, and zinc (Table 3.1 and Appendix A). For each concentration that exceeded criteria, an exceedance factor was calculated. For example, if a concentration was two times greater than criteria, the exceedance factor was 2.0. Analysis of the exceedance factors showed that many concentrations of copper, lead, and zinc were more than double

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[12] This section 303(d) listing for coliform has since been changed to "Bacterial Indicators." A separate TMDL is currently under development that addresses several Bacterial Indicator listings throughout the region.

[13] Cadmium is recommended for de-listing. See Appendix B.

[14] Order No. 2001-01, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, NPDES No. CAS0108758.

[15] A separate TMDL for diazinon was developed by the San Diego Water Board and adopted by the USEPA in November 2003. Order No. R9-2001-01 was superseded by Order No. R9-2007-0001 in January 2007.

their allowable limit. California must comply with the more stringent criteria of CTR rather than NTR.

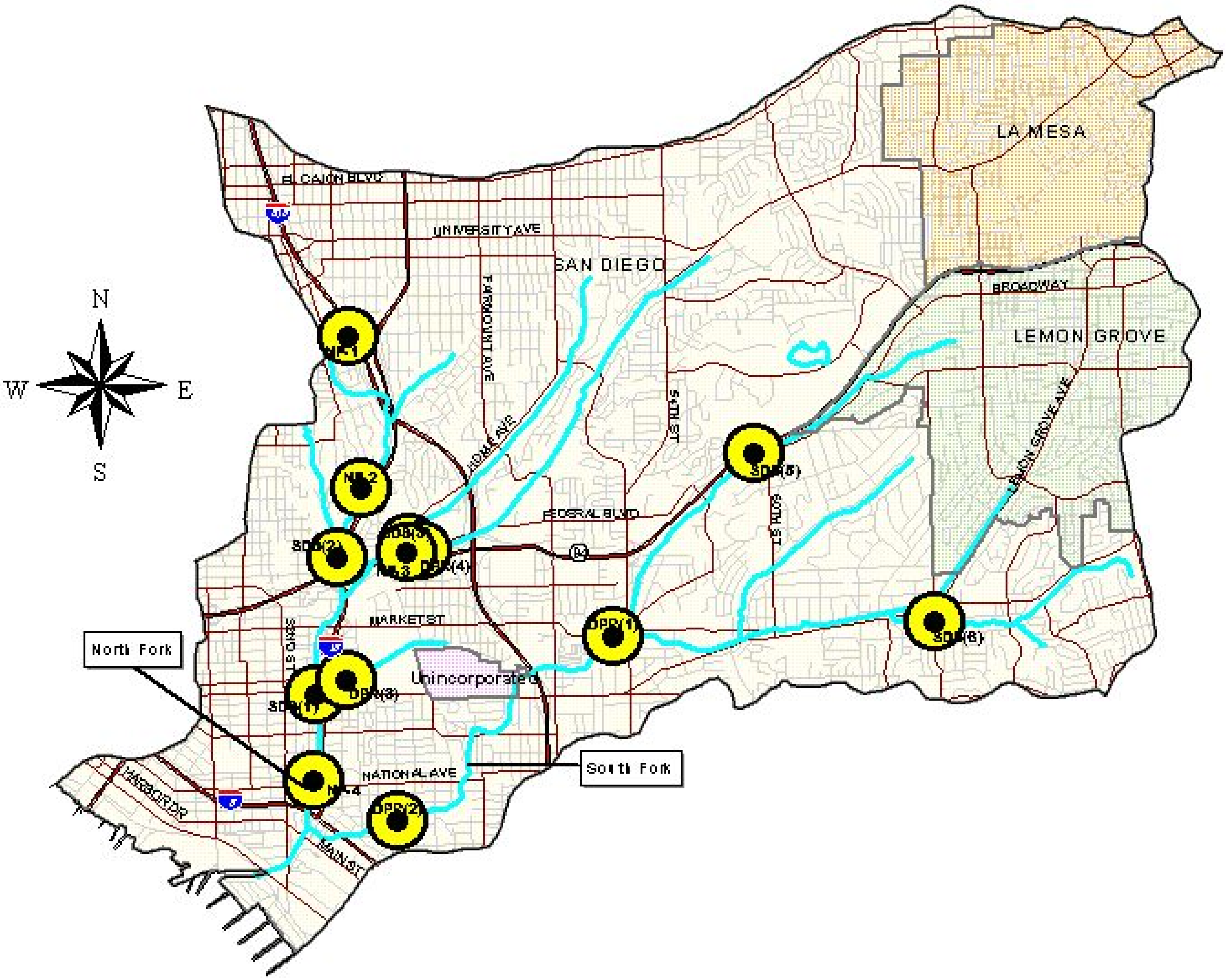

FIGURE 3.1. Chollas Creek Watershed.

3.1 De-listing of Cadmium

The available data suggest that concentrations of dissolved cadmium in Chollas Creek exceed neither acute nor chronic CTR water quality criteria. Most samples were below DLs, though some of the DL concentrations exceed CTR acute and chronic criteria. Since cadmium did not appear to exceed dissolved CTR criteria and was not found to cause toxicity in test organisms, a TMDL for cadmium was not established in this project. Based on this evidence, the San Diego Water Board recommended that cadmium be removed from the List of Water Quality Limited Segments in the 2006 listing update undertaken by the State and Regional Water Boards. The State Water Board removed the Cadmium listing from the 2006 list. The USEPA has yet to approve the delisting. The USEPA has recommended (USEPA, 2001) a more stringent dissolved cadmium criteria that it plans to incorporate in to the CTR by 2008. These criteria are approximately ten-fold more stringent than current CTR criteria; and would warrant listing for exceedances of the chronic criteria (see Table 3.1 below). However, these criteria are only proposed and have not been promulgated by the USEPA.

When and if the CTR is updated to incorporate these criteria, the San Diego Water Board will re-evaluate the potential listing of cadmium for Chollas Creek. Appendix B contains the details supporting the cadmium delisting recommendation.

3.2 Watershed Characteristics

Chollas Creek is an urban creek with highly variable flows. The highest flow rates are associated with storm events. Extended periods with no surface flows occur during dry weather, although pools of standing water may be present. The annual average rainfall in the Chollas Creek Watershed is approximately 9 inches (URS Greiner Woodward Clyde 1999). The average annual rainfall in the watershed (from October 1948 through February 2002) measured at La Mesa, CA is approximately 12.6 inches (Western Regional Climate Center, 2003). Rainfall statistics for the San Diego International Airport (Lindbergh Field, located approximately 4 miles northwest of Chollas Creek, near San Diego Bay) indicate that an average of 18 storms occur each year (URS Greiner Woodward Clyde 1999).

Much of the creek has been channelized and concrete lined, but some sections of earthen creek bed remain. The mouth of the creek is located on the eastern shoreline of the central portion of San Diego Bay. San Diego Bay at the mouth of Chollas Creek is also on the List of Water Quality Limited Segments; being impaired for sediment toxicity and degraded benthic community.

The watershed of Chollas Creek encompasses 16,273 acres. The area of the north fork of the watershed (9,276 acres) is larger than that of the south fork (6,997 acres) (URS Greiner Woodward Clyde 1999). However, a 2000 report by the San Diego Association of Governments reported the Chollas Creek Watershed to contain 28.52 square miles (18,253 acres). As Table 3.2 indicates, the watershed is highly urbanized. Land use is predominantly residential, with some commercial/institutional and industrial use. A significant portion of the remainder of the watershed consists of roadways, while the rest is open space. Portions of the cities of San Diego, Lemon Grove, and La Mesa are located within the watershed. A small portion of the watershed consists of "tidelands" immediately adjacent to San Diego Bay. Some of this tideland area is under the jurisdiction of the San Diego Unified Port District (Port); the remainder is under the jurisdiction of the U.S. Navy (Navy). San Diego County also holds jurisdiction over a small portion of the watershed (<1.0 percent) as shown in Figure 3.1.

CADMIUM Collection Dates	Organization	n	Concentrations reported in ug / L min	max	mean	median	# of exceedances (CTR)[D] CMC	CCC	# of exceedances (USEPA, 2001)[D] CMC	CCC
Feb 94 - Feb 03	MS4 Copermittees	42	0.2[A]	3.93[B]	0.8[C]	0.5[C]	0 of 4	0 of 4	0 of 4	3 of 4
Feb 00 - Apr 00	CalTrans	4	0.2[A]	0.3	0.2[C]	0.2[C]	NA[E]	NA[E]	NA[E]	NA[E]
Mar 99 - Apr 99	SCCWRP	3	< 0.3	< 2.0	< 2.0	< 2.0	NA[F]	NA[F]	NA[F]	NA[F]
Jun 91 & Mar 92	Regional Board	5	1.0[A]	< 1.0	0.5[C]	0.5[C]	NA[F]	NA[F]	NA[F]	NA[F]

COPPER Collection Dates	Organization	n	Concentrations reported in ug / L min	max	mean	median	# of exceedances (CTR)[D] CMC	CCC
Feb 94 - Feb 03	MS4 Copermittees	58	2.5[A]	81.6[B]	16.4[C]	11.0[C]	16 of 32	20 of 32
Feb - Apr, 00	CalTrans	4	5.1	11	7.8	7.5	NA[E]	NA[E]
Feb - Mar, 00	SCCWRP	2	51.2	63	57.1	57.1	NA[E]	NA[E]
Jan , Feb & Nov, 01	DPR	14	5	34	11.7	9.8	5 of 12	7 of 12
Sep-00	ES Babcock	4	1.92	28.8	9.8	4.3	NA[G]	NA[G]
Mar - Apr 99	SCCWRP (TIE)	3	10	30	18.3	15	2 of 3	3 of 3
Jun 91 & Mar 92	Regional Board	5	3	8	6.4	7	0 of 5	0 of 5

LEAD Collection Dates	Organization	n	Concentrations reported in ug / L min	max	mean	median	# of exceedances (CTR)[D] CMC	CCC
Feb 94 - Feb 03	MS4 Copermittees	57	1.0[A]	118[B]	16.4[C]	3.0[C]	0 of 19	10 of 19
Feb - Apr, 00	CalTrans	4	2.9	11	5.5	4	NA[E]	NA[E]
Jan , Feb & Nov, 01	DPR	14	1..0[A]	46	7.3	2	1 of 12	6 of 12
Sep-00	ES Babcock	4	2.0[A]	4.1	1.9	1.2	NA[G]	NA[G]
Mar - Apr 99	SCCWRP (TIE)	3	10.0[A]	82	39	30	1 of 2	2 of 2
Jun 91 & Mar 92	Regional Board	5	5.0[A]	29	12.2	11	0 of 3	1 of 3

ZINC Collection Dates	Organization	n	Concentrations reported in ug / L min	max	mean	median	# of exceedances (CTR)[D] CMC	CCC
Feb 94 - Feb 03	MS4 Copermittees	57	8	548[B]	105.6[C]	73[C]	12 of 42	12 of 42
Feb - Apr, 00	CalTrans	4	17	42	28.8	28	NA[E]	NA[E]
Feb - Mar, 00	SCCWRP	2	146	150.8	148.4	148.4	NA[E]	NA[E]
Jan , Feb & Nov, 01	DPR	14	16.8	370	137.6	105	7 of 12	7 of 12
Sep-00	ES Babcock/RB	4	10.0[A]	45	21.3	17.5	NA[G]	NA[G]
Mar - Apr 99	SCCWRP (TIE)	3	90	220	173.3	210	2 of 3	2 of 3
Jun 91 & Mar 92	Regional Board	5	3	188	45	11	0 of 5	1 of 5

[A] sample below Reporting Limit
[B] calculated from total concentration
[C] using all samples (measured dissolved and calculated from total). Samples below detection limit entered as 1/2 detection limit for calculations
[D] considering only measured dissolved concentrations and samples not below DL or RL. (number in parenthesis represents available sample pool under these criteria)
[E] no associated hardness values available
[F] all samples reported as "less than"
[G] all dissolved samples calculated from total.

TABLE 3.1. Metal data summaries.

TABLE 3.2. Land use in the Chollas Creek Watershed. (URS Greiner Woodward Clyde 1999)

Land Use	Percent of Total Area (Entire Watershed)
Residential	67%
Commercial/Institutional	5%
Industrial	7%
Roadways	4%
Open Space	16%

3.3 Applicable Water Quality Standards

WQSs consist of beneficial uses, WQOs and an anti-degradation policy. The Basin Plan (San Diego Water Board, 1994) specifies WQSs for all waters in the San Diego region, including Chollas Creek and San Diego Bay. The WQSs that apply to this TMDL are the existing and potential beneficial uses in Chollas Creek that could be adversely affected by toxicity, combined with the Basin Plan narrative WQOs for toxicity, and the numeric criteria for toxic pollutants found in the federal California Toxics Rule. The beneficial uses for Chollas Creek and San Diego Bay are listed in Table 3.3. Chollas Creek is also subject to State Water Board Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, which establishes a general principle of non-degradation.

TABLE 3.3. Beneficial uses in the Chollas Creek Watershed and San Diego Bay.

Beneficial Use	Chollas Creek	San Diego Bay
Industrial service supply		•
Navigation		•
Contact water recreation	o	•
Non-contact water recreation	•	•
Commercial and sport fishing		•
Preservation of biological habitats of special significance		•
Estuarine habitat		•
Warm freshwater habitat	•	
Wildlife habitat	•	•
Rare, threatened, or endangered species		•
Marine habitat		•
Migration of aquatic organisms		•
Shellfish harvesting		•

• Existing Beneficial Use
o Potential Beneficial Use

The following Basin Plan narrative WQO (Basin Plan p. 3.15) for toxicity is applicable to all inland surface waters (including Chollas Creek), enclosed bays (including San Diego Bay) and estuaries, coastal lagoons and ground waters of the San Diego region.

Water Quality Objective for Toxicity
All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Testing of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the San Diego Water Board will be used to determine compliance with this objective.

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with requirements specified in USEPA, State Water Resources Control Board or other protocol authorized by the San Diego Water Board. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.

In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available and source control of toxic substances will be encouraged.

In addition to Basin Plan objectives, the CTR also establishes numeric water quality criteria legally applicable in the state of California as WQOs for inland surface waters and enclosed bays and estuaries. These criteria are discussed in full in section 4 of this chapter.

3.4 Metals Chemistry

Copper and zinc are essential elements for all living organisms, but elevated levels may cause adverse effects in all biological species. Lead is presumed to be a non-essential element for life; more importantly, even at extremely low environmental concentrations this element may create adverse impacts on biota. Dissolved forms of these metals are directly taken up by bacteria, algae, plants and planktonic and benthic organisms. Dissolved metals can also adsorb to particulate matter in the water column and enter aquatic organisms through various routes. Copper, lead, and zinc may bioaccumulate within lower organisms, yet they are not expected to biomagnify up the food chain as do mercury and selenium (Moore and Ramamoorthy, 1984). The issue of biomagnification is still being debated among the scientific community (Besser, et al, 200) and cannot be assessed in Chollas Creek with the available information. Of all of these metals, copper is considered the most potent toxicant at environmentally relevant aqueous concentrations. Copper is more commonly found at higher concentrations in herbivorous fish than carnivorous fish from the same location (USF&W, 1998). Copper is used as an aquatic herbicide to reduce algae growth in reservoirs and is applied (via antifouling paints) to boat hulls in marinas.

The fate and transport of metals in natural waters is influenced by the physical state and chemical complexation of each element. Physical separation methods (i.e., filters) define metals associated with the particulate, colloidal, or dissolved phases. Unfiltered or "total" metal samples represent the sum of all size fractions; whereas filtered or "dissolved" samples yield metals in solution. As a general rule, particulate metal concentrations are higher than those in dissolved phase for all metals in this TMDL. This is based in part on the inherent reactivity of negatively charged particulate matter and positively charged metal ions (Buffle, 1989). As outlined in the CTR, the USEPA has defined aquatic life water quality criteria for these metals based on the dissolved fraction of aqueous samples (USEPA 2000a). These water quality criteria serve as numeric targets for the copper, lead, and zinc TMDLs.

Exposure to two or more chemicals may result in toxicity that is additive or a simple summation of the toxicity of the individual chemicals. Likewise, the presence of two or more chemicals may result in a synergistic effect, or toxicity that is greater than would be expected based on a simple summation of the individual toxicities of the chemicals. Copper and zinc have been shown to have an additive toxic effect on aquatic life (Taylor and Francis, 1995). However, there is insufficient data to determine if these effects are found in Chollas Creek. This will be addressed as part of the monitoring required in the implementation (sections 11 and 12) phase of the TMDL.

3.5 Sediment Metals

Sediment samples have been collected for chemical analysis in Chollas Creek since 1994 (Appendix C), generally as a single sampling event every late spring and early fall. Extensive sampling occurred during June 1998 at several stations within the creek. All samples were analyzed for total cadmium, copper, lead, and zinc (Table 3.4). With few exceptions, all four metals were below their applicable Probable Effects Level (PEL) (MacDonald et al., 1996). The PEL or Probable Effects Concentration (PEC) (MacDonald et al., 2000) is an empirical approach to determine what concentration of a chemical is likely to have an environmental impact. In the PEL approach, the chemical concentrations of the samples are ranked from high to low toxicity. The PEL is the geometric mean of the 50th percentile of the effects data and the 85th percentile of the no effects data. The PEL represents the concentration above which adverse effects are expected to occur frequently (Smith et al., 1996). Freshwater sediment chemistry regulations to protect aquatic life in California have not been promulgated. However, PELs were used to screen sediment chemistry data from San Diego Creek in a TMDL written by USEPA (2002) and are therefore appropriate to use as screening values in this TMDL.

TABLE 3.4. Summary of total metal concentrations in Chollas Creek sediments.

Metal	no. of detections / no. of samples analyzed	Average[1] (mg/kg, dry wt.)	Median[1] (mg/kg, dry wt.)	Std Dev[1] (mg/kg, dry wt.)	PEL[2] (mg/kg, dry wt.)	no. of samples > PEL[2]	no. of samples > PEL[2]
Cadmium	11 of 81	2.10	2.50	2.54	3.53	1	1.2%
Copper	45 of 81	10.2	3.6	17.9	197	0	0.0%
Lead	37 of 81	18.7	6.3	27.4	91.3	3	3.7%
Zinc	81 of 81	61.6	42.2	62.4	315	1	1.2%

[1] Non-detects are considered as 1/2 of the Reporting Limit for calculations of average, median and standard deviation.

[2] PEL = Probable Effects Level

A review of the available sediment metal chemistry data indicate that accumulation of metals above potentially harmful concentrations is unlikely. Additionally, metals are expected to continuously partition out of the dissolved phase and settle out of the water column with particulate organic matter. Residence time in the creek is likely less than one year because each season's major storms will effectively remove any metals accumulated in the creek sediment and transport them downstream to San Diego Bay.[16] Therefore, this TMDL will focus on water column concentrations of dissolved metals.

3.6 Sampling History in the Watershed

Stormwater monitoring of Chollas Creek began in the 1993-94 rainy season under the MS4 stormwater order in effect at that time. Each rainy season, stormwater samples are collected from two or three storms at a station located on the north fork of Chollas Creek near the intersection of 33rd and Durant Streets. To avoid tidal influence, the monitoring station is installed on the north fork above the north and south fork confluence. Runoff from approximately 57 percent of the entire watershed is sampled at the monitoring site (URS Greiner Woodward Clyde 1999). This station samples run-off that is representative of the entire watershed because the land use distribution in the north fork portion of the watershed is nearly identical to the land use distribution of the entire watershed as shown in Table 3.5 below.

TABLE 3.5. Land use distribution for Chollas Creek Watershed. (URS Greiner Woodward Clyde 1999)

Land Use	Percent of Total Acreage (Entire Watershed)	Percent of Sampled Acreage (North Fork Watershed)
Residential	67%	62%
Commercial/Institutional	5%	9%
Industrial	7%	10%
Open Space	16%	14%
Roadways	4%	5%

[16] The sediment deposited in San Diego Bay will be addressed in the "San Diego Bay Shoreline, near Chollas Creek" TMDL currently under development.

Since the 1993-94 rainy season, stormwater samples have been analyzed for general physical constituents, nutrients, biochemical oxygen demand, chemical oxygen demand, bacteriological constituents, organic constituents and total recoverable metals. Since 2000, samples have also been analyzed for dissolved metals. Toxicity testing began with the 1994-95 rainy season and is conducted using the water flea *Ceriodaphnia dubia* and the fish commonly known as a fathead minnow (*Pimephales promelas*). Toxicity as indicated by mortality was found in every test run on the water flea for the municipal stormwater program. Reproduction of the water flea was generally not impaired. Toxicity was generally not found in tests run on the fathead minnow, but frequently some inhibition of growth was found.

The San Diego Water Board, the California Department of Transportation (Caltrans), the Southern California Coastal Water Research Project (SCCWRP) and the Department of Pesticide Regulation (DPR) have also conducted metals sampling and analysis in the Chollas Creek Watershed. Appendix A has a summary of the data used in this TMDL. Currently, dischargers in the watershed are under order to file monitoring program reports for dissolved metals and diazinon.[17] Monitoring results are filed in the Watershed Urban Runoff Management Plans required in the San Diego County stormwater WDRs.[18]

[17] Order No. R9-2004-0277
[18] Order No. R9-2007-0001

4 Numeric Targets

When calculating TMDLs, numeric targets are established to ensure that WQOs are met and beneficial uses are protected. The CTR criteria for metals are the basis of the numeric targets. However, because dissolved metals toxicity is a function of hardness, the CTR criteria for copper lead, and zinc are expressed as hardness-based equations. The numeric target equations are shown in Table 4.1. This section will discuss why CTR was chosen as the basis for the numeric targets in this TMDL and will discuss the following different factors/variables of the numeric target equations: continuous and maximum criteria concentrations (CCC and CMC), Water-effect Ratios (WER), total-to-dissolved metal conversion factor (CF), hardness, and correlation coefficients (m and b, respectively). Newly proposed copper criteria will also be mentioned at the end of this section.

TABLE 4.1. Numeric targets for dissolved metals in Chollas Creek.

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Continuous Concentration
Copper	(1) * (0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(1) * (0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(1) * (0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

Hardness is expressed as milligrams per liter.
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)].
The natural log and exponential functions are represented as "ln" and "e," respectively.

The CTR criteria were chosen as the basis for these numeric targets, because they are the most current, defendable WQOs for dissolved copper, lead, and zinc concentrations in fresh water (USEPA, 2000a). The Basin Plan (San Diego Water Board, 1994) provides only narrative WQOs for determining allowable concentrations of copper, lead, and zinc in Chollas Creek. CTR criteria are legally applicable as WQOs in inland surface waters (e.g., Chollas Creek), enclosed bays and estuaries of California for all purposes and programs under the CWA (USEPA, 2000a).

Specifically, the numeric targets for the Chollas Creek TMDLs were set equal to the CTR's hardness-based equations criteria for dissolved copper, lead, and zinc (Table 3.1) and are shown below in their simplified forms (Equations 4.1 and 4.2). These equations were derived by USEPA in order to calculate the criteria that a metal concentration must be below in order to protect freshwater aquatic life from toxicity. Therefore by this definition, setting the numeric targets equal to the CTR equations will also ensure that the narrative water quality objectives for toxicity are met in the water column for copper, lead, and zinc. In addition, because they are equations, the numeric targets for Chollas

Creek do not vary spatially or temporally and thus apply throughout all freshwater portions of Chollas Creek at all times.

EQUATION 4.1: General Criteria Continuous Concentration (CCC)

$$CCC = (WER) * (CF_C) * \{e\hat{}[(m_C * \ln hardness) + b_C]\}$$

Where: CCC = Criteria Continuous Concentration
WER = Water-effect Ratio
CF_C = Conversion Factor for freshwater chronic criteria
m_C = correlation coefficient
b_C = correlation coefficient

The subscript "c" stands for "chronic" and designates a variable in the CCC equation. The natural log and exponential functions are represented as "ln" and "e," respectively [40 CFR 131.38(b)(2)].

EQUATION 4.2: General Criteria Maximum Concentration (CMC)

$$CMC = (WER) * (CF_A) * \{e\hat{}[(m_A * \ln hardness) + b_A]\}$$

Where: CCC = Criteria Continuous Concentration
WER = Water-effect Ratio
CF_A = Conversion Factor for freshwater chronic criteria
m_A = correlation coefficient
b_A = correlation coefficient

The subscript "A" stands for "acute" and designates a variable in the CMC equation. The natural log and exponential functions are represented as "ln" and "e," respectively [40 CFR 131.38(b)(2)].

4.1 Criteria for Maximum and Continuous Concentration

Table 4.1 (above) identifies targets for both chronic and acute conditions: the CCC equation (Equation 4.1) and the CMC equation (Equation 4.2), respectively. The CMC is the highest concentration that will protect aquatic life from acute or short-term effects, such as mortality. In order to protect aquatic life, the one-hour average water column concentration must be below the CMC. Similarly, the CCC is the highest concentration that will protect aquatic life from chronic or long-term effects, such as reduced birth rates. In order to protect aquatic life, the four-day average water column concentration must be below the CCC. Neither the CCC nor the CMC can be exceeded more than once every three years [40 CFR 131.38 (c)(2)]. For purposes of evaluating if the Numeric Targets have been attained, sample results should be used according to the requirements in Table 4.2.

TABLE 4.2. Requirements for using sample results to evaluate CCCs and CMCs.

1. If only one sample is collected during the time period associated with the Numeric Target (e.g., one-hour average), the single measurement shall be used to determine attainment of the numeric target for the entire time period.
2. The one-hour average shall be the moving arithmetic mean of grab samples over the specified one-hour period.
3. The four-day average shall apply to flow-weighted composite samples for the duration of a storm, or shall be the moving arithmetic mean of flow weighted 24-hour composite samples or grab samples.

4.2 Water-effect Ratio

The WER is a mechanism for developing site-specific criteria by comparing bioavailability and toxicity of a specific pollutant in receiving waters and laboratory waters and is provided as a variable in the concentration criteria equations (Equations 4.1 and 4.2; USEPA, 2000a). A site-specific WER has not been developed for Chollas Creek. In such circumstances, a WER of unity is assumed and used in the equations. Site-specific criteria are discussed in further detail in Appendix H.

4.3 Total-To-Dissolved Metal Conversion Factor

Prior to 2000, metal criteria for the protection of aquatic life were based on total metal concentrations, that is, the concentration of all sized metal fractions in the water column. Since then the USEPA recommends dissolved metal concentrations, or metals in solution, be used for metal criteria, because dissolved metals more closely represent the fraction of metals bioavailable to aquatic organisms than do total metals (USEPA, 2000a). The CTR criteria equations (Equations 4.1 and 4.2) incorporate total-to-dissolved conversion factors (CFs) to account for that fact [40 CFR 131.38 (b)(2)(iv)]. The CFs for each metal, with respect to acute and chronic conditions, are listed in Table 4.3. The CF for lead is a function of hardness. Concern has arisen in the past that non-dissolved metal in the water column, such as particulate metal, could become bioavailable. Although the Federal Register provides good reasons why this should not be a concern, an explicit MOS was applied in this TMDL to address this possibility.

TABLE 4.3. Metal acute and chronic freshwater conversion factors for copper, lead, and zinc.

Metal	CF_A	CF_C
Copper	0.960	0.960
Lead	1.46203 – [0.145712 * ln (hardness)]	1.46203 – [0.145712 * ln (hardness)]
Zinc	0.978	0.986

Reference: [40 CFR 131.38(b)(2)].

4.4 Hardness

As discussed above, CTR criteria are based on empirical relationships of toxicity (metal concentrations) to water hardness (Table 4.1). Hardness is defined as the concentration of calcium carbonate ($CaCO_3$) in the water column and has the units of milligram per liter (mg/L). Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicities of some metals. Hardness is used as a surrogate for a number of water quality characteristics that affect the toxicity of metals in a variety of ways. Increasing hardness has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness, measured in milligrams per liter as calcium carbonate.

Like many flowing freshwater bodies, Chollas Creek waters exhibit a wide range of hardness levels. Because hardness data to accurately assess this range were limited, hardness was set as a variable in the numeric targets. Consequently, hardness concentrations must be measured at the time of compliance and the criteria subsequently determined using the equations in Table 4.1. Further, because hardness will be determined at the time of compliance and included as a variable in the CTR equation, a more site-specific and temporal-specific numeric target is achieved.

At times when the hardness concentration exceeds 400 mg/L, a value of 400 mg/L will be used for hardness no matter what the extent of the exceedance. This is because the CTR caps the allowable hardness value that can be used to calculate the resulting water quality criteria. As hardness increases, so do the numeric targets. Conversely, decreasing hardness results in decreasing the numeric targets. Without the use of a WER, the maximum hardness value for associated use with the numeric targets is 400 mg/L $CaCO_3$. The available data suggests that few metal concentrations will exceed CTR criteria at a hardness of 400 mg/L $CaCO_3$.

4.5 Correlation Coefficients

The last variables are the correlation coefficients (m and b) shown in Equations 4.1 and 4.2. These coefficients are the result of fitting acute freshwater toxicity metal concentration data to hardness in a log-log relationship and are specified for each metal in Table 4.4 below (USEPA, 1985).

TABLE 4.4. Criteria correlation coefficients.

Metal	m_A	b_A	m_C	b_C
Copper	0.9422	-1.700	0.8545	-1.702
Lead	1.273	-1.460	1.273	-4.705
Zinc	0.8473	0.884	0.8473	0.884

Reference: [40 CFR 131.38(b)(2)]

4.6 Newly Proposed Copper Criteria

The USEPA has published a document, *2003 Draft Update of Ambient Water Quality Criteria for Copper* (EPA-822-R-03-026), containing updated freshwater and saltwater aquatic life criteria for copper. These criteria revisions are based in part on new data that have become available since the USEPA's last comprehensive criteria updates for copper.

In addition to incorporating new data, the freshwater criteria also incorporate the use of the biotic ligand model (BLM) in the criteria derivation procedures (USEPA, 2003).

The newly recommended freshwater criteria (the CMC and CCC is 2.1 micrograms per liter (µg/L) and 1.3 µg/L, respectively) differ from CTR's current metals criteria primarily with regard to how metal availability to organisms is addressed. As mentioned above, CTR criteria were based on empirical relationships of toxicity to water hardness. The newly recommended criteria use a BLM instead (Di Toro et al. 2001). The BLM is based on the premise that toxicity is related to metal bound to a biotic site (the biotic ligand) and that binding is related to dissolved metal concentrations and complexing ligands in the water.

The newly recommended criteria do not supersede the CTR criteria. At this time, the San Diego Water Board will continue to use CTR as the basis for the metals TMDLs numeric targets. When the TMDLs are revisited in the future, the San Diego Water Board may re-evaluate the numeric targets set forth here, based on the newly recommended criteria.

5 Source Analysis

The source analysis summarizes the major suspected sources of dissolved copper, lead, and zinc to the Chollas Creek Watershed. This includes consideration of point sources and nonpoint sources (which include background) and an estimate of their magnitude and location. Metals, such as copper, lead, and zinc, enter surface waters from point and nonpoint sources. Point sources typically discharge at specific locations from pipes, outfalls and conveyance channels from municipal wastewater treatment plants, industrial waste treatment facilities and stormwater conveyance systems. Nonpoint sources are diffuse sources that reach receiving waters from different routes of entry and originate from multiple land uses.

Essentially all sources (point and nonpoint) enter Chollas Creek through the stormwater conveyance system that is regulated by WDRs prescribed in Order No. R9-2007-0001. This order regulates discharges to surface waters from municipal separate storm sewer systems (MS4s) in San Diego County. MS4 discharges are collectively considered to be point sources of urban runoff discharges due to their release from channelized, discrete conveyance pipe systems and outfalls. Because there are currently no other known point sources, urban runoff is considered the most significant source of metals to Chollas Creek and will be the main focus of this analysis. In addition, this analysis will detail potential sources of urban runoff from activities outside and inside of the Chollas Creek Watershed boundaries, including atmospheric deposition. Estimates are drawn from several studies conducted outside the watershed as well as modeling results based on land use classifications within the watershed. Broad classes of sources (for example, urban runoff, atmospheric deposition, etc.) and specific individual sources (for example, land uses, cars, etc.) will be discussed.

Specifically, modeling results based on land use category parameters, hydrological characteristics and observed metal concentrations provided estimates of the magnitude of metal loadings (Appendix D). The top two land use categories in Chollas Creek, freeways and commercial/institutional, contribute over 75 percent of the total load for each metal (Figures 5.4, 5.5 and 5.6). Significant sources of all three metals to urban runoff are thought to include automobile operation (especially brake pads and tires) and industries with practices that may expose metals to stormwater. Water supply infrastructure corrosion, pesticide application and atmospheric deposition are also among the identified potential sources.

5.1 Urban Runoff Regulation in Chollas Creek Watershed

Urban runoff discharges from MS4s are a leading cause of receiving water quality impairments in the Chollas Creek Watershed. In addition, a direct linkage has been established between toxicity and stormwater discharges in the watershed (Schiff, 2001). According to Order No. R9-2007-0001 requirements, all entities that share a particular stormwater system are responsible for urban runoff discharges both (1) into their stormwater conveyance system and (2) from their stormwater conveyance system. Order No. R9-2007-0001 for San Diego County names 20 different entities responsible for stormwater discharges in the San Diego Region. Other than the MS4, there are no known direct point source discharges of metals to water bodies in the Chollas Creek Watershed.

The small size of the creek's riparian zone and the encroachment of development along the creek make the amount of run-off directly to the creek much smaller than that entering from storm drains. Furthermore, under Order No. R9-2007-0001, the creek itself is considered part of the storm drain system. Therefore, parties named in Order No. R9-2007-0001 are responsible for not only the run-off entering the creek, but also for the water in the creek itself.

Other responsible persons are those that hold general or individual Waste Discharge Requirements applicable in Chollas Creek. Some of the other major dischargers include Caltrans and the Navy. Caltrans is regulated under statewide Order No. 99-06-DWQ. Storm water runoff from the U.S. Navy's MS4 system, as discussed in Section 5.1.1, will also be regulated.

5.1.1 San Diego Water Board Order No. R9-2007-0001

In 1990, the USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent harmful pollutants from being washed by urban runoff into MS4s or from being dumped directly into MS4s and then subsequently into local water bodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement an urban runoff management program as a means to control polluted discharges from MS4s. Approved urban runoff management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations and hazardous waste treatment. More specifically, large and medium operators are required to develop and implement Urban Runoff Management Plans that address, at a minimum, the following elements:

- Structural control maintenance;
- Areas of significant development or redevelopment;
- Roadway runoff management;
- Flood control related to water quality issues;
- Municipally owned operations such as landfills, wastewater treatment plants, etc.;
- Hazardous waste treatment, storage, or disposal sites, etc.;
- Application of pesticides, herbicides and fertilizers;
- Illicit discharge detection and elimination;
- Regulation of sites classified as associated with industrial activity;
- Construction site and post-construction site runoff control; and
- Public education and outreach.

Of the 20 entities identified in Order R9-2007-0001, the cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego, and the Port (Municipal Dischargers) are all in the Chollas Creek Watershed and are responsible for addressing metal water quality concerns for the MS4 in the Chollas Creek Watershed, as applicable. One exception to note is that the Navy has runoff from its community facilities (Naval Base San Diego) in the Chollas Creek Watershed regulated under its industrial discharge WDRs prescribe in

Order No. 2002-0169.[19] Order No. 2002-0169 does regulate urban runoff discharges from MS4s, and the facility is not currently regulated under the MS4 WDRs prescribed in Order No. R9-2007-0001. The Navy is expected to be enrolled in the statewide general WDRs prescribed for small MS4s in Order No. 2003-0005-DWQ.[20]

5.1.2 Other Applicable Orders and Regulations

Table 5.1 lists other applicable WDR orders in the Chollas Creek Watershed. With respect to the source analysis, these orders regulate activities that may be contributing metals to Chollas Creek through urban runoff. All applicable orders must be made

TABLE 5.1. Other applicable orders for land use practices in the Chollas Creek Watershed.

Order General Name	Order Number	NPDES Permit Number	Sections[1]
Statewide Caltrans MS4, industrial, construction Stormwater WDRs	99-06-DWQ	CAS 000003	5.5.1, 5.5.3 and 5.5.6
Statewide General Industrial Stormwater WDRs	97-03-DWQ	CAS 000001	5.5.6
Statewide General Construction Stormwater WDRs	99-08-DWQ	CAS 000002	5.5.3
Landfill, burn sites - South Chollas Creek WDRs			
Temporary Groundwater Extraction and Discharge to San Diego Bay and Its Tributaries (Dewatering) WDRs	R9-97-11, Addendum No. 4		5.5.9
Groundwater Extraction Waste Discharges From Construction, Remediation, and Permanent Groundwater Extraction Projects to Surface Waters within the San Diego Region except for San Diego Bay	R9-2000-90	CAG 919001	N/A
	R9-2001-96	CAG 919002	N/A

[1] The section in this analysis of which the respective land use practice is discussed is listed beside the order.

[19] Order No. R9-2002-0169 NPDES Permit No. CA0109169, *Waste Discharge Requirements for U.S. Navy Naval Base San Diego, San Diego County*.

[20] State Water Board Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*.

consistent with the load and waste load allocations of this TMDL. In addition, other regulatory agencies may regulate other urban runoff sources, such as atmospheric deposition from industry and auto emissions, domestic water supply and various pesticide applications (sections 5.4.2, 5.4.5 and 5.5.4). Other sources, such as sewage spills and disposal of particular household products (section 5.5.2) are prohibited by law.

5.2 Estimation of Metal Magnitude and Location from Urban Runoff

Multiple sources of copper, lead, and zinc contribute to the accumulated metal on the surfaces of the Chollas Creek Watershed. Rainfall events and dry-weather urban runoff transfer these accumulated metals to Chollas Creek via the MS4 system. Because the relative loads entering Chollas Creek depend on wet or dry weather conditions, an assessment of existing loads requires separate analyses.

5.2.1 Land-use Modeling

Watershed models were developed by Tetra Tech, Inc. (Appendix D) to estimate the magnitude and source land uses of existing annual metal loadings to the Chollas Creek Watershed during both wet and dry weather conditions of a typical year. In addition, loads for a critical year, a year in which extraordinary rain volumes result in a higher mass load contribution, were also estimated. Table 5.2 shows the total estimate (wet and dry weather condition loads added together) for dissolved metal loading for both a typical and a critical year. All concentrations reported in this section are dissolved metals.

TABLE 5.2. Estimated existing total loads for Chollas Creek for both wet and dry weather conditions during a typical and critical year.

	Copper (dissolved) (g/yr)	Lead (dissolved) (g/yr)	Zinc (dissolved) (g/yr)
Typical Year	232,829	194,175	1,327,393
Critical Year	985,241	705,310	5,994,241

Unfortunately, limited data prevented complete utilization of the watershed models. Because the dry weather model simulation of metal concentration could not be properly calibrated and validated, the dry weather portion of the total estimate was calculated based only on the average observed concentrations. In addition, further refinement of both models is needed before results could be used in calculating a mass load allocation for a TMDL. Regardless, the model results quantify land use metal contributions and will be helpful in targeting higher priority subwatersheds and land uses for implementation of the TMDL during wet weather conditions. Further, the data to be collected as part of compliance monitoring for this TMDL will be used to complete the dry weather model as well as further refine the wet weather model. If modeling results warrant, the TMDL estimates could be adjusted as necessary at that time.

5.2.1.1 Urban Runoff from Wet Weather

Estimating wash-off from various land uses is an appropriate way to quantify the primary sources of copper, lead, and zinc loading during wet conditions. Runoff volume and metal concentrations from each subwatershed are therefore dependent on build-up and wash-off rates, which differ depending on the subwatershed's land uses (Figures 5.1 and 5.2). The land uses incorporated into the wet weather watershed model are described in Appendix E.

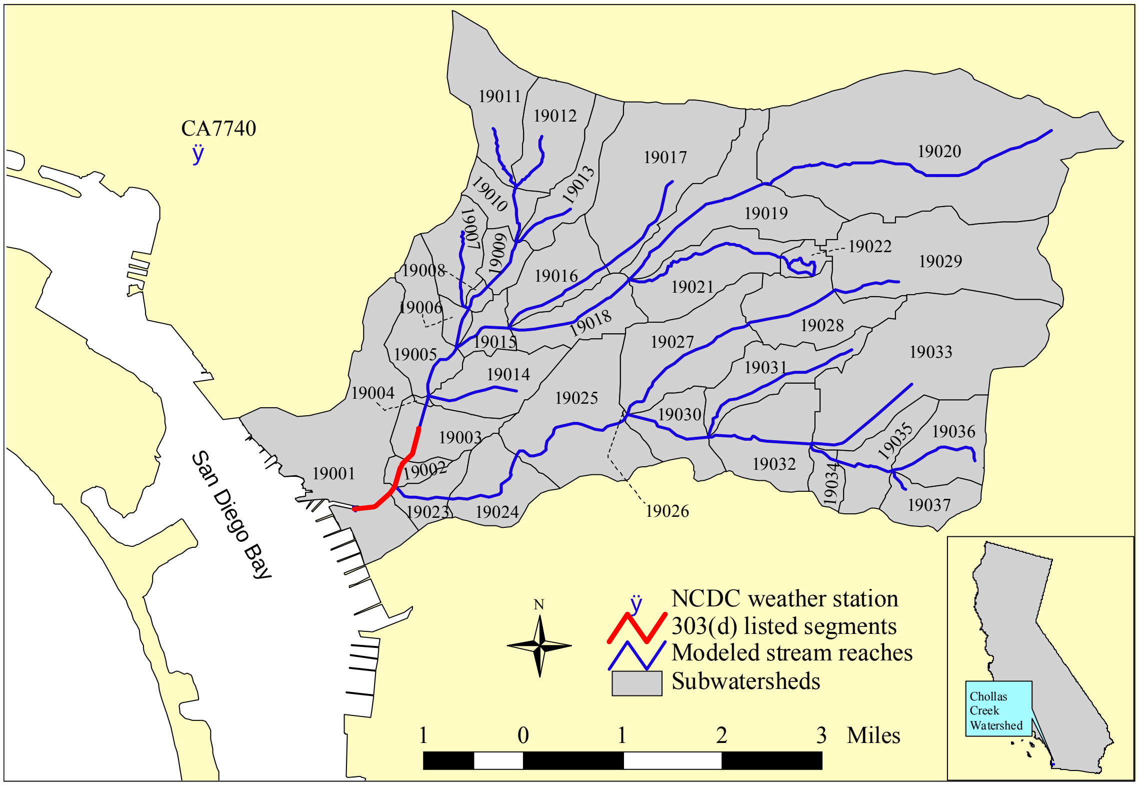

FIGURE 5.1. Chollas Creek Watershed divided into subwatersheds. (referenced by number)

To estimate total copper, lead, and zinc loadings during wet weather events, a watershed model was developed (Appendix D). Hydrology and water quality simulations were performed for 1990 through 2003. Data collected from the San Diego County stormwater programs and other special studies were used to calibrate model outputs (metal loadings) in the watershed. Table 5.3 presents the average annual wet weather load to Chollas Creek (based on model results from 1990-2003) for a typical and critical year. In comparison to the total estimate (Table 5.2), wet weather comprises at least 99.7 percent of the total load for each metal. A critical year was selected in order to understand conditions during maximum flow conditions. For the time period of 1990 through 2003, 1993 was selected as the critical year. This critical wet condition was selected based on the identification of the 93rd percentile of annual rainfall observed at multiple rainfall gages in the San Diego Region during this time period.

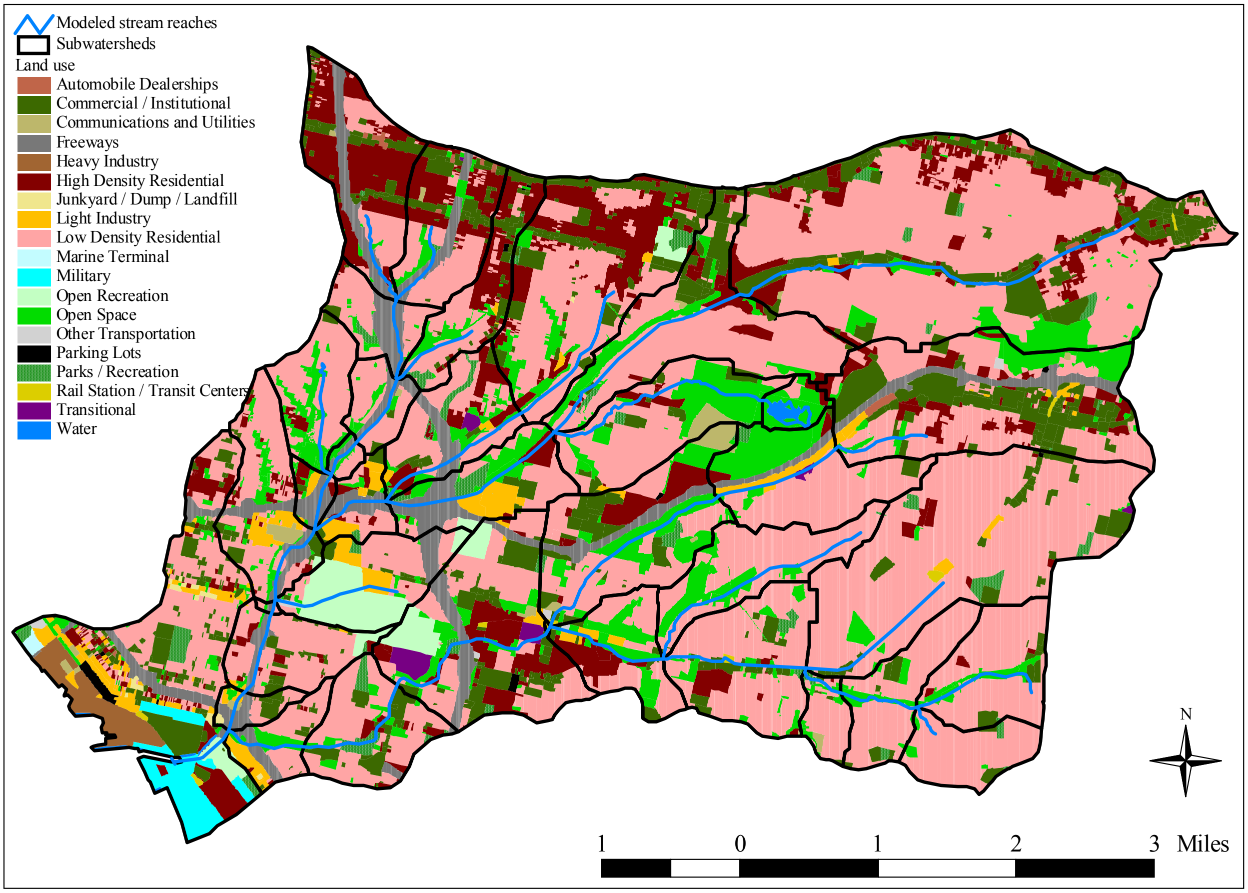

FIGURE 5.2. Land use distribution in the Chollas Creek Watershed.

TABLE 5.3. Estimated existing wet weather total loads for Chollas Creek during a typical and critical year.

	Copper (dissolved) (g/yr)	Lead (dissolved) (g/yr)	Zinc (dissolved) (g/yr)
Typical	232,137	194,007	1,326,407
Critical	984,549	705,142	5,993,255

Because the model estimated loads based on subwatershed characteristics (and hence associated land uses), the location of areas with relatively higher loading can be identified. Figure 5.3 shows annual wet weather loads from the North and South Forks of Chollas Creek. The North Fork contributes a greater pollutant load than the South Fork. These differences are most likely due to the different size and land use distribution of the two drainage areas. For another perspective, Table 5.4 summarizes the top 10 watershed mass load contributors in Chollas Creek for each subwatershed (Figure 5.1).

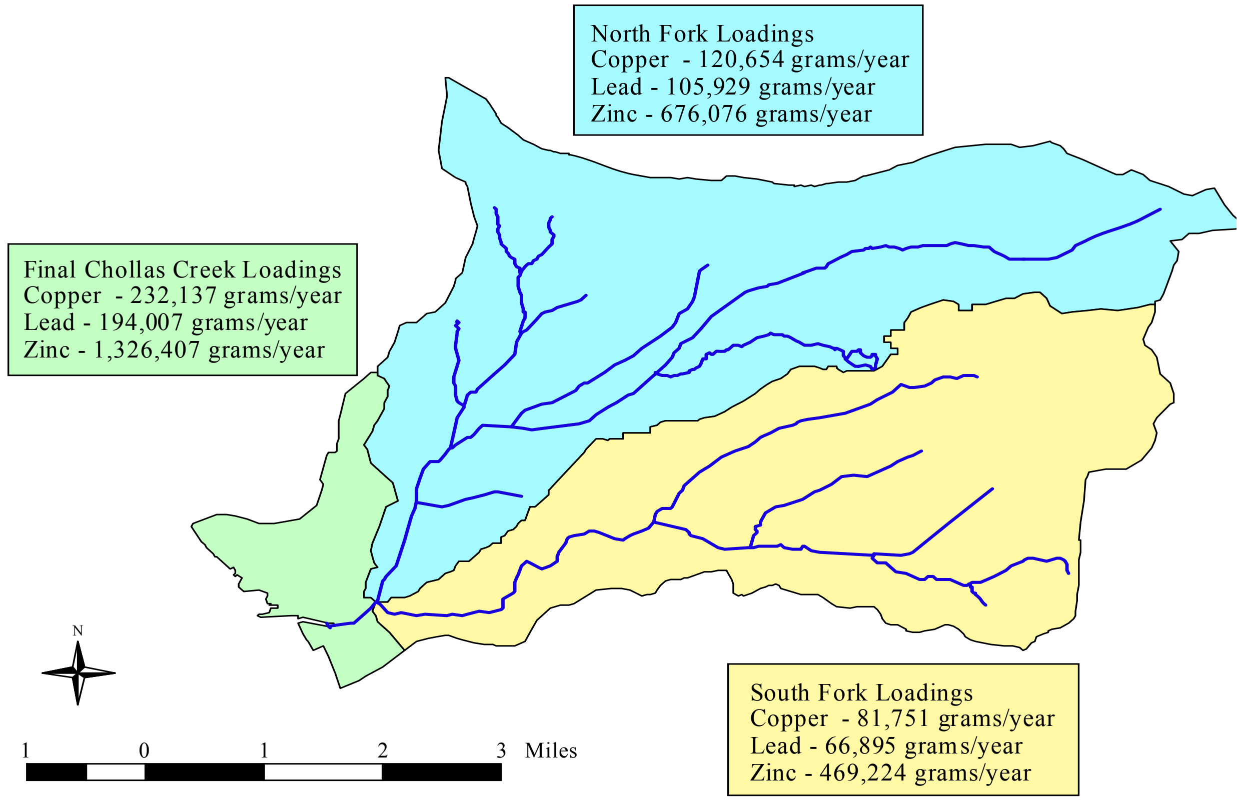

FIGURE 5.3. Average annual wet weather loads for the main branches of the Chollas Creek Watershed.

TABLE 5.4. For each metal, the top ten contributing subwatershed of mass loads relative to all thirty-seven subwatersheds.

Rank	Copper	Lead	Zinc
1	19001*	19001*	19001*
2	19020	19029	19020
3	19029	19020	19029
4	19025	19025	19027
5	19011	19011	19025
6	19027	19027	19011
7	19017	19018	19017
8	19012	19012	19012
9	19018	19017	19018
10	19005	19005	19005

**Subwatershed 19001 was assumed to drain entirely to Chollas Creek, however, portions of the watershed drain to San Diego Bay. Due to the limitations of model set-up, the watershed could only drain either to the Bay or Chollas Creek. The conservative decision was made that all drainage was to Chollas Creek.*

Relative basin-wide contributions from each land use are illustrated in Figures 5.4 through 5.6. For all three metals, freeways and commercial/institutional land uses have the highest relative loading contributions; together, these two land uses account for over 75 percent of the metal loadings. Appendix E gives average annual loadings for dissolved copper, lead, and zinc (1990 to 2003) with respect to subwatersheds and land uses and also gives subwatershed areas.

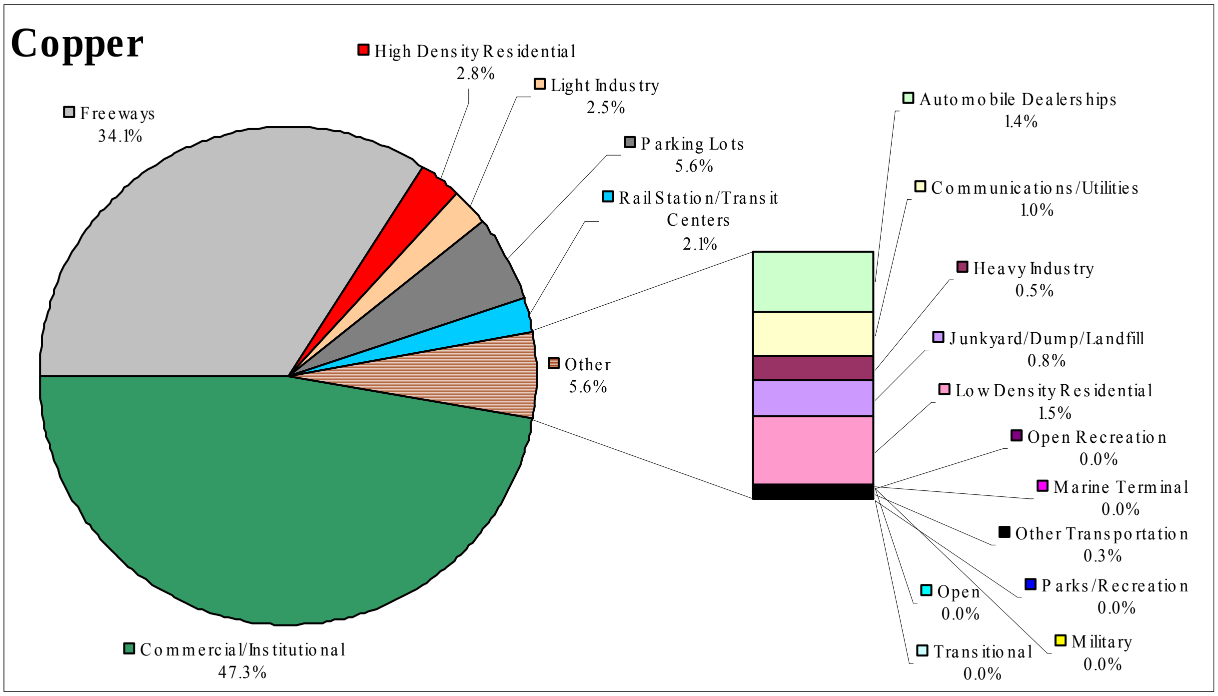

FIGURE 5.4. Basin-wide wet weather copper contributions by land use in the Chollas Creek Watershed.

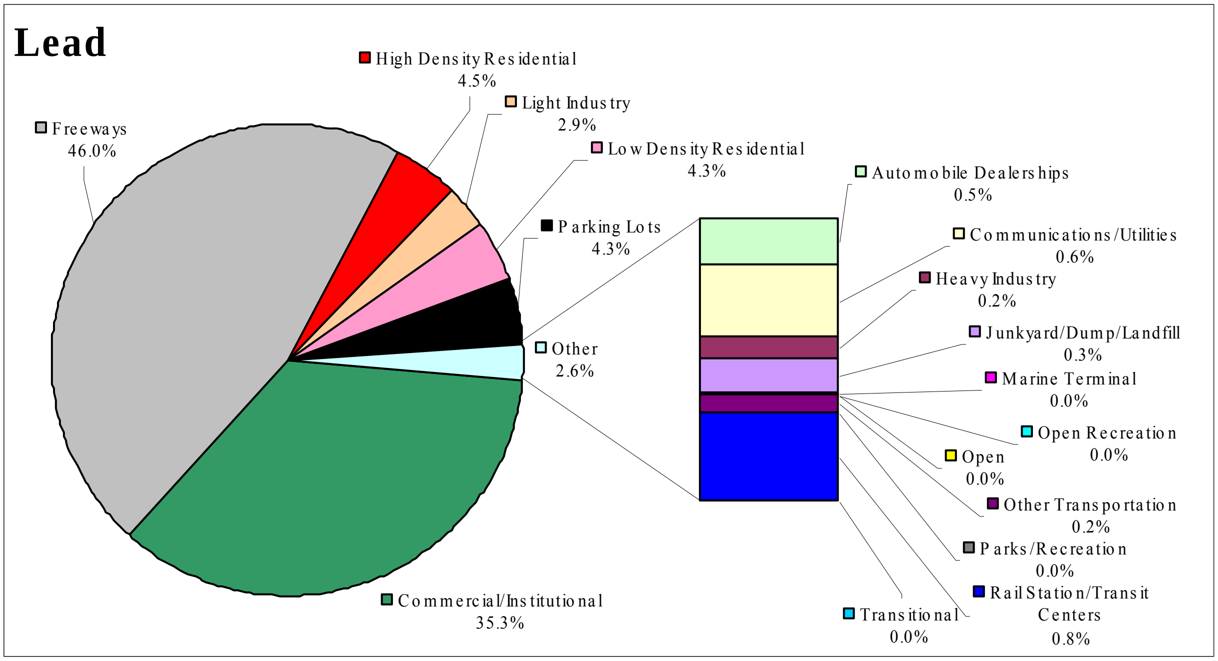

FIGURE 5.5. Basin-wide wet weather lead contributions by land use in the Chollas Creek Watershed.

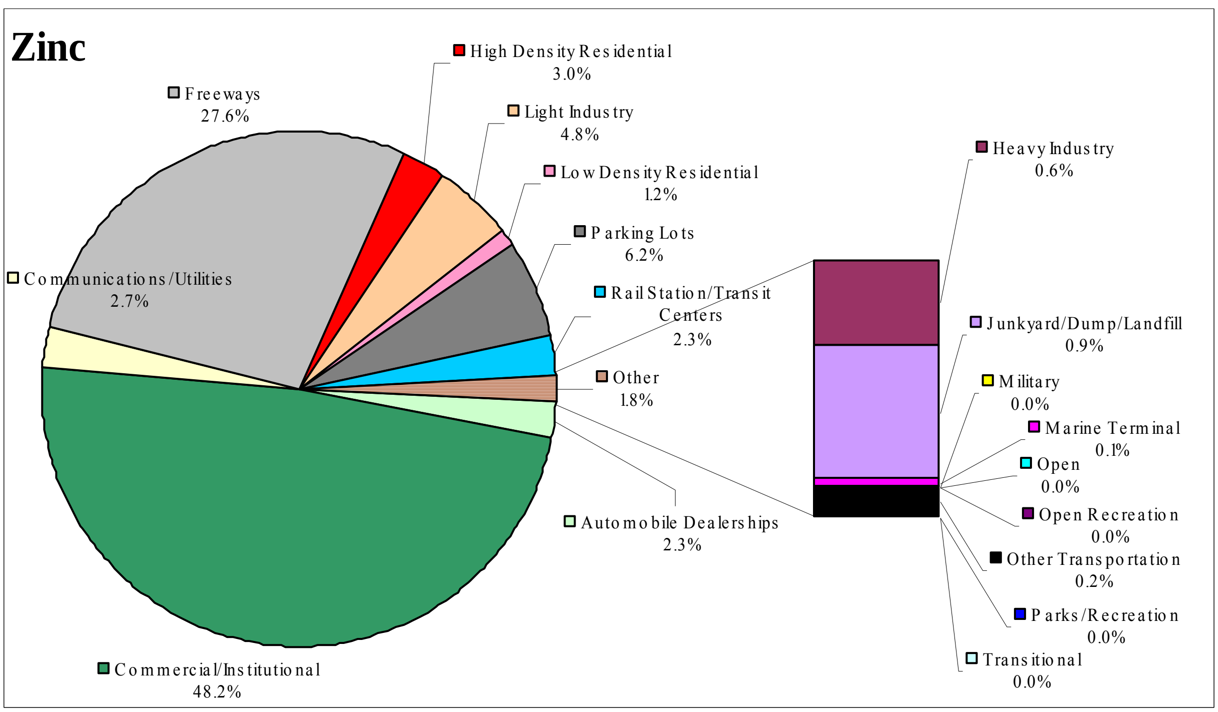

FIGURE 5.6. Basin-wide wet weather zinc contributions by land use in the Chollas Creek Watershed.

5.2.1.2 Urban Runoff from Dry Weather

During dry weather conditions, impaired streams can exhibit a sustained flow even if no rainfall has occurred for a significant period to provide runoff or groundwater flows. These flows are generally understood to result from various urban land use practices that cause water to enter storm drains and inland surface waters. Sources of urban flow in Chollas Creek include lawn irrigation runoff, car washing and sidewalk washing. Not only can these urban flows initially contain metals, they may accumulate metals as they travel across lawns and urban surfaces, transporting them to the MS4 system and thus, into Chollas Creek.

To quantify sources from runoff during dry weather, a steady state spreadsheet model was developed to estimate dry weather flow in the watershed (Appendix D). As mentioned before, because limited in-stream dry weather data were available for model calibration and validation, copper, lead, and zinc concentrations could not be simulated. Therefore, the simulated flow value was combined with average in-stream dry weather concentrations for dissolved copper, lead, and zinc to calculate estimated basin-wide existing loads for each metal (Table 5.5). Since dry weather days were selected based on the criterion that less than 0.2 inches of rain fell during the previous 72 hours, Table 5.5 values also represent the maximum loading (critical condition) during dry weather. Data limitations prohibited the calculation of land use specific loadings and more detailed analyses. Again, the dry weather contributions for each metal comprise at most 0.3 percent of the total estimated existing annual load (Table 5.2).

TABLE 5.5. Existing dry weather load (grams per year) for both typical and critical years.

Copper (dissolved)	Lead (dissolved)	Zinc (dissolved)
692	168	986

5.2.1.3 Discrepancies from Stormwater Monitoring Reports

The San Diego County dischargers regulated under Order No. R-2007-0001 (Stormwater WDR Order) are required to send in annual Stormwater Monitoring Reports containing estimates of existing metal loads from watersheds through out San Diego County, including the Chollas Creek Watershed. The method used to estimate existing metal loads in these annual monitoring reports is different than the modeling method used by Tetra Tech, Inc. for this Chollas Creek Metals TMDL project; thus, different existing metal loads are estimated from each method.

The modeling method used by Tetra Tech, Inc. incorporates a dynamic calculation of loads based on accumulated pollutants during antecedent dry conditions, amount of pollutants washed off during a rainfall event and the flow resulting from rainfall events. The Stormwater Monitoring Reports currently uses a spreadsheet to calculate loads by first estimating flow volumes based on precipitation and estimating EMCs from local monitoring and literature values. Comparatively, the modeling included a more detailed representation of the Chollas Creek Watershed, including current land use coverage, delineated subwatersheds, soil layers and 14 years of local rainfall data, which captured a wide range of meteorological conditions.

The most likely significant difference between the approaches is the land use coverage. For instance, determining how land use impacted the loads in the spreadsheet model was difficult, because specifics were not provided in Annual Reports on the land uses draining to the mass emissions stations or how this influenced the EMC calculation. Furthermore, in order to take into account recent changes in regional land uses, the most current data were needed to populate the model (LSPC used the 2000 SANDAG coverage; Stormwater Monitoring Reports used 1990 SANDAG coverage). For these reasons, the Stormwater Monitoring Report estimates are considered less robust than the modeling estimates.

5.3 Urban Runoff Studies in Other Watersheds

Many studies have been done worldwide to identify the sources of metals in urban runoff, including several studies in California, although there is minimal information available specifically for San Diego. In this section, the general conclusions of some of these studies, applicable to Chollas Creek, are presented. The main purpose is to provide information regarding potential individual sources of metals in urban runoff and the relative contribution of each of the potential sources. This information is not intended to quantify existing loads. In later sections these studies will be referred to as support of more specific metal contributions to urban runoff from outside and inside the Chollas Creek Watershed.

5.3.1 Santa Clara Valley Study

The various sources of metals in an urban watershed were detailed in a 1992 study in Santa Clara Valley (SCV study; Woodward Clyde, 1994), an urban center located in the San Jose area near San Francisco, California. In 1997 the SCV study results were largely modified to include several more years of water quality data (Woodward-Clyde, 1997). Specifically the SCV study was performed to identify major sources of metals found in the South San Francisco Bay. Major sources of several metals, including copper, lead, and zinc, were identified and a percentage of the total annual load for each metal was attributed to each major source.

An investigation of similar detail to the SCV study has not been performed in the San Diego area. However, since both San Diego and Santa Clara are large urban centers on the west coast, some general knowledge from the SCV study can be applied to Chollas Creek. Furthermore, the SCV study estimated the nearly same magnitude of metal load per acre as did the Chollas Creek Watershed model: copper was 0.030 and 0.033 pounds per acre (lb/acre), respectively; lead was 0.026 and 0.032 lb/acre, respectively; and zinc was 0.155 and 0.186, respectively.[21] Table 5.6 list sources that comprised the top five sources of loading to South San Francisco Bay for each metal.

[21] Chollas Creek has an estimated 16,000 acres. The area draining to South San Francisco Bay has an estimated 298,000 acres. The estimate from Chollas Creek was converted to total metal concentrations by conversion factors 0.96, 0.791 and 0.978, for copper, lead and zinc, respectively.

TABLE 5.6. Top five metal sources in urban runoff, in decreasing order (SCV, 1997)

Constituent	Top Metal Sources
Copper	Brake pads, POTWs*, Natural erosion, Reservoir releases, Water supply/corrosion
Lead	Tailpipe emissions, Natural erosion, Brake pads, Reservoir releases, POTWs
Zinc	POTWs, Tires, Natural erosion, Industry with metal processes, Brake pads

*POTWs – publicly owned treatment works.

Publicly owned treatment works (POTWs) were the only identified point sources in the SCV study. All other sources were considered nonpoint sources. It is important to emphasize that POTWs, or any other point sources besides the MS4, are not present in the Chollas Creek Watershed. The Chollas Creek source analysis and the SCV study also differ in that there are no reservoirs used for potable water in the Chollas Creek Watershed. Figures 5.7 through 5.9 show the relative amounts of copper, lead, and zinc contributions for the SCV study when sources from POTWs and reservoir releases are not considered. Automotive sources are thought to be a significant source of all three metals, including brake pads, tailpipe emissions and tire-wear. Industries that have processes that expose metal to stormwater, water supply and corrosion and illegal dumping, especially of motor oil, are also sources that should be mitigated to help lower metal sources to Chollas Creek.

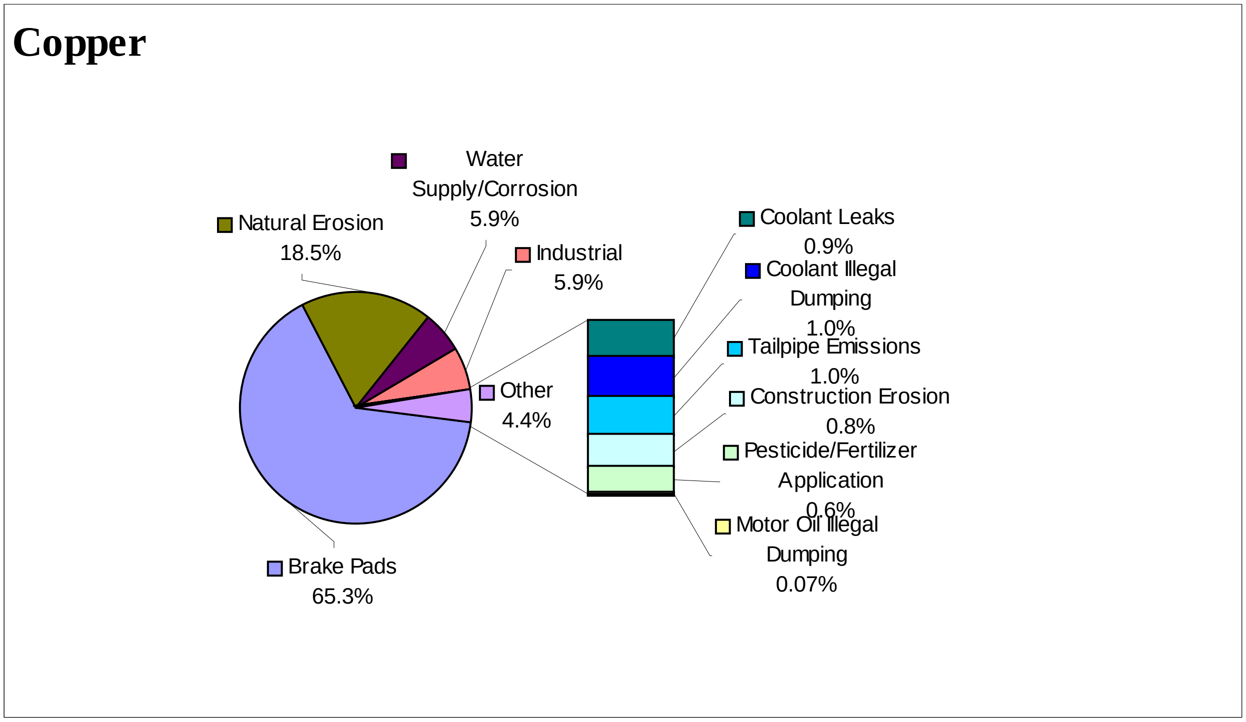

FIGURE 5.7. Relative amounts of copper loading in SCV, adjusted to omit sources from POTWs, reservoir releases and natural erosion. (Woodward Clyde, 1997)

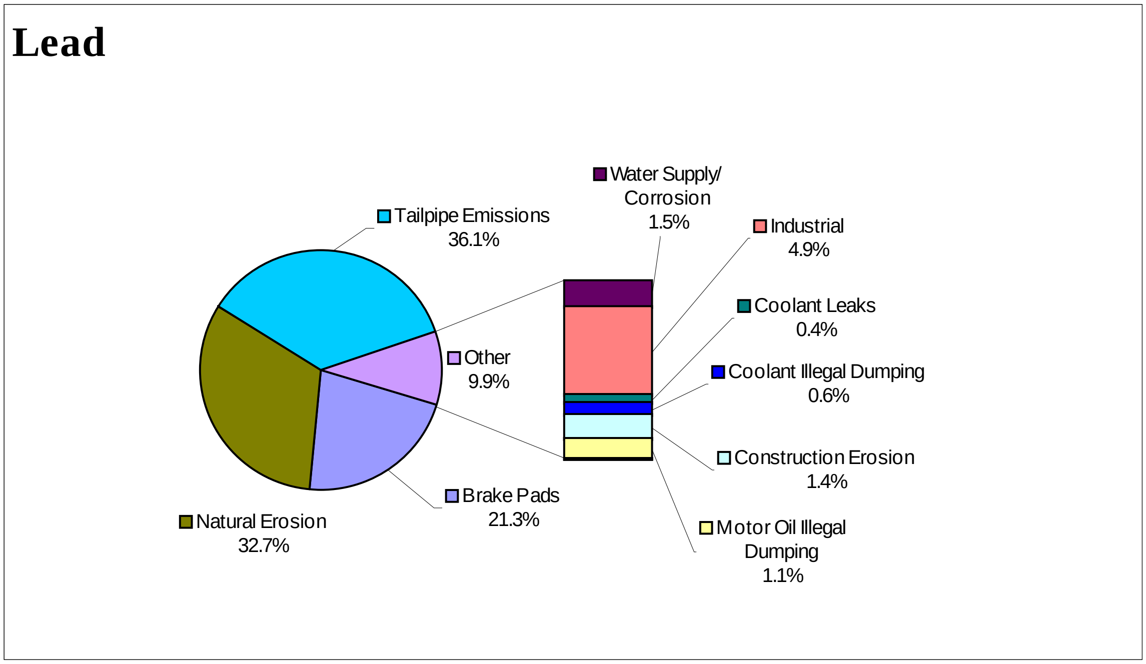

FIGURE 5.8. Relative amounts of lead loading in SCV, adjusted to omit sources from POTWs, reservoir releases and natural erosion. (Woodward Clyde, 1997)

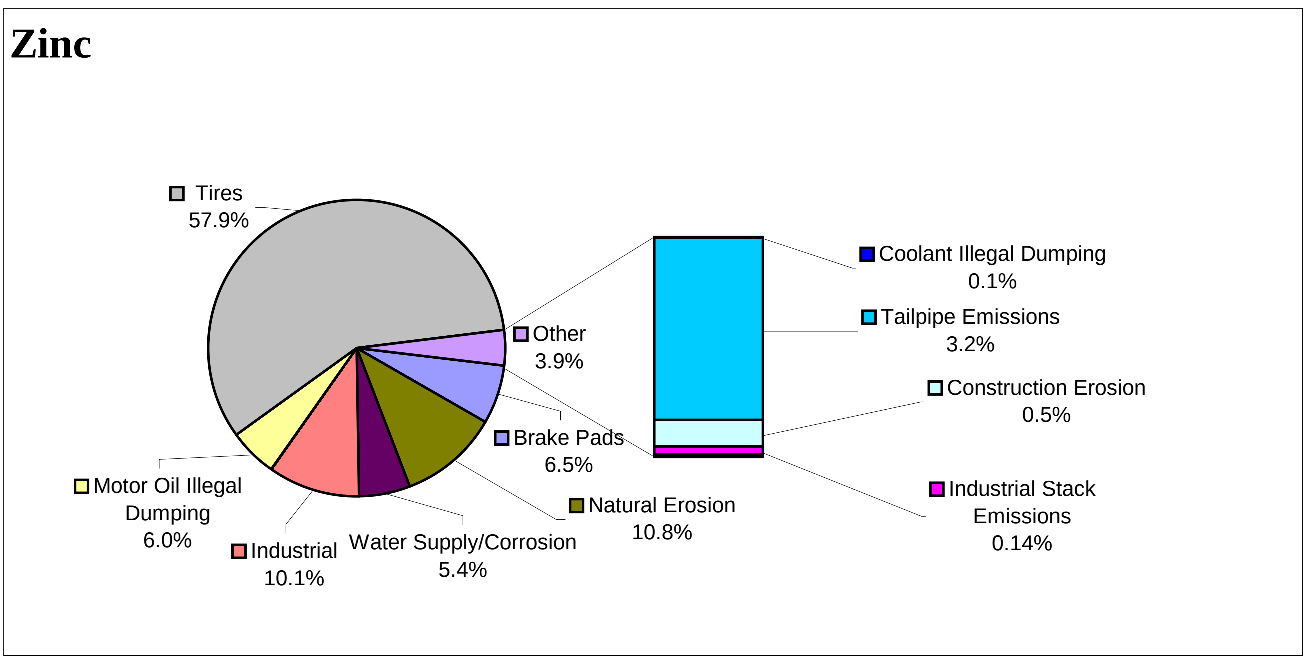

FIGURE 5.9. Relative amounts of zinc loading in SCV, adjusted to omit sources from POTWs, reservoir releases and natural erosion. (Woodward Clyde, 1997)

5.3.2 Other Studies

In addition to the SCV study, other studies in urban areas, although less extensive, have also identified many of the same sources of metals in urban runoff, further confirming them as potential sources in Chollas Creek. The USEPA (1993) and Sansalone, et al. (1997) listed many of the sources identified in the SCV study as well as new ones. Table 5.7 summarizes the following sources of copper, lead, and zinc in urban runoff (USEPA 1993; Sansalone, et al. 1997). Furthermore, Muschack (1990) identified metal sources in urban runoff from Germany that included automotive exhaust gases, tire abrasion particles, brake lining abrasion dust, lubricating oils and greases and abrasion of roadways. Also, investigations in Fresno (Brown and Caldwell, 1984) and in Santa Monica (Stolzenbach, et al. 2001), California, researched the deposition rates of atmospheric metal loads from industrial and tailpipe emissions as sources.

TABLE 5.7. Anthropogenic constituents in runoff from urban pavement. (modified from USEPA 1993)

Constituent	Primary Source
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides, insecticides
Lead	Automotive emissions, tire wear (lead oxide filler material), lubricating oil and grease, bearing wear, brake lining wear, engine wear
Zinc	Tire wear (filler material and accelerator in vulcanization process as zinc oxide 0.73%), motor oil (stabilizing additive), grease, metal plating erosion, engine wear

Source: (USEPA, 1993)

Again, general conclusions about metal sources in Chollas Creek can be made based on the similarity of the identified sources of metals in urban runoff from different areas as shown in the studies discussed above: if the major sources of metals in urban runoff were similar for different urban areas a reasonable assumption is that the same sources are present in the Chollas Creek Watershed as well. More information is needed to confirm this assumption or to quantify the amount of contributions from the different sources. The next two sections discuss potential sources from both outside and inside the Chollas Creek Watershed and confirm that many of the sources of metals in urban runoff seen in other urban areas are present in the Chollas Creek Watershed.

5.4 General Urban Runoff Sources: Background, Anthropogenic and Water Supply

The previous section identified various sources that can contribute metals[22] to urban runoff. Obviously, most of these sources cannot be pinpointed to a specific model land use category found in Section 4.2. Most sources can be ascribed to numerous land use practices and even to activity found throughout the area that encompasses a watershed. For example, atmospheric deposition may be from cars driving throughout the Chollas Creek Watershed, from equipment operating at industrial facilities within the Chollas Creek Watershed and from industrial stack emissions from facilities outside of the Chollas Creek Watershed. The sources that are found throughout the regional area are

[22] All measurements are of total metals, unless otherwise denoted as dissolved metals. TABLE 4.3 provides appropriate total to dissolved conversion factors.

addressed in this section: background, atmospheric deposition, groundwater, sediment and water supply. Background, as defined in this report, is solely the natural level of metals that would go to Chollas Creek without any influence from humans and because of this, background can also be considered a portion of the four other categories. Anthropogenic sources, as defined in this report, are from human activities throughout an area that cannot be pinpointed to a certain area, or in this case the Chollas Creek Watershed. Also, water supply is addressed in this section, because the water supply for the Chollas Creek Watershed comes from outside sources.

These categorized sources most likely enter Chollas Creek directly or indirectly through the MS4 system. As mentioned before, nonpoint sources to Chollas Creek would most likely enter through the MS4 system and thus, would become a point source. Because of this and lack of data to prove otherwise, any nonpoint source that goes directly into Chollas Creek is assumed to be comparatively insignificant. Data limitation also prevents any specific estimation of loading from these sources. Direct atmospheric deposition may be revealed as a significant source once data become available. However, other urban runoff studies have made some estimates that may provide insight into these potential nonpoint sources. The model-estimates, in a general way, capture these sources because initial land use parameters were developed from other urban studies with similar anthropogenic sources. Furthermore, the model was calibrated to observed metal concentrations in Chollas Creek, which would inherently account for all anthropogenic sources.

5.4.1 Background

Metals occur naturally and cycle by biogeochemical processes throughout the environment. Consequently, of the total metals that may be present in Chollas Creek, a fraction are likely to be from natural sources. There are no background data available for Chollas Creek and an actual quantification of background is not possible given the currently available data. However, model estimates and local reservoir data were examined in order to try to get some insight on natural background sources in the Chollas Creek Watershed.

Generally speaking, open space land uses are assumed to represent natural states of slope and vegetative cover and surface runoff from open space could account for background sources of metals. Approximately 9.73 percent of the Chollas Creek Watershed is designated as open space; however, this area likely does not represent a pristine land use. Surrounding development, urban-sourced atmospheric deposition, prior grading and non-native and invasive species all are likely to effect metal build-up and wash-off rates and surface water infiltration rates in these open spaces. Influences like these should increase metal export rates by increasing metal build-up and surface water velocity and thus, would result in higher metal concentrations than natural background. However, even with these influences, the model estimated the potential load of each metal from the open space land use to be 0.0 percent of the total existing load for each metal. According to the model, the relative contribution of metals from open space land use and thus from background, appears to be insignificant in comparison to loadings from other land uses.

Because data do not exist to determine actual background metal concentrations in Chollas Creek, data from a local reservoir were reviewed. Depending on their location and the source of water, reservoirs should theoretically contain close to background concentrations of heavy metals, because they collect surface runoff. Total metal concentrations were obtained from the City of San Diego Water Department for the Morena Reservoir between 1997 and 2003. The Morena Reservoir was chosen because it does not receive imported water and its watershed, the Cottonwood watershed, is a mainly undeveloped watershed: approximately 90 percent is undeveloped, 1 percent is residential and 8% is the Cleveland National Forest (City of San Diego, 2003). The average concentration for copper, lead, and zinc was 4.0 µg/L, 1.3 µg/L and 3.1 µg/L, respectively. Further, removing an outlier of 61.7 µg/L in the year 2000 from the data set, the average copper concentration is 1.65 µg/L.[23] These concentrations represent the initial metal load available to a treatment plant and subsequently to the Chollas Creek Watershed.

5.4.2 Atmospheric Deposition

Atmospheric deposition is another potential source of metals to Chollas Creek. Atmospheric emissions from both stationary point sources (e.g. industrial) and mobile sources, including emissions from both diesel-fueled and unleaded-fueled vehicles, enter the water bodies via direct and indirect deposition. These emissions affect rainfall and also cause settling of particulates during dry weather (Woodward-Clyde, 1992). Direct atmospheric deposition results from both wet and dry deposition directly to the surface of the water body. Indirect atmospheric deposition occurs when dissolved metals enter the watershed that drains to Chollas Creek and is therefore a component of urban runoff carried by the MS4. Topographic characteristics make indirect deposition the major component of atmospheric sources, relative to the direct deposition that may land on the surface area of Chollas Creek. Some information on atmospheric deposition follows from other urban studies. However, more site-specific information is needed to properly quantify either the direct or indirect deposition. If data are available at a future time, they may be used to further refine this analysis.

Atmospheric deposition rates of trace metals have been investigated in limited studies in California. In one Southern California study, atmospheric deposition of metals was calculated for Santa Monica Bay and the Santa Monica Bay watershed (Stolzenbach et al., 2001). Copper, lead, and zinc atmospheric deposition rates were determined through a combination of direct and indirect methods to determine contaminant loading. Researchers found that atmospheric deposition, primarily through daily dry deposition, was a significant contributor of nonpoint source pollutant loading to Santa Monica Bay.

The SCV study, previously discussed, also evaluated contributions of copper, lead, and zinc due to atmospheric emissions of particulates both from stationary and mobile sources. The study found that atmospheric emissions of copper from vehicle exhaust was largely due to diesel-fueled vehicles (Woodward-Clyde 1992) and was approximately 1 percent of the total copper load. Also, the SCV study found the largest source of lead was from tailpipe emissions and that, although it was not a top zinc source, atmospheric

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[23] Nondetects were considered as on half of the DL for statistical purposes.

emissions of zinc in SCV from vehicle exhaust were largely due to both diesel fuel and unleaded fuel exhaust (Woodward-Clyde 1992). Zinc was also the only metal of the three that had industrial stack emissions as a source.

Deposition rates determined for Fresno, California may give a rough understanding of atmospheric lead loads to Chollas Creek. The dry weather lead deposition rate for Fresno was obtained from studies by the National Urban Runoff Program (NURP) and determined to be 2.22 milligrams per meter squared per month for lead (Brown and Caldwell 1984). If these results were directly applied to the Chollas Creek Watershed[24] roughly 1,740,000 g/year total metals would be the estimated load. However, this value should only be used for an illustrative purpose: Fresno and San Diego differ in climate, population, etc. Also, the reformulated gasoline (RFG) program and the Clean Air Act as amended in 1990 have since prohibited the introduction of gasoline containing lead or lead additives for commercial use as a motor vehicle fuel. The latter point suggests the lead deposition is less now than in 1984.

In fact, since the SCV and Fresno studies were performed, the USEPA has implemented the RFG program in 17 cities across the country, including San Diego, to reduce emissions of toxic pollutants (including metals) and smog forming pollutants from automobiles. Phase I of the RFG program was implemented in 1995 and Phase II began January 1, 2000. The state of California implemented its own RFG program effective in 1996 that met USEPA's Phase II requirements. Therefore, metal emissions from automobiles are expected to be less than those determined in the SCV and Fresno studies, but emissions will not decrease further with the recent implementation of Phase II since California has been meeting the Phase II requirements since 1996. Although the RFG program does not impact diesel fuel, which contributes the largest amount of metals, the effects of the program may still be measurable.

Again, because information on atmospheric deposition of metals to the San Diego Region is not currently available, more research is needed to characterize this source of loading. Perhaps in the future the model developed for Santa Monica Bay (Stolzenbach *et al.,* 2001) could be adapted to local conditions and combined with atmospheric concentrations of metals for San Diego County. At this time however, a reasonable assumption is that Chollas Creek receives significant amounts of copper, lead, and zinc from indirect deposition. These sources must travel through the MS4 to reach Chollas Creek and thus have already been accounted for. On the other hand, direct atmospheric deposition of metals is assumed to be relatively insignificant to Chollas Creek compared to other sources, in part due to the small surface area of the creek.

5.4.3 Sediment

Chollas Creek sediment likely contains metals that could become a source in a more static system. However, Chollas Creek is a highly dynamic system that ranges from low flow (dry) during the summer to high velocity and high volume flows during and shortly after storm conditions. This leads to short residence times for any sediment and associated metals within the creek. The available data support this idea (see Problem

[24] The Chollas Creek Watershed is estimated to be 6.59 x 10^7 meters squared.

Statement). Therefore, sediment is assumed to not reside in Chollas Creek long enough to allow metal concentrations to build to high enough levels that the sediment becomes a source to the creek.

5.4.4 Groundwater

Groundwater flows may be another source of metals to Chollas Creek. Subterranean flows may seep directly through the creek bed or surface at other points within the watershed. There are portions of Chollas Creek that are lined with concrete that forms a barrier to groundwater flow into the creek. Also there are portions of Chollas Creek were water is present even during long periods of dry weather. However, groundwater flows and their contribution to Chollas Creek are poorly characterized. Groundwater may contain naturally occurring dissolved metals concentrations, or enriched concentrations from overlying metals contaminated soils that contribute to exceedances of metals water quality objectives in Chollas Creek. Groundwater discharges to storm drains or directly to the creek provide an uninterrupted pathway for dissolved metals to reach Chollas Creek. Therefore, any discharges of groundwater in the Chollas Creek watershed are considered a source of metals and will need to be regulated.

5.4.5 Water Supply

In the San Diego Region sparse rainfall requires that approximately 90 percent of water demand be met with imported water, mostly from the Colorado River. The remainder of the water supply comes from treated runoff that is collected in reservoirs (City of San Diego, 2004). In the Chollas Creek Watershed, supply water is transported in from two treatment plants (Alvarado and Otay), which process water directly from reservoirs Murray, San Vicente, El Capitan and Otay. (None of which are located in the Chollas Creek Watershed.) The SCV study concluded that water supply was a metal source for copper, lead, and zinc, which included corrosion inhibitors, algae inhibitors and corrosion of distribution infrastructure. These sources will be discussed in this subsection as they apply to Chollas Creek.

To summarize the SCV study, several pathways were found through which tap water can eventually reach surface and ground waters, including car washing, irrigation, building and sidewalk cleaning, system overflows and hydrant flushing (Woodward-Clyde 1997). The study also estimated the amount of tap water that potentially reaches surface and ground waters and multiplied that amount by the estimated concentration of metal in tap water. Copper in the water supply was attributed to both the amount found in the source water (largely influenced by algaecide application) as well as the amount that leached into the potable water from corrosion of copper piping. Also, a large portion of the zinc loading from water was attributed to the addition of zinc orthophosphate, a corrosion inhibitor, to potable water. Other sources of zinc from the water supply included corrosion of plumbing and source water. Reservoir releases were also a significant source of all three metals in the SCV study.

5.4.5.1 Reservoir Contributions – Releases and Algaecide

There are no drinking water reservoirs within the Chollas Creek Watershed. The Chollas Reservoir is no longer an active drinking supply and drains such a small watershed that overflows seem unlikely. Furthermore, the lake is maintained at a level to prevent spills; only normal leakage from the dam into a nearby canyon occurs to prevent the dam from breaking. No spills have been recorded since the concrete dam was built several decades ago (Chaffin pers. comm., January 2005). Therefore, reservoir releases are not considered a significant source of copper in Chollas Creek.

The algaecide copper sulfate, a potential source of copper, is applied infrequently and in small, strategic amounts in Metropolitan Water District (MWD) reservoirs (Wang pers. comm., January 2005), minimizing the amount of copper in the potable water supply from the MWD. In San Diego, no copper sulfate has been added to any of the reservoirs in the last five years except for the Miramar Reservoir, which is not located in the Chollas Creek Watershed and does not supply the plant that services the Chollas Creek Watershed population. Further, either the Alvarado or Otay Treatment Plants would treat the reservoir water before it would reach the Chollas Creek Watershed. Therefore algaecides used in the potable water supply in San Diego are assumed not to be a significant source of copper.

5.4.5.2 Treatment Plant Contributions and Corrosion Inhibitors

The San Diego Water Department does not add any corrosion inhibitors that contain heavy metals to the water supply; only sodium hydroxide is added for pH control (Chaffin pers. comm., January 2005). The pH is maintained at 8.2, which results in the water being slightly scale forming, thus reducing the amount of heavy metal corrosion in the piping. Therefore corrosion inhibitors used in the potable water supply in San Diego are assumed not to be a significant source of zinc.

The MWD, which manages the three San Diego plants including Alvarado and Otay, indicated that its effluent water generally has copper concentrations below the detection limit of 10 micrograms per liter (µg/L) (Wang pers. comm., January 2005). In addition, in 2003 the City of San Diego reported (City of San Diego, 2003) low average concentrations of copper, lead, and zinc (Table 5.8).

TABLE 5.8. Average metal concentration of treatment plant effluent in 2003.

Treatment Plant	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)
Alvarado	3.9	<2	<8
Otay	ND	<2	<8

Because the treatment plants' effluents have little detectable copper, lead, and zinc, it is concluded that water supply, up to the time it leaves the plant as effluent, is an insignificant contributor of these metals to the Chollas Creek Watershed.

5.4.5.3 Infrastructure Contributors – Water Supply from "Tap"

Corrosion of copper piping in San Diego, however, is considered a significant source of copper. In 1999 the City of San Diego performed a lead and copper household monitoring study on more than fifty homes, to measure copper and lead concentrations in household tap water (Brannian, pers. comm., July 2000). The first liter of tap water collected was after six to twelve hours of non-use of household water. The average copper concentration for the homes was 180.7 µg/L and the average lead concentration from household taps was 2.6 µg/L. Since the copper concentrations coming from the three plants are below 50 µg/L and more likely near 10 µg/L since MWD effluent is at that level, copper plumbing corrosion in residential homes seems to add a relatively significant amount of copper, 130 µg/L to 170 µg/L, to the potable water supply. Conversely, lead concentrations coming from the three plants are below 5 µg/L and lead sources due to plumbing corrosion, seem to be very insignificant if any at all. Also, the City of San Diego does not use lead piping in its utilities, except for plumbing fixtures (City of San Diego, 2004). No results from the 1999 household monitoring study are currently available for zinc. However, more recently the 2002 City of San Diego Water Department Consumer Confidence Report (City of San Diego, 2002) reported copper sampling results at 0.346 milligrams per liter (mg/L) or 346 µg/L, lead sampling results at less that 5 µg/L and zinc sampling results at less than 50 µg/L. The 346 µg/L copper level was reported as the 90th percentile concentration.

For illustrative purposes, consider typical per capita water usage to be 65 gallons per day (Metcalf and Eddy 1991). If the population of the watershed was roughly 300,000 (SANDAG, 1999), the total water usage in the watershed would be about 20 million gallons per day (MGD). Approximately 50 percent (10 MGD) of water used will reach the wastewater system and of the remaining amount, 10 percent will reach the creek (1.0 MGD) (Woodward Clyde 1992). Since corrosion of copper piping contributes roughly 170 µg/L of copper (the more conservative estimate) and 2.6 µg/L of lead to the water supply, this source contributes approximately 235,000 g/year (100 percent of the modeled typical year) and 3,600 g/year (2 percent of the modeled typical year) to the Chollas Creek Watershed, respectively.

Although this estimate does not exactly match model estimates (likely due to differences in time, inherent uncertainties in methodology and physical interactions when potable water travels across the watershed), it does highlight the fact that a significant amount of copper may be entering Chollas Creek as urban runoff simply from the drinking water supply, which most likely results from piping infrastructure.

5.5 Urban Runoff Sources from Chollas Creek Land Use Activities

This section supplies additional detail on the land use practices that may contribute metals to Chollas Creek. The information here is gathered from the studies mentioned in section 5.3 and can be applicable to different land uses. For example, residential land use sources include application and disposal of household products such as pesticides, fertilizers, paints and maintenance and construction activities, such as remodeling, building and cleaning roofs and gutters. Some of these sources may also result from land uses such as commercial/institutional and open recreation (golf courses/cemeteries). At this time, quantitative data are not readily available to support an estimate of the loads potentially contributed by each of these sources. In the future, if data are available, adjustments to this source analysis could be made. Also, the sources of metals are not limited those listed here. These are sources that, because of other studies, are known to commonly contribute metals to urban runoff.

5.5.1 Operating Automobiles

Automotive sources (other than emissions, which were discussed in section 5.4.2) include maintenance and operation activities for automobiles and trucks, such as wear and tear on tires and brake pads and spills and leaks of fluids such as motor oil, coolants, etc. Copper and zinc are also released through the abrasion of roadways (Muschack 1990).

Brake pad wear is likely a significant urban nonpoint source of copper in Chollas Creek and to a lesser extent a source of lead and zinc. The SCV study calculated that the typical amount of copper released from a single car due to break-pad wear was 7.23 g/26,000 miles (Woodward-Clyde 1992). Brake pad wear may also be a significant source of lead and zinc in urban runoff (Sansalone 1997). Supporting information on how much copper is contained in brakes and brake equipment is also available from the Brake Pad Partnership Program's Brake Manufacturers Council Product Environmental Committee Report. Information on how much copper (or lead and zinc) ends up on the roadways and into stormwater sewers is currently not available (Connick, 2004).

Tire wear was the second largest contributor of zinc in the 1997 SCV study. Woodward-Clyde (1992) also estimated that the typical amount of zinc released per vehicle due to tire wear was 43.04 g/40,000 miles. In addition, Sansalone, et al, also found that tire wear is a potential source of copper and lead in urban runoff (1997). There are currently very limited data on how tire wear affects urban runoff, however the Rubber Manufacturer's Association is currently assisting in the data search for tire-wear emissions.

Also according to the SCV study, copper, lead, and zinc are all found in motor oil and coolants for automobiles and can potentially affect urban runoff as leaks, spills or illegal dumping. Motor oil accounts for a larger percentage of zinc's total estimated load than for copper or lead, and although relatively less significant compared to other sources, coolant was an identified source for all three metals. Coolant contains an approximate copper concentration of 76 µg/g and motor oil contains a zinc concentration of 1,060 µg/g (Shaheen 1975). In San Diego, contributions from automotive coolant leaks, coolant dumping, oil dumping and oil leaks were assumed to be less significant relative to other sources since the San Diego and the Santa Clara Valley are similar in demographics.

5.5.2 Illegal Sources

As mentioned above copper, lead, and zinc contributions from automotive coolant dumping and oil dumping are possible in the Chollas Creek Watershed. However, this TMDL will not consider allocations for dumping of coolants and motor oil into the MS4 system because dumping is illegal. Similarly, copper, lead, and zinc loads periodically occur as a result of sewage spills. All loads from sewage spills (also illegal) are assumed to receive a 100 percent reduction for implementation of the TMDL through the enforcement of existing permits.

5.5.3 Industrial Facilities

Industrial sources may also be a significant source of copper, lead, and zinc in Chollas Creek, especially facilities that handle, process, or store metals that may be exposed to rainfall. These facilities would be included in both the heavy industry and light industry land use model categories. WDRs for San Diego County municipal dischargers require municipalities, including the City of San Diego, to identify industries that threaten water quality and to require these facilities to test for and manage pollutants that are likely to reach stormwater. Further, the Industrial Storm Water General NPDES WDRs Order 97-0003-DWQ (General Industrial NPDES Requirements) is an order that regulates discharges in Chollas Creek that are associated with ten broad categories of industrial activities.

The 1992 SCV study identified industries with potential to allow metals to enter stormwater discharges and was based on professional knowledge of processes that result in metals being exposed to stormwater. Table 5.9 shows the industries that were prioritized as having the highest likelihood to discharge quantities of metals in stormwater. Because of the similarities between Santa Clara and San Diego, any of the same industries in the Chollas Creek Watershed are likely to be potential metal contributors.

TABLE 5.9. Industries with highest likelihood to discharge metals to stormwater. (SCV, 1992)

Industry	Standard Industrial Classification (SIC) Code
Mining of Miscellaneous Metal Ores	1099
Metal Plating	3471
Boat Building and Repairing	373
Industrial Machinery	355 and 356
Trucking	4212, 4213 and 4214
Metal Scrap Industry	5093
Metal Scrap Industry Combined With Used Auto Parts Sales	5015
Automotive Repair, Include Automobile Renting And Leasing	751, 7538 and 7539
Galvanizing And Metal Coating	3479

Particular industries in the Chollas Creek Watershed that may be contributing a significant amount of metals is the auto wrecking/dismantling facilities and scrap metal recycling facilities (Standard Industrial Classification [SIC] 5015 and 5093, respectively). A report completed by Sustainable Conservation in San Francisco has also identified auto wrecking/dismantling facilities and scrap metal recycling facilities as two industries that contribute metals to stormwater runoff (O'Brien, 2000). A review of discharge reports was conducted for auto wrecking/dismantling shops and scrap metal recycling facilities in the Chollas Creek Watershed and only three of approximately twenty-two facilities tested for copper, lead, and zinc in their stormwater runoff. Notably, all three facilities had fairly high concentrations of metals in their discharge. Among the three facilities, copper ranged from 72 to 500 µg/L, lead ranged from 42 to 690 µg/L and zinc ranged from 260 to 1,000 µg/L in runoff from the facilities.

5.5.4 Pesticides

Pesticides were also identified as a potential source of copper and zinc in Chollas Creek, although the SCV study only discussed copper as a source. The 2002 DPR annual report was reviewed for pesticide use in San Diego County. All applications of pesticides that contain copper or zinc are identified and listed in Table 5.10, except for applications that would not correspond with the land uses at Chollas Creek. For example, agricultural pesticide application was not given. Moreover, DPR does not report residential, or nonprofessional, use of pesticides (DPR, 2002) and according to a survey most residents in the Chollas Creek Watershed apply pesticides themselves, as opposed to hiring a professional (Willen, 2002). Only a percentage of the pesticide amount shown in Table 5.10 is actually copper or zinc and there is not enough information to quantify the actual amount of copper or zinc that would reach a water body in the San Diego County. (Chollas Creek is approximately 0.6 percent of the total area in San Diego County).[25]

TABLE 5.10. Pounds of chemicals containing copper and zinc applied in San Diego County in 2002 as reported to DPR.

Active Ingredient of Pesticide	Pounds of Chemical Applied in San Diego County	Active Ingredient of Pesticide	Pounds of Chemical Applied in San Diego County
Copper	5693	Copper 8-Quinolinoleate	10
Copper Ammonium Complex	304	Copper Sulfate (Anhydrous)	0.3
Copper Carbonate, Basic	819	Copper Sulfate (Basic)	20
Copper Ethanolamine Complexes, Mixed	182	Copper Sulfate (Pentahydrate)	2904
Copper Ethlenediamine Complex	14	Zinc Oxide	3366
Copper Hydroxide	6	Zinc Phosphide	66
Copper Naphthenate	1394	Zinc Sulfate	3
Copper Oxide (ous)	376		

Reference: (DPR Website, 2002 Report)
The chart excludes copper and zinc pesticides used in nurseries.

5.5.5 Wood Preservatives

Wood preservatives are actually pesticides that protect wood against attack by fungi, bacteria, or insects. The active ingredients found in wood preservatives may include copper or zinc. Preservatives of this sort are injected into the wood before purchase (pressure-treated wood) or applied by the user. If wood-preservative chemicals are incorporated into a paint or stain, that product is considered a pesticide and is regulated under the DPR. Wood preservatives in residential, commercial and industrial areas could also be a contributor of copper to Chollas Creek

5.5.6 Construction

Construction erosion is a potential source of metals in Chollas Creek. In California, dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total

[25] The Chollas Creek Watershed is estimated to be about 6.59 x 10^7 meters squared. According to California State Association of Counties in 2002 San Diego County is estimated to be 4,281 square miles.

disturbs one or more acres, are required to obtain coverage under the General NPDES WDRs for Discharges of Stormwater Associated with Construction Activity (Construction General NPDES WDRs, Order No. 99-08-DWQ). Construction activities regulated under these WDRs include clearing, grading and disturbances to the ground such as stockpiling or excavation. The Storm Water Construction Notice of Intent (NOI) database can be reviewed at any time to identify current construction projects underway, according to zip code, city and waste disposal identification (WDID) number. The land use percentage of land under development is estimated to be about 0.33 percent of the Chollas Creek Watershed.

5.5.7 Galvanized Metals

Galvanized chain-link fences may also contribute zinc to urban runoff. There are extensive stretches of chain-link fencing along roadways in the Chollas Creek Watershed. However, there are no known studies on the amount of zinc contributed by fencing. Zinc loads from this potential source would be estimated if relevant data become available at a later date. Also galvanized roofing materials and gutters have been found to contribute 153 µg/L and 363 µg/L of zinc to urban runoff, respectively (Woodward-Clyde, 1992).

5.5.8 Paint

A study conducted in Kentucky by the U.S. Department of Energy (Kszos, et. al., 2004) found that paint used on metal cylinders was causing toxicity to C*eriodaphnia dubia* in stormwater. Further investigation revealed that zinc was the causative agent. Similar paints are likely to be used in the Chollas Creek Watershed and should be considered as a likely source of zinc. Data are currently unavailable to quantify this potential load in the Chollas Creek Watershed. However, the SCV study estimated that residential paints contributed less than 1 percent of the total zinc load. In San Diego, contributions from residential paints are also assumed to be relatively less significant compared to other potential sources since the cities are similar in demographics.

5.5.9 Landfill

Special consideration must be paid to groundwater flows through former and active landfills and any former burn ash areas because of the increased likelihood that these areas may contribute significant amounts of metals to groundwater. There are currently no active landfills in the Chollas Creek Watershed, as indicated by the land use model results, or former burn sites. There is however a closed landfill, South Chollas Landfill, which sits adjacent to and apparently down gradient of, the Chollas Creek Reservoir in subwatershed 19022. The landfill is regulated under General WDR Order No. 97-11[26] and is required to address groundwater contamination concerns.

The landfill was closed in 1981 and annual monitoring data have been available since 1987. Samples were analyzed for copper, lead, and zinc, however, only until January 1997. The San Diego Basin Plan does not designate any beneficial uses for the groundwater in the 908.20 hydrologic area. Subsequently, the Basin Plan does not list WQSs applicable to the groundwater under the South Chollas Landfill. Furthermore,

[26] Order No. 97-11, *General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Nonhazardous Waste Landfills within the San Diego Region.*

since hardness analyses were not performed, comparison of metal concentrations to surface water CTR criteria is not possible. The ultimate fate of groundwater at the most down gradient well at the landfill is unknown. Local geology may bring the water to the surface such that leachate would reach Chollas Creek as surface flow and come under the jurisdiction of the MS4. Also, the Chollas Creek Reservoir may be impacting groundwater through artificial recharge, which has caused higher groundwater levels in the vicinity of the landfill site. Reservoir leakage could be passing through the closed landfill and carrying metals and other pollutants down to the creek. However, the available data do not allow for reservoir leakage to be quantified.

Until further information is available, the South Chollas Landfill and the Chollas Reservoir are considered only as potential sources of metals to Chollas Creek. This designation has no bearing on the load and waste load allocations of this TMDL but is useful information when considering metal loading reduction scenarios. If the landfill is determined to be a source of metals, appropriate corrective actions will be required of the discharger responsible for the landfill to be consistent with the allocations of this TMDL.

5.6 Summary of Sources

Modeling efforts (Appendix D) have identified freeways and commercial/ institutional land uses as having the highest relative loading contributions of copper, lead, and zinc to Chollas Creek. Together, these two land uses account for over 75 percent of the predicted metal loadings. The model gives an estimate of the magnitude and location of copper, lead, and zinc in the Chollas Creek watered. Additionally, other watershed studies outside Chollas Creek have identified individual sources of copper, lead, and zinc likely to be present in the Chollas Creek Watershed, including many aspects of automobile operations, water supply systems, pesticides, industrial metal recyclers and other suspected significant sources to Chollas Creek.

More data are needed to better understand the impacts these suspected sources have on concentrations of copper, lead, and zinc in Chollas Creek. Additional information is needed to properly populate the watershed model to more accurately describe dry weather loadings. Local data are also needed to quantify other sources and should be collected under Order No. R9-2007-0001 (as amended) to be consistent with the load and wasteload allocations of this TMDL. The San Diego Water Board may also use its authority under the California Water Code to require the collection and reporting of the necessary information. However, the current modeling efforts effectively quantify and identify the land uses that are considered to be the biggest contributors of copper, lead, and zinc to Chollas Creek. The land uses and subwatersheds that contribute more than the others may be targeted during implementation planning and load reduction scenarios. Furthermore, the specific suspected sources of metals, as identified in watershed studies from other regions, will be helpful in targeting practices that may be amenable to load reduction scenarios.

6 Linkage Analysis

The TMDL technical report must estimate total assimilative capacity (loading capacity) of Chollas Creek for the metals and describe the relationship between Numeric Targets and identified metal sources [40 CFR 130.7 (d) and 40 CFR 130.2 (i) and (f)]. Collectively, these requirements are termed the linkage analysis and provide the necessary quantitative link between the TMDL and attainment of WQSs.

The total assimilative capacity, or loading capacity, is the maximum amount of pollutant that a water body can assimilate while maintaining WQSs. The loading capacity is also a function of different hydrodynamic processes that affect the environmental fate and transport of dissolved metals as they move through the system. At Chollas Creek, the loading capacity for each metal is estimated to be equal to its respective Numeric Target. Per the Numeric Target's basis on CTR (see Numeric Target section), these loading capacities will attain WQSs, because the Numeric Targets are at a minimum to be protective of aquatic life and are thus conservatively considered the total loading capacity for Chollas Creek. Also, because the loading capacity is equated to the Numeric Target, the hydrodynamic processes are not quantified. In-stream processes, such as binding to organic material, are thought to only decrease the dissolved metals' concentration in Chollas Creek and are, thus, considered an implicit MOS. Table 6.1 presents the loading capacities for the dissolved metals copper, lead, and zinc.

TABLE 6.1. Dissolved metals loading capacities for acute and chronic conditions.

Metal	Loading Capacity for Acute Conditions – One-Hour Average[1]	Loading Capacity for Chronic Conditions – Four-Day Average[1]
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

The natural log and exponential functions are represented as "ln" and "e", respectively.
[1] These equations are also the numeric targets and CTR WQOs.

These loading capacities, which are equal to the Numeric Targets, will apply to the entirety of Chollas Creek and during all times of the year. Each of the land uses identified in the Source Analysis portion of this TMDL will not be allowed to have runoff that causes in-stream waters to exceed these concentrations. Further more, all other sources of copper, lead, and zinc to Chollas Creek will be expected to not cause the creek to exceed these loading capacities. Once these capacities are achieved, it is expected that Chollas Creek copper, lead, and zinc concentrations will be protective of the creek's beneficial uses.

A concentration-based approach was chosen to link the Numeric Targets with the largest identified metal source -- urban runoff. This approach is considered more appropriate than a mass-based approach, because not only does it take into account the dynamic nature of urban runoff, which is greatly affected by stormwater, but it also accommodates the dynamic nature of freshwater systems that have a myriad of flow and hardness conditions. Metals concentrations are also generally easier to monitor; however, hardness measurements will also be needed and sampling will need to be done in accordance with Table 4.2.

In addition, a mass-based approach would be more sensitive to concerns of accumulated bottom sediment in fresh water bodies and down stream sediment toxicity. However, as discussed in the Source Analysis (section 5), sediment is not considered a source of metals due to the nature of Chollas Creek and due to low sediment toxicity results. In addition, downstream sediment toxicity is to be addressed in a separate TMDL once adequate data are collected and applicable models are developed for the Chollas Creek Watershed.

7 Margin of Safety

The TMDL must contain a MOS to account for uncertainty in the analysis. The MOS for Chollas Creek is explicit as well as implicit. The explicit MOS was calculated by taking 10 percent of the total loading capacity as generated from the CTR equation, using the currently sampled hardness concentration. This 10 percent amount is essentially reserved: It is not available for waste load allocation or load allocation and therefore makes these allocations smaller and thus, more protective. For example, if the CTR equation, using the currently sampled hardness concentration, calculated a loading capacity of 106 kg Cu/L, then 10 percent or 11 (kg Cu/L) would be allocated to the MOS. Therefore, the waste load allocation and load allocation together would have to be equal to 95 kg Cu/L/year (106 kg Cu/L minus 11 kg Cu/L). This reservation is to account for (1) uncertainty associated with the calculations in the source analysis and linkage analysis, (2) any difference between total metal concentrations and dissolved[27] or assumed bioavailable, metal concentrations and (3) the uncertain effects that default, or non site-specific, CTR values had on the TMDL loading capacity.[28]

Using actual hardness values in the CTR equation in order to calculate TMDLs is an implicit MOS. The other alternative was to use an estimated hardness value from a model, a flow-correlation, or an average from past data. Because past data were very limited, an estimated hardness would in itself have a great amount of uncertainty and this uncertainty would be incorporated into the TMDL concentration if an estimated hardness would be used in the CTR equation. Also, although not an MOS by definition, the derivation of the CTR's criteria maximum concentration (CMC) takes safety into account, because it divides the Final Acute Value, determined from laboratory acute toxicity concentrations, by a safety factor of two (Stephan, 1985). In summary, staying as close as possible to the CTR definition gives assurance that the TMDL is a conservative, defendable value.

Another implicit MOS is not allowing for metal interactions with anions and negatively charged sites on particulates when calculating the loading capacity and allocations. Theoretically, an increase in bioavailability from these types of chemical interactions in water would only take place in waters with low pH levels. The increased aqueous acidity (low pH levels) would yield higher levels of free metal ions and thereby increase bioavailability to aquatic organisms. Such low pH levels in ambient waters are more likely to be observed in areas of high acid rain; these low pH conditions are not likely in San Diego. Therefore, metal interactions with negatively charged anions and particles within the water are assumed to only decrease bioavailability. Not allowing for this interaction makes the TMDL concentration more conservative.

[27] Although dissolved concentration is the most appropriate value to use for metals [40 CFR 131], any additional concern is addressed by the 10 percent MOS.
[28] The 10 percent MOS helps account for any additional uncertainties in calculating the Load and Waste Load Calculations due to use of the CTR default conversion factors and water effect ratio. Although CTR's guidance was strictly followed (when there is not enough site-specific data default values are used) there may remain a chance that if the data were available, these site-specific values would result in a more stringent TMDL concentration than the default values. Additional studies may also be preformed in the future to create site-specific values (Appendix H).

8 TMDL and Allocations

The TMDL must be less than or equal to the loading capacity after taking into account allocations to all sources. The TMDL is the combination of a total wasteload allocation (WLA) that allocates loadings for point sources, a total load allocation (LA) that allocates loadings for nonpoint sources and background sources and a MOS that may either explicitly reserve an allocation for or implicitly account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. In this TMDL, 10 percent of the load is reserved for an MOS, or not allocated to sources, in order to account for identified uncertainties in the TMDL in addition to conservative assumptions made in the TMDL analysis (Margin of Safety Section).

In TMDL development, allowable WLA and LA from pollutant sources that cumulatively amount to no more than the TMDL must be established; this provides the basis to establish water quality-based controls. TMDLs can be expressed on a mass loading basis (e.g., grams of pollutant per year) or as a concentration in accordance with provisions in federal regulations [40 CFR 130.2(l)]. In addition, TMDLs and associated WLA and LA must be expressed in quantitative terms [40 CFR 130.2 (e-i) and 40 CFR 130.7 (c)]. For Chollas Creek, the WLAs and LAs and consequently the TMDL, are expressed as a concentration. This decision was made based on the concentration-based approach and quantitative linkage analysis. (See section 6.0, Linkage Analysis) In addition, the concentration-based TMDL will account for any future point or nonpoint sources, because any future sources will also be required to be below the same concentration.

Mass-based TMDLs typically are described by the following equation:

$$TMDL_{mass} = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

However, in concentration-based TMDLs, the allocations are not additive. Additionally, the allocation concentrations for point sources (WLAs), and nonpoint and background sources (LAs) will be equivalent for each metal. Thus, only one term is needed in the equation for the allocations. Because significant nonpoint sources and background sources were not identified in the Chollas Creek watershed, the WLA term was retained in the equation and the LA term dropped. The MOS also is not additive in concentration-based TMDLs. As described previously, the MOS is incorporated into the WLAs, rather than added to them. This reduces the equation to:

$$TMDLs_{conc} = WLAs$$

The explicit MOS reserves 10 percent of the allocation and is incorporated into the WLAs by setting them equal to 90 percent of the loading capacity. Because the loading capacities are equal to the numeric targets, which are equal to the CTR WQOs, the TMDLs are equal to 90 percent of the CTR WQO concentrations. In other words:

CTR WQOs = Numeric Targets
Numeric Targets = Loading Capacities
WLAs = Loading Capacities * 0.9

Substituting CTR WQOs for Loading Capacity results in:

TMDLs = WLAs = CTR WQOs * 0.9

The hardness-based equations for calculating TMDL concentrations are shown in Table 8.1. The sampling requirements for calculating TMDL concentrations are given in Table 4.2.

TABLE 8.1. The Total Maximum Daily Load (TMDL) for dissolved copper, lead, and zinc for acute and chronic conditions

Metal	TMDL for Acute Conditions – One-Hour Average	TMDL for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

If all copper, lead, and zinc concentrations in urban runoff to Chollas Creek meet their respective TMDL concentrations, the loading capacity of the creek should not be exceeded.

8.1 Wasteload Allocations

Federal regulations [40 CFR 130.7] require TMDLs to include individual WLAs for each point source discharge. The point sources that could affect Chollas Creek are the MS4 discharges, stormwater discharges from industrial sites, and discharges of extracted groundwater. Order No. R9-2007-0001 for San Diego County covers the entire Chollas Creek Watershed, including the creek itself and regulates all wet and dry weather runoff that enters the creek through the stormwater conveyance system. All other existing WDR orders applicable to regulating metal sources regulate discharges that reach Chollas Creek directly through the MS4 system. For example, the stormwater WDR order for Caltrans (Order No. 99-06-DWQ) regulates freeway runoff that flows into the MS4 system. A full list of the existing WDR orders applicable to this TMDL is discussed in the Source Analysis section (section 5.0). All point source discharges to Chollas Creek are expected to achieve this WLA.

Modeling results, also discussed in the Source Analysis section, demonstrate the possible land use specific and sub-watershed specific contributions of copper, lead, and zinc. However because this WLA is concentration-based it will apply to each land use and each sub-watershed at all times and will not be specific to any land use or sub-watershed.

Therefore, the model predictions of the relative metal contribution from each category will be useful in targeting problem areas during implementation.

8.2 Load Allocations

The LAs are assigned to nonpoint sources and natural background sources in the watershed. Background sources can include air deposition of metals in the watershed and any groundwater contributions. Because of the regulatory definition of the MS4 system, all source (point and nonpoint sources) contributions of metals to Chollas Creek come via the MS4 and are therefore accounted for in the allocation assigned to the MS4s. The only other possible sources that may end up directly in Chollas Creek would be direct air deposition and groundwater, which may or may not include anthropogenic sources. As discussed in the Source Analysis section, these two sources are not considered significant at this time. These sources may be re-evaluated at a future date if any additional data become available. Currently, the sources contributing to the LAs not accounted for in the WLA assigned to the MS4s are considered to be relatively insignificant. Thus, in the TMDL calculation, the LAs are equal to zero, and the TMDL calculations are equal to the WLAs.

9 Seasonal Variations and Critical Conditions

In accordance with federal regulations [40 CFR 130.7(c)], a TMDL must consider seasonal variations and critical conditions (e.g. stream flows, pollutant loadings and other water quality parameters). A flow-based approach was used for the Chollas Creek Metals TMDL, and defines critical conditions solely based on freshwater flow rates regardless of season. No matter the time of year or situation, toxicity allocations that are based on the CTR equations will be required throughout all segments of Chollas Creek and therefore, by definition, will always be protective of aquatic life.

Furthermore, the flow-based approach is appropriate because the main sources of metal accumulation in the Chollas Creek Watershed are non-seasonal (e.g. automobile wear, exhaust emissions, industry contributions). Urban runoff, which is the main mechanism by which these accumulated metals reach Chollas Creek, can occur in both dry and wet weather. As explained previously, urban runoff is a combination of non-stormwater flows (e.g. car washing, lawn watering) during dry weather and stormwater flows during wet weather. Because the climate in southern California can be described as dry weather most of the year and intermittent wet weather events throughout the year, wet weather and dry weather are also most easily characterized by precipitation flow rates as opposed to being characterized by season. To further address these differences, both the CMC and CCC equations are used for determining a metal's allocation in order to be protective for both acute and chronic conditions.

The allowable concentration will be determined with hardness values measured at the time of compliance. These data will provide a direct measure of any seasonal variations and/or critical conditions effects on hardness. Since hardness is an essential component of the LA and WLAs, seasonal variations and/or critical conditions will be covered by this TMDL. This method of using sampled hardness as the variable instead of an estimated hardness, will account for these effects because it is an absolute representation of current conditions and thus will account for any effects that may be caused by seasonal variations or extreme conditions. Other stream chemistry, which may or may not be a function of seasonal variations and critical conditions, were not taken into consideration as an implicit MOS and will therefore not have a bearing, with respect to seasonal variations and critical conditions, on the TMDL.

10 Legal Authority

This section presents the legal authority and regulatory framework used as a basis for assigning responsibilities to dischargers to implement and monitor compliance with the Chollas Creek Metals TMDL. The laws and policies governing point source[29] discharges are described below. Non-point source discharges are not discussed because these discharges are negligible in the Chollas Creek watershed, and did not receive load allocations or reductions. Discharger accountability for attaining metals wasteload allocations is established. The legal authority and regulatory framework is described in terms of the following:

- Controllable water quality factors;
- Regulatory background; and
- Persons accountable for point source discharges

10.1 Controllable Water Quality Factors

The Chollas Creek watershed lies within the Pueblo 908.00 Hydrologic Unit. The vast majority of metals are transported from sources to Chollas Creek from wet and dry weather runoff generated from human habitation and land use practices, and to a lesser extent, direct atmospheric deposition. Construction, maintenance, and operation of state-owned highways are also sources of metal discharges to Chollas Creek. These metal discharges result from controllable water quality factors which are defined as those actions, conditions, or circumstances resulting from man's activities that may influence the quality of the waters of the state and that may be reasonably controlled. This TMDL project establishes wasteload allocations for these controllable discharges.

10.2 Regulatory Background

CWA section 402 establishes the NPDES Program to regulate the ‘‘discharge of a pollutant,’’ other than dredged or fill materials, from a ‘‘point source’’ into ‘‘waters of the U.S.”[30] Under section 402, discharges of pollutants to waters of the U.S. are authorized by obtaining and complying with NPDES permits. These permits commonly contain effluent limitations consisting of either Technology Based Effluent Limitations (TBELs) or Water Quality Based Effluent Limitation (WQBELs). TBELs represent the degree of control that can be achieved by point sources using various levels of pollution control technology that are defined by the USEPA for various categories of discharges and implemented on a nation-wide basis.

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[29] The term ‘‘point source’’ is defined in Clean Water Act section 502(6) to mean any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

[30] See federal regulations [40 CFR section 122.2(c)(e)]. The USEPA has interpreted “waters of the United States” to include “intrastate lakes, rivers, streams (including intermittent streams) . . . the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce,” and “tributaries of [those] waters.” Chollas Creek is a water of the United States.

TBELs may not be sufficient to ensure that water quality standards will be attained in receiving waters. In such cases, NPDES regulations require the San Diego Water Board to develop WQBELs that derive from and comply with all applicable WQSs. If necessary to achieve compliance with the applicable WQSs, NPDES requirements must contain WQBELs more stringent than the applicable TBELs [CWA 303 (b)(1)(c)] [40 CFR 122.44(d)(1)]. WQBELs may be expressed as numeric effluent limitations or as BMP development, implementation and revision requirements. Numeric effluent limitations require monitoring to assess load reductions while non-numeric s provisions, such as BMP programs, require progress reports on BMP implementation and efficacy.

In California, state Waste Discharge Requirements (WDRs) for discharges of pollutants from point sources to navigable waters of the U.S. that implement federal NPDES regulations serve in lieu of federal NPDES permits. Such WDRs are issued by the state pursuant to independent state authority (not authority delegated by the USEPA or derived from the Clean Water Act).[31]

Within each TMDL, a "wasteload allocation"[32] is determined which is the maximum amount of a pollutant that may be contributed to a waterbody by "point source" discharges of the pollutant in order to attain and maintain WQOs. WDRs implementing NPDES regulations must include conditions that are consistent with the assumptions and requirements of the wasteload allocation. The principle regulatory means of implementing TMDLs for point source discharges regulated under these types of WDRs are:

- Allocate the total wasteload allocation calculated for point source facilities among each individual NPDES point source facility that is discharging the pollutant that needs to be controlled;

- Evaluate whether the effluent limitations or conditions within the WDRs implementing NPDES regulations are consistent with the wasteload allocations. If not, incorporate WQBELs that are consistent with the wasteload allocations into the WDRs[33] or otherwise revise the WDRs to make them consistent with the assumptions and requirements of the TMDL wasteload allocations.[34] A time schedule to achieve

[31] Pursuant to Chapter 5.5 of the Porter-Cologne Act, in order to avoid the issuance by the USEPA of separate and duplicative NPDES permits for discharges in California that would be subject to the Clean Water Act, the State's WDRs for such discharges implement the NPDES regulations and entail enforcement provisions that reflect the penalties imposed by the Clean Water Act for violation of NPDES permits issued by the USEPA.

[32] See federal regulations [40 CFR section 130.2(h)]. A wasteload allocation is the portion of the receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution.

[33] In the case of WDRs implementing NPDES regulations, WQBELs may include best management practices that evidence shows are consistent with the wasteload allocation.

[34] See federal regulations [40 CFR section 122.44(d)(1)(vii)(B)]. NPDES water quality-based effluent limitations must be consistent with the assumptions and requirements of any available TMDL wasteload allocation. The regulations do not require the WQBELs to be identical to the wasteload allocation. The regulations leave open the possibility that the San Diego Water Board could determine that fact-specific circumstances render something other than literal incorporation of the wasteload allocation to be consistent

compliance should also be incorporated into the WDRs in instances where the discharger is unable to immediately comply with the required wasteload reductions;

- Mandate discharger compliance with the wasteload allocations in accordance with the terms and conditions of the revised WDRs;

- Implement a monitoring and/or modeling plan designed to measure the effectiveness of the controls implementing the wasteload allocations and the progress the waterbody is making toward attaining WQOs; and

- Establish criteria to determine that substantial progress toward attaining water quality standards is being made and if not, the criteria for determining whether the TMDLs or wasteload allocations need to be revised.

10.3 Persons Responsible for Point Source Discharges

For Chollas Creek, all metal loading essentially comes to the creek through the MS4s within the watershed. MS4 discharges are point source discharges because they are released from channelized, discrete conveyance pipe systems and outfalls. Background loads and loads from air deposition are negligible compared to the loads delivered from the MS4s as discussed in section 5. Discharges from MS4s to navigable waters of the U.S. are considered to be point source discharges and are regulated in California through the issuance of WDRs that implement NPDES regulations. Persons owning and/or operating MS4s tributary to Chollas Creek include Caltrans, the cities of San Diego, Lemon Grove, and La Mesa, San Diego County, the San Diego Unified Port District, and the Navy.

The following discussion describes the persons responsible for actual or potential MS4 point source discharges of metals to the Chollas Creek watershed. These dischargers have specific roles and responsibilities assigned to them for achieving compliance with the metals wasteload allocations described in section 11.0, Implementation Plan.

10.4 California Department of Transportation

Caltrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, including the portion of the Interstate Highway System within the state's boundaries. The roads and highways operated by Caltrans are legally defined as MS4s and discharges of pollutants from Caltrans MS4s to waters of the U.S., such as Chollas Creek, constitute a point source discharge that is subject to regulation under WDRs implementing federal NPDES regulations.

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with the TMDL assumptions and requirements. The rationale for such a finding could include a trade amongst dischargers of portions of their load or wasteload allocations, performance of an offset program that is approved by the San Diego Water Board, or any number of other considerations bearing on facts applicable to the circumstances of the specific discharger.

Discharges of storm water from the Caltrans owned right-of-ways, properties, facilities, and activities, including storm water management activities in construction, maintenance, and operation of state-owned highways are regulated under Order No. 99-06-DWQ.[35] Caltrans is responsible, under the terms and conditions of these WDRs, for ensuring that its operations do not contribute to violations of water quality objectives in Chollas Creek.

Caltrans is a point source discharger of metals to Chollas Creek. Caltrans discharges storm water runoff containing metals from Interstates-5, 15 and 805 freeway surfaces, and State Highway 94 freeway surfaces and adjacent land areas via a storm drain system. Stormwater runoff from highways can contain pollutants, including metals, from vehicle exhaust and atmospheric deposition. These discharges are contributing to the exceedances of the metals water quality objectives in Chollas Creek.

10.5 Cities of San Diego, Lemon Grove, and La Mesa, San Diego County, and the San Diego Unified Port District

The Municipal Dischargers discharge urban runoff to Chollas Creek via MS4s that are regulated under WDRs prescribed in Order No. R9-2007-0001[36] Under the terms and conditions of this Order, the Municipal Dischargers are responsible for controlling all storm and non-storm water flows (i.e., urban runoff) that are transported through their respective MS4s to surface waters.

The Municipal Dischargers are point source dischargers of metals to Chollas Creek. Metals are present in stormwater and urban runoff from commercial/industrial and transportation land use activities within these jurisdictions. Metal-laden stormwater and urban runoff are discharged to Chollas Creek via the MS4s. These discharges are contributing to the exceedances of the metals water quality objectives in Chollas Creek.

10.6 U.S. Navy

There is a small portion of the Chollas Creek watershed, immediately adjacent to San Diego Bay, which is under the jurisdiction of the Navy. Naval Station San Diego west of Harbor Drive[37] appears to drain directly to San Diego Bay, and if so, does not contribute metals to Chollas Creek. However, east of Harbor Drive, facility MS4s discharge into Chollas Creek.

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[35] *Order No. 99-06-DWQ, NPDES No. CAS000003, National Pollutant Discharge Elimination System (NPDES) Permit Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans).*

[36] Order No. R9-2007-0001, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, NPDES No. CAS0108758

[37] These lands are regulated under Order No. R9-2003-0265, NPDES Permit No. CA0107867, *Waste Discharge Requirements for U.S. Navy Graving Dock Located at Naval Station San Diego* and Order No. R9-2002-0169, NPDES Permit No. CA0109169, *Waste Discharge Requirements for U.S. Navy Base San Diego*.

A statewide order prescribing general WDRs for discharges from small MS4s[38] regulates urban runoff not covered by the San Diego Water Board's phase I MS4 WDRs (Order No. R9-2007-0001), including discharges from MS4s on military bases. The Navy's discharge from its MS4 into Chollas Creek can be regulated by enrolling this facility under the statewide order.

10.7 Persons Discharging Stormwater Regulated Under Statewide General NPDES WDRs

Industrial facilities, construction sites, and utility vaults generate stormwater that can be discharged to Chollas Creek via the MS4s. Stormwater discharges from industrial facilities, construction sites, and utility vaults in the Chollas Creek watershed are regulated under statewide general NPDES WDRs prescribed in Order No. 99-08-DWQ, Order No. 99-08-DWQ, and Order No. 2001-11-DWQ, respectively.[39]

Stormwater discharges from industrial sites in Chollas Creek watershed may contain dissolved metals concentrations that contribute to exceedances of metals water quality objectives in Chollas Creek. Therefore, Chollas Creek watershed enrollees under the Industrial Stormwater WDRs are responsible for potential MS4 point source discharges of metals to Chollas Creek.

The principal pollutants of concern for construction site stormwater discharges are sediment and total suspended solids, however, air-deposited metals, and metals deposited from equipment operation can wash off construction sites in stormwater and be discharged to the MS4s. Therefore, Chollas Creek watershed enrollees under the Construction Stormwater WDRs are responsible for potential MS4 point source discharges of metals to Chollas Creek

For utility vault discharges, the principal pollutants of concern are total suspended solids, oil and grease. Utility vaults are typically located beneath sidewalks rather than roads. Storm water leaking into a utility vault from a sidewalk is not likely to contain significant metals concentrations because of the lack of contact between sidewalks and cars. However, air deposited metals can be washed off into utility vaults and groundwater seeping into a utility vault may contain elevated levels of metals. Nonetheless, a WLA is not assigned to these discharges because they make up an extremely small volume of

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[38] State Water Board Water Quality Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*.

[39] Order No. 97-03-DWQ NPDES No. CAS 000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities*. Active enrollees in the Chollas Creek watershed include A to Z Auto Dismantling, IMS Recycling Services, Mini Trucks and Cars, Trolley Auto Parts, Able Auto Wrecking, Pacific Coast Recycling- Always Recycling.
Order No. 99-08-DWQ NPDES No. CAS 000002 General Construction Storm Water WDRs.
Order No. 2001-11-DWQ NPDES No. CAG 99002 General Utility Vault WDRs.

water discharged, and the WDRs regulating these discharges prohibit the discharges from violating water quality objectives in the receiving water.

10.8 Persons Discharging Groundwater Regulated Under San Diego Water Board General NPDES WDRs

Groundwater discharges from dewatering sites can be discharged to Chollas Creek via the MS4s. These discharges are regulated under San Diego Water Board general NPDES WDRs prescribed in Order No. 2000-90[40] and Order No. 2001-96.[41] Groundwater discharges may contain naturally occurring dissolved metals concentrations, or enriched concentrations from overlying metals contaminated soils that contribute to exceedances of metals water quality objectives in Chollas Creek. Both orders contain numeric effluent limitations for copper, lead, and zinc that are equivalent to the CTR WQOs. At this time, there are no enrollees discharging extracted groundwater to MS4s in the Chollas Creek watershed. However, copper, lead, and zinc wasteload reductions for groundwater dewatering will be required in the event that future groundwater dewatering dischargers apply for coverage under Orders No. 2000-90 and No. 2001-96 to ensure that water quality standards are attained and maintained in Chollas Creek.

10.9 Persons Discharging Hydrostatic Test Water Regulated under San Diego Water Board General NPDES WDRs

Hydrostatic test water discharges to the MS4s can contain dissolved copper, lead, and zinc. These discharges are regulated under San Diego Water Board general NPDES WDRs prescribed in Order No. R9-2002-0020. A WLA is not assigned to these discharges because they make up an extremely small volume of water discharged, and the WDRs regulating these discharges contain a requirement that the discharger provide data and information to be used by the San Diego Water Board to determine whether the proposed discharge may cause, have a reasonable potential to cause, or contribute to an excursion above any applicable priority pollutant, criterion or objective. If so, an effluent limitation may be required for the pollutant.

10.10 School Districts

In addition to the Navy, other owners and operators of small MS4s in the Chollas Creek Watershed include the school districts of Lemon Grove, La Mesa, and San Diego. These facilities are classified under the institutional land use category, which is associated with the highest copper and lead loading, and second highest zinc loading of all the land uses in the Chollas Creek Watershed. The correlation between institutional land uses and high

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[40] Order No. 2000-90, NPDES Permit No. CAG919001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or Other Conveyance Systems Tributary Thereto* or subsequent superceding NPDES renewal orders.

[41] Order No. 2001-90, NPDES No. CAG19001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or other Conveyance Systems Tributary Thereto.*

metals loading may be because parking lots constitute a significant portion of this land use. A statewide order prescribing general WDRs for discharges from small MS4s[42] regulates urban runoff not covered by the San Diego Water Board's phase I MS4 WDRs (Order No. R9-2007-0001), including discharges from MS4s on school property. The school districts' discharges from their MS4 into Chollas Creek can be regulated by enrolling these facilities under the statewide order.

[42] State Water Board Water Quality Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*.

11 Implementation Plan

This Chapter describes the actions necessary to implement the TMDL to attain and maintain copper, lead, and zinc WQOs in Chollas Creek. The plan describes implementation responsibilities assigned to cooperating agencies and dischargers and describes the schedule and key milestones for the actions to be taken. A monitoring strategy to assess the success of this implementation plan is presented in section 12, Implementation Monitoring Plan.

The goal of the Implementation Plan is to ensure that Chollas Creek does not exceed CTR WQOs[43] for copper, lead, and zinc at all times and in all points of the creek. Since nonpoint source discharges to the creek are considered negligible, compliance with the TMDL will be accomplished by ensuring that all point source discharges meet the WLAs as set forth in section 8 of this Technical Report. Applicable WDRs will be revised to incorporate WLAs to ensure that the discharges comply with the WLAs and do not contribute to an exceedance of the WQOs in Chollas Creek

11.1 Regulatory Authority for Implementation Plans

TMDL implementation plans are not directly required under federal law; however federal policy is that TMDLs should include implementation plans. CWA section 303 [40 CFR 130] authorizes USEPA to require implementation plans for TMDLs. Although current USEPA regulations implementing section 303 do not now require states to include implementation plans for TMDLs, regulations are likely to be revised in the future to do so. USEPA regulations [40 CFR 130.6] do require states to incorporate TMDLs in the State Water Quality Management Plans (Basin Plans) along with adequate implementation measures to implement all aspects of the plan (including the TMDLs). USEPA policy is that states must include implementation plans as an element of TMDL Basin Plan amendments submitted to EPA for approval.[44]

TMDL implementation plans are required under state law. Basin plans must have a program of implementation to achieve WQOs.[45] The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the WQOs.[46] State law requires that a TMDL include an implementation plan because the TMDL normally is, in essence, an interpretation or refinement of an existing water quality objective. The TMDLs and WLAs must be incorporated into the Basin Plan.[47] Because the TMDL supplements, interprets, or refines existing WQOs, state law requires a program of implementation.

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[43] [40 CFR 131.38(b)(2)]
[44] See *Guidance for Developing TMDLs in California,* USEPA Region 9, (January 7, 2000), Page 11.
[45] See Water Code section 13050(j). A "Water quality control plan" or "Basin Plan" consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) Water quality objectives and (3) A program of implementation needed for achieving water quality objectives.
[46] See Water Code section 13242.
[47] See Clean Water Act section 303(e).

11.2 Implementation Plan Objectives

The specific objectives of this Implementation Plan are as follows:

1. Amend the different statewide and San Diego Water Board orders that regulate point source discharges to Chollas Creek to require that urban runoff discharges from MS4s achieve the WLAs set forth in section 11.3 below;

2. Establish mechanisms to track BMP implementation, monitor BMP effectiveness in achieving the WLAs in urban runoff discharges to and from MS4s, assess success in achieving TMDL objectives and milestones, and report on TMDL program effectiveness in attaining the copper, lead, and zinc water quality objectives in Chollas Creek.

3. Establish a time schedule for meeting the WLAs of this TMDL project. The schedule will establish an interim milestone that is to be achieved until the WLAs are achieved.

4. Identify the regulatory authority under which the San Diego Water Board will direct the NPDES dischargers to initiate the elements of the implementation plan. This will only be required if the relevant WDRs are not modified to incorporate wasteload allocations in a timely manner.

5. Identify the persons responsible for meeting the WLAs in urban runoff discharged to Chollas Creek.

11.3 Waste Load Allocations and Responsible Persons

The WLAs must be met in specified point source waste discharges, which are or can be subject to regulation through NPDES WDRs, and which drain to Chollas Creek. The Chollas Creek metals WLAs are expressed as concentrations equal to 90 percent of the loading capacities for the three metals. The loading capacities are equal to the hardness based CTR maximum (acute) and continuous (chronic) criteria for copper, lead, and zinc. Setting the WLAs equal to ninety percent of the loading capacity provides the explicit MOS. Because the toxicity of dissolved metals varies with hardness, the CTR criteria are expressed as the equations in Table 11.1 below. Background sources and nonpoint sources of metals were insignificant. Therefore, this TMDL has no LAs.

TABLE 11.1 The Wasteload Allocations for dissolved copper, lead, and zinc for acute and chronic conditions

Metal	WLA for Acute Conditions – One-Hour Average = Loading Capacity* MOS	WLA for Chronic Conditions – Four-Day Average =Loading Capacity*MOS
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

Persons whose discharges contribute to the exceedance of WQOs for copper, lead, and zinc in Chollas Creek (as discussed in section 10) will be required to meet the WLA hardness dependant concentrations. The Municipal Dischargers and Caltrans are responsible for meeting the WLAs in their urban runoff because they own or operate MS4s that discharge copper, lead, and zinc to Chollas Creek. The Navy facility, Naval Station San Diego, has MS4s that drain directly to Chollas Creek. The Navy is responsible for meeting the WLAs in its MS4 urban runoff discharges to Chollas Creek.

Persons enrolled in the statewide General Industrial WDRs (State Water Board Order No. 99-08-DWQ) will be also be required to meet the WLAs in their regulated discharges to Chollas Creek. At this time, there are no persons enrolled in the general WDRs for Groundwater Extraction Discharges to San Diego Bay and Tributaries (San Diego Water Board Order No. 2001-90).

11.4 Interim Goals for Achieving Wasteload Allocations

The purpose of these TMDLs is to attain and maintain the applicable WQOs in Chollas Creek through mandated wasteload reductions of pollutants in point sources discharging to the creek. The TMDL requires dischargers to improve water quality conditions in the Chollas Creek receiving water by achieving wasteload reductions in their discharges. The copper, lead, and zinc TMDLs shall be implemented with a monitoring component to determine the effectiveness of each phase and guide the selection of BMPs.

Concentrations of metals in urban runoff shall only be allowed to exceed the WLAs by a certain percentage for the first nineteen years after initiation of this TMDL. Allowable concentrations shall decrease to the amounts indicated in Table 11.2 by the times indicated. For example, if the measured hardness ten years after initiation of this TMDL project dictates the WLA for copper in urban runoff is 10 µg/l, the maximum allowable measured copper concentration would be 12.0 µg/L. The phases require loading reductions in two steps through the use of expanded or better tailored BMPs to achieve the ultimate goal of attaining and maintaining compliance with copper, lead, and zinc water quality objectives. By the end of the twentieth year after initiation of this TMDL, the WLAs of this TMDL shall be met. This will ensure that copper, lead, and zinc water quality objectives are being met at all locations in the creek during all times of the year.

TABLE 11.2 Interim goals for achieving Wasteload Allocations

	Allowable Exceedance of the WLAs (allowable percentage above)		
Compliance Year	**Copper**	**Lead**	**Zinc**
1	100%	100%	100%
10	20%	20%	20%
20	0%	0%	0%

Compliance with the interim goals in this schedule can be assessed by showing that dissolved metals concentrations in the receiving water exceed the WQOs for copper, lead, and zinc by no more than the allowable exceedances for WLAs shown in Table 11.2. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges.

Dischargers are expected to implement metal reduction BMPs during the first year of this TMDL, with all necessary metal load reductions being achieved within twenty years. The first ten years will require the bulk of the metal load reduction, while the remaining ten years provide for adequate construction and implementation time for potential structural BMPs, to achieve the full (100 percent) metal load reduction. As described in Appendix I section 8.4, this compliance schedule of 20 years requires comprehensive BMP planning for all pollutants impairing Chollas Creek, including coordination with all TMDLs and all other water quality project requirements within the Chollas Creek watershed.

11.5 San Diego Water Board Actions

This section describes the actions that the San Diego Water Board will take to implement the TMDL. WDRs that implement federal NPDES regulations must be made consistent with the assumptions and requirements of the WLA. NPDES WDRs must contain water quality based effluent limitations (WQBELs) consistent with the WLAs but not necessarily the strict equivalent of the WLAs. WQBELs can be numeric, non-numeric, or both. Non-numeric effluent limitations typically are a program of expanded or better-tailored BMPs. USEPA expects that most WQBELs for NPDES-regulated municipal discharges will be in the form of BMPs, and that numeric limitations will be used only in rare instances.[48] WQBELs can be incorporated into new WDRs, or into existing WDRs by reissuing or revising these WDRs. The following paragraphs describe regulatory actions that are appropriate for regulating discharges of metals and ensuring compliance with TMDL provisions.

NPDES requirements (individual and general requirements) should be issued, revised, or reissued "as expeditiously as practicable" to incorporate WQBELs derived from the TMDL wasteload allocation. As "expeditiously as practicable" means the following:

[48] EPA Memorandum entitled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," dated November 22, 2002.

(1) New Facilities. For facilities receiving a NPDES WDRs for the first time, "as expeditiously as practicable" means that the San Diego Water Board issues the NPDES WDRs that implements the WLA upon the initiation of the discharge.

(2) Facilities Currently Regulated. For facilities currently regulated under NPDES WDRs, "as expeditiously as practicable" means that:

(i)The San Diego Water Board should consider revision of the NPDES WDRs during its 5 year term, prior to expiration, in accordance with the applicable NPDES reopening provisions, taking into account factors such as available NPDES resources, staff and budget constraints, and other competing priorities.

(ii) In the event the San Diego Water Board cannot consider modification following the five-year term expiration of the NPDES WDRs, the San Diego Water Board will reissue the NPDES WDRs implementing the WLA at the end of its five-year term. Please see Table 11.3 for more details.

1. Caltrans MS4 Discharges

This point source discharge is subject to NPDES WDRs under statewide Order No. 99-06-DWQ.[49] NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the WLAs described in Table 11.1. The WQBELs may include 1) numeric effluent limitations consistent with the WLAs; 2) a program of expanded or better tailored BMPs consistent with the WLAs; or 3) some combination of both. The WDRs shall also include:

a. The schedule of compliance applicable to MS4 discharges into Chollas Creek described in Table 11.2.

b. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

c. A requirement to submit annual progress reports to the San Diego Water Board on the progress in attaining the WLAs in urban runoff discharges and WQOs in Chollas Creek. The reports shall be due on April 1 of each year and shall be incorporated within the report required by section 2, Program Management of Order No. 99-06. Reporting shall continue on an annual basis until the metals WQOs are attained and maintained in Chollas Creek. Please see Table 11.3 for more details.

[49] Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal Orders.

The reports should describe the BMPs being implemented by Caltrans in the Chollas Creek watershed and additional BMPs that will be implemented. The reports should describe the steps Caltrans will take to develop a long-term strategy for assessing the effectiveness of its BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that it will use to track the long-term progress towards achieving the copper, lead, and zinc load reductions required under this TMDL. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

2. Discharges from MS4s Owned by the Cities, the County, and the Port

These point source discharges are subject to NPDES WDRs under Order No. R9-2007-0001.[50] NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the WLAs described in Table 11.1. The WQBELs may include 1) numeric effluent limitations consistent with the WLAs; 2) a program of expanded or better tailored BMPs consistent with the WLAs; or 3) some combination of both. The WDRs shall also include:

a. The schedule of compliance applicable to MS4 discharges into Chollas Creek described in Table 11.2.

b. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

c. A requirement that the Municipal Dischargers submit annual progress reports to the San Diego Water Board on the progress in attaining the WLAs in effluent discharges and WQOs in Chollas Creek. Annual reports shall cover the period of July 1 through June 30. The reports shall be submitted to the San Diego Water Board by January 31 of the following year and shall be incorporated within the annual receiving water monitoring reports required in the Receiving Waters and Urban Runoff Monitoring Annual Report Requirements outlined in the Receiving Waters and Urban Runoff Monitoring and Report Program of Order No. R9-2007-0001. Reporting shall continue on an annual basis until the metal water quality objectives are attained and maintained in Chollas Creek. Please see Table 11.3 for more details.

The reports should describe the BMPs being implemented by the Municipal Dischargers in the Chollas Creek watershed and additional BMPs that will be

[50] Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal Orders.

implemented. The reports should describe the steps the Municipal Dischargers will take to develop a long-term strategy for assessing the effectiveness of their BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that they will use to track the long-term progress towards achieving the copper, lead, and zinc WLAs required under this TMDL Project. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

For copper, lead, and zinc discharges in urban runoff to or from MS4s within the Chollas Creek watershed, the Municipal Dischargers have an existing obligation under Order No. R9-2007-0001 to require increasingly stringent BMPs, pursuant to the iterative process described in Prohibitions and Receiving Water Limitation A.3.a.(1)[51] of the Order, to reduce metal discharges in the Chollas Creek watershed to the maximum extent practicable and to restore compliance with the copper, lead, and zinc components of the toxic pollutants water quality objectives.

3. Municipal Dischargers and the Navy – Amend Order No. R9-2004-0277, Chollas Creek Investigation and Monitoring Program for Diazinon and Metals

   The San Diego Water Board shall amend Order No. R9-2004-0277 (or subsequent superseding renewal orders) to include the following:

   A requirement that the Municipal Dischargers and Caltrans investigate excessive levels of metals in Chollas Creek and feasible management strategies to reduce metal loadings in Chollas Creek. The amendment will require additional monitoring to collect the data necessary to refine the watershed wash-off model to provide a more accurate estimate of the mass loads of copper, lead, and zinc leaving Chollas Creek each year. The Navy will be added to this order when it is amended to include the requirements of this TMDL Project. Please see Table 11.3 for more details.

4. Amend Orders No. 2000-90 and No. 2001-96 General WDRs for Groundwater Extraction Discharges

[51] Receiving Water Limitation A.3.a (1) provides that "[u]pon a determination by either the Copermittee or the San Diego Water Board that MS4 discharges are causing or contributing to an exceedance of an applicable water quality standard, the Copermittee shall promptly notify and thereafter submit a report to the San Diego Water Board that describes BMPs that are currently being implemented and additional BMPs that will be implemented to prevent or reduce any pollutants that are causing or contributing to the exceedance of water quality standards…"

The San Diego Water Board will amend Orders No. 2000-90,[52] and No. 2001-96[53] which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries. The existing effluent limitations for copper, lead, and zinc for extracted groundwater discharges to MS4s in the Chollas Creek watershed, and directly to Chollas Creek, will be revised to equal the WLAs of this TMDL. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges. A revision of the receiving water limitations is not required since they are equal to the WQOs for metals in Chollas Creek.

5. Stormwater Discharges from Industrial Facilities

These point source discharges are subject to NPDES WDRs under Order No. 97-03-DWQ.[54] NPDES WDRs shall be issued, reissued, or revised to include requirements of the WLAs described in Table 11.1. The WQBELs may include 1) numeric effluent limitations consistent with the WLAs; 2) a program of expanded or increasing BMPs consistent with the WLAs; or 3) some combination of both. The WDRs shall also include:

a. The schedule of compliance applicable to industrial facility stormwater discharges into Chollas Creek described in Table 11.2.

b. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

c. A requirement to submit annual progress reports to the San Diego Water Board on the progress in attaining the WLAs in effluent discharges. The reports shall be due on July 1 of each year and shall be incorporated within the annual report required by section A.14 of Order No. 97-03-DWQ. Reporting shall continue on an annual basis until the metals WQOs are attained and maintained in Chollas Creek. Please see Table 11.3 for more details.

The report should describe the steps industrial dischargers will take to develop a long-term strategy for assessing the effectiveness of its BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that it will use to track the long-term progress towards

[52] Order No. 2000-90, NPDES Permit No. CAG919001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or Other Conveyance Systems Tributary Thereto* or subsequent superseding NPDES renewal orders.
[53] Order No. 2001-96, NPDES Permit No. CAG919002, *General Waste Discharge Requirements for Groundwater Extraction Waste Discharges from Construction, Remediation and Permanent Groundwater Extractioi Projects to Surface Waters within the San Diego Region Except for San Diego Bay* or subsequent superseding NPDES renewal orders.
[54] Order No. 97-03-DWQ, NPDES Permit No. CAS000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities* or subsequent superseding NPDES renewal orders.

achieving the copper, lead, and zinc load reductions required by this TMDL. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

6. Take Enforcement Actions

   The San Diego Water Board shall consider enforcement action,[55] as necessary, against any discharger failing to comply with applicable waiver conditions, WDRs, discharge prohibitions, or take enforcement action, as necessary, to control the discharge of metals to Chollas Creek, to attain compliance with the metals WLAs specified in this Technical Report, or to attain compliance with the metals WQOs. The San Diego Water Board may also terminate the applicability of waivers and issue WDRs or take other appropriate action against any discharger(s) failing to comply with the waiver conditions. Please see Table 11.3 for more details.

7. Recommend High Priority for Grant Funds

   The San Diego Water Board shall recommend that the State Water Board assign a high priority to awarding grant funding[56] for projects to implement the Chollas Creek metal TMDLs. Special emphasis will be given to projects that can achieve quantifiable metal load reductions consistent with the specific metal TMDL WLAs. Please see Table 11.3 for more details.

8. Enroll the Navy in Order No. 2003-0005-DWQ, Statewide general WDRs for Discharges from Small MS4s

   The San Diego Water Board shall require the Navy to submit a complete Report of Waste Discharge (ROWD), and shall enroll the Navy community facilities of Naval Base San Diego under Order No. 2003-0005-DWQ.[57] Alternatively, the San Diego

[55] An enforcement action is any formal or informal action taken to address an incidence of actual or threatened noncompliance with existing regulations or provisions designed to protect water quality. Potential enforcement actions include notices of violations (NOVs), notices to comply (NTCs), imposition of time schedules (TSO), issuance of cease and desist orders (CDOs) and cleanup and abatement orders (CAOs), administrative civil liability (ACL), and referral to the attorney general (AG) or district attorney (DA). The San Diego Water Board generally implements enforcement through an escalating series of actions to: (1) assist cooperative dischargers in achieving compliance; (2) compel compliance for repeat violations and recalcitrant violators; and (3) provide a disincentive for noncompliance.

[56] Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal Orders.

[57] Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal Orders.

Water Board could issue new WDRs to the Navy. Please see Table 11.3 for more details.

9. Construction Stormwater Discharges

These point source discharges are subject to NPDES WDRs under statewide Order No. 97-03-DWQ.[58] NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the WLAs described in Table 11.1. The WQBELs may include 1) numeric effluent limitations consistent with the WLAs; 2) a program of expanded or better tailored BMPs consistent with the WLAs; or 3) some combination of both. The WDRs shall also include:

d. The schedule of compliance applicable to industrial facility stormwater discharges into Chollas Creek described in Table 11.2.

e. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

f. A requirement to submit annual progress reports to the San Diego Water Board on the progress in attaining the WLAs in effluent discharges. The reports shall be due on July 1 of each year and shall be incorporated within the annual report required by section A.14 of Order No. 97-03-DWQ. Reporting shall continue on an annual basis until the metals WQOs are attained and maintained in Chollas Creek. Please see Table 11.3 for more details.

   The report should describe the steps industrial dischargers will take to develop a long-term strategy for assessing the effectiveness of its BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that it will use to track the long-term progress towards achieving the copper, lead, and zinc load reductions required by this TMDL. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

10. South Chollas Landfill

There is only one landfill in the Chollas Creek Watershed and it was closed in 1981. Order No. 97-11[59] and Addendum No. 4 require monitoring of groundwater below and near the South Chollas Landfill. The San Diego Water Board will revise this WDR to re-institute analysis for metals and begin analysis for hardness as part of the

[58] Order No. 99-08-DWQ NPDES No. CAS 000002 General Construction Storm Water WDRs or subsequent superseding NPDES renewal orders.
[59] Order No. R9-97-11, *General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Nonhazardous Waste Landfills within the San Diego Region* or subsequent superseding NPDES renewal orders.

monitoring requirements. Furthermore, if the data indicate that metal concentrations are in excess of the WLAs of this TMDL, the San Diego Water Board may require additional actions. Since the landfill is down gradient from Chollas Reservoir and is up gradient from Chollas Creek, the possibility exists that groundwater recharge from the reservoir may be transporting landfill pollutants to the creek. The WDR may be revised or the San Diego Water Board may issue an investigative order (under the authority of the Water Code section 13267) to require a technical report examining this potential metals pathway to Chollas Creek. Please see Table 11.3 for more details.

11. School Districts

Order No. 2003-0005-DWQ (or superseding renewal order) identifies Phase II small MS4 dischargers and requires them to develop and implement a Stormwater Management Plan/Program with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). In addition to the Navy, the Phase II small MS4 dischargers identified in the Chollas Creek watershed include the Lemon Grove, La Mesa, and San Diego School Districts. Currently, none of the school districts are enrolled under the general NPDES requirements.

MEP is the performance standard specified in section 402(p) of the CWA. The management programs specify what BMPs will be used to address certain program areas. The program areas include public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping for municipal operations. In general, medium and large municipalities are required to conduct chemical monitoring, though small municipalities are not.

The San Diego Water Board shall require the school districts in the Chollas Creek watershed, subject to these TMDLs, to submit Notices of Intent[60] to comply with the requirements of Order No. 2003-0005-DWQ, immediately upon adoption of these TMDLs. Once enrolled under the order, the school districts will be required to comply with the provisions of the order to reduce the discharge of copper, lead and zinc to the MEP as specified in their Stormwater Management Plans/Programs. Please see Table 11.3 for more details.

12. New Facilities

All new facilities in the Chollas Creek watershed enrolling for regulation under existing NPDES WDRs for the first time, will not be given a compliance schedule for their discharge to meet the WQBELs that implement the WLAs of this TMDL. Upon initiation of enrollment, their discharge must be in compliance with the WQBELs.

[60] The Notice of Intent, or NOI, is attachment 7 to Order No. 2003-0005-DWQ.

11.6 Compliance Schedule

The Compliance Schedule is shown in Table 11.3. This schedule includes the implementation actions of the San Diego Water Board and the dischargers discussed in the preceeding sections, the due dates for those actions, and the interim and final allowable exceedances of the WLAs.

TABLE 11.3 Compliance schedule.

Item	Implementation Action	Responsible Parties	Date
1	Effective date of Chollas Creek Metals TMDL Waste Load Allocations.	San Diego Water Board, Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	October 22, 2008[61]
2	Recommend High Priority for grant funds.	San Diego Water Board	Immediately after effective date
3	Submit annual Progress Report to San Diego Water Board due January 1 of each year.	Municipal Dischargers	Annually after reissue of NPDES WDRs.
4	Submit annual Progress Report to San Diego Water Board due April 1 of each year.	Caltrans	Annually after reissue of NPDES WDRs.
5	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Industrial Stormwater Dischargers	Annually after reissue of NPDES WDRs.
6	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Construction Stormwater Dischargers	Annually after reissue of NPDES WDRs.
7	Municipal NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
8	Caltrans NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
9	Construction NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
10	Industrial NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
11	Amend Orders No. 2000-90, and No. 2001-96 (or superseding renewal orders) which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date

[61] Upon approval of by OAL.

Item	Implementation Action	Responsible Parties	Date
12	Municipal and Navy WDR Order No. R9-2004-0277 shall amended to require additional monitoring for metals and hardness.	San Diego Water Board	Within 5 years of effective date
13	Landfill NPDES WDR Order No. 97-11 (or superseding renewal orders) shall be issued, reissued, or revised to monitor for metals and hardness.	San Diego Water Board	Within 5 years of effective date
14	Navy and all other Phase II small MS4 permittees in the Chollas Creek watershed shall be enrolled in Order No. 2003-0005-DWQ (or superseding renewal orders).	San Diego Water Board	Immediately after effective date.
15	Take enforcement actions	San Diego Water Board	As needed after effective date.
16	Meet 80% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	10 years after effective date.
17	Meet 100% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	20 years after effective date.

12 Implementation Monitoring Plan

This section describes an Implementation Monitoring Plan to assess the success of the implementation plan presented in section 10 in 1) achieving the copper, lead, and zinc wasteload allocations and 2) attaining copper, lead, and zinc water quality objectives in Chollas Creek. The plan assigns monitoring responsibilities and describes key milestones.

12.1 Regulatory Authority for Implementation Monitoring Plan

Basin Plans must have a program of implementation to achieve WQOs.[62] The implementation program must include a description of actions that are necessary to achieve WQOs, a time schedule for these actions, and a description of "surveillance" to determine compliance with the water quality objectives.[63] The term "surveillance" in a TMDL context refers to an implementation monitoring plan designed to measure the effectiveness of the TMDL point and nonpoint source control measures and the progress the waterbody is making toward attaining WQOs. Such a plan would necessarily include collection of water quality data. State law requires that a TMDL include an implementation monitoring plan because the TMDL normally is, in essence, an interpretation or refinement of an existing WQO. The TMDL must be incorporated into the Basin Plan,[64] and, because the TMDL supplements, interprets, or refines an existing WQO, state law requires an implementation monitoring plan be included to determine the success of the implementation plan measures

Water Code section 13267 provides that the San Diego Water Board can require any person who has discharged, discharges, proposes to discharge or is suspected of discharging waste to investigate, monitor, and report information. The only restriction is that the burden of preparing the reports bears a reasonable relationship to the need for and the benefits to be obtained from the reports.

Water Code section 13383 provides that the San Diego Water Board may establish monitoring requirements for any person who discharges, or proposes to discharge, pollutants to navigable waters of the U.S. Order No. R9-2004-0277, issued by the San Diego Water Board pursuant to section 13383, requires the Municipal Dischargers and Caltrans to conduct an investigation and monitoring program for diazinon, copper, lead, and zinc in Chollas Creek.

12.2 Monitoring Objectives

The specific objectives of this Implementation Monitoring Plan are as follows:

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[62] See CWC section 13050(j). A "Water Quality Control Plan" or "Basin Plan" consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) WQOs and (3) A program of implementation needed for achieving water quality objectives.

[63] See CWC section 13242.

[64] See CWA section 303(e).

1. Establish a monitoring program for Chollas Creek and its tributaries using monitoring, sampling and analytical methods consistent with the State Water Board Surface Water Ambient Monitoring Program (SWAMP); SWAMP data quality assurance protocols; and SWAMP data management;

2. Characterize baseline conditions in Chollas Creek and its tributaries with respect to metals to place future monitoring data into perspective and document progress towards cleaner water;

3. Track changes in water quality over time in Chollas Creek and its tributaries with respect to metals and enable comparison of baseline data and TMDL project target values with conditions. Determine whether the "trajectory" of the measured water quality values points toward attainment of the copper, lead, and zinc WQOs;

4. Evaluate the effectiveness of the TMDL implementation actions over time and determine the need for revisions to improve the implementation plan;

5. Provide the monitoring data needed to verify or refine assumptions, resolve uncertainties, and improve the scientific foundation of the TMDL. This includes the metals, hardness, and flow data necessary to refine land use wash-off models to more accurately estimate copper, lead, and zinc mass loads from the Chollas Creek watershed; and

6. Provide the monitoring data needed to evaluate the overall TMDL implementation effectiveness and success in attaining copper, lead, and zinc WQOs in Chollas Creek and its tributaries.

12.3 San Diego Water Board Actions

1. Review Order No. R9-2004-0277[65] - This Order requires the Municipal Dischargers to submit monitoring program reports for copper, lead, zinc, calcium carbonate, and diazinon monitoring in Chollas Creek. The San Diego Water Board will review the Order to ensure that all elements of the Implementation Monitoring Plan for this TMDL Project are being addressed in the Order. Furthermore, the San Diego Water Board will research the data requirements to refine the watershed wash-off models to provide more accurate estimates of the mass loads of copper, lead, and zinc leaving the Chollas Creek Watershed on an annual basis. If necessary, Order No. R9-2004-0277 will be amended to include additional monitoring.

2. Amend Order No. R9-2004-0277, if Necessary, to Require Submission of Revised Monitoring and Reporting Program Plan - If the monitoring and reporting

[65] Order No. R9-2004-0277, Investigation Order issued to California Department Of Transportation and San Diego Municipal Separate Storm Sewer System Copermittees Responsible for the Discharge Of Diazinon into the Chollas Creek Watershed, San Diego, California

program ongoing in Chollas Creek is inadequate to fulfill the monitoring objectives listed is section 12.2, Order No. R9-2004-0277 shall be amended to require Caltrans and the Municipal Dischargers to prepare and submit a revised Implementation Monitoring and Reporting Program Plan containing the additional elements described in section 12.5 Implementation Monitoring Plan Elements below. Caltrans and the Municipal Dischargers shall be required to implement the revised Implementation Monitoring Plan in accordance with the revised order. The San Diego Water Board may further amend this order at any time.

12.4 Municipal Dischargers and Caltrans Actions

1. Prepare and Submit Monitoring Plan, if Required - The Municipal Dischargers and Caltrans shall collaborate to prepare and submit a revised Implementation Monitoring Plan for the Chollas Creek watershed containing the elements described in section 12.5 Implementation Monitoring Plan Elements below, upon order of the San Diego Water Board pursuant to CWC section 13383. The revised Implementation Monitoring Plan shall be modified as required by the San Diego Water Board.

2. Implement Monitoring Plan - The Municipal Dischargers and Caltrans shall implement the revised Implementation Monitoring Plan upon order of the San Diego Water Board pursuant to CWC section 13383. The San Diego Water Board may amend this order at any time.

12.5 Revised Implementation Monitoring Plan Elements

The revised Implementation Monitoring Plan shall contain the following elements:

1. The data necessary to refine the watershed wash-off models, to provide more accurate estimates of the mass loads of copper, lead, and zinc leaving the Chollas Creek Watershed on an annual basis. This is likely to include, at a minimum, measurements of calcium carbonate, copper, lead, zinc and flow during dry weather.

2. Additional dry and wet weather monitoring. The San Diego Water Board has worked with SCCWRP to identify data gaps and has collected samples as part of the development of the TMDL for metals in San Diego Bay at the mouth of Chollas Creek.

3. All monitoring shall concurrently sample for both hardness and metals. Hardness analysis will be conducted on unfiltered samples according to Standard Method 2340-B at a detection level 1 mg/L $CaCO_3$. Analysis for dissolved metals will be conducted on filtered samples using trace metal clean analytical and sampling methods. To ensure detection limits are low enough to compare to the wasteload allocations, USEPA methods 1638 and 1669 shall be used. Equivalent

methods with equal or lower detection limits may be used after approval by the San Diego Water Board.

Until Order No. R9-2004-0277 is amended, all monitoring and reporting requirements are in full force and effect. Most, if not all, of the existing requirements will be unchanged if the order is amended.

13 Environmental Analysis, Checklist, and Economic Factors

The San Diego Water Board must comply with the California Environmental Quality Act (CEQA) when amending the Basin Plan as proposed in this project to adopt TMDLs for copper, lead, and zinc in Chollas Creek. Under the CEQA, the San Diego Water Board is the Lead Agency for evaluating the environmental impacts of the reasonably foreseeable methods of compliance with the proposed TMDLs. The following section summarizes the environmental analysis conducted to fulfill the CEQA requirements. The complete Environmental Analysis, Checklist and Economic Factors are discussed in detail in Appendix I.

13.1 California Environmental Quality Act Requirements

The CEQA authorizes the Secretary of the Resources Agency to certify state regulatory programs, designed to meet the goals of the CEQA, as exempt from its requirements to prepare an Environmental Impact Report (EIR), Negative Declaration, or Initial Study. The State Water Board's and San Diego Water Board's Basin Plan amendment process is a certified regulatory program and is therefore exempt from the CEQA's requirements to prepare such documents.[66]

The State Water Board's CEQA implementation regulations[67] describe the environmental documents required for Basin Plan amendment actions. These documents consist of a written report that includes a description of the proposed activity, alternatives to the proposed activity to lesson or eliminate potentially significant environmental impacts, and identification of mitigation measures to minimize any significant adverse impacts.

The CEQA and CEQA Guidelines limit the scope to an environmental analysis of the reasonably foreseeable methods of compliance with the WLAs and LAs. The State Water Board CEQA Implementation Regulations for Certified Regulatory Programs[68] require the environmental analysis to include at least the following:

1. A brief description of the proposed activity. In this case, the proposed activity is the TMDL Basin Plan amendment.

2. Reasonable alternatives to the proposed activity.

3. Mitigation measures to minimize any significant adverse environmental impacts of the proposed activity.

Additionally, the CEQA[69] and CEQA Guidelines[70] require the following components, some of which are repetitive of the list above:

[66] 14 CCR section 15251(g) and Public Resources Code section 21080.5.
[67] 23 CCR section 3720 et seq. "Implementation of the Environmental Quality Act of 1970."
[68] Ibid.
[69] Public Resources Code section 21159(a)
[70] 14 CCR section 15187(c)

1. An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.

2. An analysis of the reasonably foreseeable feasible mitigation measures relating to those impacts.

3. An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts.

Additionally, the CEQA Guidelines require the environmental analysis take into account a reasonable range of:[71]

1. Environmental factors
2. Economic factors
3. Technical factors
4. Population
5. Geographic areas
6. Specific sites

13.2 Analysis of Reasonably Foreseeable Methods of Compliance

The analysis of potential environmental impacts is based on the numerous alternative means of compliance available for controlling copper, lead, and zinc loading to Chollas Creek. The majority of metals discharged into the Chollas Creek watershed result from stormwater runoff of metals from freeway surfaces and commercial/institutional land uses. Attainment of the WLAs will be achieved through discharger implementation of structural and nonstructural control strategies designed to reduce metals loading in urban runoff. The controls evaluated in Appendix I include:

1. Education and Outreach
2. Road and Street Maintenance
3. Illicit Discharges
4. Inspections
5. Development/Enforcement of Local Ordinances
6. Vegetated Swales and Buffer Strips
7. Bioretention
8. Detention Basins
9. Retention Ponds
10. Sand Filters
11. Diversion Systems
12. Porous Pavement
13. Infiltration Systems

Structural and non-structural control strategies can be based on specific land uses, sources, or periods of a storm event. In order to comply with these TMDLs, emphasis

[71] 14 CCR section 15187(d) and Public Resources Code section 21159(c)

should be placed on Best Management Practices (BMPs) that control the sources of pollutants and on the maintenance of BMPs that remove pollutants from runoff.

13.3 Possible Environmental Impacts

The CEQA[72] and CEQA Guidelines [73] require an analysis of the reasonably foreseeable environmental impacts of the methods of compliance with the TMDL Basin Plan amendment. The Environmental Checklist identifies the potential environmental impacts associated with these methods with respect to earth, air, water, plant life, animal life, noise, light, land use, natural resources, risk of upset, population, housing, transportation, public services, energy, utilities and services systems, human health, aesthetics, recreation, and archeological/historical concerns.

From the 61 reasonably foreseeable environmental impacts identified in the checklist none were considered to be "Potentially Significant." Forty nine were considered either "Less Than Significant with Mitigation" or "Less Than Significant." Twelve were considered to have "No Impact" on the environment. See sections 4 and 5 in Appendix I for a complete discussion of the potential environmental impacts.

In addition to the potential impacts mentioned above, mandatory finding of significance regarding short-term, long-term, cumulative, and substantial impacts were evaluated. Based on this review, the San Diego Water Board concluded that the potentially significant cumulative impacts can be mitigated to less than significant levels as discussed in Appendix I.

13.4 Alternative Means of Compliance

The CEQA requires an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts.[74] The dischargers can use the structural and non-structural BMPs described in Appendix I or other structural and non-structural BMPs, to control and prevent pollution, and meet the TMDLs' required load reductions. The alternative means of compliance with the TMDLs consist of the different combinations of structural and non-structural BMPs that the dischargers might use. Since most of the adverse environmental effects are associated with the construction and installation of large scale structural BMPs, to avoid or eliminate impacts, compliance alternatives should minimize structural BMPs, maximize non-structural BMPs, and site, size, and design structural BMPs in ways to minimize environmental effects.

13.5 Reasonably Foreseeable Methods of Compliance at Specific Sites

The most reasonably foreseeable method of compliance with this Basin Plan amendment establishing TMDLs for copper, lead, and zinc is through the implementation of BMPs. The types of BMPs suitable for different specific sites in the watershed depend on the

[72] Public Resources Code section 21159(a)
[73] 14 CCR section 15187(c)
[74] 14 CCR section 15187 (c) (3)

land use at the site, particularly as it relates to population density and the amount of vehicular traffic. In open space areas, and residential areas, where vehicular traffic is lower than other land uses, non-structural BMPs alone may be adequate to reduce metals loading. Appropriate non-structural BMPs include street sweeping, development and enforcement of municipal ordinances prohibiting exposure of copper, lead, and zinc materials to stormwater, and development and enforcement of municipal ordinances prohibiting nuisance flows. However, in commercial/institutional and roadways land use areas, both structural and non-structural BMPs likely will be needed. Appropriate structural BMPs include vegetated swales and buffer strips, detention basins and retention ponds, sand filters, diversion systems, porous pavement/infiltration systems, and bioretention.

13.6 Economic Factors

The environmental analysis required by the CEQA must take into account a reasonable range of economic factors. This section contains estimates of the costs of implementing the reasonably foreseeable methods of compliance with the TMDL Basin Plan amendment. Specifically, this analysis estimates the costs of implementing the structural and non-structural BMPs which the dischargers could use to reduce copper, lead, and zinc loading to Chollas Creek in 10 percent of the watershed.

As discussed in section 7 in Appendix I, the cost estimates for non-structural BMPs ranged from $0 to $200,000. The cost estimates for treating 10 percent of the watershed with structural BMPs ranged from $960,000 to $490 million with yearly maintenance costs estimated from $10,000 to $2 million.

Implementation of these TMDLs will also entail water quality monitoring which has associated costs. Assuming that a two-person sampling team can collect samples at 5 sites per day, the total cost for one day of sampling would be $1,907.

The specific BMPs to be implemented will be chosen by the dischargers after adoption of these TMDLs. All costs are preliminary estimates since particular elements of a BMP, such as type, size, and location, would need to be developed to provide a basis for more accurate cost estimations.

13.7 Reasonable Alternatives to the Proposed Activity

The environmental analysis must include an analysis of reasonable alternatives to the proposed activity.[75] The proposed activity is a Basin Plan Amendment to incorporate TMDLs for copper, lead, and zinc in Chollas Creek. The purpose of this analysis was to determine if there is an alternative that would feasibly attain the basic objective of the rule or regulation (the proposed activity), but would lessen, avoid, or eliminate any identified impacts. The alternatives analyzed included taking no action and modifying water quality standards in Chollas Creek. In addition, two alternative time schedules for implementing load reductions to meet the TMDL were analyzed.

[75] 23 CCR section 3777

Taking no action and modifying water quality standards in Chollas Creek do not meet the objective of the TMDLs and are therefore, not feasible. Of the two compliance schedule alternatives, the longer 20-year schedule is the preferred alternative because it allows the dischargers time to choose cost effective and low-impact BMPs that are designed to remove a comprehensive suite of pollutants, not just copper, lead, and zinc. These alternative actions and time schedules are discussed in section 8 of Appendix I.

14 Necessity of Regulatory Provisions

The OAL is responsible for reviewing administrative regulations proposed by state agencies for compliance with standards set forth in California's Administrative Procedure Act, Government Code section 11340 et seq., for transmitting these regulations to the Secretary of State and for publishing regulations in the California Code of Regulations (CCR). Following State Water Board approval of this Basin Plan amendment establishing TMDLs, any regulatory portions of the amendment must be approved by OAL per Government Code section 11352. The State Water Board must include in its submittal to OAL a summary of the necessity[76] for the regulatory provision.

This Basin Plan amendment for Chollas Creek meets the "necessity standard" of Government Code section 11353(b). Amendment of the Basin Plan to establish and implement copper, lead, and zinc TMDLs in Chollas Creek is necessary because the existing water quality does not meet applicable numeric WQOs for these metals. Applicable state and federal laws require the adoption of this Basin Plan amendment and regulations as provided below.

The State and Regional Water Boards are delegated the responsibility for implementing California's Porter Cologne Water Quality Control Act and the federal CWA. Pursuant to relevant provisions of both of those acts the State and Regional Water Boards establish WQSs, including designated (beneficial) uses and criteria or objectives to protect those uses.

Section 303(d) of the CWA [33 USC section 1313(d)] requires the states to identify certain waters within their borders that are not attaining WQSs and to establish TMDLs for certain pollutants impairing those waters. USEPA regulations in Title 40 of the CFR section 130.2 provide that a TMDL is a numerical calculation of the amount of a pollutant that a water body can assimilate and still meet standards. A TMDL includes one or more numeric targets that represent attainment of the applicable standards, considering seasonal variations and a MOS, in addition to the allocation of the target or load among the various sources of the pollutant. These include WLAs for point sources and LAs for nonpoint sources and natural background. TMDLs established for impaired waters must be submitted to the USEPA for approval.

CWA section 303(e) requires that TMDLs, upon USEPA approval, be incorporated into the State's Water Quality Management Plans, along with adequate measures to implement all aspects of the TMDL. In California, these are the basin plans for the nine regions. CWC sections 13050(j) and 13242 require that basin plans have a program of implementation to achieve WQOs. The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the

[76] "Necessity" means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, provision of law that the regulation implements, interprets, or makes, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion. [Government Code section 11349(a)].

objectives. State law requires that a TMDL project include an implementation plan because TMDLs normally are, in essence, interpretations or refinements of existing WQOs. The TMDLs have to be incorporated into the Basin Plan [CWA section 303(e)], and, because the TMDLs supplement, interpret, or refine existing objectives, state law requires a program of implementation.

15 Public Participation

Public participation is an important component of TMDL development. The federal regulations [40 CFR 130.7] require that TMDL projects be subject to public review. All public hearings and public meetings have been conducted as stipulated in the regulations [40 CFR 25.5 and 40 CFR 25.6, respectively], for all programs under the CWA. Public participation was provided through four public workshops, numerous stakeholder group meetings and communications, and public presentations and participation at relevant conferences. In addition, staff contact information was provided on the San Diego Water Board's web site, along with periodically updated drafts of TMDL project documents throughout the development process. Public participation will also occur through the San Diego Water Board's Basin Plan amendment process, which includes a public workshop and formal public comment period. A chronology of public participation and major milestones is provided in Table 16.1 below:

TABLE 16.1. Public Participation Milestones

Date	Event
May 2000–Ongoing	Web Site – Information including drafts of the technical report and contact information were made available on the San Diego Water Board's web site.
August 1999	Public Workshop
December 1999	Public Workshop
May 2000	Public Workshop
March 2003	Public Workshop and CEQA Scoping Meeting
March 17, 2005	Informal Public Review
March 28, 2005	Release draft for formal Public Review
April 28, 2005	Public Workshop
May 11, 2005	Public Hearing
May 18, 2005	Informal meeting with interested parties to discuss the compliance schedule
June 29, 2005	Deliberation and adoption
July 25, 2006	Re-release draft for formal Public Review
March 9, 2007	Re-release draft for formal Public Review
April 25, 2007	Public Hearing
June 13, 2007	Public Hearing, deliberation, and adoption

16 References

Besser, J. M., W.G. Brumbaugh, T.W. May, S.E. Church and B.A. Kimball, *Bioavailability of metals in stream food webs and hazards to brook trout (Salvelinus fontinalis) in the Upper Animas River Watershed, Colorado*. Arch Environ Contam Toxicol 40 (2001), pp. 48–59.

Birch, G. F. and A. Scollen. *Heavy metals in road dust, gully pots and parkland soils in a highly urbanized sub-catchment of Port Jackson, Australia*. Australian Journal of Soil Research, 41(7): 1329 – 1342. December, 2003.

Brown and Caldwell. *Fresno Nationwide Urban Runoff Program Project, 1984*. Prepared for Fresno Metropolitan Flood Control District. May 1984. (See Appendix B, Table B2-1 in Woodward-Clyde 1992. Source Identification and Control Report, Santa Clara Valley Nonpoint Source Pollution Control Program. December 1, 1992.

Brannian, S. City of San Diego Water Department. *personal communication*, July 2000.

Buffle, J. *Complexation reactions in aquatic systems: an analytical approach*. Chichester. Ellis Horwood. 1988.

Caltrans. BMP Retrofit Pilot Program, Final Report, Report ID CTSW-RT-01-050, January 2004

Chaffin, John. Water Quality Superintendent, The City of San Diego Water Department. *personal communication*. January 2005.

City of San Diego. *Consumer Confidence Report 2001*: *Water Quality Report and Information*. The City of San Diego Water Department. San Diego, CA. February 19, 2003.

City of San Diego. *Consumer Confidence Report 2002*. The City of San Diego Water Department. San Diego, CA. 2002.

City of San Diego. *San Diego Water Department Watershed Sanitary Survey*. The City of San Diego Water Department. San Diego, CA. 2003.

City of San Diego, *San Diego Water Department Frequently Asked Questions*. The City of San Diego Water Department Website: http://www.sandiego.gov/water/quality/index.shtml#f accessed March 28, 05.

Connick, S. (Facilitator). *Copper Use Monitoring Program Results for Model Years 1998-2002*. Brake Pad Partnership Project, Sustainable Conservation. San Francisco, CA. 2004.

Department of Pesticide Regulation. *2002 Annual Pesticide Use Report Indexed by Commodity for San Diego County.* http://www.cdpr.ca.gov/docs/pur/pur02rep/comcnty/sandieo02.pdf

Desert Research Institute. *Southern California Climate Summaries*. Western Regional Climate Center. 2003.

Di Toro, D.M., H.E. Allen, H.L. Bergman, J.S. Meyer, P.R. Paqiun, and R.C. Santore. *A biotic ligand model of the acute toxicity of metals. I. Technical basis*. Environ. Tox. Chem. 20 (2001): 2383-2396. 2001.

King. A., 2002. *A Time-Series Analysis of the Bi-national Tijuana River Watershed: Using BASINS To Understand the Flow and Loading of Fecal Coliforms.* A Thesis Presented to the Faculty of San Diego State University In Partial Fulfillment of the Requirements for the Degree Master of Public Health. Spring 2002.

Kinnetic Laboratories, Incorporated. City of San Diego and Co-Permittee Stormwater Monitoring Program 1994-1995. July 1995.

Kinnetic Laboratories, Incorporated and ToxScan Incorporated. *1993-1994 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program*. July 29, 1994.

Kszos, L. A., G. W Morris, and B. K. Konetsky. *Source of Toxicity in Stormwater: Zinc from Commonly Used Paint*. Environmental Toxicology and Chemistry, Vol 23, No. 1, pp. 12-16. SETAC Press, USA. 2004.

MacDonald, DD, RS Carr, FD Calder, ER Long and CG Ingersoll. *Development and Evaluation of Sediment Quality Guidelines for Florida Coastal Waters. Ecotoxicology,* 5: 253-278. 1996.

MacDonald, DD, CG Ingersoll and T. Berger. *Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems*. Arch. Environ. Contam. Toxicol. 39: p. 20-31. 2000.

MacDonald, D.D., C.G. Ingersoll, D.E. Smorong, R.A. Lindskoog, G. Sloane and T. Biernacki. *Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters*. Technical Report. Prepared for Florida Department of Environmental Protection. January 2003.

MEC Analytical Systems, Inc. *Draft Report 2000-2001 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program, Volume 1*. June 2001.

Metcalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse.* Third Edition. Irwin McGraw-Hill, San Francisco, CA. 1991.

Moore, J.W. and S. Ramamoorthy. *Aromatic Hydrocarbons-Polycyclics.* Organic Chemicals in Natural Waters: Applied Monitoring and Impact Assessment. Springer-Verlag, New York, NY. p. 67-87. 1984.

Muschack, Werner. *Pollution of Street Run-off by Traffic and Local Conditions.* The Science of the Total Environment, 93: 419-431. 1990.

O'Brien, E. *Final Report to the Arco Foundation from Sustainable Conservation, Working In Urban Watersheds: Industry Analyses Auto Recycling, Scrap Processing, Tires, and Marine Paint*. January 2000.

RWQCB. *Total Maximum Daily Load for Selenium in the Lower San Joaquin River.* Regional Water Quality Control Board – Central Valley Region. August 2001.

RWQCB. *Clear Lake TMDL for Mercury Staff Report.* Regional Water Quality Control Board – Central Valley Region. February 2002.

SANDAG. *2020 Cities/County Forecast for the Chollas Hydrologic Basin (908.22).* San Diego Association of Governments. February 1999.

San Diego Water Board. *Water Quality Control Plan for the San Diego Basin (9).* San Diego, CA. 1994.

Sansalone, J. J. and S. G. Buchberger. *Partitioning and First Flush of Metals in Urban Roadway Storm Water.* Journal of Environmental Engineering, pp 134-143. 1997.

SCCWRP. Southern California Coastal Waters Research Project, *Characterization of Stormwater Toxicity in Chollas Creek, San Diego*. SCCWRP. Westminster, CA. 1999.

Schiff, K., S. Bay and C. Stransky. *Characterization of stormwater toxicity from Chollas Creek, San Diego*. In Weishberg, S. and D. Elmore (eds) Southern California Coastal Water Research Project Annual Report 1999-2000. Westminster, CA. pp 71-84. 2001.

Shaheen, D. G. *Contributions of Urban Roadway Usage to Water Pollution.* USEPA Office of Research and Development. EPA-600/2-75-004. Washington, D.C. 1975.

Smith, S.L., D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and J. Field. *A preliminary evaluation of sediment quality assessment values for freshwater ecosystems.* Journal of Great Lakes Research 22:624-638. 1996.

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman, and W.A. Brungs. *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses*. USEPA, Washington, D.C. NTIS No. PB85-227049. 1985.

Stolzenbach, R. L., C. Xiong, S. Freidlander, R. Turco, K. Schiff and L. Tiefenthaler, *Measuring and Modeling of Atmospheric Deposition on Santa Monica Bay and the Santa Monica Bay Watershed*. Final Report to the Santa Monica Bay Restoration Project. Institute of the Environment University of California, Los Angeles and the Southern California Coastal Water Research Project. Los Angeles and Westminster, CA. 2001.

State Water Board, 2004. *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, 2004*. State Water Resources Control Board, September 2004.

Taylor and Francis. *Fundamentals of Aquatic Toxicology, Effects, Environmental Fate, and Risk Assessment*, Second Edition. Edited by Gary M. Rand. 1995. Pages 28-29.

URS Greiner Woodward Clyde. *1998–1999 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report*. August 10, 1999.

URS Greiner Woodward Clyde. *1999-2000 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report*. August 11, 2000.

USEPA, 2000a. *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health.* EPA-822-B-00-004. Office of Water. Oct. 2000.

USEPA, 2001. *Total Maximum Daily Loads for Toxic Pollutants – San Diego Creek and Newport Bay, California.* United States Environmental Protection Agency - Region 9. June 14, 2002.

USEPA. *2003 Draft Update of Ambient Water Quality Criteria for Copper. EPA-822-R-03-026*. Office of Water. November 2003.

USEPA. California Toxics Rule [CTR]. *Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California*; Federal Registry Rule – 40 CFR Part 131. May 28, 2002.

USEPA. *Guidance for Developing TMDLs in California.* USEPA Region 9. January 7, 2000.

USEPA. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-93-001c. Office of Water. United States Environmental Protection Agency. Washington, DC. January 1993.

USEPA. *Interim Guidance on the Determination and Use of the Water-Effect Ratios for Metals*. Incorporated into the Second Edition of the Water Quality Standards Handbook, Appendix L. USEPA 823-B-94-001. February 22, 1994.

USEPA. *National Menu of Best Management Practices for Stormwater-Phase II*, http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/poll_10.cfm. 1999.

USEPA. *Total Maximum Daily Loads For Pollutants San Diego Creek and Newport Bay, California*. Water Division, EPA Region 9. April 2002.

USEPA. *Update of Ambient Water Quality Criteria for Cadmium*. EPA-823-B-00-007. Office of Water. April 2001.

USF&W. *Guidelines for Interpretation of the Biological Effect of Selected Constituents in Biota, Water and Sediment*. National Irrigation Water Quality Program. US Department of Interior Report. 1998.

Wang, Hsiao-Chiu. Principal Chemist, Metropolitan Water District of Southern California, *personal communication*. January 2005.

Wilen, Cheryl A. *Survey of Residential Pesticide Use in the Chollas Creek Area of San Diego County and Delhi Channel of Orange County, California*. University of California Statewide IPM Project, UC Cooperative Extension, September 2002.

Woodward-Clyde Consultants. *Source Identification and Control Report prepared for the Santa Clara Valley Nonpoint Source Pollution Control Program.* Oakland, CA. December 1, 1992.

Woodward-Clyde Consultants. 1995-1996 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program. August 9, 1996.

Woodward-Clyde Consultants. *Metals Control Measures Plan (Volume I) and Evaluation of Nine Metals of Concern (Volume II).* Prepared for the Santa Clara Valley Nonpoint Source Pollution Control Program. Oakland, CA. February 12, 1997.

Woodward-Clyde International-Americas. 1996-1997 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report. August 8, 1997.

Woodward-Clyde International-Americas. 1997-1998 City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report. August 10, 1998.

Appendix A
Data

Used in the Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

May 30, 2007

Appendix A: Chollas Creek Metals (Cd) Data

Station ID	Sample Date	Total Hardness as $CaCO_3$ (mg/L)		Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF	CCC Freshwater CF	EMC (ug/L)	Reporting Limit (ug/L)	Reference
				Dissolved Cadmium (ug/L)			Acute Dissolved Cadmium	Chronic Dissolved Cadmium	Total Cadmium		
11-87	2/12/2000	-	<	0.2	0.1	0.20	#VALUE!	#VALUE!	1.3	0.20	v
11-87	2/23/2000	-	=	0.3	0.3	0.20	#VALUE!	#VALUE!	0.7	0.20	v
11-87	3/5/2000	-	<	0.2	0.1	0.20	#VALUE!	#VALUE!	<.2 U	0.20	v
11-87	4/17/2000	-	=	0.3	0.3	0.20	#VALUE!	#VALUE!	1	0.20	v
Allways Recycling	4/12/1999	NA					#VALUE!	#VALUE!	9		s
north fork	3/15/1999	90.8	<	0.30	1.00	2.00	0.948	0.913038713	NA	-	o
north fork	3/25/1999	68	<	2.00	1.00	2.00	0.960	0.925136237	NA	-	o
north fork	4/6/1999	110	<	2.00	1.00	2.00	0.940	0.905013302	NA	-	o
SD8(1)	2/17/1994	120	=	1.40	1.40	0.20	0.936	0.90137292	1.5	0.2	k
SD8(1)	3/24/1994	71	=	1.63	1.63	0.20	0.958	0.923329999	1.7	0.2	k
SD8(1)	4/24/1994	110	=	1.13	1.13	0.20	0.940	0.905013302	1.2	0.2	k
SD8(1)	11/10/1994	150	=	0.46	0.46	0.20	0.927	0.892037041	0.5	0.2	a
SD8(1)	1/11/1995	58	=	0.77	0.77	0.20	0.967	0.931791185	0.8	0.2	a
SD8(1)	2/14/1995	100	=	1.60	1.60	0.20	0.944	0.90900089	1.7	0.2	a
SD8(1)	4/16/1995	120	=	2.34	2.34	0.20	0.936	0.90137292	2.5	0.2	a
SD8(1)	11/1/1995	91	=	0.57	0.57	0.25	0.948	0.91294666	0.6	0.25	b
SD8(1)	1/22/1996	74.5	<	0.25	0.125	0.25	0.956	0.921316786	NA	-	b
SD8(1)	1/31/1996	52.2	<	0.25	0.125	0.25	0.971	0.936199259	NA	-	b
SD8(1)	3/5/1996	78.6	=	0.44	0.44	0.25	0.954	0.919075417	NA	-	b
SD8(1)	12/9/1996	57.4	=	0.5	0.5	0.50	0.967	0.932226246	0.6	0.5	i
SD8(1)	1/16/1997	61.5	=	1.2	1.2	0.50	0.964	0.929339723	0.7	0.5	i
SD8(1)	11/10/1997	116	=	0.28	0.28	0.25	0.938	0.902791294	0.3	0.25	c
SD8(1)	12/6/1997	39.0	<	3.93	2.00	4.00	0.983	0.948395908	<4.0	4	c
SD8(1)	3/14/1998	96.4	<	3.78	2.00	4.00	0.946	0.910534838	<4.0	4	c
SD8(1)	11/8/1998	77	=	1.91	1.91	0.25	0.955	0.919935869	2	0.25	d
SD8(1)	1/25/1999	42.5	<	0.24	0.13	0.25	0.980	0.944800248	<0.25	0.25	d
SD8(1)	3/15/1999	90.8	<	0.24	0.13	0.25	0.948	0.913038713	<0.25	0.25	d
SD8(1)	3/15/1999	85	<	0.24	0.13	0.25	0.951	0.915800357	<0.25	0.25	d
SD8(1)	2/12/2000	40.9	<	0.25	0.13	0.25	0.981	0.94640574	<.25	0.25	e
SD8(1)	2/20/2000	35.1	<	0.25	0.00		0.988	0.952803981	2		h
SD8(1)	3/5/2000	45.5	<	0.25	0.13	0.25	0.977	0.941946552	<0.25	0.25	e
SD8(1)	10/27/2000	85	<	1	0.13	0.25	0.951	0.915800357	<1	0.25	f
SD8(1)	1/8/2001	78	<	1	0.13	0.25	0.954	0.919396016	<1	0.25	f
SD8(1)	2/13/2001	59	<	1	0.13	0.25	0.966	0.931075988	<1	0.25	f
SD8(1)	11/29/2001	68	<	1	0.50	1.00	0.960	0.925136237	1	1	j
SD8(1)	2/17/2002	111	<	1	0.50	1.00	0.940	0.904634675	1	1	j
SD8(1)	3/8/2002	148	<	1	0.50	1.00	0.928	0.892598633	1	1	j
SD8(1)	11/8/2002	69.1	<	1	0.50		0.959	0.924464861	<1		w
SD8(1)	2/11/2003	78	<	1	0.50		0.954	0.919396016	<1		w
SD8(1)	2/25/2003	44	<	1	0.50		0.978	0.943349074	<1		w
SD8(2)	2/12/2000	58	<	2	1.00	2.00	0.967	0.931791185	<2	2	h
SD8(2)	2/21/2000	47	<	2	1.00	2.00	0.976	0.940589525	<2	2	h
SD8(3)	2/12/2000	54	<	2	1.00	2.00	0.970	0.934780885	<2	2	h
SD8(3)	2/21/2000	36	<	2	1.00	2.00	0.987	0.951744735	<2	2	h
SD8(4)	2/12/2000	190	<	0.2	0.10	0.20	0.917	0.882147007	1.3	0.2	h [1]
SD8(4)	2/23/2000	232	=	0.3	0.30	0.20	0.909	0.873791402	0.7	0.2	h [1]
SD8(5)	2/12/2000	100	<	2	1.00	2.00	0.944	0.90900089	<2	2	h
SD8(5)	2/21/2000	63	<	2	1.00	2.00	0.963	0.928331529	<2	2	h
SD8(6)	2/12/2000	120	<	2	1.00	2.00	0.936	0.90137292	<2	2	h
SD8(6)	2/21/2000	100	<	2	1.00	2.00	0.944	0.90900089	<2	2	h
unknown	6/4/1991	484	<	1.0	0.50		0.878	0.843025932	<1		l
unknown	3/12/1992	472	<	1.0	0.50		0.879	0.844076313	<1		m

Appendix A: Chollas Creek Metals (Cd) Data

Station ID	Sample Date	Total Hardness as $CaCO_3$ (mg/L)	Dissolved Cadmium (ug/L)				CMC Freshwater CF	CCC Freshwater CF	Total Cadmium		Reference
				Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	Acute Dissolved Cadmium	Chronic Dissolved Cadmium	EMC (ug/L)	Reporting Limit (ug/L)	
unknown	3/19/1992	1050	<	1.0	0.50		0.846	0.810624052	<1		n
unknown	3/19/1992	1040	<	1.0	0.50		0.846	0.811024418	<1		n
unknown	3/19/1992	1050	<	1.0	0.50		0.846	0.810624052	<1		n
	Mean =	**158.35**		**1.11**	**0.69**						
	Median =	**81.80**		**1.00**	**0.50**						

[1] Reference h cites N/A for Total Hardness.

Acronyms:
CF- conversion factor
CMC - Criteria Maximum Concentration
CCC - Criteria Continuous Concentration
RL = Reporting Limit
WQO- water quality objective
EMC- event mean concentration
NA- not analyzed

(yellow)	unverified
(green)	dissolved [ ] calculated from total [ ]
(pink)	Reporting limit not known, concentration is 1/2 reported estimate

Appendix A: Chollas Creek Metals (Cu) Data

Station ID	Sample Date	Total Hardness as $CaCO_3$ (mg/L)		Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF	CCC Freshwater CF	EMC (ug/L)	Reporting Limit (ug/L)	Reference
			Dissolved Copper				Acute Dissolved Copper	Chronic Dissolved Copper	Total Copper		
11-87	2/12/2000	-	=	5.3	5.3	1	0.960	0.960	33	1	v
11-87	2/23/2000	-	=	9.6	9.6	1	0.960	0.960	19	1	v
11-87	3/5/2000	-	=	5.1	5.1	1	0.960	0.960	12	1	v
11-87	4/17/2000	-	=	11	11	1	0.960	0.960	13	1	v
Able Auto Wrecking	3/15/1999	NA					0.960	0.960	81		r
Allways Recycling	4/12/1999	NA					0.960	0.960	72		s
CREEK	2/12/2000	-	=	51.2	51.2	-	0.96	0.960	-	-	u
CREEK	3/5/2000	-	=	63	63	-	0.96	0.960	-	-	u
DPR(1)	1/8/2001	210	=	13	13	1	0.960	0.960	32	2	g
DPR(1)	2/13/2001	48	=	8	8	1	0.960	0.960	17	2	g
DPR(1)	11/12/2001	370	=	6	6		0.96	0.960	170		g
DPR(2)	2/12/2000	NA	=	5.3	5.3		0.96	0.960	33		g
DPR(2)	2/21/2000	NA	=	9.6	9.6		0.960	0.960	19		g
DPR(2)	1/8/2001	150	=	13	13	1	0.960	0.960	56	2	g
DPR(2)	2/13/2001	110	=	5	5	1	0.96	0.960	41	2	g
DPR(2)	11/12/2001	100	=	11	11		0.96	0.960	32		g
DPR(3)	1/8/2001	73	=	17	17	1	0.960	0.960	36	2	g
DPR(3)	2/13/2001	35	=	34	34	1	0.960	0.960	19	2	g
DPR(3)	11/12/2001	73	=	19	19		0.96	0.960	37		g
DPR(4)	1/8/2001	160	=	8	8	1	0.96	0.960	70	2	g
DPR(4)	2/13/2001	69	=	5	5	1	0.960	0.960	38	2	g
DPR(4)	11/12/2001	72	=	10	10		0.960	0.960	42		g
Mini Trucks & Cars	1/25/1999	NA	=	172.8	172.8		0.96	0.960	180		q
NF-1	9/1/2000	230		ND	na		0.96	0.960	ND	2	t
NF-2	9/1/2000	220	=	4.8	4.8		0.960	0.960	5	2	t
NF-3	9/1/2000	280	=	3.84	3.84		0.960	0.960	4	2	t
NF-4	9/1/2000	3200	=	28.8	28.8		0.96	0.960	30	2	t
north fork	3/15/1999	90.8	=	15.0	15.0	10	0.96	0.960	NA	-	o
north fork	3/25/1999	68	=	30.0	30.0	10	0.960	0.960	NA	-	o
north fork	4/6/1999	110	=	10.0	10.0	10	0.960	0.960	NA	-	o
SD8(1)	2/17/1994	120	=	32.6	32.6	5	0.96	0.960	34	5	k
SD8(1)	3/24/1994	71	=	27.8	27.8	5	0.96	0.960	29	5	k
SD8(1)	4/24/1994	110	=	42.2	42.2	5	0.960	0.960	44	5	k
SD8(1)	11/10/1994	150	=	34.6	34.6	5	0.960	0.960	36	5	a
SD8(1)	1/11/1995	58	=	16.3	16.3	5	0.96	0.960	17	5	a
SD8(1)	2/14/1995	100	=	38.4	38.4	5	0.96	0.960	40	5	a
SD8(1)	4/16/1995	120	=	81.6	81.6	5	0.960	0.960	85	5	a
SD8(1)	11/1/1995	91	=	44.2	44.2	5	0.960	0.960	46	5	b
SD8(1)	1/22/1996	74.5	=	12	12	5	0.96	0.960	NA	-	b
SD8(1)	1/31/1996	52.2	=	8	8	5	0.96	0.960	NA	-	b
SD8(1)	3/5/1996	78.6	=	34	34	5	0.960	0.960	NA	-	b
SD8(1)	12/9/1996	57.4	=	10	10	10	0.960	0.960	20	10	i
SD8(1)	1/16/1997	61.5	=	20	20	10	0.96	0.960	10	10	i
SD8(1)	11/10/1997	116	=	16.3	16.3	5.0	0.96	0.960	17	5	c
SD8(1)	12/6/1997	39.0	=	26.9	26.9	6.0	0.960	0.960	28	6	c
SD8(1)	3/14/1998	96.4	=	26.9	26.9	6.0	0.960	0.960	28	6	c
SD8(1)	11/8/1998	77.0	=	5.8	5.8	5	0.96	0.960	6	5	d
SD8(1)	1/25/1999	42.5	<	4.8	2.5	5	0.96	0.960	5	5	d
SD8(1)	3/15/1999	90.8	=	14.4	14.4	5	0.960	0.960	15	5	d
SD8(1)	3/15/1999	85.0	=	14.4	14.4	5	0.960	0.960	15	5	d
SD8(1)	2/12/2000	40.9	<	5	2.5	5	0.96	0.960	29	5	e, g
SD8(1)	2/20/2000	35.1	<	5	2.5	5	0.96	0.960	16	5	
SD8(1)	3/5/2000	45.5	<	5	2.5	5	0.960	0.960	14	5	e

Appendix A: Chollas Creek Metals (Cu) Data

Station ID	Sample Date	Total Hardness as $CaCO_3$ (mg/L)		Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF	CCC Freshwater CF	EMC (ug/L)	Reporting Limit (ug/L)	Reference
			Dissolved Copper				Acute Dissolved Copper	Chronic Dissolved Copper	Total Copper		
SD8(1)	10/27/2000	85	=	17	17	5	0.960	0.960	27	5	f
SD8(1)	1/8/2001	78	=	13	13	5	0.96	0.960	49	5	f
SD8(1)	1/8/2001	170	=	11	11	5	0.96	0.960	65	2	g
SD8(1)	2/13/2001	45	=	4	4	5	0.960	0.960	15	2	g
SD8(1)	2/13/2001	59	<	5	2.5	5	0.960	0.960	16	5	f
SD8(1)	11/12/2001	200	=	5	5	5	0.96	0.960	97		g
SD8(1)	11/29/2001	68	=	9	9	5	0.96	0.960	27	5	j
SD8(1)	2/17/2002	111	=	24	24	5	0.960	0.960	53	5	j
SD8(1)	3/8/2002	148	=	18	18	5	0.960	0.960	56	5	j
SD8(1)	11/8/2002	69.1	=	22	22		0.96	0.960	28		w
SD8(1)	2/11/2003	78	=	52	52		0.96	0.960	33		w
SD8(1)	2/25/2003	44	=	8.8	8.8		0.960	0.960	16		w
SD8(1)	2/20/00 [1]	35.1	<	5	2.5	5	0.960	0.960	16	5	e
SD8(2)	2/12/2000	58	=	37	37	5	0.96	0.960	68	10	g
SD8(2)	2/21/2000	47	=	11	11	5	0.96	0.960	23	10	g
SD8(2)	1/8/2001	68	=	12	12	5	0.960	0.960	52	2	g
SD8(2)	2/13/2001	37	=	5	5	5	0.960	0.960	16	2	g
SD8(2)	11/12/2001	58	=	18	18		0.96	0.960	49		g
SD8(3)	2/12/2000	54	<	10	2.5	5	0.96	0.960	68	10	g
SD8(3)	2/21/2000	36	<	10	2.5	5	0.960	0.960	19	10	g
SD8(3)	1/8/2001	87	=	19	19	5	0.960	0.960	65	2	g
SD8(3)	2/13/2001	40	=	5	5	5	0.96	0.960	15	2	g
SD8(3)	11/12/2001	300	=	5	5		0.96	0.960	45		g
SD8(4)	2/12/2000	190	=	5.3	5.3	5	0.960	0.960	33	1	h [2]
SD8(4)	2/23/2000	232	=	9.6	9.6	5	0.960	0.960	19	1	h [2]
SD8(5)	2/12/2000	100	<	10	2.5	5	0.96	0.960	43	10	g
SD8(5)	2/21/2000	63	<	10	2.5	5	0.96	0.960	27	10	g
SD8(5)	1/8/2001	200	=	13	13	5	0.960	0.960	37	2	g
SD8(5)	2/13/2001	52	=	5	5	5	0.960	0.960	33	2	g
SD8(5)	11/12/2001	310	=	4	4		0.96	0.960	180		g
SD8(6)	2/12/2000	120	<	10	2.5	5	0.96	0.960	23	10	g
SD8(6)	2/21/2000	100	<	10	2.5	5	0.960	0.960	10	10	g
SD8(6)	1/8/2001	640	=	13	13	5	0.960	0.960	32	2	g
SD8(6)	2/13/2001	91	=	3	3	5	0.96	0.960	10	2	g
SD8(6)	11/12/2001	280	=	6	6		0.96	0.960	49		g
SF-1	9/1/2000	520					0.960	0.960	5	2	t
Trolley Auto Parts	5/5/1998	NA					0.960	0.960	500	200	p
unknown	6/4/1991	484	=	3	3		0.96	0.960	5		l
unknown	3/12/1992	472	=	7	7		0.96	0.960	7		m
unknown	3/19/1992	1050	=	7	7		0.960	0.960	36		n
unknown	3/19/1992	1040	=	7	7		0.960	0.960	6		n
unknown	3/19/1992	1050	=	8	8		0.96	0.960	7		n
	Mean =	**198.20**		**17.30**	**16.64**						
	Median =	**90.80**		**10.00**	**10.00**						

[1] Reference g cites date as 2/21/00.
[2] Reference h cites N/A for Total Hardness.
Acronyms:
CF- conversion factor
WQO- water quality objective
CMC-
CCC-
EMC- event mean concentration

NA- not analyzed
(yellow) unverified
(orange) data may be duplicative
(green) dissolved [ ] calculated from total [ ]

Appendix A: Chollas Creek Metals (Pb) Data

Station ID	Sampling Date	Total Hardness as $CaCO_3$ (mg/L)		Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF	CCC Freshwater CF	EMC (ug/L)	Reporting Limit (ug/L)	Reference
			Dissolved Lead (ug/L)				Acute Dissolved Lead	Chronic Dissolved Lead	Total Lead		
Able Auto Wrecking	3/15/1999	NA		NA			#VALUE!	#VALUE!	30		r
Allways Recycling	4/12/1999	NA		NA			#VALUE!	#VALUE!	42		s
DPR(1)	1/8/2001	210	=	1	1.0	1.0	0.683	0.683	27	2	g
DPR(1)	2/13/2001	48	=	27	27.0	1.0	0.898	0.898	23	2	g
DPR(1)	11/12/2001	370	<	1	0.5		0.600	0.600	270		g
DPR(2)	2/12/2000	NS	=	3.6	3.6		#VALUE!	#VALUE!	83		g, h
DPR(2)	2/21/2000	NS	=	10.5	10.5		#VALUE!	#VALUE!	25.9		
DPR(2)	1/8/2001	150	=	1	1.0	1.0	0.732	0.732	59	2	g
DPR(2)	2/13/2001	110	=	1	1.0	1.0	0.777	0.777	61	2	g
DPR(2)	11/12/2001	100	<	1	0.5		0.791	0.791	19		g
DPR(3)	1/8/2001	73	=	2	2.0	1.0	0.837	0.837	21	2	g
DPR(3)	2/13/2001	35	=	46	46.0	1.0	0.944	0.944	18	2	g
DPR(3)	11/12/2001	73	=	2	2.0		0.837	0.837	12		g
DPR(4)	1/8/2001	160	=	1	1.0	1.0	0.723	0.723	68	2	g
DPR(4)	2/13/2001	69	=	4	4.0	1.0	0.845	0.845	53	2	g
DPR(4)	11/12/2001	72	=	2	2.0		0.839	0.839	29		g
Mini Trucks & Cars	1/25/1999	NA					#VALUE!	#VALUE!	160		q
NF-1	9/1/2000	230	<	2	1.0	2.0	0.670	0.670	ND	2.0	t
NF-2	9/1/2000	220	=	4.1	4.1	2.0	0.676	0.676	6	2.0	t
NF-3	9/1/2000	280	=	1.3	1.3	2.0	0.641	0.641	2	2.0	t
NF-4	9/1/2000	3200	<	2	1.0	2.0	0.286	0.286	ND	2.0	t
north fork	3/15/1999	90.8	=	82	82.0	10.0	0.805	0.805	NA	-	o
north fork	3/25/1999	68	=	30	30.0	10.0	0.847	0.847	NA	-	o
north fork	4/6/1999	110	<	10	5.0	10.0	0.777	0.777	NA	-	o
SD8(1)	2/17/1994	120	=	84	84.0		0.764	0.764	110	1	k
SD8(1)	3/24/1994	71	=	118	118.0		0.841	0.841	140	1	k
SD8(1)	4/24/1994	110	=	54	54.0		0.777	0.777	70	1	k
SD8(1)	11/10/1994	150	=	26	26.0		0.732	0.732	35	1	a
SD8(1)	1/11/1995	58	=	38	38.0		0.870	0.870	44	1	a
SD8(1)	2/14/1995	100	=	87	87.0		0.791	0.791	110	1	a
SD8(1)	4/16/1995	120	=	107	107.0		0.764	0.764	140	1	a
SD8(1)	11/1/1995	91	=	18	18.0		0.805	0.805	22.9	1	b
SD8(1)	1/22/1996	74.5	<	2	0.5	1.0	0.834	0.834	NA	-	b
SD8(1)	1/31/1996	52.2	<	2	0.5	1.0	0.886	0.886	NA	-	b
SD8(1)	3/5/1996	78.6	=	18	18.0	1.0	0.826	0.826	NA	-	b
SD8(1)	12/9/1996	57.4	=	15	15.0	2.0	0.872	0.872	16	2	i
SD8(1)	1/16/1997	61.5	=	7	7.0	2.0	0.862	0.862	58	2	i
SD8(1)	11/10/1997	116	=	2	2.0		0.769	0.769	3	1	c
SD8(1)	12/6/1997	39.0	=	39	39.0		0.928	0.928	<42	42	c
SD8(1)	3/14/1998	96.4	=	76	76.0		0.796	0.796	95	42	c
SD8(1)	11/8/1998	77	<	1	0.5	-	0.829	0.829	<1	1	d
SD8(1)	1/25/1999	42.5	=	6	6.0	-	0.916	0.916	7	1	d
SD8(1)	3/15/1999	90.8	=	66	66.0	-	0.805	0.805	82	1	d
SD8(1)	3/15/1999	85	=	67	67.0	-	0.815	0.815	82	1	d
SD8(1)	2/12/2000	40.9	<	1	0.5	1.0	0.921	0.921	15	1	e
SD8(1)	2/21/2000	35.1	<	1	0.5	1.0	0.944	0.944	<1	1	e, g, h
SD8(1)	3/5/2000	45.5	<	1	0.5	1.0	0.906	0.906	<1	1	e
SD8(1)	10/27/2000	85	=	3	3.0	1.0	0.815	0.815	22	1	f
SD8(1)	1/8/2001	78	=	2	2.0	1.0	0.827	0.827	55	1	f
SD8(1)	1/8/2001	170	=	3	3.0	1.0	0.714	0.714	83	2	g
SD8(1)	2/13/2001	45	<	1	0.5	1.0	0.907	0.907	22	2	g
SD8(1)	2/13/2001	59	=	14	14.0	1.0	0.868	0.868	27	1	f
SD8(1)	11/12/2001	200	<	1	0.5		0.690	0.690	94		g

Appendix A: Chollas Creek Metals (Pb) Data

Station ID	Sampling Date	Total Hardness as $CaCO_3$ (mg/L)	Dissolved Lead (ug/L)	Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF	CCC Freshwater CF	Total Lead EMC (ug/L)	Total Lead Reporting Limit (ug/L)	Reference
							Acute Dissolved Lead	Chronic Dissolved Lead			
SD8(1)	11/29/2001	68	<	2	1.0	2.0	0.847	0.847	28	2	j
SD8(1)	2/17/2002	111	<	2	1.0	2.0	0.776	0.776	32	2	j
SD8(1)	3/8/2002	148	=	2	2.0	2.0	0.734	0.734	61	2	j
SD8(1)	11/8/2002	69.1	=	6	6.0		0.845	0.845	17		w
SD8(1)	2/11/2003	78	<	2	1.0		0.827	0.827	29		w
SD8(1)	2/25/2003	44	<	2	1.0		0.911	0.911	23		w
SD8(2)	2/12/2000	58	<	10	5.0	10.0	0.870	0.870	34	10	g, h
SD8(2)	2/21/2000	47	<	10	5.0	10.0	0.901	0.901	23	10	g, h
SD8(2)	1/8/2001	68	=	1	1.0	1.0	0.847	0.847	91	2	g
SD8(2)	2/13/2001	37	=	1	1.0	1.0	0.936	0.936	29	2	g
SD8(2)	11/12/2001	58	<	1	0.5		0.870	0.870	39		g
SD8(3)	2/12/2000	54	<	10	5.0	10.0	0.881	0.881	52	10	g, h
SD8(3)	2/21/2000	36	<	10	5.0	10.0	0.940	0.940	19	10	g, h
SD8(3)	1/8/2001	87	=	1	1.0	1.0	0.811	0.811	90	2	g
SD8(3)	2/13/2001	40	=	2	2.0	1.0	0.925	0.925	21	2	g
SD8(3)	11/12/2001	300	=	3	3.0		0.631	0.631	52		g
SD8(4)	2/12/2000	NA	=	3.6	3.6	1.0	#VALUE!	#VALUE!	83	1	h [1]
SD8(4)	2/23/2000	NA	=	10.5	10.5	1.0	#VALUE!	#VALUE!	25.9J	1	h [1]
SD8(5)	2/12/2000	100	<	10	5.0	10.0	0.791	0.791	76	10	g, h
SD8(5)	2/21/2000	63	<	10	5.0	10.0	0.858	0.858	35	10	g, h
SD8(5)	1/8/2001	200	=	1	1.0	1.0	0.690	0.690	29	2	g
SD8(5)	2/13/2001	52	=	2	2.0	1.0	0.886	0.886	59	2	g
SD8(5)	11/12/2001	310	<	1	0.5		0.626	0.626	170		g
SD8(6)	2/12/2000	120	<	10	5.0	10.0	0.764	0.764	16	10	g, h
SD8(6)	2/21/2000	100	<	10	5.0	10.0	0.791	0.791	<10	10	g, h
SD8(6)	1/8/2001	640	=	1	1.0	1.0	0.521	0.521	19	2	g
SD8(6)	2/13/2001	91	<	1	0.5	1.0	0.805	0.805	9	2	g
SD8(6)	11/12/2001	280	<	1	0.5		0.641	0.641	36		g
SF-1	9/1/2000	520					0.551	0.551	ND	2.0	t
Trolley Auto Parts	5/5/1998	NA					#VALUE!	#VALUE!	500	200	p
unknown	6/4/1991	484	<	5	2.5		0.561	0.561	5		l
unknown	3/12/1992	472	<	5	2.5		0.565	0.565	7		m
unknown	3/19/1992	1050	=	29	29.0		0.448	0.448	5		n
unknown	3/19/1992	1040	=	16	16.0		0.450	0.450	5		n
unknown	3/19/1992	1040	=	11	11.0		0.450	0.450	5		n
11-87	4/17/2000	-	=	2.9	2.9	1.0	#VALUE!	#VALUE!	7.6	1	v
11-87	2/12/2000	-	=	3.6	3.6	1.0	#VALUE!	#VALUE!	83	1	v
11-87	3/5/2000	-	=	4.3	4.3	1.0	#VALUE!	#VALUE!	14	1	v
11-87	2/23/2000	-	=	11	11.0	1.0	#VALUE!	#VALUE!	26	1	v
	Mean =	**199.79**		**15.05**	**14.29**						
	Median =	**88.90**		**3.60**	**3.00**						

[1] Reference h cites N/A for Total Hardness.

Acronyms:
CF- conversion factor
WQO- water quality objective
CMC- criteria maximum concentration
CCC- criteria continuous criteria
EMC- event mean concentration
NA- not analyzed

Legend:
- (yellow) unverified
- (green) dissolved [ ] calculated from total [ ]
- (orange) data may be duplicative
- (pink) Reporting limit not known, concentration is 1/2 reported estimate

Appendix A: Chollas Creek Metals (Zn) Data

Station ID	Sampling Date	Total Hardness as $CaCO_3$ (mg/L)		Conc. (ug/L)	actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF	CCC Freshwater CF	EMC (ug/L)	Reporting Limit (ug/L)	Reference
				Dissolved Zinc (ug/L)			Acute Dissolved Zinc	Chronic Dissolved Zinc	Total Zinc		
11-87	2/12/2000	-	=	17	17	1			330	1	v
11-87	2/23/2000	-	=	42	42	1			81	1	v
11-87	3/5/2000	-	=	25	25	1			49	1	v
11-87	4/17/2000	-	=	31	31	1			47	1	v
Able Auto Wrecking	3/15/1999	NA							190		r
Allways Recycling	4/12/1999	NA							260		s
CREEK	2/12/2000	-	=	150.8	150.8						u
CREEK	3/5/2000	-	=	146	146						u
DPR(1)	1/8/2001	210	=	200	200	10	0.978	0.986	190	10	g
DPR(1)	2/13/2001	48	=	250	250	10	0.978	0.986	120	10	g
DPR(1)	11/12/2001	370	=	40	40		0.978	0.986	1400		g
DPR(2)	2/12/2000	NS	=	16.8	16.8		0.978	0.986	327		g
DPR(2)	2/21/2000	NS	=	42	42		0.978	0.986	81		g
DPR(2)	1/8/2001	150	=	180	180	10	0.978	0.986	360	10	g
DPR(2)	2/13/2001	110	=	66	66	10	0.978	0.986	280	10	g
DPR(2)	11/12/2001	100	=	55	55		0.978	0.986	180		g
DPR(3)	1/8/2001	73	=	220	220	10	0.978	0.986	230	10	g
DPR(3)	2/13/2001	35	=	370	370	10	0.978	0.986	110	10	g
DPR(3)	11/12/2001	73	=	100	100		0.978	0.986	200		g
DPR(4)	1/8/2001	160	=	230	230	10	0.978	0.986	660	10	g
DPR(4)	2/13/2001	69	=	46	46	10	0.978	0.986	280	10	g
DPR(4)	11/12/2001	72	=	110	110		0.978	0.986	340		g
Mini Trucks & Cars	1/25/1999	NA					0.978	0.986	690		q
NF-1	9/1/2000	230	<	10	5	10.0	0.978	0.986	ND	10	t
NF-2	9/1/2000	220	=	45	45	10.0	0.978	0.986	46	10	t
NF-3	9/1/2000	280	=	15	15	10.0	0.978	0.986	15	10	t
NF-4	9/1/2000	3200	=	20	20	10.0	0.978	0.986	20	10	t
north fork	3/15/1999	90.8	=	210	210	10.0	0.978	0.986	NA	-	o
north fork	3/25/1999	68	=	220	220	10.0	0.978	0.986	NA	-	o
north fork	4/6/1999	110	=	90	90	10.0	0.978	0.986	NA	-	o
SD8(1)	2/17/1994	120	=	254	254		0.978	0.986	260	5	k
SD8(1)	3/24/1994	71	=	235	235		0.978	0.986	240	5	k
SD8(1)	4/24/1994	110	=	313	313		0.978	0.986	320	5	k
SD8(1)	11/10/1994	150	=	176	176		0.978	0.986	180	5	a
SD8(1)	1/11/1995	58	=	147	147		0.978	0.986	150	5	a
SD8(1)	2/14/1995	100	=	352	352		0.978	0.986	360	5	a
SD8(1)	4/16/1995	120	=	548	548		0.978	0.986	560	5	a
SD8(1)	11/1/1995	91	=	181	181		0.978	0.986	185	25	b
SD8(1)	1/22/1996	74.5	=	25	25	25	0.978	0.986	NA	-	b
SD8(1)	1/31/1996	52.2	=	32	32	25	0.978	0.986	NA	-	b
SD8(1)	3/5/1996	78.6	=	141	141	25	0.978	0.986	NA	-	b
SD8(1)	12/9/1996	57.4	=	80	80	50	0.978	0.986	70	50	i
SD8(1)	1/16/1997	61.5	=	40	40	50	0.978	0.986	200	50	i
SD8(1)	11/10/1997	116	=	172	172		0.978	0.986	176	25	c
SD8(1)	12/6/1997	39.0	=	108	108		0.978	0.986	110	2	c
SD8(1)	3/14/1998	96.4	=	90	90		0.978	0.986	92	2	c
SD8(1)	11/8/1998	77	=	30	30	25.0	0.978	0.986	30	25	d
SD8(1)	1/25/1999	42.5	=	48	48	25.0	0.978	0.986	48	25	d
SD8(1)	3/15/1999	90.8	=	210	210	25.0	0.978	0.986	210	25	d
SD8(1)	3/15/1999	85	=	210	210	25.0	0.978	0.986	210	25	d
SD8(1)	2/12/2000	40.9	=	19	19	25.0	0.978	0.986	96	25	e, g, h
SD8(1)	2/20/2000	35.1	=	28	28	25.0	0.978	0.986	50	25	e
SD8(1)	3/5/2000	45.5	=	8	8	25.0	0.978	0.986	80	25	e

Appendix A: Chollas Creek Metals (Zn) Data

Station ID	Sampling Date	Total Hardness as $CaCO_3$ (mg/L)		Dissolved Zinc (ug/L): Conc. (ug/L)	Dissolved Zinc (ug/L): actual conc. or 1/2 RL	Reporting Limit (ug/L)	CMC Freshwater CF: Acute Dissolved Zinc	CCC Freshwater CF: Chronic Dissolved Zinc	Total Zinc: EMC (ug/L)	Total Zinc: Reporting Limit (ug/L)	Reference
SD8(1)	10/27/2000	85	=	90	90	25	0.978	0.986	150	25	f
SD8(1)	1/8/2001	78	=	110	110	25	0.978	0.986	29	25	f
SD8(1)	1/8/2001	170	=	87	87	10	0.978	0.986	480	10	g
SD8(1)	2/13/2001	45	=	32	32	10	0.978	0.986	100	10	g
SD8(1)	2/13/2001	59	=	30	30	25	0.978	0.986	120	25	f
SD8(1)	11/12/2001	200	=	62	62		0.978	0.986	740		g
SD8(1)	11/29/2001	68	=	53	53	20	0.978	0.986	162	20	j
SD8(1)	2/17/2002	111	=	118	118	20	0.978	0.986	314	20	j
SD8(1)	3/8/2002	148	=	79	79	20	0.978	0.986	430	20	j
SD8(1)	11/8/2002	69.1	=	152	152		0.978	0.986	118		w
SD8(1)	2/11/2003	78	=	139	139		0.978	0.986	230		w
SD8(1)	2/25/2003	44	=	18	18		0.978	0.986	154		w
SD8(2)	2/12/2000	58	=	45	45	10	0.978	0.986	160	10	g, h
SD8(2)	2/21/2000	47	=	67	67	10	0.978	0.986	180	10	g
SD8(2)	1/8/2001	68	=	160	160	10	0.978	0.986	420	10	g
SD8(2)	2/13/2001	37	=	36	36	10	0.978	0.986	100	10	g
SD8(2)	11/12/2001	58	=	130	130		0.978	0.986	370		g
SD8(3)	2/12/2000	54	=	20	20	10	0.978	0.986	300	10	g, h
SD8(3)	2/21/2000	36	=	57	57	10	0.978	0.986	160	10	g
SD8(3)	1/8/2001	87	=	130	130	10	0.978	0.986	480	10	g
SD8(3)	2/13/2001	40	=	36	36	10	0.978	0.986	110	10	g
SD8(3)	11/12/2001	300	=	47	47		0.978	0.986	300		g
SD8(4)	2/12/2000	190	=	16.8	16.8	1	0.978	0.986	327	1	h [2]
SD8(4)	2/23/2000	232	=	42	42	1	0.978	0.986	81	1	h [2]
SD8(5)	2/12/2000	100	=	45	45	10	0.978	0.986	370	10	g, h
SD8(5)	2/21/2000	63	=	10	10	10	0.978	0.986	10	10	g
SD8(5)	1/8/2001	200	=	290	290	10	0.978	0.986	260	10	g
SD8(5)	2/13/2001	52	=	68	68	10	0.978	0.986	270	10	g
SD8(5)	11/12/2001	310	=	73	73		0.978	0.986	1900		g
SD8(6)	2/12/2000	120	=	20	20	10	0.978	0.986	100	10	g, h
SD8(6)	2/21/2000	100	=	30	30	10	0.978	0.986	54	10	g
SD8(6)	1/8/2001	640	=	170	170	10	0.978	0.986	160	10	g
SD8(6)	2/13/2001	91	=	33	33	10	0.978	0.986	55	10	g
SD8(6)	11/12/2001	280	=	76	76		0.978	0.986	290		g
SF-1	9/1/2000	520	=	12	12		0.978	0.986	12	10	t
Trolley Auto Parts	5/5/1998	NA					0.978	0.986	1000	50	p
unknown	6/4/1991	484	=	3	3		0.978	0.986	6		l
unknown	3/12/1992	472	=	188	188		0.978	0.986	224		m
unknown	3/19/1992	1050	=	11	11		0.978	0.986	59		n
unknown	3/19/1992	1040	=	11	11		0.978	0.986	29		n
unknown	3/19/1992	1050	=	12	12		0.978	0.986	21		n
	Mean =	**200.19**		**102.24**	**102.20**						
	Median =	**90.80**		**66.50**	**66.50**						

[2] Reference h cites N/A for Total Hardness.

Acronyms:
CF- conversion factor
WQO- water quality objective
CMC-
CCC-
EMC- event mean concentration
NA- not analyzed

Legend (cell shading):
- unverified (yellow)
- dissolved [ ] calculated from total [ ] (green)
- data may be duplicative (orange)

Appendix B

Cadmium Delisting

Used in the Chollas Creek Metals Total Maximum Daily Loads

California Regional Water Quality Control Board, San Diego Region

Chollas Creek – Cadmium Delisting
Hydrologic Subarea 908.22

SUMMARY OF ACTIONS

Non-consideration of dissolved cadmium for Total Maximum Daily Load (TMDL) and subsequent removal from the list of Water Quality Limited Segments [Clean Water Act (CWA) section 303(d)].

TMDL PRIORITY

Non-consideration.

LIST Of WATER QUALITY LIMITED SEGMENTS

Proposed delisting.

WATERSHED CHARACTERISTICS

Chollas Creek is an urban creek that runs through portions of San Diego, La Mesa, and Lemon Grove before emptying into San Diego Bay. Chollas Creek is designated with water contact recreation (REC-1) as a potential beneficial use as well as the following existing beneficial uses: non-contact water recreation (REC-2), warm freshwater habitat (WARM), and wildlife habitat (WILD). San Diego Bay is designated with the following beneficial uses: industrial service supply (IND), navigation (NAV), REC-1, REC-2, commercial and sport fishing (COMM), preservation for biological habitats of special significance (BIOL), estuarine habitat (EST), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), marine habitat (MAR), migration of aquatic organisms (MIGR), and shellfish harvesting (SHELL) (Regional Board, 1994).

EVIDENCE OF NON-IMPAIRMENT

The available data suggests that concentrations of dissolved cadmium in Chollas Creek do not exceed acute or chronic California Toxics Rule (CTR) water quality criteria. Most samples were below detection limits, though some of the detection limit concentrations exceed CTR acute and chronic criteria. Since cadmium does not appear to exceed dissolved CTR criteria, and was not found to cause toxicity in test organisms, it is not considered an agent for the impairment of designated beneficial uses. Based on this evidence, removal of the pollutant/water body combination of cadmium and Chollas Creek from the List of Water Quality Limited Segments will be recommended by the California Regional Water Quality Control Board, San Diego Region (Regional Board).

The United States Environmental Protection Agency (USEPA) has recommended a more stringent dissolved cadmium criteria (USEPA, 2001) that it hopes California will incorporate in to the CTR by 2008. These criteria are approximately ten-fold more stringent than current CTR criteria, and may be exceeded in Chollas Creek. The available cadmium data appears to support inclusion on subsequent Water Quality Limited Segments lists based on this more stringent recommended criteria. When CTR is updated to incorporate these criteria, the Regional Board will re-evaluate the potential listing of Chollas Creek for cadmium.

As shown in the Table D.1 below, with a total of 54 samples collected and analyzed between February 2000 and February 2004, no (0 percent) exceedances of the CTR for dissolved cadmium were recorded.

Table D.1 - Summary of Sampling Evidence for Delisting

CADMIUM Collection Dates	Organization	n	min	max	mean	median	No. of exceedances (CTR) CMC	CCC	No. of exceedances (USEPA, 2001) CMC	CCC
Feb 94 - Feb 03	MS4 Copermittees	42	0.2 [a]	3.93 [b]	0.8 [c]	0.5 [c]	0 [d] (4)	0 [d] (4)	0 [d] (4)	3 [d] (4)
Feb 00 - Apr 00	CalTrans	4	0.2 [a]	0.3	0.2 [c]	0.2 [c]	NA [e]	NA [e]	NA [e]	NA [e]
Mar 99 - Apr 99	SCCWRP	3	< 0.3	< 2.0	< 2.0	< 2.0	NA [f]	NA [f]	NA [f]	NA [f]
Jun 91 & Mar 92	Regional Board	5	1.0 [a]	< 1.0	0.5 [c]	0.5 [c]	NA [f]	NA [f]	NA [f]	NA [f]

a. Sample below Reporting Limit.
b. Calculated from total concentration.
c. Using all samples (measured dissolved and calculated from total). Samples below detection limit entered as 1/2 detection limit for calculations.
d. Considering only measured dissolved concentrations and samples not below DL or RL. (Number in parenthesis represents available sample pool under these criteria).
e. No associated hardness values available.
f. All samples reported as "less than."

Applying the listing policy (SWRCB, 2004) to the available cadmium data confirms that cadmium should be delisted (Table D.2). In applying the policy, total metal data and metals data without associated hardness were not considered. As seen in the table, when and if the CTR is updated to include the new cadmium criteria from the USEPA, it may be necessary to re-list cadmium. At that future time, additional data should be available to evaluate the concentrations of cadmium in the creek. Until then and in accordance with the listing policy, cadmium should be removed from the current list of water quality limited segments during the next list update.

Table D.2 - 303(d) Listing Summary

	CTR		USEPA, 2001	
	CMC	**CCC**	**CMC**	**CCC**
No. of samples appropriate for 303(d) listing consideration	47	42	41	19
No. of exceedances	0	1	3	13
List Decision	delist	delist	delist	list

EXTENT OF NON-IMPAIRMENT

Major branches of the contributing watershed were sampled as well as the main channel. The exact locations and descriptions are as follows:

A. **Main Chollas Channel -** Station Name SD8(1). (Longitude: 117 07.2995 Latitude: 32 42.2914) North Fork, south of Imperial Avenue. This station is located in a concrete-lined section of the creek at the end of the 3300 block of Durant Street, near the intersection of 33rd Street, in the City of San Diego.

B. **Wabash Avenue Branch of the Main Chollas Channel -** Station Name SD8(2). (Longitude: 117 07.1140 Latitude: 32 43.0917) North Fork, located just north of the State Highway 94 and Interstate-15 Interchange.
C. **Home Avenue Branch of Main Chollas Channel -** Station Name SD8(3). (Longitude: 117 06.6055 Latitude: 32 43.1619) Located next to the San Diego Police Department canine training field and the Police Pistol Range and is downstream from residential areas. This area tends to remain wet year-round as a result of irrigation runoff from upstream residential areas. This portion of the creek is channelized, but has a natural bottom.
D. **South Chollas Creek at 38th Street -** Station Name SD8(4). Located in Chollas Creek at the 38th Street Bridge, just north of Beta Street and several blocks east of Interstate 5. The station is located in a channelized portion of the creek and has a natural bottom. It is approximately 4 blocks upstream of the confluence with the north fork of Chollas Creek. This station is located within a designated open space area and the wetland water quality study area for the Chollas Creek Enhancement Project.
E. **Federal Boulevard Branch of South Chollas Creek -** Station Name SD8(5). (Longitude: 117 04.1844 Latitude: 32 43.6324) Located in Chollas Creek at the 38th Street Bridge, just north of Beta Street and several blocks east of Interstate 5. The station is located in a channelized portion of the creek and has a natural bottom. It is approximately 4 blocks upstream of the confluence with the north fork of Chollas Creek. This station is located within a designated open space area and the wetland water quality study area for the Chollas Creek Enhancement Project.
F. **Jamacha Road Branch of South Chollas Creek -** Station Name SD8(6). (Longitude: 117 02.9650 Latitude: 32 42.6029) Located just south of Jamacha Road at the 69th Street crossing of South Chollas Creek. The station is located just downstream from Lemon Grove and upstream of designated open space. The station is along a natural portion of the creek within a residential area and is typically wet all year long.

Based on the locations and results of the samples, non-impairment of dissolved cadmium can be determined. Data from all stations indicates that the entire watershed is free from dissolved cadmium impairment.

INFORMATION SOURCES

Regional Board, 1994. *Water Quality Control Plan for the San Diego Basin (9), 1994.* California Regional Water Quality Control Board, San Diego Region.

USEPA, 2001. *2001 Update of Ambient Water Quality Criteria for Cadmium, 2001*. United States Environmental Protection Agency, EPA-822-R-01-001.

SWRCB, 2004. *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, 2004.* State Water Resources Control Board, September2004.

Appendix C

Chollas Creek Sediment Metals

Used in the Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

May 30, 2007

Appendix C: Chollas Creek Sediment Metals (Cd, Cu, Pb and Zn)

Sample Date	Station ID	Cadmium Result mg/kg	Cadmium Method	Cadmium Limit mg/kg	Copper Result mg/kg	Copper Method	Copper Limit mg/kg	Lead Result mg/kg	Lead Method	Lead Limit mg/kg	Zinc Result mg/kg	Zinc Method	Zinc Limit mg/kg	Comments	Reference
23-Sep-94	PREBAY1	0.5	EPA/SW-846 6017	5 (MDL)	33.0	EPA/SW-846 6017	0.2 (MDL)	57.0	EPA/SW-846 6017	1 (MDL)	120	EPA/SW-846 6017	5 (MDL)	dry weight	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report 1994-1995
23-Sep-94	PREBAY2	ND	EPA/SW-846 6017	5 (MDL)	42.0	EPA/SW-846 6017	0.2 (MDL)	50.0	EPA/SW-846 6017	1 (MDL)	140	EPA/SW-846 6017	5 (MDL)	dry weight	
23-Sep-94	PREBAY3	0.6	EPA/SW-846 6017	5 (MDL)	430.0	EPA/SW-846 6017	0.2 (MDL)	64.0	EPA/SW-846 6017	1 (MDL)	170	EPA/SW-846 6017	5 (MDL)	dry weight	
25-Sep-94	PRECREEK1	ND	EPA/SW-846 6017	0.5 (MDL)	9.6	EPA/SW-846 6017	0.5 (MDL)	10.0	EPA/SW-846 6017	0.5 (MDL)	27	EPA/SW-846 6017	0.2 (MDL)	dry weight	
09-May-95	POSTCREEK1	0.1	EPA/SW-846 6017	0.5 (MDL)	6.4	EPA/SW-846 6017	0.5 (MDL)	14.0	EPA/SW-846 6017	0.5 (MDL)	29	EPA/SW-846 6017	0.2 (MDL)	dry weight	
10-May-95	POSTBAY1	1.2	EPA/SW-846 6017	5 (MDL)	67.0	EPA/SW-846 6017	0.2 (MDL)	150.0	EPA/SW-846 6017	1 (MDL)	190	EPA/SW-846 6017	5 (MDL)	dry weight	
10-May-95	POSTBAY2	0.8	EPA/SW-846 6017	5 (MDL)	59.0	EPA/SW-846 6017	0.2 (MDL)	71.0	EPA/SW-846 6017	1 (MDL)	160	EPA/SW-846 6017	5 (MDL)	dry weight	
10-May-95	POSTBAY3	1.4	EPA/SW-846 6017	5 (MDL)	76.0	EPA/SW-846 6017	0.2 (MDL)	120.0	EPA/SW-846 6017	1 (MDL)	220	EPA/SW-846 6017	5 (MDL)	dry weight	
28-Sep-96	1A/1B	<0.080	EPA/SW-846 6010	.5 (LDL)	186.0	EPA/SW-846 6010	.5 (LDL)	54.5	EPA/SW-846 7471	.5 (LDL)	137	EPA/SW-846 6010	2 (LDL)	dry weight	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program 1995-1996
28-Sep-96	2A/2B	<0.080	EPA/SW-846 6010	.5 (LDL)	38.6	EPA/SW-846 6010	.5 (LDL)	55.5	EPA/SW-846 7471	.5 (LDL)	118	EPA/SW-846 6010	2 (LDL)	dry weight	
28-Sep-96	3A/3B	<0.080	EPA/SW-846 6010	.5 (LDL)	37.8	EPA/SW-846 6010	.5 (LDL)	36.8	EPA/SW-846 7471	.5 (LDL)	97.2	EPA/SW-846 6010	2 (LDL)	dry weight	
28-Sep-96	Chollas	<0.080	EPA/SW-846 6010	.5 (LDL)	3.7	EPA/SW-846 6010	.5 (LDL)	23.2	EPA/SW-846 7471	.5 (LDL)	24.2	EPA/SW-846 6010	2 (LDL)	dry weight	
02-May-96	1A/1B	<0.5	EPA/SW-846 6010	.5 (LDL)	32.7	EPA/SW-846 6010	.5 (LDL)	46.3	EPA/SW-846 7471	.5 (LDL)	141	EPA/SW-846 6010	2 (LDL)	dry weight	
02-May-96	2A/2B	<0.5	EPA/SW-846 6010	.5 (LDL)	35.7	EPA/SW-846 6010	.5 (LDL)	36.7	EPA/SW-846 7471	.5 (LDL)	102	EPA/SW-846 6010	2 (LDL)	dry weight	
02-May-96	3A/3B	<0.5	EPA/SW-846 6010	.5 (LDL)	40.0	EPA/SW-846 6010	.5 (LDL)	38.2	EPA/SW-846 7471	.5 (LDL)	105	EPA/SW-846 6010	2 (LDL)	dry weight	
02-May-96	Chollas	<0.5	EPA/SW-846 6010	.5 (LDL)	3.1	EPA/SW-846 6010	.5 (LDL)	54.1	EPA/SW-846 7471	.5 (LDL)	21.6	EPA/SW-846 6010	2 (LDL)	dry weight	
19-Sep-96	1A/1B	<1.0	EPA/SW-846 6010	0.5 (RL)	47.3	EPA/SW-846 6010	0.5 (RL)	47.3	EPA/SW-846 7471	0.5 (RL)	134	EPA/SW-846 6010	2 (RL)	dry weight	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report 1996-1997
19-Sep-96	2A/2B	<1.0	EPA/SW-846 6010	0.5 (RL)	54.2	EPA/SW-846 6010	0.5 (RL)	32.0	EPA/SW-846 7471	0.5 (RL)	107	EPA/SW-846 6010	2 (RL)	dry weight	
19-Sep-96	3A/3B	<1.0	EPA/SW-846 6010	0.5 (RL)	58.6	EPA/SW-846 6010	0.5 (RL)	37.3	EPA/SW-846 7471	0.5 (RL)	111	EPA/SW-846 6010	2 (RL)	dry weight	
19-Sep-96	Chollas	<0.5	EPA/SW-846 6010	0.5 (RL)	3.6	EPA/SW-846 6010	0.5 (RL)	9.0	EPA/SW-846 7471	0.5 (RL)	28.8	EPA/SW-846 6010	2 (RL)	dry weight	
01-May-97	1A/1B	0.6	EPA/SW-846 6010	0.5 (RL)	51.5	EPA/SW-846 6010	0.5 (RL)	31.6	EPA/SW-846 7471	0.5 (RL)	132	EPA/SW-846 6010	2 (RL)	dry weight	
01-May-97	2A/2B	<0.4	EPA/SW-846 6010	0.5 (RL)	55.3	EPA/SW-846 6010	0.5 (RL)	48.5	EPA/SW-846 7471	0.5 (RL)	139	EPA/SW-846 6010	2 (RL)	dry weight	
01-May-97	3A/3B	<0.4	EPA/SW-846 6010	0.5 (RL)	58.4	EPA/SW-846 6010	0.5 (RL)	45.7	EPA/SW-846 7471	0.5 (RL)	156	EPA/SW-846 6010	2 (RL)	dry weight	
01-May-97	Chollas	<0.4	EPA/SW-846 6010	0.5 (RL)	3.1	EPA/SW-846 6010	0.5 (RL)	5.3	EPA/SW-846 7471	0.5 (RL)	27.4	EPA/SW-846 6010	2 (RL)	dry weight	
29-Sep-97	1A/1B	<0.5	EPA 6010	0.25 (DL)	67.9	EPA 6010	5 (DL)	53.9	EPA 6010	1 (DL)	179	EPA 6010	25 (DL)	assume dry weight	
29-Sep-97	2A/2B	<0.5	EPA 6010	0.25 (DL)	60.7	EPA 6010	5 (DL)	39.2	EPA 6010	1 (DL)	144	EPA 6010	25 (DL)	assume dry weight	

Appendix C: Chollas Creek Sediment Metals (Cd, Cu, Pb and Zn)

Sample Date	Station ID	Cadmium Result mg/kg	Cadmium Method	Cadmium Limit mg/kg	Copper Result mg/kg	Copper Method	Copper Limit mg/kg	Lead Result mg/kg	Lead Method	Lead Limit mg/kg	Zinc Result mg/kg	Zinc Method	Zinc Limit mg/kg	Comments	Reference
29-Sep-97	3A/3B	<0.5	EPA 6010	0.25 (DL)	69.6	EPA 6010	5 (DL)	76.0	EPA 6010	1 (DL)	157	EPA 6010	25 (DL)	assume dry weight	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report 1997-1998
30-Sep-97	Chollas	<0.5	EPA 6010	0.25 (DL)	7.9	EPA 6010	5 (DL)	9.0	EPA 6010	1 (DL)	29	EPA 6010	25 (DL)	assume dry weight	
05-May-98	1A/1B	<0.5	EPA 213.1	0.05 (DL)	59.0	EPA 220.1	0.05 (DL)	110.0	EPA 239.1	0.05 (DL)	202	EPA 289.1	0.05 (DL)	assume dry weight	
05-May-98	2A/2B	<0.5	EPA 213.1	0.05 (DL)	72.0	EPA 220.1	0.05 (DL)	130.0	EPA 239.1	0.05 (DL)	190	EPA 289.1	0.05 (DL)	assume dry weight	
05-May-98	3A/3B	<0.5	EPA 213.1	0.05 (DL)	40.0	EPA 220.1	0.05 (DL)	67.0	EPA 239.1	0.05 (DL)	102	EPA 289.1	0.05 (DL)	assume dry weight	
15-May-98	Chollas	<0.5	EPA 213.1	0.05 (DL)	<0.5	EPA 220.1	0.05 (DL)	0.8	EPA 239.1	0.05 (DL)	16.2	EPA 289.1	0.05 (DL)	assume dry weight	
18-Jun-98	978-270	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	26.8	EPA 6010	5.0 (DL)	wet weight	Lab Results. 18 June 98. Sampling by R. Kolb (P of SD) Truesdail Laboratories, Inc.
18-Jun-98	978-271	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	18.5	EPA 6010	5.0 (DL)	wet weight. Duplicate	
18-Jun-98	978-272	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	30.1	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-273	ND	EPA 6010	5.0 (DL)	6.2	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	45.6	EPA 6010	5.0 (DL)	wet weight. Duplicate	
18-Jun-98	978-274	ND	EPA 6010	5.0 (DL)	9.1	EPA 6010	5.0 (DL)	29.9	EPA 6010	12.5 (DL)	35.8	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-275	ND	EPA 6010	5.0 (DL)	32.7	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	33.6	EPA 6010	5.0 (DL)	wet weight. Duplicate	
18-Jun-98	978-276	ND	EPA 6010	5.0 (DL)	35.8	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	28.6	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-278	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	25.0	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-279	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	73.5	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-280	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	55.1	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-281	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	67.2	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-282	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	53.9	EPA 6010	5.0 (DL)	wet weight. Duplicate	
18-Jun-98	978-283	ND	EPA 6010	5.0 (DL)	10.7	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	95.9	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-284	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	50.9	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	278-285	ND	EPA 6010	5.0 (DL)	25.4	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	69.9	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-286	ND	EPA 6010	5.0 (DL)	5.6	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	125.0	EPA 6010	5.0 (DL)	wet weight. Duplicate	
18-Jun-98	978-287	ND	EPA 6010	5.0 (DL)	5.6	EPA 6010	5.0 (DL)	12.5	EPA 6010	12.5 (DL)	75.1	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-288	ND	EPA 6010	5.0 (DL)	9.1	EPA 6010	5.0 (DL)	25.3	EPA 6010	12.5 (DL)	88.9	EPA 6010	5.0 (DL)	wet weight. Duplicate	
18-Jun-98	978-289	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	36.0	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-290	ND	EPA 6010	5.0 (DL)	13.5	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	44.9	EPA 6010	5.0 (DL)	wet weight. Duplicate	

Appendix C: Chollas Creek Sediment Metals (Cd, Cu, Pb and Zn)

Sample Date	Station ID	Cadmium Result mg/kg	Cadmium Method	Cadmium Limit mg/kg	Copper Result mg/kg	Copper Method	Copper Limit mg/kg	Lead Result mg/kg	Lead Method	Lead Limit mg/kg	Zinc Result mg/kg	Zinc Method	Zinc Limit mg/kg	Comments	Reference
18-Jun-98	978-291	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	27.9	EPA 6010	12.5 (DL)	61.8	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-292	ND	EPA 6010	5.0 (DL)	7.0	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	40.1	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-293	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	42.2	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-294	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	24.8	EPA 6010	5.0 (DL)	wet weight	
18-Jun-98	978-295	ND	EPA 6010	5.0 (DL)	6.2	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	45.0	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-296	ND	EPA 6010	5.0 (DL)	5.1	EPA 6010	5.0 (DL)	23.0	EPA 6010	12.5 (DL)	56.9	EPA 6010	5.0 (DL)	wet weight	Lab Results. 19 June 98. Sampling by R. Kolb (P of SD) Truesdail Laboratories, Inc.
19-Jun-98	978-297	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	42.6	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-298	ND	EPA 6010	5.0 (DL)	5.4	EPA 6010	5.0 (DL)	53.5	EPA 6010	12.5 (DL)	67.9	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-299	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	13.8	EPA 6010	12.5 (DL)	56.2	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-300	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	51.4	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-301	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	26.0	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-302	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	44.3	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-303	ND	EPA 6010	5.0 (DL)	5.9	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	43.2	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-304	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	32.2	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-305	ND	EPA 6010	5.0 (DL)	9.7	EPA 6010	5.0 (DL)	20.8	EPA 6010	12.5 (DL)	112.0	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-306	ND	EPA 6010	5.0 (DL)	17.9	EPA 6010	5.0 (DL)	129.0	EPA 6010	12.5 (DL)	203.0	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-307	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	44.2	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-308	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	32.1	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-309	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	18.8	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-310	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	23.0	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-311	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	44.5	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-312	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	25.8	EPA 6010	5.0 (DL)	wet weight	
19-Jun-98	978-313	ND	EPA 6010	5.0 (DL)	9.0	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	42.6	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-314	ND	EPA 6010	0.4	13.7	EPA 6010	0.4	150.0	EPA 6010	1.0	72.8	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-315	ND	EPA 6010	5.0 (DL)	8.2	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	88.8	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-316	?	EPA 6010	5.0 (DL)	?	EPA 6010	5.0 (DL)	?	EPA 6010	12.5 (DL)	?	EPA 6010	5.0 (DL)	wet weight. metals analysis requested, data report missing	

Appendix C: Chollas Creek Sediment Metals (Cd, Cu, Pb and Zn)

Sample Date	Station ID	Cadmium Result mg/kg	Cadmium Method	Cadmium Limit mg/kg	Copper Result mg/kg	Copper Method	Copper Limit mg/kg	Lead Result mg/kg	Lead Method	Lead Limit mg/kg	Zinc Result mg/kg	Zinc Method	Zinc Limit mg/kg	Comments	Reference
26-Jun-98	978-317	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	34.2	EPA 6010	5.0 (DL)	wet weight	Lab Results. 26 June 98. Sampling by R. Kolb (P of SD) Truesdail Laboratories, Inc.
26-Jun-98	978-318	1.1	EPA 6010	0.4	26.3	EPA 6010	0.4	36.7	EPA 6010	1.0	182.0	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-319	ND	EPA 6010	0.4	6.1	EPA 6010	0.4	9.2	EPA 6010	1.0	53.8	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-320	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	25.9	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-321	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	34.2	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-322	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	17.6	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-323	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	5.8	EPA 6010	12.5 (DL)	30.9	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-324	ND	EPA 6010	0.4	20.0	EPA 6010	0.4	1.7	EPA 6010	1.0	26.2	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-325	ND	EPA 6010	0.4	4.0	EPA 6010	0.4	6.7	EPA 6010	1.0	24.3	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-326	0.44	EPA 6010	0.4	9.1	EPA 6010	0.4	12.3	EPA 6010	1.0	81.1	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-327	?	EPA 6010	5.0 (DL)	?	EPA 6010	5.0 (DL)	?	EPA 6010	12.5 (DL)	?	EPA 6010	5.0 (DL)	wet weight. metals analysis requested, data report missing	
26-Jun-98	978-328	?	EPA 6010	5.0 (DL)	?	EPA 6010	5.0 (DL)	?	EPA 6010	12.5 (DL)	?	EPA 6010	5.0 (DL)	wet weight. metals analysis requested, data report missing	
26-Jun-98	978-329	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	26.2	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-330	ND	EPA 6010	0.4	2.2	EPA 6010	0.4	ND	EPA 6010	1.0	16.0	EPA 6010	0.4	wet weight. analyzed on 28 Sep 98	
26-Jun-98	978-331	?	EPA 6010	5.0 (DL)	?	EPA 6010	5.0 (DL)	?	EPA 6010	12.5 (DL)	?	EPA 6010	5.0 (DL)	wet weight. metals analysis requested, data report missing	
26-Jun-98	978-332	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	5.7	EPA 6010	12.5 (DL)	21.9	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-333	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	20.2	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-334	ND	EPA 6010	5.0 (DL)	23.9	EPA 6010	5.0 (DL)	52.9	EPA 6010	12.5 (DL)	72.9	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-335	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	32.3	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-336	ND	EPA 6010	5.0 (DL)	7.1	EPA 6010	5.0 (DL)	34.7	EPA 6010	12.5 (DL)	52.9	EPA 6010	5.0 (DL)	wet weight	
26-Jun-98	978-337	22.9	EPA 6010	5.0 (DL)	ND	EPA 6010	5.0 (DL)	ND	EPA 6010	12.5 (DL)	20.9	EPA 6010	5.0 (DL)	wet weight	
28-Sep-98	1A/1B	<0.5	EPA 6010A	0.5	51.7	EPA 6010A	0.5	27.0	EPA 6010	0.5	143.0	EPA 6010A	0.5	assume dry weight	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report 1998-1999
28-Sep-98	2A/2B	<0.5	EPA 6010A	0.5	83.6	EPA 6010A	0.5	34.8	EPA 6010	0.5	172.0	EPA 6010A	0.5	assume dry weight	
28-Sep-98	3A/3B	<0.5	EPA 6010A	0.5	57.9	EPA 6010A	0.5	31.8	EPA 6010	0.5	117.0	EPA 6010A	0.5	assume dry weight	
29-Sep-98	Chollas	<0.5	EPA 6010A	0.5	3.3	EPA 6010A	0.5	8.2	EPA 6010	0.5	260.0	EPA 6010A	0.5	assume dry weight	
10-May-99	1A/1B	2.5	EPA 6010A	0.5	103.0	EPA 6010A	0.5	52.0	EPA 6010	0.5	211.0	EPA 6010A	0.5	assume dry weight	
10-May-99	2A/2B	2.4	EPA 6010A	0.5	86.0	EPA 6010A	0.5	56.0	EPA 6010	0.5	205.0	EPA 6010A	0.5	assume dry weight	
10-May-99	3A/3B	1.8	EPA 6010A	0.5	84.0	EPA 6010A	0.5	46.0	EPA 6010	0.5	221.0	EPA 6010A	0.5	assume dry weight	
11-May-99	Chollas	0.5	EPA 6010A	0.5	22.0	EPA 6010A	0.5	73.0	EPA 6010	0.5	75.0	EPA 6010A	0.5	assume dry weight	

Appendix C: Chollas Creek Sediment Metals (Cd, Cu, Pb and Zn)

Sample Date	Station ID	Cadmium Result mg/kg	Cadmium Method	Cadmium Limit mg/kg	Copper Result mg/kg	Copper Method	Copper Limit mg/kg	Lead Result mg/kg	Lead Method	Lead Limit mg/kg	Zinc Result mg/kg	Zinc Method	Zinc Limit mg/kg	Comments	Reference
27-Sep-98	1A/1B	<0.5	EPA 6010A	0.5 (RL)	89.1	EPA 6010A	0.5 (RL)	52.4	EPA 6010	0.5 (RL)	172.0	EPA 6010A	0.5 (RL)	assume dry weight	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Report 1999-2000
27-Sep-98	2A/2B	<0.5	EPA 6010A	0.5 (RL)	90.4	EPA 6010A	0.5 (RL)	68.0	EPA 6010	0.5 (RL)	166.0	EPA 6010A	0.5 (RL)	assume dry weight	
27-Sep-98	3A/3B	<0.5	EPA 6010A	0.5 (RL)	99.5	EPA 6010A	0.5 (RL)	76.8	EPA 6010	0.5 (RL)	173.0	EPA 6010A	0.5 (RL)	assume dry weight	
27-Sep-98	Chollas	0.8	EPA 6010A	0.5 (RL)	4.7	EPA 6010A	0.5 (RL)	23.2	EPA 6010	0.5 (RL)	32.7	EPA 6010A	0.5 (RL)	assume dry weight	
3-May-00	1A/1B	<0.5	EPA 6010A	0.5 (RL)	77.4	EPA 6010A	0.5 (RL)	82.4	EPA 6010	0.5 (RL)	186.0	EPA 6010A	0.5 (RL)	assume dry weight	
3-May-00	2A/2B	<0.5	EPA 6010A	0.5 (RL)	168.0	EPA 6010A	0.5 (RL)	79.5	EPA 6010	0.5 (RL)	253.0	EPA 6010A	0.5 (RL)	assume dry weight	
3-May-00	3A/3B	<0.5	EPA 6010A	0.5 (RL)	108.0	EPA 6010A	0.5 (RL)	76.3	EPA 6010	0.5 (RL)	261.0	EPA 6010A	0.5 (RL)	assume dry weight	
3-May-00	Chollas	<0.5	EPA 6010A	0.5 (RL)	26.0	EPA 6010A	0.5 (RL)	32.5	EPA 6010	0.5 (RL)	108.0	EPA 6010A	0.5 (RL)	assume dry weight	
2-Oct-00	1A/1B	<0.1	EPA 3050/6020	no info	4.6	EPA 3050/6020	no info	10.3	EPA 3050/6020	no info	33.0	EPA 3050/6020	no info	dry weight; 03-Oct-00 is before first rain; no post-rain data	City of San Diego and Co-Permittee NPDES Stormwater Monitoring Program Draft Report 2000-2001
2-Oct-00	2A/2B	0.3	EPA 3050/6020	no info	76.0	EPA 3050/6020	no info	46.5	EPA 3050/6020	no info	99.0	EPA 3050/6020	no info	dry weight; 03-Oct-00 is before first rain; no post-rain data	
2-Oct-00	3A/3B	0.4	EPA 3050/6020	no info	126.0	EPA 3050/6020	no info	68.4	EPA 3050/6020	no info	172.0	EPA 3050/6020	no info	dry weight; 03-Oct-00 is before first rain; no post-rain data	
3-Oct-00	Chollas	0.5	EPA 3050/6020	no info	116.0	EPA 3050/6020	no info	65.7	EPA 3050/6020	no info	172.0	EPA 3050/6020	no info	dry weight; 03-Oct-00 is before first rain; no post-rain data	
17 and 18 Jul 01	C14	1.4	-	-	94.9	-	-	103.0	-	-	347.0	-	-		Characterization of Sediment Toxicity in Chollas and Paleta Creek Toxic Hot Spot Sediments, San Diego Bay Summary Report, SCCWRP. 23 Apr 2003.
12-Sep-01	Chollas Creek North Fork	<0.1	EPA 3050/6020	0.1 (RL)	5.5	EPA 3050/6020	0.5 (RL)	7.9	EPA 3050/6020	0.5 (RL)	37.0	EPA 3050/6021	5 (RL)	dry weight; report also contains wet weight values (see Excel Comments)	City of San Diego and Co-Permittees NPDES Storm Water Monitoring Program Addendum 2000-2001
12-Sep-01	Chollas Creek South Fork	0.8	EPA 3050/6020	0.2 (RL)	41.6	EPA 3050/6020	0.8 (RL)	68.9	EPA 3050/6020	7.9 (RL)	252.0	EPA 3050/6022	79 (RL)	dry weight; report also contains wet weight values (see Excel Comments)	
12-Sep-01	Chollas Creek South Fork (Dup)	0.8	EPA 3050/6020	0.2 (RL)	40.9	EPA 3050/6020	0.8 (RL)	67.0	EPA 3050/6020	7.9 (RL)	269.0	EPA 3050/6023	79 (RL)	dry weight; report also contains wet weight values (see Excel Comments); duplicate	
12-Sep-01	Chollas Creek Downstream	0.2	EPA 3050/6020	0.1 (RL)	8.5	EPA 3050/6020	0.5 (RL)	17.4	EPA 3050/6020	0.5 (RL)	37.0	EPA 3050/6024	5 (RL)	dry weight; report also contains wet weight values (see Excel Comments)	

Appendix C: Sediment Sampling Stations in Chollas Creek

Date of Sampling	Station ID	Location	Sampler	Comments
18-Jun-98	978-270	S. Chollas u/s of confluence	RK	
18-Jun-98	978-271	S. Chollas u/s of confluence	BC	Duplicate
18-Jun-98	978-272	N. Chollas u/s of confluence	BC	
18-Jun-98	978-273	N. Chollas u/s of confluence	BC	Duplicate
18-Jun-98	978-274	Main Chollas d/s of confluence	BC	
18-Jun-98	978-275	Main Chollas d/s of confluence	BC	Duplicate
18-Jun-98	978-276	S. Chollas u/s of National Ave	RK	
18-Jun-98	978-278	S. Chollas d/s of National Ave	BC	
18-Jun-98	978-279	S. Chollas d/s of Imperial Ave	BC	
18-Jun-98	978-280	S. Chollas d/s of Imperial Ave in ditch	RK	
18-Jun-98	978-281	S. Chollas u/s of Imperial Ave	BC	
18-Jun-98	978-282	S. Chollas u/s of Imperial Ave	RK	Duplicate
18-Jun-98	978-283	S. Chollas u/s of 47th Street	BC	
18-Jun-98	978-284	S. Chollas d/s of 47th Street	RK	
18-Jun-98	278-285	S. Chollas Encanto Branch u/s of confluence	BC	
18-Jun-98	978-286	S. Chollas Encanto Branch u/s of confluence	RK	Duplicate
18-Jun-98	978-287	S. Chollas u/s of Encanto confluence	RK	
18-Jun-98	978-288	S. Chollas u/s of Encanto confluence	RK	Duplicate
18-Jun-98	978-289	S. Chollas d/s of Encanto confluence	BC	
18-Jun-98	978-290	S. Chollas d/s of Encanto confluence	RK	Duplicate
18-Jun-98	978-291	S. Chollas w/in Radio Canyon Branch	BC	
18-Jun-98	978-292	S. Chollas u/s of Radio Cnyn Branch confluence	BC	
18-Jun-98	978-293	S. Chollas d/s of Radio Cnyn Branch confluence	RK	
18-Jun-98	978-294	S. Chollas Jamacha Branch u/s of confluence w/Encanto Branch west of 68th St	BC	
18-Jun-98	978-295	S. Chollas Jamacha Branch u/s of confluence w/Encanto Branch at 69th St	RK	
19-Jun-98	978-296	S. Chollas Main Branch at Lenox	BC	
19-Jun-98	978-297	S. Chollas Main Branch at Lenox	RK	Duplicate
19-Jun-98	978-298	S. Chollas Main Branch at Kelton	BC	
19-Jun-98	978-299	S. Chollas Main Branch 600' E of Kelton	RK	
19-Jun-98	978-300	S. Chollas Main Branch at Federal	RK	
19-Jun-98	978-301	S. Chollas Main Branch at 6700 Central	RK	
19-Jun-98	978-302	Main Chollas at Logan/Gregory	BC	
19-Jun-98	978-303	Main Chollas at National Ave-north side	RK	
19-Jun-98	978-304	Main Chollas at National Ave - south side	RK	
19-Jun-98	978-305	Main Chollas at National Ave - north side in storm drain	BC	
19-Jun-98	978-306	Main Chollas at 35th & Martin	RK	
19-Jun-98	978-307	Main Chollas in the Greenwood Cemetary Tributary	RK	
19-Jun-98	978-308	Main Chollas at Market (1 block west)	BC	
19-Jun-98	978-309	Main Chollas at Market (east)	RK	

Appendix C: Sediment Sampling Stations in Chollas Creek

Date of Sampling	Station ID	Location	Sampler	Comments
19-Jun-98	978-310	Main Wabash Branch (north of 94)	RK	
19-Jun-98	978-311	Home Ave Branch u/s of Main Chollas in storm drain	RK	
19-Jun-98	978-312	Home Ave Branch u/s of Main Chollas u/s of storm drain	BC	
19-Jun-98	978-313	Home Ave Branch u/s of Main Chollas d/s of storm drain	RK	
26-Jun-98	978-314	Main Chollas at Home Ave above pipe	DL	
26-Jun-98	978-315	Main Chollas at Home Ave below pipe	BC	
26-Jun-98	978-316	Main Chollas at Home Ave at pipe	BC	
26-Jun-98	978-317	Main Chollas at Home Ave E of Menlo d/s of pipe	BC	
26-Jun-98	978-318	Main Chollas at Home Ave E of Menlo in side ditch	BC	
26-Jun-98	978-319	Main Chollas at Home Ave E of Menlo u/s of pipe	DL	
26-Jun-98	978-320	Main Chollas at Home Ave E of Euclid	DL	
26-Jun-98	978-321	Main Chollas at Home Ave d/s of Auburn Dr	DL	
26-Jun-98	978-322	Main Chollas at Home Ave u/s of Auburn Dr	DL	
26-Jun-98	978-323	Main Chollas at Home Ave 1000' E of Auburn / Ontario	BC	
26-Jun-98	978-324	Main Chollas u/s of Federal / 805 u/s of side drainage	DL	
26-Jun-98	978-325	Main Chollas u/s of Federal / 805 in side drainage	DL	
26-Jun-98	978-326	Main Chollas u/s of Federal / 805 d/s of drainage	BC	
26-Jun-98	978-327	Main Chollas u/s of Chollas Lake drain	BC	Samples 327-329 and 330-332 were taken from u/s to d/s according to the time entry on the COC.
26-Jun-98	978-328	Main Chollas in Chollas Lake drain	DL	
26-Jun-98	978-329	Main Chollas d/s of Chollas Lake drain	DL	
26-Jun-98	978-330	Main Chollas u/s of Trailer Park Drain	BC	
26-Jun-98	978-331	Main Chollas in Trailer Park Drain	DL	
26-Jun-98	978-332	Main Chollas d/s of Trailer Park Drain	BC	
26-Jun-98	978-333	Main Chollas east of Euclid	DL	
26-Jun-98	978-334	Main Chollas east of 54th Street		
26-Jun-98	978-335	Main Chollas, deep and just u/s of S. Chollas		sampled from u/s to d/s according to the time entries on the COC.
26-Jun-98	978-336	S. Chollas, deep, just u/s of Main Chollas		
26-Jun-98	978-337	Main Chollas, deep and just d/s of S. Chollas		
23-Sep-94	PREBAY1	composite from stations 1A and 1B pre-wet season		
23-Sep-94	PREBAY2	composite from stations 2A and 2B pre-wet season		
23-Sep-94	PREBAY3	composite from stations 3A and 3B pre-wet season		
25-Sep-94	PRECREEK1	approximately .25 miles upstream from SD8(1), pre-wet season		
09-May-95	POSTCREEK1	approximately .25 miles upstream from SD8(1), post-wet season		
10-May-95	POSTBAY1	composite from stations 1A and 1B post-wet season		
10-May-95	POSTBAY2	composite from stations 2A and 2B post-wet season		
10-May-95	POSTBAY3	composite from stations 3A and 3B post-wet season		
	1A (SD Bay)	lat 32 deg 41.251"/ long 117 deg 07.938"		
	1B (SD Bay)	lat 32 deg 41.238"/ long 117 deg 07.935"		
	2A (SD Bay)	lat 32 deg 41.248"/ long 117 deg 07.953"		

Appendix C: Sediment Sampling Stations in Chollas Creek

Date of Sampling	Station ID	Location	Sampler	Comments
	2B (SD Bay)	lat 32 deg 41.233"/ long 117 deg 07.941"		
	3A (SD Bay)	lat 32 deg 41.241"/ long 117 deg 07.955"		
	3B (SD Bay)	lat 32 deg 41.222"/ long 117 deg 09.954"		
	chollas			
12-Sep-01	Chollas Crk North Fork			GPS coordinates mentioned, but not supplied
12-Sep-01	Chollas Crk South Fork			
12-Sep-01	Chollas Crk South Fork (Dup)			
12-Sep-01	Chollas Creek Downstream			

Appendix D

Wet and Dry Weather Models

Used in the Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

Table of Contents

List of Tables and Figures

1. Watershed Modeling and General Considerations

Models are developed as tools to perform experiments on watersheds that would otherwise be impractical or impossible due to cost, personnel, or time constraints (Nix, 1994). A significant advantage of watershed modeling is the ability to process and effectively present copious amounts of spatial and time-series data. Additionally, models can prove beneficial in data-limited environments; they can estimate values for unavailable or incomplete data sets by utilizing available preexisting data in the model calibration process. These functionalities allow users to determine the impacts of different parameters on the natural processes occurring in a watershed.

Watershed-scale models range from simple to complex. Simple models are used to rapidly identify critical areas in the environment and are often utilized when data limitations and financial constraints prohibit the use of more complex models. Simple models describe a limited number of hydrologic and water quality processes and are used to estimate pollutant loadings, thus acting as a screening tool. More complex models depend on deterministic algorithms that closely simulate the physical processes in the watershed. Additionally, such models are data intensive and require substantial model calibration to accurately depict the natural system.

In selecting an appropriate approach to support the Total Maximum Daily Load (TMDL) for Chollas Creek, technical and regulatory criteria were considered. Technical criteria include the physical system in question, including the constituents of interest and watershed or stream characteristics and processes (physical domain, source contributions, critical conditions, and constituents). Consideration of each topic was critical in selecting the most appropriate modeling system to address the types of sources associated with the listed waters.

Representation of the physical domain is perhaps the most important consideration in model selection. The physical domain is the focus of the modeling effort—typically, either the receiving water itself or a combination of the contributing watershed and the receiving water. Selection of the appropriate modeling domain depends on the constituents and the conditions under which the stream exhibits impairment. For streams affected additionally or solely by nonpoint sources or primarily rainfall-driven flow and pollutant contributions, a dynamic approach is recommended. Dynamic watershed models consider time-variable nonpoint source contributions from a watershed surface or subsurface. Some models consider monthly or seasonal variability, while others enable assessment of conditions immediately before, during, and after individual rainfall events. Dynamic models require a substantial amount of information regarding input parameters and data for calibration purposes.

1.1. Source Contributions of Metal Loads

The primary sources contributions of metal loads to Chollas Creek had to be considered in the model selection process. Accurately representing contributions from nonpoint sources and regulated point sources is critical in properly representing the system and ultimately evaluating potential load reduction scenarios.

Water quality monitoring data were not sufficient to fully characterize all sources of metals in the Chollas Creek watershed. However, analyses of the available data indicate that the main sources are associated with surface runoff. As a result, the models selected to develop copper, lead, and zinc TMDLs for the Chollas Creek watershed need to address the major source categories during dry and wet weather conditions.

1.2. Critical Conditions

The critical condition is the set of natural conditions, including flow rates and critical points that identifies when and where a water body exhibits the most vulnerability. In the Chollas Creek Metals TMDL project, separate critical flow conditions were identified for dry and wet weather conditions. This allowed for a better characterization of the critical condition than only addressing a single critical flow condition. Additionally for the Chollas Creek Metals TMDL project, a critical point was selected at the mouth of the Chollas Creek watershed. A critical point is a location in an impaired water body that is selected based on high pollutant loads predicted at that location. Not only does the Clean Water Act (CWA) require that critical conditions be taken into account [40 CFR 130.7(c)], but both the identification of dry and wet weather critical flow conditions and the Chollas Creek watershed's critical point are useful in conservatively assessing impairments to Water Quality Objectives (WQOs) and in directing implementation of load reduction strategies. However, although this critical point for water quality assessment is utilized for TMDL analysis, compliance to WQOs must be assessed and maintained for all segments in the Chollas Creek watershed to ensure that beneficial uses are protected.

1.3. Constituents

Another important consideration in model selection and application is the constituent(s) to be assessed. Choice of state variables is a critical part of model implementation. The more state variables included, the more difficult the model will be to apply and calibrate. However, if key state variables are omitted from the simulation, the model might not simulate all necessary aspects of the system and might produce unrealistic results. A delicate balance must be met between minimal constituent simulation and maximum applicability.

The focuses of the Chollas Creek Metals TMDL project is assessing the copper, lead, and zinc loads that cause impairment to the beneficial uses of the Chollas Creek watershed. These metal loads can be estimated by combining the flow rates and concentration. Factors affecting the concentration of metals include hardness, pH, and available sediment. Metal concentrations in the water column are also influenced by in-stream losses and settling. In-stream metal dynamics can be extremely complex, and accurate estimation of concentrations relies on a host of interrelated environmental factors. The available data provided few insights into which other factors might be most influential on metal behavior for the model.

1.4. Regulatory Criteria

A properly designed and applied model provides the source analysis component of the Chollas Creek Metals TMDL project. The Regional Water Quality Control Board, San Diego Region's (Regional Board) Basin Plan establishes, for all waters in the San Diego region, the beneficial uses to be protected, the WQOs that those uses, and an implementation plan that achieves those objectives (Regional Board, 1994). For the watershed source analysis and the implementation plan, it is also important that the modeling platform enable examination of gross land use loading as well as in-stream concentration.

1.5. Application of San Diego Regional Hydrologic Model for both Dry and Wet Weather Models

The San Diego regional hydrologic model described in this appendix was originally designed to simulate dry weather bacteria concentrations in the San Diego region, as described in *Bacteria TMDLs for Beaches and Inland Surface Waters of the San Diego Region – DRAFT* (Tetra Tech, Inc., 2004). Because the flow model was based on data from the San Diego region and has robustly calibrated and validated measured parameters for the San Diego region, it is appropriate to use for the Chollas Creek Metals TMDL project. This single set of parameters was calibrated and validated over a diverse geographic (includes mountainous and coastal regions as well as highly urbanized and open areas) and temporal scale (includes extreme dry and wet weather periods), and can therefore be applied to many of the ungaged streams within the San Diego region, including Chollas Creek.

Without this regional set of parameter values, a watershed model would be unfeasible for the source analysis support needed for the Chollas Creek Metals TMDL project. By applying the regionally calibrated hydrology parameter values to the updated watershed delineations and land use reclassifications for the Chollas Creek watershed, flow was simulated for the watershed. Current analyses utilize the calibrated flow parameters from the San Diego regional hydrologic model, while considering additional local information. This appendix describes model set-up, calibration, and validation of the San Diego regional hydrologic model, emphasizes why this regional model is applicable to the Chollas Creek watershed, and notes the modifications that were made to adapt the model for the Chollas Creek watershed.

1.6. Model Calibration and Validation

After any model is configured, model calibration and validation must be performed to ensure the natural environment is represented as accurately as possible. For watershed modeling, this is generally a two-phase process, with hydrology (flow rate) calibration and validation completed before repeating the process for water quality (pollutant concentration). Upon completion of the calibration and validation at selected locations, a calibrated dataset containing parameter values for each modeled land use and pollutant was developed.

2. Estimated Existing Loads for Dry and Wet Weather Conditions

2.1. Explanation of Dry and Wet Weather Conditions

A distinction is made between dry and wet weather conditions because the sources and amounts of metals vary between the two scenarios and implementation measures will be specific to these conditions. Existing copper, lead, and zinc loads were estimated for both dry and wet weather conditions to provide year-round representation of the Chollas Creek watershed.

Utilizing separate approaches for dry and wet weather conditions ensured that the Chollas Creek Metals TMDL project addressed the variable flow patterns in the Chollas Creek watershed with an appropriate methodology. A flow-based cutoff to separate dry and wet weather conditions, as opposed to a dry and wet weather season approach, was applied to accurately capture rainfall events and sustained dry periods throughout the year. The dry weather flow approach uses a steady-state model to estimate existing loads during dry periods that are not addressed through the wet weather flow rate approach.

Before existing loads for dry and wet weather conditions could be estimated, the two conditions need finite definitions. Dry weather conditions are based on dry weather days that were selected based on the criterion that less than 0.2 inch of rainfall was observed on each of the previous three days[1]. A wet weather condition was characterized as any flow greater than the dry weather condition criteria as predicted by the dry weather model based on the definition above.

2.2. Dry and Wet Weather Critical Flow Conditions

The dry weather critical flow condition was based on predictions of steady-state flows, which were derived through modeling analysis of average dry weather flows observed in the San Diego region. The dry weather critical condition was based on the prediction of steady-state flows. As described in section 3, regionally calibrated model parameters were developed through a modeling analysis of average dry weather flows observed in Aliso Creek (2001), Rose Creek (2001-2002), and Tecolote Creek (2001-2002). These parameters were applied to the Chollas Creek watershed to determine the watershed-specific critical dry weather flow condition.

To ensure protection of the Chollas Creek watershed during wet weather conditions, a critical flow condition was selected based on identification of the 93rd percentile of annual rainfall observed over the past 14 years (1990 through 2003) at multiple rainfall gages in the San Diego region. Essentially the critical flow condition was based on the wettest year of the past 14 years. This resulted in selection of 1993 as the critical wet year for assessment of wet weather conditions. This critical flow condition was consistent with studies performed by the Southern California Coastal Research Project (SCCWRP), where a 90th percentile year was selected based on rainfall data for the Los Angeles Airport from 1947 to 2000, also resulting in selection of 1993 as the critical wet year (Regional Water Quality Control Board, Los Angeles Region (LARWQCB), 2002).

2.3. Estimated Existing Annual Loads from Dry and Wet Weather Models

According to the CWA [40 CFR 130.2 (i) and 40 CFR 130.7 © (1)] a TMDL document must analyze all sources, and the magnitude and location of the sources. In order to comply with

[1] This definition comes from the California Department of Environmental Health's general advisory that is issued to alert the public of ocean and bay water contamination by urban runoff. It is also supported by CFR section 122.21 and section 122.26.

the CWA, both the dry and wet weather models were used to estimate existing annual loads of copper, lead, and zinc. In addition the mass loadings estimated from the model outputs also offer support for the implementation plan. Relative amounts of mass loadings for dry and wet weather conditions can identify where more serious problems occur and on which subwatersheds or land uses efforts should be concentrated. For example, for all three metals, freeways and commercial/institutional land uses have the highest relative loading contributions. Responsible parties may want to concentrate efforts on controlling metal sources in these areas.

The simulated flow rate was combined with average in-stream dry weather concentrations for dissolved copper, lead, and zinc in order to estimate basin-wide existing loads for each metal (Table 1). The estimated loads for the dry weather critical flow conditions were the same as the average estimated loads for the dry weather typical condition because the dry weather metal concentration could not be simulated due to limited observed data for calibration. The estimated existing loads for the wet weather critical flow rate condition and the average estimated existing loads (1990-2003) for the wet typical weather condition are provided in Table 2 and Table 3 for each metal. All estimated existing loads are calculated at the mouth of the Chollas Creek watershed, which is the critical point.

Table 1. Estimated existing loads (grams per year) for the dry weather critical flow condition and average estimated existing loads for the dry weather typical condition at the critical point.

Copper (dissolved)	Lead (dissolved)	Zinc (dissolved)
692	168	986

Table 2. Estimated existing loads (grams per year) for the wet weather critical flow rate condition at the mouth of the Chollas Creek watershed.

Copper (dissolved)	Lead (dissolved)	Zinc (dissolved)
984,549	705,142	5,993,255

Table 3. Average estimated existing loads (grams per year) for the average wet weather condition for 1990 through 2003 at the critical point.

Copper (dissolved)	Lead (dissolved)	Zinc (dissolved)
232,137	194,007	1,326,407

2.4. Model Assumptions/Limitations

While highly beneficial tools for analyzing surface runoff pollution problems, all mathematical models are based on assumptions or inferences made about the processes and systems being simulated, which must be considered (Charbeneau & Barrett, 1998; Loague, Corwin, & Ellsworth, 1998; Nix, 1994; Tim & Jolly, 1994). These limitations include the steep learning curve for model use, the accuracy of the mathematical equations, and inadequacies and assumptions of the input data (Charbeneau & Barrett, 1998; Nix, 1994; Tim & Jolly, 1994). Model users must keep in mind that a model is a tool; and while it can extract information, it cannot overcome data inadequacies or assumptions. The specific assumptions made with the modeling approach used for in the Chollas Creek Metals TMDL project include but are not limited to the following:

2.4.1. General Model Assumptions

- The critical point was assumed to be at the mouth of the Chollas Creek watershed.
- Water quality monitoring data were not sufficient to fully characterize all sources of metals in the Chollas Creek watershed.
- The limited data available provide few insights into which other factors might be most influential on metal behavior for the model

2.4.2. Wet Weather Model Assumptions

The following assumptions are relevant to the Loading Simulation Program written in C++ (LSPC) model developed to simulate wet-weather sources of metals in Chollas Creek.

- *Source Representation* - All sources can be represented through build-up/wash-off of metals from specific land use types.
- *Flow* - Because modeled and observed flow ranges are similar, a simulation program hydrology model flow rate results were considered representative of flow in the Chollas Creek watershed. Differences can be explained by localized events, and until additional flow data become available, further calibration is not possible, nor warranted.
- *Water Quality Data* - Observed water quality data, unlike stream flow data, are usually not continuous; thus making time-series comparisons difficult and reducing the accuracy of the water quality model calibration.
- *General LSPC/HSPF Model Assumptions* - Many model assumptions are inherent in the algorithms used by the LSPC watershed model and are reported extensively in Bicknell et al. (1996).
- *Land Use* - The San Diego Association of Governments (SANDAG) land use GIS dataset is assumed representative of the current land use areas. For areas where significant changes in land use have occurred since the creation of these datasets, model predictions may not be representative of observed conditions.
- *Stream Representation* - Each delineated subwatershed was represented with a single stream assumed to be a completely mixed, one-dimensional segment with a trapezoidal cross-section.
- *Hydrologic Modeling Parameters* - Hydrologic modeling parameters were developed during previous modeling studies in Southern California (e.g., LA River, San Jacinto River) and refined through calibration to stream flow data collected in the San Diego region. Through the calibration and validation process (reported in the Bacteria TMDLs for the San Diego Region), a set of modeling parameters were obtained specific to land use and hydrologic soil groups. These parameters are assumed to be representative of the hydrology of the Chollas Creek watershed, which is presently ungaged and therefore unverified.

- *Water Quality Modeling Parameters* - Dynamic models require a substantial amount of information regarding input parameters and data for calibration purposes. All sources of metals from watersheds are represented in the LSPC model as build-up/wash-off from specific land use types. Limited data are currently available in the San Diego region to allow development of unique modeling parameters for simulation of build-up/wash-off, so initial parameters values were obtained from land use-specific storm water data in the Los Angeles region. These build-up/wash-off modeling parameters were refined during the calibration and validation process in which observed data from Chollas Creek were compared with the model predicted values.
- *Lumped Parameter Model Characteristic* - LSPC is a lumped-parameter model and is assumed to be sufficient for modeling transport of flows and metal loads from watersheds in the region. For lumped parameter models, transport of flows and metal loads to the streams within a given model subwatershed cannot consider relative distances of land use activities and topography that may enhance or impede time of travel over the land surface.
- *First-order Losses* - Each stream is modeled assuming first-order loss of metals.
- *Wet-weather Critical Condition* – The critical wet-weather condition was selected based on identification of the 93rd percentile of annual rainfalls observed over the past 12 years (1990 through 2002) at multiple rainfall gages in the San Diego region. This resulted in selection of 1993 as the critical wet year for assessment of wet weather loading conditions. This condition was consistent with studies performed by SCCWRP, where a 90th percentile year was selected based on rainfall data for the Los Angeles Airport (LAX) from 1947 to 2000, also resulting in selection of 1993 as the critical year (LARWQCB, 2002).

2.4.3. Dry Weather Model Assumptions

The following assumptions are relevant to the watershed modeling system developed for simulation of steady-state dry-weather flows and sources of metals.

- *Limited Dry Weather Data* - Because there were only seven in-stream dry weather metal concentration data points in the Chollas Creek watershed, copper, lead, and zinc concentrations could not be simulated. Therefore, land use specific loadings and more detailed analyses could not be calculated.
- *Stream Representation* - This predictive model represents the stream network as a series of plug-flow reactors, with each reactor having a constant, steady state flow and pollutant load.
- *Flow Condition* - These constant flows were assumed representative of the average flow caused by various urban land use practices (e.g., runoff from lawn irrigation or sidewalk washing).
- *Channel Geometry* - Channel geometry during low-flow, dry-weather conditions is assumed to be represented appropriately using equations derived from flows and physical data collected at 53 U.S. Geological Survey (USGS) stream gages in Southern California.

- *Steady-state Model Configuration* - Although dry-weather flows vary over time for any given stream, for prediction of average conditions in the stream, flows were assumed to be steady state.
- *Plug Flow Model Configuration* - Plug flow reaction kinetics were assumed sufficient in modeling dry-weather, steady state stream routing.
- *Sources for Characterization of Dry-weather Conditions* - Data used for characterization of dry-weather flows were assumed representative of conditions throughout the region.
- *Methods for Characterization of Dry-weather Conditions* - The equations derived through multivariable regression analyses were assumed sufficient to represent the dry-weather flows as a function of land use and watershed size. This assumption was verified through model calibration and validation reported.
- *Stream Infiltration* - Losses of volume through stream infiltration were modeled assuming infiltration rates were constant for each of the four hydrologic soil groups (A, B, C, and D[2]). Infiltration rates were based on literature vales and refined through model calibration and validation. The resulting infiltration rates were 1.368 inches per hour (in/hr) (Soil Group A), 0.698 in/hr (Soil Group B), 0.209 in/hr (Soil Group C), and 0.084 in/hr (Soil Group D). These infiltration rates are within the range of values found in literature (Wanielisata et al., 1997). These infiltration rates are assumed representative for all streams studied in the region within each hydrologic soil group.
- *Dry-weather Critical Condition* - The critical dry period was based on predictions of steady-state flows based on results of analysis of average dry-weather flows observed in Aliso Creek, Rose Creek, and Tecolote Creek. Dry-weather days were selected based on the criterion that less than 0.2 inch of rainfall was observed on each of the previous 3 days.

3. Dry Weather Model

During dry weather conditions, many streams exhibit a sustained base flow even if no rainfall has occurred for a significant period to provide storm water runoff or groundwater flows. These sustained flows are generally understood to result from various urban land use practices (e.g. lawn irrigation runoff, car washing, and sidewalk washing) and are referred to as urban runoff. As these urban runoffs travel across land areas (e.g. lawns and other urban surfaces), accumulated metal loads are carried from these areas to receiving waterbodies.

[2] Group A Soils have low runoff potential and high infiltration rates even when wet. They consist chiefly of sand and gravel and are well drained to excessively-drained. Group B Soils have moderate infiltration rates when wet and consist chiefly of soils that are moderately-deep to deep, moderately- to well-drained, and moderately course textures. Group C Soils have low infiltration rates when wet and consist chiefly of soils having a layer that impedes downward movement of water with moderately-fine to fine texture. Group D Soils have high runoff potential, very low infiltration rates and consist chiefly of clay soils. These soils also include urban areas (USDA, 1986).

The dry weather model was used to estimate the flow rates of urban runoff in the Chollas Creek watershed. The average metal concentrations were used to estimate the existing metal concentrations that end up in Chollas Creek from urban runoff transportation of metal loads. Figure 1 is a visual representation of how the model outputs were used. Because there were only seven in-stream dry weather metal concentration data points in the Chollas Creek watershed, copper, lead, and zinc concentrations could not be simulated. The simulated flow values from a San Diego regional hydrologic model were instead combined with average in-stream dry weather metal concentrations for dissolved copper, lead, and zinc to calculate estimated basin-wide loads for each metal (Table 1).

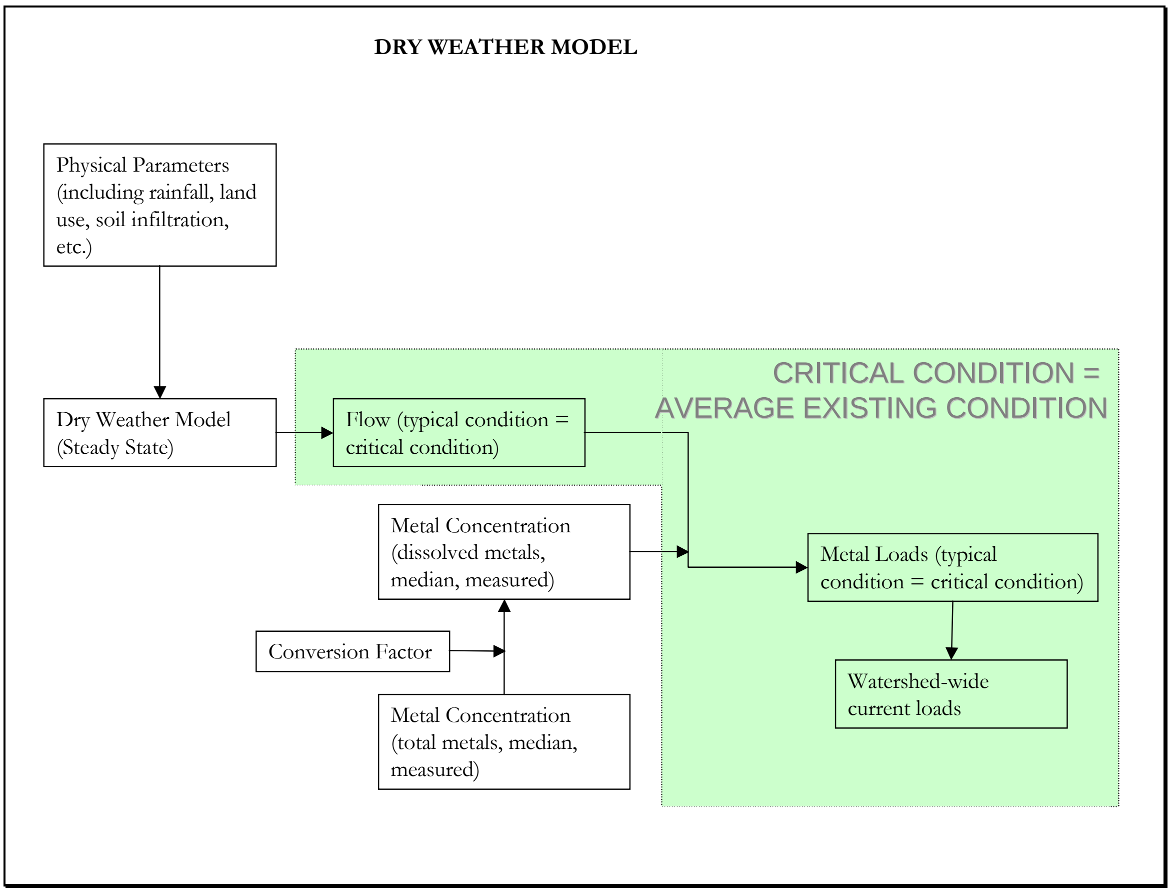


Figure 1. Dry weather model outputs.

3.1 Dry Weather Modeling Details

To estimate sources from dry weather urban runoff, a steady-state spreadsheet was developed for the San Diego region to model dry weather flow in the watershed. However, because limited in-stream dry weather metal concentration data were available for model calibration and validation, copper, lead, and zinc concentrations could not be simulated and average values from available data were used. The calibrated, low flow, steady-state model was used to estimate flows during dry weather conditions. These constant flows were assumed representative of the average flow caused by various urban land use practices (e.g., runoff from lawn irrigation or sidewalk washing).

3.1.1 Dry Weather Model Use of the Chollas Creek Watershed Representation

The initial step in this watershed-based analysis was to clearly define the watershed boundary. Therefore, before the model could be configured, an appropriate scale for analysis was determined. Model subwatersheds were delineated based on CALWTR 2.2, a standard nested watershed delineation scheme, watersheds, stream networks, locations of flow and water quality monitoring stations, consistency of hydrologic factors, and land use uniformity. The subwatersheds, soil types, and stream lengths used in the dry weather model were identical to those described in the wet weather model. Figure 2 provides a schematic of the stream network for the Chollas Creek watershed, which includes model segment connectivity, used for the Chollas Creek Metals TMDL project. Section 4.2 also provides a more detailed discussion of the watershed representation used for the wet weather model.

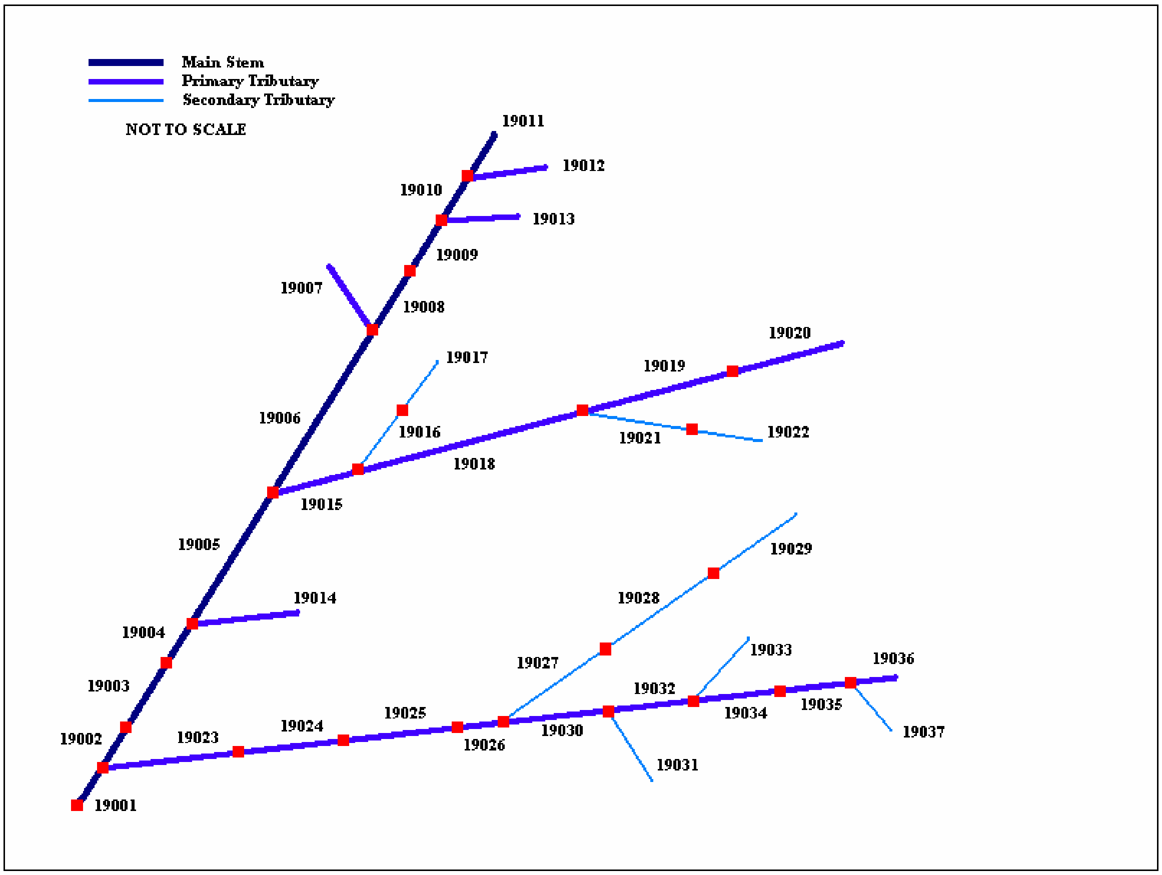


Figure 2. Schematic of model segments (indicated by subwatershed identification numbers) for Chollas Creek and its tributaries. Each segment is identified with a model number.[3]

[3] See Figure 11 for the segments as they appear on a map of the Chollas Creek watershed.

3.1.2. Channel Geometry

Precise channel geometry data were not available for the modeled stream segments; therefore, stream dimensions were estimated from analysis of observed data from other areas. Analyses were performed on flow data and associated stream dimension data from 53 USGS gages throughout Southern California. For this analysis, all flow less than 15 cubic feet per second (ft^3/s) was assumed to represent dry weather flow conditions. Using these dry weather flow data, the relationship between flow and cross-sectional area was estimated ($R^2 = 0.51$). The following regression equation describes the relationship between flow and cross-sectional area:

$$A = e^{0.2253 \times Q}$$

where:

A = cross-sectional area, feet squared (ft^2)
Q = flow, cubic feet per second (ft^3/s)

In addition, data from the USGS gages were used to determine the width of each segment based on a regression between cross-sectional area and width. The relationship with the greatest correlation ($R^2 = 0.75$) was based on the natural logarithms of each parameter. The following regression equation describes the relationship between cross-sectional area and width:

$$LN(W) = (0.6296 \times LN(A)) + 1.3003 \quad \text{or} \quad W = e^{((0.6296 \times LN(A)) + 1.3003)}$$

where:

W = width of model segment (ft)
A = cross-sectional area (ft^2)

3.1.3. Steady-State Mass Balance Overview

To represent the linkage between dry weather source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of pollutants in the impaired stream segment. This predictive model represents the stream network as a series of plug-flow reactors, with each reactor having a constant, steady state flow and pollutant load. A plug-flow reactor can be thought of as an elongated rectangular basin with a constant level in which advection (unidirectional transport) dominates (Figure 3).

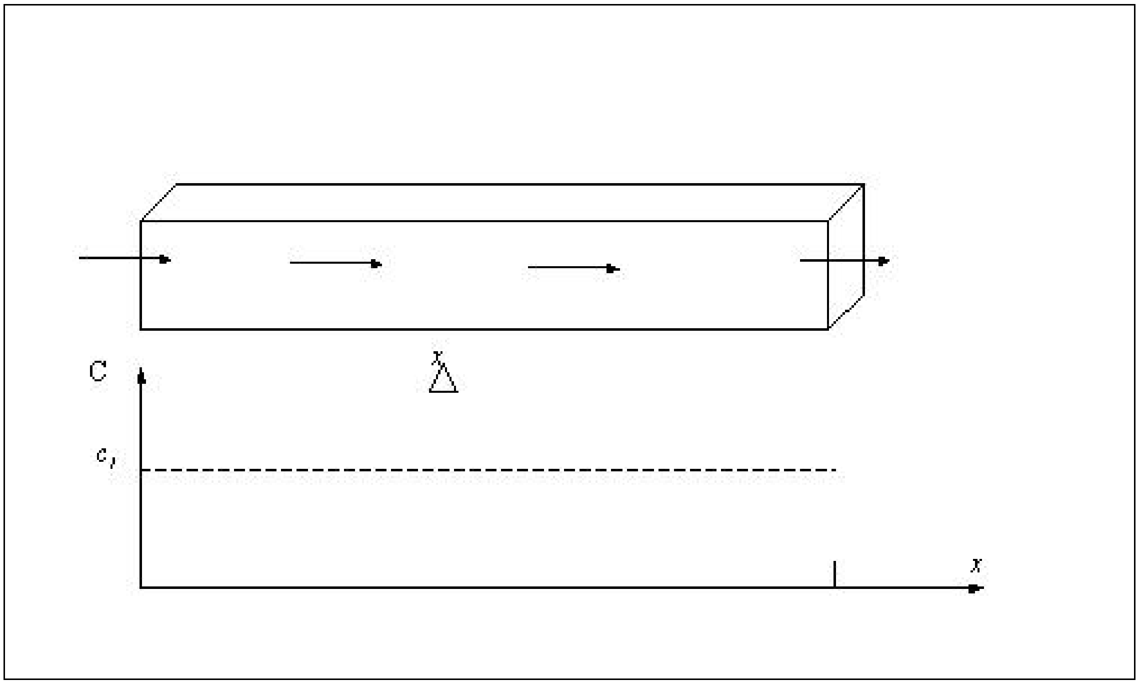


Figure 3. Theoretical plug-flow reactor. See dry weather model equations for definition of variables.

This modeling approach relies on basic segment characteristics, which include flow, width, and cross-sectional area. Model segments are assumed to be well-mixed laterally and vertically at a steady-state condition (constant flow input). Variations in the longitudinal dimension determine changes in flow and pollutant concentrations. A "plug" of a conservative substance introduced at one end of the reactor will remain intact as it passes through the reactor. The initial concentration of a pollutant from multiple sources can be represented based on empirically derived inflows as a single input at the injection point. Each reactor defines the mass balance for the pollutant and flow. At points further downstream, the concentration can be estimated based on first-order loss and mass balance.

3.1.4. Dry Weather Model Equations

There are two core equations used in the dry model, one to represent the mass balance and one to represent the loss of concentration downstream.

A mass-balance of the watershed load and, if applicable, of the load from the upstream tributary were performed to determine the change in concentration. This is represented by the following equation:

$$C_0 = \frac{Q_r C_r + Q_t C_t}{Q_r + Q_t}$$

where:

Q = flow (ft^3/s)
C = concentration

In the previous equation, Q_r and C_r refer to the flow and concentration from the receiving watershed and Q_t and C_t refer to the flow and concentration from the upstream tributary. The concentration estimated from this equation was then used as the initial concentration (C_0) in the loss equation for the receiving segment.

To describe instream losses, a first order rate equation was derived. An initial concentration (C_0) for inflow was set as an upstream boundary condition. The final water column concentration (C) in a segment can be estimated using the loss equation given below:

$$\frac{dc}{dt} = -kc \quad \text{or} \quad C = C_0 e^{-kt} = C_0 e^{-\left(k\frac{x}{u}\right)}$$

where:

C_0 = initial concentration
C = final concentration
k = loss rate (1/day)
χ = segment length (miles)
u = stream velocity (miles per day)

3.2. Dry Weather Model Use of a San Diego Regional Hydrologic model

The San Diego regional hydrologic model used estimates of subwatershed inflows obtained through analysis of available data. Data collected as part of detailed monitoring efforts of Aliso Creek (performed by the Orange County Pubic Facilities and Resources Department and the Orange County Public Health Laboratory) and of Rose Creek and Tecolote Creek (performed by the City of San Diego) were analyzed to estimate dry weather flow data. Information from these studies was assumed sufficient for use in characterizing dry weather flow conditions for the entire study area.

For each of the detailed studies, flow data were collected throughout the year at stations within the watersheds (27 stations for Aliso Creek, 3 stations for Rose Creek, and 2 stations for Tecolote Creek). The watersheds were delineated to each sampling location. Analyses were performed to determine whether there is a correlation between the respective land use types and average dry weather flow data collected at the mouth of each subwatershed.

The results of the analyses showed good correlation between flow and commercial/institutional, open space, and industrial/transportation land uses (R^2 = 0.78). The following equation was derived from the analysis:

$$Q = (A_{1400} \times 0.00168) + (A_{4000} \times 0.000256) - (A_{1500} \times 0.00141)$$

where:

Q = flow (ft^3/s)
A_{1400} = area of commercial/institutional (acres)
A_{4000} = area of open space, including military operations (acres)
A_{1500} = area of industrial/transportation (acres)

The empirical equation presented above that represented water quantity associated with dry weather urban runoff from various land uses can be used to predict flow. Figure 4 shows the flow predicted by the above equation compared to observed data for Aliso Creek, Rose Creek, and Tecolote Creek.

Overall, the statistical relationship established between each land use area and flow showed good correlation with the observed flow data. To improve model fit, model calibration and validation were conducted.

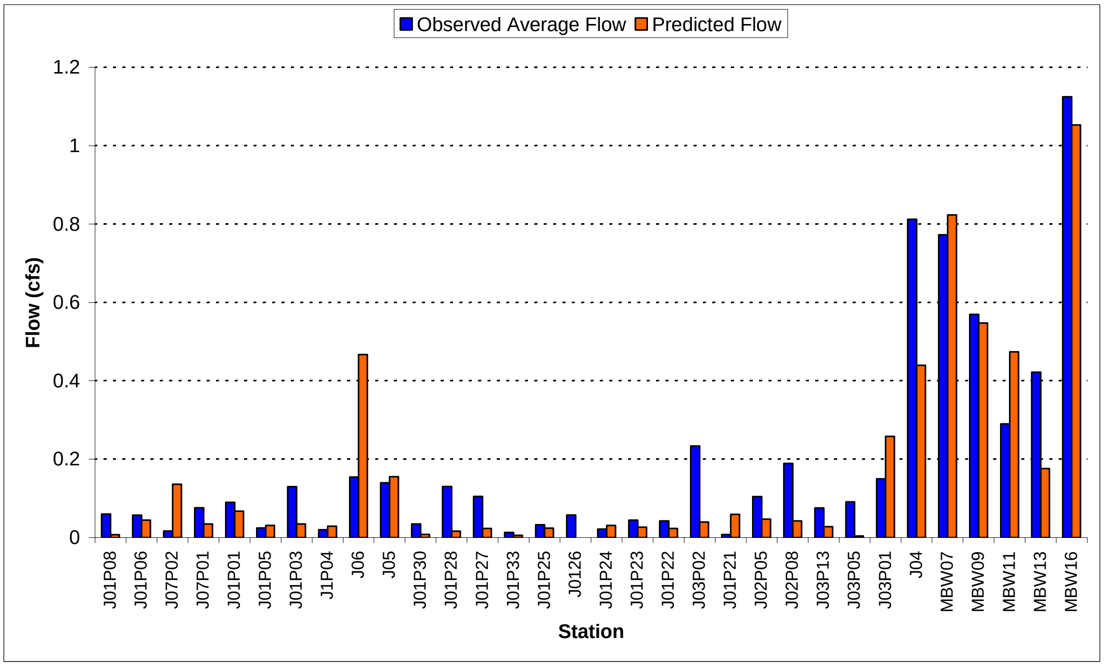


Figure 4. Predicted and observed flows in Aliso Creek, Rose Creek, and Tecolote Creek indicated by station numbers (Tetra Tech, Inc., 2004).

3.2.1. Calibration and Validation of the San Diego Regional Hydrologic model

Model calibration was performed using data from Aliso Creek and Rose Creek. Calibration involved the adjustment of infiltration rates to reflect observed in-stream flow conditions. Following model calibration, a separate validation process was undertaken to verify the predictive capability of the model in other watersheds. Table 4 lists the sampling locations used in calibration and validation, along with their corresponding watershed identification number from the San Diego regional hydrologic model. Figure 5 shows the sampling locations and their proximity to the Chollas Creek watershed. The model results presented in the next sections, especially the model calibration and validation, directly apply to the Chollas Creek watershed modeling effort because the Chollas Creek watershed is within the San Diego region.

Table 4. Sampling location for calibration and validation. (Tetra Tech, Inc., 2004)

Calibration – Flow						Validation – Flow	
Watershed	Sampling Location	Watershed	Sampling Location	Watershed	Sampling Location	Watershed	Sampling Location

208	J01P22	214	J01P01	1602	MBW17	1701	MBW06
209	J01P23	215	J01TBN8	1603	MBW15	1702	MBW07
210	J01P28	219	J04	1605	MBW11	1703	MBW10
211	J01P27	220	J03P13	1606	MBW13	1704	MBW08
212	J06	221	J03P01	1607	MBW24	1705	MBW09
213	J01P05	1601	MBW20			403	USGS 11047300

Watersheds beginning with a "2" are located in Aliso Creek, with a "4" are in San Juan Creek, with a "16" are in Rose Creek and with a "17" are in Tecolote Creek.

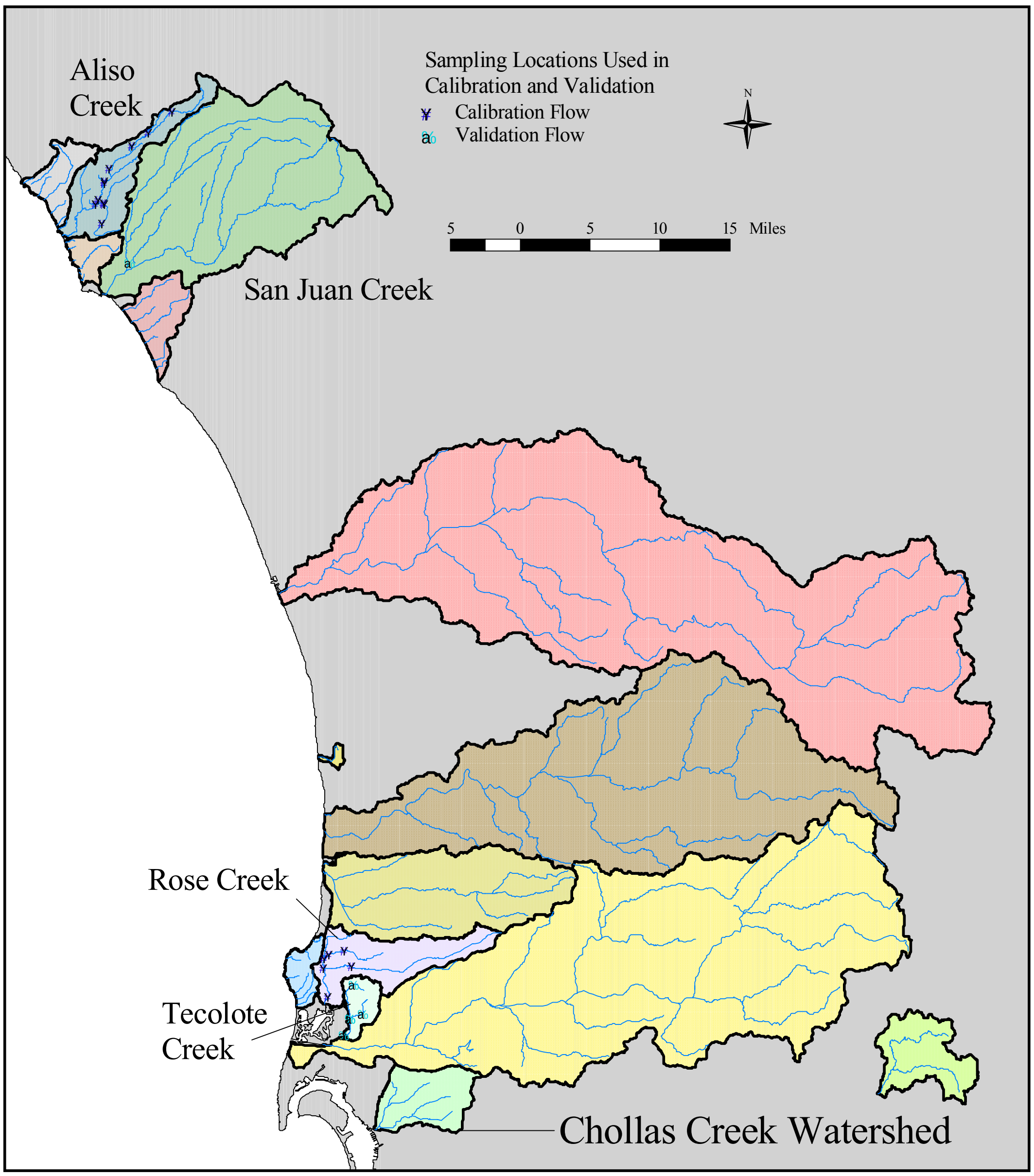


Figure 5. Sampling locations used for San Diego regional hydrologic model calibration and validation. (Tetra Tech, Inc., 2004)

3.2.2. San Diego Regional Hydrologic Model Calibration and Validation Results
Infiltration rates vary by soil type and model configuration included identifying a soil type for each subwatershed. Stream infiltration was calibrated by adjusting the infiltration rate. This rate was adjusted for each soil type within ranges identified from literature values (USEPA, 2000a). The goal of calibration was to minimize the difference between average observed flow and modeled flow at each calibration station location (Table 4). The model closely predicted observed flows and the calibration results are graphically presented in Figure 6.

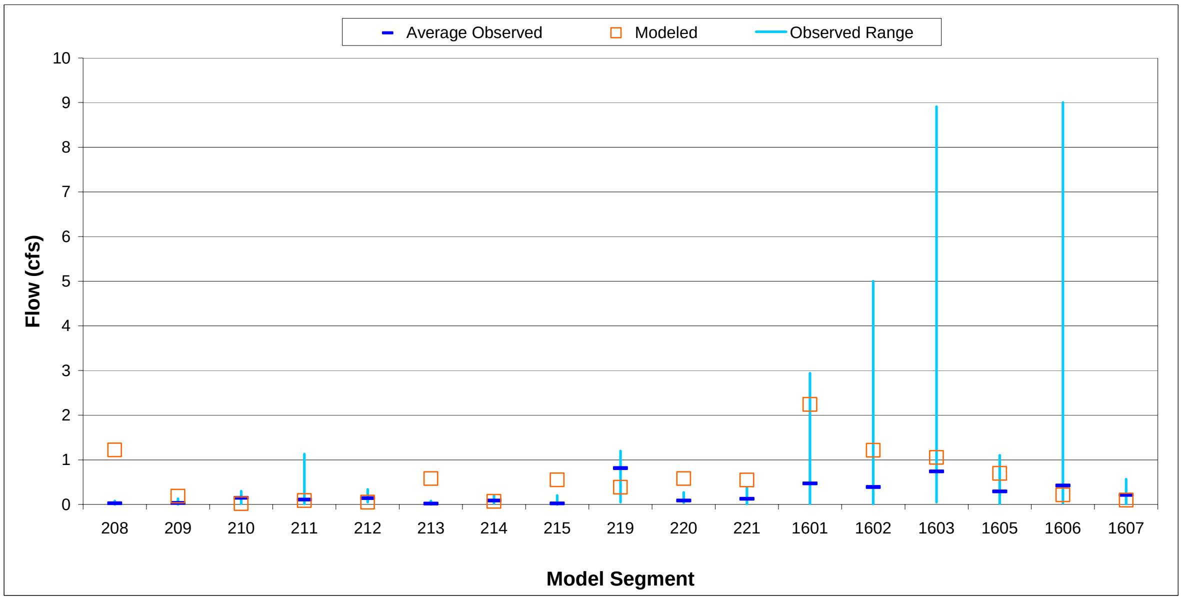


Figure 6. Calibration results of modeled versus observed flow. Model segment numbers are from the San Diego regional hydrologic model. (Tetra Tech, Inc., 2004)

The calibrated infiltration rates were 1.368 in/hr for Soil Group A, 0.698 in/hr for Soil Group B, 0.209 in/hr for Soil Group C, and 0.084 in/hr for Soil Group D. The infiltration rates for Soil Groups B, C, and D fall within the range of values described in the literature. The calibrated rate for Soil Group A is below the range identified in Wanielisata et al. (1997); however, Soil Group A is not present in the Chollas Creek watershed, which is dominated by Soil Groups C and D.

Subsequent to model calibration, the model was validated using six stations in the San Juan Creek and Tecolote Creek Watersheds. (Table 4) The model-predicted flows were within the observed ranges of dry weather flows (Figure 7), demonstrating very good overall model fit.

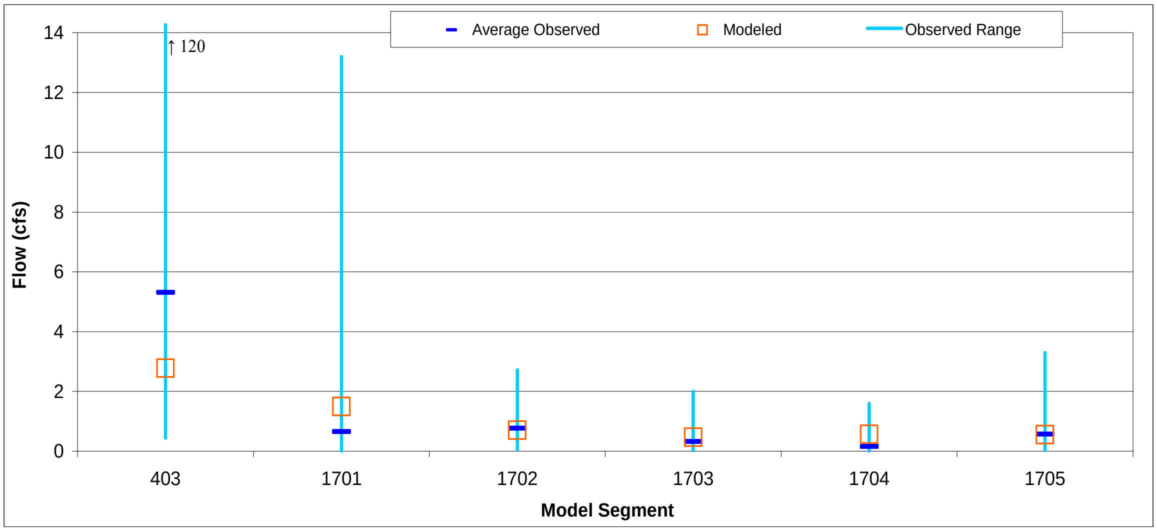


Figure 7. Validation results of modeled versus observed flow. Model segment numbers are from the San Diego regional hydrologic model. (Tetra Tech, Inc., 2004)

3.3. Summary of the Dry Weather Model Results

The steady-state model is calibrated for flow; however, data were not adequate to model dry weather metal loads from specific sources. At a future time, additional water quality data could be readily incorporated into the model and then be used to estimate pollutant concentrations in Chollas Creek or to support load allocations for another TMDL project. At that time, the pollutant concentrations in each segment could be estimated using metals concentration data, an in-stream loss rate, stream infiltration, basic channel geometry, and flow rate data.

3.3.1. San Diego Regional Hydrologic Model Application

Per the equation in section 3.1.4, for each model segment in the Chollas Creek watershed mass balances were performed on the following: inflows from upstream segments, input from local surface runoff, stream infiltration and evaporation, and outflow. The resulting overall dry weather model flow rate for Chollas Creek was 2.28 cubic feet per second (cfs). There is currently only one observed flow value available for comparison with the San Diego regional hydrologic model flow results: a flow measurement of 1.0 cfs was recorded at the in-stream dry weather flow data sampling location DW298. The corresponding model output for this location was 1.33 cfs indicating that the model is consistent with the magnitude of the measured dry weather flow rate datum.

3.3.2. Use of Average In-Stream Metals Concentration

As mentioned before, the model is currently configured to simulate steady-state pollutant concentrations through a mechanism similar to that for flow. Specifically, concentrations can be estimated in each reactor, or segment, using water quality data, a loss rate, basic channel geometry, and flow. Loss rates, which can be attributed to settling and other environmental conditions, were modeled as first-order. Model calibration and validation can be performed by adjusting the rate of in-stream loss so that the predicted concentrations more closely match the observed data.

The amount of available dry weather metal concentration data currently prohibits the full utilization of the water quality, or concentration, component of this model, which has only been calibrated for bacteria to date. If sufficient data become available to establish a relationship between land use and metal concentrations during dry weather conditions, this feature of the model could be used to simulate source loadings and transport of pollutants in the Chollas Creek watershed and to help support other TMDL projects. Therefore, only the average observed concentrations were used to calculate the dry weather portion of the total estimates (Table 1).

4. Wet Weather Model

Wet weather source contributions of metal loads are generally associated with the wash-off of metal loads that have accumulated on the land surface. During rainfall events, these metal loads are delivered to the water body through creeks and storm water collection systems. Often, source contributions of metal, such as copper, lead, and zinc, loads can be linked to specific land use types that have higher relative accumulation rates, or are more likely to deliver metals to water bodies due to delivery through storm water collection systems. To assess the link between sources of metals and the impaired waters, a modeling system may be utilized that simulates the build-up and wash-off of metals and the hydrologic and hydraulic processes that affect delivery.

In order to model these processes for the Chollas Creek watershed, the watershed itself had to be delineated and categorized as subwatersheds with certain land uses. The land uses incorporated into the watershed model are described and illustrated in Appendix E, along with a table that identifies the subwatershed area associated with each land use. Next, observed rainfall data collected from the San Diego County storm water programs and other special studies were used to calibrate land use and soil-specific parameters in the watershed. Hydrology and water quality simulations were then performed for 1990 through 2003 to obtain modeled flow rates and concentrations, respectively. Transport processes of metal loads from the source to the impaired waterbodies were also simulated in the model with a first-order in-stream loss rate based on literature values. The model execution provided two outputs: estimated water quality concentration and estimated flows. These two outputs, in turn, can be used to estimate existing land use specific and subwatershed specific mass loads.

These estimated daily loads, which are based on model-predicted flows and metal concentrations, allowed for assessment of existing loading to the Chollas Creek watershed. To estimate the existing loads, first the maximum hourly total metal concentration was determined for each wet weather day predicted during the critical wet year. These maximum concentrations were then calculated as maximum daily values and then converted to the dissolved metal fraction by applying the appropriate acute conversion factor provided in the California Toxic Rule (CTR). Next, these dissolved metal values were multiplied by their respective average daily flow to estimate the existing dissolved metal load (Figure 8).

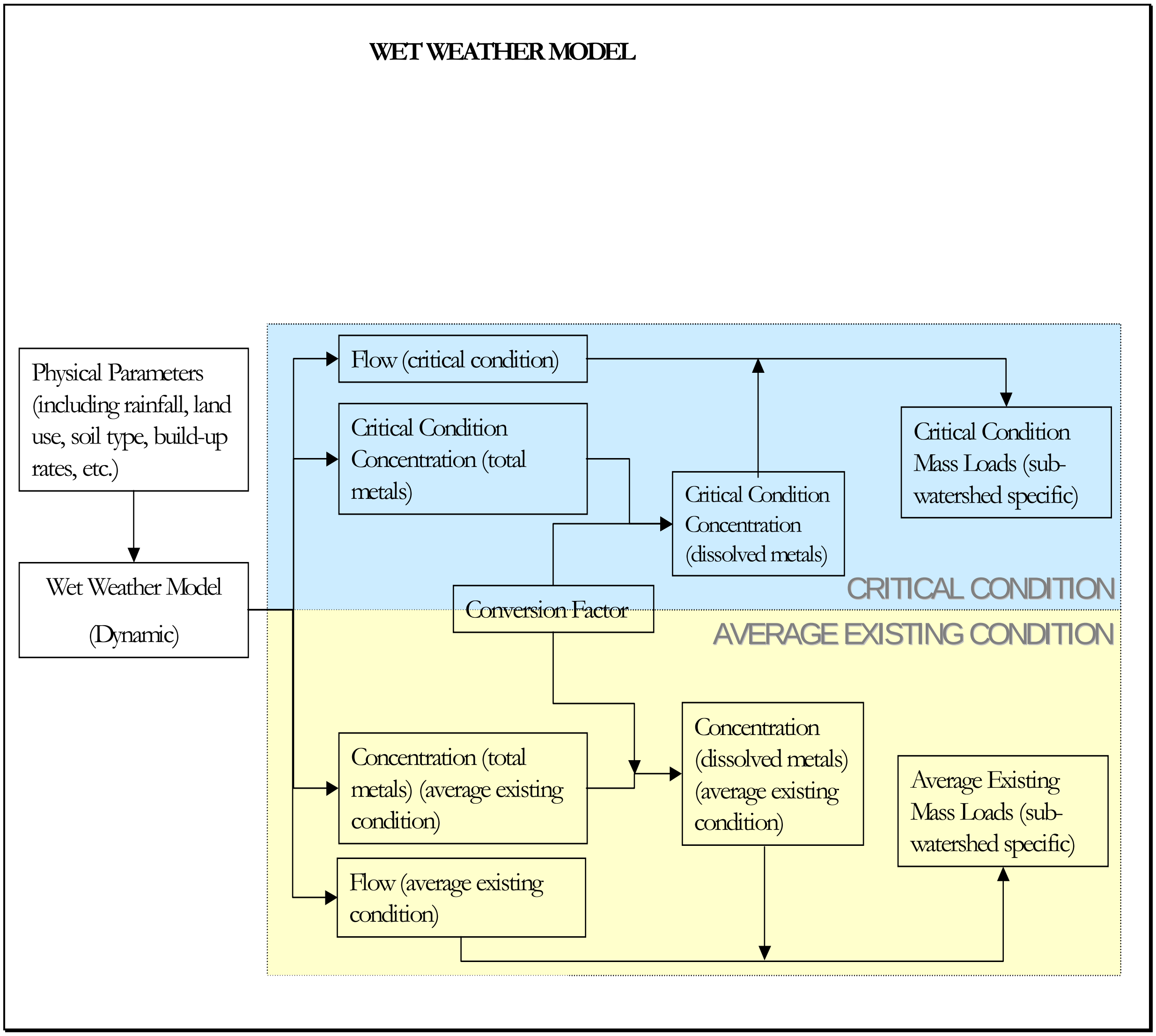


Figure 8. Wet weather model outputs.

4.1. Wet Weather Model Programs

Due to the complex nature of analyzing storm water contributions by drainage area associated with the Chollas Creek watershed, the source analysis for the Chollas Creek Metals TMDL project is based partly on a complex watershed model for wet weather conditions. This type of watershed analysis approach is a strategy for comprehensively addressing land management and water quality and quantity issues over an entire watershed. This approach is applicable to watersheds throughout the world because local information is taken into consideration. Such information includes the local geography and meteorological conditions.

The watershed model chosen to support the source analysis, which will in turn be used in the implementation plan, was the USEPA LSPC, a re-coded version of USEPA's Hydrological Simulation Program -FORTRAN (HSPF), which simulated the hydrologic processes and the metal loading to receiving waterbodies in the Chollas Creek watershed. A description of the model programs and the basic process of modeling used to support the Chollas Creek Metals TMDL project follows

4.1.1. HSPF Program

HSPF, an adaptation of the Stanford Watershed Model, was primarily developed to evaluate the effect of land use changes on water, sediment, and pollutant movement (Donigian, Imhoff, Bicknell, & Kittle, 1984). This model uses geographic and continuous meteorological data to compute stream flow and can then simulate both point and nonpoint source pollution through a wide range of complex mathematical equations. These equations represent surface and subsurface hydrologic conditions, including interflow and evapotranspiration, as well as water quality processes (Bicknell, Imhoff, Kittle, Jobes, & Donigian, 2001). Coefficients for these conditions and processes are manipulated during model calibration. HSPF is over 30 years old and has been extensively applied, despite its substantial learning curve (Whittemore, 1998). There have been hundreds of applications of HSPF all over the world, ranging from the 62,000 square mile Chesapeake Bay tributary area to a few-acre plot near Watkinsville, Georgia (USGS, 2002).

4.1.2. LSPC Program

LSPC is a program for dynamically modeling watersheds and is essentially a re-coded version of HSPF, which has further been integrated with a geographic information system (GIS), comprehensive data storage and management capabilities, and a data analysis/post-processing system into a convenient PC-based windows interface that dictates no software requirements. LSPC has been applied and calibrated in many Southern California waterbodies including the Los Angeles, San Gabriel, and San Jacinto Rivers and 20 watersheds in the San Diego region.

4.1.3. General Simulation Process

Understanding and modeling hydrologic and hydraulic processes provides the necessary decision support for TMDL development and implementation. A basic function of the model can be described in several steps:

(1) **LSPC Execution**. This process involved launching LSPC, inputting necessary data, and performing initial model simulations.

(2) **Comparison of Results**. Upon successful execution of LSPC, model results were compared with observed data and analyzed for accuracy and applicability.

(3) **Parameter Adjustments for Model Calibration**. The analyses performed in step 2 determine which parameters, if any, should be altered in this step to more accurately predict the observed data.

(4) **Simulation Runs for Model Calibration**. This step involved performing additional model runs with the adjusted parameter values.

(5) **Model Validation**. This step involved testing the calibrated parameters using independent date ranges and gage locations.

Steps 2, 3, and 4 described above are an iterative process and were performed in order, but eventually terminated with an analysis of the model results. These intermediate steps were conducted until the model results achieved satisfactory agreement with the natural system. See Figures 9 and 10 for a visual representation.

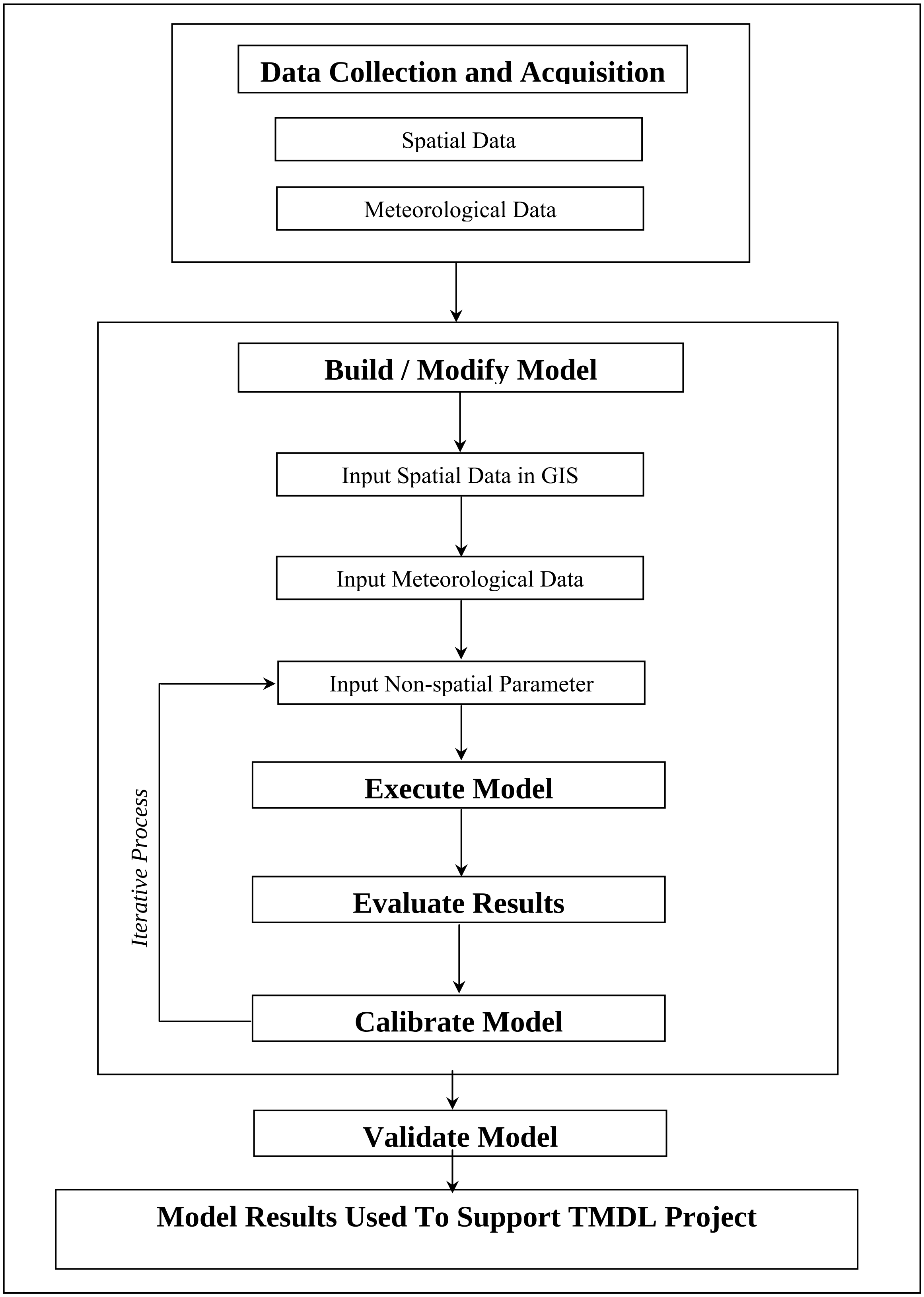


Figure 9. Overview of the methodology used.

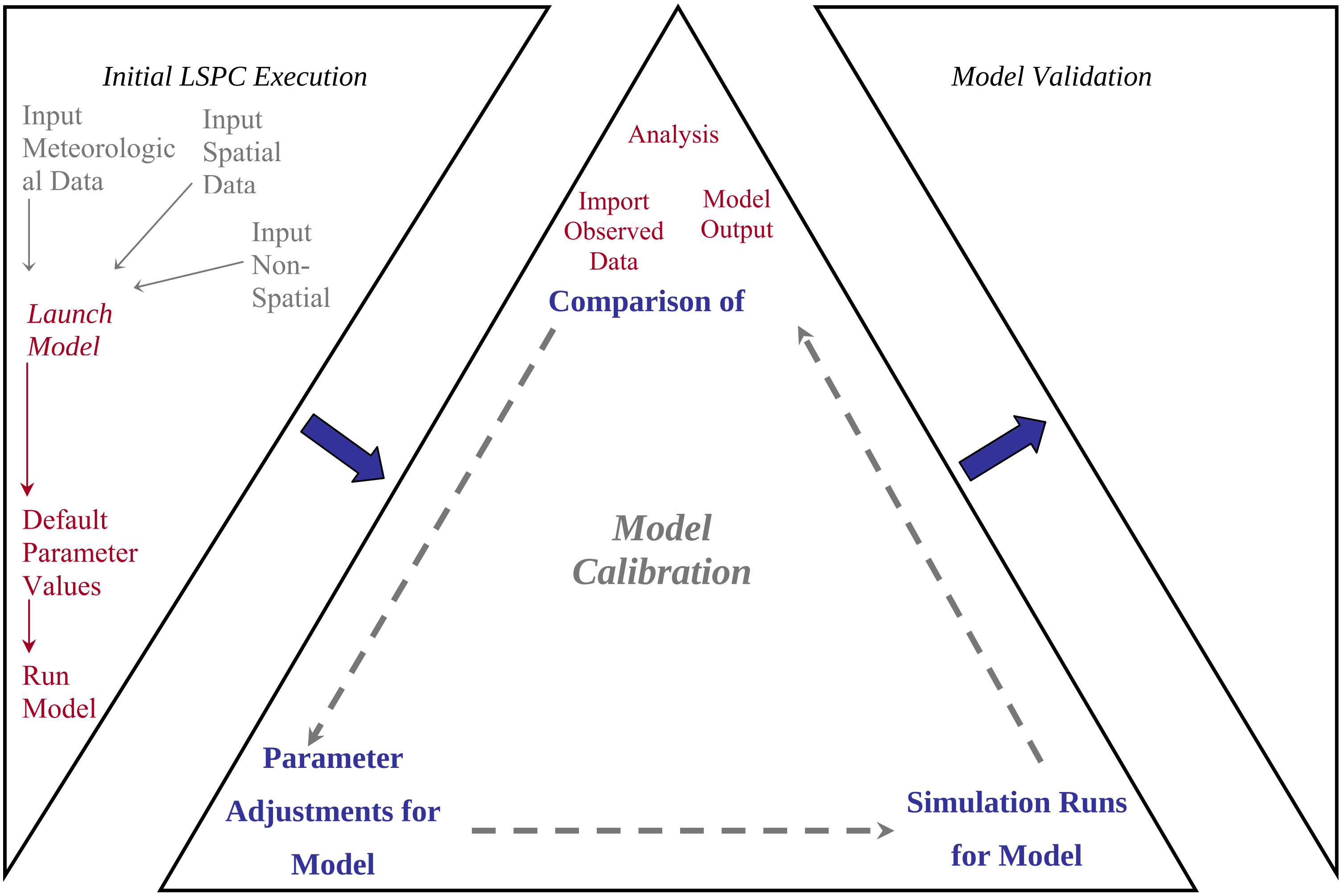


Figure 10. Hydrologic Simulation Program – Fortran (HSPF) modeling process

4.2. Wet Weather Model Details

Configuration of the watershed model involved consideration of four major components: water body representation, land use representation, meteorological data, hydrologic, and pollutant representation. These components provided the basis for the model's ability to estimate flow and pollutant loadings. Water body representation refers to LSPC modules or algorithms used to simulate flow and pollutant transport through streams and rivers. The land use representation provides the basis for distributing soils and pollutant loading characteristics throughout the basin. In addition to these components, meteorological data, hydrological representation and pollutants representation is very important. Meteorological data essentially drive the watershed model. Rainfall and other parameters are key inputs to LSPC's hydrologic algorithms. Hydrologic and pollutant representation refers to the LSPC modules or algorithms used to simulate hydrologic processes (e.g., surface runoff, evapotranspiration, and infiltration) and pollutant loading processes (primarily accumulation and wash-off). This section describes more of the specific details that were used in modeling the Chollas Creek watershed.

4.2.1. Wet Weather Model Water Body Representation

Each delineated subwatershed was represented with a single stream assumed to be completely mixed, one-dimensional segments with a trapezoidal cross-section. The National Hydrography Dataset (NHD) stream reach network for USGS hydrologic units 18070301 through 18070305 were used to determine the representative stream reach for each subwatershed. The Chollas Creek watershed is in the 18070304 USGS hydrologic unit.

Once the representative reach was identified, slopes were estimated based on digital elevation models (DEM) data and stream lengths measured from the original NHD stream coverage. In addition to stream slope and length, mean depths and channel widths are required to route flow and pollutants through the hydrologically connected subwatersheds. Mean stream depth and channel width were estimated using regression curves that relate upstream drainage area to stream dimensions. An estimated Manning's roughness coefficient of 0.2 was also applied to each representative stream reach.

4.2.2. Wet Weather Model Watershed Segmentation

As mentioned in section 3.1.1, the initial step in any watershed-based analysis is to clearly define the watershed boundary. A watershed is defined as a drainage basin, or an area of land in which all waters drain to a single river system (Heathcote, 1998). Watershed segmentation refers to the subdivision of watersheds into smaller, discrete subwatersheds for modeling and analysis. This subdivision was primarily based on the stream networks and topographic variability, and secondarily on the locations of flow and water quality monitoring stations, consistency of hydrologic factors, land use consistency, and existing watershed boundaries (based on CALWTR 2.2 watershed boundaries).

For this current model application, the Chollas Creek watershed was divided into thirty-seven separate sub-basins (Figure 11). These subwatersheds were based on the stream network and topographic data and were further delineated to each station where wet weather metal concentration data was collected. Delineation to the water quality stations allows for direct comparison between model output and observed water quality data in order to evaluate what subwatersheds were sources of metal loads to The Chollas Creek watershed.

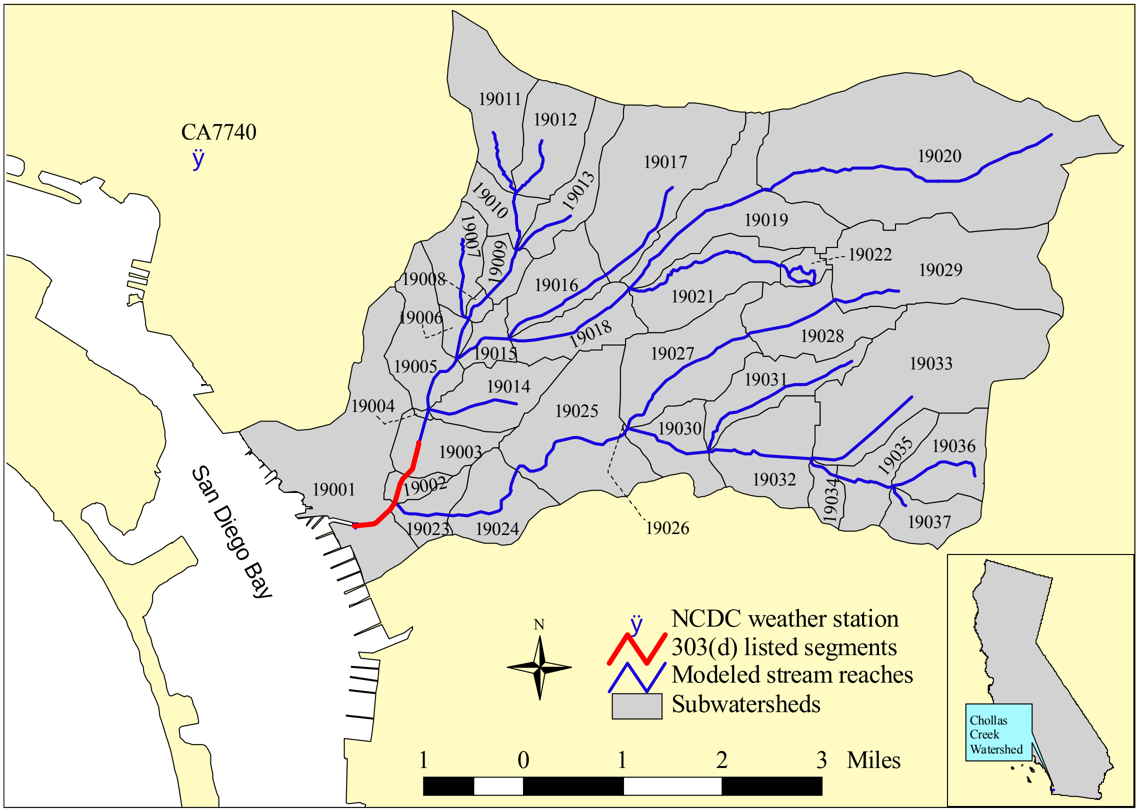


Figure 11. The Chollas Creek watershed. The numbers refer to the segment identifications used in the models.

The Chollas Creek watershed boundary was based primarily on the Cal Water GIS coverage. The only exception is the western-northwestern border. This border was refined from the Cal Water boundary based on the shape file provided by the Regional Board. This border was further refined using the topography lines on the USGS quadrangle maps. See Figure 12 for an illustration of the final watershed boundary, the Regional Board boundary, and the Cal Water boundary. The three boundaries overlap around the entire watershed except for the western-northwestern edge.

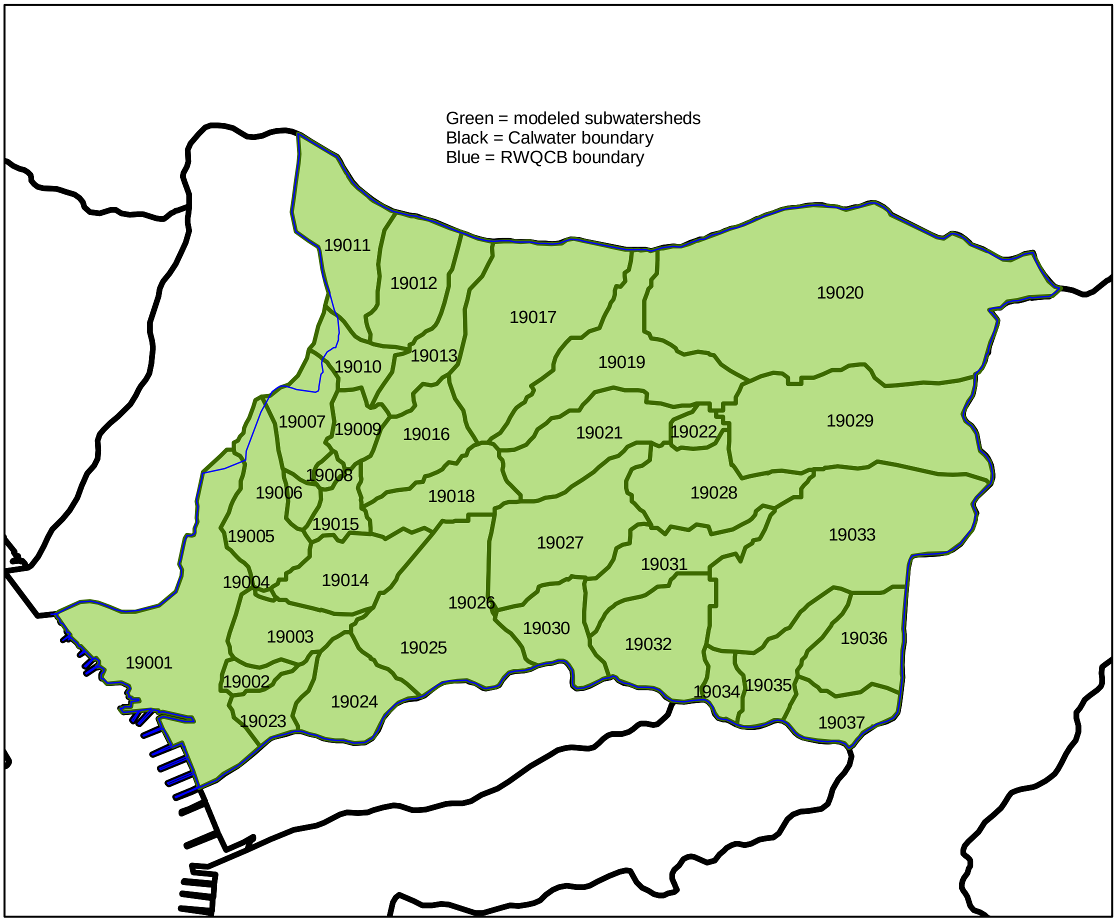


Figure 12. Three boundaries comprising the watershed boundary for Chollas Creek with model segment identification numbers.

4.2.3. Wet Weather Model Land Use Representation

The watershed model requires a basis for distributing hydrologic and pollutant loading parameters. This is necessary to appropriately represent hydrologic variability throughout the basin, which is influenced by land surface and subsurface characteristics. Representing variability in pollutant loading, which is highly correlated to land practices, also is necessary. The basis for this distribution was provided by land use coverage of the entire modeled area.

Three sources of land use data were used in the San Diego regional hydrologic model modeling effort. The primary source of data was the SANDAG 2000 land use dataset that covers San Diego County. This dataset was supplemented with land use data from the Southern California Association of Governments (SCAG) for Orange County and portions of Riverside County. A small area in Riverside County was not covered by either land use dataset. To obtain complete coverage, the 1993 USGS Multi-Resolution Land Characteristic data were used to fill this remaining data gap.

Although the multiple categories in the land use coverage provide much detail regarding spatial representation of land practices in the watershed, such resolution is unnecessary for watershed modeling if many of the categories share hydrologic or pollutant loading characteristics. Therefore, many land use categories were grouped into similar classifications, resulting in a subset of 13 categories for the San Diego region (Tetra Tech, 2004).

For the current modeling effort, land use reclassification was also performed. SANDAG was the only source necessary for land use data in the Chollas Creek watershed. The original SANDAG land uses were grouped into categories that share hydrologic and metal loading characteristics. For example, many urban categories were represented independently (e.g., high density residential, low density residential, industrial, and commercial/ institutional) because they have different levels of impervious cover and their associated metal-contributing practices (and thus, accumulation rates) vary. During the reclassification process, land uses were kept hydrologically consistent with the land use classifications for the San Diego regional hydrologic model so that the regionally calibrated land use-specific hydrology parameters could be applied to the current modeling effort. Appendix E provides descriptions of the land uses used and the areas associated with each land use grouping for the Chollas Creek Metals TMDL project.

LSPC algorithms require that land use categories be divided into separate pervious and impervious land units for modeling. This division was made for the appropriate land uses (primarily urban) to represent impervious and pervious areas separately. The division was based on typical impervious percentages associated with different land use types from the Soil Conservation Service's TR-55 Manual (Soil Conservation Service, 1986).

In addition, soil data were obtained from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Services State Soil Geographic (STATSGO) database. Topographic data, or DEM, were obtained from USEPA’s Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system (USEPA, 1998).

4.2.4. Wet Weather Model Meteorology

Meteorological data are a critical component of the watershed model. LSPC requires appropriate representation of precipitation and potential evapotranspiration. In general, hourly precipitation (or finer resolution) data are recommended for nonpoint source modeling. Therefore, only weather stations with hourly-recorded data were considered in the precipitation data selection process. Storm water runoff processes for each subwatershed were driven by precipitation data from the most representative station. These data provide necessary input to LSPC algorithms for hydrologic and water quality representation.

Meteorological data were accessed from a number of sources in an effort to develop the most representative dataset for the San Diego region. Hourly rainfall data were obtained from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA), the Automatic Local Evaluation in Real Time (ALERT) Flood Warning System managed by the County of San Diego, and the California Irrigation Management Information System (CIMIS). The above data were reviewed based on geographic location, period of record, and missing data to determine the most appropriate meteorological stations. Ultimately, meteorological data were utilized from 16 area weather stations for January 1990 to September 2002 (Figure 13) for the San Diego regional hydrologic model. The spatial variability captured by these weather stations greatly enhanced the hydrology calibration and validation and development of the regionally calibrated parameters, which were utilized for the Chollas Creek Metals TMDL project.

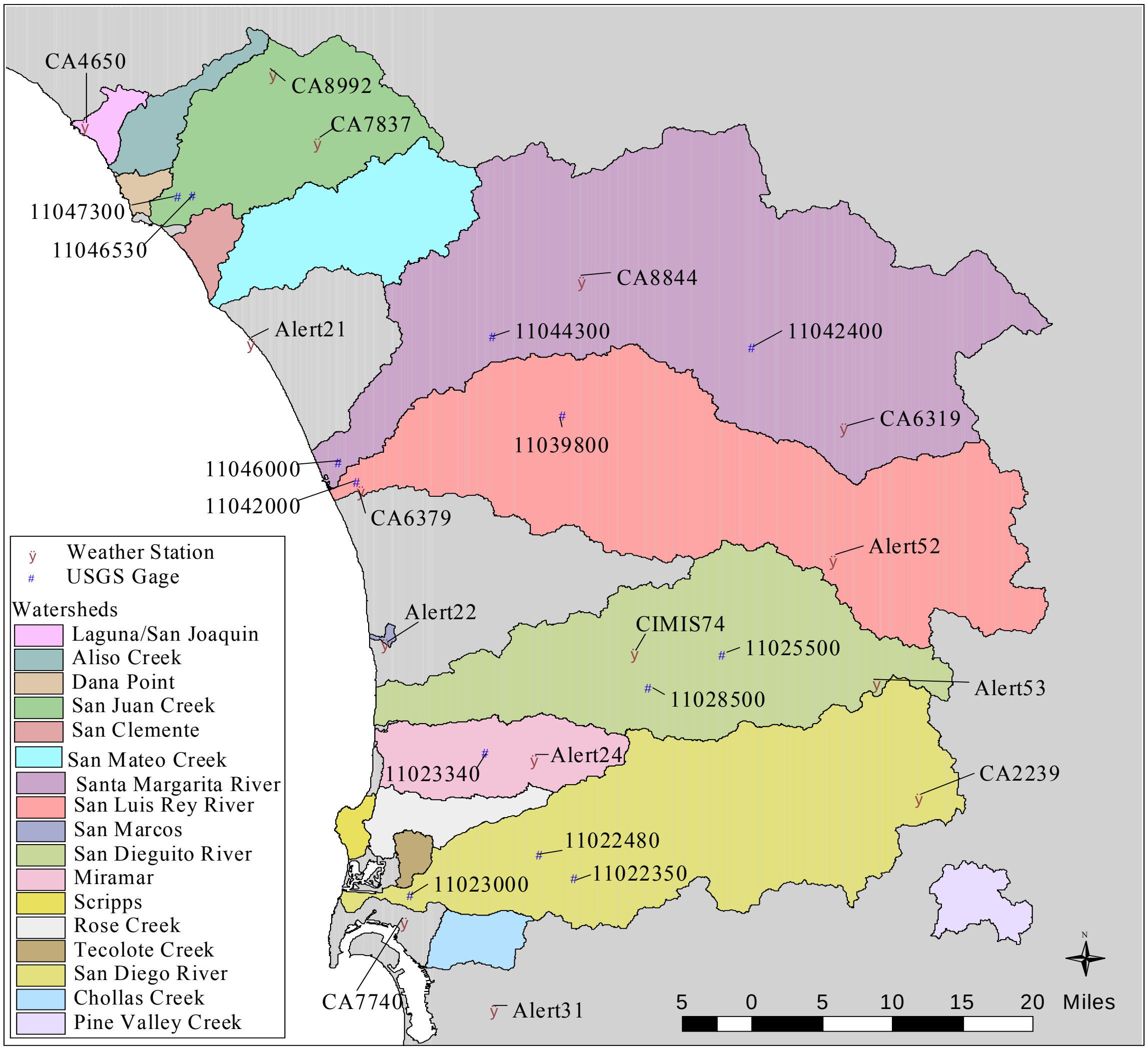


Figure 13. Weather stations and flow gages utilized for the San Diego regional hydrological model.[4]

Long-term hourly wind speed, cloud cover, temperature, and dew point data are available for a number of weather stations in the San Diego region. Data from San Diego Airport, Lindbergh Field, (#CA7740 on Figure 13) were obtained from NCDC for characterization of meteorology of the modeled watersheds. Using these data, the METCMP (Computation of Meterological Time Series) utility, available from USGS, was employed to estimate hourly potential evapotranspiration.

Lindbergh Field is the most representative weather station for the Chollas Creek watershed with hourly data. In order to utilize the most current data possible for the Chollas Creek Metals TMDL project, the period of record for Lindbergh Field meteorological data was extended through 2003.

[4] Table 5 gives more information on data collected at each station.

4.2.5. Wet Weather Model Hydrology Representation

Generally, LSPC hydrologic simulations combine the observed meteorological data and the physical characteristics of the watershed. Surface runoff in a watershed was simulated in four components: surface runoff from impervious surfaces, surface runoff from pervious surfaces, interflow from pervious areas, and groundwater flow (Donigian et al., 1984). Parameter values within LSPC represented different characteristics of these components.

Here, the LSPC PWATER (water simulation for pervious land segments) and IWATER (water simulation for impervious land segments) modules, which are identical to those in HSPF, were used to represent hydrology for all pervious and impervious land units (Bicknell et al., 1996). Designation of key hydrologic parameters in the PWATER and IWATER modules of LSPC were required. As discussed previously, in order to satisfy this requirement, the regionally calibrated hydrologic parameter values from the San Diego regional hydrologic model were used. Model calibration and validation of the San Diego regional hydrologic model is discussed the next section, thus describing the applicability of these parameter values to the Chollas Creek watershed.

In some watersheds, in addition to the streams which route flow and transport pollutants through the watersheds, there are several reservoirs that are large enough to impound a significant portion of flow during wet weather periods. There is one small reservoir in the Chollas Creek watershed; however, it drains an extremely small land area and is not hydrologically connected to the main stream network in the watershed. Therefore, the Chollas Reservoir was not simulated as an impoundment in the LSPC model.

4.2.6. Wet Weather Model Metals Water Quality Representation

For the San Diego regional hydrologic modeling efforts, six major inland dischargers were incorporated into the LSPC model as point sources of flow and bacteria concentration. Each point source was located in the Santa Margarita River watershed – five at Camp Pendleton and one along Murrieta Creek (Santa Rosa Water Reclamation Facility). Although the Santa Margarita River watershed had no waterbodies impaired from bacteria loads, it was simulated in the wet weather model due to the availability of flow rates and bacteria concentration monitoring data, which were used for hydrologic and water quality calibration and validation. There are no inland dischargers impacting flow in the Chollas Creek watershed. However, discussion of the facilities in the Santa Margarita River Watershed is important because they were incorporated into the flow model calibration and validation for the San Diego regional hydrologic model, which was utilized during this current LPSC application.

Loading processes for copper, lead, and zinc loads were represented for each land unit using the LSPC PQUAL (simulation of quality constituents for pervious land segments) and IQUAL (simulation of quality constituents for impervious land segments) modules, which are identical to those in HSPF. These modules simulate the accumulation of pollutants during dry periods and the wash-off of pollutants during storm events. Starting values for parameters relating to land use-specific accumulation rates and buildup limits, were derived from 1997 through 1999 storm water program data from the County of Los Angeles (LACDPW, 1998, 1999). These starting values served as baseline conditions for water quality calibration. Although atmospheric deposition may be an issue in the watersheds, it was not explicitly simulated in the watershed model. It was, however, represented implicitly in the model through use of the land use- and pollutant-specific accumulation rates.

4.3. Wet Weather Model Calibration and Validation

As described above, model calibration is an iterative process, because it involves the adjustment or fine-tuning of modeling parameters to reproduce observations. After modifying individual parameters, a new simulation was performed for different LSPC modules, at multiple locations throughout the San Diego region, and for the same time periods. The resultant simulated and observed stream flows were then compared. This process was repeated until the best agreement between the modeled and observed flows was achieved. This method provides the most accurate prediction possible for the hydrologic functions by ensuring that heterogeneities were represented.

Subsequently, model validation was performed to test the calibrated parameters at different locations or for different time periods, without further adjustment. Model validation consisted of re-running the model for a different date range using the same parameter values as the calibrated model. The results of this simulation were then compared to applicable observed data. This process performs a similar function to that of a control test subject, in which the model validation results indicate if selected parameter values are representative of the hydrologic functions of the watershed over time. If model validation indicates that the model results are not representative of the watershed over a certain time period, model calibration may be repeated or the model user may evaluate the watershed-specific functions responsible for the differences.

4.3.1. General Hydrologic Calibration and Validation for Wet Weather Conditions

Hydrology is the first model component calibrated because estimation of pollutant loading relies heavily on flow prediction. The hydrology calibration involves a comparison of model results to in-stream flow observations at selected locations. After comparing the results, key hydrologic parameters were adjusted and additional model simulations were performed. This iterative process was repeated until the simulated results closely represented the system and reproduced observed flow patterns and magnitudes. The last step is to validate the hydrologic model output with observed flow data.

The first step in hydrologic calibration is to establish an annual water balance between modeled and actual flow rates. The following water balance can estimate surface runoff: precipitation minus actual evapotranspiration, deep percolation, and change in soil moisture. Parameters in the PWATER and IWATER sub-modules had the greatest impact on these hydrologic functions. Specifically, LZSN, INFILT, LZETP, and DEEPFR were the key parameters that govern the water balance. (Figure 14)

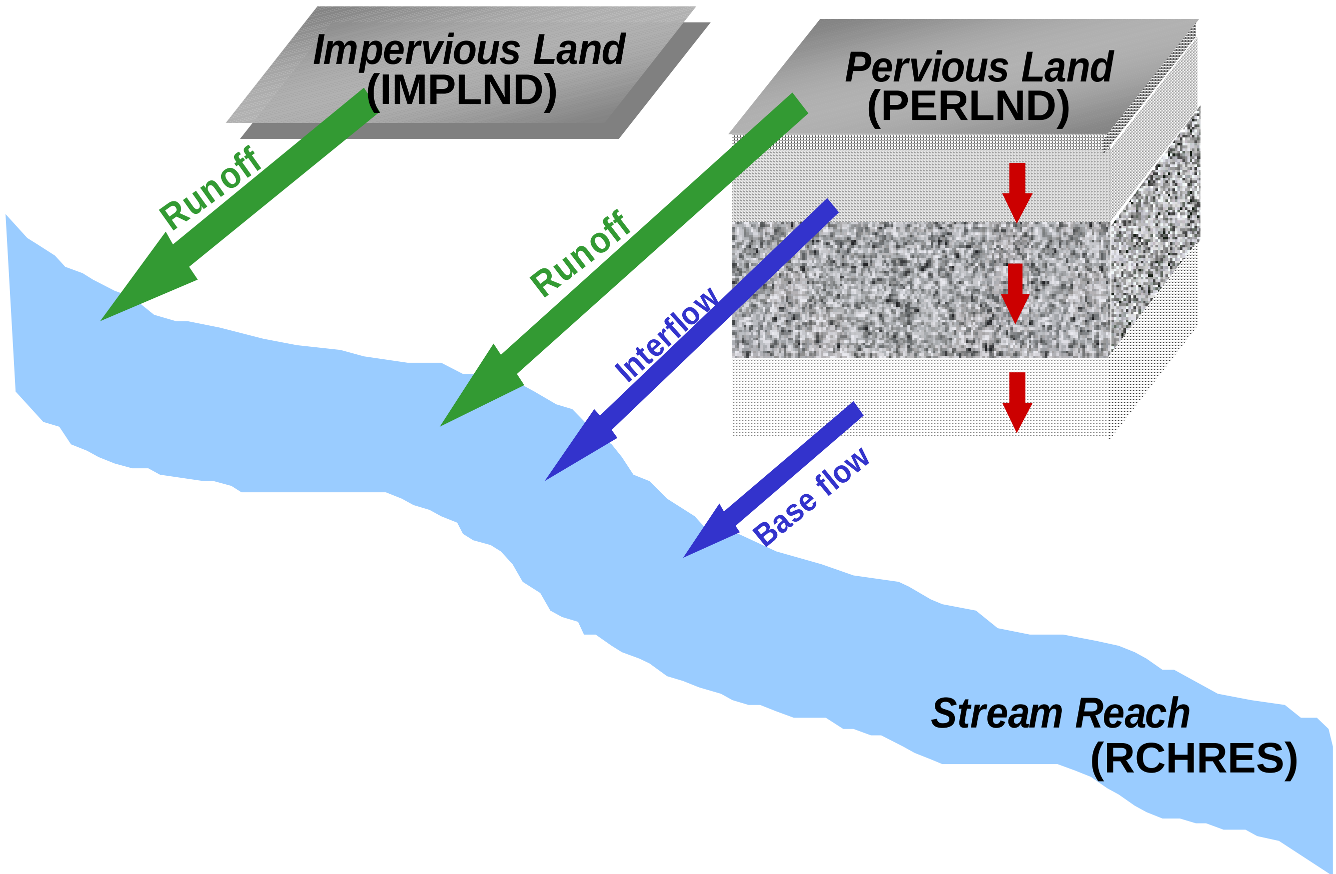


Figure 14. Physical representation of the three LSPC modules (USEPA, 1998).

The LZSN parameter is the lower zone nominal soil moisture storage. It is related to the precipitation patterns and soil characteristics in the subwatershed. Specifically, increasing LZSN will increase actual evapotranspiration, thus decreasing annual surface runoff (USEPA, 2000). The index to mean soil infiltration rate is represented by INFILT. This parameter controls the overall distribution of the available moisture from precipitation that has been intercepted into the ground. This parameter is usually utilized to represent seasonal surface runoff distributions. Increasing the value of INFILT will ultimately decrease surface runoff since it increases the transfer of water to the lower zone and groundwater. The LZETP parameter is a coefficient that represents the lower zone evapotranspiration and as values of LZETP increase, evapotranspiration increases thereby decreasing annual surface runoff. The last key parameter to effect annual water balance is DEEPFR, or the fraction of infiltrating water lost to inactive groundwater. Decreasing DEEPFR results in higher base flow and an increase in annual water balance (Donigian et al., 1984).

Subsequent to establishing an annual water balance, hydrographs for selected storm events can be adjusted to better agree with observed values. There are a variety of parameters that can be altered to effectively calibrate such hydrographs. However, continuous flow data over individual storms are necessary to create the desired hydrographs. These data were not available for The Chollas Creek watershed; therefore, stream flow calibration was limited to the annual water balance.

In addition to hydrologic calibration of the surface water, performed by adjusting parameters in the PWATER and IWATER sub-modules, hydraulic calibration was conducted using the RCHRES sub-module. The overall flows simulated in the RCHRES sub-module are a result of the overland hydrology from pervious and impervious lands and the stream characteristics contained in the hydrologic function tables (Donigian et al., 1984).

The rest of this discussion is divided into two sections: one on regional hydrological simulations and one on the application of these regional hydrology simulations to the Chollas Creek watershed. The hydrology simulations conducted for the San Diego region resulted in a regionally calibrated set of parameter values. These parameters were applied to the Chollas Creek watershed in order to make flow predictions.

4.3.2. Wet Weather Model Use of the San Diego Region Hydrologic Model

Gaging stations representing diverse hydrologic regions of the San Diego region were used for calibration, including eleven USGS flow gage stations (Table 5 and Figure 13). These gaging stations were selected because they either had a robust historical record or they were in a strategic location (i.e. along a listed water quality limited segment, downstream of a reservoir, or along an otherwise unmonitored reach).

Table 5. USGS Stations Used For Hydrology Calibration and Validation

Station Number	Station Name	Historical Record	Selected Calibration Period	Selected Validation Period	Watershed and Model Subwatershed
11022480	San Diego River at Mast Road near Santee, CA	5/1/1912 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	San Diego River (1805)
11023000	San Diego River at Fashion Valley at San Diego, CA	1/18/1982 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	San Diego River (1801)
11023340	Los Penasquitos Creek near Poway, CA	10/1/1964 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	Miramar (1406)
11025500	Santa Ysabel Creek near Ramona, CA	2/1/1912 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	San Dieguito (1316)
11028500	Santa Maria Creek near Ramona, CA	12/1/1912 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	San Dieguito (1324)
11042000	San Luis Rey River at Oceanside, CA	10/1/1912 - 11/10/1997; 4/29/1998 - 9/30/2002	9/1/1993 - 8/31/1997	5/1/1998 - 4/30/0202	San Luis Rey (702)
11042400	Temecula Creek near Aguanga, CA	8/1/1957 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	Santa Margarita (658)
11044300	Santa Margarita River at FPUD Sump near Fallbrook, CA	10/1/1989 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	Santa Margarita (615)
11046000	Santa Margarita River at Ysidora, CA	3/1/1923 - 2/25/1999; 10/1/2001 - 9/30/2002	1/1/1991 - 12/31/1995	1/1/1996 - 12/31/1998	Santa Margarita (602)
11046530	San Juan Creek at La Novia Street Bridge near San Juan Capistrano, CA	10/1/1985 - 9/30/2002	1/1/1991 - 12/31/1996	1/1/1997 - 12/31/2001	San Juan (411)
11047300	Arroyo Trabuco near San Juan Capistrano, CA	10/1/1970 - 9/30/1989; 10/1/1995 - 9/30/2002	10/1/1995 - 4/30/1999	5/1/1999 - 4/30/2002	San Juan (403)
11022350	Forester Creek near El Cajon, CA	10/1/1993 - 9/30/2002	none (insufficient period of record)	1/1/1991 - 9/30/1993	San Diego River (1843)
11039800	San Luis Rey River at Couser Canyon Bridge near Pala, CA	10/1/1986 - 1/4/1993	none (insufficient period of record)	1/1/1991 - 12/31/1992	San Luis Rey (711)

January 1991 through September 2002 was selected as the time period for the regional simulation.[5] The calibration years were selected based on annual precipitation variability and the availability of observation data to represent a continuum of hydrologic conditions: low,

[5] The range was expanded for the Chollas Creek metals TMDL (January 1991 through December 2003) because newer meteorological data was available at the time of simulation.

mean, and high flow. Calibration for these conditions was necessary to ensure that the model would accurately predict a range of conditions over a longer period of time.

Key considerations in the hydrology calibration included the overall water balance, the high-flow/low-flow distribution, storm-flows, and seasonal variation. At least two criteria for goodness of fit were used for calibration: graphical comparison and the relative error method. Graphical comparisons were extremely useful for judging the results of model calibration; time-variable plots of observed versus modeled flow provided insight into the model's representation of storm hydrographs, base flow recession, time distributions, and other pertinent factors often overlooked by statistical comparisons. The model's accuracy was primarily assessed through interpretation of the time-variable plots. The relative error method was used to support the goodness of fit evaluation through a quantitative comparison.

After calibrating hydrology at the eleven locations, a validation of these hydrologic parameters was made through a comparison of model output to different time periods at the same gages as well as two additional gages (Table 1). The validation essentially confirmed the applicability of the regional hydrologic parameters derived during the calibration process. Validation results were assessed similar to calibration: via graphical comparison and the relative error method.

Hydrology calibration and validation results, including time series plots and relative error tables, are presented for each gage in Appendix E of the draft TMDL report for bacteria impairment in the San Diego region (Tetra Tech, Inc., 2004). The calibration results, which are presented first, include graphs to represent overall model fit, seasonal trends, and two time series plots. A table that quantifies the model results and observed gage data follows these graphs. This table also provides relative errors between the modeled and observed values in the storm volumes and highest flows. The presentation of model validation results follows the calibration tables and graphs for each gage. Two additional gages that had a relatively less historical record were used as additional validation. Validation was assessed through a time series plot and a relative error table identical to the calibration table.

To ensure that the watershed delineation and land use reclassification processes performed for the Chollas Creek watershed did not significantly alter the predicted hydrology, the current model output was compared with the regional model output specifically for the Chollas Creek watershed. Although the Chollas Creek watershed does not have a stream gage collecting daily flow data, data were available for a series of storms (or for a period of time during a storm season) between 2001 and 2003.

4.3.3. Metal Concentration Calibration and Validation for the Chollas Creek Watershed

Once the stream flow was calibrated and validated, other hydrologically-dependent functions, including metal concentration, were simulated in order to calibrate the remaining model parameters. Regionally calibrated land use-specific accumulation and maximum build up rates for metals are not available in Southern California;[6] therefore, a more traditional water quality calibration and validation process was performed. In addition, observed water quality

[6] Ideally these rates would be available and could be used with water quality simulations to further validate their accuracy

data, unlike stream flow data, are usually not continuous; thus making time-series comparisons difficult and reducing the accuracy of the water quality model calibration.

The available wet weather metal concentration data (Appendix A) was separated into calibration and validation groups based on sampling stations. Station SD(8)-1 was used for calibration, because it had the most data (approximately 35 metal concentrations). Because the rest of the water quality monitoring stations had only three to five metal concentration data points, the remaining data were separated into two groups with similar spatial representation of land uses and of watersheds (Figure 15).

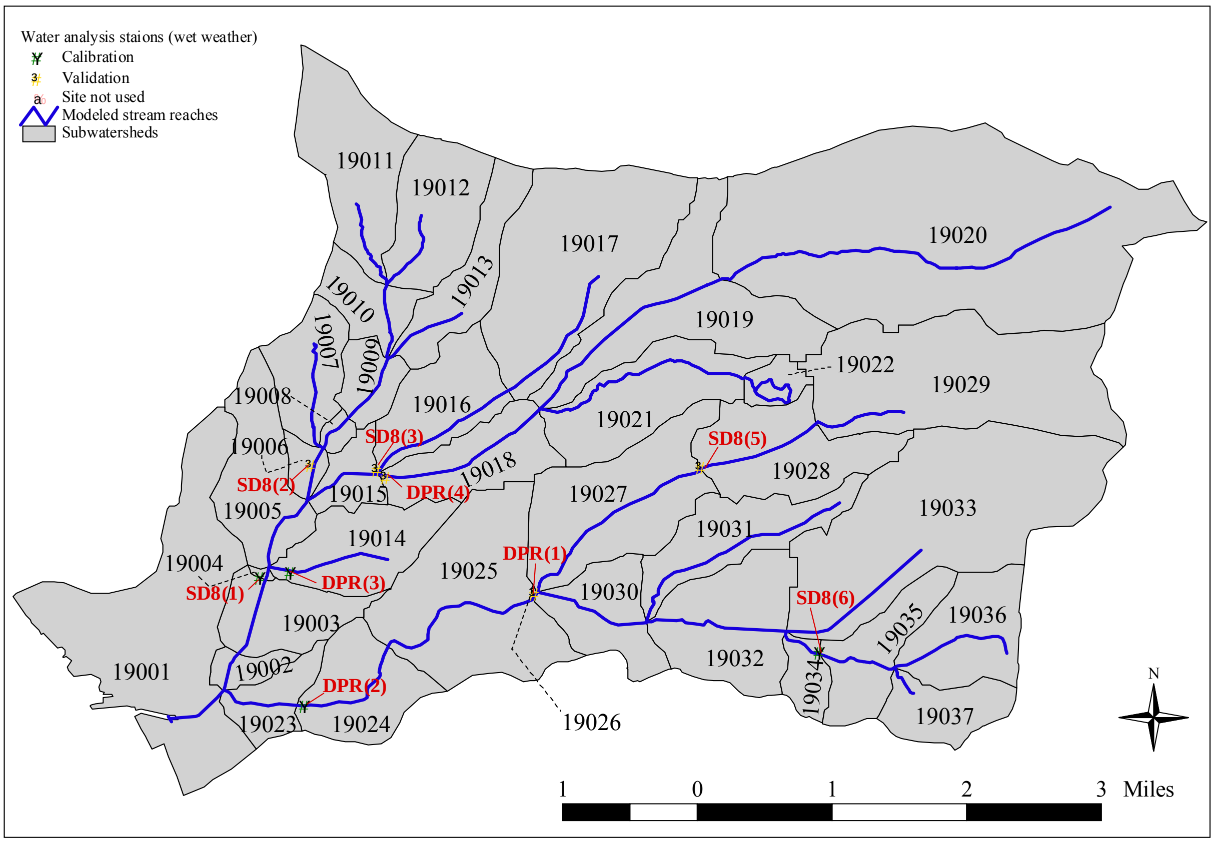


Figure 15. Map of monitoring locations used for model calibration and validation of the wet weather model.

After the appropriate calibration and validation groups were defined, the starting values for parameters relating to land use-specific accumulation rates (ACQOP) and buildup limits (SQOLIM) were defined. Their values were input for each stream reach and land use in the surrounding subwatershed. The ACQOP parameter is the daily pollutant accumulation rate. Based on this value, the concentration of a constituent accumulates until it reaches the maximum storage level, represented by SQOLIM. Additionally, the WSQOP[7] parameter is the rate of surface runoff that will remove 90 percent of the stored constituent per hour. This

[7] WQSOP is the rate of surface runoff that results in 90 percent wash off of fecal coliform bacteria in one hour (in/hr).

parameter, along with the modeled surface runoff, controls the overall pollutant loading to the stream (Bicknell, Imhoff, Kittle, Donigian, & Johanson, 1996). The initial accumulation rates used for this model were derived from land use specific metals data collected for the County of Los Angeles storm water program (LACDPW, 1998, 1999). Initial maximum build up rates were obtained from literature values (Butcher, 2003). These starting values served as initial conditions for water quality calibration.

Once model setup was complete, baseline simulations were performed. After entering the accumulation rate and wash-off data for each stream reach and its associated land uses, simulations were performed during time periods that overlapped the hydrology simulations. The modeled results were then compared with observed concentration data for copper, lead, and zinc. To assess model fit with available data, the time series model output was statistically and graphically compared to the observed data. Similar to the hydrology calibration process, the key parameter values (ACQOP and SQOLIM) were adjusted based on these differences and the simulations were performed again.

Once the water quality model calibration was complete, model validation was performed. This process is identical to the model validation procedures described above for hydrology validation. Namely, the model was run again using the calibrated parameter values for different monitoring locations. The results of this simulation were then compared to applicable observed metal concentration data to determine the predictive value of the model. Depending on the results of the water quality validation, the model can be considered complete, or model calibration may be repeated. (Figure 9)

4.4. Summary of Wet Weather Model Calibration and Validation

The observed flow hydrographs were on a sub-hourly time scale; however, the simulations were performed at an hourly timescale. For a comparison of the modeled and observed results, the data were summarized into average daily values and general statistical comparisons were made between the two sets of values (Appendix F). Because of the differences in time scale, the comparison is not entirely accurate.

4.4.1. Wet Weather Model Flow Rate Results

Overall, during calibration, the model predicted increased flow rates during dates when storm events had occurred. This is because the wet weather condition and surface runoff flow rate are dependent on rainfall. Occasional storms were over-predicted or under-predicted depending on the spatiality of the meteorologic and gage stations compared to the location of storms that did not cover the entire Chollas Creek watershed. The validation results also showed a good fit between modeled flow rates and observed flow rates, thus confirming the applicability of the calibrated hydrologic parameters to the San Diego region.

Minor differences were observed (the current model predicted flows approximately 8 percent higher than those from the San Diego regional hydrologic model) which resulted from the changes to the stream network and subwatershed boundaries in the current application. Specifically for the Chollas Creek Metals TMDL project, the total stream lengths increased while the total watershed area was nearly the same. This resulted in less opportunity for infiltration, because as water passed over the land surface it had to travel a shorter distance to reach a stream than it did in the simulation initially ran for the San Diego region hydrologic model (i.e. overland flow was reduced). This small difference between the hydrology results was considered acceptable, especially when compared to the significant benefit of using the more detailed stream network for the Chollas Creek Metals TMDL project.

Figure 16 compares the predicted flow with these average daily observed flows. Model predictions generally fell within the range of observed data; however, some peaks were observed that were not predicted by the model. These differences are likely due to localized storms that impacted the Chollas Creek watershed, but were not detected at the modeled weather station, Lindbergh Field. In addition, the shortest time step simulated was one hour, while the observed data were on a five or fifteen minute time step. The model output and observed data were both summarized to obtain average daily flow for comparative purposes. Therefore, the storm hydrographs, including maximum storm peaks, are not represented in Figure 16. Because modeled and observed flow ranges are similar, the LSPC hydrology model flow rate results were considered representative of flow in the Chollas Creek watershed. Differences can be explained by localized events, and until additional flow data become available, further calibration is not possible, nor warranted.

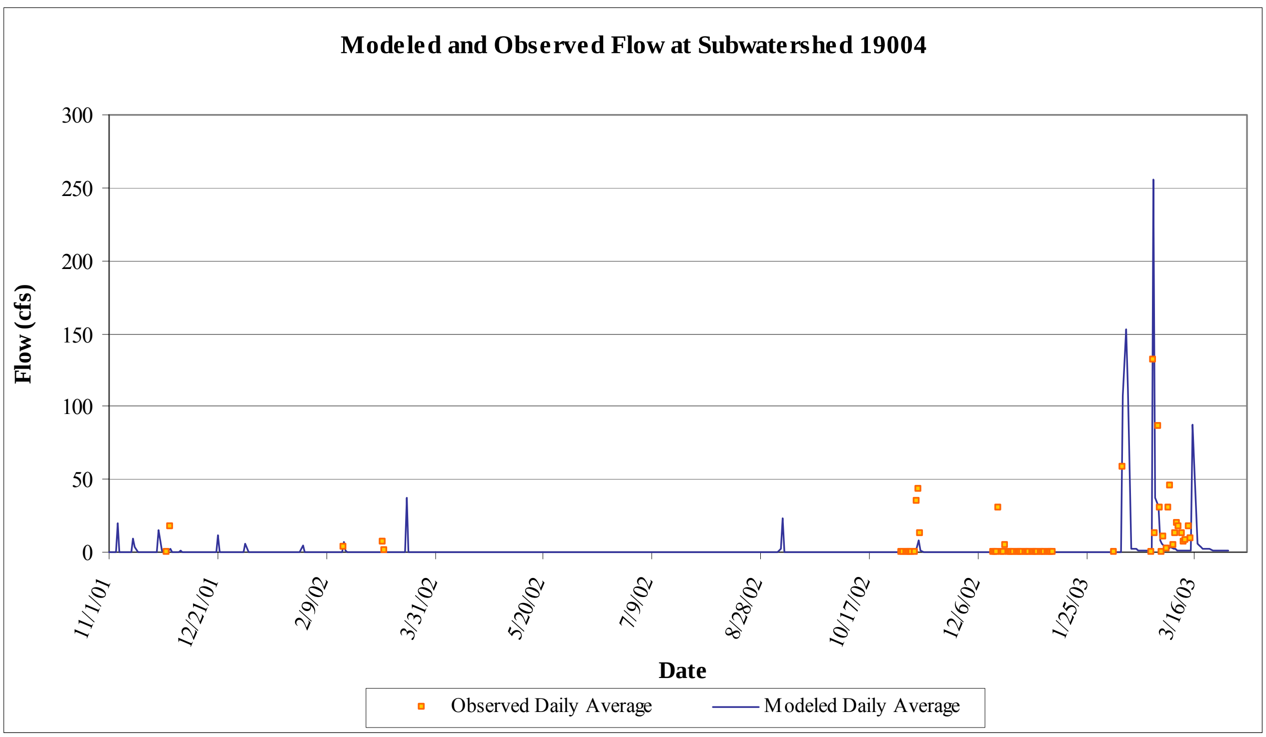


Figure 16. Modeled and observed flow at the Chollas Creek watershed Mass Loading Station

4.4.2. Wet Weather Model Metal Concentration Results

Figures 17, 19, 21, and 23 present time series graphs of modeled and observed data for the calibrated subwatersheds. Figures 18, 20, 22, and 24 are box plot graphs showing the minimum, mean, and maximum modeled values for the dates with corresponding observed data. These plots indicate that the model predicts copper, lead, and zinc concentrations well within the range of observed data and following similar patterns and magnitudes. This is especially evident in subwatersheds where there are data across a wide temporal range (Figures 17 and 18).

Using the same parameter values, model simulations were performed for validation of the calibrated parameters. Figures 25 through 34 present time series graphs and box plots for the validation subwatersheds. These results confirm the previous conclusion that the model closely predicts the observed data for copper, lead, and zinc concentrations.

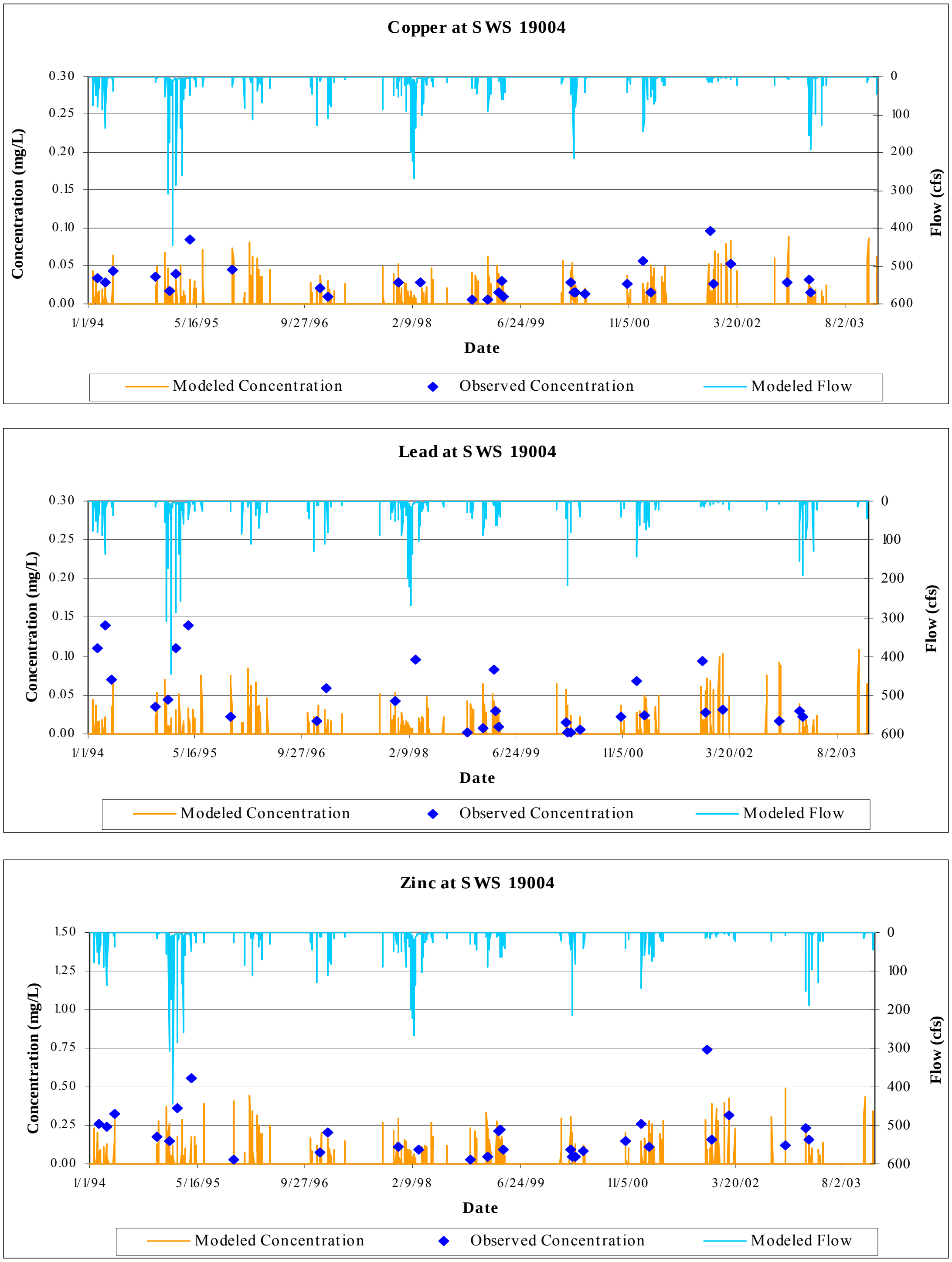


Figure 17. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location SD8(1) (model calibration)

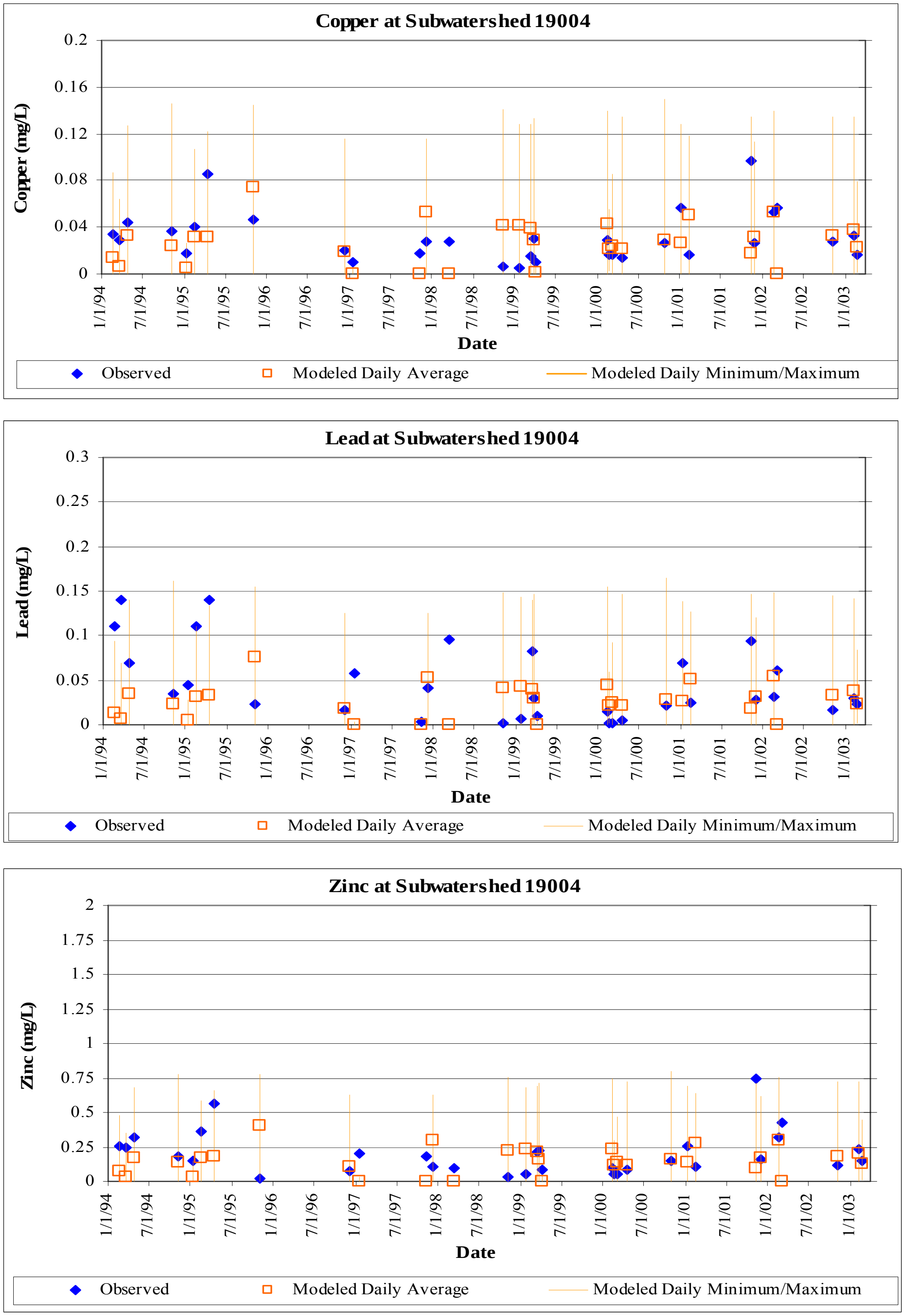


Figure 18. LSPC model results and corresponding observed metals data at sampling location SD8(1) (model calibration)

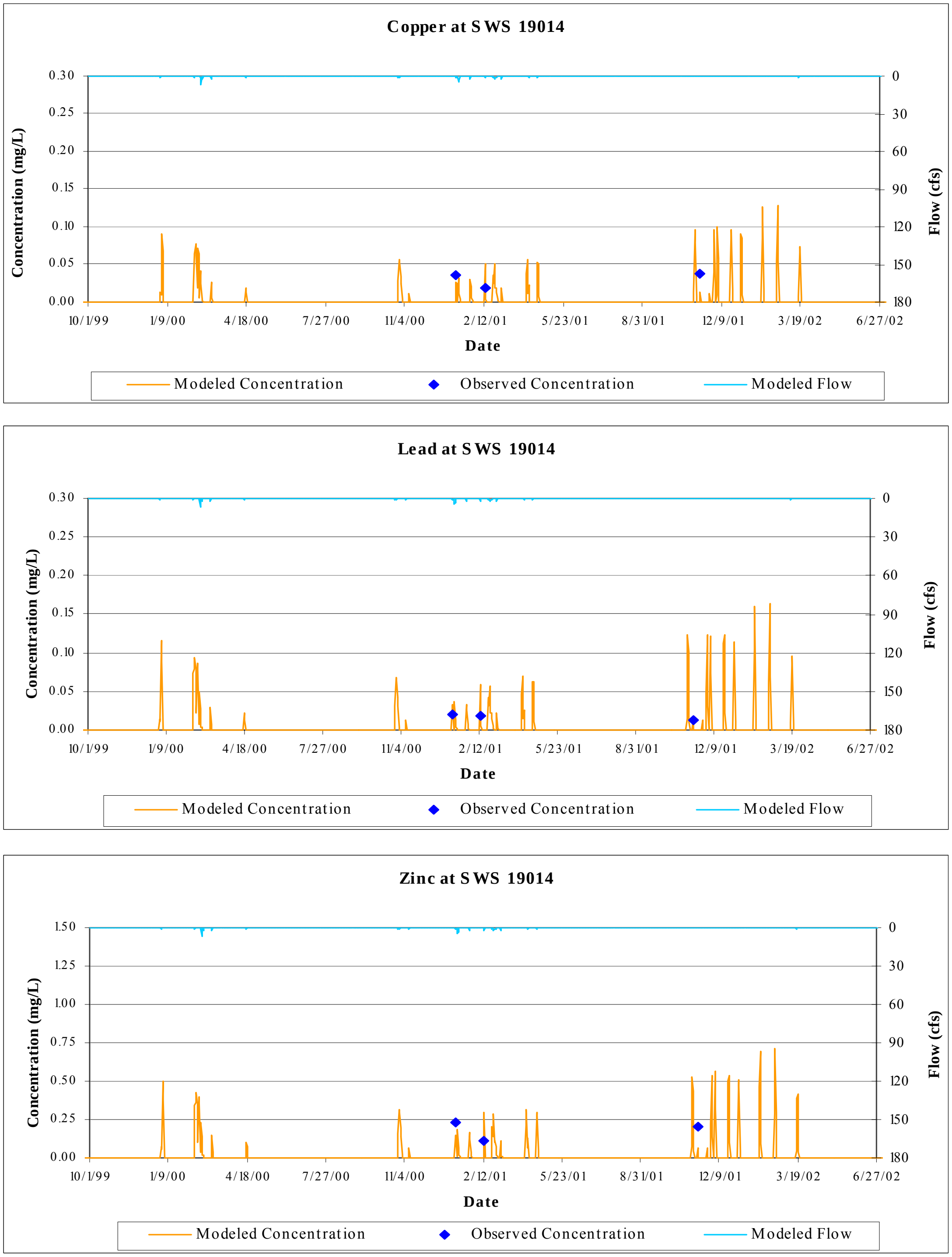
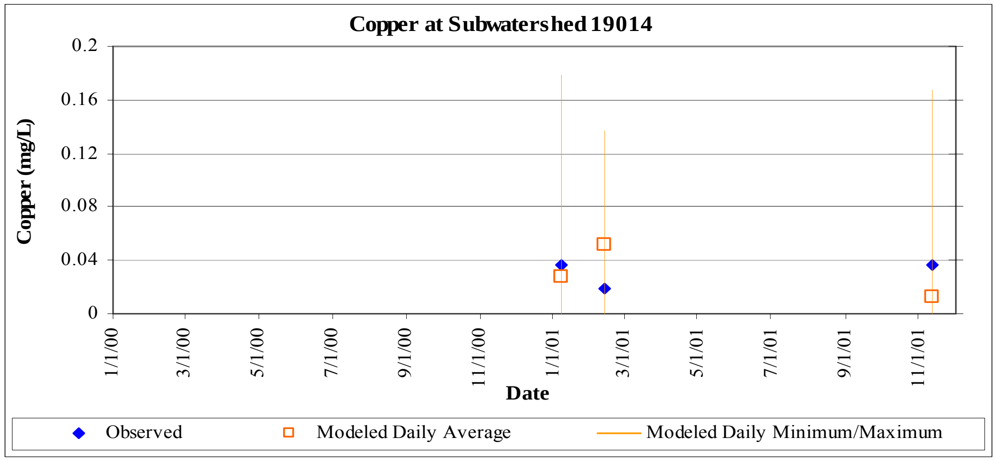
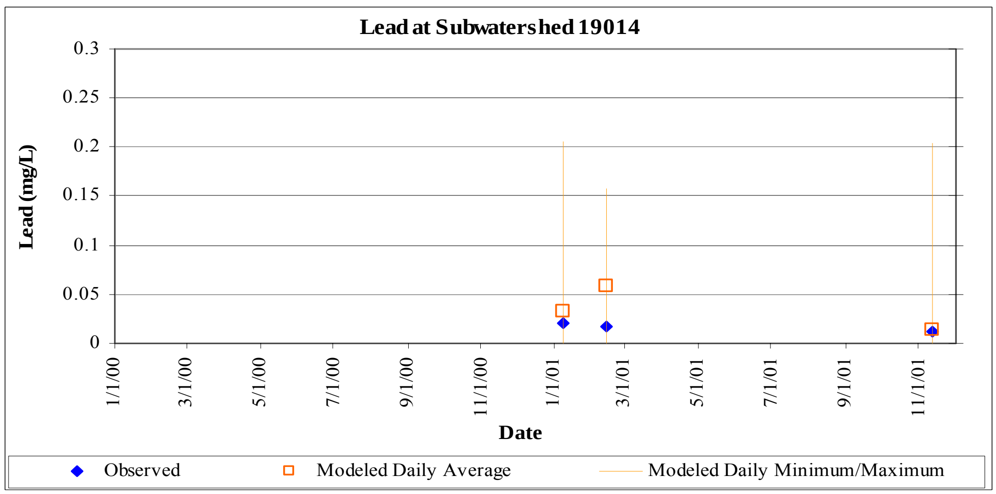


Figure 19. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location DPR(3) (model calibration).





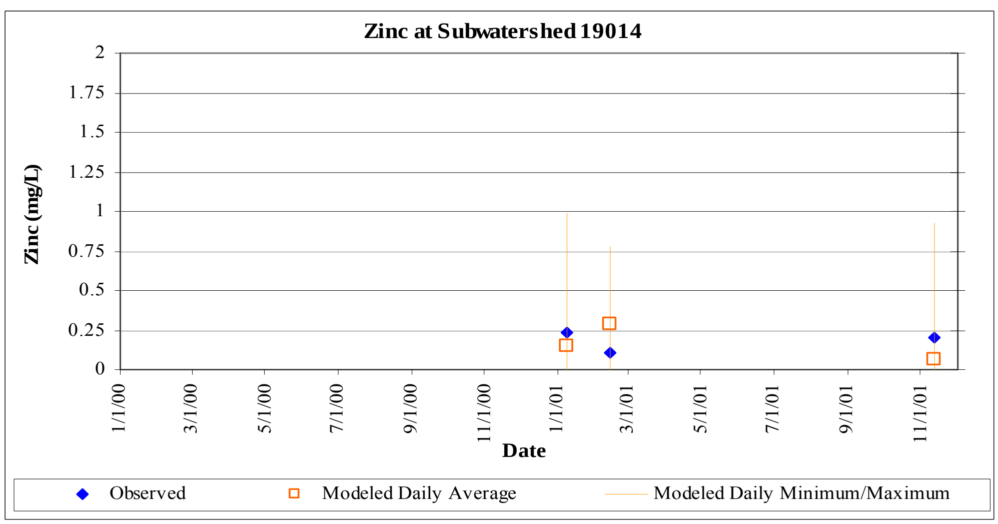
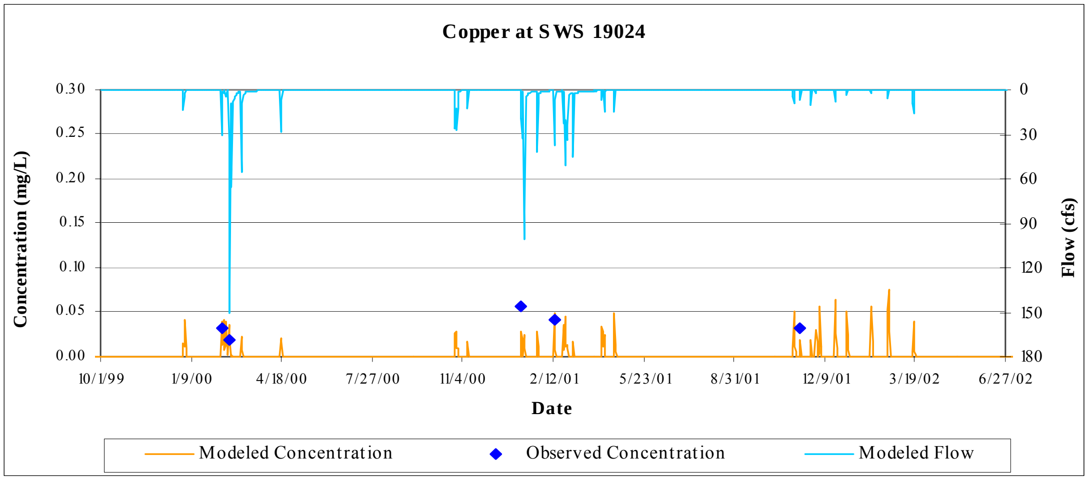
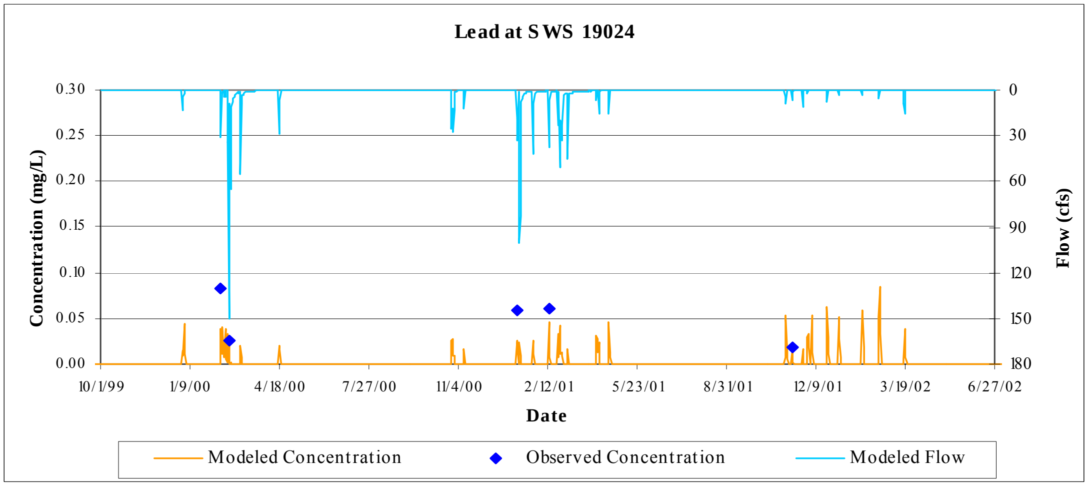


Figure 20. LSPC model results and corresponding observed metals data at sampling location DPR(3) (model calibration)





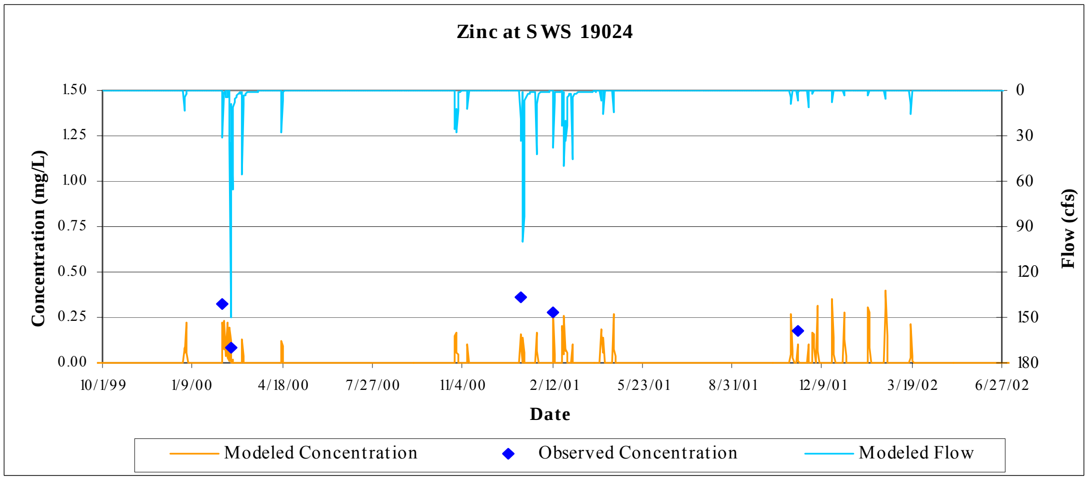


Figure 21. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location DPR(2) (model calibration)

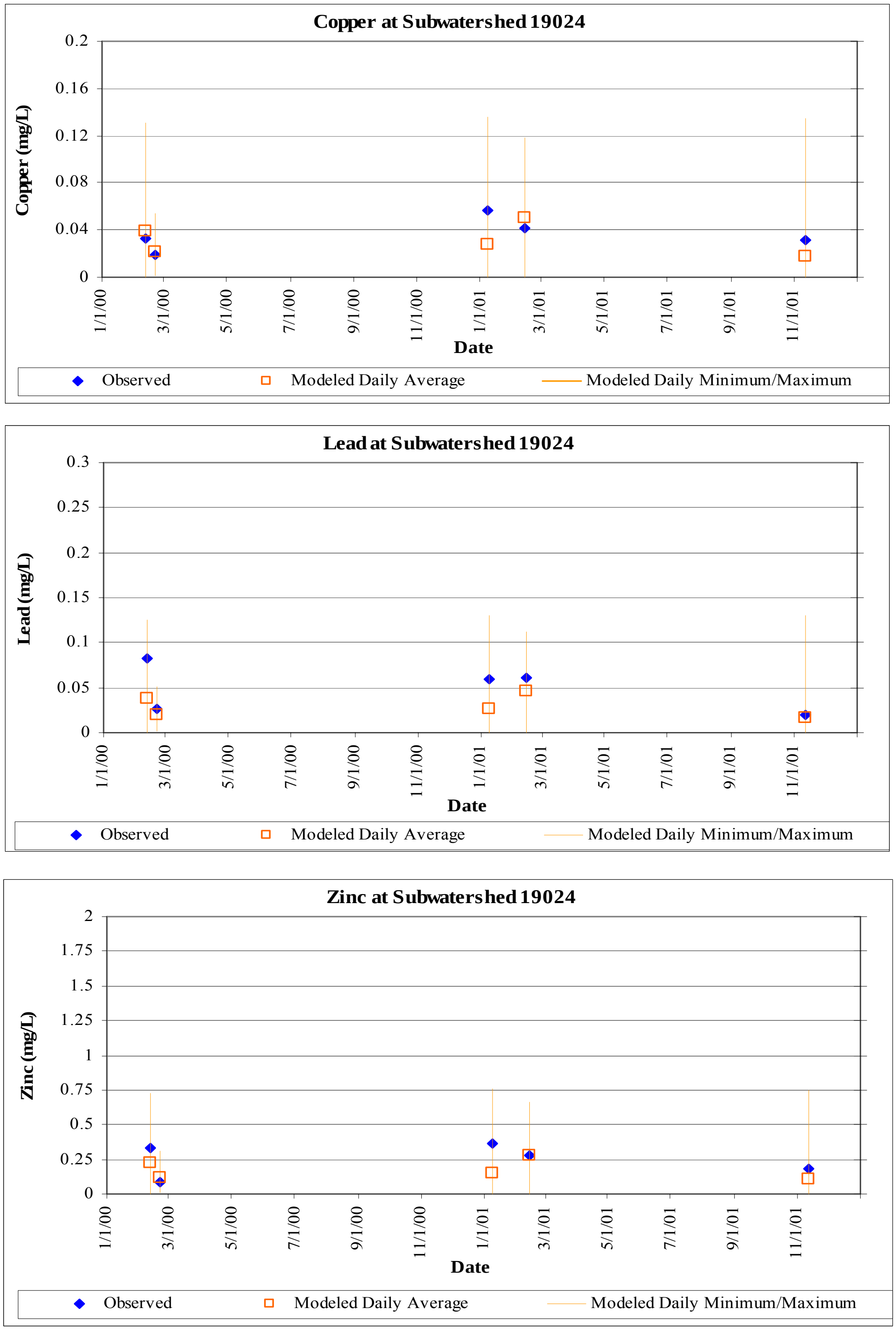
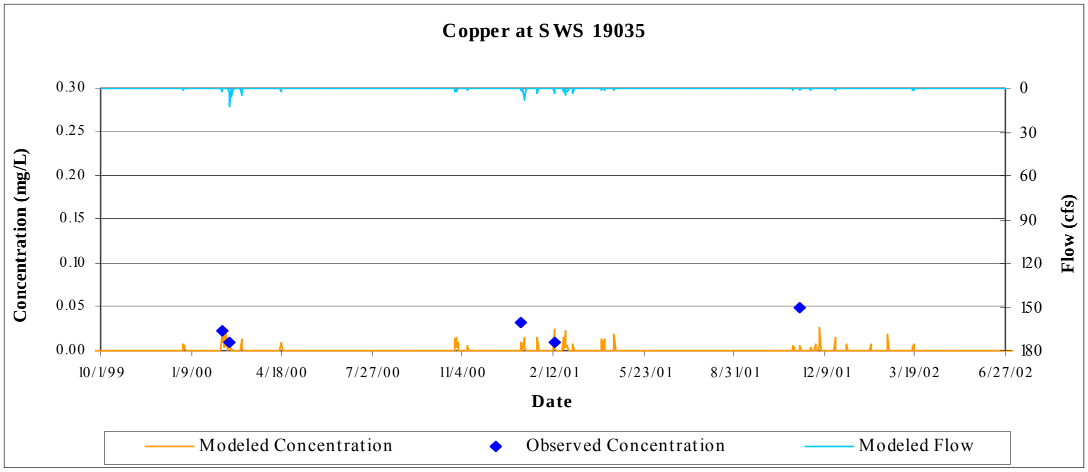
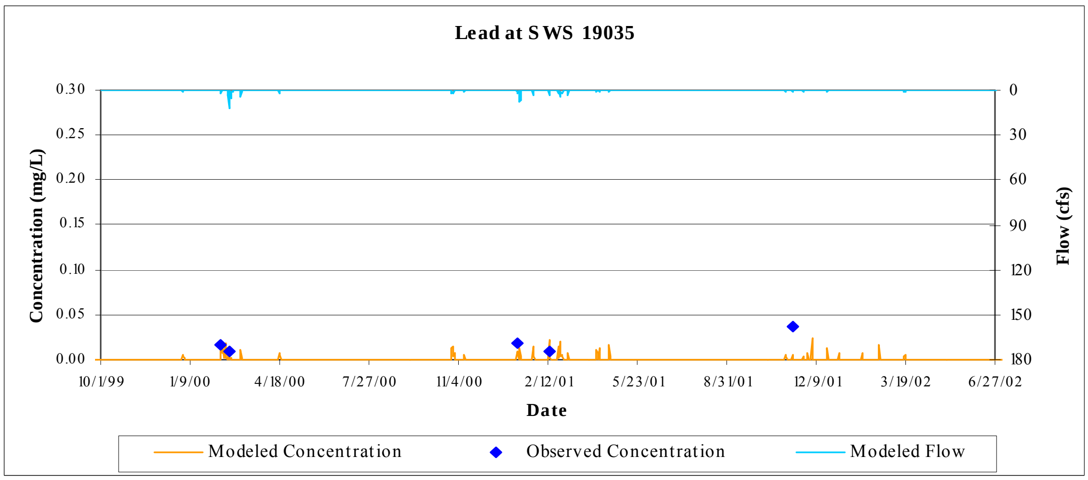


Figure 22. LSPC model results and corresponding observed metals data at sampling location DPR(2) (model calibration)





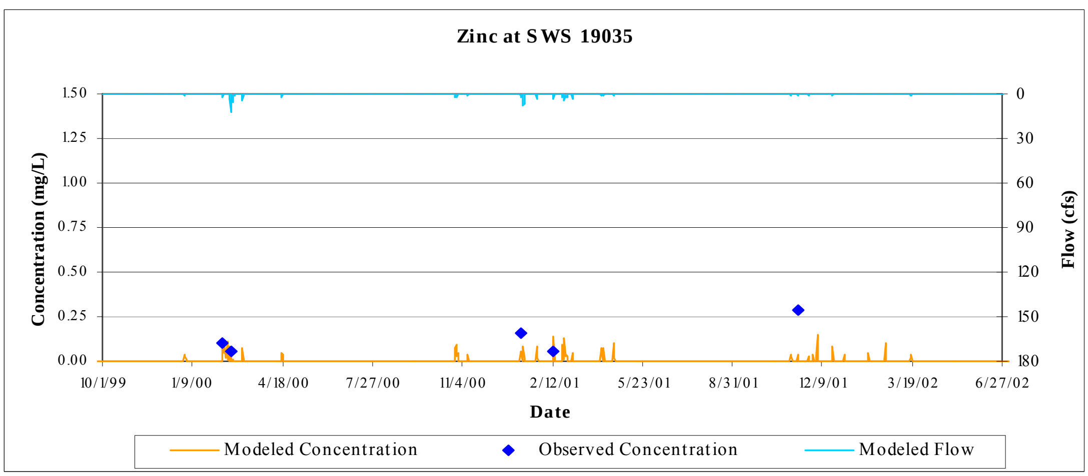
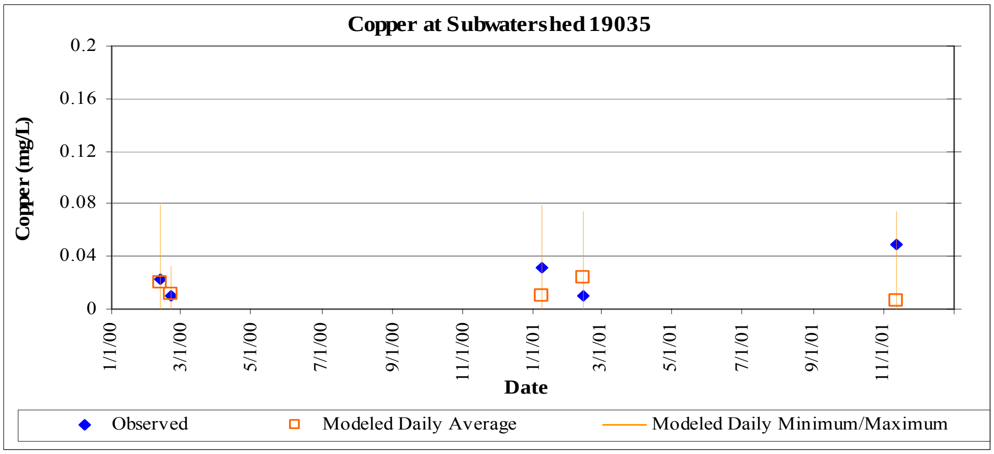
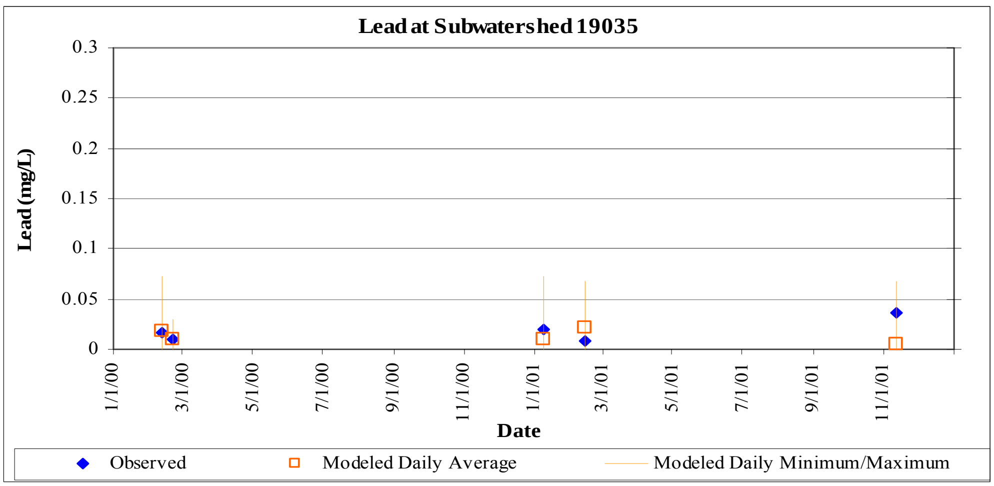


Figure 23. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location SD8(6) (model calibration)





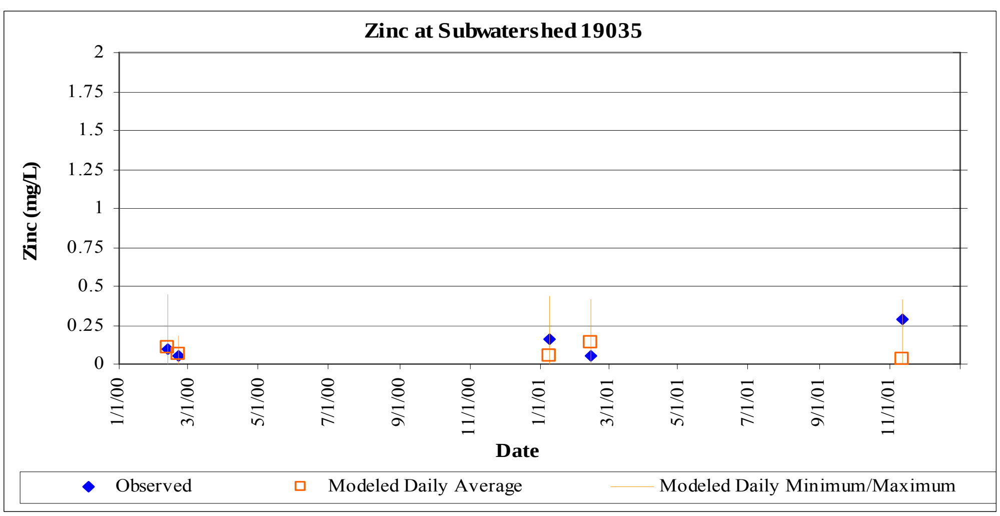
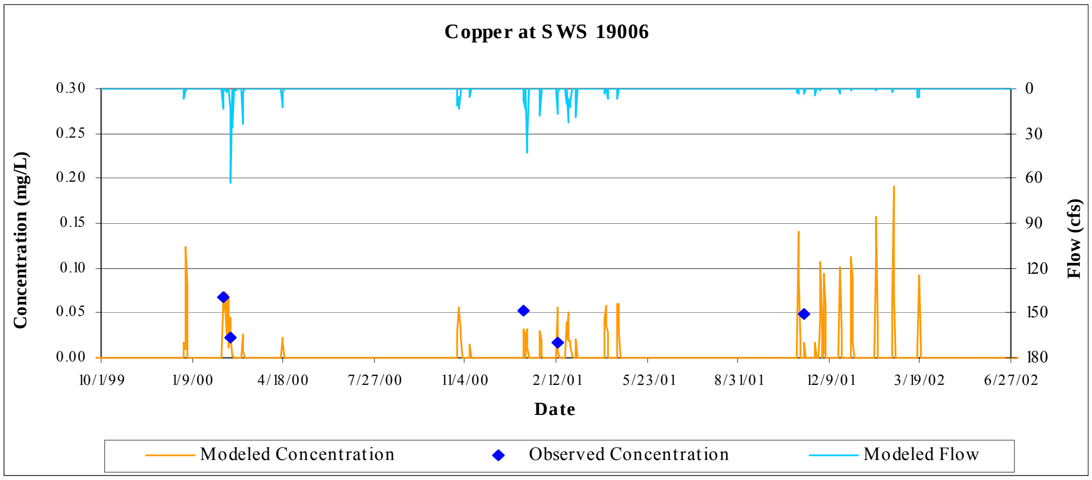
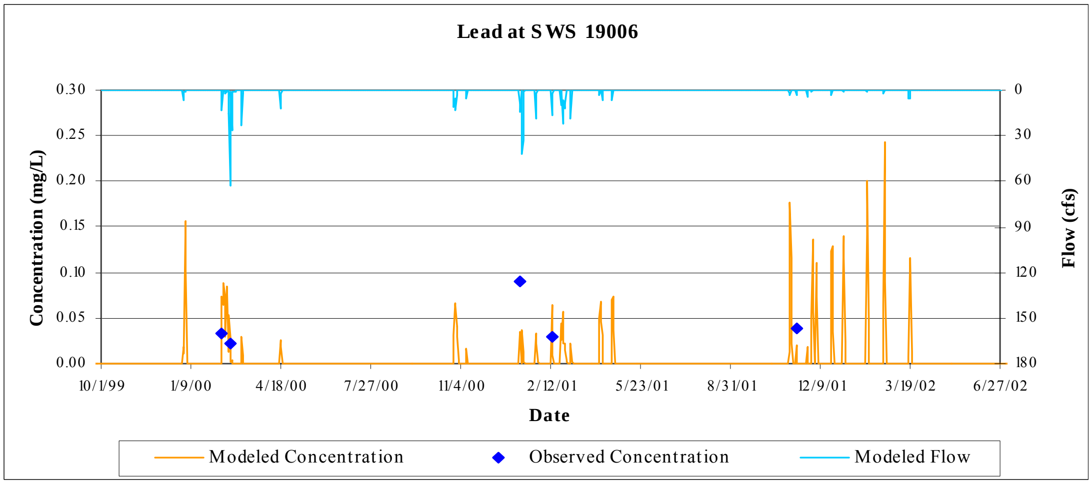


Figure 24. LSPC model results and corresponding observed metals data at sampling location SD8(6) (model calibration)





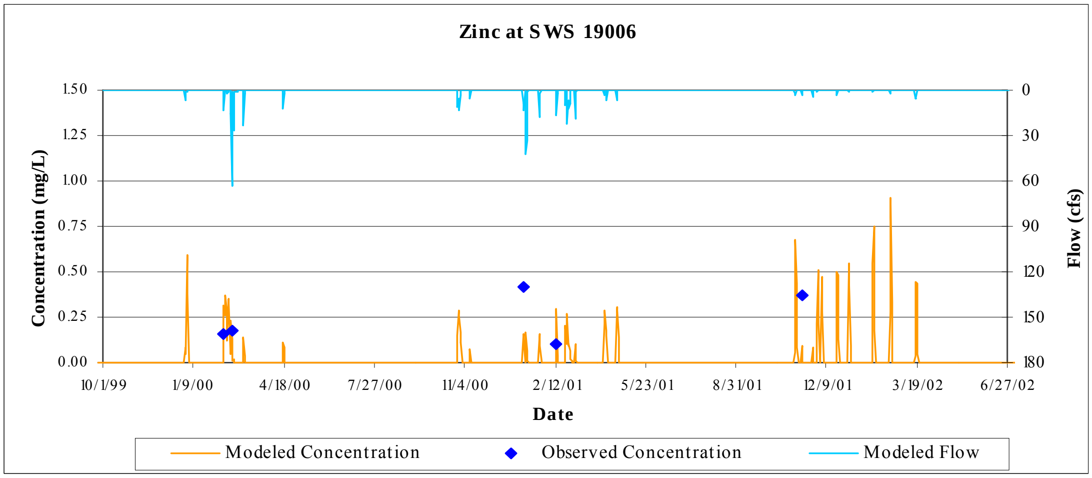


Figure 25. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location SD8(2) (model validation)

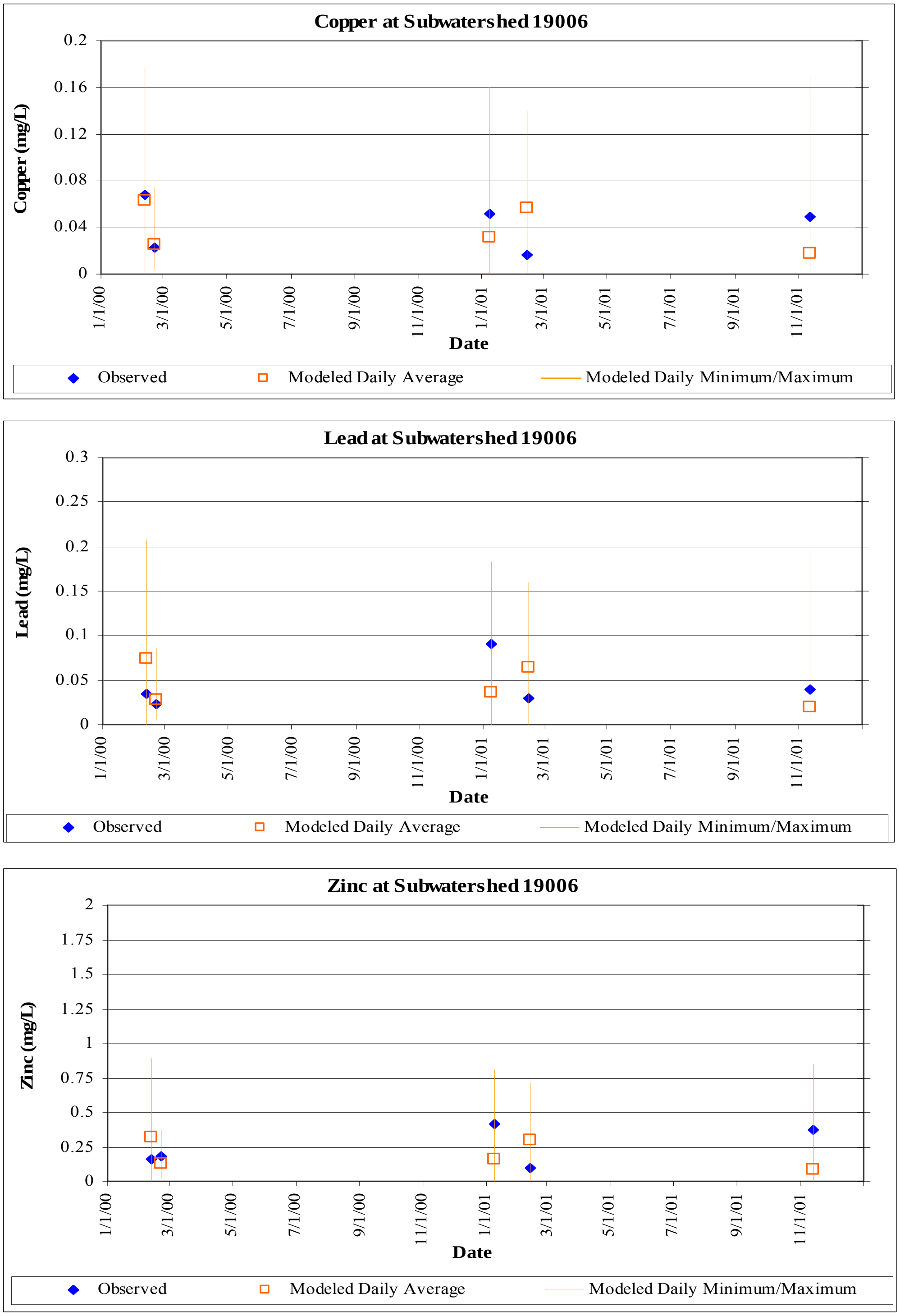
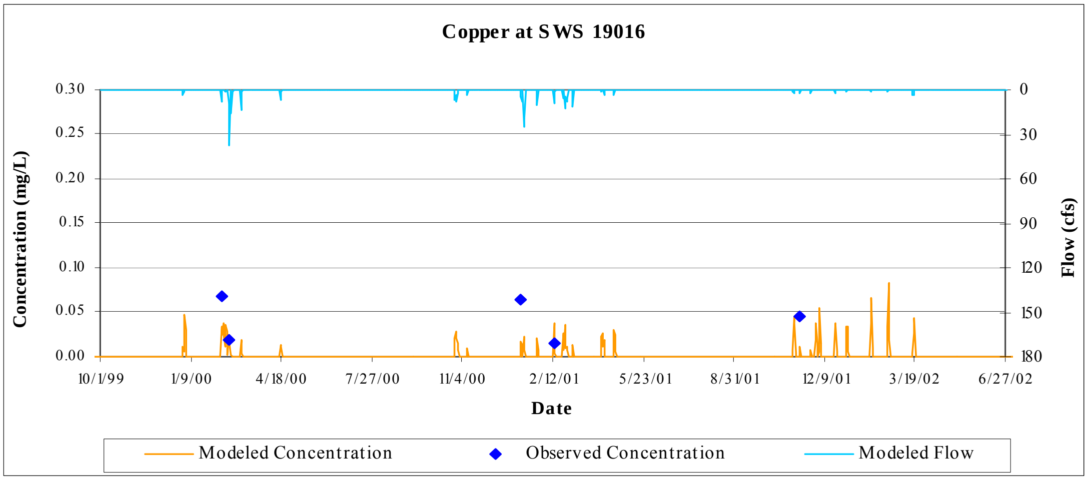
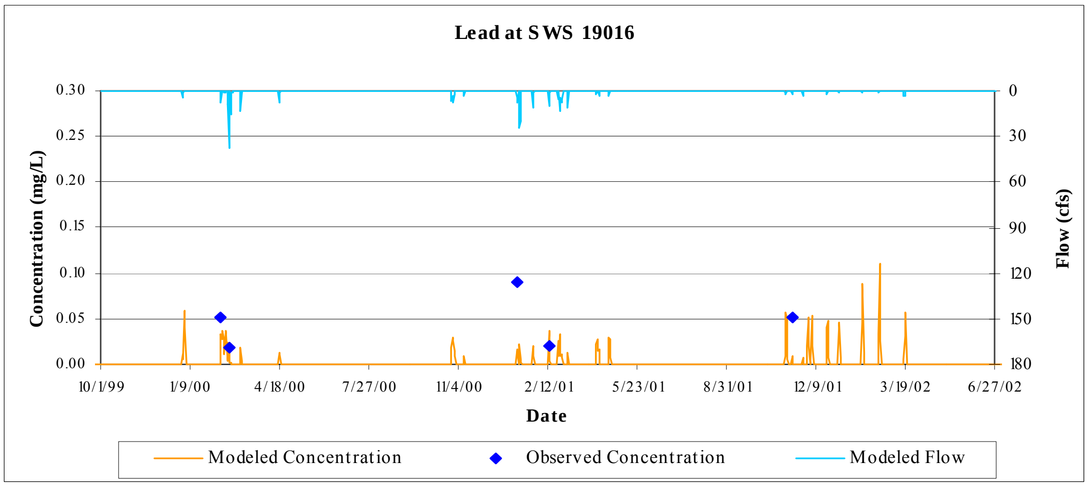


Figure 26. LSPC model results and corresponding observed metals data at sampling location SD8(2) (model validation)





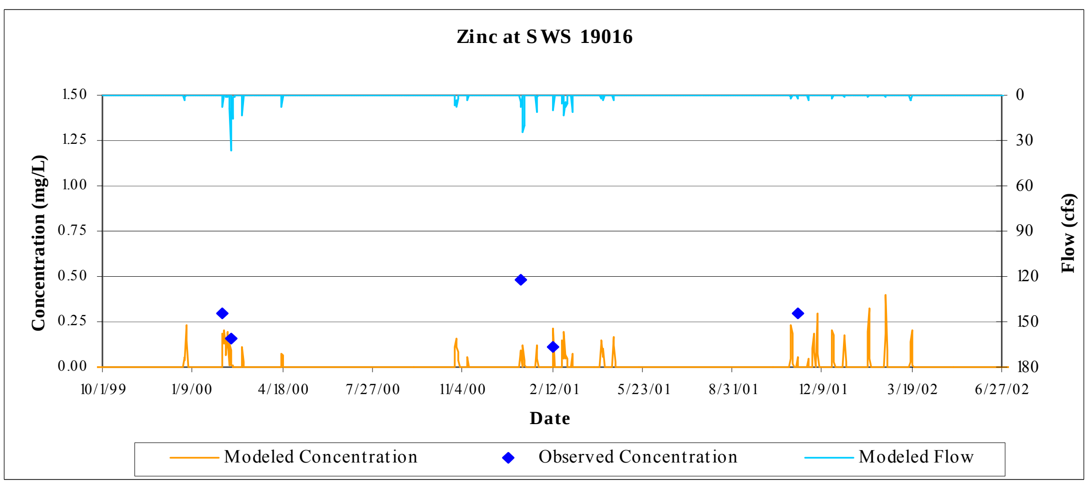
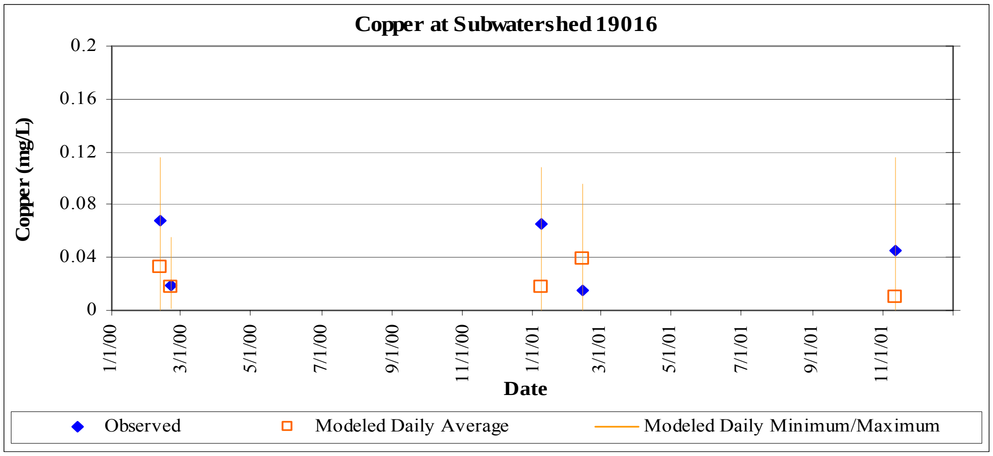
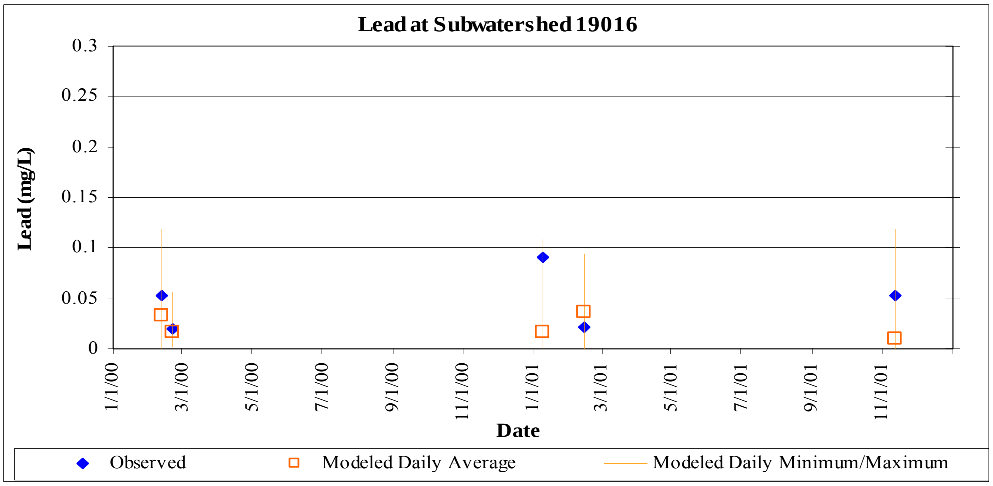


Figure 27. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location SD8(3) (model validation)





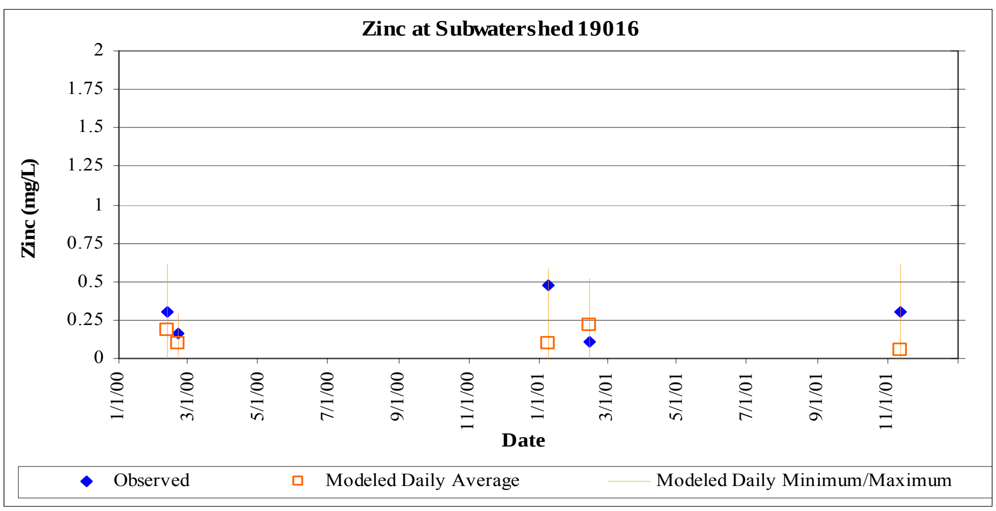
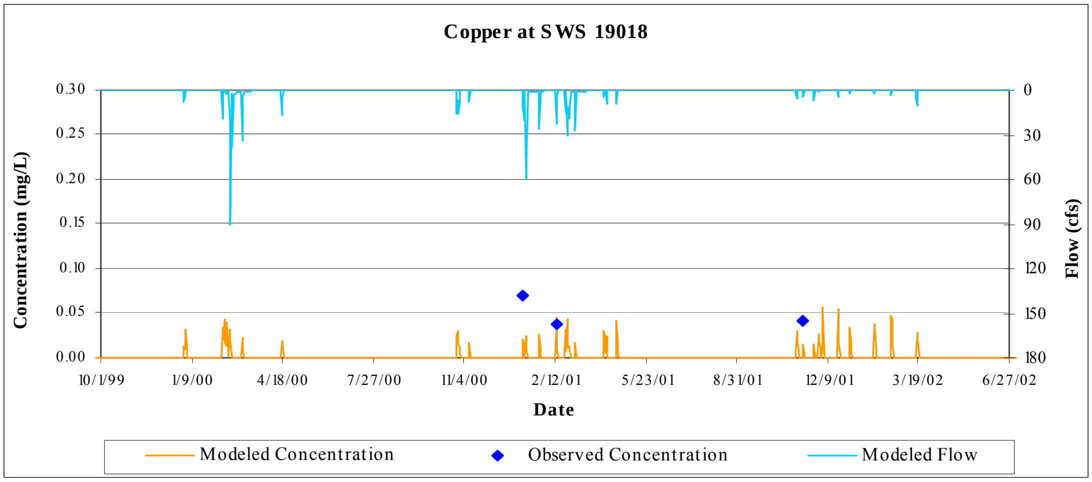
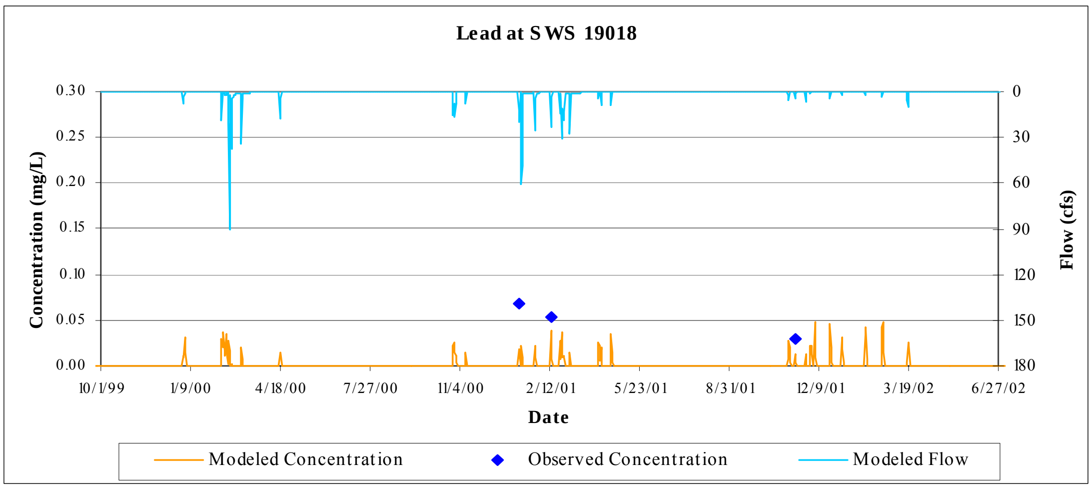


Figure 28. LSPC model results and corresponding observed metals data at sampling location SD8(3) (model validation)





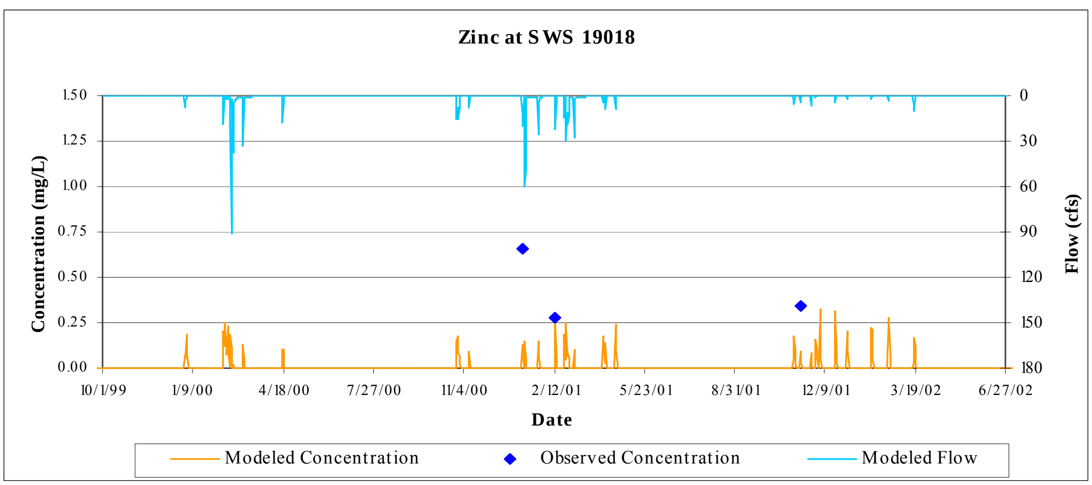
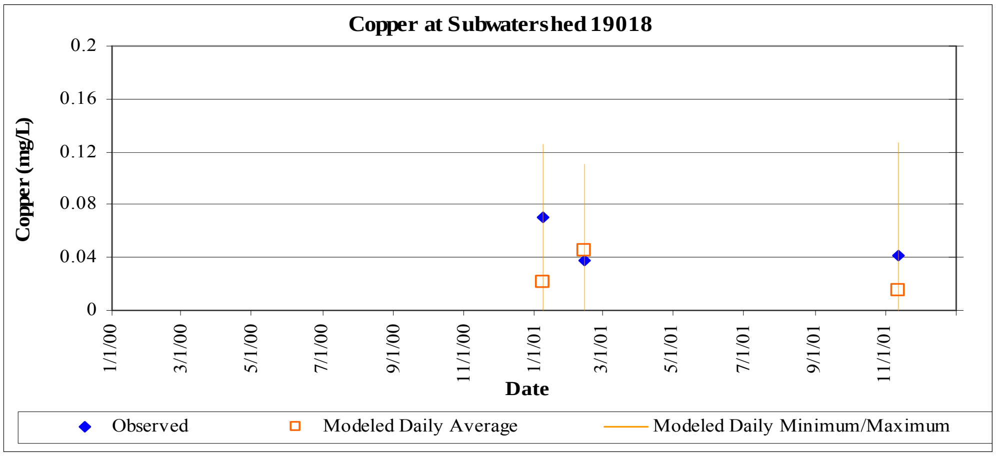
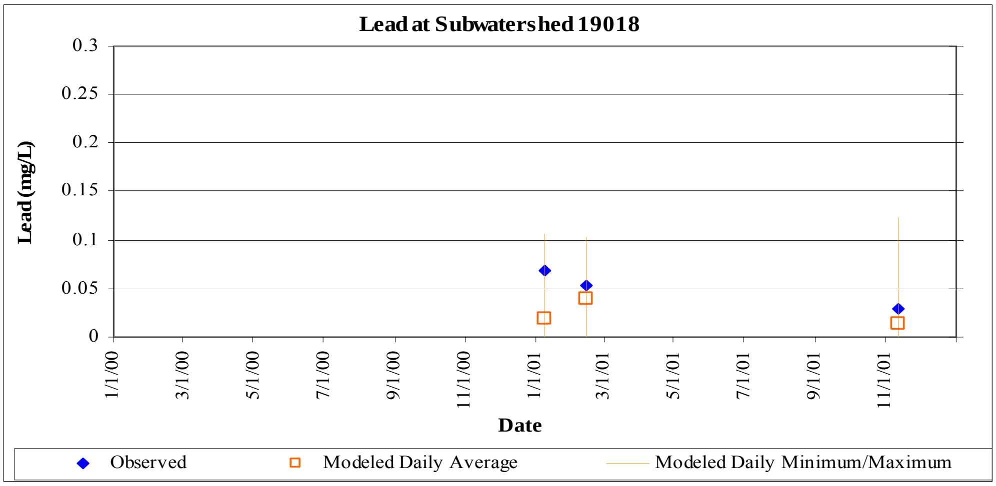


Figure 29. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location DPR(4) (model validation)





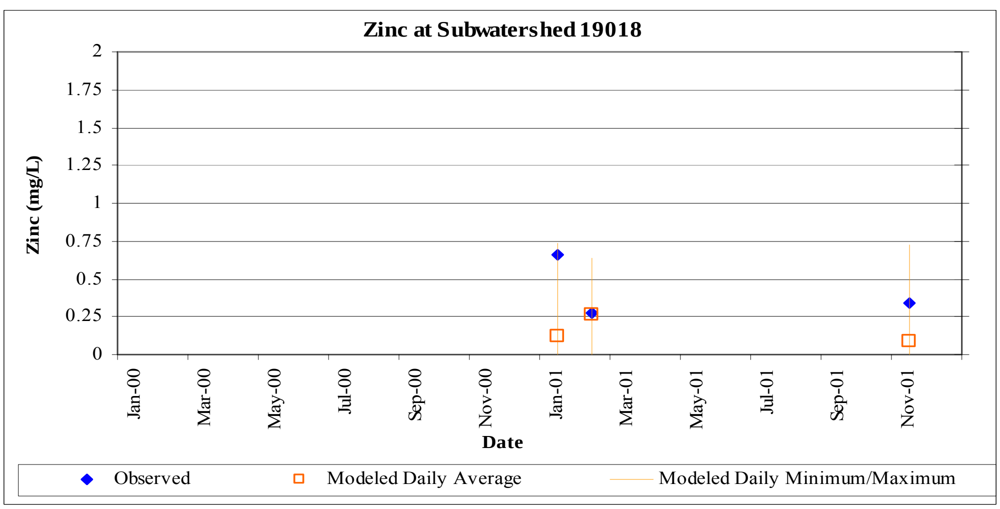


Figure 30. LSPC model results and corresponding observed metals data at sampling location DPR(4) (model validation)

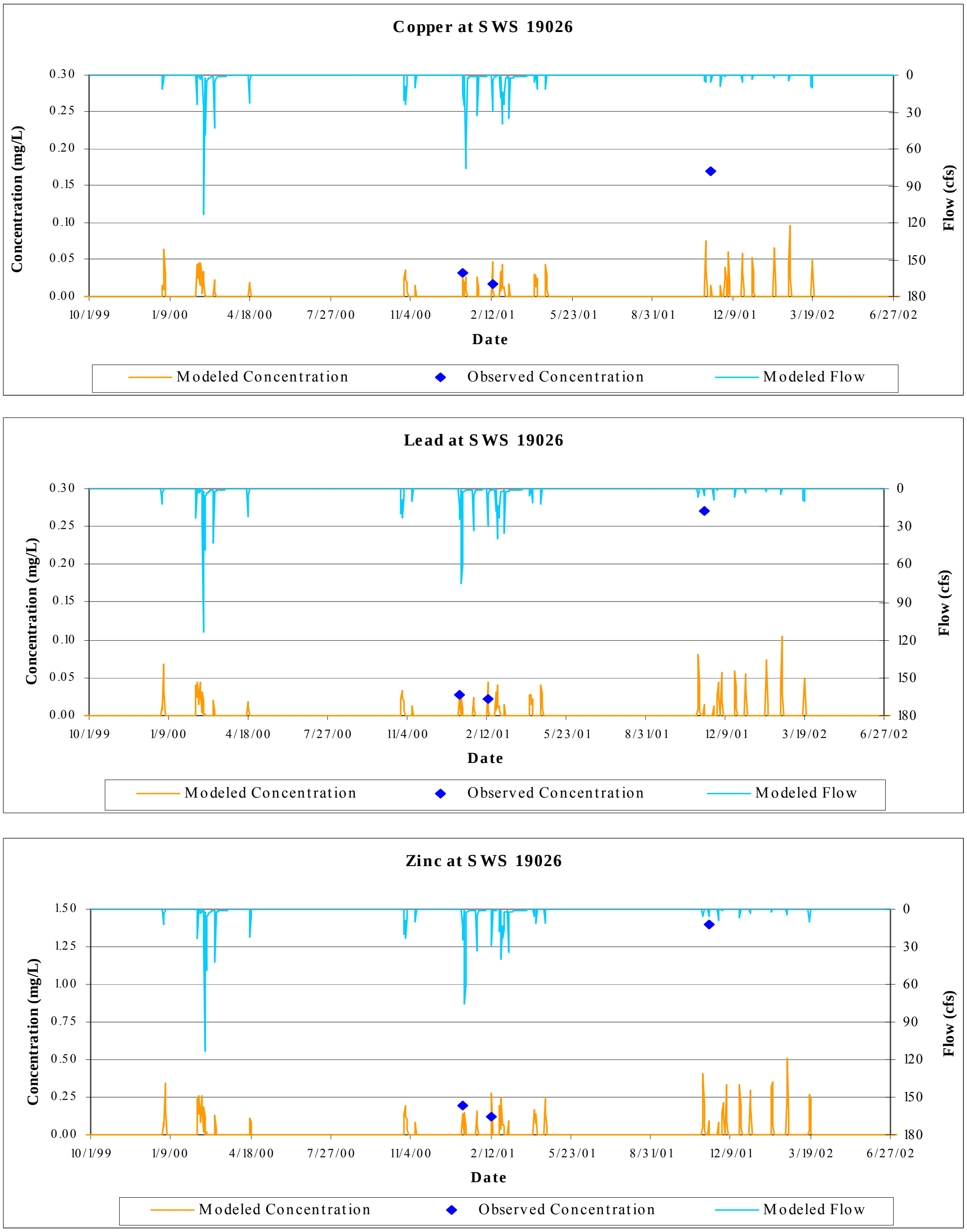
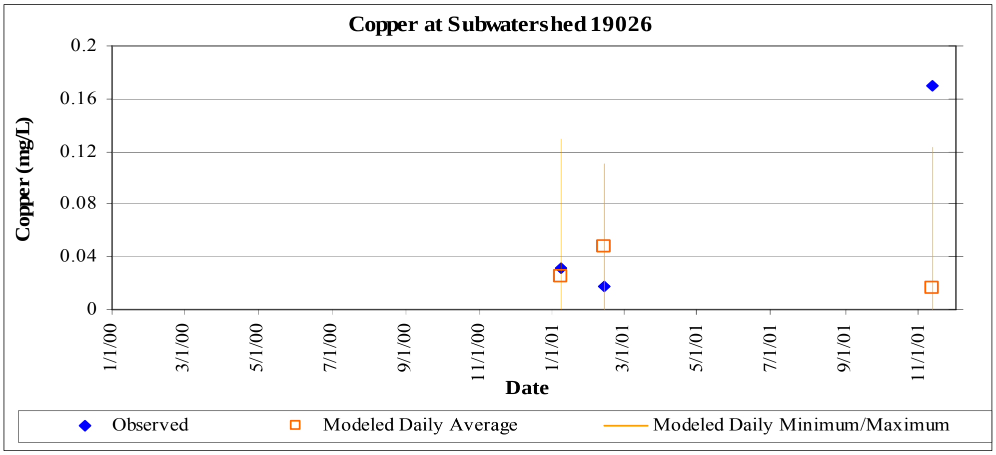
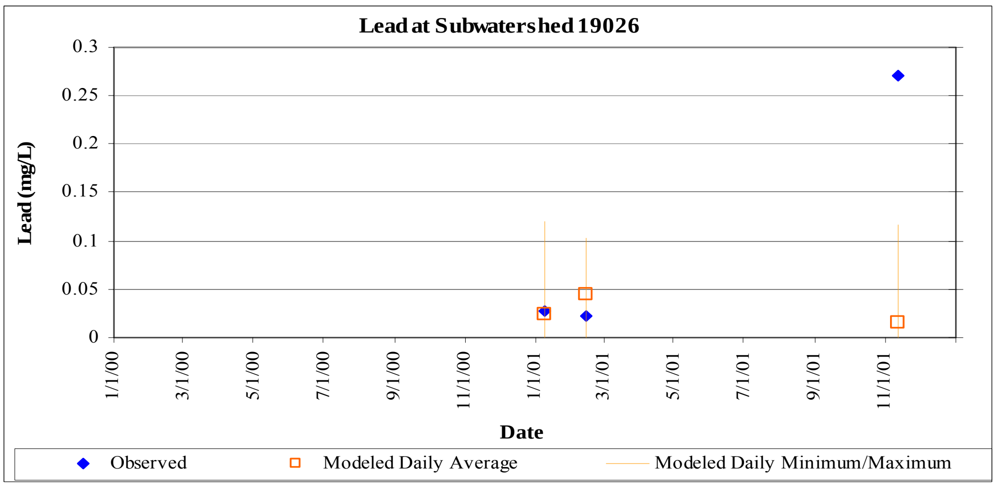


Figure 31. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location DPR(1) (model validation)





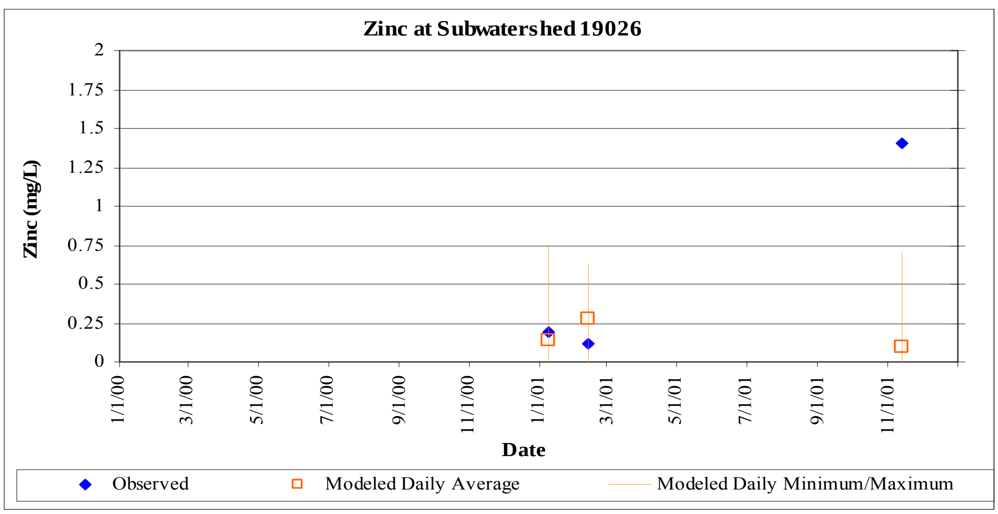
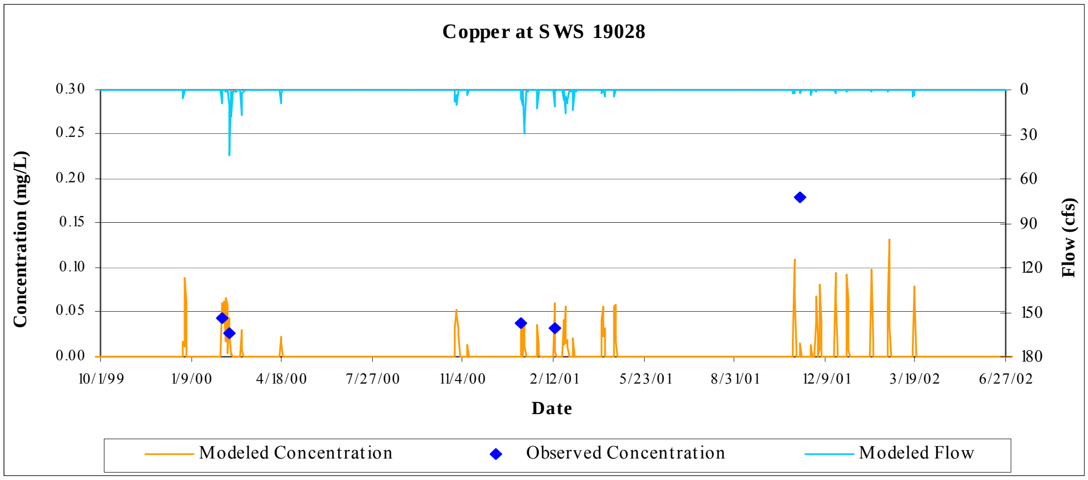
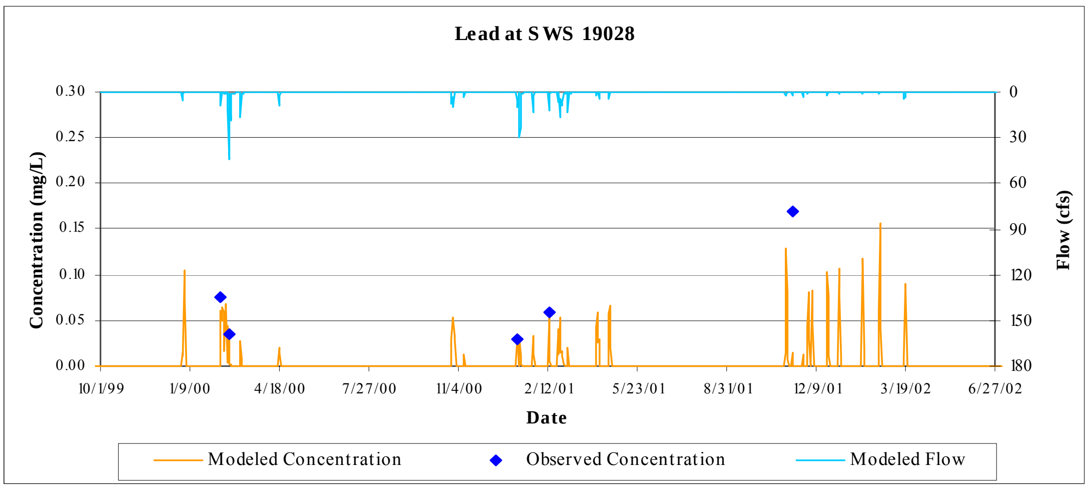


Figure 32. LSPC model results and corresponding observed metals data at sampling location DPR(1) (model validation)





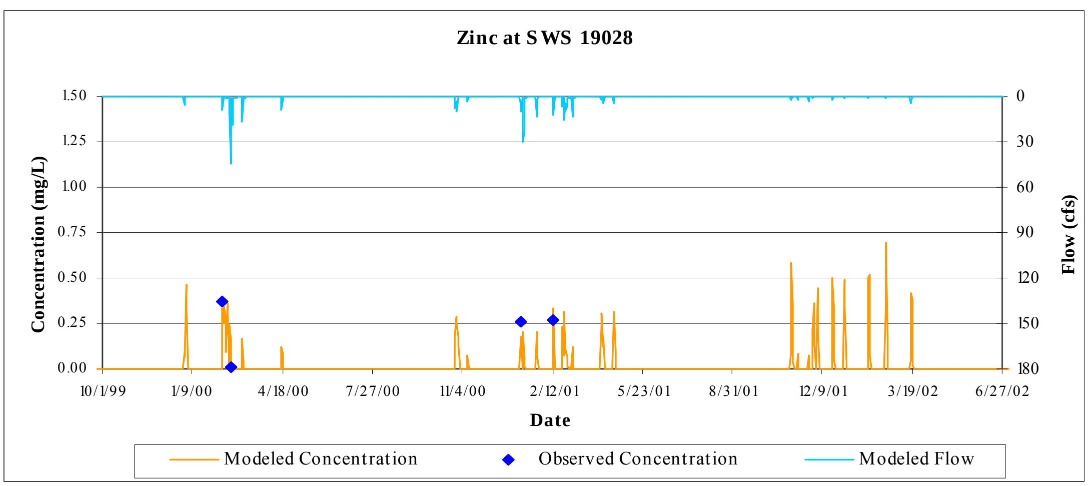
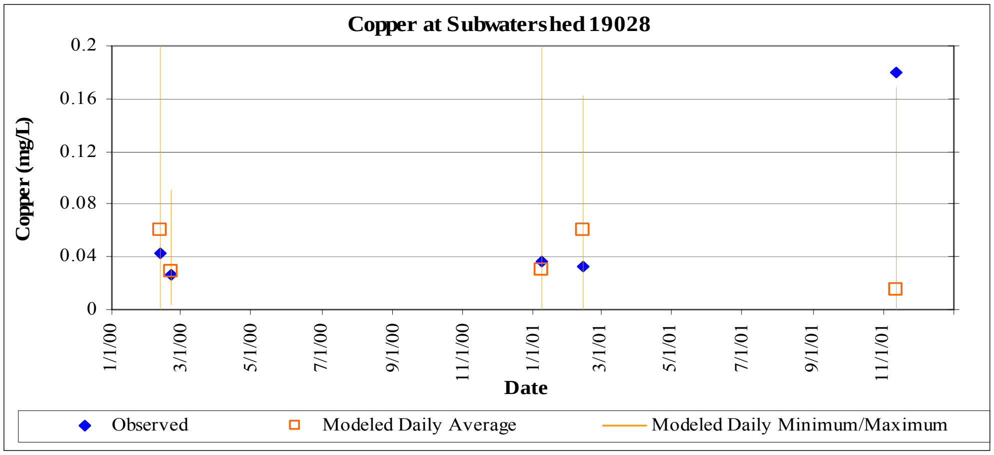
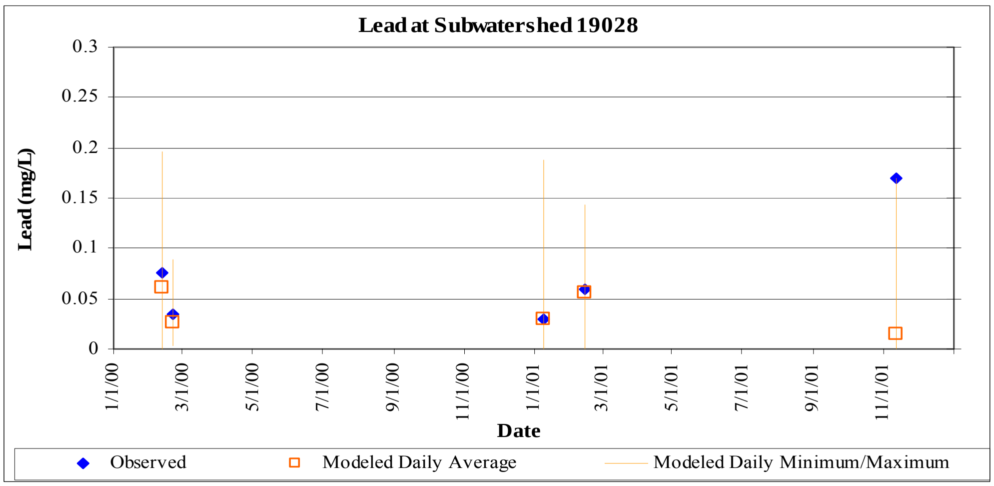


Figure 33. Time-series comparison of modeled and observed wet weather metals concentrations at sampling location SD8(5) (model validation)





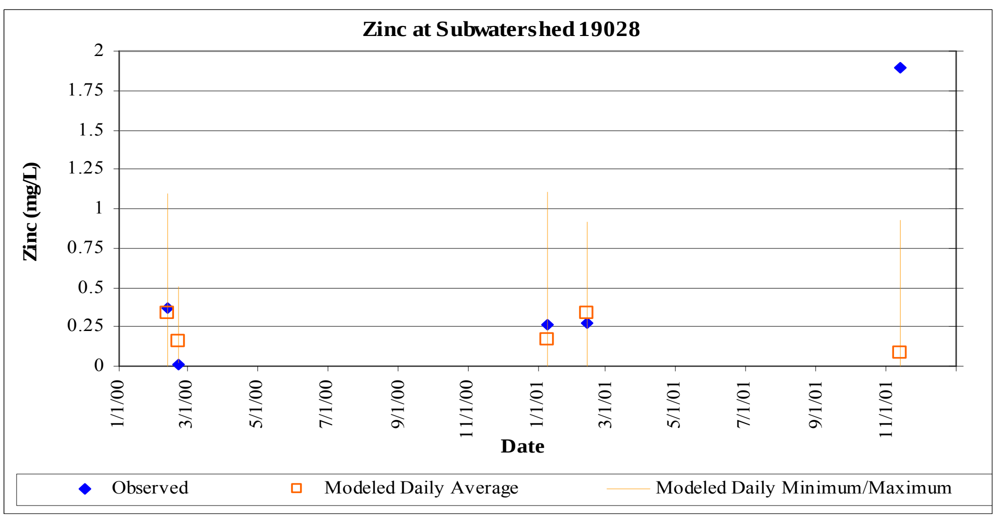


Figure 34. LSPC model results and corresponding observed metals data at sampling location SD8(5) (model validation)

5. References

Bicknell, B.R., Imhoff, J.C., Kittle, J. L., Donigian, A. S., & Johanson, R.C.. 1996 Hydrological Simulation Program – FORTRAN (HSPF): User's Manual Release 11. Environmental Research Laboratory, Office of Research and Development, USEPA, Athens, Georgia.

Bicknell, B. R., Imhoff, J. C., Kittle, J. L., Jobes, T. H., & Donigian, A. S. (2001). Hydrologic Simulation Program FORTRAN (HSPF) version 12 users manual. Mountain View, California: United States Geologic Survey and United States Environmental Protection Agency

Butcher, J.B. 2003. Buildup, Washoff, and Event Mean Concentrations. *Journal of the American Water Resources Association*. 39(6): 1521-1528.

Charbeneau, R. J., & Barrett, M. E. 1998. Evaluation of methods for estimating stormwater pollutant loads. *Water Environment Research, 70*, 1295-1302

Cocca, P. (2001, June 1). Maximum build-up parameter values. Message posted to http://www.epa.gov/ostwater/BASINS/blistsrv/jun01.txt

Donigian, A. S., Imhoff, J. C., Bicknell, B. R., & Kittle, J. L. 1984. Application guide for Hydrologic Simulation Program - Fortran (HSPF) (No. EPA 600/3-84-065). Athens, G.A.: United States Environmental Protection Agency.

Heathcote, I. W. 1998. *Integrated watershed management*. New York: John Wiley & Sons, Inc.

King, A. S. 2002. *A Time-Series Analysis of the Bi-national Tijuana River Watershed: Using BASINS to Understand the Flow and Loading of Fecal Coliforms.*

Loague, K., Corwin, D. L., & Ellsworth, T. R. 1998. The challenge of predicting nonpoint source pollution. *Environmental Science & Technology, 32*, 130A-133A

Los Angeles County Department of Public Works (LACDPW), URS Greiner Woodward Clyde and Southern California Coastal Waters Research Project. 1998. Los Angeles County 1997-1998 Stormwater Monitoring Report. Alhambra, CA.

Los Angeles County Department of Public Works, URS Greiner Woodward Clyde and Southern California Coastal Waters Research Project. 1999. Los Angeles County 1998-1999 Stormwater Monitoring Report. Alhambra, CA.

LARWQCB (Los Angeles Regional Water Quality Control Board). 2002. *Total Maximum Daily Load to Reduce Bacterial Indicator Densities at Santa Monica Bay Beaches During Wet Weather*. Los Angeles, CA.

Nix, S. J. 1994. *Urban stormwater modeling and simulation*. Boca Raton, FL: Lewis Publishers.

San Diego Association of Governments (SANDAG). 2000. *Land use data*. SANDAG GIS Digital Boundary Files & Layers: Land Cover and Activity Centers. Available online at http://www.sandag.org/resources/maps_and_gis/gis_downloads/land.asp.

SDRWQCB (San Diego Regional Water Quality Control Board). 1994. *Water Quality Control Plan for the San Diego Basin (9)*. San Diego Regional Water Quality Control Board, San Diego, CA.

Soil Conservation Service. 1986. *Urban Hydrology of Small Watersheds, Technical Release 55*. United States Department of Agriculture.

Tetra Tech, Inc. 2004. *Bacteria TMDLs for Beaches and Inland Surface Waters of the San Diego Region.* Prepared for the USEPA, Region 9 and San Diego Regional Water Quality Control Board by Tetra Tech, Inc., Fairfax, VA.

Tim, U. S., & Jolly, R. 1994. Evaluating agricultural nonpoint-source pollution using integrated geographic information systems and hydrologic/water quality model. *Journal of Environmental Quality, 23*, 25-35.

United States Department of Agriculture (USDA). 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division, Technical Release 55 (TR-55).

USEPA (United States Environmental Protection Agency). 1998. *Better Assessment Science Integrating Point and Nonpoint Sources. BASINS version 2.0*. EPA-823-B-98-006. United States Environmental Protection Agency, Office of Water, Washington, DC.

United States Environmental Protection Agency. 2000a. *BASINS technical note 6: Estimating hydrology and hydraulic parameters for HSPF* (No. EPA-823-R00-012). Washington, D.C.: Author.

United States Geological Survey. (2002). *Water resources applications software: Summary of HSPF*. Retrieved January 14, 2002, from http://water.usgs.gov/cgi-bin/man_wrdapp?hspf

Wanielista, M., R. Kersten, and R. Eaglan. 1997. *Hydrology: Water Quantity and Quality Control*, 2nd ed. John Wiley and Sons, Inc., New York.

Whittemore, R. C. 1998. The BASINS model. *Water Environment & Technology, 10*, 57-61.

Appendix E

Land Use Loading Analyses

Used in the Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

Table 1 presents descriptions of the land uses present in the Chollas Creek watershed. The original land uses categories were developed by the San Diego Association of Governments (SANDAG, 2000) and were reclassified for use in the water quality models.

Table 1. Description of land uses in the Chollas Creek Watershed

Model Land Use Code	SANDAG Land Use Code	Land Use Description
1100	1000	Spaced Rural Residential - Homes in rural areas with lot sizes of approximately 1 to 10 acres
	1100	Single Family Residential - Single family detached housing units with lot sizes less than 1 acre
1200	1200	Multi-Family Residential - Attached housing units, two or more units per structure
	1300	Mobile Home Parks- 10 or more spaces that are primarily for residential use
	1403	Military Barracks
	1409	Other Group Quarters - Convalescent or retirement homes
	1501	Hotels, motels, and other transient accommodations with three or less floors
1400	5001	Wholesale Trade - Examples are clothing and supply, includes Swap meet areas
	5002	Regional Shopping Centers - Typically larger than 40 acres
	5003	Community Commercial - Smaller in size (8 to 20 acres) than the regional shopping centers
	5004	Neighborhood Shopping Centers- Usually less than 10 acres in size with on-site parking
	5007	Store-front Commercial - Commercial activities along major streets, with limited on-site parking
	5009	Other Retail - Other retail land uses not classified above
	6002	Office (Low Rise) - Buildings with less than 5 stories
	6003	Government/Civic Centers - Large government office buildings or centers; and civic centers
	6102	Churches
	6103	Libraries
	6104	Post Offices
	6105	Fire/Police/Ranger Stations
	6109	Other Public Services - Museums, art galleries, social service agencies, historic sites
	6502	Hospitals-General
	6509	Other Health Care - Medical centers, health care services, and other health care facilities
	6802	Universities and Colleges
	6803-6805	High Schools - Senior High Schools, Junior High Schools, Middle Schools
	6806	Elementary Schools
	6807	School District Offices
	6809	Other Schools - Includes adult schools, non-residential day care and nursery schools
	7205	Golf Course Clubhouses - Clubhouses, swimming and tennis facilities, and parking lots
1401	5006	Auto dealerships
1501	4113	Communications and Utilities - Broadcasting stations, relay towers, electrical generating plants, water and sewage treatment facilities
1502	4112	Freeway - Divided roadways with 4 or more lanes, and right-of-way widths greater than 200 ft.
1503	2001	Heavy Industry - Shipbuilding, airframe, and aircraft manufacturing
1505	2101	Industrial Parks - Office/Industrial Uses Clustered Into A Center
	2103	Light Industry, General - Includes manufacturing uses such as lumber, furniture, paper, rubber, stone, clay, and glass; auto repair services, and recycling centers
	2104	Warehousing/Public storage
1506	4120	Marine Terminals
1507	4119	Other Transportation - Maintenance yards, transit yards and walking bridges
1508	4114	Parking, Surface - All surface parking lots not associated with another land use
	4116	Park and Ride Lots- Stand-alone parking areas that are not associated with any land use
1509	4111	Rail Stations/Transit Centers/Seaports- Parking areas are included

Table 1. Continued

Model Land Use Code	SANDAG Land Use Code	Land Use Description
1600	6701	Military Use
1700	7210	Other Recreation - RV parks, campgrounds, swim clubs, and Stand-alone movie theaters
	7601	Parks, Active- Tennis or basketball courts, baseball diamonds, soccer fields, or swings
	7606	Landscape, Open Space - Actively landscaped areas within residential neighborhoods
1800	6101	Cemetery
	7204	Golf Courses
2301	2301	Junkyard/Dumps/Landfills - Include auto wrecking/dismantling and recycling centers
4000	7603	Open Space Parks & Preserves
	9101	Vacant
5000	9201	Bays, Lagoons
	9202	Inland Water
7000	9501	Residential Under Construction
	9502	Commercial Under Construction
	9507	Freeway Under Construction

A land use distribution map is provided in Figure 1.

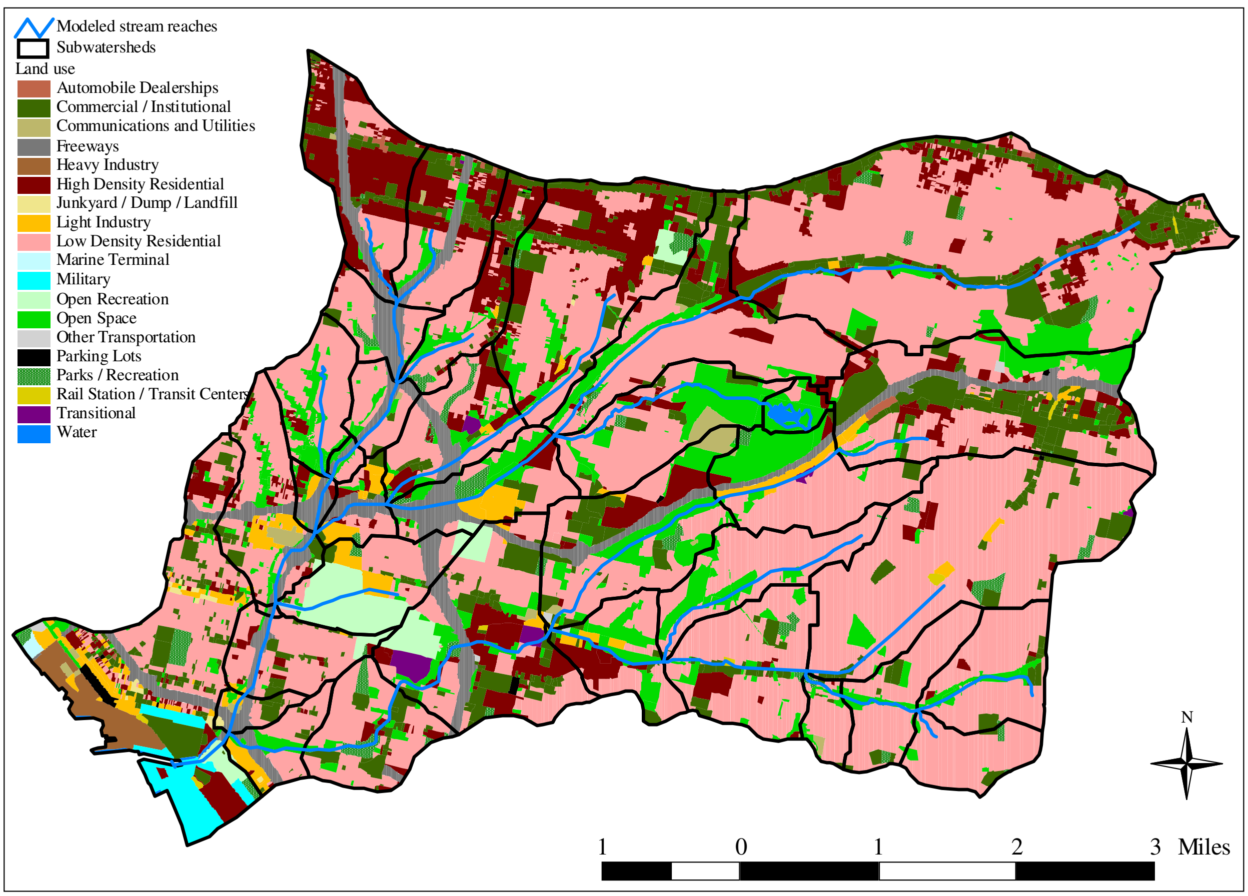


Figure 1. Land uses in the Chollas Creek Watershed

To supplement Figure 1, the land use areas (in square miles) associated with each subwatershed are presented in Table 2. This table also presents the total area for each subwatershed, the total area for each land use, and the percent of total area associated with each land use.

Tables 3 through 5 present the average annual wet weather loadings of copper, lead, and zinc for each land use by subwatershed (average of 1990-2003 simulation results). Similarly, Tables 6 through 8 present the average relative copper, lead, and zinc load by land use for each subwatershed. These six tables will provide useful information for development of a TMDL implementation strategy by identifying areas and land uses that contribute the greatest copper, lead, and/or zinc loads.

Table 2. Land use area (square miles) of each subwatershed

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Automobile Dealerships (1401)	Communications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Terminal (1506)	Other Trans-portation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recreation (1800)	Open Space (4000)	Water (5000)	Transitional (7000)	**Total Area**
19001	0.56	0.20	0.29	0.00	0.01	0.11	0.21	0.03	0.14	0.02	0.01	0.03	0.01	0.24	0.05	0.05	0.06	0.02	0.00	**2.01**
19002	0.04	0.00	0.03	0.00	0.01	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.13**
19003	0.33	0.03	0.05	0.00	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	**0.49**
19004	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**
19005	0.36	0.04	0.05	0.00	0.03	0.09	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	**0.70**
19006	0.01	0.02	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.11**
19007	0.31	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	**0.46**
19008	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	**0.06**
19009	0.16	0.00	0.01	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	**0.25**
19010	0.18	0.01	0.01	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	**0.32**
19011	0.17	0.42	0.11	0.01	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.86**
19012	0.23	0.20	0.11	0.01	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	**0.68**
19013	0.19	0.17	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.05	0.00	0.00	**0.52**
19014	0.19	0.00	0.03	0.00	0.00	0.05	0.00	0.00	0.06	0.00	0.01	0.00	0.00	0.00	0.01	0.28	0.01	0.00	0.00	**0.63**
19015	0.06	0.02	0.02	0.00	0.00	0.06	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	**0.23**
19016	0.28	0.10	0.03	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.06	0.00	0.01	**0.61**
19017	0.70	0.45	0.29	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.11	0.00	0.00	**1.62**
19018	0.16	0.05	0.03	0.00	0.00	0.13	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.10	0.00	0.00	**0.58**
19019	0.77	0.12	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.14	0.00	0.00	**1.22**
19020	2.63	0.44	0.74	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.20	0.00	0.00	**4.07**
19021	0.43	0.03	0.06	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.24	0.00	0.00	**0.82**
19022	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.02	0.00	**0.14**
19023	0.15	0.00	0.01	0.00	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	**0.29**
19024	0.36	0.04	0.10	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.05	0.00	0.00	**0.61**
19025	0.47	0.25	0.23	0.00	0.01	0.13	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.13	0.11	0.00	0.07	**1.43**
19026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
19027	0.41	0.13	0.15	0.00	0.05	0.09	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.25	0.00	0.00	**1.11**
19028	0.46	0.02	0.02	0.00	0.00	0.04	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.21	0.00	0.01	**0.82**
19029	0.69	0.21	0.48	0.01	0.00	0.15	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	**1.78**
19030	0.23	0.09	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	**0.51**
19031	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	**0.66**
19032	0.64	0.05	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.06	0.00	0.00	**0.86**
19033	1.90	0.04	0.15	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.05	0.00	0.04	0.00	0.00	**2.21**
19034	0.14	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	**0.18**
19035	0.42	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05	0.00	0.00	**0.51**
19036	0.51	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	**0.63**
19037	0.35	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	**0.39**
Total Area	**15.06**	**3.15**	**3.45**	**0.04**	**0.17**	**1.52**	**0.21**	**0.03**	**0.65**	**0.02**	**0.03**	**0.04**	**0.03**	**0.24**	**0.43**	**0.53**	**2.78**	**0.04**	**0.09**	**28.52**
Relative Area	**52.81%**	**11.04%**	**12.08%**	**0.15%**	**0.60%**	**5.34%**	**0.73%**	**0.11%**	**2.28%**	**0.05%**	**0.10%**	**0.15%**	**0.12%**	**0.84%**	**1.52%**	**1.87%**	**9.73%**	**0.14%**	**0.33%**	

Table E. Average annual wet weather loadings by land use for copper (grams per year)

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Automobile Dealerships (1401)	Communications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Terminal (1506)	Other Trans-portation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recreation (1800)	Open Space (4000)	Transitional (7000)	**Total Load**
19001	116.91	413.23	9,125.79	98.74	158.55	5,559.78	1,258.60	1,493.39	1,231.38	116.06	183.73	8,733.47	1,242.39	0.00	0.35	0.00	0.00	0.00	29,732.37
19002	7.74	0.00	908.13	0.00	79.29	2,112.00	0.00	290.43	79.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,477.04
19003	69.12	59.44	1,517.27	0.00	0.00	2,328.64	0.00	0.00	51.95	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	4,026.43
19004	1.74	0.00	0.00	0.00	0.00	180.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	182.26
19005	85.57	83.51	1,673.39	0.00	345.10	4,729.43	0.00	0.00	453.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	7,370.01
19006	1.49	38.87	110.83	0.00	0.00	3,032.61	0.00	0.00	107.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,290.93
19007	75.12	32.40	199.48	0.00	0.00	36.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	343.12
19008	6.80	0.00	0.00	0.00	0.00	758.19	0.00	0.00	3.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	768.05
19009	38.14	0.00	232.71	0.00	32.65	2,689.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,993.18
19010	42.37	11.52	288.13	0.00	0.00	5,180.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	5,522.81
19011	40.55	876.08	3,435.48	646.64	23.32	7,491.26	0.00	0.00	3.06	0.00	0.00	94.60	0.00	0.00	0.01	0.00	0.00	0.00	12,610.99
19012	54.64	411.76	3,369.01	517.31	46.64	4,296.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	8,695.62
19013	45.93	354.18	2,559.99	77.57	0.00	180.52	0.00	0.00	30.61	0.00	0.00	663.45	0.00	0.00	0.11	0.00	0.00	0.00	3,912.37
19014	45.52	2.16	820.08	0.00	0.00	2,364.76	0.00	0.00	547.90	0.00	138.73	0.00	0.00	0.00	0.04	0.25	0.00	0.00	3,919.43
19015	14.34	43.91	609.54	0.00	0.00	3,140.97	0.00	0.00	483.61	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	4,292.41
19016	67.74	214.52	953.08	0.00	0.00	3,664.42	0.00	0.00	104.06	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.01	0.00	5,004.08
19017	167.16	925.03	9,353.37	0.00	0.00	0.00	0.00	41.50	82.65	0.00	0.00	0.00	0.00	0.00	0.18	0.03	0.01	0.00	10,569.93
19018	37.56	94.30	875.49	0.00	0.00	6,588.75	0.00	0.00	740.72	0.00	0.00	0.00	0.00	0.00	0.24	0.01	0.01	0.00	8,337.08
19019	184.32	246.20	5,385.94	0.00	41.98	0.00	0.00	0.00	0.00	0.00	0.00	94.60	0.00	0.00	0.07	0.00	0.01	0.00	5,953.11
19020	628.00	902.71	23,693.79	931.12	37.31	0.00	0.00	0.00	36.73	0.00	0.00	94.60	329.96	0.00	0.25	0.00	0.02	0.00	26,654.48
19021	103.73	69.11	1,917.22	0.00	545.63	0.00	0.00	0.00	33.66	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.02	0.00	2,669.42
19022	3.23	24.47	33.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	60.96
19023	30.69	8.59	387.63	0.00	0.00	2,256.40	0.00	83.01	375.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,142.15
19024	76.28	78.78	3,123.14	0.00	0.00	667.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	3,946.47
19025	112.60	515.43	7,181.27	0.00	107.26	6,805.39	0.00	0.00	140.80	0.00	33.03	2,084.95	329.96	0.00	0.13	0.11	0.01	0.01	17,310.94
19026	0.00	0.00	22.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	188.61	0.00	0.00	0.00	0.00	0.00	210.78
19027	98.50	261.31	4,632.39	0.00	671.56	4,855.81	0.00	0.00	48.97	0.00	72.66	473.83	424.26	0.00	0.16	0.00	0.02	0.00	11,539.48
19028	109.12	39.59	609.54	0.00	37.31	2,310.54	0.00	0.00	474.43	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.02	0.00	3,580.61
19029	165.83	426.16	15,260.20	1,008.69	41.98	7,906.52	0.00	0.00	296.90	0.00	99.10	473.83	471.31	0.00	0.02	0.00	0.02	0.00	26,150.56
19030	53.73	179.25	941.97	0.00	0.00	0.00	0.00	0.00	226.50	0.00	66.07	0.00	141.35	0.00	0.00	0.00	0.01	0.00	1,608.87
19031	123.46	0.00	55.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	178.89
19032	152.31	105.82	2,615.41	0.00	18.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	565.61	0.00	0.15	0.00	0.01	0.00	3,457.97
19033	453.96	77.75	4,831.86	0.00	0.00	0.00	0.00	0.00	168.35	0.00	0.00	284.21	1,178.27	0.00	0.33	0.00	0.00	0.00	6,994.74
19034	32.50	2.16	221.65	0.00	97.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	354.29
19035	99.08	0.00	1,019.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	1,118.68
19036	122.55	21.60	1,418.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1,562.66
19037	84.08	0.00	509.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	593.90

Table 4. Average annual wet weather loadings by land use for lead (grams per year)

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Automobile Dealerships (1401)	Communications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Terminal (1506)	Other Transportation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recreation (1800)	Open Space (4000)	Transitional (7000)	**Total Load**
19001	291.73	559.84	5,689.73	26.38	86.99	6,273.81	404.30	479.69	1,216.23	37.28	106.22	5,610.64	399.07	0.00	0.06	0.00	0.00	0.00	21,181.97
19002	19.33	0.00	566.20	0.00	43.50	2,383.24	0.00	93.29	78.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,184.02
19003	172.49	80.53	945.99	0.00	0.00	2,627.70	0.00	0.00	51.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,878.01
19004	4.05	0.00	0.00	0.00	0.00	203.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	207.75
19005	199.03	112.80	1,042.93	0.00	189.34	5,336.82	0.00	0.00	447.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7,328.01
19006	3.47	52.51	69.07	0.00	0.00	3,422.08	0.00	0.00	105.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,652.86
19007	174.73	43.76	124.32	0.00	0.00	40.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	383.57
19008	15.81	0.00	0.00	0.00	0.00	855.57	0.00	0.00	3.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	874.39
19009	88.71	0.00	145.04	0.00	17.91	3,035.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,286.77
19010	98.55	15.56	179.57	0.00	0.00	5,846.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	6,139.77
19011	94.31	1,183.41	2,141.15	172.76	12.79	8,453.34	0.00	0.00	3.02	0.00	0.00	60.76	0.00	0.00	0.00	0.00	0.00	0.00	12,121.55
19012	127.09	556.21	2,099.72	138.21	25.59	4,847.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7,794.81
19013	106.84	478.42	1,595.50	20.73	0.00	203.70	0.00	0.00	30.21	0.00	0.00	426.17	0.00	0.00	0.02	0.00	0.00	0.00	2,861.59
19014	105.88	2.92	511.11	0.00	0.00	2,668.46	0.00	0.00	540.74	0.00	80.09	0.00	0.00	0.00	0.01	0.04	0.00	0.00	3,909.23
19015	33.36	59.32	379.89	0.00	0.00	3,544.35	0.00	0.00	477.29	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	4,494.22
19016	157.56	289.77	594.00	0.00	0.00	4,135.03	0.00	0.00	102.70	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	5,279.12
19017	388.80	1,249.54	5,829.44	0.00	0.00	0.00	0.00	13.33	81.57	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	7,562.71
19018	87.36	127.39	545.64	0.00	0.00	7,434.93	0.00	0.00	731.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	8,926.41
19019	428.72	332.56	3,356.76	0.00	23.03	0.00	0.00	0.00	0.00	0.00	0.00	60.76	0.00	0.00	0.01	0.00	0.00	0.00	4,201.85
19020	1,460.70	1,219.39	14,767.02	248.76	20.47	0.00	0.00	0.00	36.25	0.00	0.00	60.76	105.99	0.00	0.04	0.00	0.00	0.00	17,919.40
19021	241.26	93.35	1,194.90	0.00	299.37	0.00	0.00	0.00	33.23	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1,862.11
19022	7.52	33.06	20.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.30
19023	76.58	11.64	241.68	0.00	0.00	2,546.18	0.00	26.66	371.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,273.95
19024	190.35	106.73	1,947.21	0.00	0.00	753.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	2,998.06
19025	261.90	696.24	4,475.69	0.00	58.85	7,679.39	0.00	0.00	138.96	0.00	19.07	1,339.28	105.99	0.00	0.02	0.02	0.00	0.00	14,775.40
19026	0.00	0.00	13.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.58	0.00	0.00	0.00	0.00	0.00	74.40
19027	229.11	352.98	2,887.11	0.00	368.45	5,479.43	0.00	0.00	48.33	0.00	41.95	304.37	136.28	0.00	0.03	0.00	0.00	0.00	9,848.04
19028	253.80	53.48	379.89	0.00	20.47	2,607.27	0.00	0.00	468.23	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	3,783.16
19029	385.71	575.66	9,510.84	269.49	23.03	8,921.93	0.00	0.00	293.02	0.00	57.21	304.37	151.39	0.00	0.00	0.00	0.00	0.00	20,492.66
19030	124.97	242.13	587.07	0.00	0.00	0.00	0.00	0.00	223.54	0.00	38.14	0.00	45.40	0.00	0.00	0.00	0.00	0.00	1,261.26
19031	287.17	0.00	34.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	321.70
19032	354.28	142.94	1,630.04	0.00	10.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	181.68	0.00	0.02	0.00	0.00	0.00	2,319.21
19033	1,055.89	105.02	3,011.43	0.00	0.00	0.00	0.00	0.00	166.15	0.00	0.00	182.57	378.48	0.00	0.05	0.00	0.00	0.00	4,899.60
19034	75.60	2.92	138.14	0.00	53.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	270.40
19035	230.46	0.00	635.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	865.90
19036	285.04	29.17	884.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,198.29
19037	195.56	0.00	317.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	513.28

Table 5. Average annual wet weather loadings by land use for zinc (grams per year)

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Auto-mobile Dealer-ships (1401)	Commun-ications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Term-inal (1506)	Other Trans-portation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recre-ation (1800)	Open Space (4000)	Trans-itional (7000)	**Total Load**
19001	488.77	2,475.28	53,126.96	903.19	2,454.80	25,697.50	7,975.51	9,463.58	13,728.43	735.44	838.21	55,343.97	7,873.01	0.01	2.59	0.00	0.04	0.00	181,107.29
19002	32.38	0.00	5,286.81	0.00	1,227.56	9,761.73	0.00	1,840.47	885.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19,034.62
19003	288.99	356.07	8,832.99	0.00	0.00	10,763.04	0.00	0.00	579.16	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	20,820.35
19004	7.65	0.00	0.00	0.00	0.00	834.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	842.01
19005	375.89	501.67	9,745.51	0.00	5,343.02	21,859.59	0.00	0.00	5,053.83	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.00	42,879.59
19006	6.56	233.53	645.42	0.00	0.00	14,016.82	0.00	0.00	1,195.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	16,097.55
19007	330.00	194.62	1,161.71	0.00	0.00	166.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	1,853.35
19008	29.87	0.00	0.00	0.00	0.00	3,504.39	0.00	0.00	34.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	3,568.36
19009	167.55	0.00	1,355.28	0.00	505.50	12,431.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	14,460.12
19010	186.12	69.19	1,677.99	0.00	0.00	23,945.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.01	0.00	25,879.37
19011	178.11	5,263.19	20,007.59	5,915.23	361.03	34,624.87	0.00	0.00	34.09	0.00	0.00	599.45	0.00	0.00	0.07	0.00	0.00	0.00	66,983.63
19012	240.03	2,473.74	19,620.45	4,732.18	722.06	19,857.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.03	0.00	47,645.99
19013	201.79	2,127.77	14,908.91	709.61	0.00	834.36	0.00	0.00	341.49	0.00	0.00	4,204.28	0.00	0.00	0.84	0.00	0.03	0.00	23,329.09
19014	199.96	12.97	4,775.97	0.00	0.00	10,929.98	0.00	0.00	6,112.53	0.00	633.76	0.00	0.00	0.00	0.30	1.81	0.01	0.00	22,667.29
19015	63.01	263.81	3,549.84	0.00	0.00	14,517.66	0.00	0.00	5,395.32	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.01	0.00	23,789.94
19016	297.58	1,288.76	5,550.54	0.00	0.00	16,937.09	0.00	0.00	1,160.97	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.04	0.01	25,236.82
19017	734.30	5,557.27	54,472.23	0.00	0.00	0.00	0.00	263.01	922.05	0.00	0.00	0.00	0.00	0.00	1.31	0.22	0.07	0.00	61,950.45
19018	165.00	566.55	5,098.68	0.00	0.00	30,453.44	0.00	0.00	8,263.72	0.00	0.00	0.00	0.00	0.00	1.82	0.07	0.06	0.00	44,549.34
19019	809.69	1,479.06	31,366.66	0.00	649.98	0.00	0.00	0.00	0.00	0.00	0.00	599.45	0.00	0.00	0.53	0.00	0.09	0.00	34,905.46
19020	2,758.71	5,423.21	137,987.99	8,517.50	577.58	0.00	0.00	0.00	409.82	0.00	0.00	599.45	2,090.95	0.00	1.89	0.00	0.13	0.00	158,367.23
19021	455.66	415.18	11,165.50	0.00	8,447.80	0.00	0.00	0.00	375.57	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.15	0.00	20,860.26
19022	14.20	147.03	193.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.06	0.00	354.90
19023	128.30	51.48	2,256.66	0.00	0.00	10,429.14	0.00	526.02	4,189.99	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	17,581.64
19024	318.92	471.89	18,181.74	0.00	0.00	3,087.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.52	0.00	0.03	0.00	22,062.30
19025	494.63	3,096.51	41,822.31	0.00	1,660.66	31,454.75	0.00	0.00	1,570.78	0.00	150.91	13,212.30	2,090.95	0.00	0.99	0.82	0.07	0.05	95,555.73
19026	0.00	0.00	129.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,195.21	0.00	0.00	0.00	0.00	0.00	1,324.35
19027	432.71	1,569.88	26,978.12	0.00	10,397.42	22,443.72	0.00	0.00	546.32	0.00	331.94	3,002.67	2,688.55	0.00	1.20	0.00	0.16	0.00	68,392.69
19028	479.33	237.87	3,549.84	0.00	577.58	10,679.38	0.00	0.00	5,292.90	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.13	0.01	20,817.57
19029	728.47	2,560.24	88,872.44	9,227.12	649.98	36,544.20	0.00	0.00	3,312.31	0.00	452.72	3,002.67	2,986.68	0.00	0.11	0.00	0.11	0.00	148,337.05
19030	236.02	1,076.86	5,485.82	0.00	0.00	0.00	0.00	0.00	2,526.91	0.00	301.82	0.00	895.74	0.00	0.00	0.00	0.09	0.00	10,523.25
19031	542.35	0.00	322.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.09	0.00	865.18
19032	669.10	635.74	15,231.62	0.00	288.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,584.29	0.00	1.09	0.00	0.04	0.00	20,410.82
19033	1,994.18	467.08	28,139.82	0.00	0.00	0.00	0.00	0.00	1,878.18	0.00	0.00	1,801.06	7,466.71	0.00	2.48	0.00	0.03	0.00	41,749.54
19034	142.78	12.97	1,290.85	0.00	1,516.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.01	0.00	2,963.12
19035	435.26	0.00	5,937.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.03	0.00	6,373.29
19036	538.34	129.75	8,261.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.04	0.00	8,929.28
19037	369.33	0.00	2,968.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.01	0.00	3,338.55

Table 6. Relative copper loadings for each land use by subwatershed (percent)

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Automobile Dealerships (1401)	Commun-ications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Terminal (1506)	Other Trans-portation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recreation (1800)	Open Space (4000)	Transitional (7000)	**Total Relative Subwatershed Loading**
19001	0.33	30.69	0.53	18.70	4.23	1.39	5.02	4.14	0.39	0.39	0.00	0.00	0.00	0.62	29.37	0.00	4.18	0.00	12.81
19002	0.00	26.12	2.28	60.74	0.00	0.00	8.35	2.28	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50
19003	0.00	37.68	0.00	57.83	0.00	1.48	0.00	1.29	1.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.73
19004	0.00	0.00	0.00	99.04	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
19005	0.00	22.71	4.68	64.17	0.00	1.13	0.00	6.15	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.17
19006	0.00	3.37	0.00	92.15	0.00	1.18	0.00	3.26	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42
19007	0.00	58.14	0.00	10.53	0.00	9.44	0.00	0.00	21.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
19008	0.00	0.00	0.00	98.72	0.00	0.00	0.00	0.40	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
19009	0.00	7.77	1.09	89.86	0.00	0.00	0.00	0.00	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.29
19010	0.00	5.22	0.00	93.81	0.00	0.21	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.38
19011	5.13	27.24	0.18	59.40	0.00	6.95	0.00	0.02	0.32	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.00	5.43
19012	5.95	38.74	0.54	49.41	0.00	4.74	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.75
19013	1.98	65.43	0.00	4.61	0.00	9.05	0.00	0.78	1.17	0.00	0.00	0.00	0.00	0.00	16.96	0.00	0.00	0.00	1.69
19014	0.00	20.92	0.00	60.33	0.00	0.06	0.00	13.98	1.16	0.00	0.00	0.00	0.01	3.54	0.00	0.00	0.00	0.00	1.69
19015	0.00	14.20	0.00	73.17	0.00	1.02	0.00	11.27	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.85
19016	0.00	19.05	0.00	73.23	0.00	4.29	0.00	2.08	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.16
19017	0.00	88.49	0.00	0.00	0.00	8.75	0.39	0.78	1.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55
19018	0.00	10.50	0.00	79.03	0.00	1.13	0.00	8.88	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.59
19019	0.00	90.47	0.71	0.00	0.00	4.14	0.00	0.00	3.10	0.00	0.00	0.00	0.00	0.00	1.59	0.00	0.00	0.00	2.56
19020	3.49	88.89	0.14	0.00	0.00	3.39	0.00	0.14	2.36	0.00	0.00	0.00	0.00	0.00	0.35	0.00	1.24	0.00	11.48
19021	0.00	71.82	20.44	0.00	0.00	2.59	0.00	1.26	3.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15
19022	0.00	54.53	0.00	0.00	0.00	40.15	0.00	0.00	5.30	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.03
19023	0.00	12.34	0.00	71.81	0.00	0.27	2.64	11.96	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35
19024	0.00	79.14	0.00	16.92	0.00	2.00	0.00	0.00	1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.70
19025	0.00	41.48	0.62	39.31	0.00	2.98	0.00	0.81	0.65	0.00	0.00	0.00	0.00	0.19	12.04	0.00	1.91	0.00	7.46
19026	0.00	10.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	89.48	0.00	0.09
19027	0.00	40.14	5.82	42.08	0.00	2.26	0.00	0.42	0.85	0.00	0.00	0.00	0.00	0.63	4.11	0.00	3.68	0.00	4.97
19028	0.00	17.02	1.04	64.53	0.00	1.11	0.00	13.25	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.54
19029	3.86	58.36	0.16	30.23	0.00	1.63	0.00	1.14	0.63	0.00	0.00	0.00	0.00	0.38	1.81	0.00	1.80	0.00	11.27
19030	0.00	58.55	0.00	0.00	0.00	11.14	0.00	14.08	3.34	0.00	0.00	0.00	0.00	4.11	0.00	0.00	8.79	0.00	0.69
19031	0.00	30.98	0.00	0.00	0.00	0.00	0.00	0.00	69.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.08
19032	0.00	75.63	0.54	0.00	0.00	3.06	0.00	0.00	4.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.36	0.00	1.49
19033	0.00	69.08	0.00	0.00	0.00	1.11	0.00	2.41	6.49	0.00	0.00	0.00	0.00	0.00	4.06	0.00	16.85	0.00	3.01
19034	0.00	62.56	27.64	0.00	0.00	0.61	0.00	0.00	9.17	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.15
19035	0.00	91.14	0.00	0.00	0.00	0.00	0.00	0.00	8.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
19036	0.00	90.77	0.00	0.00	0.00	1.38	0.00	0.00	7.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67
19037	0.00	85.83	0.00	0.00	0.00	0.00	0.00	0.00	14.16	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.26

Table 7. Relative lead loadings for each land use by subwatershed (percent)

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Automobile Dealerships (1401)	Commun-ications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Terminal (1506)	Other Trans-portation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recreation (1800)	Open Space (4000)	Transitional (7000)	**Total Relative Subwatershed Loading**
19001	0.12	26.86	0.41	29.62	1.91	2.64	2.26	5.74	1.38	0.18	0.00	0.00	0.00	0.50	26.49	0.00	1.88	0.00	10.92
19002	0.00	17.78	1.37	74.85	0.00	0.00	2.93	2.46	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64
19003	0.00	24.39	0.00	67.76	0.00	2.08	0.00	1.32	4.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
19004	0.00	0.00	0.00	98.05	0.00	0.00	0.00	0.00	1.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
19005	0.00	14.23	2.58	72.83	0.00	1.54	0.00	6.10	2.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.78
19006	0.00	1.89	0.00	93.68	0.00	1.44	0.00	2.89	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88
19007	0.00	32.41	0.00	10.63	0.00	11.41	0.00	0.00	45.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
19008	0.00	0.00	0.00	97.85	0.00	0.00	0.00	0.34	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
19009	0.00	4.41	0.55	92.34	0.00	0.00	0.00	0.00	2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.69
19010	0.00	2.92	0.00	95.22	0.00	0.25	0.00	0.00	1.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.16
19011	1.43	17.66	0.11	69.74	0.00	9.76	0.00	0.02	0.78	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	6.25
19012	1.77	26.94	0.33	62.20	0.00	7.14	0.00	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.02
19013	0.72	55.76	0.00	7.12	0.00	16.72	0.00	1.06	3.73	0.00	0.00	0.00	0.00	0.00	14.89	0.00	0.00	0.00	1.47
19014	0.00	13.07	0.00	68.26	0.00	0.07	0.00	13.83	2.71	0.00	0.00	0.00	0.00	2.05	0.00	0.00	0.00	0.00	2.01
19015	0.00	8.45	0.00	78.86	0.00	1.32	0.00	10.62	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.32
19016	0.00	11.25	0.00	78.33	0.00	5.49	0.00	1.95	2.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.72
19017	0.00	77.08	0.00	0.00	0.00	16.52	0.18	1.08	5.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.90
19018	0.00	6.11	0.00	83.29	0.00	1.43	0.00	8.19	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60
19019	0.00	79.89	0.55	0.00	0.00	7.91	0.00	0.00	10.20	0.00	0.00	0.00	0.00	0.00	1.45	0.00	0.00	0.00	2.17
19020	1.39	82.41	0.11	0.00	0.00	6.80	0.00	0.20	8.15	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.59	0.00	9.24
19021	0.00	64.17	16.08	0.00	0.00	5.01	0.00	1.78	12.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96
19022	0.00	33.79	0.00	0.00	0.00	53.93	0.00	0.00	12.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
19023	0.00	7.38	0.00	77.77	0.00	0.36	0.81	11.34	2.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.69
19024	0.00	64.95	0.00	25.14	0.00	3.56	0.00	0.00	6.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.55
19025	0.00	30.29	0.40	51.97	0.00	4.71	0.00	0.94	1.77	0.00	0.00	0.00	0.00	0.13	9.06	0.00	0.72	0.00	7.62
19026	0.00	18.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.43	0.00	0.04
19027	0.00	29.32	3.74	55.64	0.00	3.58	0.00	0.49	2.33	0.00	0.00	0.00	0.00	0.43	3.09	0.00	1.38	0.00	5.08
19028	0.00	10.04	0.54	68.92	0.00	1.41	0.00	12.38	6.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.95
19029	1.32	46.41	0.11	43.54	0.00	2.81	0.00	1.43	1.88	0.00	0.00	0.00	0.00	0.28	1.49	0.00	0.74	0.00	10.56
19030	0.00	46.55	0.00	0.00	0.00	19.20	0.00	17.72	9.91	0.00	0.00	0.00	0.00	3.02	0.00	0.00	3.60	0.00	0.65
19031	0.00	10.74	0.00	0.00	0.00	0.00	0.00	0.00	89.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17
19032	0.00	70.28	0.44	0.00	0.00	6.16	0.00	0.00	15.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.83	0.00	1.20
19033	0.00	61.46	0.00	0.00	0.00	2.14	0.00	3.39	21.55	0.00	0.00	0.00	0.00	0.00	3.73	0.00	7.72	0.00	2.53
19034	0.00	51.09	19.87	0.00	0.00	1.08	0.00	0.00	27.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
19035	0.00	73.38	0.00	0.00	0.00	0.00	0.00	0.00	26.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
19036	0.00	73.78	0.00	0.00	0.00	2.43	0.00	0.00	23.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62
19037	0.00	61.90	0.00	0.00	0.00	0.00	0.00	0.00	38.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26

Table 8. Relative zinc loadings for each land use by subwatershed (percent)

Sub-watershed Number	Low Density Residential (1100)	High Density Residential (1200)	Commercial / Institutional (1400)	Automobile Dealerships (1401)	Communications and Utilities (1501)	Freeways (1502)	Heavy Industry (1503)	Junkyard / Dump / Landfill (1504)	Light Industry (1505)	Marine Terminal (1506)	Other Trans-portation (1507)	Parking Lots (1508)	Rail Station / Transit Centers (1509)	Military (1600)	Parks / Recreation (1700)	Open Recreation (1800)	Open Space (4000)	Transitional (7000)	**Total Relative Subwatershed Loading**
19001	0.50	29.33	1.36	14.19	4.40	1.37	5.23	7.58	0.27	0.41	0.00	0.00	0.00	0.46	30.56	0.00	4.35	0.00	13.65
19002	0.00	27.77	6.45	51.28	0.00	0.00	9.67	4.65	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
19003	0.00	42.42	0.00	51.69	0.00	1.71	0.00	2.78	1.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.57
19004	0.00	0.00	0.00	99.09	0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
19005	0.00	22.73	12.46	50.98	0.00	1.17	0.00	11.79	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.23
19006	0.00	4.01	0.00	87.07	0.00	1.45	0.00	7.42	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.21
19007	0.00	62.68	0.00	9.01	0.00	10.50	0.00	0.00	17.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14
19008	0.00	0.00	0.00	98.21	0.00	0.00	0.00	0.96	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
19009	0.00	9.37	3.50	85.97	0.00	0.00	0.00	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.09
19010	0.00	6.48	0.00	92.53	0.00	0.27	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.95
19011	8.83	29.87	0.54	51.69	0.00	7.86	0.00	0.05	0.27	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	5.05
19012	9.93	41.18	1.52	41.68	0.00	5.19	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.59
19013	3.04	63.91	0.00	3.58	0.00	9.12	0.00	1.46	0.86	0.00	0.00	0.00	0.00	0.00	18.02	0.00	0.00	0.00	1.76
19014	0.00	21.07	0.00	48.22	0.00	0.06	0.00	26.97	0.88	0.00	0.00	0.00	0.01	2.80	0.00	0.00	0.00	0.00	1.71
19015	0.00	14.92	0.00	61.02	0.00	1.11	0.00	22.68	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.79
19016	0.00	21.99	0.00	67.11	0.00	5.11	0.00	4.60	1.18	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.90
19017	0.00	87.93	0.00	0.00	0.00	8.97	0.42	1.49	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.67
19018	0.00	11.45	0.00	68.36	0.00	1.27	0.00	18.55	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.36
19019	0.00	89.86	1.86	0.00	0.00	4.24	0.00	0.00	2.32	0.00	0.00	0.00	0.00	0.00	1.72	0.00	0.00	0.00	2.63
19020	5.38	87.13	0.36	0.00	0.00	3.42	0.00	0.26	1.74	0.00	0.00	0.00	0.00	0.00	0.38	0.00	1.32	0.00	11.94
19021	0.00	53.53	40.50	0.00	0.00	1.99	0.00	1.80	2.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.57
19022	0.00	54.54	0.00	0.00	0.00	41.43	0.00	0.00	4.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.03
19023	0.00	12.84	0.00	59.32	0.00	0.29	2.99	23.83	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33
19024	0.00	82.41	0.00	13.99	0.00	2.14	0.00	0.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.66
19025	0.00	43.77	1.74	32.92	0.00	3.24	0.00	1.64	0.52	0.00	0.00	0.00	0.00	0.16	13.83	0.00	2.19	0.00	7.20
19026	0.00	9.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.25	0.00	0.10
19027	0.00	39.45	15.20	32.82	0.00	2.30	0.00	0.80	0.63	0.00	0.00	0.00	0.00	0.49	4.39	0.00	3.93	0.00	5.16
19028	0.00	17.05	2.77	51.30	0.00	1.14	0.00	25.43	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.57
19029	6.22	59.91	0.44	24.64	0.00	1.73	0.00	2.23	0.49	0.00	0.00	0.00	0.00	0.31	2.02	0.00	2.01	0.00	11.18
19030	0.00	52.13	0.00	0.00	0.00	10.23	0.00	24.01	2.24	0.00	0.00	0.00	0.00	2.87	0.00	0.00	8.51	0.00	0.79
19031	0.00	37.30	0.00	0.00	0.00	0.00	0.00	0.00	62.69	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.07
19032	0.00	74.63	1.42	0.00	0.00	3.11	0.00	0.00	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.01	17.56	0.00	1.54
19033	0.00	67.40	0.00	0.00	0.00	1.12	0.00	4.50	4.78	0.00	0.00	0.00	0.00	0.00	4.31	0.01	17.88	0.00	3.15
19034	0.00	43.56	51.17	0.00	0.00	0.44	0.00	0.00	4.82	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.22
19035	0.00	93.17	0.00	0.00	0.00	0.00	0.00	0.00	6.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48
19036	0.00	92.52	0.00	0.00	0.00	1.45	0.00	0.00	6.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67
19037	0.00	88.93	0.00	0.00	0.00	0.00	0.00	0.00	11.06	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.25

Appendix F

Statistical Comparison of Measured Values and Modeled Values for Flow and Water Quality

Used in the Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

Introduction

This appendix compares measured flow and water quality values against those generated from model runs. Data are presented side-by-side for direct comparison. Simple statistical comparisons are also offered.

Flow

Table 1 lists all modeled and measured values from November 1, 2001 to December 30, 2003 for the Chollas Creek Watershed. Table 2 shows all observed values above 2.28 cubic feet per second (cfs), which is the definition of wet weather conditions, and the corresponding modeled average flows. Also in Table 2 are the percent and actual differences. Table 3 gives the total volume per day in cubic feet (cf) for corresponding dates in Table 2. Figure 1 plots volume per day from the model versus volume per day from the observed values. The R^2 value is 0.7035 for 26 data pairs. Table 4 gives the total volume for the 28 days in liters for modeled and observed values and the percent differences and actual differences between the two. Table 5 gives summary statistics of the 26 values in both the modeled and observed value data sets and from the percent differences and actual differences.

Water Quality

Tables 6 and 7 show the measured water quality data and the corresponding model results. Tables 8 and 9 show the percent and actual differences of the water quality data that corresponds with flows over 2.28 cfs. Tables 10 and 11 show the five dates that both measured flow and water quality data were available. The loads per day were calculated and compared, by percent and actual difference, with the model values for the same days.

Table 1. All modeled and measured values. Observed values have approximately the same significant figures as the original values in copermittees reports.

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2001	11	1	11/1/01	0.000	
2001	11	2	11/2/01	0.000	
2001	11	3	11/3/01	0.000	
2001	11	4	11/4/01	6.723	
2001	11	5	11/5/01	13.326	
2001	11	6	11/6/01	0.082	
2001	11	7	11/7/01	0.080	
2001	11	8	11/8/01	0.059	
2001	11	9	11/9/01	0.060	
2001	11	10	11/10/01	0.069	
2001	11	11	11/11/01	0.059	
2001	11	12	11/12/01	10.591	
2001	11	13	11/13/01	1.907	
2001	11	14	11/14/01	0.099	
2001	11	15	11/15/01	0.088	
2001	11	16	11/16/01	0.090	
2001	11	17	11/17/01	0.091	
2001	11	18	11/18/01	0.087	
2001	11	19	11/19/01	0.074	
2001	11	20	11/20/01	0.075	
2001	11	21	11/21/01	0.076	
2001	11	22	11/22/01	0.077	
2001	11	23	11/23/01	0.074	
2001	11	24	11/24/01	15.867	
2001	11	25	11/25/01	0.791	
2001	11	26	11/26/01	0.133	
2001	11	27	11/27/01	0.106	
2001	11	28	11/28/01	0.114	0
2001	11	29	11/29/01	2.801	18
2001	11	30	11/30/01	0.207	
2001	12	1	12/1/01	0.126	
2001	12	2	12/2/01	0.112	
2001	12	3	12/3/01	0.183	
2001	12	4	12/4/01	0.570	
2001	12	5	12/5/01	0.115	
2001	12	6	12/6/01	0.086	
2001	12	7	12/7/01	0.047	
2001	12	8	12/8/01	0.005	
2001	12	9	12/9/01	0.070	
2001	12	10	12/10/01	0.085	
2001	12	11	12/11/01	0.073	
2001	12	12	12/12/01	0.073	
2001	12	13	12/13/01	0.070	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2001	12	14	12/14/01	0.082	
2001	12	15	12/15/01	0.061	
2001	12	16	12/16/01	0.058	
2001	12	17	12/17/01	0.052	
2001	12	18	12/18/01	0.053	
2001	12	19	12/19/01	0.048	
2001	12	20	12/20/01	0.054	
2001	12	21	12/21/01	11.824	
2001	12	22	12/22/01	0.134	
2001	12	23	12/23/01	0.108	
2001	12	24	12/24/01	0.081	
2001	12	25	12/25/01	0.082	
2001	12	26	12/26/01	0.078	
2001	12	27	12/27/01	0.079	
2001	12	28	12/28/01	0.084	
2001	12	29	12/29/01	0.080	
2001	12	30	12/30/01	0.073	
2001	12	31	12/31/01	0.084	
2002	1	1	1/1/02	0.070	
2002	1	2	1/2/02	0.064	
2002	1	3	1/3/02	5.539	
2002	1	4	1/4/02	0.084	
2002	1	5	1/5/02	0.077	
2002	1	6	1/6/02	0.068	
2002	1	7	1/7/02	0.054	
2002	1	8	1/8/02	0.055	
2002	1	9	1/9/02	0.067	
2002	1	10	1/10/02	0.054	
2002	1	11	1/11/02	0.047	
2002	1	12	1/12/02	0.031	
2002	1	13	1/13/02	0.044	
2002	1	14	1/14/02	0.048	
2002	1	15	1/15/02	0.054	
2002	1	16	1/16/02	0.044	
2002	1	17	1/17/02	0.042	
2002	1	18	1/18/02	0.040	
2002	1	19	1/19/02	0.036	
2002	1	20	1/20/02	0.037	
2002	1	21	1/21/02	0.033	
2002	1	22	1/22/02	0.034	
2002	1	23	1/23/02	0.027	
2002	1	24	1/24/02	0.024	
2002	1	25	1/25/02	0.026	
2002	1	26	1/26/02	0.028	
2002	1	27	1/27/02	0.027	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	1	28	1/28/02	0.026	
2002	1	29	1/29/02	4.119	
2002	1	30	1/30/02	0.057	
2002	1	31	1/31/02	0.043	
2002	2	1	2/1/02	0.035	
2002	2	2	2/2/02	0.032	
2002	2	3	2/3/02	0.032	
2002	2	4	2/4/02	0.029	
2002	2	5	2/5/02	0.026	
2002	2	6	2/6/02	0.028	
2002	2	7	2/7/02	0.027	
2002	2	8	2/8/02	0.028	
2002	2	9	2/9/02	0.013	
2002	2	10	2/10/02	0.000	
2002	2	11	2/11/02	0.013	
2002	2	12	2/12/02	0.017	
2002	2	13	2/13/02	0.020	
2002	2	14	2/14/02	0.020	
2002	2	15	2/15/02	0.019	
2002	2	16	2/16/02	0.021	
2002	2	17	2/17/02	7.614	3
2002	2	18	2/18/02	0.401	
2002	2	19	2/19/02	0.055	
2002	2	20	2/20/02	0.041	
2002	2	21	2/21/02	0.021	
2002	2	22	2/22/02	0.012	
2002	2	23	2/23/02	0.036	
2002	2	24	2/24/02	0.034	
2002	2	25	2/25/02	0.032	
2002	2	26	2/26/02	0.015	
2002	2	27	2/27/02	0.024	
2002	2	28	2/28/02	0.029	
2002	3	1	3/1/02	0.028	
2002	3	2	3/2/02	0.023	
2002	3	3	3/3/02	0.021	
2002	3	4	3/4/02	0.021	
2002	3	5	3/5/02	0.023	
2002	3	6	3/6/02	0.024	
2002	3	7	3/7/02	0.023	7
2002	3	8	3/8/02	0.021	1
2002	3	9	3/9/02	0.018	
2002	3	10	3/10/02	0.018	
2002	3	11	3/11/02	0.018	
2002	3	12	3/12/02	0.016	
2002	3	13	3/13/02	0.018	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	3	14	3/14/02	0.016	
2002	3	15	3/15/02	0.014	
2002	3	16	3/16/02	0.014	
2002	3	17	3/17/02	14.441	
2002	3	18	3/18/02	22.644	
2002	3	19	3/19/02	0.136	
2002	3	20	3/20/02	0.124	
2002	3	21	3/21/02	0.113	
2002	3	22	3/22/02	0.107	
2002	3	23	3/23/02	0.110	
2002	3	24	3/24/02	0.098	
2002	3	25	3/25/02	0.093	
2002	3	26	3/26/02	0.089	
2002	3	27	3/27/02	0.097	
2002	3	28	3/28/02	0.122	
2002	3	29	3/29/02	0.083	
2002	3	30	3/30/02	0.085	
2002	3	31	3/31/02	0.071	
2002	4	1	4/1/02	0.068	
2002	4	2	4/2/02	0.069	
2002	4	3	4/3/02	0.071	
2002	4	4	4/4/02	0.063	
2002	4	5	4/5/02	0.069	
2002	4	6	4/6/02	0.058	
2002	4	7	4/7/02	0.052	
2002	4	8	4/8/02	0.053	
2002	4	9	4/9/02	0.051	
2002	4	10	4/10/02	0.045	
2002	4	11	4/11/02	0.043	
2002	4	12	4/12/02	0.039	
2002	4	13	4/13/02	0.039	
2002	4	14	4/14/02	0.035	
2002	4	15	4/15/02	0.039	
2002	4	16	4/16/02	0.035	
2002	4	17	4/17/02	0.036	
2002	4	18	4/18/02	0.032	
2002	4	19	4/19/02	0.030	
2002	4	20	4/20/02	0.027	
2002	4	21	4/21/02	0.026	
2002	4	22	4/22/02	0.023	
2002	4	23	4/23/02	0.024	
2002	4	24	4/24/02	0.031	
2002	4	25	4/25/02	0.022	
2002	4	26	4/26/02	0.026	
2002	4	27	4/27/02	0.022	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	4	28	4/28/02	0.019	
2002	4	29	4/29/02	0.017	
2002	4	30	4/30/02	0.018	
2002	5	1	5/1/02	0.017	
2002	5	2	5/2/02	0.015	
2002	5	3	5/3/02	0.015	
2002	5	4	5/4/02	0.015	
2002	5	5	5/5/02	0.015	
2002	5	6	5/6/02	0.015	
2002	5	7	5/7/02	0.017	
2002	5	8	5/8/02	0.013	
2002	5	9	5/9/02	0.012	
2002	5	10	5/10/02	0.012	
2002	5	11	5/11/02	0.011	
2002	5	12	5/12/02	0.009	
2002	5	13	5/13/02	0.007	
2002	5	14	5/14/02	0.009	
2002	5	15	5/15/02	0.010	
2002	5	16	5/16/02	0.010	
2002	5	17	5/17/02	0.009	
2002	5	18	5/18/02	0.010	
2002	5	19	5/19/02	0.009	
2002	5	20	5/20/02	0.007	
2002	5	21	5/21/02	0.007	
2002	5	22	5/22/02	0.006	
2002	5	23	5/23/02	0.006	
2002	5	24	5/24/02	0.006	
2002	5	25	5/25/02	0.007	
2002	5	26	5/26/02	0.006	
2002	5	27	5/27/02	0.006	
2002	5	28	5/28/02	0.005	
2002	5	29	5/29/02	0.005	
2002	5	30	5/30/02	0.005	
2002	5	31	5/31/02	0.004	
2002	6	1	6/1/02	0.005	
2002	6	2	6/2/02	0.004	
2002	6	3	6/3/02	0.004	
2002	6	4	6/4/02	0.004	
2002	6	5	6/5/02	0.004	
2002	6	6	6/6/02	0.003	
2002	6	7	6/7/02	0.003	
2002	6	8	6/8/02	0.003	
2002	6	9	6/9/02	0.004	
2002	6	10	6/10/02	0.004	
2002	6	11	6/11/02	0.003	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	6	12	6/12/02	0.003	
2002	6	13	6/13/02	0.003	
2002	6	14	6/14/02	0.002	
2002	6	15	6/15/02	0.002	
2002	6	16	6/16/02	0.002	
2002	6	17	6/17/02	0.002	
2002	6	18	6/18/02	0.002	
2002	6	19	6/19/02	0.002	
2002	6	20	6/20/02	0.002	
2002	6	21	6/21/02	0.002	
2002	6	22	6/22/02	0.002	
2002	6	23	6/23/02	0.002	
2002	6	24	6/24/02	0.002	
2002	6	25	6/25/02	0.002	
2002	6	26	6/26/02	0.002	
2002	6	27	6/27/02	0.001	
2002	6	28	6/28/02	0.001	
2002	6	29	6/29/02	0.001	
2002	6	30	6/30/02	0.001	
2002	7	1	7/1/02	0.001	
2002	7	2	7/2/02	0.001	
2002	7	3	7/3/02	0.001	
2002	7	4	7/4/02	0.001	
2002	7	5	7/5/02	0.001	
2002	7	6	7/6/02	0.001	
2002	7	7	7/7/02	0.001	
2002	7	8	7/8/02	0.001	
2002	7	9	7/9/02	0.001	
2002	7	10	7/10/02	0.001	
2002	7	11	7/11/02	0.001	
2002	7	12	7/12/02	0.001	
2002	7	13	7/13/02	0.001	
2002	7	14	7/14/02	0.001	
2002	7	15	7/15/02	0.001	
2002	7	16	7/16/02	0.001	
2002	7	17	7/17/02	0.001	
2002	7	18	7/18/02	0.001	
2002	7	19	7/19/02	0.001	
2002	7	20	7/20/02	0.001	
2002	7	21	7/21/02	0.001	
2002	7	22	7/22/02	0.001	
2002	7	23	7/23/02	0.000	
2002	7	24	7/24/02	0.000	
2002	7	25	7/25/02	0.000	
2002	7	26	7/26/02	0.000	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	7	27	7/27/02	0.000	
2002	7	28	7/28/02	0.000	
2002	7	29	7/29/02	0.000	
2002	7	30	7/30/02	0.000	
2002	7	31	7/31/02	0.000	
2002	8	1	8/1/02	0.000	
2002	8	2	8/2/02	0.000	
2002	8	3	8/3/02	0.000	
2002	8	4	8/4/02	0.000	
2002	8	5	8/5/02	0.000	
2002	8	6	8/6/02	0.000	
2002	8	7	8/7/02	0.000	
2002	8	8	8/8/02	0.000	
2002	8	9	8/9/02	0.000	
2002	8	10	8/10/02	0.000	
2002	8	11	8/11/02	0.000	
2002	8	12	8/12/02	0.000	
2002	8	13	8/13/02	0.000	
2002	8	14	8/14/02	0.000	
2002	8	15	8/15/02	0.000	
2002	8	16	8/16/02	0.000	
2002	8	17	8/17/02	0.000	
2002	8	18	8/18/02	0.000	
2002	8	19	8/19/02	0.000	
2002	8	20	8/20/02	0.000	
2002	8	21	8/21/02	0.000	
2002	8	22	8/22/02	0.000	
2002	8	23	8/23/02	0.000	
2002	8	24	8/24/02	0.000	
2002	8	25	8/25/02	0.000	
2002	8	26	8/26/02	0.000	
2002	8	27	8/27/02	0.000	
2002	8	28	8/28/02	0.000	
2002	8	29	8/29/02	0.000	
2002	8	30	8/30/02	0.000	
2002	8	31	8/31/02	0.000	
2002	9	1	9/1/02	0.000	
2002	9	2	9/2/02	0.000	
2002	9	3	9/3/02	0.000	
2002	9	4	9/4/02	0.000	
2002	9	5	9/5/02	0.000	
2002	9	6	9/6/02	2.065	
2002	9	7	9/7/02	23.162	
2002	9	8	9/8/02	0.069	
2002	9	9	9/9/02	0.062	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	9	10	9/10/02	0.055	
2002	9	11	9/11/02	0.057	
2002	9	12	9/12/02	0.054	
2002	9	13	9/13/02	0.048	
2002	9	14	9/14/02	0.046	
2002	9	15	9/15/02	0.044	
2002	9	16	9/16/02	0.045	
2002	9	17	9/17/02	0.044	
2002	9	18	9/18/02	0.045	
2002	9	19	9/19/02	0.037	
2002	9	20	9/20/02	0.038	
2002	9	21	9/21/02	0.037	
2002	9	22	9/22/02	0.033	
2002	9	23	9/23/02	0.031	
2002	9	24	9/24/02	0.030	
2002	9	25	9/25/02	0.031	
2002	9	26	9/26/02	0.029	
2002	9	27	9/27/02	0.030	
2002	9	28	9/28/02	0.033	
2002	9	29	9/29/02	0.030	
2002	9	30	9/30/02	0.028	
2002	10	1	10/1/02	0.027	
2002	10	2	10/2/02	0.023	
2002	10	3	10/3/02	0.022	
2002	10	4	10/4/02	0.021	
2002	10	5	10/5/02	0.019	
2002	10	6	10/6/02	0.019	
2002	10	7	10/7/02	0.017	
2002	10	8	10/8/02	0.018	
2002	10	9	10/9/02	0.017	
2002	10	10	10/10/02	0.017	
2002	10	11	10/11/02	0.017	
2002	10	12	10/12/02	0.019	
2002	10	13	10/13/02	0.015	
2002	10	14	10/14/02	0.016	
2002	10	15	10/15/02	0.016	
2002	10	16	10/16/02	0.016	
2002	10	17	10/17/02	0.016	
2002	10	18	10/18/02	0.015	
2002	10	19	10/19/02	0.014	
2002	10	20	10/20/02	0.012	
2002	10	21	10/21/02	0.013	
2002	10	22	10/22/02	0.012	
2002	10	23	10/23/02	0.011	
2002	10	24	10/24/02	0.011	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	10	25	10/25/02	0.011	
2002	10	26	10/26/02	0.010	
2002	10	27	10/27/02	0.009	
2002	10	28	10/28/02	0.009	
2002	10	29	10/29/02	0.009	
2002	10	30	10/30/02	0.008	
2002	10	31	10/31/02	0.008	
2002	11	1	11/1/02	0.008	0
2002	11	2	11/2/02	0.007	0
2002	11	3	11/3/02	0.006	0
2002	11	4	11/4/02	0.007	0
2002	11	5	11/5/02	0.006	0
2002	11	6	11/6/02	0.006	0
2002	11	7	11/7/02	0.006	0
2002	11	8	11/8/02	3.241	35
2002	11	9	11/9/02	8.193	43
2002	11	10	11/10/02	0.967	13
2002	11	11	11/11/02	0.048	
2002	11	12	11/12/02	0.017	
2002	11	13	11/13/02	0.035	
2002	11	14	11/14/02	0.032	
2002	11	15	11/15/02	0.010	
2002	11	16	11/16/02	0.010	
2002	11	17	11/17/02	0.030	
2002	11	18	11/18/02	0.021	
2002	11	19	11/19/02	0.019	
2002	11	20	11/20/02	0.014	
2002	11	21	11/21/02	0.011	
2002	11	22	11/22/02	0.023	
2002	11	23	11/23/02	0.026	
2002	11	24	11/24/02	0.024	
2002	11	25	11/25/02	0.016	
2002	11	26	11/26/02	0.013	
2002	11	27	11/27/02	0.009	
2002	11	28	11/28/02	0.009	
2002	11	29	11/29/02	0.020	
2002	11	30	11/30/02	0.018	
2002	12	1	12/1/02	0.019	
2002	12	2	12/2/02	0.017	
2002	12	3	12/3/02	0.017	
2002	12	4	12/4/02	0.015	
2002	12	5	12/5/02	0.014	
2002	12	6	12/6/02	0.013	
2002	12	7	12/7/02	0.014	
2002	12	8	12/8/02	0.013	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2002	12	9	12/9/02	0.013	
2002	12	10	12/10/02	0.013	
2002	12	11	12/11/02	0.012	
2002	12	12	12/12/02	0.011	
2002	12	13	12/13/02	0.011	0
2002	12	14	12/14/02	0.011	0
2002	12	15	12/15/02	0.010	0
2002	12	16	12/16/02	0.010	30
2002	12	17	12/17/02	0.010	0
2002	12	18	12/18/02	0.009	0
2002	12	19	12/19/02	0.008	5
2002	12	20	12/20/02	0.010	0
2002	12	21	12/21/02	0.009	0
2002	12	22	12/22/02	0.008	0
2002	12	23	12/23/02	0.007	0
2002	12	24	12/24/02	0.008	0
2002	12	25	12/25/02	0.007	0
2002	12	26	12/26/02	0.007	0
2002	12	27	12/27/02	0.006	0
2002	12	28	12/28/02	0.006	0
2002	12	29	12/29/02	0.006	0
2002	12	30	12/30/02	0.006	0
2002	12	31	12/31/02	0.005	0
2003	1	1	1/1/03	0.004	0
2003	1	2	1/2/03	0.004	0
2003	1	3	1/3/03	0.004	0
2003	1	4	1/4/03	0.004	0
2003	1	5	1/5/03	0.004	0
2003	1	6	1/6/03	0.003	0
2003	1	7	1/7/03	0.003	0
2003	1	8	1/8/03	0.003	0
2003	1	9	1/9/03	0.003	0
2003	1	10	1/10/03	0.003	0
2003	1	11	1/11/03	0.003	
2003	1	12	1/12/03	0.003	
2003	1	13	1/13/03	0.003	
2003	1	14	1/14/03	0.002	
2003	1	15	1/15/03	0.002	
2003	1	16	1/16/03	0.002	
2003	1	17	1/17/03	0.002	
2003	1	18	1/18/03	0.002	
2003	1	19	1/19/03	0.002	
2003	1	20	1/20/03	0.002	
2003	1	21	1/21/03	0.002	
2003	1	22	1/22/03	0.002	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	1	23	1/23/03	0.001	
2003	1	24	1/24/03	0.001	
2003	1	25	1/25/03	0.001	
2003	1	26	1/26/03	0.001	
2003	1	27	1/27/03	0.001	
2003	1	28	1/28/03	0.001	
2003	1	29	1/29/03	0.001	
2003	1	30	1/30/03	0.001	
2003	1	31	1/31/03	0.001	
2003	2	1	2/1/03	0.001	
2003	2	2	2/2/03	0.001	
2003	2	3	2/3/03	0.001	
2003	2	4	2/4/03	0.001	
2003	2	5	2/5/03	0.001	
2003	2	6	2/6/03	0.001	
2003	2	7	2/7/03	0.001	0
2003	2	8	2/8/03	0.001	
2003	2	9	2/9/03	0.001	
2003	2	10	2/10/03	0.001	
2003	2	11	2/11/03	50.308	59
2003	2	12	2/12/03	153.553	
2003	2	13	2/13/03	116.327	
2003	2	14	2/14/03	55.564	
2003	2	15	2/15/03	2.439	
2003	2	16	2/16/03	2.031	
2003	2	17	2/17/03	1.739	
2003	2	18	2/18/03	1.538	
2003	2	19	2/19/03	1.410	
2003	2	20	2/20/03	1.244	
2003	2	21	2/21/03	1.120	
2003	2	22	2/22/03	1.042	
2003	2	23	2/23/03	0.943	
2003	2	24	2/24/03	0.866	0
2003	2	25	2/25/03	190.710	132
2003	2	26	2/26/03	28.383	13
2003	2	27	2/27/03	31.744	86
2003	2	28	2/28/03	8.011	31
2003	3	1	3/1/03	5.550	0
2003	3	2	3/2/03	4.193	10
2003	3	3	3/3/03	3.367	2
2003	3	4	3/4/03	2.781	31
2003	3	5	3/5/03	2.912	45
2003	3	6	3/6/03	2.097	5
2003	3	7	3/7/03	1.839	12
2003	3	8	3/8/03	1.629	20

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	3	9	3/9/03	1.481	17
2003	3	10	3/10/03	1.373	12
2003	3	11	3/11/03	1.279	8
2003	3	12	3/12/03	1.164	8
2003	3	13	3/13/03	1.088	18
2003	3	14	3/14/03	1.018	10
2003	3	15	3/15/03	96.332	
2003	3	16	3/16/03	51.539	
2003	3	17	3/17/03	5.526	
2003	3	18	3/18/03	4.174	
2003	3	19	3/19/03	3.297	
2003	3	20	3/20/03	2.713	
2003	3	21	3/21/03	2.300	
2003	3	22	3/22/03	1.996	
2003	3	23	3/23/03	1.824	
2003	3	24	3/24/03	1.650	
2003	3	25	3/25/03	1.493	
2003	3	26	3/26/03	1.389	
2003	3	27	3/27/03	1.301	
2003	3	28	3/28/03	1.188	
2003	3	29	3/29/03	1.114	
2003	3	30	3/30/03	1.040	
2003	3	31	3/31/03	1.141	
2003	4	1	4/1/03	0.974	
2003	4	2	4/2/03	0.920	
2003	4	3	4/3/03	0.886	
2003	4	4	4/4/03	0.849	
2003	4	5	4/5/03	0.805	
2003	4	6	4/6/03	0.765	
2003	4	7	4/7/03	0.705	
2003	4	8	4/8/03	0.636	
2003	4	9	4/9/03	0.612	
2003	4	10	4/10/03	0.603	
2003	4	11	4/11/03	0.567	
2003	4	12	4/12/03	0.523	
2003	4	13	4/13/03	0.504	
2003	4	14	4/14/03	127.782	
2003	4	15	4/15/03	6.659	
2003	4	16	4/16/03	1.486	
2003	4	17	4/17/03	23.888	
2003	4	18	4/18/03	1.572	
2003	4	19	4/19/03	1.378	
2003	4	20	4/20/03	1.250	
2003	4	21	4/21/03	1.163	
2003	4	22	4/22/03	1.095	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	4	23	4/23/03	1.018	
2003	4	24	4/24/03	0.941	
2003	4	25	4/25/03	0.882	
2003	4	26	4/26/03	0.836	
2003	4	27	4/27/03	0.793	
2003	4	28	4/28/03	0.738	
2003	4	29	4/29/03	0.704	
2003	4	30	4/30/03	0.799	
2003	5	1	5/1/03	0.639	
2003	5	2	5/2/03	0.601	
2003	5	3	5/3/03	21.329	
2003	5	4	5/4/03	0.717	
2003	5	5	5/5/03	0.634	
2003	5	6	5/6/03	0.602	
2003	5	7	5/7/03	0.564	
2003	5	8	5/8/03	0.534	
2003	5	9	5/9/03	0.506	
2003	5	10	5/10/03	0.479	
2003	5	11	5/11/03	0.442	
2003	5	12	5/12/03	0.416	
2003	5	13	5/13/03	0.390	
2003	5	14	5/14/03	0.378	
2003	5	15	5/15/03	0.360	
2003	5	16	5/16/03	0.338	
2003	5	17	5/17/03	0.322	
2003	5	18	5/18/03	0.306	
2003	5	19	5/19/03	0.289	
2003	5	20	5/20/03	0.272	
2003	5	21	5/21/03	0.255	
2003	5	22	5/22/03	0.245	
2003	5	23	5/23/03	0.236	
2003	5	24	5/24/03	0.225	
2003	5	25	5/25/03	0.212	
2003	5	26	5/26/03	0.201	
2003	5	27	5/27/03	0.189	
2003	5	28	5/28/03	0.179	
2003	5	29	5/29/03	0.172	
2003	5	30	5/30/03	0.164	
2003	5	31	5/31/03	0.197	
2003	6	1	6/1/03	0.152	
2003	6	2	6/2/03	0.145	
2003	6	3	6/3/03	0.136	
2003	6	4	6/4/03	0.129	
2003	6	5	6/5/03	0.122	
2003	6	6	6/6/03	0.116	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	6	7	6/7/03	0.110	
2003	6	8	6/8/03	0.104	
2003	6	9	6/9/03	0.099	
2003	6	10	6/10/03	0.090	
2003	6	11	6/11/03	0.085	
2003	6	12	6/12/03	0.080	
2003	6	13	6/13/03	0.075	
2003	6	14	6/14/03	0.070	
2003	6	15	6/15/03	0.066	
2003	6	16	6/16/03	0.061	
2003	6	17	6/17/03	0.057	
2003	6	18	6/18/03	0.053	
2003	6	19	6/19/03	0.050	
2003	6	20	6/20/03	0.046	
2003	6	21	6/21/03	0.042	
2003	6	22	6/22/03	0.039	
2003	6	23	6/23/03	0.035	
2003	6	24	6/24/03	0.032	
2003	6	25	6/25/03	0.028	
2003	6	26	6/26/03	0.025	
2003	6	27	6/27/03	0.021	
2003	6	28	6/28/03	0.018	
2003	6	29	6/29/03	0.014	
2003	6	30	6/30/03	0.012	
2003	7	1	7/1/03	0.010	
2003	7	2	7/2/03	0.009	
2003	7	3	7/3/03	0.008	
2003	7	4	7/4/03	0.008	
2003	7	5	7/5/03	0.007	
2003	7	6	7/6/03	0.007	
2003	7	7	7/7/03	0.007	
2003	7	8	7/8/03	0.007	
2003	7	9	7/9/03	0.006	
2003	7	10	7/10/03	0.007	
2003	7	11	7/11/03	0.007	
2003	7	12	7/12/03	0.007	
2003	7	13	7/13/03	0.006	
2003	7	14	7/14/03	0.006	
2003	7	15	7/15/03	0.006	
2003	7	16	7/16/03	0.006	
2003	7	17	7/17/03	0.005	
2003	7	18	7/18/03	0.005	
2003	7	19	7/19/03	0.005	
2003	7	20	7/20/03	0.005	
2003	7	21	7/21/03	0.004	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	7	22	7/22/03	0.004	
2003	7	23	7/23/03	0.004	
2003	7	24	7/24/03	0.004	
2003	7	25	7/25/03	0.004	
2003	7	26	7/26/03	0.004	
2003	7	27	7/27/03	0.003	
2003	7	28	7/28/03	0.003	
2003	7	29	7/29/03	0.003	
2003	7	30	7/30/03	0.003	
2003	7	31	7/31/03	0.003	
2003	8	1	8/1/03	0.003	
2003	8	2	8/2/03	0.003	
2003	8	3	8/3/03	0.003	
2003	8	4	8/4/03	0.002	
2003	8	5	8/5/03	0.002	
2003	8	6	8/6/03	0.002	
2003	8	7	8/7/03	0.002	
2003	8	8	8/8/03	0.002	
2003	8	9	8/9/03	0.002	
2003	8	10	8/10/03	0.002	
2003	8	11	8/11/03	0.002	
2003	8	12	8/12/03	0.002	
2003	8	13	8/13/03	0.002	
2003	8	14	8/14/03	0.002	
2003	8	15	8/15/03	0.002	
2003	8	16	8/16/03	0.001	
2003	8	17	8/17/03	0.001	
2003	8	18	8/18/03	0.001	
2003	8	19	8/19/03	0.001	
2003	8	20	8/20/03	0.001	
2003	8	21	8/21/03	0.001	
2003	8	22	8/22/03	0.001	
2003	8	23	8/23/03	0.001	
2003	8	24	8/24/03	0.001	
2003	8	25	8/25/03	0.001	
2003	8	26	8/26/03	0.001	
2003	8	27	8/27/03	0.001	
2003	8	28	8/28/03	0.001	
2003	8	29	8/29/03	0.001	
2003	8	30	8/30/03	0.001	
2003	8	31	8/31/03	0.001	
2003	9	1	9/1/03	0.001	
2003	9	2	9/2/03	0.001	
2003	9	3	9/3/03	0.001	
2003	9	4	9/4/03	0.001	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	9	5	9/5/03	0.001	
2003	9	6	9/6/03	0.001	
2003	9	7	9/7/03	0.001	
2003	9	8	9/8/03	0.001	
2003	9	9	9/9/03	0.001	
2003	9	10	9/10/03	0.001	
2003	9	11	9/11/03	0.000	
2003	9	12	9/12/03	0.000	
2003	9	13	9/13/03	0.000	
2003	9	14	9/14/03	0.000	
2003	9	15	9/15/03	0.000	
2003	9	16	9/16/03	0.000	
2003	9	17	9/17/03	0.000	
2003	9	18	9/18/03	0.000	
2003	9	19	9/19/03	0.000	
2003	9	20	9/20/03	0.000	
2003	9	21	9/21/03	0.000	
2003	9	22	9/22/03	0.000	
2003	9	23	9/23/03	0.000	
2003	9	24	9/24/03	0.000	
2003	9	25	9/25/03	0.000	
2003	9	26	9/26/03	0.000	
2003	9	27	9/27/03	0.000	
2003	9	28	9/28/03	0.000	
2003	9	29	9/29/03	0.000	
2003	9	30	9/30/03	0.000	
2003	10	1	10/1/03	0.000	
2003	10	2	10/2/03	0.000	
2003	10	3	10/3/03	0.000	
2003	10	4	10/4/03	0.000	
2003	10	5	10/5/03	0.000	
2003	10	6	10/6/03	0.000	
2003	10	7	10/7/03	0.000	
2003	10	8	10/8/03	0.000	
2003	10	9	10/9/03	0.000	
2003	10	10	10/10/03	0.000	
2003	10	11	10/11/03	0.000	
2003	10	12	10/12/03	0.000	
2003	10	13	10/13/03	0.000	
2003	10	14	10/14/03	0.000	
2003	10	15	10/15/03	0.000	
2003	10	16	10/16/03	0.000	
2003	10	17	10/17/03	0.000	
2003	10	18	10/18/03	0.000	
2003	10	19	10/19/03	0.000	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	10	20	10/20/03	0.000	
2003	10	21	10/21/03	0.000	
2003	10	22	10/22/03	0.000	
2003	10	23	10/23/03	0.000	
2003	10	24	10/24/03	0.000	
2003	10	25	10/25/03	0.000	
2003	10	26	10/26/03	0.000	
2003	10	27	10/27/03	0.000	
2003	10	28	10/28/03	0.000	
2003	10	29	10/29/03	0.000	
2003	10	30	10/30/03	0.000	
2003	10	31	10/31/03	0.000	
2003	11	1	11/1/03	0.000	
2003	11	2	11/2/03	0.000	
2003	11	3	11/3/03	0.000	
2003	11	4	11/4/03	0.000	
2003	11	5	11/5/03	0.000	
2003	11	6	11/6/03	0.000	
2003	11	7	11/7/03	0.000	
2003	11	8	11/8/03	0.000	
2003	11	9	11/9/03	0.000	
2003	11	10	11/10/03	0.000	
2003	11	11	11/11/03	0.000	
2003	11	12	11/12/03	15.002	
2003	11	13	11/13/03	0.056	
2003	11	14	11/14/03	0.047	
2003	11	15	11/15/03	0.039	
2003	11	16	11/16/03	0.038	
2003	11	17	11/17/03	0.036	
2003	11	18	11/18/03	0.035	
2003	11	19	11/19/03	0.033	
2003	11	20	11/20/03	0.033	
2003	11	21	11/21/03	0.031	
2003	11	22	11/22/03	0.030	
2003	11	23	11/23/03	0.030	
2003	11	24	11/24/03	0.029	
2003	11	25	11/25/03	0.028	
2003	11	26	11/26/03	0.026	
2003	11	27	11/27/03	0.025	
2003	11	28	11/28/03	0.026	
2003	11	29	11/29/03	0.025	
2003	11	30	11/30/03	0.024	
2003	12	1	12/1/03	0.023	
2003	12	2	12/2/03	0.022	
2003	12	3	12/3/03	0.021	

Year	Month	Day	Date	Model Daily Average Flow	Measured Daily Average Flow
Units				cfs	cfs
2003	12	4	12/4/03	0.020	
2003	12	5	12/5/03	0.019	
2003	12	6	12/6/03	0.019	
2003	12	7	12/7/03	0.018	
2003	12	8	12/8/03	0.017	
2003	12	9	12/9/03	0.016	
2003	12	10	12/10/03	0.016	
2003	12	11	12/11/03	0.015	
2003	12	12	12/12/03	0.014	
2003	12	13	12/13/03	0.014	
2003	12	14	12/14/03	0.013	
2003	12	15	12/15/03	0.013	
2003	12	16	12/16/03	0.012	
2003	12	17	12/17/03	0.012	
2003	12	18	12/18/03	0.011	
2003	12	19	12/19/03	0.011	
2003	12	20	12/20/03	0.010	
2003	12	21	12/21/03	0.010	
2003	12	22	12/22/03	0.009	
2003	12	23	12/23/03	0.009	
2003	12	24	12/24/03	0.278	
2003	12	25	12/25/03	43.532	
2003	12	26	12/26/03	0.878	
2003	12	27	12/27/03	0.154	
2003	12	28	12/28/03	0.146	
2003	12	29	12/29/03	0.139	
2003	12	30	12/30/03	0.133	

Table 2. Modeled Flow vs Measured Flows

Date	Model Daily Average Flow -cfs	Observed Daily Average Flow - cfs	Percent Difference -%, difference of observed from model over observed	Actual Difference -cfs, observed from model
11/29/01	2.801	18	-84.4%	-15.20
2/17/02	7.614	3	153.8%	4.61
3/7/02	0.023	7	-99.7%	-6.98
11/8/02	3.241	35	-90.7%	-31.76
11/9/02	8.193	43	-80.9%	-34.81
11/10/02	0.967	13	-92.6%	-12.03
12/16/02	0.010	30	-99.97%	-29.99
12/19/02	0.008	5	-99.8%	-4.99
2/11/03	50.308	59	-14.7%	-8.69
2/25/03	190.710	132	44.5%	58.71
2/26/03	28.383	13	118.3%	15.38
2/27/03	31.744	86	-63.1%	-54.26
2/28/03	8.011	31	-74.2%	-22.99
3/2/03	4.193	10	-58.1%	-5.81
3/3/03	3.367	2	68.4%	1.37
3/4/03	2.781	31	-91.0%	-28.22
3/5/03	2.912	45	-93.5%	-42.09
3/6/03	2.097	5	-58.1%	-2.90
3/7/03	1.839	12	-84.7%	-10.16
3/8/03	1.629	20	-91.9%	-18.37
3/9/03	1.481	17	-91.3%	-15.52
3/10/03	1.373	12	-88.6%	-10.63
3/11/03	1.279	8	-84.0%	-6.72
3/12/03	1.164	8	-85.5%	-6.84
3/13/03	1.088	18	-94.0%	-16.91
3/14/03	1.018	10	-89.8%	-8.98

Table 3. Modeled Volume vs. Measured Volume

Date	Changing Model Values to Daily Volume, cf	Changing Observed Values to Daily Volume, cf
11/29/01	241996	1555200
2/17/02	657867	259200
3/7/02	1982	604800
11/8/02	280035	3024000
11/9/02	707867	3715200
11/10/02	83510	1123200
12/16/02	904	2592000
12/19/02	715	432000
2/11/03	4346577	5097600
2/25/03	16477344	11404800
2/26/03	2452326	1123200
2/27/03	2742682	7430400
2/28/03	692118	2678400
3/2/03	362239	864000
3/3/03	290940	172800
3/4/03	240244	2678400
3/5/03	251590	3888000
3/6/03	181142	432000
3/7/03	158903	1036800
3/8/03	140781	1728000
3/9/03	127993	1468800
3/10/03	118657	1036800
3/11/03	110532	691200
3/12/03	100566	691200
3/13/03	94005	1555200
3/14/03	87948	864000

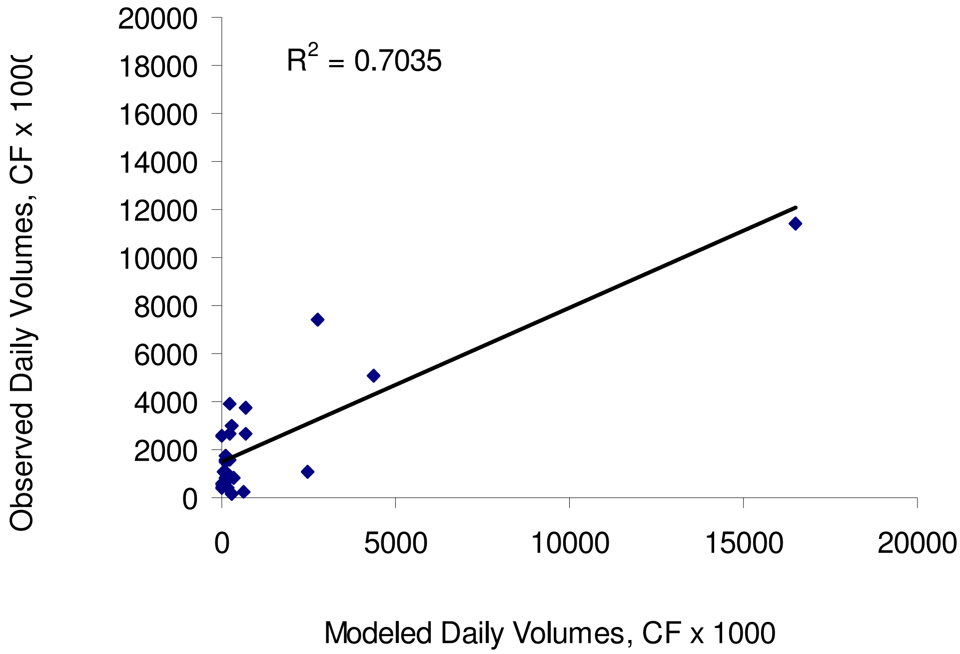


Figure 1. Measured Daily Volumes vs Modeled Daily Volumes

Table 4. Modeled Total Volume vs Measured Total Volume

Total Modeled Volumes for 26 days, L	Total Observed Volumes for 26 days, L	Percent Difference -%, difference of observed from model over observed	Actual Difference -L, observed from model
876421612	1646496115	47%	-770074503

Table 5. Comparison of Modeled and Measured Flows

Statistics of Directly Comparable Model Values to Observed Values Above CFS of 2.28 (26 Values)		Statistics of Observed Values Above CFS of 2.28 (26 Values)	
Mean	14	Mean	26
Median	2	Median	15
25th	1	25th	9
75th	7	75th	31
STDEV	38	STDEV	29
Statistics of Percent Differences		**Statistics of Actual Differences**	
Mean	-55%	Mean	-12
Median	-85%	Median	-10
25th	-92%	25th	-22
75th	-59%	75th	-6
STDEV	0.70	STDEV	21

Table 6. Modeled Water Quality, All Values.

Number	Date	Flow	Total Copper	Total Lead	Total Zinc
			µg/L	µg/L	µg/L
19004	2/17/94	80.6874	14	14	78
19004	3/24/94	77.9417	6	6	35
19004	4/24/94	15.4465	32	34	175
19004	11/10/94	14.4909	24	24	134
19004	1/11/95	47.9248	5	5	30
19004	2/14/95	285.361	31	31	173
19004	4/16/95	47.6048	32	32	176
19004	11/1/95	24.6359	74	76	408
19004	12/9/96	10.7718	19	18	106
19004	1/16/97	1.78252	1	0	4
19004	12/6/97	51.7472	53	53	294
19004	3/14/98	2.98883	0	0	0
19004	11/8/98	28.7118	41	42	228
19004	1/25/99	88.7292	42	43	231
19004	3/15/99	8.14882	39	39	216
19004	2/12/00	45.11	43	44	237
19004	2/21/00	216.509	22	22	121
19004	3/5/00	79.8623	24	24	134
19004	4/17/00	41.7563	21	22	118
19004	10/27/00	37.9718	28	28	157
19004	1/8/01	28.0362	26	26	142
19004	2/13/01	54.4753	50	50	280
19004	11/12/01	10.5909	17	18	95
19004	11/29/01	2.80088	32	32	175
19004	2/17/02	7.6142	53	54	293
19004	11/8/02	3.24115	33	34	183
19004	2/11/03	50.3076	38	38	206
19004	2/25/03	190.71	23	23	129
19006	2/12/00	13.2766	63	74	316
19006	2/21/00	63.4845	25	28	128
19006	1/8/01	8.38546	31	36	157
19006	2/13/01	16.4391	57	64	293
19006	11/12/01	3.47155	17	20	89
19014	1/8/01	0.866875	27	32	151
19014	2/13/01	1.68843	51	59	292
19014	11/12/01	0.362798	12	14	69
19016	2/12/00	7.75739	33	33	181
19016	2/21/00	37.1424	17	16	93
19016	1/8/01	4.87796	17	17	96
19016	2/13/01	9.55507	38	36	212
19016	11/12/01	1.94136	11	10	58
19018	1/8/01	11.6857	22	19	125
19018	2/13/01	22.7255	46	40	267
19018	11/12/01	4.22921	16	14	91
19024	2/12/00	30.7277	40	38	221

Number	Date	Flow	Total Copper	Total Lead	Total Zinc
			µg/L	µg/L	µg/L
19024	2/21/00	150.342	21	20	120
19024	1/8/01	18.9028	28	26	154
19024	2/13/01	37.2259	50	47	282
19024	11/12/01	7.10023	18	17	102
19026	1/8/01	14.8463	25	23	140
19026	2/13/01	29.3028	48	44	275
19026	11/12/01	5.99581	16	15	91
19028	2/12/00	9.20883	60	60	332
19028	2/21/00	44.0897	28	27	159
19028	1/8/01	5.8327	31	30	169
19028	2/13/01	11.6731	60	56	334
19028	11/12/01	2.49796	15	15	85
19035	2/12/00	2.48031	20	18	110
19035	2/21/00	11.9094	11	10	64
19035	1/8/01	1.57353	10	9	58
19035	2/13/01	3.18453	24	22	134
19035	11/12/01	0.668691	6	6	35

Table 7. Observed Water Quality, All Values.

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc
		µg/L	µg/L	µg/L
19004	2/17/94	34	110	260
19004	3/24/94	29	140	240
19004	4/24/94	44	70	320
19004	11/10/94	36	35	180
19004	1/11/95	17	44	150
19004	2/14/95	40	110	360
19004	4/16/95	85	140	560
19004	11/1/95	46	23	25
19004	12/9/96	20	16	70
19004	1/16/97	10	58	200
19004	12/6/97	28	42	110
19004	3/14/98	28	95	92
19004	11/8/98	6	1	30
19004	1/25/99	5	7	48
19004	3/15/99	15	82	210
19004	2/12/00	29	15	96
19004	2/21/00	16	1	50
19004	3/5/00	16	1	50
19004	4/17/00	14	5	80
19004	10/27/00	27	22	150
19004	1/8/01	57	69	255
19004	2/13/01	16	25	110
19004	11/12/01	97	94	740
19004	11/29/01	27	28	162
19004	2/17/02	53	32	314

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc
		µg/L	µg/L	µg/L
19004	11/8/02	28	17	118
19004	2/11/03	33	29	230
19004	2/25/03	16	23	154
19006	2/12/00	68	34	160
19006	2/21/00	23	23	180
19006	1/8/01	52	91	420
19006	2/13/01	16	29	100
19006	11/12/01	49	39	370
19014	1/8/01	36	21	230
19014	2/13/01	19	18	110
19014	11/12/01	37	12	200
19016	2/12/00	68	52	300
19016	2/21/00	19	19	160
19016	1/8/01	65	90	480
19016	2/13/01	15	21	110
19016	11/12/01	45	52	300
19018	1/8/01	70	68	660
19018	2/13/01	38	53	280
19018	11/12/01	42	29	340
19024	2/12/00	33	83	327
19024	2/21/00	19	26	81
19024	1/8/01	56	59	360
19024	2/13/01	41	61	280
19024	11/12/01	32	19	180
19026	1/8/01	32	27	190
19026	2/13/01	17	23	120
19026	11/12/01	170	270	1400
19028	2/12/00	43	76	370
19028	2/21/00	27	35	10
19028	1/8/01	37	29	260
19028	2/13/01	33	59	270
19028	11/12/01	180	170	1900
19035	2/12/00	23	16	100
19035	2/21/00	10	10	54
19035	1/8/01	32	19	160
19035	2/13/01	10	9	55
19035	11/12/01	49	36	290

Table 8. Percent Differences for Water Qualities with Flows Over 2.28 cfs.

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc
		%	%	%
19004	2/17/94	-59%	-87%	-70%
19004	3/24/94	-78%	-95%	-85%
19004	4/24/94	-27%	-51%	-45%
19004	11/10/94	-33%	-32%	-25%
19004	1/11/95	-68%	-88%	-80%
19004	2/14/95	-22%	-72%	-52%
19004	4/16/95	-63%	-77%	-69%
19004	11/1/95	62%	231%	1534%
19004	12/9/96	-6%	15%	51%
19004	12/6/97	89%	26%	167%
19004	3/14/98	-100%	-100%	-100%
19004	11/8/98	591%	4097%	660%
19004	1/25/99	741%	513%	381%
19004	3/15/99	161%	-52%	3%
19004	2/12/00	49%	195%	147%
19004	2/21/00	37%	2105%	142%
19004	3/5/00	50%	2292%	168%
19004	4/17/00	53%	335%	47%
19004	10/27/00	5%	28%	4%
19004	1/8/01	-54%	-62%	-44%
19004	2/13/01	215%	106%	154%
19004	11/12/01	-82%	-81%	-87%
19004	11/29/01	18%	14%	8%
19004	2/17/02	1%	68%	-7%
19004	11/8/02	19%	99%	55%
19004	2/11/03	14%	32%	-10%
19004	2/25/03	45%	1%	-16%
19006	2/12/00	-8%	116%	97%
19006	2/21/00	8%	22%	-29%
19006	1/8/01	-40%	-61%	-63%
19006	2/13/01	255%	119%	193%
19006	11/12/01	-64%	-49%	-76%
19016	2/12/00	-51%	-37%	-40%
19016	2/21/00	-10%	-14%	-42%
19016	1/8/01	-73%	-81%	-80%
19016	2/13/01	156%	73%	93%
19018	1/8/01	-69%	-73%	-81%
19018	2/13/01	21%	-25%	-5%
19018	11/12/01	-63%	-53%	-73%
19024	2/12/00	20%	-54%	-32%
19024	2/21/00	12%	-23%	49%
19024	1/8/01	-51%	-56%	-57%
19024	2/13/01	22%	-24%	1%
19024	11/12/01	-43%	-10%	-43%
19026	1/8/01	-23%	-14%	-26%

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc
		%	%	%
19026	2/13/01	183%	92%	129%
19026	11/12/01	-91%	-95%	-94%
19028	2/12/00	41%	-21%	-10%
19028	2/21/00	5%	-24%	1489%
19028	1/8/01	-17%	4%	-35%
19028	2/13/01	81%	-5%	24%
19028	11/12/01	-91%	-91%	-96%
19035	2/12/00	-14%	12%	10%
19035	2/21/00	15%	4%	19%
19035	2/13/01	141%	143%	145%

Table 9. Actual Differences for Water Qualities with Flows Over 2.28 cfs.

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc
		µg/L	µg/L	µg/L
19004	2/17/94	-20	-96	-182
19004	3/24/94	-23	-134	-205
19004	4/24/94	-12	-36	-145
19004	11/10/94	-12	-11	-46
19004	1/11/95	-12	-39	-120
19004	2/14/95	-9	-79	-187
19004	4/16/95	-53	-108	-384
19004	11/1/95	28	53	383
19004	12/9/96	-1	2	36
19004	12/6/97	25	11	184
19004	3/14/98	-28	-95	-92
19004	11/8/98	35	41	198
19004	1/25/99	37	36	183
19004	3/15/99	24	-43	6
19004	2/12/00	14	29	141
19004	2/21/00	6	21	71
19004	3/5/00	8	23	84
19004	4/17/00	7	17	38
19004	10/27/00	1	6	7
19004	1/8/01	-31	-43	-113
19004	2/13/01	34	26	170
19004	11/12/01	-80	-76	-645
19004	11/29/01	5	4	13
19004	2/17/02	0	22	-21
19004	11/8/02	5	17	65
19004	2/11/03	5	9	-24
19004	2/25/03	7	0	-25
19006	2/12/00	-5	40	156
19006	2/21/00	2	5	-52
19006	1/8/01	-21	-55	-263
19006	2/13/01	41	35	193
19006	11/12/01	-32	-19	-281
19016	2/12/00	-35	-19	-119
19016	2/21/00	-2	-3	-67
19016	1/8/01	-48	-73	-384
19016	2/13/01	23	15	102
19018	1/8/01	-48	-49	-535
19018	2/13/01	8	-13	-13
19018	11/12/01	-26	-15	-249
19024	2/12/00	7	-45	-106
19024	2/21/00	2	-6	39
19024	1/8/01	-28	-33	-206
19024	2/13/01	9	-14	2
19024	11/12/01	-14	-2	-78
19026	1/8/01	-7	-4	-50

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc
		µg/L	µg/L	µg/L
19026	2/13/01	31	21	155
19026	11/12/01	-154	-255	-1309
19028	2/12/00	17	-16	-38
19028	2/21/00	1	-8	149
19028	1/8/01	-6	1	-91
19028	2/13/01	27	-3	64
19028	11/12/01	-165	-155	-1815
19035	2/12/00	-3	2	10
19035	2/21/00	1	0	10
19035	2/13/01	14	13	79

Table 10. Water Quality Statistical Summary of Modeled and Observed Data Sets and Percent and Actual Differences.

Statistics of Modeled Values (55 values)	Copper - ug/L	Lead -ug/L	Zinc -ug/L	Statistics of Modeled Values that directly compared to Observed Values (55 values)	Copper -ug/L	Lead -ug/L	Zinc -ug/L
Mean	31	31	170	Mean	39	51	270
Median	28	28	157	Median	32	32	180
25th	19	18	100	25th	18	22	100
75th	40	45	317	75th	45	70	320
Statistics of Percent Differences (55 Values)	**Copper -%**	**Lead -%**	**Zinc -%**	**Statistics of Actual Differences (55 Values)**	**Copper -ug/L**	**Lead -ug/L**	**Zinc -ug/L**
Mean	33%	166%	76%	Mean	-8.1	-20.0	-96.5
Median	5%	-14%	-10%	Median	1.3	-3.1	-23.9
25th	-51%	-55%	-55%	25th	-21	-41	-132
75th	47%	71%	74%	75th	8.5	14.1	68.0

Table 11. Calculated Loads for Modeled and Observed Values.

Sub watershed Number	Date	Flow Volume	Total Copper	Total Lead	Total Zinc	Total Copper	Total Lead	Total Zinc
			Modeled	Modeled	Modeled	Observed	Observed	Observed
Units		L	g	g	g	g	g	g
19004	11/29/01	6,852,360	217	219	1197	185	192	1110
19004	2/17/02	18,628,159	992	1003	5452	987	596	5849
19004	11/8/02	7,929,481	264	268	1451	222	135	936
19004	2/11/03	123,077,664	4629	4724	25361	4062	3569	28308
19004	2/25/03	466,572,473	10789	10856	60216	7465	10731	71852

Table 12. Percent and Actual Differences Between Model and Observed Values in Table B-11.

Subwatershed Number	Date	Total Copper	Total Lead	Total Zinc	Total Copper	Total Lead	Total Zinc
		Percent Difference	Percent Difference	Percent Difference	Actual Difference	Actual Difference	Actual Difference
Units		%	%	%	g	g	g
19004	11/29/01	18%	14%	8%	32.48	27	87
19004	2/17/02	0.5%	68%	-7%	5.0	407	(397)
19004	11/8/02	19%	99%	55%	42.27	132.8	515
19004	2/11/03	14%	32%	-10%	567	1,154	(2,947)
19004	2/25/03	45%	1.2%	-16%	3,324	125	(11,636)

Appendix G

Metals Concentration Reduction Percentages

Required to Meet the Chollas Creek Metals Total Maximum Daily Loads

California Regional Water Quality Control Board, San Diego Region

Metals Concentration Reduction Percentages Required to Meet the Total Maximum Daily Load for Metals in Chollas Creek

The load allocation (LA) and waste load allocations (WLA) of the copper, lead, and zinc Total Maximum Daily Loads (TMDL) for Chollas Creek establish concentrations of copper, lead, and zinc that are protective of aquatic life beneficial uses in Chollas Creek.[1] Because the concentrations protective of aquatic life vary with hardness, the allocations in this TMDL are expressed as formulas that incorporate a hardness term, rather than as a constant concentration. To achieve Water Quality Objectives (WQOs) in the creek, concentrations of copper, lead and zinc must be significantly lower than presently measured. The potential ranges of the reductions should be thoroughly considered, as they will have practical implications on the feasibility and nature of implementation scenarios. Using concentration and hardness data from Chollas Creek, the likely range of metals concentration reduction percentages needed to meet the WQOs for copper, lead and zinc were calculated.

The Numeric Targets for copper, lead and zinc are presented in Table G.1 and are discussed in detail in the Technical Report. Concentrations of metals in Chollas Creek will be compared against the WQOs to assess compliance with this TMDL Project. The TMDLs (equal to the WLA and LA) for copper, lead, and zinc are listed in Table G.2. All discharges to Chollas Creek will be expected to meet this WLA and LA. Average and median concentrations of copper, lead and zinc currently exceed the proposed load and waste load allocations (Table G.3). The data used to calculate the mean and median concentrations can be found in Appendix A. To calculate the percent reductions required to meet the allocations, the following formula was applied:

$$\text{Percent Reduction} = \frac{(\text{Measured Concentration - WQO})}{\text{Measured Concentration}} \times 100$$

The loading capacity of Chollas Creek is equal to the Numeric Targets that are equal to either the Criteria Maximum Concentration (CMC) or Criteria Continuous Concentration (CCC) calculated from the hardness that is associated with the measured concentration of metal.

Example:

Mean Measured Copper Concentration = 16.6 µg/L
Mean Measured Hardness = 198.2 mg/L
At this hardness;
CCC = 16.1 µg/L
Percent Reduction = [(16.64 – 16.1) / 16.64] * 100 = 3.4%
CMC = 25.6 µg/L
Percent Reduction = [(16.64 – 25.6) / 16.64] * 100 = -54.2%

Therefore, if water quality conditions are equal to the mean copper concentration and mean hardness, the ambient copper concentration would need to be decreased by 3.4 percent to achieve the allowable chronic concentration and would not exceed the allowable maximum

[1] In this concentration based TMDL, the LAs and WLAs are equal to the same concentration, and can vary depending on hardness. The LAs and WLAs are not additive.

concentration. Negative percent reductions in Table G.2 indicate that the proposed WQOs are met and a reduction is not needed.

TABLE G.1. Numeric Targets for dissolved copper, lead and zinc for acute and chronic conditions

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Continuous Concentration
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	{1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

TABLE G.2. The Wasteload and Load Allcoations for dissolved copper, lead and zinc for acute and chronic conditions

Metal	Allocations for Acute Conditions – One-Hour Average (LA = WLA = 0.9 * Numeric Target)	Allocations for Chronic Conditions – Four-Day Average (LA = WLA = 0.9 * Numeric Target)
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

WLA = Waste Load Allocation LA = Load Allocation

Table G.3 is for illustrative purposes to frame the potential ranges of reductions in metal concentrations required to meet the proposed WQOs. Many of the scenarios presented do not result in a required reduction.

Table G.3. Average metal concentrations, hardness, associated allocations and percent reductions required

Metal	Total Hardness as $CaCO_3$ (mg/L)	CMC Freshwater CF	WQO (ug/L)	LA and WLA	CCC Freshwater CF	WQO (ug/L)	LA and WLA	Measured Concentration	Percent Reduction Required to meet WQO	
		Acute Dissolved			Chronic Dissolved			Dissolved (ug/L)	CMC	CCC
Copper										
Minimum*	42.5	0.96	6.0	5.4	0.96	4.3	3.9	2.4	-150.1%	-79.6%
Median^	90.8	0.96	12.3	11.0	0.96	8.2	7.4	10.0	-22.7%	**17.5%**
Mean^	198.2	0.96	25.6	23.0	0.96	16.1	14.5	16.6	-53.9%	**3.4%**
Maximum*	120.0	0.96	16.0	14.4	0.96	10.5	9.4	81.6	**80.4%**	**87.2%**
Lead										
Minimum*	35.1	0.944	20.32	18.3	0.944	0.79	0.7	0.50	-3963.5%	-58.4%
Median^	88.9	0.808	56.80	51.1	0.808	2.21	2.0	3.00	-1793.4%	**26.2%**
Mean^	199.8	0.690	135.99	122.4	0.690	5.30	4.8	14.29	-851.6%	**62.9%**
Maximum*	71.0	0.841	44.39	40.0	0.841	1.73	1.6	118.00	**62.4%**	**98.5%**
Zinc										
Minimum*	484.0	0.978	446	401.2	0.986	449	404.5	3.0	-14759.5%	-14881.0%
Median^	90.8	0.978	108	97.2	0.986	109	98.0	66.5	-62.4%	-63.7%
Mean^	200.2	0.978	211	189.9	0.986	213	191.4	102.2	-106.5%	-108.1%
Maximum*	120.0	0.978	137	123.1	0.986	138	124.1	548.0	**75.0%**	**74.8%**

* Uses measured hardness that corresponds to max and min measured metal concentrations
^ Hardness listed is the statistical median or mean, respectively.
CCC = Criteria Continuous Concentration
CF = Conversion Factor
WLA = Waste Load Allocation
CMC = Criteria Maximum Concentration
LA = Load Allocation
WQO = Water Quality Objective

Figures G.1 through G.3 present the available metals data plotted against the associated hardness. The graphs also show CMC and CCC WQOs required at hardness concentrations from 25 to 400 mg/L.[2] These views of the data better illustrate that the majority of the metals concentration reductions need to occur at the lower hardness concentrations. Both the CMC (acute) and CCC (chronic) WQOs for all metals are exceeded within the lower range of measured hardness.

Thirty-six of eighty-one (39.5 percent) measured copper samples exceed the proposed acute WQO and forty-four (50.5 percent) exceed the proposed chronic WQO. The vast majority of the exceedances occur at or below a hardness of 150 mg/L. The maximum percent reduction required is approximately 90 percent for both the acute and chronic WQOs. The average reduction required is approximately 50 percent to meet the chronic WQO and 40 percent to meet the acute WQO. There is some good news in that almost half of the measured copper samples would not require a reduction under the proposed WQOs.

Eleven of seventy-nine (13.9 percent) measured lead samples exceed the proposed acute WQO and forty-three (54.4 percent) exceed the proposed chronic WQO. The vast majority of the exceedances occur at or below a hardness of 120 mg/L. The maximum percent reduction required is approximately 99 percent for the chronic WQO and 62 percent for the acute WQO. The average reduction required is approximately 66 percent to meet the chronic WQO and 25 percent to meet the acute WQO. Almost half of the measured lead samples

[2] This is the range of hardness that is appropriate for use in the California Toxics Rule (40 CFR 131.38).

would not require a reduction to meet the proposed chronic WQO and over 85 percent would already meet the proposed acute WQO.

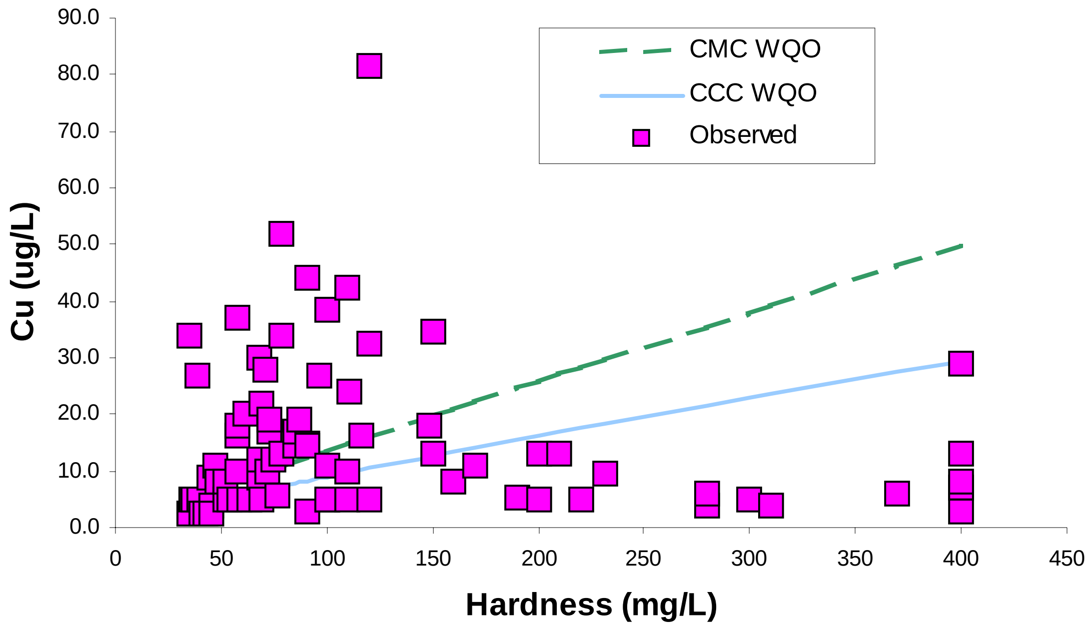


Figure G.1. Copper concentrations in Chollas Creek

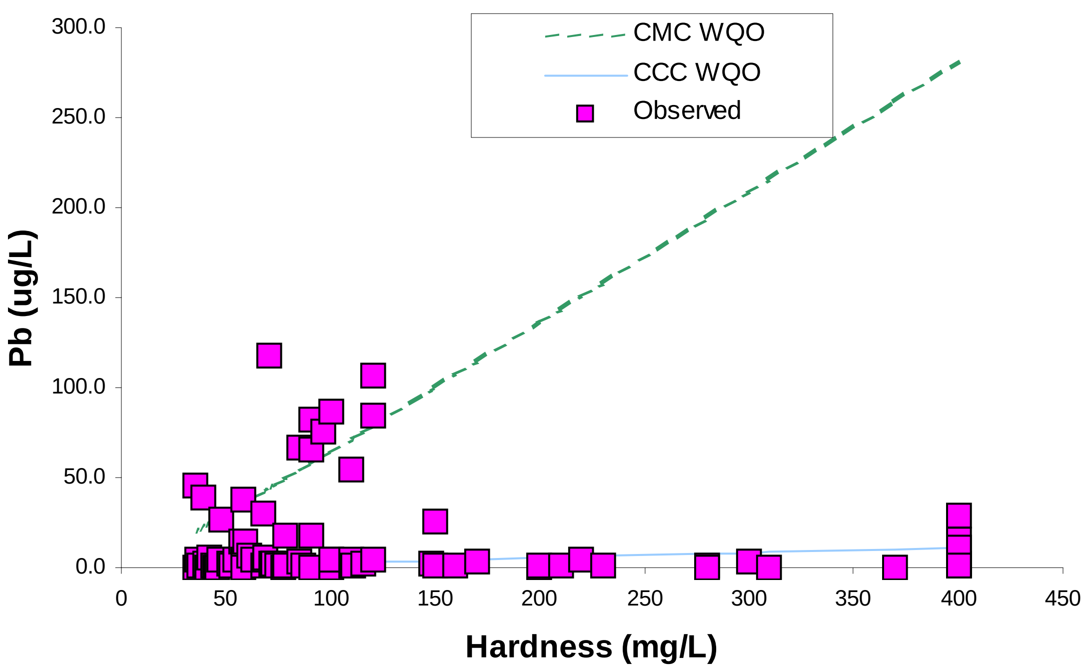


Figure G.2. Lead concentrations in Chollas Creek

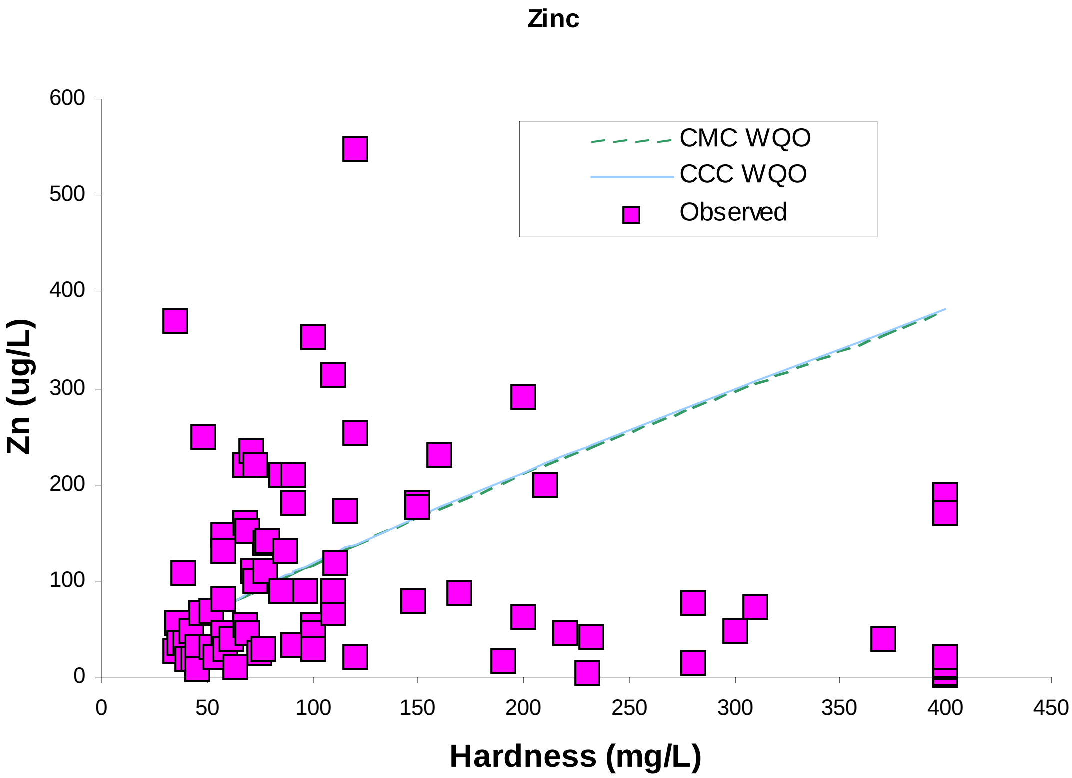


Figure G.3. Zinc concentrations in Chollas Creek

Thirty-three of eighty-two (40 percent) measured zinc samples exceed both the proposed acute and chronic WQOs. All of the exceedances occur at or below a hardness of 210 mg/L. The maximum percent reduction required is approximately 87 percent for both the acute and chronic WQOs, while the average reduction required is approximately 35 percent. For zinc, well over half of the measured samples would not require a reduction under the proposed WQOs.

All three metals require significant reductions from current concentrations to meet the WQOs. Most reductions are required at the lower range of the measured hardness and represent up to a 98 percent reduction. However, the average reduction required is closer to 50 percent and a significant number of previously measured metal concentrations would not require a reduction. This data should be investigated further when implementing best management practices and considering load reduction scenarios.

Appendix H

Site-Specific Objectives

Chollas Creek Metals Total Maximum Daily Loads

California Regional Water Quality Control Board, San Diego Region

Site-Specific Objectives

Currently, there are no site-specific objectives (SSOs) for the Chollas Creek Metals Total Maximum Daily Load (TMDL) project. The following is the San Diego Regional Water Quality Control Board general comment about developing site-specific objectives with respect to TMDLs.

In the TMDL, the numeric targets are set equal to numeric water quality criteria for dissolved copper, lead, and zinc, as defined in the California Toxics Rule (CTR). The CTR's numeric criteria serve as legally applicable water quality standards in the State of California for inland surface waters, enclosed bays and estuaries for all purposes and programs under the Clean Water Act. Criteria are derived based on a rigorous set of guidelines to provide both short-term and long-term protection to aquatic life. In the absence of site-specific objectives, the CTR's water quality criteria represent the most appropriate water quality objectives and therefore numeric targets for dissolved copper, lead, and zinc at Chollas Creek.

The CTR criteria are based on the toxicity results of a large number of nationally representative species to a single pollutant in clean controlled laboratory waters. The physical and chemical characteristics of ambient water at a particular site may result in an increase or decrease in the bioavailability and/or toxicity of a given pollutant. Examples of potentially confounding water chemistry characteristics may include dissolved organic matter, particulate matter, other contaminants, pH, and hardness. Similarly, the aquatic life community at a particular site may be more or less sensitive to a pollutant than the aquatic organisms used to develop the CTR criteria. Because (1) ambient water chemistry, and/or (2) the biological communities at Chollas Creek may be different than the chemistry and biological communities upon which the CTR criteria were based, the CTR criteria may be over - or under- protective for Chollas Creek.

Differences in bioavailability and toxicity may exist for several reasons, including the presence of dissolved organic matter, particulate matter, other contaminants, pH, and hardness. Additionally, the aquatic organisms that live in the receiving waters may be more or less sensitive than the organisms used in the controlled laboratory waters. Therefore, by definition, site-specific criteria may be more or less stringent than the criteria presented in the CTR.

The Regional Board recognizes that there are situations where site-specific conditions affect the toxicity of a pollutant, which results in a criterion that is over- or under-protective. Water quality criteria are primarily based on studies conducted using laboratory water in which organisms are exposed to one pollutant. Site-specific objectives adjust water quality objectives to account for differences in toxicity among sites based on site-specific information and scientific studies. Site-specific objectives must protect the beneficial uses of a water body, must be developed in accordance with federal and State laws and regulations based on sound scientific rationale and must be adopted by the Regional Board in a Basin Plan amendment..

The Regional Board agrees that it may be appropriate to investigate the relevance of site-specific objectives for copper, lead, and zinc in the Chollas Creek watershed. However, the Regional Board does not plan to initiate or fund studies to develop site-specific objectives. Typically, such studies are initiated by dischargers or other interested parties under the regulatory oversight of the Regional Board. There is no effort currently underway or planned by interested persons to fund the scientific studies needed to develop SSOs for copper, lead, and zinc in Chollas Creek. The development of a copper, lead, and zinc SSOs for Chollas Creek waters, including the scientific studies necessary to support it, would be costly, time consuming and resource intensive. Dischargers or other interested parties would need to fund and initiate the scientific studies to develop SSOs.

The appropriate strategy is for the Regional Board to proceed with adoption of the TMDL at this time, which will mandate copper, lead, and zinc load reductions. If scientific studies demonstrate that the ambient water chemistry and/or biological communities at Chollas Creek are significantly different from the chemistry and biological communities upon which the CTR criterion were based, a site specific objective for copper, lead, and zinc may be appropriate. If and when site-specific copper, lead, and zinc water quality objectives are developed for Chollas Creek, this TMDL will be modified accordingly. The Regional Board will not delay adoption of this TMDL mandating copper, lead, and zinc load reductions on the premise that it is necessary to first develop site-specific copper, lead, and zinc water quality objectives. Studies by interested parties supporting the development and adoption of site-specific objectives may occur concurrently with actions by dischargers to meet compliance with this TMDL. Development of site-specific objectives is discussed in more detail in the State's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed bays, and Estuaries of California* (State Board, 2000). The State Board's 2000 Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP) provides further guidance on when SSOs may be used.

Appendix I

Environmental Analysis, Checklist, and Economic Factors

For the Chollas Creek Metals Total Maximum Daily Loads

California Regional Water Quality Control Board
San Diego Region

May 30, 2007

1 California Environmental Quality Act Requirements

The California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) must comply with the California Environmental Quality Act (CEQA) when amending the Water Quality Control Plan for the San Diego Basin 9 (Basin Plan) as proposed in this project to adopt total maximum daily loads (TMDLs) for copper, lead, and zinc in Chollas Creek. Under the CEQA, the San Diego Water Board is the Lead Agency for evaluating the environmental impacts of the reasonably foreseeable methods of compliance with the proposed TMDLs.

The adoption of a Basin Plan amendment is an activity subject to CEQA requirements because Basin Plan amendments constitute rules or regulations requiring the installation of pollution control equipment, establishing a performance standard, or establishing a treatment requirement.[1] TMDL Basin Plan amendments normally contain a quantifiable numeric target that interprets the applicable water quality objective. TMDLs also include wasteload allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural background. The quantifiable target together with the allocations may be considered a performance standard.[2] Sections 1.1 and 1.2 below describe in detail the statutory requirements and scope of this environmental analysis required by the CEQA for Basin Plan amendments.

1.1 Exemption from Requirement to Prepare Standard CEQA Documents

The CEQA authorizes the Secretary of the Resources Agency to certify state regulatory programs, designed to meet the goals of the CEQA, as exempt from its requirements to prepare an Environmental Impact Report (EIR), Negative Declaration, or Initial Study. The State Water Resources Control Board's (State Water Board) and the San Diego Water Board's Basin Plan amendment process is a certified regulatory program and is therefore exempt from the CEQA's requirements to prepare such documents. [3]

The State Water Board's CEQA implementation regulations[4] describe the environmental documents required for Basin Plan amendment actions. These documents consist of a written report that includes a description of the proposed activity, alternatives to the proposed activity to lesson or eliminate potentially significant environmental impacts, and identification of mitigation measures to minimize any significant adverse impacts. For this project, these documents are the Technical Report entitled *Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay* (Technical Report), an initial draft of the Basin Plan amendment (Appendix J) and an environmental checklist (section 4 below). These components fulfill the requirements of the CEQA for preparation of environmental documents for this Basin Plan amendment.[5]

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[1] 14 CCR section 15187 (a).
[2] The term "performance standard" is defined in the rulemaking provisions of the Administrative Procedure Act [Government Code sections 11340-l 1359]. A "performance standard" is a regulation that describes an objective with the criteria stated for achieving the objective [Government Code section 11342(d)].
[3] 14 CCR section 15251(g) and Public Resources Code section 21080.5.
[4] 23 CCR section 3720 et seq. "Implementation of the Environmental Quality Act of 1970."
[5] 23 CCR section 3777

1.2 Scope of Environmental Analysis

The CEQA has specific provisions that establish the scope of the environmental analysis required for the adoption of this metals TMDLs Basin Plan amendment. The CEQA limits the scope to an environmental analysis of the reasonably foreseeable methods of compliance with the WLAs and LAs. The State Water Board CEQA Implementation Regulations for Certified Regulatory Programs[6] require the environmental analysis to include at least the following:

1. A brief description of the proposed activity. In this case, the proposed activity is the metals TMDLs Basin Plan amendment. This amendment is described in section 2 of this appendix.

2. Reasonable alternatives to the proposed activity (discussed in section 8).

3. Mitigation measures to minimize any significant adverse environmental impacts of the proposed activity (discussed in section 5).

Additionally, the CEQA[7] and CEQA Guidelines[8] require the following components, some of which are repetitive of the list above:

1. An analysis of the reasonably foreseeable environmental impacts of the methods of compliance. These methods may be employed to comply with the metals TMDLs Basin Plan amendment. Reasonably foreseeable methods of compliance are described in section 3. Sections 4 and 5 identify the environmental impacts associated with the methods of compliance.

2. An analysis of the reasonably foreseeable feasible mitigation measures relating to those impacts. This discussion is also in section 5.

3. An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts. This discussion is in section 5.1.

Additionally, the CEQA Guidelines require the environmental analysis take into account a reasonable range of:[9]

1. Environmental factors (section 5).
2. Economic factors (section 7).
3. Technical factors (section 6).
4. Population (section 6).

[6] Ibid.
[7] Public Resources Code section 21159 (a)
[8] 14 CCR section 15187(c)
[9] 14 CCR section 15187(d),Public Resources Code section 21159 (c)

5. Geographic areas (section 6).
6. Specific sites. (section 6)

A "reasonable range" does not require an examination of every site, but a reasonably representative sample of them. The statute specifically states that the agency shall not conduct a "project level analysis."[10] Rather, a project level analysis must be performed by the dischargers that are required to implement the TMDLs.[11] Notably, the San Diego Water Board is prohibited from specifying the manner of compliance with its regulations,[12] and accordingly, the actual environmental impacts will necessarily depend upon the compliance strategy selected by the dischargers. In preparing this environmental analysis, the San Diego Water Board has considered the pertinent requirements of state law,[13] and intends this analysis to serve as a tier 1 environmental review.

Any potential environmental impacts associated with the TMDLs depend upon the specific compliance projects selected by the dischargers, most of whom are public agencies subject to their own CEQA obligations. If not properly implemented or mitigated at the project level, there could be adverse environmental impacts from implementing the Chollas Creek metals TMDLs. The substitute CEQA documents identify broad mitigation approaches that could be considered at the project level. Consistent with the CEQA, the substitute documents do not engage in speculation or conjecture, but rather consider the reasonably foreseeable environmental impacts of the reasonably foreseeable methods of compliance, the reasonably foreseeable mitigation measures, and the reasonably foreseeable alternative means of compliance, which would avoid, eliminate, or reduce the identified impacts.

2 Description of the Proposed Activity

The Basin Plan designates beneficial uses of waterbodies, establishes water quality objectives for the protection of these beneficial uses, and outlines a plan of implementation for maintaining and enhancing water quality. The proposed amendment would incorporate into the Basin Plan TMDLs for copper, lead, and zinc in the Chollas Creek Watershed.

Two beneficial uses exist in Chollas Creek that are sensitive to, and subject to impairment by elevated concentrations of dissolved metals in the water column. Warm Freshwater Habitat (WARM) and Wildlife Habitat (WILD) require water quality suitable for the protection of aquatic life and aquatic dependent wildlife. The water quality in Chollas Creek does not support the WARM and WILD beneficial uses of the creek because of elevated levels of dissolved copper, lead, and zinc.

[10] Public Resources Code section 21159(d)
[11] Public Resources Code section 21159.2
[12] Water Code section 13360
[13] Public Resources Code section 21159 and 14 CCR section 15187

The San Diego Water Board's goal in adopting the TMDLs is to eliminate the water quality problems caused by copper, lead, and zinc in Chollas Creek. Dissolved copper, lead, and zinc can inhibit the growth of aquatic vegetation, decreasing spawning areas and habitats for fish and other living organisms. Wildlife living in rivers and in riparian areas can be harmed by ingesting or coming into contact with dissolved copper, lead, and zinc. The adoption of a TMDL is not discretionary; rather, it is compelled by section 303(d) of the federal Clean Water Act.

The TMDLs for copper lead and zinc, and their derivation are discussed in the Technical Report, section 6. The TMDLs will be implemented primarily through regulation of urban runoff with waste discharge requirements (WDRs) that implement federal National Pollutant Discharge Elimination System (NPDES) regulations. The primary dischargers are municipalities located in the Chollas Creek watershed, the California Department of Transportation (Caltrans), and the U.S. Navy Dischargers will receive wasteload allocations that can be met over a phased compliance schedule that should result in attainment of water quality standards. The wasteload allocations and their derivation are discussed in the Technical Report, section 8. The Implementation Plan and compliance schedule are discussed in the Technical Report, section 11.

2.1 Surrounding Land Uses and Setting

Chollas Creek is a highly urbanized watershed. Flow in Chollas Creek is highly variable with the highest flow rates associated with storm events. During the summer, the creek has only standing pools of water with no surface flow for extended periods of time. Much of the creek has been channelized and concrete lined, but some sections of natural creek bed remain. Many plant communities within Chollas Creek have been replaced by non-native and/or invasive species (such as *Arundo donax*). These types of plants can produce habitats that are much less desirable than the native plant species with regard not only to providing a structure to hide or perch, but also as a food source. Non-native and/ or invasive species also may grow so abundantly that they reduce the capacity of the stream channel, which may lead to more frequent or more severe flooding. Neither the surface water nor groundwater resources in the watershed are used for municipal or domestic drinking water supplies. In fact, the San Diego Water Board has exempted the groundwater from the MUN beneficial use designation under the terms and conditions of the State Water Board's *Sources of Drinking Water Policy*.[14] The predominant land use in the watershed is residential, followed by open space, industrial, commercial/institutional and roadways land uses. More information on the watershed characteristics is found in the Technical Report, section 3.2.

3 Analysis of Reasonably Foreseeable Methods of Compliance

The analysis of potential environmental impacts is based on the numerous alternative methods of compliance available for controlling copper, lead, and zinc loading in Chollas Creek. The majority of metals discharged into the Chollas Creek watershed result from stormwater runoff of metals from freeway surfaces and commercial/industrial land uses. Attainment of the WLAs will be achieved through discharger implementation of

[14] State Water Board Resolution No. 88-63

structural and nonstructural control strategies designed to reduce metals loading in urban runoff. Structural and non-structural control strategies can be based on specific land uses, sources, or periods of a storm event, and are described in general below. Nonstructural BMPs are generally designed to control or eliminate the sources of pollutants to a watershed. Structural BMPs include source control as well as treatment control BMPs designed to remove pollutants from runoff. In order to comply with these TMDLs, emphasis should be placed on BMPs that control the sources of pollutants and on the maintenance of BMPs that remove pollutants from runoff. Some examples of BMPs that may be implemented by the dischargers to meet the WLAs are described below. These examples are general, (not specific to metals treatment and not specific to Chollas Creek), and are not meant to be exhaustive of the suitable suit of appropriate BMPs.

The City of San Diego, in its comments, suggested that large areas of private property would need to be condemned and demolished in order to build large detention basins and treatment works as a BMP option. This BMP option was not considered in the analysis because significantly cheaper and smaller BMPs are available to meet the WLAs of these TMDLs.

Nonstructural Controls

1. **Education and Outreach**: Conduct education and outreach to residents and businesses to discourage over-watering. Conduct education and outreach to residents, businesses, and municipal fleets to encourage vehicle and equipment practices that minimize the potential for contamination of stormwater runoff.

2. **Road and Street Maintenance**: Increase the frequency of street sweeping to maintain clean sidewalks, streets, and gutters. Street sweeping reduces non-point source pollution by five to 30 percent when a conventional mechanical broom and vacuum-assisted wet sweeper is used. The USEPA reported that the new vacuum assisted dry sweepers can achieve a 50 to 88 percent overall reduction in the annual sediment loading for a residential street, depending on sweeping frequency. A reduction in sediment load may lead to a reduction in metals being carried to the MS4, and ultimately to Chollas Creek, since sediment, or road dust, has been found to adsorb metals (Birch and Scollen, 2003). Researchers have found that the metals concentrations in road dust increases with traffic volume. High traffic areas should be given a priority when scheduling street sweepings.

3. **Illicit Discharges**: Identify and eliminate illicit discharges to the storm drain system.

4. **Inspections**: Conduct inspections of commercial and industrial facilities for compliance with local ordinances and permits, as well as copper, lead, and zinc load reductions required under these TMDLs. Conduct inspections of treatment control BMPs to ensure their adequacy of design and proper function.

5. **Development/Enforcement of Local Ordinances**: Develop and enforce municipal ordinances prohibiting exposure of copper, lead, and zinc materials to stormwater and stormwater drainage pathways, or eliminating dry weather nuisance flows.

Structural Controls

1. **Vegetated Swales and Buffer Strips**: Construct and maintain vegetative buffer strips along roadsides and in medians to slow runoff velocities and increase stormwater infiltration. Replace curbs with vegetated swales to allow highway and road runoff to be filtered through vegetated shoulders and medians. Eliminate constructed curbs to increase infiltration to ground water.

2. **Bioretention**: Construct and maintain bioretention BMPs to provide on-site removal of metals from storm water runoff through landscaping features. Field and laboratory analysis of bio-retention facilities shows high removal rates of copper (43 to 97 percent), lead (70 to 95 percent), and zinc (64 to 95 percent).

3. **Detention Basins**: Construct and maintain detention basins designed to capture and treat stormwater runoff.

4. **Retention Ponds**: Construct and maintain retention/irrigation ponds to capture stormwater runoff for later irrigation of landscape.

5. **Sand Filters:** Install and maintain sand filters, in some instances including pumps, which are effective for pollutant removal from stormwater. Sand filters may be a good option in densely developed urban areas with little pervious surface since the filters occupy minimal space.

6. **Diversion Systems**: Install diversion systems to capture non-stormwater runoff. During low flow conditions, runoff may be diverted from storm drain outlets to an on-site treatment system and released back to the creek, or it may be diverted to wastewater collection plants for treatment.

7. **Porous Pavement**: Install and maintain pavement systems that allow storm water to infiltrate into ground water, and come into contact with biological systems in the soil. Storm water coming into contact with soil as overland flow can benefit from metals reductions.

8. **Infiltration Systems**: Install and maintain pavement systems that allow storm water to infiltrate into ground water, and come into contact with biological systems in the soil. Storm water coming into contact with soil as groundwater can benefit from metals reductions.

4 Environmental Checklist

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
1.	**Earth. Will the proposal result in:**				
	a. Unstable earth conditions or in changes in geologic substructures?		X		
	b. Disruptions, displacements, compaction or overcoming of the soil?			X	
	c. Change in topography or ground surface relief features?		X		
	d. The destruction, covering or modification of any unique geologic or physical features?				X
	e. Any increase in wind or water erosion of soils, either on or off the site?			X	
	f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?			X	
	g. Exposure of people or property to geologic hazards, such as earthquakes, landslides, mudslides, ground failure, or similar hazards?		X		
2.	**Air. Will the proposal result in:**				
	a. Substantial air emissions or deterioration of ambient air quality?		X		
	b. The creation of objectionable odors?		X		
	c. Alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally?				X

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
3.	**Water. Will the proposal result in:**				
	a. Changes in currents, or the course of direction or water movements, in either marine or fresh waters?			X	
	b. Changes in absorption rates, drainage patterns, or the rate and amount of surface water runoff?			X	
	c. Alterations to the course of flow of flood waters?		X		
	d. Change in the amount of surface water in any water body?		X		
	e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen, or turbidity?			X	
	f. Alteration of the direction or rate of flow of ground waters?		X		
	g. Change in the quantity or quality of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?		X		
	h. Substantial reduction in the amount of water otherwise available for public water supplies?				X
	i. Exposure of people or property to water related hazards such as flooding or tidal waves?		X		
4.	**Plant Life. Will the proposal result in:**				
	a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, microflora and aquatic plants)?		X		
	b. Reduction of the numbers of any unique, rare or endangered species of plants?		X		

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
	c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?		X		
	d. Reduction in acreage of any agricultural crop?				X
	e. Toxic conditions that effect plant growth?		X		
5.	**Animal Life. Will the proposal result in:**				
	a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms, insects or microfauna)?		X		
	b. Reduction of the numbers of any unique, rare or endangered species of animals?		X		
	c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?		X		
	d. Deterioration to existing fish or wildlife habitat?		X		
6.	**Noise. Will the proposal result in:**				
	a. Increases in existing noise levels?		X		
	b. Exposure of people to severe noise levels?		X		
7.	**Light and Glare. Will the proposal:**				
	a. Produce new light or glare?		X		
8.	**Land Use. Will the proposal result in:**				
	a. Substantial alteration of the present or planned land use of an area?			X	
9.	**Natural Resources. Will the proposal result in:**				
	a. Increase in the rate of use of any natural resources?				X
	b. Substantial depletion of any nonrenewable natural resource?				X

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
10.	**Risk of Upset. Will the proposal involve:**				
	a. A risk of an explosion or the release of hazardous substances (including, but not limited to: oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?			X	
11.	**Population. Will the proposal:**				
	a. Alter the location, distribution, density, or growth rate of the human population of an area?			X	
12.	**Housing. Will the proposal:**				
	a. Affect existing housing, or create a demand for additional housing?			X	
13.	**Transportation/Circulation. Will the proposal result in:**				
	a. Generation of substantial additional vehicular movement?			X	
	b. Effects on existing parking facilities, or demand for new parking?		X		
	c. Substantial impact upon existing transportation systems?			X	
	d. Alterations to present patterns of circulation or movement of people and/or goods?			X	
	e. Alterations to waterborne, rail or air traffic?			X	
	f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?			X	
14.	**Public Service. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:**				
	a. Fire protection?			X	
	b. Police protection?			X	

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
	c. Schools?				X
	d. Parks or other recreational facilities?			X	
	e. Maintenance of public facilities, including roads?		X		
	f. Other governmental services?		X		
15.	**Energy. Will the proposal result in:**				
	a. Use of substantial amounts of fuel or energy?				X
	b. Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?				X
16.	**Utilities and Service Systems. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:**				
	a. Power or natural gas?			X	
	b. Communications systems?				X
	c. Water?				X
	d. Sewer or septic tanks?			X	
	e. Storm water drainage?			X	
	f. Solid waste and disposal?				X
17.	**Human Health. Will the proposal result in:**				
	a. Creation of, and exposure of people to, any health hazard or potential health hazard (excluding mental health)?		X		
18.	**Aesthetics. Will the proposal result in:**				
	a. The obstruction of any scenic vista or view open to the public?		X		

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
	b. The creation of an aesthetically offensive site open to public view?		X		
19.	**Recreation. Will the proposal result in:**				
	a. Impact upon the quality or quantity of existing recreational opportunities?		X		
20.	**Archeological/Historical. Will the proposal:**				
	a. Result in the alteration of a significant archeological or historical site, structure, object or building?		X		
21.	**Mandatory Findings of Significance**				
	Potential to degrade: Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?		X		
	Short-term: Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time, while long-term impacts will endure well into the future.)				X
	Cumulative: Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)		X		
	Substantial adverse: Does the project have environmental effects which will cause		X		

	ENVIRONMENTAL CHECKLIST	Potentially Significant Impact	Less Than Significant with Mitigation	Less Than Significant	No Impact
	substantial adverse effects on human beings, either directly or indirectly?				

5 Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures

As stated previously, the environmental analysis must include an analysis of the reasonably foreseeable environmental impacts of the methods of compliance and the reasonably foreseeable feasible mitigation measures relating to those impacts. This section, consisting of answers to the questions in the checklist, discusses compliance methods and mitigation measures as they pertain to the checklist.

In formulating these answers, the impacts of implementing in the Chollas Creek watershed the non-structural and structural BMPs listed in section 3 were evaluated. At this time, the exact type, size, and location of BMPs that might be implemented to comply with the TMDLs is unknown. This analysis considers a range of non-structural and structural BMPs that might be used, but is by no means an exhaustive list of available BMPs. When BMPs are selected for implementation, a project-level and site-specific CEQA analysis must be performed by the responsible agency.

Potential reasonably foreseeable impacts were evaluated with respect to earth, air, water, plant life, animal life, noise, light, land use, natural resources, risk of upset, population, housing, transportation, public services, energy, utilities and services systems, human health, aesthetics, recreation, and archeological/historical concerns. Additionally, mandatory finding of significance regarding short-term, long-term, cumulative and substantial impacts were evaluated. Based on this review, we concluded that the potentially significant impacts can be mitigated to less than significant levels. The evaluation considered whether the construction or implementation of the BMPs would cause a substantial, adverse change in any of the physical conditions within the area affected by the BMP. In addition, the evaluation considered environmental effects in proportion to their severity and probability of occurrence.

A significant effect on the environment is defined in regulation as "*a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance. A social or economic change by itself shall not be considered a significant effect on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant.*"[15]

[15] 14 CCR section 15382

A significant effect on the environment is defined in statute as "*a substantial, or potentially substantial, adverse change in the environment*" where "*Environment*" is defined by Public Resources Code section 21060.5 as "*the physical conditions which exist within the area which will be affected by a proposed project, including air, water, minerals, flora, fauna, noise, objects of historic or aesthetic significance*."[16]

In this analysis, the level of significance was based on baseline conditions (i.e., current conditions). Short-term impacts associated with the construction of structural BMPs were considered less than significant because the impacts due to construction activities are temporary and similar to typical capital improvement projects and maintenance activities currently performed by municipalities. The long-term impacts associated with structural BMPs were considered potentially significant, but only if they could have an adverse, or potentially adverse, impact on the environment.

Social or economic changes related to a physical change of the environment were also considered in determining whether there would be a significant effect on the environment. However, adverse social and economic impacts alone are not significant effects on the environment.

1. Earth. a. Will the proposal result in unstable earth conditions or in changes in geologic substructure?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs would not create unstable earth conditions or changes in geologic substructure because none of these BMPs include earth moving activities.

For structural BMPs, infiltration of collected stormwater could potentially result in unstable earth conditions if loose or compressible soils are present, or if such BMPs were to be located where infiltrated stormwater flowing as groundwater could destabilize existing slopes. These impacts can be avoided by siting infiltration type BMPs away from areas with loose or compressible soils, and away from slopes that could become destabilized by an increase in groundwater flow. Infiltration type BMPs can also be built on a small enough scale to avoid these types of impacts. In the unlikely event that municipalities might install facilities on a scale that could result in unstable earth conditions or in changes in geologic substructures, potential impacts could be avoided through proper geotechnical investigations, siting, design, and ground and groundwater level monitoring to ensure that structural BMPs are not employed in areas subject to unstable soil conditions.

[16] Public Resources Code section 21068

1. Earth. b. Will the proposal result in disruptions, displacements, compaction or overcoming of the soil?

Answer: Less than significant

Discussion: Non-structural BMPs would not result in disruptions, displacements, compaction or overcoming of the soil because none of these BMPs include earth moving activities.

Depending on the structural BMPs selected, the proposal may result in minor surface soil excavation or grading during construction of structural BMPs resulting in increased disturbance of the soil. However, most of the relevant areas are already urbanized, and have already suffered soil compaction and hardscaping. Standard construction techniques, including but not limited to, shoring, piling and soil stabilization can mitigate any potential short-term impacts. In addition, structural BMPs can be designed and sited in areas where the risk of new soil disruption is minimal. Soil disruptions, displacements, compaction or overcoming during construction activities would be similar to typical temporary capital improvement construction and maintenance activities currently performed by municipalities, and no long-term impacts to the soil are expected.

1. Earth. c. Will the proposal result in change in topography or ground surface relief features?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs would not affect topography or ground relief features because none of the non-structural BMPs would result in earth moving activities.

Implementation of structural BMPs could result in some change in topography or ground surface relief features, however, most of the potential BMPs are so small that changes to topography will not be noticeable. If the municipalities implement BMPs on a scale large enough to change topography or ground relief features, then potential adverse impacts could be avoided or mitigated through siting such topographic alterations in geologically stable areas, or by installing or designing structural BMPs with the least amount of impact to the topography. Additionally, any structural BMPs can, if necessary, be constructed underground to minimize topographic or ground surface relief issues.

1. **Earth d.** Will the proposal result in the destruction, covering or modification of any unique geologic or physical features?

   Answer: No impact

Discussion: Non-structural BMPs would not cause the destruction, covering or modification of any unique geologic or physical features because none of these BMPs would result in earth moving activities.

Complying with these TMDLs using structural BMPs in areas where doing so would result in the destruction, covering or modification of a unique geologic or physical features is not a reasonably foreseeable alternative that responsible agencies would choose. Furthermore, no impact is expected because foreseeable methods of compliance, including implementation of structural BMPs to control metals, would not be of the size or scale to result in the destruction, covering or modification of any unique geologic or physical features. In the unlikely event that municipalities might install facilities on a scale that could result in the destruction, covering or modification of any unique geologic or physical features, potential impacts could be mitigated by mapping these features to avoid siting facilities in these areas. Additionally, any structural BMPs can, if necessary, be constructed underground to minimize destruction, covering or modification of any unique geologic or physical features.

1. **Earth. e.** Will the proposal result in any increase in wind or water erosion of soils, either on or off the site?

   Answer: Less than significant

Discussion: Non-structural BMPs would not result in increase in wind or water erosion of soils, either on or off site because none of the non-structural BMPs would result in increased storm water discharge to the MS4 system, or in exposing soils to erosion by wind and water.

Depending on the structural BMPs selected, the proposal may result in minor soil excavation during construction of structural BMPs. However, construction related erosion impacts will cease with the cessation of construction. Wind or water erosion of soils may occur as a potential short-term impact. On site soil erosion during construction activities will be similar to typical temporary capital improvement projects and maintenance activities currently performed by the municipalities. Typical established best management practices should be used during implementation to minimize offsite sediment runoff or deposition. Construction sites are required to retain sediments on site, both under general construction stormwater WDRs and through the construction program of the applicable MS4 WDRs; both of which are already designed to minimize or eliminate erosion impacts on receiving water. Over the long term, off-site erosion of canyons and natural channels could potentially be reduced if the structural BMPs divert stormwater from entering the canyons and channels, or reduce the runoff flow velocity, which may be considered a beneficial impact.

1. Earth. f. Will the proposal result in changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?

Answer: Less than significant

Discussion: No impact to beach sands is expected because no downstream beaches exist at the mouth of Chollas Creek. Chollas Creek empties into San Diego Bay between two deep water industrial facilities. These facilities maintain a dredging schedule as part of their ship birthing operations.

Non-structural BMPs would not result in erosion of beach sands, or increases in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake; however, non-structural BMPs, such as increased street sweeping, may reduce siltation and sediment deposition in canyons and natural channels. Reduction in siltation and sediment deposition in the creek is beneficial as fine sediments may contain toxic pollutants.

Depending on the structural BMPs selected, the proposal may result in a reduction of siltation or sediment deposition in the Chollas Creek channels. This may result because certain BMPs, such as detention basins, may change the time and volume of stormwater released to the creek. Reduction in siltation and sediment deposition in the creek is beneficial as fine sediments may contain toxic pollutants.

Little or no impact is expected for creek bed erosion, since the flow rate in the creek is not expected to increase using foreseeable methods of compliance and much of the creek channel is concrete lined.

BMPs that reduce or eliminate dry weather flows are not expected to impact Chollas Creek because of the small flow volumes involved. Additionally, a potential reduction of pollutant laden silt is considered a benefit.

1. Earth. g. Will the proposal result in exposure of people or property to geologic hazards, such as earthquakes, landslides, mudslides, ground failure, or similar hazards?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs would not result in exposure of people or property to geologic hazards because none of these BMPs would result in earth moving activities.

For structural BMPs, infiltration of collected stormwater could possibly result in ground failure if loose or compressible soils are present, or if such BMPs were to be located where introduced groundwater movements could destabilize existing slopes. This may result in landslides, mudslides, ground failure, or similar hazards. However, complying with these TMDLs using structural BMPs in areas where doing so, or of a size or scale that would result in exposure of people or property to such geologic hazards is unlikely when other alternatives exist. In the unlikely event that municipalities might install facilities on a scale that could result in exposure of people or property to geologic hazards, a geotechnical investigation should be prepared at the project level to ensure that structural BMPs are not employed in areas subject to potential geologic hazards.

2. Air. a. Will the proposal result in substantial air emissions or deterioration of ambient air quality?

Answer: Less than significant with mitigation

Discussion: Short term increases in traffic during the construction and installation of structural BMPs and long-term increases in traffic caused by non-structural BMPs and maintenance of structural BMPs are potential sources of air emissions that may adversely affect ambient air quality. Several mitigation measures are available to reduce potential impacts to ambient air quality due to increased traffic during short-term construction and long-term maintenance activities. Mitigation measures could include, but are not limited to, the following: 1) use of construction, maintenance, and street sweeper vehicles with lower-emission engines, 2) use of soot reduction traps or diesel particulate filters, 3) use of emulsified diesel fuel, 4) use of vacuum-assisted street sweepers to eliminate potential re-suspension of sediments during sweeping activity, 5) the design of structural devices to minimize the frequency of maintenance trips, and/or 6) proper maintanance of vehicles so they operate cleanly and efficiently.

The generation of fugitive dust and particulate matter during construction or maintenance activities could also impact ambient air quality. An operations plan for the specific construction and/or maintenance activities could be completed to address the variety of available measures to limit the ambient air quality impacts. These could include vapor barriers and moisture control to reduce transfer of particulates and dust to air.

The emission of air pollutants during short-term construction activities associated with reasonably foreseeable methods of compliance would not likely change ambient air conditions, because long-term ambient air quality would not change after short-term construction activities are completed.

Ambient air quality may change as a result of increased traffic due to an increase in street sweeping and/or structural BMP maintenance activities. However, the impact to ambient air quality can be reduced by using the mitigation measures described above for street sweepers and maintenance vehicles. The potential impact to ambient air quality can be further reduced if street sweeping and/or maintenance activities are scheduled to be performed at the same time as other maintenance activities performed by the municipalities, or at times when these activities have lower impact, such as periods of low traffic activity. In any case, the number of additional vehicles expected in the watershed due to non-structural and structural BMPs is not expected to increase the level of pollutants in the air compared to current conditions, because various common managerial practices are available to mitigate the adverse effects. In fact, additional street sweeping could potentially reduce the amount of dust and particulates that may be available on the streets.

2. Air. b. Will the proposal result in creation of objectionable odors?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs could result in the creation of objectionable odors caused by exhaust from street sweepers or maintenance vehicles. Objectionable odors due to engine exhaust would be temporary and dissipate once the vehicle has passed through the area. Objectionable odors from exhaust could be reduced if gasoline or propane engines were used instead of diesel engines. Additionally, street sweepers and maintenance vehicles could be scheduled to be performed at the same time as other maintenance activities performed by the municipalities, or at times when these activities have lower impact, such as periods when there are fewer people in the area.

Construction and installation of structural BMPs may result in objectionable odors in the short-term due to exhaust from construction equipment and vehicles, but no more so than during typical infrastructure construction and maintenance activities currently performed by the municipalities. However, structural BMPs may be a source of objectionable odors if BMP designs allow for water stagnation or collection of water with sulfur-containing compounds. Stormwater runoff is not likely to contain sulfur-containing compounds, but stagnant water could create objectionable odors. Mitigation measures to eliminate odors caused by stagnation could include proper BMP design to eliminate standing water, covers, aeration, filters, barriers, and/or odor suppressing chemical additives. Structural BMPs should be inspected regularly to ensure that treatment devices are not clogged, pooling water, or odorous. During maintenance, odorous sources should be uncovered for as short of a time period as possible. Structural BMPs should be designed to minimize stagnation of water and installed in such a way so as to increase the distance to sensitive receptors in the event of any stagnation.

2. Air. c. Will the proposal result in alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally?

Answer: No impact

Discussion: Non-structural and/or structural BMPs would not be of the size or scale to result in alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally.

3. Water. a. Will the proposal result in changes in currents, or the course of direction or water movements, in either marine or fresh waters?

Answer: Less than significant

Discussion: Most non-structural BMPs will not cause changes in currents, or the course of direction or water movements, in either marine or fresh waters because most of these BMPs would not introduce any physical effects that could impact these characteristics. Reduction of dry weather nuisance flows is the only foreseeable non-structural BMP that could have a physical impact in Chollas. However, any reduction of dry weather flows would bring Chollas Creek to a more natural, pre-development condition with respect to currents, which is beneficial to the environment, as discussed in the answer to question 4a.

Structural BMPs may change the currents in Chollas Creek. However, streamflow in the lower watershed is highly channelized, therefore none of the reasonably foreseeable structural BMPs would alter the direction or slope of the stream channels in the lower watershed. The roughness coefficient may be reduced as sediment is kept out of the channels, which could increase the flow rate in the channel but would not change the direction of flow. The increase in flow rate in the channels could be offset by the reduction of peak flow, as a result of the installation of structural BMPs such as detention basins, porous pavement, sand filters or infiltration basins. Overland flow in the urbanized portion of the watershed is directed primarily to storm drains. This overland flow may change depending on the structural BMPs installed such as porous pavement or infiltration basins. If stormwater runoff flow is reduced, or is diverted to wastewater treatment plants, these changes would reduce the potential for erosion, which is beneficial to the environment. Unchannelized portions of Chollas Creek could also be subject to a reduction of peak flow resulting in a reduction of channel scour. This would return Chollas Creek to a more natural, pre-development condition with respect to currents or the course of direction or water movements, which is beneficial to the environment.

3. Water. b. Will the proposal result in changes in absorption rates, drainage patterns, or the rate and amount of surface water runoff?

Answer: Less than significant

Discussion: Non-structural BMPs would not result in changes in absorption rates, drainage patterns, or the rate and amount of surface water runoff because none of these BMPs would introduce any physical effects that could impact these characteristics.

Depending on the structural BMPs selected, absorption rates, drainage patterns, and surface water runoff may change. Grading and excavation during construction and installation of structural BMPs could result in alterations in absorption rates, drainage patterns, and surface water runoff. However this is less than significant because these effects will not persist after construction has ceased. Several types of structural BMPs collect and/or inhibit stormwater runoff flow, which would likely alter drainage patterns and surface runoff. For example, structural BMPs such as buffer strips would change drainage patterns by increasing absorption rates, which would reduce the amount of surface runoff. If stormwater runoff is diverted to wastewater treatment facilities, drainage patterns would be altered and surface runoff to the canyons would be reduced. If stormwater is diverted to wastewater treatment facilities, thereby reducing the overall flow, the erosion and scour that would normally be caused in the canyons by stormwater runoff would be reduced. The amount of flow within the stream channel may change, however, the channelized drainage pattern would remain essentially unchanged.

In general, reducing stormwater runoff due to non-structural and structural BMPs would be beneficial to the environment because peak flows would be attenuated, reducing erosion and channel scour. Reduction in the amount of water in the stream channel may affect the ecology of the stream, however, all of these affects can be mitigated to less than significant levels as discussed below in the answers to questions 4 and 5 on Plant Life and Animal Life.

3. Water. c. Will the proposal result in alterations to the course of flow of flood waters?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs are unlikely to alter the course of flow of flood waters because none of the BMPs would introduce any physical effects that could impact these characteristics.

The course of flow of flood waters may change depending on the structural BMPs selected. Structural BMPs, such as sand filters, could reduce a storm drain's ability to convey flood waters. This can be mitigated through proper design (including flood water bypass systems), sizing, and maintenance of these types of structural BMPs. Other structural BMPs, such as sewer diversions, detention basins or infiltration basins, could alter the course of flood waters by diverting a portion of the flood waters. If these types of structural BMPs are used, then Chollas Creek flood waters would likely return to a more natural, pre-development condition with respect the volume of flood waters in the channel, which is beneficial to the environment.

3. Water. d. Will the proposal result in change in the amount of surface water in any water body?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs such as ordinances that prohibit nuisance flows would result in a reduction in the amount of dry weather surface water in Chollas Creek. This would decrease the water which is available to in-channel wetlands. However, dry weather wetlands did not exist in Chollas Creek under predevelopment conditions. Today’s dry weather wetlands in Chollas Creek are not high value wetlands because of the predominance of *Arundo donax*, and invasive plant species. Reduction of nuisance flows would return Chollas Creek to predevelopment conditions, i.e., a seasonal, ephemeral stream which does no support dry season wetlands. Therefore, this impact is not significant.
Depending on the structural BMPs selected, stormwater runoff may be retained and/or diverted for groundwater infiltration and/or to wastewater treatment facilities. Water that is retained or diverted would not flow into the canyons and the Chollas Creek stream channel. Because the surface water runoff to the canyons would be reduced, the adverse effects of channel scour and erosion of the canyons would also be reduced. Reduction in the amount of water in the stream channel may affect the ecology of the stream, however, all of these affects can be mitigated to less than significant levels as discussed below in the answers to questions 4 and 5 on Plant Life and Animal Life.

3. Water. e. Will the proposal result in discharge to surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen, or turbidity?

Answer: Less than significant

Discussion: Non-structural and/or structural BMPs would not result in any additional discharge to surface waters. Depending on the structural BMPs selected, the current amount of runoff discharged to surface waters may actually be reduced if diverted for groundwater infiltration or to wastewater treatment facilities.

If non-structural and/or structural BMPs are implemented, the level of pollutants discharged to Chollas Creek would be reduced. The purpose of these TMDLs is to improve the surface water quality to meet water quality objectives and beneficial uses. When municipalities comply with these TMDLs, water quality will be improved, which is beneficial to the environment.

During wet weather discharges, certain structural BMPs (including detention basins, infiltration basins, and sand filters) would reduce turbidity and increase dissolved oxygen, because these BMPs would remove sediment and bioavailable oxygen demanding substances from the surface water. Reduced turbidity, and increased dissolved oxygen is beneficial to the environment.

A reduction of dry weather discharges (i.e., a cessation or reduction in nuisance flows) would result in a reduction of overall water in Chollas Creek during the dry season. This would result in a water temperature increase, and a decrease of dissolved oxygen in dry weather pools in Chollas Creek. Reduction in the amount of water in the stream channel may affect the ecology of the stream, however, all of these affects can be mitigated to less than significant levels as discussed below in the answers to questions 4 and 5 on Plant Life and Animal Life.

3. Water. f. Will the proposal result in alteration of the direction or rate of flow of groundwaters?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs would not result in alteration of the direction or rate of flow of groundwaters because none of the BMPs would introduce any physical effects that could impact these characteristics.

Over the long term, infiltration of stormwater runoff via infiltration type BMPs such as porous pavement, and infiltration trenches, could significantly alter the direction or rate of flow of groundwaters. This could result in unstable earth conditions if such BMPs were to be located where infiltrated stormwater flowing as groundwater could destabilize existing slopes. As discussed in the answer to question 1.a, these impacts can be avoided by siting infiltration type BMPs away from areas with loose or compressible soils, and away from slopes that could become destabilized by an increase in groundwater flow. Infiltration type BMPs can also be built on a small enough scale to avoid these types of impacts. In the unlikely event that municipalities might install facilities on a scale that could result in unstable earth conditions, potential impacts could be avoided through proper groundwater investigations, siting, design, and groundwater level monitoring to ensure that structural BMPs are not employed in areas where slopes could become destabilized.

3. Water. g. Change in the quantity or quality of groundwaters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not change the quantity or quality of groundwaters because none of these BMPs would introduce any physical effects that could impact these characteristics.

Infiltration type BMPs such as porous pavement and infiltration trenches may increase the quantity and degrade the quality of ground waters. The increase in quantity is unlikely to have any adverse effects since, under pre-development conditions, infiltration rates of stormwater runoff to groundwater were most likely much higher than they are today due to the absence of hardscapes. However, as discussed in question 3.f above, increased infiltration of stormwater near steep slopes, such as canyon walls, could potentially destabilize these slopes by saturating the soils making them more prone to sliding. Mitigation would include not siting large infiltration BMPs near canyon walls or other steep slopes.

Stormwater also contains dissolved pollutants such as nutrients, metals, pesticides, hydrocarbons, oil and grease. However, infiltration BMPs are not expected to degrade groundwater with respect to these pollutants for the following reasons.

Ambient nitrogen and phosphorus concentrations in groundwater are likely higher than nutrient concentrations in stormwater due to decades of over application of fertilizers on domestic and commercial landscapes and deep percolation of applied irrigation water. Nonetheless, if stormwater nutrient concentrations are higher than ambient concentrations in the groundwater, mitigation could include education and outreach to homes and business to better manage fertilizer use. Phytoremediation can also be used to remove nutrients from stormwater runoff.

Metals in stormwater runoff are not expected to degrade groundwater quality since metals tend to adsorb to clay and organic particles in the soil. Likewise, oil and grease would become bound up in the soil and remain nearer to the surface due to lower densities. Pesticides and hydrocarbons are not expected to degrade groundwater quality because natural bacteria in the soil and groundwater tend to break pesticides down.

3. Water. h. Will the proposal result in substantial reduction in the amount of water otherwise available for public water supplies?

Answer: No impact.

Discussion: Non-structural and/or structural BMPs would not result in substantial reduction in the amount of water otherwise available for public water supplies because the Chollas Creek watershed provides no public water supplies. None of the surface water or groundwater in the Chollas Creek watershed is used for public water supply In fact, the groundwater has no designated beneficial uses and has been exempted, along with the surface waters, by the San Diego Water Board from the MUN use designation under the terms and conditions of the State Water Board's *Sources of Drinking Water Policy*.[17]

3. Water. i. Will the proposal result in exposure of people or property to water related hazards such as flooding or tidal waves?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in exposure of people or property to water related hazards such as flooding or tidal waves because none of these BMPs would introduce any physical effects that could impact these characteristics.

Installation of structural BMPs that are not properly designed and constructed to allow for bypass of stormwater during storms that exceed design capacity can cause flooding. However, this potential impact can be mitigated through proper design and maintenance of structural BMPs. Any modifications to the watershed hydrology should be modeled and accounted for in the design of BMPs.

4. Plant Life. a. Will the proposal result in change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, microflora and aquatic plants)?

Answer: Less than significant with mitigation

Discussion: Most non-structural BMPs will not result in change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, microflora and aquatic plants) because most of these BMPs would not introduce any physical effects that could impact these characteristics. However, the creation and

[17] State Water Board Resolution No. 88-63.

enforcement of ordinances to eliminate nuisance flows could result in a change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, microflora and aquatic plants), especially in the dry weather season. However, this would return Chollas Creek's dry weather flows to a more natural, pre-development condition, returning the stream's plant community to a more natural, dry weather condition.

These flow reductions could lead to a reduction in total plant biomass along the Chollas Creek corridor. The reduced plant biomass could very well represent a significant decrease in the area of invasive and non-native plant species (such as *Arundo donax*) within the watershed. A reduction in invasive species is necessary before the native plant populations could be restored to pre-development conditions.

The decrease in flow may result in an increase in native plant species. Native plant species that previously thrived in the Chollas Creek corridor may naturally repopulate the areas that are currently occupied by invasive species. Increased diversity or area of native plant cover also could be accomplished through restoration/mitigation projects within the Chollas Creek corridor. Regardless of the method, the opportunity for restoration/enhancement of the stream corridor to pre-development conditions is realistic.

Conversely, a decrease in flow may decrease plant diversity by reducing the number of species that require a more constant water supply. However, these plant species are likely non-natives to Southern California and would not be present in the watershed absent the nuisance dry weather flows. Impeding the propagation of invasive species is not a negative impact.

During the wet weather season, the installation of structural BMPs such as vegetated swales, buffer strips, engineered (bioretention) wetlands, or retention ponds could increase the diversity or number of plant species by increasing available habitat, which is beneficial to the environment. However, during storm events, structural BMPs could also divert, reduce, and/or eliminate surface water runoff discharge, which may reduce the number and/or diversity of plant species within the canyons and stream channel, by modifying the hydrology of the creek, which could be adverse. This can be mitigated through proper project modeling, siting and design so that the resulting creek hydrology mimics natural conditions.

Construction activities could result in the elimination of plant cover in the construction zone. The number or diversity of plant species could be maintained by preserving them prior, during, and after the construction of structural BMPs, or by re-establishing and maintaining the plant communities post construction. Or, municipalities may choose to implement non-structural BMPs and/or structural BMPs that do not divert or reduce the surface water runoff that would be discharged to the canyons and stream channel.

Should a large impermeable detention basin be required, this could be constructed underground so as not to impact the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, microflora and aquatic plants).

4. Plant life. b. Will the proposal result in reduction of the numbers of any unique, rare or endangered species of plants?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in reduction of the numbers of any unique, rare, or endangered species of plants because these BMPs will not affect the habitat of any unique, rare, or endangered species of plants.

Depending on the structural BMPs selected, direct or indirect impacts to special-status plant species may occur. However, the installation of structural BMPs would likely be implemented in highly urbanized areas and would not likely result in a change or reduction in the number of unique, rare or endangered species of plants in the immediate area of the installation.

Mitigation measures could be implemented to ensure that potential impacts to unique, rare or endangered plant species are eliminated. When the specific projects are developed and sites identified, a focused protocol plant survey and/or a search of the California Natural Diversity Database should be performed to confirm that any potentially sensitive or special status plant species in the site area are properly identified and protected as necessary. If sensitive plant species occur on the project site, mitigation is required in accordance with the Endangered Species Act. Mitigation measures should be developed in consultation with the California Department of Fish and Game (CDFG) and the United States Fish and Wildlife Service (USFWS).

Responsible agencies should endeavor to avoid installing structural BMPs that could result in reduction of the numbers of unique, rare or endangered species of plants, and instead opt for non-structural BMPs and/or identify and install structural BMPs in areas that will not reduce the numbers o such plants.

Should an impermeable detention basin be required, this could be constructed underground so as not to result in reduction of the numbers of any unique, rare or endangered species of plants.

4. Plant life. c. Will the proposal result in introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?

Answer: Less than significant with mitigation

Discussion: Most non-structural BMPs will not result in introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species because most of the BMPs would not introduce any physical effects that could impact these characteristics. However, the creation and enforcement of ordinances to eliminate nuisance flows could result in the introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species especially in the dry weather season. However, this would cause Chollas Creek's dry weather flows to return to a more natural, pre-development condition, facilitating a return to a more natural, dry weather habitat. As discussed in the answer to question 4.a., impeding the propagation of invasive species is not a negative impact.

For structural BMPs that may include the use of plants, such as vegetated swales or engineered (bioretention) wetlands, new species of plants may possibly be introduced into the area. However, in cases where plants or landscaping is incorporated into the specific project design, the possibility of disruption of resident native species could be avoided or minimized by using only plants native to the area. The use of exotic invasive species or other plants listed in the Exotic Pest Plant of Greatest Ecological Concern in California (1999, California Invasive Plant Council, as amended) should be prohibited.

4. Plant life. d. Will the proposal result in reduction in acreage of any agricultural crop?

Answer: No impact

Discussion: Non-structural and/or structural BMPs will not result in reduction in acreage of any agricultural crop. Based on the California Department of Conservation Division of Land Resources Protection Farmland Mapping and Monitoring Program Important Farmland in California, 2002, there is no Prime Farmland, Farmland of Statewide Importance, Unique Farmland or Farmland of Local Importance in the Chollas Creek watershed. Structural BMPs are not expected to be placed in any area currently engaged in crop production. If structural BMPs are installed, they would likely be located in already highly urbanized areas and would not impact the acreage of any agricultural crop.

4. Plant life. e. Will the proposal result in toxic conditions that effect plant growth?

Answer: Less than significant impact with mitigation.

Discussion: Non-structural BMPs will not result in toxic conditions that effect plant growth because non of the BMP would include physical effects that could lead to the accumulation of toxicity.

Structural BMPs such as infiltration basins may accumulate metal to level that are toxic to certain plants. Metals that are removed by infiltration BMPs typically are retained in the upper 2 to 5 inches of soil or sediment. Typically, metals levels returned to background levels or non-detectable levels below about 5 inches depth.

There is a potential (given enough time) that metals may accumulate in the upper 2 to 5 inches of soil to levels that might be toxic to plants. The mitigation measures could include replanting with metals resistant plants, or covering with gravel or cobblestones, or covering with compost as a mulch. The added benefit that compost might have is a higher affinity to bind with metals (due to its high organic content), and that placement of compost on the soil surface will capture the metals before they bind with the soil As metals concentrations build, the mulch could be removed and replaced. Other options for minimizing exposure to soil could include putting the infiltration BMP underground or indoors, and/or restricting access. Finally, the metals-laden, top 2 to 5 inches of soil could be removed, disposed of and replaced.

5. Animal Life. a. Will the proposal result in change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms, insects or microfauna)?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs, such as the creation and enforcement of ordinances to eliminate nuisance flows, could result in change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms, insects or microfauna) due to a reduction of dry weather flows that could eliminate instream habitats dependant on those flows. However, this would return Chollas Creek's dry weather flows to a more natural, pre-development condition, facilitating a return to a more natural, dry weather habitat, as discussed in the answer to question 4.a.

Stream riffle and run habitat would decrease in duration during dry weather conditions, thereby limiting aquatic-dependent species to pools during that time period. While migration of aquatic species would be limited during dry weather, migration would be possible during wet weather flows. Furthermore, aquatic species that would naturally occur in Chollas Creek would not have a life cycle that would be dependent upon riffle and run habitat during dry weather since none existed under pre-development conditions. Note that Chollas Creek is not considered potential habitat for species that may require a comparatively higher volume of flow for migration upstream, which is required for species such as Steelhead Trout. Therefore, such consideration is not necessary.

The installation of structural BMPs such as vegetated swales, buffer strips, engineered (bioretention) wetlands, or retention ponds could increase the diversity or number of animal species, which is beneficial by creating habitat for those species. However, these types of structural BMPs could also increase the likelihood of vectors and pests. For example, constructed basins and vegetated swales may develop locations of pooled standing water that would increase the likelihood of mosquito breeding. Mitigation includes the prevention of standing water through the construction and maintenance of appropriate drainage slopes and through the use of aeration pumps.[18] Mitigation for vectors and pests should involve the use of appropriate vector and pest control strategies, maintenance, and frequent inspections.

Installation of non-vector producing structural BMPs can help mitigate vector production from standing water. Netting can be installed over structural BMPs to further mitigate vector production. Structural BMPs can be designed and sites can be properly protected to prevent accidental vector production. Vector control agencies may also be employed as another source of mitigation. Structural BMPs prone to standing water can be selectively installed away from high-density areas and away from residential housing and/or by requiring oversight and treatment of those systems by vector control agencies.

Structural BMPs could also divert, or reduce stormwater runoff discharge, which could decrease the number and/or diversity of animal species within the canyons and stream channel by eliminating habitat dependant on those flows. Because the Chollas Creek watershed is heavily developed with significant areas of impermeable surfaces, stormflow generated streamflow in Chollas Creek is very likely higher today than under pre-development conditions. Therefore, native communities of animals and the habitats they depend upon likely can thrive under lower streamflow conditions than what currently exist in Chollas Creek. Hydrologic modeling could be used to estimate the rate and volume of pre-development stormwater runoff to, and flow in Chollas Creek. Using this information, BMPs could be selected and sized to not reduce streamflows in Chollas Creek below pre-development levels. BMPs that completely eliminate stormwater runoff are not reasonably foreseeable because of their cost and the availability of other feasible and less costly alternatives. Furthermore, the removal of toxic metals from Chollas Creek water will increase the number and/or diversity of benthic organisms, insects or microfauna in the sediment in the stream channel.

The current number or diversity of animal species could be maintained by minimizing the size of structural BMPs and limiting the encroachment and/or removal of animal habitat. Additionally, municipalities may choose to implement non-structural BMPs and/or structural BMPs that do not divert or reduce the stormwater runoff that would be discharged to the canyons and stream channel. Additionally, should an impermeable detention basin be required, it could be constructed underground so as not remove habitat leading to a change in the diversity of species, or numbers of any

[18] http://www.cabmphandbooks.com/Muncipal.asp

species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms, insects or microfauna).

5. Animal Life. b. Will the proposal result in reduction of the numbers of any unique, rare or endangered species of animals?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in reduction of the numbers of unique, rare or endangered species of animals because these BMPs will not cause a reduction in habitat for unique, rare, or endangered animals.

Depending on the structural BMPs selected, direct or indirect impacts to special-status animal species may possibly occur. The installation of structural BMPs would likely be implemented in highly urbanized areas, which are not likely to be inhabited by special-status species. However, there is the possibility for special-status species (such as the gnat catcher) to be present. If special status species are present during activities such as, ground disturbance, construction, operation and maintenance activities associated with the potential projects, it could conceivably result in direct impacts to special status species including the following:

- Direct loss of a special status species
- Increased human disturbance in previously undisturbed habitats
- Mortality by construction or other human-related activity
- Impairing essential behavioral activities, such as breeding, feeding or shelter/refuge
- Destruction or abandonment of active nest(s)/den sites
- Direct loss of occupied habitat

In addition, potential indirect impacts may include but are not limited to, the following:

- Displacement of wildlife by construction activities
- Disturbance in essential behavioral activities due to an increase in ambient noise levels and/or artificial light from outdoor lighting around facilities

Mitigation measures, however, could be implemented to ensure that special status animals are not negatively impacted, nor their habitats diminished. For example, when the specific projects are developed and sites identified, a focus protocol animal survey and/or a search of the California Natural Diversity Database should be performed to confirm that any potentially special-status animal species in the site area are properly identified and protected as necessary.

If special-status animal species are potentially near the project site area, as required by the Endangered Species Act (ESA), two weeks prior to grading or the construction of facilities and per applicable USFWS and/or CDFG protocols, pre-construction surveys to determine the presence or absence of special-status species should be conducted. The surveys should extend an appropriate distance (buffer area) off site in accordance with USFWS and/or CDFG protocols to determine the presence or absence of any special-status species adjacent to the project site. If special-status species are present on the project site or within the buffer area, mitigation would be required under the ESA. To this extent, mitigation measures shall be developed with the USFWS and CDFG to reduce potential impacts.

In sensitive habitat areas with unique, rare or endangered species, responsible agencies should endeavor to avoid implementing structural BMPs and instead opt for implementing non-structural BMPs, such as developing and enforcing ordinances, and/or low impact structural BMPs that can be retrofitted into existing facilities that will not divert or reduce surface water runoff discharge to the canyons and stream channel.

Additionally, should an impermeable detention basin be required, this could be constructed underground so as not to result in reduction of the numbers of any unique, rare or endangered species of animals through the destruction of habitat.

5. **Animal Life. c.** Will the proposal result in introduction of new species of animals into an area, or in a barrier to the migration or movement of animals?

Answer: Less than significant with mitigation

Discussion: Most non-structural BMPs will not result in introduction of new species of animal into an area, or in a barrier to the migration or movement of animals because most of the BMPs would not introduce any physical effects that could impact these characteristics. However, the creation and enforcement of ordinances to eliminate nuisance flows could result in a barrier to the migration or movement of animals especially in the dry weather season by eliminating habitat dependant on those flows. However, this would cause Chollas Creek's dry weather flows to return to a more natural, pre-development condition, facilitating a return to a more natural, dry weather habitat, as discussed in the answer to question 5a.

Structural BMPs would not foreseeably introduce new species. In addition, because structural BMPs would likely be installed in urbanized areas, the potential installation sites would not act as a travel route or regional wildlife corridor. However, BMPs could potentially be constructed in open space where travel routs or regional wildlife corridors exist. A travel route is generally described as a landscape feature (such as a ridgeline, canyon, or riparian strip) within a larger natural habitat area that is used frequently by animals to facilitate movement and provide access to necessary resources such as water, food, or den sites). Wildlife corridors are generally an area of habitat, usually linear in nature, which connect two or more habitat patches that would otherwise be fragmented or isolated from one another. Construction of reasonably foreseeable structural BMPs should not restrict wildlife movement because the size of BMPs are generally too small to obstruct a corridor.

A corridor for terrestrial animals would be maintained regardless of flow since reduced flows would not provide physical barriers for these animals. In the event that any structural BMPs built would hinder animals from moving throughout the stream corridor, a pathway around the BMPs could be constructed.

A net loss of native animal species habitat in the stream corridor due to BMP installation should be mitigated. Initially, avoidance and minimization of habitat loss should be considered. In some cases, BMPs may actually provide important habitat for animals in the stream corridor. Examples of such BMPs include detention/ retention ponds, vegetated swales, and buffer strips.

Responsible agencies should endeavor to avoid compliance measures that could result in significant barriers to the migration or movement of animals, and instead opt for non-structural BMPs and/or structural BMPs that would not change the migration or movement of animals. Potential project sites in open space areas that might be used to install structural BMPs should be evaluated in consultation with CDFG to identify potential wildlife travel routes. If a wildlife travel route is identified that could be impacted by the installation of structural BMPs, then the project should be designed to include a new wildlife travel route in the same general location.

Some migratory avian species may use portions of potential project sites, including ornamental vegetation, during breeding season and may be protected under the Migratory Bird Treaty Act (MBTA) while nesting. The MBTA includes provisions for protection of migratory birds under the authority of the USFWS and CDFG. The MBTA protects over 800 species including, geese, ducks, shorebirds, raptors, songbirds, and many other relatively common species. If construction occurs during the avian breeding season for special status species and/or MBTA-covered species, generally February through August, then prior (within 2 weeks) to the onset of construction activities, surveys for nesting migratory avian species should be conducted on the project site following USFWS and/or CDFG guidelines. If no active avian nests are identified on or within the appropriate distance of construction areas, further mitigation may not be necessary.

Alternatively, to avoid impacts, the agencies implementing the TMDLs may begin construction after the previous breeding season for covered avian species and before the next breeding season begins. If a protected avian species was to establish an active nest after construction was initiated and outside of the typical breeding season (February – August), the project sponsor, would be required to establish a buffer as required by USFWS between the construction activities and the nest site.

If active nest for protected avian species are found within the construction footprint or within the proscribed buffer zone, construction would be required to be delayed within the construction footprint and buffer zone until the young have fledged or appropriate mitigation measures responding to the specific situation are developed in consultation with USFWS or CDFG. These impacts are highly site specific, and assuming they are foreseeable, they would require a project-level analysis and mitigation plan.

5. Animal Life. d. Will the proposal result in deterioration to existing fish or wildlife habitat?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in deterioration to existing fish or wildlife habitat. The creation and enforcement of ordinances to eliminate nuisance flows could result in improved water quality to existing fish or wildlife habitat. In addition, this would return Chollas Creek's dry weather flows to a more natural, pre-development condition, which is a significant improvement to the environment as discussed in the answer to question 5a.

Depending on the structural BMPs selected, direct or indirect impacts to existing fish or wildlife habitat may occur. However, the installation of structural BMPs would likely be implemented in highly urbanized areas; therefore, the installation of structural BMPs would not likely result in the deterioration of existing fish and or wildlife habitat in the immediate area of a project. Nonetheless, potential effects on fish or wildlife habitat can be reduced by minimizing the size of structural BMPs and limiting the encroachment and/or removal of animal habitat.

Structural BMPs could also divert, reduce, and/or eliminate stormwater runoff discharge, which could potentially change the fish and wildlife habitat within the canyons and stream channels by changing the flow regime of the creek. Because the Chollas Creek watershed is heavily developed with significant areas of impermeable surfaces, stormflow generated streamflow in Chollas Creek is very likely higher today than under pre-development conditions. Therefore, native communities of animals and the habitats they depend on likely can thrive under lower stormflow generated streamflow conditions than what currently exist in Chollas Creek. Hydrologic modeling could be used to estimate the rate and volume of pre-development stormwater runoff to, and flow in Chollas Creek. Using this information, BMPs could be selected and sized to not reduce streamflows in Chollas Creek below pre-development levels. BMPs that completely eliminate stormwater runoff are not reasonably foreseeable because of their cost and the availability of other feasible and less costly alternatives. The return to more natural, pre-development flow regimes in Chollas Creek could be beneficial to restoring native habitats in the creek. Furthermore, the removal of toxic metals from the water could also improve the fish and wildlife habitat in the canyons and stream channels.

Dischargers may also choose to implement non-structural BMPs and/or structural BMPs that do not divert or reduce the surface water runoff that would be discharged to the canyons and stream channel. Additionally, should an impermeable detention basin be required, this could be constructed underground so as not to result in deterioration to existing fish or wildlife habitat at the project site.

Additionally, metals that are removed by infiltration BMPs typically are retained in the upper 2 to 5 inches of soil or sediment. Typically, metals levels returned to background levels or non-detectable levels below about 5 inches depth.

There is a potential (given enough time) that metals may accumulate in the upper 2 to 5 inches of soil to levels that might be toxic to animals. The mitigation measures that could be implemented would include proper and adequate cover materials that would limit the access to the soil that is being affected by metals in stormwater. Options could include planting grass or iceplant, covering with gravel or cobblestones, or covering with compost as a mulch. Any of these cover options would reduce the potential for exposure to soils with elevated metals concentrations. The added benefit that compost might have is a higher affinity to bind with metals (due to its high organic content), and that placement of compost on the soil surface will capture the metals before they bind with the soil As metals concentrations build, the mulch could be removed and replaced. Other options for minimizing exposure to soil could include putting the infiltration BMP underground or indoors, and/or restricting access. Finally, the metals-laden, top 2 to 5 inches of soil could be removed, disposed of and replaced.

6. Noise. a. Will the proposal result in increases in existing noise levels?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs could result in increases in existing noise levels due to increased traffic from street sweepers and/or maintenance vehicles which may increase the noise level temporarily as the vehicles pass through an area. However, the increase in noise levels would be no greater than typical infrastructure maintenance activities currently performed by municipalities and is therefore, less than significant.

The construction and installation of structural BMPs would result in temporary increases in existing noise levels, but this would be short term and only exist until construction is completed. Therefore, this noise impact is less than significant. The noise associated with the construction and installation of structural BMPs would be the same as typical construction activities in urbanized areas, such as ordinary road and infrastructure maintenance and building activities. Contractors and equipment manufacturers have been addressing noise problems for many years and through design improvements, technological advances, and a better understanding of how to minimize exposures to noise, noise effects can be minimized. An operations plan for the specific construction and/or maintenance activities could be prepared to identify the variety of available measures to limit the impacts from noise to adjacent homes and businesses.

Severe noise levels could be mitigated by implementing commonly-used noise abatement procedures, such as sound barriers, mufflers, and limiting construction and maintenance activities to times when these activities have lower impact, such as periods when there are fewer people near the construction area. Applicable and appropriate mitigation measures could be evaluated when specific projects are determined, depending upon proximity of construction activities to receptors.

6. Noise. b. Will the proposal result in exposure of people to severe noise levels?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs would not result in increases in exposure of people to severe noise levels because none of these BMPs would introduce any physical effects that could impact this characteristic. Increased traffic from street sweepers and/or maintenance vehicles may increase the noise level temporarily as the vehicles pass through an area, but these levels will not be severe.

There is the possibility that severe noise levels could be emitted during construction activities. The increase in noise levels could be mitigated by implementing commonly-used noise abatement procedures, such as sound barriers, mufflers, and limiting construction and maintenance activities to times when these activities have lower impact, such as periods when there are fewer people in the area. Applicable and appropriate mitigation measures should be evaluated when specific projects are determined, depending upon proximity of construction activities to receptors.

7. Light and Glare. Will the proposal produce new light or glare?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not produce new light or glare because none of the BMPs would introduce any physical effects that could impact light and glare.

The construction and installation of structural BMPs could potentially be performed during evening or night time hours. If this scenario were to occur, night time lighting would be required to perform the work. Also, lighting could possibly be used to increase safety around structural BMPs.

In the unlikely event that construction is performed during night time hours, a lighting plan should be prepared to include mitigation measures. Mitigation measures can include shielding on all light fixtures, and limiting light trespass and glare through the use of directional lighting methods. Other potential mitigation measures may include using screening and low-impact lighting, performing construction during daylight hours, or designing security measures for installed structural BMPs that do not require night lighting.

8. Land Use. Will the proposal result in substantial alteration of the present or planned land use of an area?

Answer: Less than significant

Discussion: Non-structural BMPs will not result in alteration of the present or planned land use of an area because none of the BMPs would introduce any physical effects that could impact land uses.

Implementation of structural BMPs may potentially cause minor alterations in present or planned land use of an area. However, municipalities are not required or expected to change present or planned land uses to comply with the TMDLs, and are encouraged to seek alternatives that would have the lowest impact on the land use and the environment. Potential conflicts between complying with the TMDLs and other land uses can be resolved by standard planning efforts under which specific projects are reviewed by local planning agencies. Applicable and appropriate mitigation measures could be evaluated when specific projects are determined, and a cost-benefit analysis of proposed compliance alternatives should be performed.

More reasonable alternatives should be evaluated and implemented, such as non-structural BMPs and low impact and/or small scale structural BMPs, before considering an alternative that would create considerable hardship for the community in the area.

9. Natural Resources. a. Will the proposal result in increase in the rate of use of any natural resources?

Answer: No impact

Discussion: Non-structural and/or structural BMPs will not increase the rate of use of any natural resources. Implementation of non-structural and/or structural BMPs should not require quarrying, mining, dredging, or extraction of locally important mineral resources. Operation of street sweepers, construction, and maintenance vehicles could increase the use of fossil fuels, and some types of equipment used in structural BMPs may consume electricity to operate pumps, etc. However, the relative amounts of additional fossil fuel and electricity that might be used would fall well within the capacity and expectations of normal city maintenance. The additional use of fossil fuels and electricity could be mitigated and reduced if municipalities used alternative fuels and/or renewable energies to power their vehicles and equipment.

9. Natural Resources. b. Will the proposal result in substantial depletion of any non-renewable natural resource?

Answer: No impact

Discussion: Non-structural and/or structural BMPs will not substantially deplete any non-renewable natural resource. Operation of street sweepers, construction, and maintenance vehicles could increase the use of fossil fuels, and some types equipment used in structural BMPs may consume electricity to operate pumps, etc. However, the relative amounts of additional fossil fuel and electricity that might be used would fall well within the capacity and expectations of normal city maintenance. The additional use of fossil fuels and electricity could be mitigated and reduced if municipalities used alternative fuels and/or renewable energies to power their vehicles and equipment.

10. Risk of Upset. Will the proposal involve a risk of an explosion or the release of hazardous substances (including, but not limited to: oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?

Answer: Less than significant

Discussion: Non-structural and structural BMPs will not involve a risk of an explosion or the release of hazardous substances (including, but not limited to: oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions. The reasonably foreseeable non-structural and structural BMPs included in this evaluation would not be subject to explosion or the release of hazardous substances in the event of an accident because these types of substances would not be present. There is the possibility that hazardous materials (e.g., paint, oil, gasoline) may be present during construction and installation activities, but potential risks of exposure can be mitigated with proper handling and storage procedures. All risks of exposure would be short term and would be eliminated with the completion of construction and installation activities.

11. Population. Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?

Answer: Less than significant

Discussion: Non-structural BMPs will not alter the location, distribution, density, or growth rate of the human population of an area because none of the BMPs would introduce any physical effects that could impact these characteristics.

Implementation of structural BMPs may potentially alter the location, distribution, density, or growth rate of the human population of an area. However, municipalities are not required or expected to change present or planned land uses to comply with the TMDLs, and municipalities are encouraged to seek alternatives that would have the lowest impact on the existing and planned population of an area. Potential conflicts between complying with the TMDLs and planned growth can be resolved by standard planning efforts under which specific projects are reviewed by local planning agencies. Applicable and appropriate mitigation measures could be evaluated when specific projects are determined.

More reasonable alternatives should be evaluated and implemented, such as non-structural BMPs and low impact and/or small scale structural BMPs, before considering an alternative that would create the need to relocate the population of parts of the watershed..

12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?

Answer: Less than significant

Discussion: Non-structural BMPs will not affect existing housing, or create a demand for additional housing because none of these BMPs would introduce any physical effects that could impact housing.

Implementation of structural BMPs may potentially affect existing housing. However, municipalities are not required or expected to change present or planned land uses to comply with the TMDLs, and municipalities are encouraged to seek alternatives that would have the lowest impact on land use and the environment. Potential conflicts between complying with the TMDLs and other land uses can be resolved by standard planning efforts under which specific projects are reviewed by local planning agencies. Applicable and appropriate mitigation measures could be evaluated when specific projects are determined.

More reasonable alternatives should be evaluated and implemented, such as non-structural BMPs and low impact and/or small scale structural BMPs, before considering an alternative that would create considerable hardship for the community in the area.

13. Transportation/Circulation. a. Will the proposal result in generation of substantial additional vehicular movement?

Answer: Less than significant

Discussion: Non-structural and/or structural BMPs will not result in generation of substantial additional long-term vehicular movement. There may be additional vehicular movement during construction of structural BMPs and during street sweeping and/or maintenance activities. However, vehicular movement during construction would be temporary, and vehicular movement during street sweeping and/or maintenance activities would be periodic and only as the vehicle passes through the area. This may generate minor additional vehicular movement.

In order to reduce the impact of construction traffic, a construction traffic management plan could be prepared for traffic control during any street closure, detour, or other disruption to traffic circulation. The plan could identify the routes that construction vehicles would use to access the site, hours of construction traffic, and traffic controls and detours. The plan could also include plans for temporary traffic control, temporary signage and stripping, location points for ingress and egress of construction vehicles, staging areas, and timing of construction activity which appropriately limits hours during which large construction equipment may be brought on or off site.

The potential impact to vehicular movement can be reduced if street sweeping and/or maintenance activities are scheduled to be performed at the same time as other maintenance activities performed by municipalities, or at times when these activities have lower impact, such as periods of low traffic activity.

13. Transportation/Circulation. b. Effects on existing parking facilities, or demand for new parking?

Answer: Less than significant with mitigation.

Discussion: Non-structural BMPs may affect existing parking facilities, or create demand for new parking structural, if increased street sweeping and/or maintenance is implemented in areas with parking along roadsides. Available parking in an area could be reduced during certain times of the day, week, and/or month, depending on frequency of street sweeping and/or maintenance events. Street sweeping and maintenance events should be scheduled to be performed at the same time as other maintenance activities performed by the municipalities, and/or at times when these activities have lower impact, such as periods of low traffic activity and parking demand.

Depending on the structural BMPs selected, alterations to existing parking facilities may occur to incorporate structural BMPs. This could reduce available parking in an area. However, structural BMPs can be designed to accommodate space constraints or be placed under parking spaces and do not have to occupy space in existing parking facilities. Available parking spaces can be reconfigured to provide equivalent number of spaces or provide functionally similar parcels for use as offsite parking to reduce potential impacts.

13. Transportation/Circulation. c. Will the proposal result in substantial impacts upon existing transportation systems?

Answer: Less than significant

Discussion: Non-structural BMPs will not result in significant impacts upon existing transportation systems. The only foreseeable impact would come from increased street sweeping, however long-term impacts are unlikely because any increase in maintenance vehicular activities would fall well within the present day activities in any municipality, and would therefore not qualify as substantial.

Depending on the structural BMPs selected, temporary alterations to existing transportation systems may be required during construction and installation activities. The potential impacts would be limited and short-term. Potential impacts could be reduced by limiting or restricting hours of construction so as to avoid peak traffic times and by providing temporary traffic signals and flagging to facilitate traffic movement.

13. Transportation/Circulation. d. Will the proposal result in alterations to present patterns of circulation or movement of people and/or goods?

Answer: Less than significant

Discussion: Non-structural BMPs will not result in alterations to present patterns of circulation or movement of people and/or goods, because none of the BMPs, including increased street sweeping, would introduce any physical effects that could impact these characteristics. No long-term impacts are expected because any increase in maintenance vehicular activities would fall well within the present day activities in any municipality.

Depending on the structural BMPs selected, temporary alterations to present patterns of circulation or movement of people and/or goods may be required during construction and installation activities. The potential impacts would be limited and short-term. Potential impacts could be reduced by limiting or restricting hours of construction so as to avoid peak traffic times and by providing temporary traffic signals and flagging to facilitate traffic movement.

13. Transportation/Circulation. e. Will the proposal result in alterations to waterborne, rail or air traffic?

Answer: Less than significant

Discussion: Non-structural and/or structural BMPs are not expected to result in alterations to waterborne, rail or air traffic because none of the BMPs would introduce any physical effects that could impact these characteristics.

Depending on the structural BMPs selected, temporary alterations to rail transportation could potentially occur during construction and installation activities. However those potential impacts would limited and short-term and could be avoided through proper siting and design, and scheduling of construction activities

13. Transportation/Circulation. f. Will the proposal result in increase in traffic hazards to motor vehicles, bicyclists or pedestrians?

Answer: Less than significant

Discussion: Non-structural BMPs could result in an increase in traffic hazards to motor vehicles, bicyclists or pedestrians due, for example, to increased street sweeping. However, any foreseeable impact from increased street sweeping would fall well within the present day conditions in any municipality, and would therefore not present new safety concerns.

Depending on the structural BMPs selected, a temporary increase in traffic hazards may occur during construction and installation activities. The specific project impacts can be reduced and mitigated by marking, barricading, and controlling traffic flow with signals or traffic control personnel in compliance with authorized local police or California Highway Patrol requirements. These methods would be selected and implemented by responsible local agencies considering project level concerns. Standard safety measures should be employed including fencing, other physical safety structures, signage, and other physical impediments designed to promote safety and minimize pedestrian/bicyclists accidents.

14. Public Service. a. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas: Fire protection?

Answer: Less than significant

Discussion: Non-structural BMPs will not have an effect upon, or result in a need for new or altered fire protection services because none of the BMPs would introduce any physical effects that could impact this characteristic.

During construction and installation of structural BMPs, temporary delays in response time of fire vehicles due to road closure/traffic congestion during construction activities may occur. However, any construction activities would be subject to applicable building and safety and fire prevention regulations and codes. The responsible agencies could notify local emergency service providers of construction activities and road closures and could coordinate with local providers to establish alternative routes and appropriate signage. In addition, an Emergency Preparedness Plan could be developed for the construction of proposed new facilities in consultation with local emergency providers to ensure that the proposed project's contribution to cumulative demand on emergency response services would not result in a need for new or altered fire protection services. Most jurisdictions have in place established procedures to ensure safe passage of emergency vehicles during periods of road maintenance, construction, or other attention to physical infrastructure. In any case, the installation of structural devices would not create any more significant impediments than such other ordinary activities.

14. Public Service. b. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas: Police protection?

Answer: Less than significant

Discussion: Non-structural BMPs will not have an effect upon, or result in a need for new or altered fire protection services because none of the BMPs would introduce any physical effects that could impact this characteristic.

During construction and installation of structural BMPs, temporary delays in response time of police vehicles due to road closure/traffic congestion during construction activities may occur. The responsible agencies could notify local police service providers of construction activities and road closures and could coordinate with local police to establish alternative routes and traffic control during construction projects. In addition, an Emergency Preparedness Plan could be developed for the proposed new facilities in consultation with local emergency providers to ensure that the proposed project's contribution to cumulative demand on emergency response services would not result in a need for new or altered police protection services. Most jurisdictions have in place established procedures to ensure safe passage of emergency vehicles during periods of road maintenance, construction, or other attention to physical infrastructure. In any case, the installation of structural devices would not create any more significant impediments than such other ordinary activities.

14. Public Service. c. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas: Schools?

Answer: No impact.

Discussion: Non-structural and structural BMPs will not have an effect upon, or result in a need for new or altered schools or school services because none of the BMPs would introduce any physical effects that could impact this characteristic.

14. Public Service. d. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas: Parks or other recreational facilities?

Answer: Less than significant.

Discussion: Non-structural BMPs will not have an effect upon, or result in a need for new or altered parks or other recreational facilities because none of the BMPs would introduce any physical effects that could impact parks or recreational facilities.

During construction and installation of structural BMPs, parks or other recreational facilities could be temporarily affected. Construction activities could potentially be performed near or within a park or recreational facilities. Potential impacts would be limited and short-term and could be avoided through siting, designing, and scheduling of construction activities.

In the unlikely event that the municipalities might install facilities on a scale that could alter a park or recreational facility, the structural BMPs could be designed in such a way as to be incorporated into the park or recreational facility. Additionally, should an impermeable detention basin be required, this could be constructed underground so as not to result in need for new or altered parks or other recreational facilities.

14. Public Service. e. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas: maintenance of public facilities, including roads?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs may include additional road maintenance such as additional and/or increased street sweeping. Structural BMPs may require additional maintenance by municipalities to ensure proper operation. As discussed above for

Questions 2, 6, and 13, additional or increased street sweeping and maintenance activities could affect air, noise, and transportation/circulation. The increase in air pollutants and noise levels would be no greater than typical street sweeping and maintenance activities currently performed by the municipalities. Street sweeping and maintenance events could be scheduled to be performed at the same time as other maintenance activities performed by the municipalities, or at times when these activities have lower impact, such as periods of low traffic activity and parking demand.

14. Public Service. f. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas: other government services?

Answer: Less than significant with mitigation

Discussion: As discussed above, non-structural and/or structural BMPs may include increased street sweeping and/or additional maintenance by dischargers to ensure proper operation of newly installed structural BMPs. However, the potential impacts to air, noise, and transportation/circulation would be no greater than typical street sweeping and maintenance activities currently performed by municipalities. Street sweeping and maintenance events could be scheduled to be performed at the same time as other maintenance activities performed by the municipalities, or at times when these activities have lower impact, such as periods of low traffic activity and parking demand.

Implementation of the TMDLs will result in the need for increased monitoring in Chollas Creek and its tributaries to track compliance with the TMDLs. However, no effects to the environment would be expected from these monitoring activities.

15. Energy. a. Will the proposal result in use of substantial amounts of fuel or energy?

Answer: No impact

Discussion: Non-structural and/or structural BMPs will not use substantial amounts of fuel or energy. As discussed above for Question 9, operation of street sweepers, construction, and maintenance vehicles could increase the use of fossil fuels, and some types equipment used in structural BMPs may consume electricity to operate pumps, etc. However, the relative amounts of additional fossil fuel and electricity that might be used would fall well within the capacity and expectations of normal city maintenance. The additional use of fossil fuels and electricity could be reduced if the municipalities used alternative fuels and/or renewable energies to power their vehicles and equipment.

15. Energy. b. Will the proposal result in a substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?

Answer: No impact

Discussion: Non-structural and/or structural BMPs will not result in a substantial increase in demand upon existing sources of energy, or require the development of new sources of energy. As discussed for Questions 9 and 15a above, operation of street sweepers, construction, and maintenance vehicles could increase the use of fossil fuels, and some types equipment used in structural BMPs may consume electricity to operate pumps, etc. However, the relative amounts of additional fossil fuel and electricity that might be used would fall well within the capacity and expectations of normal city maintenance. The additional use of fossil fuels and electricity could be reduced if the municipalities used alternative fuels and/or renewable energies to power their vehicles and equipment.

If alternative sources of energy are used, sources of alternative energy and fuel may be needed. Equipment and components for renewable sources of energy such as solar or wind are readily available. Alternative fuels such as ethanol or biodiesel are commercially available and can be used. Sources of new energy are not required to be developed.

16. Utilities and Service Systems. a. Will the proposal result in a need for new systems, or substantial alterations to the following utilities: power or natural gas?

Answer: Less than significant

Discussion: Non-structural BMPs will not result in a need for new systems or alterations to power or natural gas utilities because none of the BMPs would introduce any physical effects that could impact this characteristic.

Installation of structural BMPs may require alterations or installation of new power or natural gas lines. Power, and natural gas lines might need to be rerouted to accommodate the addition of structural BMPs. The degree of alteration depends upon local system layouts which careful placement and design can minimize. However, that the installation of structural BMPs will result in a substantial increased need for new systems, or substantial alterations to power or natural gas utilities, is not reasonably foreseeable, because none of these BMPs are large enough to substantially tax current power or natural gas sources. No long term effects on the environment are expected if alterations to power or natural gas utilities are required.

16. Utilities and Service Systems. b. Will the proposal result in a need for new systems, or substantial alterations to the following utilities: communications systems?

Answer: No impact

Discussion: Non-structural BMPs will not result in a need for new systems or alterations to communications systems because none of the BMPs would introduce any physical effects that could impact this characteristic. Current forms of communications used in street sweeping and maintenance vehicles could still be used.

New systems or alterations to communications systems are not necessarily required for structural BMPs. Structural BMPs can be manually inspected and maintained without any communications system required. However, that municipalities could install a remote monitoring system, which could include a new communications system, is possible. A telephone line or wireless communications system could be installed, which would not be a substantial alteration.

16. Utilities and Service Systems. c. Will the proposal result in a need for new systems, or substantial alterations to the following utilities: water?

Answer: No impact

Discussion: Non-structural and/or structural BMPs will not result in a need for new systems or alterations to water lines. The need for new municipal or recycled water to implement these TMDLs, is not foreseeable.

16. Utilities and Service Systems. d. Will the proposal result in a need for new systems, or substantial alterations to the following utilities: Sewer or septic tanks?

Answer: Less than significant

Discussion: Non-structural and/or structural BMPs will not result in a need for new systems or alterations to sewer or septic tanks because none of the BMPs would introduce any physical effects that could impact this characteristic.

Depending on the structural BMPs selected, a portion or all of the surface water runoff may be diverted to wastewater treatment facilities. If stormwater is diverted for treatment at a wastewater treatment facility, new connections to existing sanitary sewer lines may be required, but no new major sewer trunks or substantial alterations to sewer system would be expected because BMPs utilizing the sewer would likely contribute small amounts of first flush storm water. Any environmental affects from associated construction activities would be small scale and short-term and similar to typical municipal capital improvement projects.

16. Utilities and Service Systems. e. Will the proposal result in a need for new systems, or substantial alterations to the following utilities: stormwater drainage?

Answer: Less than significant with mitigation.

Discussion: Non-structural BMPs will not result in a need for new systems, or substantial alterations to stormwater drainage systems because none of the BMPs would introduce any physical effects that could impact this characteristic.

In order to achieve compliance with the TMDLs, the stormwater drainage systems may need to be reconfigured and/or retrofitted with structural BMPs to capture and/or treat a portion or all of the stormwater runoff. The alterations and/or additions to stormwater drainage systems will depend on the compliance strategy selected by each municipality at each location where structural BMPs might be installed. Impacts from construction activities to retrofit or reconfigure the storm drain system as part of BMP installation, and mitigation measures have been considered and discussed in the previous responses to the questions.

16. Utilities and Service Systems. f. Will the proposal result in a need for new systems, or substantial alterations to the following utilities: solid waste and disposal?

Answer: No impact

Discussion: Most non-structural BMPs will not result in a need for new systems, or substantial alterations to the solid waste and disposal systems because none of the BMPs would introduce any physical effects that could impact this characteristic. However, increased street sweeping would generate additional solid waste, but this additional waste is not expected to exceed the maintenance capacity of normal city operations. No new solid waste or disposal systems would be expected.

Structural BMPs may generate solid wastes requiring disposal. The installation of structural BMPs may generate construction debris. Installed structural BMPs may collect sediment and solid wastes that will require disposal. Structural BMPs may require disposal of construction debris and collected sediment and solid waste material, but no new solid waste or disposal systems would be needed to handle the relatively small volume generated by these projects. Construction debris may be recycled at aggregate recycling centers or disposed of at landfills. Sediment and solid wastes that may be collected can be disposed of at appropriate landfill and/or disposal facilities.

17. Human Health. a. Will the proposal result in creation of, and exposure of people to, any health hazard or potential health hazard (excluding mental health)?

Answer: Less than significant with mitigation

Discussion: As discussed above for Questions 2 and 13, non-structural BMPs such as street sweeping and maintenance vehicles could have an effect on air and transportation/circulation. Non-structural BMPs could increase the amount of pollutants emitted into the atmosphere above ambient conditions. Non-structural BMPs could also increase traffic, which could potentially decrease the safety of pedestrians. In both cases, potential impacts can be reduced or eliminated if street sweeping and/or maintenance activities are scheduled to be performed at the same time as other maintenance activities performed by the municipalities, or at times when these activities have lower impact, such as periods of low traffic activity.

As discussed above for questions 1, 2, 3, 5, and 13, the installation of structural BMPs could have an effect on earth, air, water, animal life, and transportation/circulation. Structural BMPs could increase the risk of unstable earth conditions, which could pose a physical risk to persons in the area should a slope fail. Construction, installation, and maintenance of structural BMPs could increase the amount of pollutants the air, which could have an effect on health. Structural BMPs could potentially result in additional habitat and/or standing water which can attract pests, such as flies, mosquitoes and/or rodents, which can be carriers of disease. Maintenance of structural BMPs could also increase traffic, which could potentially decrease the safety of pedestrians. Additionally, heavy machinery and materials that may be used during construction and installation of structural BMPs could pose physical and/or chemical risks to human health.

Potential impacts to earth could be avoided or mitigated through proper geotechnical investigations, siting, design, and ground and groundwater level monitoring to ensure that structural BMPs are not employed in areas subject to unstable soil conditions. Potential health hazards attributed to installation and maintenance of structural BMPs can be mitigated by use of OSHA construction and maintenance health and safety guidelines. Potential health hazards attributed to BMP maintenance can be mitigated through OSHA industrial hygiene guidelines. Installation of non-vector producing structural BMPs can help mitigate vector production from standing water. Netting can be installed over structural BMPs to further mitigate vector production. Structural BMPs can be designed and sites can be properly protected to prevent accidental health hazards as well as prevent vector production. Vector control agencies may also be employed as another source of mitigation. Structural BMPs prone to standing water can be selectively installed away from high-density areas and away from residential housing and/or by requiring oversight and treatment of those systems by vector control agencies. Potential impacts to transportation/circulation can be reduced or eliminated if maintenance activities are scheduled to be performed at the same time as other maintenance activities performed by the municipalities, or at times when these activities have lower impact, such as periods of low traffic activity. Appropriate planning, design, siting, and implementation can reduce or eliminate potential health hazards due to the installation of structural BMPs.

Additionally, potential benefits will include a reduction in the rate of bioaccumulation of lead, copper and zinc, because of the result reduction of exposure to people eating fish caught at the mouth of Chollas Creek or otherwise in San Diego Bay.

Finally, metals that are removed by infiltration BMPs typically are retained in the upper 2 to 5 inches of soil or sediment. Typically, metals levels returned to background levels or non-detectable levels below about 5 inches depth.

There is a potential (given enough time) that metals may accumulate in the upper 2 to 5 inches of soil to levels that might be toxic to humans, plants, and/or animals. The mitigation measures that could be implemented would include proper and adequate cover materials that would limit the access to the soil that is being affected by metals in stormwater. Options could include planting grass or iceplant, covering with gravel or cobblestones, or covering with compost as a mulch. Any of these cover options would reduce the potential for exposure to soils with elevated metals concentrations. The added benefit that compost might have is a higher affinity to bind with metals (due to its high organic content), and that placement of compost on the soil surface will capture the metals before they bind with the soil As metals concentrations build, the mulch could be removed and replaced. Other options for minimizing exposure to soil could include putting the infiltration BMP underground or indoors, and/or restricting access. Finally, the metals-laden, top 2 to 5 inches of soil could be removed, disposed of and replaced.

18. Aesthetics. a. Will the proposal result in the obstruction of any scenic vista or view open to the public?

Answer: Less than significant with mitigation.

Discussion: Non-structural BMPs will not result in the obstruction of any scenic vista or view open to the public because none of the BMPs would introduce any physical effects that could impact this characteristic.

That municipalities would comply with these TMDLs by installing structural BMPs that would adversely affect a scenic vista or view open to the public, is not reasonably foreseeable. Most structural BMPs, which will likely be used, are subsurface devices such as sand filters. Once completed, structural BMPs would not foreseeably obstruct scenic vistas or open views to the public. In the unlikely event that the municipalities might install facilities on a scale that could obstruct scenic views, such impacts could be reduced or eliminated with appropriate planning, design, and siting of the structural BMPs. Additionally, any structural BMPs can, if necessary, be constructed underground to eliminate aesthetic issues.

18. Aesthetics. b. Will the proposal result in the creation of an aesthetically offensive site open to public view?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in the creation of an aesthetically offensive site open to public view because none of the BMPs would introduce any physical effects that could impact this characteristic.

The installation of structural BMPs could potentially create an aesthetically offensive site open to public view. Structural BMPs may create an aesthetically offensive site to the public during construction and installation, but this would be temporary until construction is completed. Once installation of the structural BMPs is complete, the site may continue to be aesthetically offensive to the public. However, many structural BMPs can be designed to provide wildlife habitat, recreational areas, and green spaces in addition to improving stormwater quality. Appropriate architectural and landscape design practices can be implemented to reduce adverse aesthetic effects. Screening and landscaping may also be used to mitigate adverse aesthetic effects. The adverse aesthetic effects could be reduced or eliminated and possibly improved with appropriate planning and design of the structural BMPs. Additionally, any structural BMPs can, if necessary, be constructed underground to eliminate aesthetic issues.

Above-ground structural BMPs may also become targets of vandalism. Vandalized structures may become aesthetically offensive. Vandalism, however, already exists to some degree in most, if not all, urbanized areas. Adding several new structures is not of itself likely to have any impact upon current vandalism trends. Improved lighting and enforcement of current vandalism ordinances may decrease vandalism of structural BMPs.

19. Recreation. Will the proposal result in impact on the quality or quantity of existing recreational opportunities?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in impact on the quality or quantity of existing recreational opportunities because none of the BMPs would introduce any physical effects that could impact these characteristics.

During construction and installation of structural BMPs, parks or other recreational areas could be temporarily affected. Construction activities could potentially be performed near or within a park or recreational area. Potential impacts would be limited and short-term and could be avoided through proper siting, design, and scheduling of construction activities.

In the event that the municipalities might install facilities on a scale that could alter a park or recreational area, the structural BMPs could be designed in such a way as to be incorporated into the park or recreational area. Additionally, any structural BMPs can, if necessary, be constructed underground to minimize impacts on the quality or quantity of existing recreational opportunities. Mitigation to replace lost areas may include the creation of new open space recreation areas and/or improved access to existing open space recreation areas.

Additionally, improvement of water quality could create new recreation opportunities in Chollas Creek by providing the opportunity to recreate in and near a clean water body with a robust and diverse population of plants and animals.

20. Archeological/Historical a. Will the proposal result in the alteration of a significant archeological or historical site, structure, object or building?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in the alteration of a significant archeological or historical site, structure, object or building because none of the BMPs would introduce any physical effects that could impact these characteristics.

In the unlikely event that municipalities might install facilities on a scale that could result in significant adverse effects on a significant archeological or historical site, structure, object or building, a project level, site-specific environmental assessment should be performed to identify the mitigation measures that could be employed to minimize the potential effects on archeological or historical sites and identify alternatives that could potentially be used that would have less impact. The agencies responsible for implementing these TMDLs could consult the relevant local archeological or historical commissions or authorities to identify these types of sites and determine ways to avoid significant adverse impacts. The potentially adverse effects on archeological or historical sites that might be present could be reduced or eliminated with appropriate planning, design, and siting of the structural BMPs.

Additionally, if during ground-disturbing activities paleontological resources are identified within the project area, all work within 50 feet of the discovery should be halted and a qualified paleontologist contacted to evaluate the finds and make recommendations. If the paleontological resources are not significant as determined by a qualified paleontologist, no further protection is necessary. If such paleontological resources are found to be significant, they should be avoided by project activities. If avoidance is not feasible, adverse effects to such paleontological resources should be mitigated. Upon completion of the paleontological assessment, a report should be prepared documenting the methods and results, as well as recommendations. The City should require implementation of the recommendations of the report. The report should be submitted to the appropriate City agencies.

21. Mandatory Findings of Significance - Potential to degrade: Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?

Answer: Less than significant with mitigation

Discussion: Non-structural BMPs will not result in the substantial degradation of the environment for plant and animal species because none of the BMPs would introduce any physical effects that could impact these characteristics.

As discussed above in Questions 4 and 5, plant and animal species could potentially be adversely affected by the installation and operation of structural BMPs. Mitigation measures could be implemented to ensure that unique, rare or endangered plant and/or animal species and their habitats are not taken or destroyed. When specific projects are developed and sites identified, a focused protocol plant and/or animal survey and/or a search of the California Natural Diversity Database should be performed to confirm that any potentially sensitive or special status plant and/or animal species in the site area are properly identified and protected as necessary. If sensitive plant and/or animal species occur on the project site, mitigation is required in accordance with the Endangered Species Act. Mitigation measures should be developed in consultation with the CDFG and the USFWS. Responsible agencies should endeavor to avoid installing structural BMPs that could adversely affect any unique, rare or endangered species of plants and/or animals, and instead opt for non-structural BMPs and/or identify and install structural BMPs that will have little or no impact such as underground BMPs.

Taken all together, the potential impacts of the project will not cause a significant cumulative impact in the environment. In any case, the implementation of these TMDLs will result in improved water quality in the waters of the Region and will have significant beneficial impacts to the environment over the long term.

21. Mandatory Findings of Significance - Short-term: Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time, while long-term impacts will endure well into the future.)

Answer: No impact

Discussion: There are no short-term beneficial effects on the environment from the implementation of non-structural and/or structural BMPs that would be at the expense of long-term beneficial effects on the environment. The implementation and compliance with these TMDLs will result in improved water quality in the waters of the Region and will have significant beneficial impacts to the environment over the long term.

21. Mandatory Findings of Significance - Cumulative: Does the project have impacts which are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)

Answer: Less than significant with mitigation

Discussion: Cumulative impacts, defined in section 15355 of the CEQA Guidelines, refer to two or more individual effects, that when considered together, are considerable or that increase other environmental impacts. Cumulative impact assessment must consider not only the impacts of the proposed metals TMDLs, but also the impacts from other TMDL, municipal, and private projects, which have occurred in the past, are presently occurring, and may occur in the future, in the watershed during the period of implementation.

Past and present projects may be regarded as the general construction (development and maintenance) which has brought the Chollas Creek watershed from a natural, pristine condition, to the urban, developed setting which is present today. This provides a baseline level of construction with which to compare all water quality project requirements. The past and present baseline of construction in the Chollas Creek watershed are typical of any fully developed urban area, and will probably remain constant in the future. The increment of increase proposed by the cumulative requirements of all water quality requirements can be mitigated through scheduling, and is insignificant compared to the past and on-going baseline of typical municipal construction.

Present and future impacts will come from all of the water quality control programs and pollutant load reduction projects being implemented in the watershed or planned for the near future. For Chollas Creek, these include TMDLs for Diazinon, Indicator Bacteria TMDLs, the mouth of Chollas Creek toxic sediment TMDLs, toxic pollutants in sediment in San Diego Bay near Chollas Creek, and projects to comply with the WDRs in Order No. R9-2007-0001 (the San Diego County municipal stormwater requirements).

The San Diego Water Board adopted a diazinon TMDL for Chollas Creek in 2002, and will likely adopt TMDLs for indicator bacteria in 2007. The San Diego Water Board has also required the cities of La Mesa, Lemon Grove, and San Diego to initiate trash reduction programs in an iterative BMP implementation process, under section C of Order No. 2001-01,[19] (the previous San Diego County municipal stormwater requirements) and section A.3.a.(1) of Order No. R9-2007-01. In assessing cumulative impacts from multiple water quality control requirements, this CEQA analysis considers the nature, source and transport of impairing compounds, the pollutant loading mechanisms and the reasonably foreseeable methods of compliance.

Cumulative impacts are not expected to be significant because effective non-structural BMPs, that have no adverse impacts, are available to implement the Diazinon TMDL, Indicator Bacteria TMDLs, and trash reduction program. The principal implementation provision for the Diazinon TMDL was federal legislation banning the sale and use of the pesticide in the United States.[20] Other BMPs for Diazinon reduction include education and outreach to discourage homeowners and businesses from using stockpiled Diazinon, and encourage integrated pest management practices, none of which will have adverse effects on the physical environment, and therefore no significant cumulative impact.

The Indicator Bacteria TMDLs can be implemented through education and outreach, and enforcement of ordinances requiring pet owners to properly dispose of pet waste, ordinances prohibiting disposal of grease, food products, and other bacteria-laden waste products into the storm drain, and ordinances banning nuisance flows into the stormdrain system. Another important bacteria load reduction program is to find and fix illegal cross-connections between the sanitary sewer system and the stormdrain system, such as the recently discover cross-connection and large sewage spill at Naval Station San Diego, at the mouth of Chollas Creek. Fixing cross connections between the stormdrain and sanitary sewer systems may increase the overall number of construction projects needed in the watershed to implement TMDLs. However, estimating the number of cross connections that might exist is purely speculative. Further, these types of construction projects are on a small scale and fall well within typical municipal capital improvement and maintenance activities. Therefore the cumulative effects will not be considerable, and can be mitigated, if necessary, through scheduling.

The mouth of Chollas Creek toxic sediment TMDL is currently in the initial stages of development. The San Diego Water Board identified the 1-10 acres near the mouth of Chollas Creek in San Diego Bay as one of five priority toxic hotspots in San Diego Bay. The San Diego Water Board listed the same areas on the 1998 List of Water Quality Limited Segments as a priority for establishing a TMDL that addresses benthic community degradation and toxicity in the marine sediment of Chollas Creek channel in San Diego bay. The likely contaminants of concern that cause the benthic

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[19] Order No. 2001-01 was superseded by Order No. R9-2007-0001 adopted on January 24, 2007.
[20] Diazinon Revised Risk Assessment And Agreement With Registrants; Prevention, Pesticides And Toxic Substances (7506C)

community degradation are: chlordane and non-polar organics (including polychlorinated biphenyls (PCBs)) and polycyclic aromatic hydrocarbons (PAHs) in sediment. However, cumulative effects are not expected since the likely implementation action will result in some form of dredging and cleanup. Therefore the cumulative effects will not be considerable, and can be mitigated, if necessary, through scheduling.

Trash reduction can be achieved through education and outreach, and enforcement of ordinances against littering. For the most part, these activities will not have adverse environmental impacts, and therefore no significant cumulative impact.

Ordinances prohibiting nuisance flows will reduce both bacteria and metals loading to Chollas Creek. The effects of eliminating nuisance flows may be attributable to several water quality control projects, but the effects of each will not be cumulative because they are not additive, i.e., once flows are reduced for any project, other projects won't result in further reductions.

The dischargers may opt to use structural BMPs to reduce bacteria and metals loading to Chollas Creek which would increase the likelihood of environmental effects that are cumulatively considerable. The City of San Diego funded an assessment of BMP strategies that would lessen the anticipated impacts and allow an integrated TMDL strategy that address both current and anticipated TMDLs. In this study,[21] the authors recommended a strategy that used a tiered approach that reduces the impact to the environment, and allows for more cost effective implementation of lower-impact BMPs. The tiered approach consists of three major components:

- Tier 1 – Control of Pollutants at the Source and Prevent Pollutants from Entering Runoff
- Tier 2 – Conduct Design Studies and Implement Aggressive Street Sweeping and Runoff and Treatment Volume Reduction BMPs
- Tier 3 – Infrastructure Intensive Treatment BMPs

Implementation of this BMP strategy, because it emphasizes BMPs with the least adverse impacts to the environment, should reduce cumulative impacts to less than significant levels.

However, present and future specific TMDL projects may include structural BMP construction which must be environmentally evaluated for potential cumulative impacts by the implementing municipality. Present and future specific TMDL projects and other construction activities may result in short-term cumulative impacts as described below. However, appropriate and available mitigation measures, including scheduling, are available to reduce adverse environmental impacts associated with construction to less than significant levels.

Noise and Vibration - Local residents in the near vicinity of installation and

[21] Weston Solutions, 2006. *Chollas Creek TMDL Source Loading, Best Management Practices, and Monitoring Strategy Assessment,* September, 2006.

maintenance activities may be exposed to noise and possible vibration. The cumulative effects, both in terms of added noise and vibration at multiple metals TMDL installation sites, and in the context of other related projects, are not likely to be cumulatively considerable due to the temporary nature of noise increases and the small scale of the projects. Noise mitigation methods including scheduling of construction are discussed above, and should be used to keep cumulative noise and vibration affects to acceptable levels.

Air Quality - Implementation of the metals TMDLs program may cause additional emissions of air pollutants and slightly elevated levels of carbon monoxide during construction activities. Emission of air pollutants resulting from installation of TMDL compliance devices may exceed certain regulatory thresholds, and therefore the TMDLs, in conjunction with all other construction activity, may contribute to the region's overall exceedance of certain regulatory thresholds during the installation period. However, because these installation-related emissions are temporary, compliance with the TMDLs would not result in long-term cumulatively considerable air quality impacts. Short-term impacts can be avoided through scheduling.

Transportation and Circulation - Compliance with the metals TMDLs could involve installation activities occurring simultaneously at a number of sites along Chollas Creek and tributaries to the creek. Installation of metals reduction BMPs may occur in the same general time and space as other related or unrelated projects. In these instances, construction activities from all projects could produce cumulative traffic effects depending upon a range of factors including the specific location involved and the precise nature of the conditions created by the numerous construction activities. Special coordination efforts may be necessary to reduce the combined effects to an acceptable level. Overall, cumulatively considerable impacts are not anticipated because coordination can occur and because transportation mitigation methods are available.

Public Services - The cumulative effects on public services due to the metals TMDLs would be limited to traffic inconveniences. These effects are not likely to be cumulatively considerable as long as alternative traffic route are available around construction sites.

Aesthetics - Construction activities associated with other related projects may be ongoing in the vicinity of one or more metals TMDL construction sites. To the extent that combined construction activities do occur, there would be temporary elevated adverse visual effects. However, these effects are not cumulatively considerable in the long-term because the effects will cease with the completion of construction. Short-term impacts can be avoided through scheduling.

As analyzed above, the construction of structural BMP, along with other construction and maintenance projects, could have short-term cumulative effects; however, these effects can be mitigated through proper construction scheduling. In addition, these effects are not cumulatively considerable in the long-term because the effects will cease with the completion of construction. In summary, appropriate and available mitigation measures, including scheduling, are available to reduce adverse environmental impacts associated with construction to less than significant levels.

21. Mandatory Findings of Significance - Substantial adverse: Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?

Answer: Less than significant with mitigation

Discussion: All of the potentially significant impacts to human beings, such as air quality, noise, aesthetics, alterations to utilities, fire protection, police protections etc., are either short-term in nature, or can be mitigated to acceptable levels as previously discussed.

5.1 Alternative Means of Compliance

The CEQA requires an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate the identified impacts.[22] The dischargers can use the structural and non-structural BMPs described in section 3, or other structural and non-structural BMPs, to control and prevent pollution, and meet the TMDLs' required load reductions. The alternative means of compliance with the TMDLs consist of the different combinations of structural and non-structural BMPs that the dischargers might use. Because there are innumerable ways to combine BMPs, all of the possible alternative means of compliance cannot be discussed here. However, because most of the adverse environmental effects are associated with the construction and installation of large scale structural BMPs, to avoid or eliminate impacts, compliance alternatives should minimize structural BMPs, maximize non-structural BMPs, and site, size, and design structural BMPs in ways to minimize environmental effects.

For example, in a residential area where metals loading is not as high as in commercial or roadways areas, the dischargers might be able to reduce metals loading through nonstructural BMPs like increased street sweeping, development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and development and enforcement of municipal ordinances prohibiting nuisance flows. This compliance alternative would be environmentally superior to constructing detention basins and treatment works in residential areas.

As an additional example, in a commercial area where metals loading is typically as high or higher than all other areas including, residential, roadways, open space, and industrial, the dischargers might be able to reduce metals loading through nonstructural and structural BMPs. Non-structural BMPs may include increased street sweeping, development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and

[22] 14 CCR section 15187 (c) (3)

development and enforcement of municipal ordinances prohibiting nuisance flows. Structural BMPs may include small storm drain sand filters. This compliance alternative would be environmentally superior to constructing large detention basins and treatment works in commercial areas.

6 Reasonably Foreseeable Methods of Compliance at Specific Sites

The most reasonably foreseeable method of compliance with this Basin Plan amendment establishing TMDLs for copper, lead, and zinc is through the implementation of BMPs. The Chollas Creek watershed is highly urbanized and includes the following land uses; residential, commercial/institutional, industrial, roadways, and open space. These land uses have varying geographic settings and population densities, however, generalization is possible. For example, the residential land use has a suburban developed geographical setting with a relatively high population density, while the open space land use has a more natural, undeveloped geographical setting with a relatively low population density. Potential site specific BMPs (both structural and non-structural), or combinations of BMPs, that will likely be employed to reduce copper, lead, and zinc will vary from site to site. However, specific land uses will probably require BMPs that reflect the typical copper, lead, and zinc loading associated with that land use. For example, major traffic intersections in the commercial/institutional land use areas will likely generate higher copper waste (due to automobile braking) than the residential land use where vehicular traffic is much lower. Therefore, a more intensive combination of BMPs may be required in the commercial/institutional land use areas compared to the residential land use areas.

Following is a discussion of reasonably foreseeable BMP combinations that could potentially be implemented in the land use areas listed above based on conditions at specific sites in the Chollas Creek watershed. Also included is an analysis of the possible impacts to the environment. Keep in mind that in the Environmental Checklist (section 4) and Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures (section 5) above, all short term environmental impacts, as a result of BMP implementation, were found to be less than significant with mitigation, less than significant, or of no impact. However, three possible long term impacts were consider potentially significant, including implementing BMPs which could change the amount of surface waters, alter the flow rate of groundwaters, or alter the quantity or quality of groundwaters.

The dischargers are in no way limited to the following BMP combinations, and may choose not to implement BMPs at the specific sites discussed below. The actual BMPs to be implemented will be determined by the dischargers, after careful analysis of the site specific characteristics of the locations where the dischargers intend to implement the BMPs.

6.1 Potential BMPs for Residential Land Use Areas

The site specific BMPs to be implemented in the Residential land use areas will be chosen by the dischargers after adoption of these TMDLs. The residential land use has a suburban developed geographical setting marked by both high and low building and population densities depending on the neighborhood. Vehicular traffic, which is correlated with higher metals concentrations, is higher than in open space areas but lower than in commercial/institutional, industrial, and roadway land use areas. The source analysis indicates that residential land use areas account for less than 10 percent of the wet weather loading of copper, lead, and zinc to Chollas Creek (Technical Report Figures 5.4, 5.5, and 5.6). Therefore, residential land use areas, like the area shown in Figure I.1, may only require non-structural BMPs.

Figure I.1. Residential land use in Chollas Creek watershed located at the intersection of N. Thorn Street and S. Thorn Street.

Potential non-structural BMPs at this specific site could include (1) increased street sweeping, and (2) development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and (3) development and enforcement of municipal ordinances prohibiting nuisance flows.

Non-structural BMPs

Increasing street sweeping and the development and enforcement of municipal ordinances prohibiting exposure of copper, lead, and zinc materials to stormwater and stormwater drainage pathways, have no foreseeable potentially significant impacts. However, the development and enforcement of municipal ordinances prohibiting nuisance flows may change the amount of surface water in Chollas Creek. This would impact the water which is available to in-channel wetlands. However, it was noted that wetlands in Chollas Creek are not high value wetlands because of the predominance of *Arundo donax*, and invasive plant species, and that the reduction of nuisance flows would return Chollas Creek to predevelopment conditions, i.e., a seasonal, ephemeral stream which does not support dry season wetlands. Additional benefits of nuisance flow reductions include elimination of non-targeted pollutants (such as lawn fertilizers and pesticides) in Chollas Creek. For a more thorough discussion of potential impacts, please see the Environmental Checklist (section 4) and Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures (section 5) above.

6.2 Potential BMPs for Commercial/Institutional Land Use Areas

The potential site specific BMPs to be implemented in the commercial/institutional land use areas will be chosen by the dischargers after adoption of these TMDLs. The commercial/institutional land use has an urban developed geographical setting marked by high building and population densities. Vehicular traffic, which is correlated with higher metals concentrations, is higher than in open space, residential, and industrial areas but lower than in the roadway land use area. The source analysis indicates that commercial/institutional land use areas account for more than 35 percent of the wet weather loading of copper, lead, and zinc to Chollas Creek (Technical Report Figures 5.4, 5.5, and 5.6). Therefore, commercial/institutional land use areas, like the one shown in Figure I.2, likely will require both structural and non-structural BMPs due to higher building densities and vehicular traffic.

Figure I.2. Commercial land use in Chollas Creek watershed located at the intersection of 54th Street and Redwood Street.

Potential non-structural BMPs at this specific site could include (1) increased street sweeping, and (2) development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and (3) development and enforcement of municipal ordinances prohibiting nuisance flows. Potential structural BMPs for this specific site could include sand filter storm drain retrofits and porous pavements.

Non-structural BMPs

Increasing street sweeping and the development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, have no foreseeable potentially significant impacts. However, the development and enforcement of municipal ordinances prohibiting nuisance flows may change the amount of surface water in Chollas Creek. This would impact the water which is available to in-channel wetlands. However, it was noted that wetlands in Chollas Creek are not high value wetlands because of the predominance of *Arundo donax*, and invasive plant species, and that the reduction of nuisance flows would return Chollas Creek to predevelopment conditions, i.e., a seasonal, ephemeral stream which does not support dry season wetlands. Additional benefits of nuisance flow reductions include elimination of non-targeted pollutants (such as lawn fertilizers and pesticides) in Chollas Creek.

Structural BMPs

Sand filter storm drain retrofit BMPs that are well maintained by municipal agencies have the advantage of high metals treatment effectiveness and no foreseeable potentially significant adverse environmental impacts. Sand filter storm drain retrofit BMPs are not expected to change the amount of surface waters, alter the flow rate of groundwaters, or alter the quantity or quality of groundwaters. Additionally, the impermeable hardscape in the area dividing the roadways shown in the picture above could be replaced with porous pavement. Installing and maintaining porous pavement systems that allow storm water to infiltrate into groundwater and come into contact with organic material in the soil, are effective metals BMPs. Storm water coming into contact with soil as overland flow can benefit from metals reductions. However, porous pavement BMPs may change the amount of surface waters, may alter the flow rate of groundwaters, and/or may alter the quantity or quality of groundwaters. None of these changes will result in adverse impacts to the environment. For a more thorough discussion of potential impacts, please see the Environmental Checklist (section 4) and Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures (section 5) above.

6.3 Potential BMPs for Industrial Land Use Areas

The potential site specific BMPs to be implemented in the industrial land use areas will be chosen by the dischargers after adoption of these TMDLs. The industrial land use has an urban developed geographical setting marked by high building density but low population density. Vehicular traffic, which is correlated with higher metals concentrations, is higher than in open space and residential areas but lower than in the commercial and roadway land use areas. The source analysis indicates that industrial land use areas account for less than 5 percent of the wet weather loading of copper, lead, and zinc to Chollas Creek (Technical Report Figures 5.4, 5.5, and 5.6). However, because of the relatively higher concentration of vehicular traffic, higher concentrations of metals are expected in these areas. Therefore, industrial land use areas, like the one shown in Figure I.3, likely will require both structural and non-structural BMPs due to higher building densities and vehicular traffic.

Figure I.3. Industrial land use in Chollas Creek watershed located near the intersection of 30th Street and Market Street.

Potential non-structural BMPs at this specific site could include (1) increased street sweeping, and (2) development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and (3) development and enforcement of municipal ordinances prohibiting nuisance flows. Potential structural BMPs for this specific site could include sand filter storm drain retrofits and porous pavements.

Non-structural BMPs

Increasing street sweeping and the development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, have no foreseeable potentially significant impacts. However, the development and enforcement of municipal ordinances prohibiting nuisance flows may change the amount of surface water in Chollas Creek. This would impact the water which is available to in-channel wetlands. However, it was noted that wetlands in Chollas Creek are not high value wetlands because of the predominance of *Arundo donax*, and invasive plant species, and that the reduction of nuisance flows would return Chollas Creek to predevelopment conditions, i.e., a seasonal, ephemeral stream which does not support dry season wetlands. Additional benefits of nuisance flow reductions include elimination of non-targeted pollutants (such as lawn fertilizers and pesticides) in Chollas Creek.

Structural BMPs

Sand filter storm drain retrofit BMPs that are well maintained by municipal agencies have the advantage of high metals treatment effectiveness and no foreseeable potentially significant adverse environmental impacts. Sand filter storm drain retrofit BMPs are not expected to change the amount of surface waters, alter the flow rate of groundwaters, or alter the quantity or quality of groundwaters. Additionally, parking lots and other hardscape areas could be converted to porous pavement. Installing and maintaining porous pavement systems that allow storm water to infiltrate into groundwater and come into contact with biological systems in the soil, are effective metals BMPs. Storm water coming into contact with soil as overland flow can benefit from metals reductions. However, porous pavement BMPs may change the amount of surface waters, may alter the flow rate of groundwaters, and/or may alter the quantity or quality of groundwaters. None of these changes will result in adverse impacts to the environment. For a more thorough discussion of potential impacts, please see the Environmental Checklist (section 4) and Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures (section 5) above.

6.4 Potential BMPs for Roadways Land Use Areas

The site specific BMPs to be implemented in the roadways land use areas will be chosen by the dischargers after adoption of these TMDLs. The roadways land use has an urban developed geographical setting marked by both high and low building and population densities depending on the neighborhood. Vehicular traffic, which is correlated with higher metals concentrations, is higher than that all other areas, including open space areas, commercial/institutional, industrial, and residential land use areas. The source analysis indicates that roadways land use areas account for more than 27 percent of the wet weather loading of copper, lead, and zinc to Chollas Creek (Technical Report Figures 5.4, 5.5, and 5.6). Therefore, roadways land use areas, like the one shown in Figure I.4, likely will require both structural and non-structural BMPs due to higher vehicular traffic.

Figure I.4. Roadways land use in Chollas Creek watershed located at the intersection of Quince Street and Chollas Parkway.

Potential non-structural BMPs at this specific site could include (1) increased street sweeping, and (2) development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and (3) development and enforcement of municipal ordinances prohibiting nuisance flows. Potential structural BMPs for this specific site could include sand filter storm drain retrofits.

Non-structural BMPs

Increasing street sweeping and the development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, have no foreseeable potentially significant impacts. However, the development and enforcement of municipal ordinances prohibiting nuisance flows may change the amount of surface water in Chollas Creek. This would impact the water which is available to in-channel wetlands. However, it was noted that wetlands in Chollas Creek are not high value wetlands because of the predominance of *Arundo donax*, and invasive plant species, and that the reduction of nuisance flows would return Chollas Creek to predevelopment conditions, i.e., a seasonal, ephemeral stream which does not support dry season wetlands. Additional benefits of nuisance flow reductions include elimination of non-targeted pollutants (such as lawn fertilizers and pesticides) in Chollas Creek.

Structural BMPs

Sand filter storm drain retrofit BMPs that are well maintained by municipal agencies have the advantage of high metals treatment effectiveness and no foreseeable potentially significant adverse environmental impacts. Sand filter storm drain retrofit BMPs are not expected to change the amount of surface waters, alter the flow rate of groundwaters, or alter the quantity or quality of groundwaters. For a more thorough discussion of potential impacts, please see the Environmental Checklist (section 4) and Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures (section 5) above.

6.5 Potential Site Specific BMPs for Open Space Land Use Areas

The site specific BMPs to be implemented in the open space land use areas will be chosen by the dischargers after adoption of these TMDLs. The open space land use has a natural, undeveloped geographical setting with a relatively low population density. Vehicular traffic, which is correlated with higher metals concentrations, is lower than all other areas, including residential, commercial/institutional, industrial, and roadway land use areas. The source analysis indicates that open space land use areas account for less than 1 percent of the wet weather loading of copper, lead, and zinc to Chollas Creek (Technical Report Figures 5.4, 5.5, and 5.6). Therefore, open space land use areas, like the one shown in Figure I.5, may require no BMPs, or may require non-structural BMPs only, due to lower vehicular traffic. However, because of the availability of undeveloped space, the dischargers might choose open space areas to construct detention basins.

Figure I.5. Open Space land use in Chollas Creek watershed located at the intersection of Quince Street and Chollas Parkway.

Potential non-structural BMPs at this specific site could include (1) increased street sweeping, and (2) development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, and (3) development and enforcement of municipal ordinances prohibiting nuisance flows.

Non-structural BMPs

Increasing street sweeping and the development and enforcement of municipal ordinances prohibiting exposure of copper, lead and zinc materials to stormwater and stormwater drainage pathways, have no foreseeable potentially significant impacts. However, the development and enforcement of municipal ordinances prohibiting nuisance flows may change the amount of surface water in Chollas Creek. This would impact the water which is available to in-channel wetlands. However, it was noted that wetlands in Chollas Creek are not high value wetlands because of the predominance of *Arundo donax*, and invasive plant species, and that the reduction of nuisance flows would return Chollas Creek to predevelopment conditions, i.e., a seasonal, ephemeral stream which does not support dry season wetlands. Additional benefits of nuisance flow reductions include elimination of non-targeted pollutants (such as lawn fertilizers and pesticides) in Chollas Creek.

Structural BMPs

Open spaces shown in the picture above could be seen as an opportunity for detention basin BMPs. Installing and maintaining detention basin systems that allow storm water to infiltrate into groundwater and come into contact with biological systems in the soil, are effect metals BMPs. However, detention basin BMPs may alter the flow rate of groundwaters, and/or may alter the quantity or quality of groundwaters. In both cases, appropriate mitigation measures have been identified in section 5 above. For a more thorough discussion of potential impacts, please see the Environmental Checklist (section 4) and Discussion of Possible Environmental Impacts of Reasonably Foreseeable Compliance Methods and Mitigation Measures (section 5) above.

7 Economic Factors

As stated in section 1.2, the environmental analysis required by the CEQA must take into account a reasonable range of economic factors. This section on economic factors contains an estimate of the costs of implementing the reasonably foreseeable methods of compliance with the metals TMDLs Basin Plan amendment. Specifically, this analysis estimates the costs of implementing the structural and non-structural BMPs, discussed in section 3, which could be used to reduce copper, lead, and zinc loading to Chollas Creek. Implementation of these TMDLs will also entail water quality monitoring. This section provides information on the costs of collecting, transporting, and analyzing a water sample for copper, lead, and zinc.

The specific BMPs to be implemented will be chosen by the dischargers after adoption of these TMDLs. All costs are preliminary estimates only, since particular elements of a BMP, such as type, size, and location, would need to be developed to provide a basis for more accurate cost estimations. Identifying the specific BMPs that dischargers will choose to implement is speculative at this time. Therefore, this section discloses typical costs of conventional stormwater BMPs, as discussed above.

7.1 Cost Estimates of Typical BMPs for Stormwater and Urban Runoff Discharges

Approximate costs associated with typical non-structural and structural BMPs that might be implemented in order to comply with the requirements of these TMDLs are provided below. The BMPs are divided into non-structural and structural classes. Some BMPs may already be implemented in Chollas Creek in compliance with San Diego Water Board Order No. R9-2006-0011.

Non-Structural BMPs

Education and Outreach: Education and outreach to residents, businesses and industries can be a very effective tool. These efforts might be focused on the reduction of metal releases from the activities associated with the normal operation of automobiles. The cost of producing educational materials, organizing field trips, holding meetings, etc. will vary with the scope of efforts and are estimated to be between $1,000 to $200,000.[23] Because education and outreach is a component of Order No. R9-2006-0011, which regulates urban runoff discharges, costs to develop and conduct outreach and educational programs to comply with the TMDLs' requirements are expected to be minimal.

Road and Street Maintenance: Another effective BMP to prevent pollutants from entering the MS4 is to maintain clean sidewalks, streets, and gutters. The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a street sweeper is approximately $60,000 for a mechanical street sweeper and $180,000 for a vacuum-assisted street sweeper. The average useful life of a sweeper is about four to eight years. Operation and maintenance costs for street sweeper were estimated at $30/curb mile for mechanical street sweepers and $15/curb mile for vacuum-assisted street sweepers.[24] Increased street sweeping could lead to faster wear and tear of the road surface, which would add additional costs for road repair work. This particular BMP may prove to be more cost-effective than certain structural controls, especially in more urbanized areas with greater areas of pavement.

Illicit Discharges: Illicit discharges to the stormwater system can be identified through visual inspections during dry weather or through the use of smoke or dye tests. The costs of smoke and dye tests vary from $1,250 to $1,750. The overall costs associated with compliance with the TMDLs are expected to be relatively minor since the identification of illicit discharges is an important component of compliance with Order No. 2001-0001 regulating urban runoff discharges.

Inspections/Enforcement of Ordinances: The costs associated with inspections and enforcement of local ordinances include staffing, travel and administrative costs. The costs to comply with the TMDLs' requirements are expected to be relatively minor since inspections are an important component of compliance with Order No. R9-2006-0011 (municipal dischargers) and Order No. 99-06-DWQ (Caltrans).

Structural BMPs

Vegetated Swales and Buffer Strips: The costs associated with vegetated swales and vegetated buffer strips vary and are dependent of the costs associated with establishing the vegetation.[25] The USEPA estimated costs ranging from $3,500 for vegetated swales, to $0 to $9,000 for buffer strips to treat a 5-acre residential site.[26] Caltrans reported that the actual costs for installation of an infiltration trench that treats a 2-acre site (100 percent impervious area) was between $203,000 and $294,000.[27]

Bioretention: Bioretention areas are landscaping features adapted to provide on-site treatment of storm water runoff (USEPA, 1999, National Menu of Best Management

[23] USEPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. [EPA-821-R-99-012. August 1999].
[24] Ibid.
[25] Ibid
[26] Ibid.
[27] Caltrans. 2004. Report ID CTSW-RT-01-050

Practices for Stormwater-Phase II).[28] Field and laboratory analysis of bioretention facilities show high removal rates of copper (43 to 97 percent), lead (70 to 95 percent), and zinc (64 to 95 percent). Bioretention facilities are relatively expensive. The USEPA reported the following cost equation to estimate this storm water management practice, adjusting for inflation:

$$\mathbf{C = 7.30\ V^{0.99}}$$

where:

C = Construction, design, and permitting cost ($); and

V = Volume of water treated by the facility (ft^3).

Consideration should be made when evaluating the costs of bioretention that the practice replaces areas that most likely would have been landscaped. The true cost of the practice is therefore less than the construction cost reported. Maintenance activities conducted on bioretention facilities were also not found to be very different from maintenance of a landscaped area. The USEPA estimated the cost around $60,000 for a bioretention area that treats a 5-acre commercial site.[29] Caltrans reported actual costs of a bio-swale that treats a 3-acre site at Interstate 5 and Palomar to be $136,000.

Detention Basins and Retention Ponds: The costs vary depending on the volume of the basin. Costs for retention and detention basins are estimated at approximately $100,000 for a 50-acre residential site.[30]

Sand Filters: The USEPA reported that the typical cost of installation of sand filters, of various designs (in some instances including pumps), ranged between $2.50 and $7.50 per cubic foot of stormwater treated, with an average cost of about $5 per cubic foot (USEPA, 1999). The cost to treat a 5-acre commercial site was estimated between $35,000 and $70,000.[31] The cost per impervious acre treated varied considerably depending on the region and design used. The observed volume of stormwater in the Chollas Creek watershed from Table F-4 in Appendix F of this report for the 2001 through 2003 storm years[32] is 1,646,496,115 liters. Dividing this number by two and converting to cubic feet gives an average of 29,072,731 cubic feet of stormwater per year. Therefore, the maximum cost of using sand filters to treat all Chollas Creek stormwater could range from approximately $70 to $220 million. The average expected costs would be $145 million.

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[28] http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm
[29] USEPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. [EPA-821-R-99-012]. August 1999.
[30] Ibid.
[31] Ibid.
[32] These estimates come from only two years of storm flow observations. These years may or may not represent the average flow volume experienced in Chollas Creek.

Additionally, Caltrans reported that the mean cost for the Austin Sand Filter is $1,447 per cubic meter of stormwater treated.[33] Therefore, using the same average volume of yearly stormwater (29,072,731 cubic feet = 823,284 cubic meters), the average cost for treating all of Chollas Creek's stormwater would be $1.19 billion.

Porous Pavement / Infiltration Systems: The USEPA reported that the typical cost of installation of porous pavement systems was $8.20 per square foot of pavement installed (USEPA, 1999). Maintenance cost were estimated at $200 per acre per year.

Diversion Systems: If no other on-site treatment options are available, diverting the polluted runoff to the sanitary sewer systems treatment plant may be considered. An individual diversion structure was estimated to cost about one million dollars, which does not include maintenance costs. The maintenance costs could be significant due to the need for regular inspections and maintenance of the diversion structures (Ruth Kolb, City of San Diego, personal communication, March 14, 2005).

7.2 Cost Estimate Summary for Non-Structural and Structural BMPs

Table I.1 summarizes the estimated costs for the specific BMPs that were evaluated. Costs for structural BMPs were estimated for treatment of ten percent of the urbanized watershed area (approximately 1,370 acres) with the exception of diversion structures, which are costs per unit. Cost estimates are provided in increments of 10 percent to allow for upward scaling of costs since the exact combination, size, and siting of structural BMPs is not known. For example, using the 10 percent cost estimates provided in Table I.2 below, a cost estimate for treatment of 100 percent of the watershed could easily be calculated by multiplying the 10 percent cost estimate by 10. The cost of treating 50 percent of the watershed could be calculated by multiplying the 10 percent cost estimate by five and so on.

TABLE I.1: Summary of Cost Estimates for Non-Structural BMPs

Non-Structural BMPs	Estimated Cost*	Estimated Cost Adjusted For Inflation 2006 Dollars**
Education and Outreach	$1,000 - $200,000 per program	$1,210 - $242,000 per program
Street Sweeping	$ 60,000 - $180,000 per unit	$ 72,600 - $218,000 per unit
Illicit Discharges	$0 to $1,750	$0 to $2,120

*The costs were obtained from USEPA, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. (EPA-821-R-99-012). August 1999.
** Sahr, R.C. 2007. Consumer Price Index (CPI) Conversion Factors 1800 to Estimated 2016 to Convert to Dollars of 2006. Oregon State University, Political Science Department, Corvallis, OR. Revised January 18, 2006.

[33] Caltrans. 2004. Report ID CTSW-RT-01-050

TABLE I.2: Summary of Cost Estimates for Structural BMPs

Structural BMPs	Estimated Cost to treat 10% of Urbanized Area (ECUA 10%)	ECUA 10% Adjusted For Inflation 2006 Dollars*****	Estimated Yearly Maintenance Cost (EYMC)	EYMC Adjusted For Inflation 2006 Dollars*****
Vegetated Swale	$960,000*	$1.2 million	$67,000	$81,000
Vegetated Buffer Strip	$1.2 million*	$1.45 million	$120,000	$145,000
Infiltration Trench	$60 Million	$64 Million	$5.8 Million	$6.2 Million
Bioretention	$16.4 million*	$19.9 million	$1.1 million	$1.3 million
Detention Basins and Retention Ponds	$2.7million*	$3.3 million	$27,000	$33,000
Sand Filters	$15 million*	$18.2 million	$2 million	$2.4 million
Austin Sand Filters	$119 million**	$127 million	$6.4 Million	$6.8 Million
Porous Pavement	$490 Million***	$593 Million	$274,000	$332,000
Diversion	$1 million****	$1.03 million	$10,000	$10,300

* Based on USEPA, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. [EPA-821-R-99-012. August 1999].
** Based on Caltrans, 2004. Report ID CTSW-RT-01-050.
*** Based on USEPA, 1999 Storm Water Technology Fact Sheet Porous Pavement [EPA 823-F-023]
**** Cost per unit. Based on personal communication with Ruth Kolb, City of San Diego, March 14, 2005.
***** Sahr, R.C. 2007. Consumer Price Index (CPI) Conversion Factors 1800 to Estimated 2016 to Convert to Dollars of 2006. Oregon State University, Political Science Department, Corvallis, OR. Revised January 18, 2006.

7.3 Cost Estimates for Surface Water Monitoring

Investigation Order No. R9-2004-0227[34] already includes a monitoring and reporting program for dissolved metals in Chollas Creek. Whether or not TMDL implementation will require an expansion of this monitoring program is not known at this time, but will be evaluated by the San Diego Water Board following adoption of these TMDLs. In the event that additional monitoring locations or frequencies are needed beyond the requirements of the Investigation Order, the costs of collecting, transporting, and analyzing a water sample for copper, lead, and zinc is estimated below.

The costs disclosed are that of a two-person team, day-long sampling effort. The laboratory analytical costs were taken from the San Diego Water Board's Laboratory Services Contract cost tables. Where different analytical methods were available, the more expensive method was used in the estimate. Staff costs were estimated based on a two person sampling team in the field for an 8-hour day. The staff costs were estimated based on a billing rate of $110 per hour, the rate used for billing San Diego Water Board staff costs in the Cost Recovery Programs. This rate includes overhead costs. The vehicle costs were estimated assuming a distance traveled of 25 miles per day, and a vehicle cost of $0.48 per mile, the per diem reimbursement rate for San Diego Water

[34] Investigative Order No. R9-2004-0227 [CWC section 13383], *California Department of Transportation and San Diego Municipal Separate Storm Sewer System Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California*

Board staff when they use their own cars for State business. This analysis assumes that the dischargers possess basic field monitoring equipment, including meters to measure temperature, conductivity, and pH, and equipment to measure flow in the field. No additional costs were computed for these items. Surface water monitoring costs are summarized in the table below. Assuming that a two-person sampling team can collect samples at 5 sites per day, the total cost for one day of sampling would be $1,907.

Table I.3: Cost Estimates for Surface Water Monitoring

Expenditure	Cost per Unit
Laboratory Analyses	
Copper (total)	$9 per sample
Lead	$9 per sample
Zinc	$9 per sample
Staff Costs	$220 per hr
Vehicle Costs	$12 per 25 mi

8 Reasonable Alternatives to the Proposed Activity

The environmental analysis must include an analysis of reasonable alternatives to the proposed activity.[35] The proposed activity is a Basin Plan Amendment to incorporate TMDLs for copper, lead, and zinc in Chollas Creek. The purpose of this analysis is to determine if there is an alternative that would feasibly attain the basic objective of the rule or regulation (the proposed activity), but would lessen, avoid, or eliminate any identified impacts. The alternatives analyzed include taking no action, and modifying water quality standards in Chollas Creek. In addition, two alternative time schedules for implementing load reductions to meet the TMDLs were analyzed. These alternatives are discussed in the subsections below.

8.1 No Action Alternative

Under the "no action" alternative, the San Diego Water Board would not adopt the proposed metals TMDLs Basin Plan amendment, and metals loading would likely continue at current levels. The "no action" alternative 1) does not comply with the Clean Water Act; 2) is inconsistent with the mission of the San Diego Water Board; and 3) does not meet the purpose of the proposed metals TMDLs Basin Plan Amendment. Under CWA section 303(d), TMDL development is not discretionary; the San Diego Water Board is obligated to adopt TMDL projects for waters that do not meet water quality standards.[36] Therefore the "no action" alternative is not viable and cannot be considered an acceptable alternative.

[35] 23 CCR section 3777

[36] Water quality standards are comprised of designated beneficial uses, the applicable numeric and/or narrative WQOs to protect those uses, and the State Water Board's anti-degradation policy provisions (Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*).

8.2 Water Quality Standards Action

Another alternative to adopting the metals TMDLs Basin Plan amendment is the modification of water quality standards. If the applicable standards are not appropriate, a plausible regulatory response may be to correct the standards through mechanisms such as a use attainability analysis (UAA) or a site-specific objective (SSO). If the WARM and WILD beneficial uses are improperly designated for Chollas Creek, or if SSOs for copper, lead, and zinc would be less stringent than the current California Toxic Rule water quality objectives, the TMDLs might not be necessary, or the required pollutant load reductions might be lower. This alternative might lessen or eliminate the adverse impacts associated with constructing structural BMPs by eliminating the need for structural BMPs or reducing the number of structural BMPs necessary. This alternative should not be construed as implying that standards may be changed as a convenient means of "restoring" waterbodies. To the contrary, federal and state law contain numerous detailed requirements that in many cases would prevent modifications of the standards, especially if modifications would result in less stringent waste discharge requirements. However, modification of standards may be appropriate to make uses more specific, to manage conflicting uses, to address site-specific conditions, and for other such reasons.[37]

As a first step in developing TMDLs, the San Diego Water Board confirmed the impairment status of Chollas Creek and determined, from the available evidence, that concentrations of dissolved copper, lead, and zinc in Chollas Creek exceeded water quality objectives that support WARM and WILD beneficial uses. At this time, the San Diego Water Board has no evidence that WARM and WILD beneficial uses were inappropriately designated for Chollas Creek. Therefore based on the available information, an action to de-designate these beneficial uses may be harmful to the environment, and this option is not preferred.

Developing SSOs for dissolved copper, lead, and/or zinc in Chollas Creek may be appropriate if scientific studies demonstrate that the ambient water chemistry and/or biological communities at Chollas Creek are significantly different from the chemistry and biological communities upon which the current objectives are based. SSOs should be (1) based on sound scientific rationale; (2) protect the designated beneficial uses of Chollas Creek waters; and (3) be adopted by the San Diego Water Board in a Basin Plan amendment.

There are no efforts currently underway or planned by interested persons to fund the scientific studies needed to develop SSOs for metals in Chollas Creek. Furthermore, the development of SSOs for metals in Chollas Creek, including the scientific studies necessary to support them, would be costly, time consuming, and resource intensive.

Even in the event that scientific studies were initiated and SSOs developed and adopted, the need for TMDLs likely would not be eliminated. If SSOs for metals were developed in the future and adopted, this metals TMDLs Basin Plan Amendment would be modified

[37] State Water Board 2005. *A Process for Addressing Impaired Waters in California*, June 2005

accordingly. If interested parties were willing to fund and oversee development of scientific studies to investigate SSOs, the most effective and expeditious means to improve water quality would be to conduct these studies concurrent with actions necessary to achieve compliance with these current TMDLs.

8.3 10-Year Compliance Schedule for Metals Load Reductions Only

The compliance schedule is part of the TMDLs' Implementation Plan and describes the pollutant load reduction milestones that dischargers must achieve to meet interim goals and the final TMDLs. The first version of the proposed Chollas Creek Metals TMDLs (June 2005), called for an aggressive 10-year compliance schedule for dischargers to implement structural and non-structural BMPs to reduce loading of dissolved copper, lead, and zinc. This compliance schedule has the environmental advantage of restoring water quality in Chollas Creek in a relatively short time frame, but may not provide enough time for dischargers to integrate BMP planning, design, and implementation to reduce bacteria, diazinon, and trash loading which also contribute to water quality problems in the watershed.

8.4 20-Year Compliance Schedule for Metals, Bacteria, Diazinon, and Trash Reductions

As opposed to the previous alternative, this approach allows the dischargers to engage in comprehensive BMP planning for all pollutants impairing water quality in Chollas Creek. Instead of meeting the requirements of these metals TMDLs independently, dischargers would utilize a longer compliance schedule (20 years) to address multiple pollutants.

Due to the environmental impacts anticipated from constructing BMPs in the aggressive schedule described in the previous alternative, the City of San Diego funded an assessment of BMP strategies that would lessen the anticipated impacts. In this study,[38] the authors recommend an alternative strategy that used a tiered or phased approach that reduces the impact to the environment, and allows for more cost effective implementation of lower-impact BMPs. The tiered approach consists of three major components:

- Tier 1 – Control of Pollutants at the Source and Prevent Pollutants from Entering Runoff
- Tier 2 – Conduct Design Studies and Implement Aggressive Street Sweeping and Runoff and Treatment Volume Reduction BMPs
- Tier 3 – Infrastructure Intensive Treatment BMPs

To address additional time requirements to implement a lower-impact and cost effective program that will meet the integrated TMDL goals, the authors recommend a compliance time schedule of 20 years. Tier 1 and 2 activities would be implemented on an aggressive timetable in targeted areas. Effective assessment monitoring would then be implemented to determine if these BMPs should be extended to other areas or modified to

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[38] Weston Solutions, 2006. *Chollas Creek TMDL Source Loading, Best Management Practices, and Monitoring Strategy Assessment,* September, 2006.

improve effectiveness. The approach is therefore an iterative process of implementation, assessment, and further implementation or improvement.

The authors of this study assert that a 20-year compliance schedule is necessary in order to:

- Meet an integrated TMDL strategy that address both current and anticipated TMDLs;
- Assess the effectiveness of the aggressive implementation of source control and pollution prevention BMPs in targeted areas to identify which techniques are more effective and to modify approaches and/or extend aggressive activities to other sub-watersheds in a cost effective manner;
- Collect needed data on the soils and hydrological conditions within the watershed to identify where lower-impact development techniques are best suited and what engineering modifications are needed to make these systems most effective;
- Assess the effectiveness of aggressive street sweeping in targeted areas to confirm that the integrated reduction goals are being met or if additional BMPs are needed along with other Tier 1 and Tier 2 activities;
- Work with communities in which these activities will be taking place and changes occurring within their neighborhood; and
- Acquire property and easements for sub-watersheds that will require retention of storm flows prior to treatment where Tier 1 and Tier 2 activities do not achieve the reduction goals.

In short, this alternative allows dischargers to choose low-impact BMPs that are designed to remove a comprehensive suite of common pollutants found in urban runoff. Using this approach, fewer structural BMPs will probably be needed compared to addressing each pollutant individually on a different compliance schedule. This approach should minimize the adverse environmental effects from installing such structures. Although the compliance schedule is longer, this approach addressed multiple pollutants, not just metals. Because of the efficiency and minimal adverse effects expected from this approach, this is the preferred alternative.

9 CEQA Determination

The implementation of these TMDLs will result in improved water quality in Chollas Creek, but it may result in temporary or permanent localized significant adverse impacts to the environment. Specific projects employed to implement the TMDLs may have significant impacts, but these impacts are expected to be limited, short-term, or may be mitigated through careful design and scheduling. The Technical Report, the draft Basin Plan amendment, and the Environmental Checklist and associated analysis provide the necessary information pursuant to state law[39] to conclude that properly designed and implemented structural or non-structural methods of compliance will not have a significant adverse effect on the environment, and all agencies responsible for implementing the TMDLs should ensure that their projects are properly designed and implemented. Any of the potential impacts need to be mitigated at a subsequent project

[39] Public Resources Code, section 21159

level because they involve specific sites and designs not specified or specifically required by the Basin Plan amendment to implement the TMDLs. At this stage, any more particularized conclusions would be speculative.

Specific projects that may have a significant impact would be subject to a separate environmental review. The lead agency for subsequent projects would be obligated to mitigate any impacts they identify, for example, by mitigating potential flooding impacts by designing the BMPs with adequate margins of safety.

Furthermore, implementation of the TMDLs is both necessary and beneficial. If at some time, it is determined that the alternatives, mitigation measures, or both, are not deemed feasible by those local agencies, the necessity of implementing the federally required TMDLs and removing the metals impairment from Chollas Creek (an action required to achieve the express, national policy of the Clean Water Act) remains.

The benefits of meeting water quality standards to achieve the expressed, national policy of the Clean Water Act far outweigh the potential adverse environmental impacts that may be associated with the projects undertaken by persons responsible for reducing discharges of copper, lead, and zinc pollutants to Chollas Creek. Meeting water quality standards and the national policy of the Clean Water Act is a benefit to the people of the state because of their paramount interest in the conservation, control, and utilization of the water resources of the state for beneficial use and enjoyment (Water Code section 13000). Furthermore, the health, safety and welfare of the people of the state requires that the state be prepared to exercise its full power and jurisdiction to protect the quality of waters in the state from degradation, particularly including degradation that unreasonably impairs the water quality necessary for beneficial uses.

Water quality that supports the beneficial uses of water are necessary for the survival and well being of people, plants, and animals. Warm Freshwater Habitat (WARM) and Wildlife Habitat (WILD) are beneficial uses of water that serve to promote the social and environmental goals of the people of the San Diego Region and require water quality suitable for the protection of aquatic life and aquatic dependent wildlife.

In addition, implementation of the TMDLs will have substantial benefits to water quality and will enhance beneficial uses. Enhancement of the WARM and WILD beneficial uses will have positive, indirect social and economic effects by increasing the natural habitat and aesthetic value of the Chollas Creek watershed. These substantial benefits outweigh any unavoidable temporary adverse environmental effects.

In accordance with state law,[40] the San Diego Water Board finds that, although the proposed project could have significant effect on the environment, revisions in the project to avoid or substantially lessen the impacts, can and should be made or agreed to by the project proponents. This finding is supported by the evidence provided in the impact evaluation section of this document, which indicates that all foreseeable impacts are either short-term or can be readily mitigated.

[40] Public Resources Code, section 15091

On the basis of the initial environmental review checklist and analysis, and Technical Report for these TMDLs, which collectively provide the required information;

☐ I find the proposed Basin Plan amendment could not have a significant effect on the environment.

☒ I find that the proposed Basin Plan amendment could have a significant adverse effect on the environment, but that those impacts should be mitigated. This substitute environmental documentation constitutes a program-level analysis. The Water Boards cannot specify manner of compliance. Any impacts that might occur as a result of specific implementation projects can and should be mitigated by the entity carrying out or permitting that project. However, there are feasible mitigation measures that would substantially lessen any significant adverse impacts. These mitigation measures are discussed above and in the Technical Report for the TMDLs.

☐ I find the proposed Basin Plan amendment may have a significant effect on the environment. There are no feasible alternatives and/or feasible mitigation measures available which would substantially lessen any significant adverse impacts. See the attached written report for a discussion of this determination.

______________________________________ June 13, 2007
John H. Robertus Date
Executive Officer

Appendix J

RESOLUTION NO. R9-2007-0043

AND

ATTACHMENT A

AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SAN DIEGO BASIN (9) TO INCORPORATE TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD, AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY,

AND TO REVISE THE TOXIC POLLUTANTS SECTION OF CHAPTER 3 TO REFERENCE THE CALIFORNIA TOXICS RULE

May 30, 2007

California Regional Water Quality Control Board
San Diego Region

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

RESOLUTION NO. R9-2007-0043

A RESOLUTION ADOPTING AN AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SAN DIEGO BASIN (9) TO INCORPORATE TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD, AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY,

AND TO REVISE THE TOXIC POLLUTANTS SECTION OF CHAPTER 3 TO REFERENCE THE CALIFORNIA TOXICS RULE

WHEREAS, The San Diego Regional Water Quality Control Board (hereinafter, San Diego Water Board), finds that:

1. **BASIN PLAN AMENDMENT**: Total Maximum Daily Loads (TMDLs) and allocations for pollutants that exceed water quality objectives in waterbodies that do not meet water quality standards under the conditions set forth in section 303(d) of the Clean Water Act [33 U.S.C. 1250, *et seq*., at 1313(d)] ("Water Quality Limited Segments") should be incorporated into the *Water Quality Control Plan for the San DiegoBasin (9)* (Basin Plan) pursuant to Article 3, commencing with section 13240, of Chapter 4 of the Porter-Cologne Water Quality Control Act, as amended, codified in Division 7, commencing with section 13000, of the Water Code.

2. **CLEAN WATER ACT SECTION 303(d)**: The lowest 1.2 miles of Chollas Creek (from the mouth of Chollas Creek at San Diego Bay to 1.2 miles inland) were placed on the List of Water Quality Limited Segments in 1996 due to levels of dissolved copper, lead, and zinc (metals) in the water column that exceeded numeric water quality objectives for copper, lead, and zinc, and narrative water quality objectives for toxicity, as required by Clean Water Act (CWA) section 303(d).

3. **BENEFICIAL USE IMPAIRMENTS**: Two beneficial uses exist in Chollas Creek that are sensitive to, and subject to impairment by elevated concentrations of dissolved metals in the water column. Warm Freshwater Habitat (WARM) and Wildlife Habitat (WILD) require water quality suitable for the protection of aquatic life and aquatic dependent wildlife. Dissolved metals are toxic to aquatic life and aquatic dependent wildlife at relatively low concentrations. Concentrations of dissolved metals in Chollas Creek exceed the water quality necessary to support the WARM and WILD beneficial uses of Chollas Creek.

4. **NECESSITY STANDARD** [Government Code section 11353(b)]: Amendment of the Basin Plan to establish and implement TMDLs for Chollas Creek is necessary because the existing water quality in the lowest 1.2 miles of Chollas Creek does not meet applicable

water quality objectives for copper, lead, zinc, or toxicity. CWA section 303(d) requires the establishment and implementation of TMDLs under the conditions that exist in Chollas Creek. TMDLs for copper, lead, and zinc are necessary to ensure attainment of applicable water quality objectives and restoration of water quality needed to support the beneficial uses designated for Chollas Creek.

5. **WATER QUALITY OBJECTIVES**: The United States Environmental Protection Agency (USEPA) has established numeric criteria for toxic pollutants which are applicable water quality objectives for dissolved copper, lead, and zinc in the inland surface waters, enclosed bays, and estuaries of California through promulgation of the California Toxics Rule (CTR). [40 CFR 131.38]. These water quality objectives, presented below, are applicable to Chollas Creek.

Water Quality Objectives for dissolved metals in Chollas Creek.

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Continuous Concentration
Copper	(1) * (0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(1) * (0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(1) * (0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

Hardness is expressed as milligrams per liter.
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)].
The natural log and exponential functions are represented as "ln" and "e," respectively.

In addition, the Basin Plan establishes the following narrative water quality objective for "toxicity" to ensure the protection of the WARM and WILD beneficial uses.

Toxicity Objective: *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the San Diego Water Board.*

The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water factors, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with requirements specified in USEPA, State Water Resources Control Board (State Board) or other protocol authorized by the San Diego Water Board. As *a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.*

In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.

6. **NUMERIC TARGETS**: Numeric targets are established for the purposes of calculating TMDLs. Since the numeric targets are equal to the water quality objectives in the CTR for dissolved copper, lead, and zinc cited in finding 5, attainment of TMDLs will ensure attainment of these water quality objectives.

7. **SOURCES OF DISSOLVED METALS**: Many land uses and activities associated with urbanization are sources of copper, lead, and zinc to Chollas Creek. Freeways and commercial/ industrial land uses are major contributors. Automobiles are a significant source of all three metals. Water supply systems, pesticides, industrial metal recyclers and other industrial activities also contribute to levels of copper, lead, and zinc in excess of water quality objectives for Chollas Creek. Metals released to the environment by different land uses and activities are washed off of the land surface by urban runoff and storm flows and conveyed to Chollas Creek through municipal separate storm sewer systems. Quantification of bacteria loading in all watersheds is necessary to calculate the load reductions required to meet TMDLs.

8. **WATER QUALITY OBJECTIVE VIOLATIONS**: Concentrations of dissolved copper, lead, and zinc have frequently exceeded numeric water quality objectives contained in the CTR. Furthermore, in a Toxicity Identification Evaluation performed in 1999, Chollas Creek stormwater concentrations of zinc and to a lesser extent copper, were identified as causing or contributing to reduced fertility in the purple sea urchin.

9. **ADVERSE EFFECTS OF COPPER, LEAD, AND ZINC**: Concentrations of copper, lead, and zinc in excess of CTR criteria entail increased risk of adverse toxic effects in aquatic organisms exposed to them. Copper, lead, and zinc may bioaccumulate within lower organisms, however they do not biomagnify up the food chain. Of these three metals, copper is considered the most potent toxin at environmentally relevant aqueous concentrations.

10. **TOTAL MAXIMUM DAILY LOADS AND ALLOCTIONS**: TMDLs for dissolved copper, lead, and zinc are equal to the total assimilative or loading capacity of Chollas Creek for dissolved copper, lead, and zinc. The loading capacities are defined as the maximum amount of each dissolved metal that Chollas Creek can assimilate and still attain water quality objectives needed for the protection of designated beneficial uses. Each TMDLS must accommodate all known sources of a pollutant, whether from natural background, nonpoint sources, or point sources, and must include a margin of safety (MOS) to preclude pollutant loading from exceeding the actual assimilative capacities of Chollas Creek. The TMDL calculations also account for seasonal variations and critical conditions and were developed in a manner consistent with guidelines published by the USEPA. The TMDLs are

concentration based, therefore, the allocations are not additive. The TMDLs for dissolved copper, lead, and zinc are equal to the Waste Load Allocations (WLAs) which are 90 percent of the CTR Criteria Continuous Concentration (CCC) and Criteria Maximum Concentration (CMC) equations. Discharges of dissolved copper, lead, and zinc require significant reductions from current levels to meet the allocations.

11. **IMPLEMENTATION PLAN**: The technical report entitled *Total Maximum Daily Loads for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay* dated May 30, 2007, presents a summary of measures that, if adopted by the San Diego Water Board, the State Water Resources Control Board (State Water Board), and local governmental agencies, will promote attainment of the load reductions needed to keep discharges of metals at or below the TMDLs calculated for Chollas Creek. Section 303 of the CWA and the federal National Pollutant Discharge Elimination System (NPDES) regulations direct the USEPA and authorized states to impose requirements consistent with TMDLs for point source discharges to "impaired" waterbodies. When the San Diego Water Board and the State Water Board re-issue or revise NPDES requirements for municipal, construction, and industrial stormwater discharges, and groundwater extraction discharges in the Chollas Creek watershed, including discharges of "small MS4s," they will have to include requirements that will implement all TMDLs applicable to waters affected by the regulated discharges.

12. **COMPLIANCE MONITORING**: Water quality monitoring will be necessary to assess progress in achieving WLAs and compliance in Chollas Creek with the water quality objectives for dissolved copper, lead, and zinc.

13. **COMPLIANCE SCHEDULE**: Full implementation of the TMDLs for dissolved copper, lead, and zinc shall be completed within 20 years from the effective date of the Basin Plan amendment. The compliance schedule for implementing the wasteload reductions required under these TMDLs is structured in a phased manner, with 80 percent of reductions required in 10 years, and 100 percent of reductions required within 20 years. The 20-year compliance schedule is contingent upon the dischargers implementing integrated controls to achieve required copper, lead, zinc, indicator bacteria, diazinon, and trash reductions.

14. **SCIENTIFIC PEER REVIEW**: The scientific basis of this TMDL has undergone external peer review pursuant to Health and Safety Code section 57004. The San Diego Water Board has considered and responded to all comments submitted by the peer review panel and has enhanced the Technical Report appropriately. No change to the fundamental approach to TMDL calculations was necessary as a result of this process.

15. **STAKEHOLDER AND PUBLIC PARTICIPATION**: Interested persons and the public have had reasonable opportunity to participate in review of the proposed TMDL. Efforts to solicit public review and comment included five public workshops held between April 1999 and April 2005, including a CEQA scoping meeting held on March 21, 2003; a public review and comment period of 45 days preceding the San Diego Water Board public hearing in May 2005; a two week extension of the comment period after the public hearing in May 2005; a second public review and comment period of 45 days commencing in July 2006; a third

public review and comment period of 45 days commencing on March 9, 2007; and a public hearing on April 25, 2007. Notices for all meetings were sent to interested parties including cities and San Diego County with jurisdiction in Chollas Creek. All of the written comments submitted to the San Diego Water Board during the review and comment periods have been considered, and written responses provided in Appendix M to the Technical Report.

16. **CEQA REQUIREMENTS**: Pursuant to Public Resources Code section 21080.5, the Resources Agency has approved the Regional Water Boards' basin planning process as a "certified regulatory program" that adequately satisfies the California Environmental Quality Act (CEQA) (Public Resources Code, section 21000 et seq.) requirements for preparing environmental documents. [14 CCR section 15251(g); 23 CCR section 3782] As such, the San Diego Water Board's basin planning documents together with an Environmental Checklist are the "substitute documents" that contain the required environmental documentation under CEQA. [23 CCR section 3777] The substitute documents for this project include the Environmental Checklist, the detailed technical report entitled *Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay*, responses to comments raised during the development of the TMDL, and this resolution. The project itself is the establishment of TMDLs for toxic metals in Chollas Creek where water quality has been listed as "impaired" by the State Water Board pursuant to section 303(d) of the CWA, as required by that section. While the San Diego Water Board has no discretion to not establish a TMDL (the TMDL is required by federal law) the San Diego Water Board does exercise discretion in assigning wasteload allocations, determining the program of implementation, and setting various milestones in achieving the water quality objectives for Chollas Creek.

17. **PROJECT IMPACTS:** The accompanying CEQA substitute documents satisfy the requirements of substitute documents for a Tier 1 environmental review under CEQA, pursuant to Public Resources Code section 21159 and CCR Title 14, section 15187. Nearly all of the compliance obligations anticipated to be necessary to implement the TMDLs for copper, lead, and zinc in Chollas Creek will be undertaken by public agencies that will have their own obligations under CEQA for implementation projects that could have significant environmental impacts (*e.g*., installation and operation of structural best management practices). Project level impacts will need to be considered in any subsequent environmental analysis performed by other public agencies pursuant to Public Resources Code section 21159.2.

    If not properly mitigated at the project level, implementation and compliance measures undertaken could have significant adverse environmental impacts. The substitute documents for this TMDL, and in particular the environmental checklist and responses to comments, identify broad mitigation approaches that should be considered at the project level. The San Diego Water Board does not engage in speculation or conjecture regarding the projects that may be used to implement the TMDLs and only considers the reasonably foreseeable alternative methods of compliance, the reasonably foreseeable feasible environmental impacts of the these methods of compliance, and the reasonably foreseeable mitigation measures which would avoid or eliminate the identified impacts, all from a broad general perspective consistent with the uncertainty regarding how the TMDLs, ultimately, will be implemented. The lengthy implementation period allowed by the TMDLs will allow persons responsible for compliance with wasteload allocations to develop and pursue many compliance approaches and mitigation measures.

18. **PROJECT MITIGATION:** The proposed amendment to the Basin Plan to establish TMDLs for copper, lead, and zinc in Chollas Creek could have a significant adverse effect on the environment. However, there are feasible alternatives, feasible mitigation measures, or both, that would substantially lessen any significant adverse impact. The public agencies responsible for implementation measures needed to comply with the TMDLs can and should incorporate such alternatives and mitigation into any projects or project approvals that they undertake for the impaired creek. Possible alternatives and mitigation are described in the CEQA substitute documents, specifically the Technical Report and the environmental checklist. To the extent the alternatives, mitigation measures, or both, are not deemed feasible by those agencies, the necessity of implementing the TMDLs that is mandated by the federal Clean Water Act and removing the copper, lead, and zinc impairments in Chollas Creek (an action required to achieve the express, national policy of the Clean Water Act) outweigh the unavoidable adverse environmental effects identified in the substitute documents.

19. **ECONOMIC ANALYSIS**: The San Diego Water Board has considered the costs of the reasonably foreseeable methods of compliance with the wasteload reductions specified in these TMDLs. The most reasonably foreseeable methods of compliance involve implementation of structural and non-structural controls. Surface water monitoring to evaluate the effectiveness of these controls will be necessary.

20. **NO ADVERSE ENVIRONMENTAL EFFECTS**: This Basin Plan amendment will result in no adverse effect, either individually or cumulatively, on wildlife.

21. **REVISION TO BASIN PLAN**: The USEPA promulgated a final rule prescribing water quality criteria for toxic pollutants in inland surface waters, enclosed bays, and estuaries in California in 2000 (The California Toxics Rule or "CTR;" [40 CFR 131.38]). CTR criteria constitute applicable water quality objectives in California. In addition to the CTR, certain criteria for toxic pollutants in the National Toxics Rule [40 CFR 131.36] constitute applicable water quality objectives in California as well. The section in Chapter 3 of the Basin Plan titled "Toxic Pollutants" should be revised to be consistent with the current federal rules. The subsection entitled "Water Quality Objectives for Toxic Pollutants" in Chapter 3 of the Basin Plan needs to be deleted. This subsection is redundant since the CTR and certain NTR criteria constitute applicable water quality objectives in California.

NOW, THEREFORE, BE IT RESOLVED that

1. **AMENDMENT ADOPTION**: The San Diego Water Board hereby adopts the amendment to the Basin Plan to incorporate the TMDLs for dissolved copper, lead, and zinc in Chollas Creek and to revise the Basin Plan to reference the California Toxics Rule as set forth in Attachment A hereto.

2. **TECHNICAL REPORT APPROVAL**: The San Diego Water Board hereby approves the Technical Report entitled *Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay*, dated May 30, 2007.

3. **CERTIFICATE OF FEE EXEMPTION**: The Executive Officer is authorized to sign a Certificate of Fee Exemption.

4. **AGENCY APPROVALS**: The Executive Officer is directed to submit this Basin Plan amendment to the State Water Board for approval in accordance with Water Code section 13245.

5. **NON-SUBSTANTIVE CORRECTIONS**: If, during the approval process for this amendment, the State Water Board, San Diego Water Board, or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or consistency, the Executive Officer may make such changes, and shall inform the San Diego Water Board of any such changes.

6. **ENVIRONMENTAL DOCUMENT CERTIFICATION**: The substitute environmental documents prepared pursuant to Public Resources Code section 21080.5 are hereby certified, and the Executive Officer is directed to file a Notice of Decision with the Resources Agency after State Water Board and OAL approval of the Basin Plan Amendment, in accordance with section 21080.5(d)(2)(E) of the Public Resources Code and the California Code of Regulations, title 23, section 3781.

   I, John H. Robertus, Executive Officer, do hereby certify the foregoing is a full, true and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, San Diego Region, on June 13, 2007.

JOHN H. ROBERTUS
EXECUTIVE OFFICER

ATTACHMENT A
TO RESOLUTION NO. R9-2007-0043

AMENDMENT TO THE WATER QUALITY CONTROL PLAN FOR THE SAN DIEGO BASIN (9) TO INCORPORATE TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD, AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY,

AND TO REVISE THE TOXIC POLLUTANTS SECTION OF CHAPTER 3 TO REFERENCE THE CALIFORNIA TOXICS RULE

This Basin Plan amendment establishes a Total Maximum Daily Load (TMDL) and associated load and wasteload allocations for copper, lead and zinc in Chollas Creek, and revises the Toxic Pollutants section of Chapter 3 to reference the California Toxics Rule. This amendment includes a program to implement the TMDL and monitor its effectiveness. Chapters 2, 3, and 4 of the Basin Plan are amended as follows:

Chapter 2, Beneficial Uses
Table 2-2. ***Beneficial Uses of Inland Surface Waters***

Add the following footnote 3 to Chollas Creek

> [3]Chollas Creek is designated as an impaired water body for copper, lead and zinc pursuant to Clean Water Act section 303(d). A Total Maximum Daily Load (TMDL) has been adopted to address this impairment. See Chapter 3, Water Quality Objectives for Toxicity and Toxic Pollutants and Chapter 4, Total Maximum Daily Loads.

Chapter 3, Water Quality Objectives
Inland Surface Waters, Enclosed Bays and Estuaries, Coastal Lagoons, and Ground Waters

Water Quality Objectives for Toxicity:
Add a fifth paragraph as follows:

> Chollas Creek is designated as a water quality limited segment for dissolved copper, lead, and zinc pursuant to Clean Water Act section 303(d). Total Maximum Daily Loads have been adopted to address these impairments. See Chapters 2, Table 2-2, *Beneficial Uses of Inland Surface Waters, Footnote 3* and Chapter 4, Total Maximum Daily Loads.

TOXIC POLLUTANTS:
Revise as follows:

> <u>The USEPA promulgated a final rule prescribing water quality criteria for toxic pollutants in inland surface waters, enclosed bays, and estuaries in California on May 18, 2000 (The California Toxics Rule or "CTR;" [40 CFR 131.38]). CTR criteria constitute applicable water quality objectives in California. In addition to the CTR,</u>

certain criteria for toxic pollutants in the National Toxics Rule [40 CFR 131.36] constitute applicable water quality objectives in California as well.

Chollas Creek is designated as a water quality limited segment for dissolved copper, lead, and zinc pursuant to Clean Water Act section 303(d). Total Maximum Daily Loads have been adopted to address these impairments. See Chapters 2, Table 2-2, *Beneficial Uses of Inland Surface Waters, Footnote 3* and Chapter 4, Total Maximum Daily Loads.

~~Federal Register, Volume 57, Number 246 amended Title 40, Code of Federal Regulations, Part 131.36 (40 CFR 131.36) and established numeric criteria for a limited number of priority toxic pollutant for inland surface waters and estuaries in California. USEPA promulgated these criteria on December 22, 1992, to bring California into full compliance with section 303(c)(2)(B) of the Clean Water Act. California is not currently in full compliance with this section of the Clean Water Act due to the invalidation of the Water Quality Control Plan for Inland Surface Waters of California and the Water Quality Control Plan for Bays and Estuaries of California. However, the criteria established in 57 FR 60848 (December 22, 1992) (specifically pages 60920-60921) are still applicable to surface waters in the Region.~~

~~***Water Quality Objectives for Toxic Pollutants:***~~

~~*Inland surface waters, enclosed bays, and estuaries shall not contain toxic pollutants in excess of the numerical objectives applicable to California specified in 40 CFR 131.36 (§131.36 revised at 57 FR 60848, December 22, 1992).*~~

Chapter 4, Implementation

After the subsection on the TMDL for Dissolved Copper, Shelter Island Yacht Basin, San Diego Bay add the following subsection:

Total Maximum Daily Loads for Copper, Lead, and Zinc in Chollas Creek

On June 13, 2007, the Regional Board adopted Resolution No. R9-2007-0043, *Amendment to the Water Quality Control Plan for the San Diego Region to Incorporate Total Maximum Daily Loads for Dissolved Copper, Lead and Zinc in Chollas Creek, Tributary to San Diego Bay*. The TMDL Basin Plan Amendment was subsequently approved by the State Water Resources Control Board on *[Insert Date],* the Office of Administrative Law on *[Insert Date]*, and the USEPA on *[Insert Date]*.

Problem Statement

Dissolved copper, lead and zinc concentrations in Chollas Creek violate numeric water quality objectives for copper, lead, and zinc promulgated in the California Toxics Rule, and the narrative objective for toxicity. Concentrations of these metals in Chollas Creek threaten and impair the designated beneficial uses of warm freshwater habitat (WARM), and wildlife habitat (WILD).

Numeric Targets

The TMDL numeric targets for copper, lead, and zinc are set equal to the numeric water quality objectives as defined in the California Toxics Rule (CTR) and shown below. Because the concentration of a dissolved metal causing a toxic effect varies significantly with hardness, the water quality objectives are expressed in the CTR as hardness based equations. The numeric targets are equal to the loading capacity of these metals in Chollas Creek.

Table 4 *[insert number]* Water Quality Objectives/Numeric Targets for dissolved metals in Chollas Creek.

Metal	**Numeric Target for Acute Conditions: Criteria Maximum Concentration**	**Numeric Target for Chronic Conditions: Criteria Continuous Concentration**
Copper	(1) * (0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(1) * (0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(1) * (0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

Hardness is expressed as milligrams per liter.
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)].
The natural log and exponential functions are represented as “ln” and “e,” respectively.

Source Analysis

The vast majority of metals loading to Chollas Creek are believed to come through the storm water conveyance system. An analysis of source contributions reveals many land uses and activities associated with urbanization to be potential sources of copper, lead and zinc to Chollas Creek. Modeling efforts point toward freeways and commercial/industrial land uses as the major contributors

Total Maximum Daily Loads

The TMDLs for dissolved copper, lead and zinc in Chollas Creek are concentration-based and set equal to 90 percent of the numeric targets/loading capacity.

Margin of Safety

The TMDL includes an explicit margin of safety (MOS). Ten percent of the loading capacity was reserved as an explicit MOS.

Allocations and Reductions

The source analysis showed that nonpoint sources and background concentrations of metals are insignificant, and thus, were set equal to zero in the TMDL calculations. The wasteload allocations are set equal to 90 percent of the numeric targets/loading capacity. Concentrations of dissolved copper, lead and zinc require significant reductions from current concentrations to meet the loading capacity.

TMDL Implementation Plan

Persons whose point source discharges contribute to exceedance of WQOs for copper, lead, and zinc in Chollas Creek will be required to meet the WLA hardness dependant concentrations in their urban runoff discharges before it is discharged to Chollas Creek. Actions to meet the WLAs in discharges to Chollas Creek will be required in WDRs that regulate MS4 discharges, industrial facility and construction activity stormwater discharges, and groundwater extraction discharges in the Chollas Creek watershed. The following orders may be reissued or revised by the Regional Board to include requirements to meet the WLAs. Alternatively, the Regional Board may issue new WDRs to meet the WLAs.

Order No. 2007-0001, NPDES No. CAS0108758, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, or subsequent superceding NPDES renewal orders.

Order No. 2000-90, NPDES No. CAG19001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or other Conveyance Systems Tributary Thereto*, or subsequent superceding NPDES renewal orders.

Order No. 2001-96, NPDES No. CAG 919002, *General Waste Discharge Requirements for Groundwater Extraction Waste Discharges from Construction, Remediation and Permanent Groundwater Extractioi Projects to Surface Waters within the San Diego Region Except for San Diego Bay* or subsequent superceding NPDES renewal orders.

Order No. 97-11, *General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Nonhazardous Waste Landfills within the San Diego Region* or subsequent superceding NPDES renewal orders.

The Regional Board shall request the State Water Resources Control Board amend the following statewide orders:

Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal orders.

Order No. 97-03-DWQ, NPDES No. CAS 000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities*, or subsequent superceding NPDES renewal orders.

Order No. 2003-0005-DWQ, NPDES No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*, or subsequent superceding NPDES renewal orders.

Order No. 99-08-DWQ, NPDES No. CAS000002, *General Permit for Storm Water Discharges Associated with Construction Activity*, or subsequent superceding NPDES renewal orders.

The Regional Board shall require the U.S. Navy to submit a Notice of Intent to enroll the Naval Base San Diego facility under statewide Order No. 2003-005-DWQ or subsequent superseding NPDES renewal orders .

Implementation Monitoring Plan

The dischargers will be required to monitor Chollas Creek and provide monitoring reports to the Regional Board for the purpose of assessing the effectiveness of the management practices implemented to meet the TMDL allocations. The Regional Board shall amend the following order to include a requirement that the cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego, the San Diego Unified Port District, and CalTrans investigate excessive levels of metals in Chollas Creek and feasible management strategies to reduce metal loadings in Chollas Creek, and conduct additional monitoring to collect the data necessary to refine the watershed wash-off model to provide a more accurate estimate of the mass loads of copper, lead and zinc leaving Chollas Creek each year.

Order No. R9-2004-0277, *California Department of Transportation and San Diego Municipal Separate Storm Sewer System Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California*.

Schedule of Compliance

Concentrations of metals in urban runoff shall only be allowed to exceed the WLAs by a certain percentage for the first nineteen years after initiation of this TMDL. Allowable concentrations shall decrease as shown in Table 4 *[insert number]*. For example, if the measured hardness in year ten dictates the WLA for copper in urban runoff is 10 µg/l, the maximum allowable measured copper concentration would be 12.0 µg/L. By the end of the twentieth year of this TMDL, the WLAs of this TMDL shall be met. This will ensure that copper, lead and zinc water quality objectives are being met at all locations in the creek during all times of the year.

Table 4 *[insert number]* Interim goals for achieving Wasteload Allocations

	Allowable Exceedance of the WLAs (allowable percentage above)		
Compliance Year	**Copper**	**Lead**	**Zinc**
1	100%	100%	100%
10	20%	20%	20%
20	0%	0%	0%

Compliance with the interim goals in this schedule can be assessed by showing that dissolved metals concentrations in the receiving water exceed the WQOs for copper, lead, and zinc by no more than the allowable exceedances for WLAs shown in the table above. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges.

The compliance schedule for implementation of the TMDLs shall be as follows in Table 4 *[insert number]*.

Table 4 *[insert number]* Compliance Schedule

Item	Implementation Action	Responsible Parties	Date
1	Effective date of Chollas Creek Metals TMDL Waste Load Allocations.	San Diego Water Board, Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	Effective date[1]
2	Recommend High Priority for grant funds.	San Diego Water Board	Immediately after effective date
3	Submit annual Progress Report to San Diego Water Board due January 1 of each year.	Municipal Dischargers	Annually after reissue of NPDES WDRs.
4	Submit annual Progress Report to San Diego Water Board due April 1 of each year.	Caltrans	Annually after reissue of NPDES WDRs.
5	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Industrial Stormwater Dischargers	Annually after reissue of NPDES WDRs.
6	Submit annual Progress Report to San Diego Water Board due July 1 of each year.	Construction Stormwater Dischargers	Annually after reissue of NPDES WDRs.
7	Municipal NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
8	Caltrans NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
9	Construction NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date
10	Industrial NPDES WDRs shall be issued, reissued, or revised to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	State Water Board	Within 5 years of effective date

[1] Upon approval of by Office of Administrative Law.

Item	Implementation Action	Responsible Parties	Date
11	Amend Orders No. 2000-90, and No. 2001-96 (or superseding renewal orders) which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries to include WQBELs consistent with the assumptions and requirements of the Chollas Creek WLAs.	San Diego Water Board	Within 5 years of effective date
12	Municipal and Navy WDR Order No. R9-2004-0277 shall amended to require additional monitoring for metals and hardness.	San Diego Water Board	Within 5 years of effective date
13	Landfill NPDES WDR Order No. 97-11 (or superseding renewal orders) shall be issued, reissued, or revised to monitor for metals and hardness.	San Diego Water Board	Within 5 years of effective date
14	Navy and all other Phase II small MS4 permittees in the Chollas Creek watershed shall be enrolled in Order No. 2003-0005-DWQ (or superseding renewal orders).	San Diego Water Board	Immediately after effective date.
15	Take enforcement actions	San Diego Water Board	As needed after effective date.
16	Meet 80% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	10 years after effective date.
17	Meet 100% Chollas Creek Metals TMDL WLA reductions.	Municipal Dischargers, Caltrans, Navy, Industrial Stormwater Dischargers, Construction Stormwater Dischargers, Landfill Stormwater Dischargers	20 years after effective date.

Appendix K

Scientific Peer Review

Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

May 30, 2007

Scientific Peer Review:

"Technical Report for Copper, Lead and Zinc Total Maximum Daily Loads for Chollas Creek, San Diego, Tributary to San Diego Bay"

Garrison Sposito and Jasquelin Peña
Department of Civil and Environmental Engineering
University of California at Berkeley

The draft report under review provides technical information related to the establishment of Total Maximum Daily Loads (TMDLs) for Chollas Creek, an intermittent stream that drains a highly urbanized watershed through two major tributaries in the San Diego area. Outflow from the creek, whose lower reach (see photo of the North Fork, below, taken by J. Peña, March 2005) has impaired water quality, is into San Diego Bay. (Note, however, that the introductory statements on page 4 of the draft report appear to be contradictory in respect to the documentation of impaired water quality, implying that National Toxics Rule criteria are more often exceeded than California Toxics Rule criteria, while calling the latter "more stringent".) The TMDLs discussed in the report are for the metals, copper, lead, and zinc. As noted in the Introduction of the draft report, TMDLs are load allocations (mass per day) of pollutants to a waterbody, considering both point sources and nonpoint sources, such that the assimilative capacity of the waterbody in respect to applicable water quality objectives is not exceeded.

The methodology followed in the draft report for the three metals of concern is to apply the USEPA- California Toxics Rule (USEPA-CTR) to obtain numeric targets for dissolved metals in Chollas Creek. The dissolved mconcentrations are calculated for both acute (one-hour average) and chronic (four-day average) conditions from USEPA-CTR statistical regression equations that include factors for site-specific toxicity effects, total-to-dissolved metal concentrations, and direct hardness effects (Table 3.1 in the draft report). Hardness data for the waterbody will be required in order to implement these equations. It is possible to include direct effects of temperature and pH in the equations, but this was not done in the draft report. Site-specific toxicity effects also were not considered [i.e. Water Effects Ratio (WER) = 1.0 in the regression equations] and the total-to-dissolved metal concentrations ratio for each metal was set equal to a fixed constant for all conditions using the default USEPA-CTR values.

Although the draft report states that the numeric targets set by using the USEPA-CTR equations are a function of hardness, it does not justify why this choice is appropriate for Chollas Creek, other than its legal applicability in California for inland surface waters (draft report, page 11). Reference to CFR 40 Part 131 provides the following guiding commentary on the toxicological significance of hardness-based USEPA-CTR equations:

f. Hardness
Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicities of some metals. Hardness is used as a surrogate for a number of water quality characteristics which affect the toxicity of metals in a variety of ways. Increasing hardness has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness, measured in milligrams per liter as calcium carbonate.

Given the importance accorded in the draft report (page 14) to hardness sampling as part of compliance testing, it would be very useful to have more detailed discussion on the relevance of the above paragraph to water quality criteria for the three metals of concern in Chollas Creek.

Although the choice of WER = 1.0 in the draft report is a conservative one, procedures are available from USEPA for evaluating site-specific toxicity effects and modifying the Water Effects Ratio accordingly. This additional information may be of special value in respect to copper because of its strong tendency to form toxicity-reducing soluble complexes with dissolved organic matter. Similarly, the use of a constant total-to-dissolved metal concentrations ratio as given by USEPA is problematic, since the chemical forms of copper, lead, and zinc are likely to vary both spatially and temporally depending on streamflow variation and the changing composition of streamwaters, including suspended load. In the draft report, the assumption is made that the USEPA-CTR default values for the three metals are upper limits of the actual values in Chollas Creek, the implication being that actual total-to-dissolved metal concentrations are always larger than the default values used in the USEPA-CTR regression equations. Since toxicity effect should vary inversely with total-to-dissolved metal concentration, this assumption amounts to an implicit Margin of Safety imposed on the recommended dissolved metal concentrations. An alternative approach would be to evaluate total-to-dissolved metal concentrations as a function of turbidity and include turbidity sampling as a part of compliance testing.

In the usual development of TMDLs for a waterbody, hydrologic data and pollutant source analyses are combined with the numeric targets to calculate waste load and load allocations. However, in the draft report under review, although spatial hydrologic modeling and a very thorough metal source analysis are presented, they are used only to determine TMDL Critical Conditions (Appendix D, Section 2.2). It appears that most of the data used to develop the TMDLs was collected during stormflows. Additional monitoring during low flow should be implemented since pools of slow-moving or standing water (see photo of Chollas Creek, below, taken by J. Peña) will have very different dynamics—and metal sources—from those associated with high-flow storm events. It is also possible that dissolved metal concentrations during low flow are greater than in the wet season because metal inputs are not diluted by large volumes of rainwater. Also, standing water can undergo evaporation, leading to the concentration of metals in sediments. Some additional minor points to consider in respect to the discussion of metal sources:

Page 32, Section 4.4.5. In the last sentence, the reader should be reminded that this summary applies strictly to the Santa Clara Valley study.
Page 33, Section 4.4.5.2. Quantify the difference between the "back of the envelope calculation" given here and the model results.
Page 37, Section 4.5.4. The percentage of copper contained in each pesticide should be included in Table 4.10.

Because waste load and load allocations were not made, the linkage analysis in the draft report (page 39) consists of identification of the most important metal sources and streamflows to be considered when sampling metal concentration and hardness for assessing compliance with the recommended dissolved metal concentrations. The final recommendations for the three metals are dissolved concentrations equal to 90 % of the dissolved concentrations (i.e. 10 % Margin of Safety) calculated using the USEPA-CTR hardness-based regression equations. These recommended concentrations are compared illustratively to measured concentrations in Appendix G of the draft report. The results in this appendix indicate that maximum observed concentrations of the three metals are significantly greater than the concentrations required to meet water quality objectives, with the discrepancies being much larger at lower hardness values.

The use of dissolved metal concentrations as numeric targets presupposes that the metals do not increase in concentration at higher trophic levels (i.e. no biomagnification) and that they do not accumulate in sediments. Biomagnification of copper, lead, and zinc in test organisms (e.g. daphnia) has not been observed in laboratory studies, insofar as the reviewers are aware, nor is it expected. Biomagnification is associated with hydrophobic pollutants and hydrophobic chemical forms of pollutants (e.g. methyl mercury), whereas most toxic metals have hydrophilic chemical forms in aquatic ecosystems. It is possible that lead could take on a hydrophobic chemical form under anaerobic conditions because it can be methylated by microorganisms, but this is very unlikely in well-aerated waterbodies. Accumulation in freshwater sediments is well established for the three metals of concern, which have strong sorption affinities for natural particles, especially those with organic matter content. The case is made in the draft report that metal concentrations in the creek sediments are typically below levels of probable toxic effect and that particle-bound metals are flushed from the creek within one year by winter flows. These conjectures are not unreasonable, but no database currently exists with which to evaluate them, bringing to mind the important possibility that particle-bound metals transported to San Diego Bay may pose a potential toxicity threat, thus making Chollas Creek a source of this threat.

In summary, the principal points made in this peer review of the draft report are:

Dissolved concentrations of copper, lead, and zinc for acute and chronic conditions calculated from USEPA-CTR regression equations dependent on water hardness are promulgated with a 10 % Margin of Safety instead of TMDLs, which typically combine allowable dissolved metal concentrations with hydrologic and metal source analyses to prescribe mass loadings that meet applicable water quality objectives.

Detailed scientific justification of the USEPA-CTR hardness-based equations for applicability to Chollas Creek waters in determining allowable metal concentrations is not provided. However, assumptions of no metal biomagnification or accumulation in sediments, which underlie the use of numeric targets based on dissolved concentrations, seem justified.

Compliance testing guided by TMDL Critical Conditions will require measurements of both metal concentrations and hardness (as calcium carbonate) for use with USEPA-CTR regression equations that, along with the 10 % Margin of Safety, define the numeric targets. Preliminary calculations indicate that current metal concentrations in Chollas Creek are in excess of these targets, particularly at low hardness values.

Hydrologic modeling and metal source analyses are used to select TMDL Critical Conditions for compliance testing. Hydrologic modeling is not explicitly used in metal load and wasteload allocations. All hydrologic and metal source effects are implicit in these allocations.

The current database for Chollas Creek can be improved by additional monitoring of both metal concentrations during lowflow periods and metal accumulation in creek sediments that may serve as a source of contamination for San Diego Bay. Additional laboratory toxicity testing using Chollas Creek waters would be useful in order to justify the Water Effects Ratio and to evaluate the accuracy of the default total-to-dissolved metal concentration factor assumed in the USEPA-CTR regression equations.

Peer Review Comments from Dr. Joseph Shaw
Dartmouth College

Response to: **Request for scientific peer review of the technical portion of the amendment incorporating the *copper, lead, and zinc total maximum daily loads for Chollas Creek* into the water control plan for the San Diego basin.**

I commend the California Regional Water Quality Control Board, San Diego Region for their efforts to reduce the loads of copper, lead, and zinc entering the Chollas Creek Watershed by ~50-70% (e.g., depending on metal). The technical report presents a conservative approach to establishing Total Maximum Daily Loads (TMDL) for the three metals that are required to meet the established water quality standards. Given the paucity of data in certain instances this conservative approach, which was based on concentrations derived from California Toxic Rule requirements (U.S. EPA, 2000) for these metals and source/land use models to predict load, was warranted. It should be noted that cautionary/critical statements in this review are provided as an aid to strengthen the scientific portion of the proposed rule. It is my opinion that the current draft of the technical plan far surpasses the status quo (i.e., not implementing the TMDL). Comments to specific questions are given below.

1) Biomagnification potential for copper, lead and zinc:

"Copper, lead and zinc may biomagnify in aquatic life in Chollas Creek. The California Regional Water Quality Board, San Diego Region (Regional Board) believes that these metals do not biomagnify. We would like to know if we have sufficiently justified this position and if there are substantive arguments to the contrary."

As stated in the TMDL, there is little evidence that copper, lead and zinc biomagnify in top-level feeders. However, I question whether one sentence in Section 2.4 (p.8) that cites a single 20 year old reference (Moore and Ramamoorthy, 1984) from a book on organic chemicals sufficiently justifies this position. Appropriate citations would include Timmermans et al., 1989; Suedel et al., 1994; Jarvinen and Ankley, 1999; and Besser et al., 2001. Also, there is growing evidence that zinc and to some extent copper can biomagnify within aquatic food webs (Quinn et al., 2003; Chen et al., 2000; Timmermans et al., 1989). However, these studies focused on lower food chain levels (i.e., phytoplankton, zooplankton, macro-invertebrates) and evidence extending these findings to higher trophic-level consumers (e.g., birds and mammals) is unfounded.

2) Copper, lead, and zinc accumulation in creek sediments:

"The Regional Board has reviewed the available data and concluded that copper, lead, and zinc are not a problem in the sediments of Chollas Creek. We would like to know if we have scientifically and sufficiently supported this claim."

Sediment accumulation of metals in Chollas Creek appears to be minor (Table 2.4; Appendix C). The PEL (probable effect level; more recently termed PEC, probable effects concentration, MacDonald et al., 2000) approach has been successfully used to screen sediments on both a regional and national basis (Ingersoll et al., 2001). However, there are a couple of points of caution to be made with interpreting data provided (Table 2.4, Appendix C). As indicated in the text, PELs represent concentrations where toxicity (adverse effects) is expected to occur frequently. The water quality objective *("All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life."*) is more strict, seeking to protect against toxicity, not just frequent toxicity. With this in mind, cadmium although rarely detected (11 of 81 samples) and detected in excess of PEL (1.2%), has an average concentration that approaches PEL. Also, the one time it exceeded PELs it did so by over 6.5 fold. However, it is difficult to draw conclusions about this site, since it was only sampled once. In fact, the bulk of the sampling within the creek (sampling designated 978-270 to 978-337) occurred at a single time point and no temporal replication of these sites is shown. The data set that includes temporal replication contains three sites within San Diego Bay and only one site within the creek (location not provided). Given the short residence time of the sediments within the creek (~1 year as given in Section 2.5), a single grab from 1998 could be dramatically different from 2005. For the PEL screening approach to be successful the data being screened needs to adequately reflect that of the creek. Also, as pointed out in this document (section 2.4), metal toxicity has a strong relationship with speciation. Total sediment metal concentrations (just as measurements of total metal in the water column) have proven problematic in assessing toxicity. Typically sediment metal concentrations are discussed in context of sediment characteristics such as grain size, organic carbon, simultaneously extracted metal:acid volatile sulfides ratio, pH, etc.

3) Selection of Numeric Targets:

"Numeric Targets must be appropriately chosen to ensure the attainment of the Water Quality Standards (Water Quality Objectives, Beneficial Uses and Anti-degradation Policy) of the Creek. It is expected that the used of the CTR objectives as Numeric Targets will lead to the protection of the WARM and WILD beneficial uses of the creek. However, CTR may not be protective of all species protected under these two beneficial uses. The Regional Board would like to know if the choice of Numeric Targets to protect the beneficial uses is bases upon sound scientific knowledge, methods, and practices. The regional Board would also like to know if there are other objectives that are also/more appropriate."

CTR criteria are set to protect aquatic-life in California water bodies against both acute and chronic exposures to harmful contaminants. These include hardness corrections for ambient copper, lead, and zinc standards, an approach that has been incorporated in U.S. EPA ambient water quality criteria for the protection of aquatic-life for over 20 years (including updates). The hardness corrections account for the (generally) protective effect of the two components of hardness (i.e., calcium, magnesium) on the toxicity of these metals. In the absence of site specific water quality parameters and species inventory lists for Chollas Creek, such an approach represents the most conservative and scientifically defensible action. However, there are some points of caution with their application. Criteria are designed to protect 95% of the species that fall within the range of sensitivities of those that were tested as part of the criteria development process. For acute criteria, these are generally robust and although a species inventory is not provided for Chollas Creek such targets would be expected to be protective of most species present. However, chronic criteria are established using a much smaller range of species through the development of acute to chronic ratios that are more broadly applied. For these reasons, chronic criteria would stand to be more impacted by site specific parameters. If data are present on the species residing in Chollas Creek it could really benefit application of CTR standards. Also, it is surprising that hardness data, while admittedly variable, are not provided. I agree that because of the temporal/seasonal variability of Chollas Creek that it is appropriate to present hardness dependent standards. However, information on hardness would be a useful addition to the Technical Report as a means of determining the current status of Chollas Creek. Also, these standards are less predictive at the lower and higher extremes for hardness (Gensemer et al., 2002), where other water quality parameters can have a greater influence on toxicity. Finally, I would like to compliment the authors of this report for their inclusion of the newly proposed Biotic Ligand Model (Paquin et al., 2002) for copper and support their position of revisiting Numerical Targets if/when these are adopted. The BLM represents a fundamental change in the way metals criteria are calculated that models metal binding to critical biotic ligands, such as the fish gill, and relates this metal burden to detrimental effects on the organism. While they are more inclusive of mitigating water quality parameters, they are more data intensive (e.g., requiring simultaneous measurements of copper and many complexing anions and competing cations).

4) Sampling requirements to assess Loads and Waste Load Allocations:

"The Regional Board has designated sampling requirements to evaluate the Load and Waste Load Allocations and would like to know if they are sufficient, appropriate, and based upon sound scientific knowledge, methods, and practices. The question really deals with spatial and temporal scales. Given the size of the creek and the seasonal variability of its flow, it will be key to select measurement sites and frequencies that will allow assessment of the attainment of the Load and Waste Load Allocations through the year and throughout the entire creek system."

There is insufficient material available regarding the spatial and temporal aspects of the monitoring/sampling plan to comment on its usefulness in assessing Load and Waste Load allocations for the Chollas Creek Watershed. In the absence of designating sampling requirements, it would be appropriate and necessary at a minimum to provide guidance on the development of such a plan in the Technical Report.

5) Water Effects Ratio:

"A Water Effects Ratio (WER) is part of the CTR Equation for establishing water quality criteria for copper, lead, and zinc. However, sufficient data are not available to modify the default WER value of unity (with the proposed Numerical Target). The Regional Board would like the reviewer to comment on the state of use of WERs in the freshwater systems."

Water effects ratios provide a way to calibrate numerical targets to site-specific conditions. These include endogenous species and/or water quality parameters that may vary from those used to develop the standard in sensitivity and influence on toxicity, respectively. These are typically derived after extensive on-site testing and are usually initiated by regulated parties. This approach (*i.e., making unity the WER default and letting the regulated community establish site-specific conditions under the guidance of the Regional Board*) is reasonable, especially given that WER are often implemented to make conservative Numerical Targets less restrictive. As discussed above for numerical targets, acute criteria are influenced less by site specific conditions (i.e., WER close to unity; Cherry et al., 2002). Cherry et al. (2002) established a site specific CMC for copper in the Clinch River, VA. This required a battery of toxicity tests conducted using 17 genera native to or currently residing in the river that were not part of the derivation of the Final Acute Value (FAV) used in the current U.S. EPA regulations. They concluded that the site specific CMC was not substantially different than the national copper criteria. They suggested site-specific adjustments would be most meaningful for criteria developed to protect against chronic exposures and low-level impact. I could find no published reports detailing successful integration of site-specific numerical targets using a WER approach.

It should be noted that one additional source of site-specific variability could easily be incorporated into the TMDL. Direct measurements of dissolved metals can be influenced by a number of parameters and the use of conversion factors to translate total metal concentrations into dissolved is somewhat arbitrary and likely not reflective of the specific chemistries found within the watershed. It would seem reasonable to require that the monitoring plan require dissolved metals to be measured.

6) Source Analysis:

"The Regional Board must adequately estimate the sources of the metals to the creek. The Regional Board would like the reviewer to comment on the science, methods, and practices used to estimate the

sources of copper, lead and zinc. The analysis of the sources is key to successful implementation of reduction schemes. Therefore, it is critical to address all sources of metals and to make some type of estimate of their total load to the creek. This was accomplished through a model based upon land uses and build-up/wash-off coefficients. Other sources were identified by reference to available literature that identify metal sources in other urban areas."

The methods or literature used to determine that the majority of run-off entering Chollas Creek is via the storm water conveyance system (MS4s, Section 4, introduction, p. 15) are not clearly stated. It makes sense given that there are no other point sources, but the reader is left to make the assumption that direct run-off into the creek is negligible (i.e., both volume and source). This is a crucial point as it identifies/acknowledges the jurisdiction of NPDES WDR and I think a citation or further explanation of this determination is warranted, especially since it places the load responsibility on 20 sources identified through NPDES permit requirements (Section 4.1, pp. 15-16). It would seem a mass accounting of volume entering via storm water conveyances and exciting the creek was used, but this was not mentioned. This conclusion also makes since empirically because a direct link between stormwater discharges and creek toxicity has already been established (Schiff, 2001). Given that stormwater is the major source of load input for Chollas Creek, the paradigm of identifying sources and modeling land-use specific loads for MS4s is reasonable. Additional comments on load estimates and source identification are given below (Questions 7-10).

7) Land Use Model:

"The Regional Board would like the reviewer to comment on the adequacy of the Source Analysis model description found in Appendix D. The model provides the basis of the Source analysis and was run by Tetra Tech, Inc. The Regional Board merged the Tetra Tech document with literature from the U.S. EPA (BASINs manual) and other sources in an effort to create a document (Appendix D) more accessible to the layperson. Please comment on the adequacy of Appendix E in its description of the model."

As a non-modeler I found the model description in Appendix D accessible. It did a great job explaining the process of data acquisition, populating model parameters, calibration, and independent validation, which are critical for model development. It also was effective in conveying the strengths, weaknesses, and limitations of the models, especially with regards to data gaps/needs and appropriate/inappropriate applications.

8) Model Interpretation:

"The Regional Board would like the reviewer to comment on the scientific basis of the interpretation of the model results and deficiencies. Since the model was produced by an outside consultant, the Regional Board would appreciate the reviewer's opinion on the findings and limitations of the model used as the basis for the Source Analysis."

The immediate deficiencies are obvious; lack of input data (especially water quality measurements during dry weather conditions). Given these limitations it is difficult to assess the models performance. While it has potential to estimate metal concentrations in the Creek or support load allocations across varying condition, these identified deficiencies limited its application to identifying potential sources to target for load reductions. While this is useful it has less direct bearing on the derivation of the TMDL. As noted in Section 4, when data are sufficient they could be readily incorporated into the model.

9) Source Analysis Literature:

"The Regional Board would like the reviewer to comment on the scientific basis of applying results from studies of other urban areas to the Chollas Creek watershed. There are no known peer-reviewed studies describing sources of metals to Chollas Creek, nor is there much information about metal sources in the greater Sand Diego area. Therefore, studies detailing metals sources in other urban areas served as the basis for part of the Source Analysis discussion. Some of the studies come from other highly populated cities in California, while others come from urban centers in other pars of the world. While certain land use practices are similar between all these areas, other controlling factors (climate, geology, local ordinances, social attitudes, etc) are likely to be much different. Therefore, these studies must be referenced in a conservative manner and not over extrapolated. Please comment on whether or not this boundary has not been breached."

The application of results from other studies to Chollas Creek is no different than most any discussion section found in a peer-reviewed article where the objective is to discuss results (strengths and weaknesses) in context of the body of existing literature. In this sense, such an approach seems not only warranted, but also mandated. I found the literature selections for comparisons justified in terms of similarities (i.e., the most similar studies were selected). Similarities included geographical proximity, population size, land-use, policy, etc. However, in all cases differences and their potential to influence interpretations were highlighted. The only reference I question is the inclusion of Brown and Caldwell, (1984), which was used in section 4.4.2, p. 31. While its limits were clearly noted, the inclusion of lead loading data prior to the CAA ban of lead and lead additives in gasoline provides little area for comparison.

10) Data Deficiencies:

"The available data for Chollas Creek is not as complete as desired. The Regional Board would like the reviewer to comment on whether or not data gaps have been adequately identified, particularly in the Source Analysis and in the Linkage Analysis sections. In particular, the model lacked site-specific flow data for validation and sufficient dry weather information for even a model run. These data gaps must be thoroughly discussed to ensure transparency of the document and to identify necessary monitoring areas under the Implementation Plan. Additionally, data gaps may weaken the connection between the allocations and the attainment of the Water Quality Standards."

The largest data gap I have found for the entire document deals with the lack of information pertaining to a monitoring plan. This is critical to fulfill one of the necessary requirements of Linkage Analysis (i.e., providing the quantitative link between the TMDL and attainment of WQSs) and does not seem to be appropriately identified (SEE RESPONSE TO QUESTION 4). Another unidentified gap appears in Section 5 (Linkage Analysis, p. 39) which states that the technical report is required to "estimate the total assimilative capacity (loading capacity) of Chollas Creek for the metals and *describe the relationship between Numeric Targets and identified metal sources*." I found no description of the later in this section. Also, as stated above it is a little unclear the role the model is serving (i.e., how it will be applied) in the TMDL development. Perhaps, I'm missing something, but it seems a little anticlimactic after reading section 4 and Appendix D that describe the model to get to the Linkage Analysis Section only to discover it has little application to TMDL development.

11) Synergistic Toxicity:

"The Regional Board is not aware of any synergistic toxicity effects associates with dissolved copper, lead, and zinc in the water column and has written this TMDL accordingly. Please comment on the scientific basis for this approach. If all three metals are present at just under their allowable CTR

concentration, the water may still not be safe for aquatic life. It is possible that these three metals could work together to form a toxic condition…The Regional Board would like the reviewer to comment on the scientific basis for the potential for a synergistic effect with another chemical pollutant. If an interaction is likely, please comment on the scientific impacts to the Load and Waste Load Allocations. If the metals Cu, Pb, and Zn are synergistic in their toxic effect on freshwater organisms, perhaps an additional margin of safety should be considered."

There is evidence for synergistic (i.e., greater than additive) and additive (which could also produce scenarios described above) effects of binary mixtures of copper and zinc and lead and zinc (Kraak et al., 1993; Franklin et al., 2002; Utgikar et al., 2004). However, published reports include laboratory studies that have focused on lower trophic levels (i.e., bacteria, phytoplankton, zooplankton). None of these studies investigated concentration ranges applicable to chronic effects and for the most part they focused on binary rather than more complex mixtures. It should be noted that mixture toxicity can be difficult to assess even in the laboratory as results (i.e., antagonism, additive effects, synergism) can vary with species, strain, concentration, and other parameters (Franklin et al., 2002, Borgmann et al., 2003, and numerous others). For example, Martinez et al. (2004) in studies with *Chironomous tentans* found lead and zinc to interact antagonistically to produce sub-chronic/population level effects (i.e., mouth part deformities), which is opposite from the studies cited above. This question could be pertinent, but does not appear to have been addressed in the de-listing of cadmium. There are numerous studies detailing interactive effects of cadmium combined with zinc, lead, and copper. Again, observed effects range from synergism to antagonism, but evidence exists for the scenario raised above where metals are present below the CTR concentrations and interact in a synergeistic (or depending on concentration in an additive) manner to produce toxicity (Beisenger et al., 1986; Kraak et al., 1993; Jak et al., 1996; Barata et al., 2002; Franklin et al., 2002). The CTR Numerical Targets are derived for individual chemicals and do not account for mixtures. However, given the variability in the nature of interactions reported for these metals, interactions would be difficult to regulate in the absence of site-specific data. In summary, I would conclude that while some evidence for metal interactions exists, appropriate determinations of effects would need to include site specific variables in order to be scientifically defensible. The BLM if/when it is adopted could eventually provide a means of dealing with metal mixtures (Paquin et al., 2002; Niyogi and Wood, 2004; Playle, 2004).

12) Linkage Analysis:

"The Linkage Analysis must adequately establish the link between the Load and Waste Load Allocations and the attainment of Water Quality Standards. Please comment on the scientific basis for the linkage provided in this TMDL. This is similar to number 3 above. The ultimate goal of the TMDL is to restore and protect the Water Quality Standards of Chollas Creek that are being degraded by Cu, Pb, and Zn. The Load and Waste Load Allocations must be calculated to achieve this goal. Therefore, they are the critical component of the technical discussion and must be thoroughly scrutinized. Furthermore, the Linkage Analysis must sufficiently establish this connection."

The Waste Load and Load allocations are directly linked to Water Quality Standards defined by the numerical limits, as they are identical. The decision was made by the Board to take a conservative (i.e., from the protection standpoint) approach and set load allocations based on concentration rather than mass. In other words, it is not the relative amounts (i.e., mass) of metals, but rather their respective concentrations that determine load and load reductions will be based on maintaining concentrations of metals at or below these concentration based targets (the exact concentration is fluid and depends on the water hardness). This approach seems reasonable given the dynamic nature of the system. There is one peer-reviewed study and at least one technical report that link effects of storm water drainage and more specifically the metal component of this drainage to toxicity in aquatic-life in Chollas Creek and the portions of San Diego Bay it enters (Schiff et al, 2001; 2003). Since the load allocations are identical to the numerical limits my response to question 3 is also applicable here.

13) Margin of Safety:

"The Margin of Safety (MOS), both implicit and explicit, incorporated in the TMDL should be of a reasonable magnitude to account for uncertainty. Please comment on the scientific foundations and adequacy of the Margin of Safety incorporated into this TMSL. A MOS is a required component of the allocations. It is designed to account for any uncertainty in the calculations supporting the Load and Waste Load allocations. Please comment on the scientific foundations and adequacy of the Margin of Safety incorporated into this TMDL."

The explicit 10% MOS incorporated into the TMDL represents a commonly employed safety factor. The 10% load correction is to guard against the uncertainty inherent in the Source Analysis and Linkage Analysis; differences between total and converted dissolved metal concentrations; and site-specific differences in CTR derived Numerical Targets. It is difficult to comment on the appropriateness (or scientific validity) of the 10% correction. There was greater than 10% variability in measured metal concentrations (Table 2.1). Some explanation for the rationale behind the 10% MOS would be helpful. In addition, there are implicit MOS that stem from using measured rather than estimated hardness values to calculate the TMDL. Likewise, as discussed below, the CTR values incorporate 50% correction.

I didn't understand the argument provided in the last paragraph of section 6 (p. 41). Metal interactions were discussed in question 11 above. There are numerous explanations for interactive effects, which have been observed for copper, lead, and zinc. For example, common uptake routes (e.g., calcium channels for cadmium and zinc) or distributions and detoxications could account for interactive effects. While speciation affects toxicity, biological processes have also been shown to influence interactions during laboratory tests conducted under identical water chemistries. Perhaps chemical interactions refers to complexation with anions and negatively charged sites on particulates, which would reduce bioavailability. Anyway, this paragraph/point could use clarification.

14) California Toxics Rule Inherent Margin of Safety:

"The California Toxics Rule formulas provide conservative water quality criteria that are protective of aquatic life. However, since the equations are based upon available laboratory data, they may not be protective of all aquatic life in Chollas Creek and an additional MOS has been added to the TMDL. Please Comment on the scientific basis of this approach…Criteria are based only upon available toxicity testing that may not be available for all taxonomic groups. Does this danger warrant the need for an additional10% MOS as addressed in number 12 above?

As stated above, the one peer-reviewed manuscript that described formulating site-specific CMC for copper concluded that including over 17 sensitive site-specific species to calculate the FAV did not significantly lower the CMC (Cherry et al., 2002). Also, the CTR are based on national ambient water quality criteria, for which the science has been validated through several updates over 20 years. It wasn't until recently that new approaches (i.e., BLM) gained favor. Given the defensibility and robustness of this approach coupled with the lack of evidence for extreme site-specific sensitivities another 10% MOS does not seem warranted.

15) Critical Conditions:

"The Regional Board has addressed seasonal variations and critical conditions by the use of the CTR formulas that incorporate site and time-specific hardness and metal concentration data. Please comment on the scientific basis and adequacy of this approach. This TMDL is designed to be protective of the creek in all weather and flow conditions during all times of the year. It is believed that the use of the CTR equations will adequately apply the Load and Waste Load Allocations on a temporal and spatial specificity to ensure this protection at all times. By comparing each instream metal concentration against it's appropriate criteria calculated from the hardness measured at the same time and location, the Load and Waste Load Allocations will be a moving target that accounts for ecosystem variability."

The use of a concentration (mass/volume) based TMDL negates effects of variable flow on load allocations, since regardless of the amount (mass) of metals that are present, it is the CTR derived concentrations that must be maintained. Concentration based criteria have a long history of use and even the newly proposed BLM, which relate an amount of metal bound to a critical biotic ligand to toxicity, are still expressed as concentrations. The use of concentrations is an appropriate approach for Chollas Creek given the limited data available for Land Use Models and other methods used to estimate the metal load entering during wet and dry periods. Likewise, the use of CMC and CCC targets ensure critical exposure conditions (acute, chronic) are incorporated. Furthermore, the inclusion of measured rather than estimated hardness concentrations reduce seasonal variability, especially during critical conditions. Provisions are also made to revisit other stream chemistry parameters that were not included in this TMDL if/when the BLM for copper is adopted. Collectively, these measures stabilize the TMDL even over extreme/critical conditions that could be occurred within the basin.

16) Overarching issues:

"Reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following "big picture" concerns.

a. *In regarding the staff technical report and proposed implementation language, there may be additional scientific issues that are part of the scientific basis of the proposed rule that are not described above. If so, please comment with respect to the statute language given above.*

B. *Taken as a whole, please comment on the scientific knowledge, methods, and practices that constitute the scientific portion of the proposed rule.*

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statue requirements for absolute scientific rigor. In these situations, the proposed course of action is favored over no action."

With regards to additional scientific issues relating to the Technical Report, there was little mention of specific methods, especially for metal sampling and analysis. Most every question in this reviews asked the reviewer to comment on the scientific methods, so it would appear to be information useful this review. Inclusion of methods could be done in the form of references, but I think their inclusion in necessary to ensure appropriate sampling/measurement techniques are employed and thus, TMDLs are meaningful.

Specific comments regarding the Technical report are as follows:
Attachment 1, p. 1, second paragraph- There are more appropriate references than More and Ramamoorthy, 1984).

Technical Analysis, p.1, 1st paragraph, 1st sentence- insert 'and a' between County and tributary.

" ", p. 1, 1st paragraph, with regards to de-listing Cd, see question regarding synergistic effects above.

Problem statement, p. 2, in the 1st paragraph inconsistencies with the use of lower and lowest.

" ", same paragraph- Ceriodaphnia is misspelled.

" ", same paragraph- not exactly clear on the use of the sea urchin. I assume this is from test of Bay water? Also, in general toxicity data were not presented in clearly.

Section 2.3, p. 8, 2nd paragraph, last sentence; it states that compliance shall be evaluated using a 96-hr acute bioassay. The Daphnia tests mentioned are 48-h tests.

Section 2.4., p. 8, 1st paragraph, poor reference for biomagnification of metals.

" ", toxins are natural compounds (i.e., snake venom, ammonia); toxicants is the appropriate word here.

" ". Next sentence; …same locations more commonly found at higher concentrations in ….

" ". P. 9, Better references than Buffle, 1989.

" ". P. 9. 2nd paragraph, last sentence, Unclear what is being referred to where the implementation plan is located?

Section 2.6. p. 10. In reference to the monitoring site, it is stated that this sampling station is representative of the entire watershed. How was this determination made?

" ", next paragraph. Replace 1994.95 with 1994-95.

" ". Same paragraph. Provide methods for toxicity tests.

" ". Same paragraph. Sentence that states, "Reproduction of the water fleas was generally note impaired, even in individuals that died later in the test." Is not clear.

Section 3, Numeric Targets, 1st paragraph. Reference the EPAs Metal Translator or whatever the source of the conversion factors was.

"   ". Same page, last paragraph, States that the targets given in table 3.1 were derived to be protective of marine aquatic life from toxicity. Should it read 'freshwater' aquatic life?

"   " p. 12, Equation 3.2; Where: make sure subscripts agree with acute target. I think they should be A instead of C. This also needs correcting in the descriptive sentence to follow.

Section 3.2, Water Effects Ratios. 1st paragraph, 1st sentence, delete more

"   ". Last sentence. I would remove reference to the appendix if it will not be included.

Section 3.6. last sentence. Replace biochemical with biotic. (the gill is not a biochemical stie)

Section 4.2.1.1. add period between next to last and last sentence.

Section 4.3. p. 28. 2nd paragraph. Replace Creeks with Creek

Section 4.3.2. p. 31. 1st paragraph. I don't think the argument is strengthened with the inclusion of the 1984 lead reference (SEE Comments above.).

Section 4.4.3. p. 31. second sentence. Replace do with low.
In addition, there are a number of mis-labelings in the appendices

References

Barata, C., Markich, S.J., Baird, D.J., Taylor, G. and Soares, A.M.V.M., 2002. Genetic variability in sublethal tolerance to mixtures of cadmium and zinc in clones of *Daphnia magna* Straus. *Aquat. Toxicol.* **60**, pp. 85–99.

K.F. Biesinger, G.M. Christensen, J.T. Fiandt. Effects of metal salt mixtures on Daphnia magna reproduction. *Ecotoxicol Environ Saf*, **11** (1986), pp. 9-14.

J.M. Besser, W.G. Brumbaugh, T.W. May, S.E. Church and B.A. Kimball, Bioavailability of metals in stream food webs and hazards to brook trout (*Salvelinus fontinalis*) in the Upper Animas River Watershed, Colorado. *Arch Environ Contam Toxicol* **40** (2001), pp. 48–59.

W.P., Borgmann, U., Dixon, D.G. and Wallace, A., 2003. Effects of metal mixtures on aquatic biota: a review of observations and methods. *Human and Ecological Risk Assessment* **9**, pp. 795–811.

C.Y. Chen, R.S. Stemberger, B. Klaue, J.D. Blum, P.C. Pickhardt and C.L. Folt, Accumulation of heavy metals in food web components across a gradient of lakes. *Limnol Oceanogr* **45** (2000), pp. 1525–1536.

D.S. Cherry, J.H. Van Hassel, J.L. Farris, D.J. Soucek, R.J. Neves, Site-specific derivation of the acute copper criteria for the Clinch River, Virginia. *Human Ecolog Risk Assess* **8** (2002), pp. 591-601.

N.M. Franklin, J.L. Stauber, R.P. Lim, P. Petocz. Toxicity of metal mixtures to a tropical freshwater alga (Chlorella sp): the effect of interactions between copper, cadmium, and zinc on metal cell binding and uptake. *Environ Toxicol Chem.* **21** (2002), pp. 2412-22.

A. Jarvinen and G. Ankley, editors, *Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals.* (1999), SETAC press, Pensacola, FL. pp. 364.

M.H.S. Kraak, H. Schoon, W.H.M. Peeters and N.M. van Straalen, Chronic ecotoxicity of mixtures of Cu, Zn, and Cd to the zebra mussel *Dreissena polymorpha*. *Ecotoxicol. Environ. Saf.* **25** (1993), pp. 315–327.

D.D. MacDonald, C.G. Ingersoll, T. Berger. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch Environ Contam Toxicol* **39** (2000), pp. 20-31.

Gensemer, R.B. Naddy, W.A. Stubblefield, J.R. Hockett, R. Santore and P. Paquin, Evaluating the role of ion composition on the toxicity of copper to *Ceriodaphnia dubia* in very hard waters, *Comp. Biochem. Physiol.* **133C** (2002), pp. 87–97.

P.R., Gorsuch, J.W., Apte, S., Batley, G., Bowles, K., Campbell, P., Delos, C., DiToro, D., Dwyer, R., Galvez, F., Gensemer, R., Goss, G., Hogstrand, C., Janssen, C., McGeer, J., Naddy, R., Playle, R., Santore, R., Schneider, U., Stubblefield, W., Wood, C.M. and Wu, K., 2002. The biotic ligand model: a historical overview. *Comp. Biochem. Physiol.* **133C**, pp. 3–35.

R.G. Jak, J.L. Maas, M.C.Th. Scholten, Evaluation of laboratory derived toxic effect concentrations of a mixture of metals by testing fresh water plankton communities in exposures, *Water Res* **30** (1996), pp. 1215–1227.

E.A. Martinex, B.C. Moore, J. Schaumloffel, N. Dasgupta. Effects of exposure to a combination of zinc- and lead-spiked sediments on mouthpart development and growth in Chironomus tentans, *Environ Toxicol Chem*, **23** (2004) pp. 662-667.

S. Niyogi, C.M. Wood, Biotic ligand model, a flexible tool for developing site-specific water quality guidelines for metals, *Environ Sci Technol*, **38**(2004), pp. 6177-6192.

R.C. Playle, Using multiple metal-gill binding models and the toxic unit concept to help reconcile multiple-metal toxicity results. *Aquat Toxicol*, **67**(2004), 359-370.

M. R. Quinn, X. Feng, C.L. Folt and C.P. Chamberlain, Analyzing trophic transfer of metals in stream food webs using nitrogen isotopes, *The Science of The Total Environment* **317** (2003), pp. 73–89

K. Schiff, S. Bay, D. Diehl, Stormwater Toxicity in Chollas Creek and San Diego Bay, California, *Environ Monit Assess*, **81** (2003), pp. 119-32.

B.C. Suedel, J.A. Boraczek, R.K. Peddicord, P.A. Clifford and T.M. Dillon, Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. *Rev Environ Contam Toxicol* **136** (1994), pp. 21–89.

Timmermans, K. R., van Hattum, B., Kraak, M. H. S. & Davids, C. Trace metals in a littoral foodweb: Concentrations in organisms, sediment and water. *Sci. of the Total Environ* **87-88** (1989), pp. 477-494.

V.P. Utgikar, N. Chaudhary, A. Koeniger, H. Tabah, J.R. Haines, R. Govind. Toxicity of metals and metal mixtures: analysis of concentration and time dependence for zinc and copper, *Water Res* **38** (2004), pp. 3651-8.

Appendix L

Response to Peer Review Comments

Chollas Creek Metals Total Maximum Daily Load

California Regional Water Quality Control Board, San Diego Region

May 30, 2007

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RESPONSE TO PEER REVIEW COMMENTS

Response to Peer Review Comments from Dr. Joseph Shaw

Overall Assessment by Dr. Shaw

Comment

It should be noted that cautionary/critical statements in this review are provided as an aid to strengthen the scientific portion of the proposed rule. It is my opinion that the current draft of the technical plan far surpasses the status quo (i.e., not implementing the TMDL).

Response

Comment noted.

Biomagnification of Metals

Comment

As *stated in the TMDL, there is little evidence that copper, lead and zinc biomagnify in top-level feeders. However, I question whether one sentence in Section 2.4 (p.8) that cites a single 20 year old reference (Moore and Ramamoorthy, 1984) from a book on organic chemicals sufficiently justifies this position. Appropriate citations would include Timmermans et al., 1989; Suedel et al., 1994; Jarvinen and Ankley, 1999; and Besser et al., 2001. Also, there is growing evidence that zinc and to some extent copper can biomagnify within aquatic food webs (Quinn et al., 2003; Chen et al., 2000; Timmermans et al., 1989). However, these studies focused on lower food chain levels (i.e., phytoplankton, zooplankton, macro-invertebrates) and evidence extending these findings to higher trophic-level consumers (e.g., birds and mammals) is unfounded.*

Response

Our intention was not to justify the conclusion that copper lead and zinc do not bioaccumulate in Chollas Creek based on the Moore and Ramamoorthy reference. Section 3.4 (formerly 2.4) of the Technical Report states: "*Copper, lead and zinc may bioaccumulate within lower organisms, yet they do not biomagnify up the food chain as do mercury and selenium …*". This sentence implies that mercury and selenium have a higher potential for biomagnification over copper, lead, or zinc. The technical report does not state that copper, lead, or zinc will not bioaccumulate but rather the potential for biomagnification is more likely for mercury and selenium when compared against the other three metals.

There are no site-specific studies on Chollas Creek to verify whether metals are bioaccumulating into higher trophic level consumers. However, studies have been completed on marine sediments at the mouths of Chollas and Paleta Creek where they enter into San Diego Bay. Laboratory bioaccumulation sediment studies were conducted at 7 locations in the Chollas Creek channel and 7 locations in the Paleta Creek channel using the clam *Macoma nasuta*. The results from the 28-day bioaccumulation tests indicate a slightly higher bioaccumulation potential for copper and lead when compared to the reference mean tissue concentrations (RWQCB 2004).[1] Mean tissue concentrations for mercury and zinc were comparable to the tissue levels observed in the reference tissue.

Assuming Chollas Creek discharge contributes to the metals found in the sediment in the Chollas Creek channel, the preliminary study indicates a potential might exist for some metals that originated in the creek to reach higher trophic level consumers.

An additional reference has been included in the Technical Report to further support the position that copper, lead and zinc are not expected to biomagnify. Furthermore, the first paragraph of section 3.4 has been changed to:

> Copper and zinc are essential elements for all living organisms, but elevated levels may cause adverse effects in all biological species. Lead is presumed to be a non-essential element for life; more importantly, even at extremely low environmental concentrations this element may create adverse impacts on biota. Dissolved forms of these metals are directly taken up by bacteria, algae, plants and planktonic and benthic organisms. Dissolved metals can also adsorb to particulate matter in the water column and enter aquatic organisms through various routes. Copper, lead and zinc may bioaccumulate within lower organisms, yet they are not expected to biomagnify up the food chain as do mercury and selenium (Moore and Ramamoorthy, 1984). The issue of biomagnification is still being debated among the scientific community (Besser, et al, 200) and cannot be assessed in Chollas Creek with the available information. Of all of these metals, copper is considered the most potent toxicant at environmentally relevant aqueous concentrations. Copper is more commonly found at higher concentrations in herbivorous fish than carnivorous fish from the same location (USF&W, 1998). Copper is used as an aquatic herbicide to reduce algae growth in reservoirs and also applied (via antifouling paints) to boat hulls in marinas.

Creek Sediment

Comment

Sediment accumulation of metals in Chollas Creek appears to be minor (Table 2.4; Appendix C). The PEL (probable effect level; more recently termed PEC, probable effects concentration, MacDonald et al., 2000) approach has been successfully used to screen sediments on both a regional and national basis (Ingersoll et al., 2001). However, there are a couple of points of caution to be made with interpreting data provided (Table 2.4, Appendix C). As indicated in the text, PELs represent concentrations where toxicity (adverse effects) is expected to occur frequently. The water quality objective ("All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses

[1] RWQCB 2004. Sediment Assessment Study for the Mouths of Chollas and Paleta Creek, San Diego. Phase 1 Draft Report. Southern California Coastal Water Research Project and Space and Naval Warfare Systems Center San Diego, United States Navy – San Diego. September 2004.

in human, plant, animal, or aquatic life.") is more strict, seeking to protect against toxicity, not just frequent toxicity. With this in mind, cadmium although rarely detected (11 of 81 samples) and detected in excess of PEL (1.2%), has an average concentration that approaches PEL. Also, the one time it exceeded PELs it did so by over 6.5 fold. However, it is difficult to draw conclusions about this site, since it was only sampled once. In fact, the bulk of the sampling within the creek (sampling designated 978-270 to 978-337) occurred at a single time point and no temporal replication of these sites is shown. The data set that includes temporal replication contains three sites within San Diego Bay and only one site within the creek (location not provided). Given the short residence time of the sediments within the creek (~1 year as given in Section 2.5), a single grab from 1998 could be dramatically different from 2005. For the PEL screening approach to be successful the data being screened needs to adequately reflect that of the creek. Also, as pointed out in this document (section 2.4), metal toxicity has a strong relationship with speciation. Total sediment metal concentrations (just as measurements of total metal in the water column) have proven problematic in assessing toxicity. Typically sediment metal concentrations are discussed in context of sediment characteristics such as grain size, organic carbon, simultaneously extracted metal: acid volatile sulfides ratio, pH, etc.

Response

The text in section 3.5 has been updated to include the Probable Effect Concentration (PEC) and references the 2000 paper by MacDonald et al.

The Regional Board agrees with Dr. Shaw that a sediment metal concentration at or below the PEL or PEC could be interpreted to be in violation of the more stringent water quality objective for toxicity (see Section 3.3). However, the toxicity objective is more appropriately applied to the water column. Unfortunately, neither the State of California nor the United Sates Environmental Protection Agency (USEPA) have objectives nor standards that are directly applicable to freshwater sediment metal concentrations. Until such criteria are promulgated, the interpretation of sediment metal concentrations must rely on screening values or some statistically based threshold, such at the PEL or PEC.

The average sediment concentration of cadmium in Chollas Creek is approximately 2.1 mg/kg (dry weight). This is approximately 40 percent below the PEL of 3.53 kg/mg (dry weight). Furthermore, cadmium sediment concentrations only exceeded the PEL in one out of 81 samples over a 7-year period and only 11 of those 81 samples even had detectable cadmium concentrations. While mean and median sediment cadmium concentrations are much closer to the PEL than copper, lead or zinc, cadmium still warrants removal from the Clean Water Act 303(d) List of Water Quality Limited Segments (see the response to Comment 12 for further discussion on the delisting).

If subsequent information indicates that sediment may be a contributor to water column toxicity, the Regional Board will consider revising the monitoring requirements to include cadmium, grain size, organic carbon, simultaneously extracted metal to volatile sulfide ratios and pH.

Numeric Targets

Comment

CTR criteria are set to protect aquatic-life in California water bodies against both acute and chronic exposures to harmful contaminants. These include hardness corrections for ambient copper, lead, and zinc standards, an approach that has been incorporated in U.S. EPA ambient water quality criteria for the protection of aquatic-life for over 20 years (including updates). The hardness corrections account for the (generally) protective effect of the two components of hardness (i.e., calcium, magnesium) on the toxicity of these metals. In the absence of site-specific water quality parameters and species inventory lists for Chollas Creek, such an approach represents the most conservative and scientifically defensible action. However, there are some points of caution with their application. Criteria are designed to protect 95% of the species that fall within the range of sensitivities of those that were tested as part of the criteria development process. For acute criteria, these are generally robust and although a species inventory is not provided for Chollas Creek such targets would be expected to be protective of most species present. However, chronic criteria are established using a much smaller range of species through the development of acute to chronic ratios that are more broadly applied. For these reasons, chronic criteria would stand to be more impacted by site-specific parameters. If data are present on the species residing in Chollas Creek it could really benefit application of CTR standards. Also, it is surprising that hardness data, while admittedly variable, are not provided. I agree that because of the temporal/seasonal variability of Chollas Creek that it is appropriate to present hardness dependent standards. However, information on hardness would be a useful addition to the Technical Report as a means of determining the current status of Chollas Creek. Also, these standards are less predictive at the lower and higher extremes for hardness (Gensemer et al., 2002), where other water quality parameters can have a greater influence on toxicity. Finally, I would like to compliment the authors of this report for their inclusion of the newly proposed Biotic Ligand Model (Paquin et al., 2002) for copper and support their position of revisiting Numerical Targets if/when these are adopted. The BLM represents a fundamental change in the way metals criteria are calculated that models metal binding to critical biotic ligands, such as the fish gill, and relates this metal burden to detrimental effects on the organism. While they are more inclusive of mitigating water quality parameters, they are more data intensive (e.g., requiring simultaneous measurements of copper and many complexing anions and competing cations).

Response

A comprehensive study to determine the species living in the riparian zone of Chollas Creek has not been conducted. When and if such information becomes available, it will be reviewed to ensure that the most sensitive and/or endangered and threatened species are being protected by this TMDL.

Hardness data is presented in Appendix A. Hardness ranges from 35 to 3,200 mg/L $CaCO_3$, with an average of 198 and a median of 91 mg/L $CaCO_3$. These higher hardness concentrations certainly represent the extreme upper end. However, for all applications of CTR formulas, hardness will be capped at 400 mg/L $CaCO_3$. As additional toxicity information becomes available, the protective ability of this TMDL at extreme low and high hardness concentrations will be reviewed. We hope that this additional information will include the data necessary to populate the Biotic Ligand Model.

Sampling Requirements

Comment

There is insufficient material available regarding the spatial and temporal aspects of the monitoring/sampling plan to comment on its usefulness in assessing Load and Waste Load allocations for the Chollas Creek Watershed. In the absence of designating sampling requirements, it would be appropriate and necessary at a minimum to provide guidance on the development of such a plan in the Technical Report.

Response

The cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego, and the San Diego Unified Port District are conducting a metals monitoring and reporting program under order of the Regional Board (Order No. R9-2004-0227). The order stipulates that all sampling will be conducted using appropriate methods and that analyses will use approved techniques and meet minimum detection levels. Sections 11 and 12 of the draft Technical Report provide further details and sufficient guidance for the responsible parties to develop a revised monitoring and reporting program as part of the TMDL Implementation Plan if required by the Regional Board.

Water-effect Ratio

Comment

Water-effect ratios provide a way to calibrate numerical targets to site-specific conditions. These include endogenous species and/or water quality parameters that may vary from those used to develop the standard in sensitivity and influence on toxicity, respectively. These are typically derived after extensive on-site testing and are usually initiated by regulated parties. This approach (i.e., making unity the WER default and letting the regulated community establish site-specific conditions under the guidance of the Regional Board) is reasonable, especially given that WER are often implemented to make conservative Numerical Targets less restrictive. As discussed above for numerical targets, acute criteria are influenced less by site-specific conditions (i.e., WER close to unity; Cherry et al., 2002). Cherry et al. (2002) established a site specific CMC for copper in the Clinch River, VA. This required a battery of toxicity tests conducted using 17 genera native to or currently residing in the river that were not part of the derivation of the Final Acute Value (FAV) used in *the current U.S. EPA regulations. They concluded that the site specific CMC was not substantially different than the national copper criteria. They suggested site-specific adjustments would be most meaningful for criteria developed to protect against chronic exposures and low-level impact. I could find no published reports detailing successful integration of site-specific numerical targets using a WER approach.*

It should be noted that one additional source of site-specific variability could easily be incorporated into the TMDL. Direct measurements of dissolved metals can be influenced by a number of parameters and the use of conversion factors to translate total metal concentrations into dissolved is somewhat arbitrary and likely not reflective of the specific chemistries found within the watershed. It would seem reasonable to require that the monitoring plan require dissolved metals to be measured.

Response

The Regional Board appreciates Dr. Shaw's insights on the application of the water-effect ratio (WER) to freshwater systems. If and when a WER study is undertaken for Chollas Creek, the Regional Board will ensure that any sight specific chronic conditions are protective of the beneficial uses of the creek. The monitoring plan of Sections 11 and 12 of this report does require the sampling and analysis of dissolved metals. Furthermore, under the ongoing sampling plan, total metals are also being sampled.

Source Analysis

Comment

The methods or literature used to determine that the majority of run-off entering Chollas Creek is via the storm water conveyance system (MS4s, Section 4, introduction, p. 15) are not clearly stated. It makes sense given that there are no other point sources, but the reader is left to make the assumption that direct run-off into the creek is negligible (i.e., both volume and source). This is a crucial point as it identifies/acknowledges the jurisdiction of NPDES WDR and I think a citation or further explanation of this determination is warranted, especially since it places the load responsibility on 20 sources identified through NPDES permit requirements (Section 4.1, pp. 15-16). It would seem a mass accounting of volume entering via storm water conveyances and exciting the creek was used, but this was not mentioned. This conclusion also makes since empirically because a direct link between storm water discharges and creek toxicity has already been established (Schiff, 2001). Given that storm water is the major source of load input for Chollas Creek, the paradigm of identifying sources and modeling land-use specific loads for MS4s is reasonable. Additional comments on load estimates and source identification are given below (Questions 7-10).

Response
The end of the first paragraph of Section 5.1 has been modified to clarify any confusion over the source of water and over the persons responsible for the water in the creek. The following text has been added:

> The small size of the creek's riparian zone and the encroachment of development along the creek make the amount of run-off directly to the creek much smaller than that entering from storm drains. Furthermore, under the current MS4 WDRs, the creek itself is considered part of the storm drain system. Therefore, parties named in the Order are responsible for not only the run-off entering the creek, but also for the water in the creek itself.

Land Use Model

Comment
As a non-modeler I found the model description in Appendix D accessible. It did a great job explaining the process of data acquisition, populating model parameters, calibration, and independent validation, which are critical for model development. It also was effective in conveying the strengths, weaknesses, and limitations of the models, especially with regards to data gaps/needs and appropriate/inappropriate applications.

Response
Comment noted.

Model Interpretation

The immediate deficiencies are obvious; lack of input data (especially water quality measurements during dry weather conditions). Given these limitations it is difficult to assess the models performance. While it has potential to estimate metal concentrations in the Creek or support load allocations across varying condition, these identified deficiencies limited its application to identifying potential sources to target for load reductions. While this is useful it has less direct bearing on the derivation of the TMDL. As noted in Section 4, when data are sufficient they could be readily incorporated into the model.

Response
Comment noted.

Source Analysis Literature

Comment
The application of results from other studies to Chollas Creek is no different than most any discussion section found in a peer-reviewed article where the objective is to discuss results (strengths and weaknesses) in context of the body of existing literature. In this sense, such an approach seems not only warranted, but also

mandated. I found the literature selections for comparisons justified in terms of similarities (i.e., the most similar studies were selected). Similarities included geographical proximity, population size, land-use, policy, etc. However, in all cases differences and their potential to influence interpretations were highlighted. The only reference I question is the inclusion of Brown and Caldwell, (1984), which was used in section 4.4.2, p. 31. While its limits were clearly noted, the inclusion of lead loading data prior to the CAA ban of lead and lead additives in gasoline provides little area for comparison.

Response
The inclusion of deposition rates from Fresno, California in 1984 in the Source Analysis of this TMDL illustrate the upper range of possible lead atmospheric deposition. The Clean Air Act has drastically reduced the amount of lead that can reach the atmosphere. Nevertheless, the depositional rate from Fresno remains in the technical report as an informational item. When and if a local atmospheric deposition study is conducted, a comparison of the lead rates with those estimated from the 1984 study will be interesting. Only then will evidence be available to test the reasonable assumption that a watershed of cars with unleaded fuel will lead to a lower rate of atmospheric lead deposition than that observed in Fresno in 1984.

Data Deficiencies

Comment
The largest data gap I have found for the entire document deals with the lack of information pertaining to a monitoring plan. This is critical to fulfill one of the necessary requirements of Linkage Analysis (i.e., providing the quantitative link between the TMDL and attainment of WQSs) and does not seem to be appropriately identified (SEE RESPONSE TO QUESTION 4). Another unidentified gap appears in Section 5 (Linkage Analysis, p. 39), which states that the technical report is required to "estimate the total assimilative capacity (loading capacity) of Chollas Creek for the metals and describe the relationship between Numeric Targets and identified metal sources." I found no description of the later in this section. Also, as stated above it is a little unclear the role the model is serving (i.e., how it will be applied) in the TMDL development. Perhaps, I'm missing something, but it seems a little anticlimactic after reading section 4 and Appendix D that describe the model to get to the Linkage Analysis Section only to discover it has little application to TMDL development.

Response
The details of the monitoring plan can be found in sections 11 and 12 of the of this report. Please see the response to comment no. 5 above for more information regarding the monitoring requirements of this TMDL.

The Regional Board agrees that the relationship between Numeric Targets and identified metal sources is not clearly explained in the Linkage Analysis Section. Therefore, the following text has been added as the new third paragraph of Section 6:

> These loading capacities, which are equal to the Numeric Targets, will apply to the entirety of Chollas Creek and during all times of the year. Each of the land uses identified in the Source Analysis portion of this TMDL will not be allowed to have runoff or in-stream waters in excess of these concentrations. Further more, all other sources of copper, lead and zinc to Chollas Creek will be expected to not cause the creek to exceed these loading capacities. Once these capacities are achieved, it is expected that Chollas Creek copper, lead and zinc concentrations will be protective of the creek's beneficial uses.

The model described in section 5 and in Appendix D was used to identify and quantify the relative sources of copper, lead and zinc to Chollas Creek for the Source Analysis. Once the data deficiencies are overcome, the model will be used to more accurately quantify the mass loads of these metals from the creek to San Diego Bay. At that point, the TMDLs for copper, lead and zinc in Chollas Creek will be revised to contain both a concentration limit applicable at all times and a mass load limit that is not to be exceeded on an annual basis. This model refinement is expected to take place as part of the development of the TMDLs for the Mouths of Chollas and Paleta Creek in San Diego Bay.

Synergistic Toxicity

Comment

There is evidence for synergistic (i.e., greater than additive) and additive (which could also produce scenarios described above) effects of binary mixtures of copper and zinc and lead and zinc (Kraak et al., 1993; Franklin et al., 2002; Utgikar et al., 2004). However, published reports include laboratory studies that have focused on lower trophic levels (i.e., bacteria, phytoplankton, zooplankton). None of these studies investigated concentration ranges applicable to chronic effects and for the most part they focused on binary rather than more complex mixtures. It should be noted that mixture toxicity can be difficult to assess even in the laboratory as results (i.e., antagonism, additive effects, synergism) can vary with species, strain, concentration, and other parameters (Franklin et al., 2002, Borgmann et al., 2003, and numerous others). For example, Martinez et al. (2004) in studies with Chironomous tentans found lead and zinc to interact antagonistically to produce sub-chronic/population level effects (i.e., mouth part deformities), which is opposite from the studies cited above. This question could be pertinent, but does not appear to have been addressed in the de-listing of cadmium. There are numerous studies detailing interactive effects of cadmium combined with zinc, lead, and copper. Again, observed effects range from synergism to antagonism, but evidence exists for the scenario raised above where metals are present below the CTR concentrations and interact in a synergistic (or depending on concentration in an additive) manner to produce toxicity (Beisenger et al., 1986; Kraak et al., 1993; Jak et al., 1996; Barata et al., 2002; Franklin et al., 2002). The CTR Numerical Targets are derived for individual chemicals and do not account for mixtures. However, given the variability in the nature of interactions reported for these metals, interactions would be difficult to regulate in the absence of site-specific data. In summary, I would conclude that while some evidence for metal *interactions exists, appropriate determinations of effects would need to include site-specific variables in order to be scientifically defensible. The BLM if/when it is adopted could eventually provide a means of dealing with metal mixtures (Paquin et al., 2002; Niyogi and Wood, 2004; Playle, 2004).*

Response
The Regional Board agrees that synergistic effects among metals that are individually below CTR may produce toxicity and that these interactions would be difficult to regulate in the absence of site-specific data. Should this site-specific data become available at some future date, it could be incorporated into the TMDL.

Chollas Creek samples collected and analyzed between February 2000 and February 2004 indicated no (0 percent) exceedances of the CTR for dissolved cadmium. Applying the listing policy (SWRCB, 2004) to the available cadmium data confirms that cadmium should be delisted. Therefore the Regional Board is recommending that cadmium in Chollas Creek be removed from the Clean Water Act List of Water Quality Limited Segments. The Regional Board would reconsider the listing should data become available indicating that cadmium concentrations have increased above the CTR, or that cadmium in a synergistic interaction, is producing toxicity.

Linkage Analysis

Comment
The Waste Load and Load allocations are directly linked to Water Quality Standards defined by the numerical limits, as they are identical. The decision was made by the Board to take a conservative (i.e., from the protection standpoint) approach and set load allocations based on concentration rather than mass. In other words, it is not the relative amounts (i.e., mass) of metals, but rather their respective concentrations that determine load and load reductions will be based on maintaining concentrations of metals at or below these concentration based targets (the exact concentration is fluid and depends on the water hardness). This approach seems reasonable given the dynamic nature of the system. There is one peer-reviewed study and at least one technical report that link effects of storm water drainage and more specifically the metal component of this drainage to toxicity in aquatic-life in Chollas Creek and the portions of San Diego Bay it enters (Schiff et al, 2001; 2003). Since the load allocations are identical to the numerical limits my response to question 3 is also applicable here.

Response
Comment noted. Please see the response to comment no. 4 for a discussion of the Numeric Targets.

Margin of Safety

Comment

The explicit 10% MOS incorporated into the TMDL represents a commonly employed safety factor. The 10% load correction is to guard against the uncertainty inherent in the Source Analysis and Linkage Analysis; differences between total and converted dissolved metal concentrations; and site-specific differences in CTR derived Numerical Targets. It is difficult to comment on the appropriateness (or scientific validity) of the 10% correction. There was greater than 10% variability in measured metal concentrations (Table 2.1). Some explanation for the rationale behind the 10% MOS would be helpful. In addition, there are implicit MOS that stem from using measured rather than estimated hardness values to calculate the TMDL. Likewise, as discussed below, the CTR values incorporate 50% correction.

I didn't understand the argument provided in the last paragraph of section 6 (p. 41). Metal interactions were discussed in question 11 above. There are numerous explanations for interactive effects, which have been observed for copper, lead, and zinc. For example, common uptake routes (e.g., calcium channels for cadmium and zinc) or distributions and detoxications could account for interactive effects. While speciation affects toxicity, biological processes have also been shown to influence interactions during laboratory tests conducted under identical water chemistries. Perhaps chemical interactions refers to complexation with anions and negatively charged sites on particulates, which would reduce bioavailability. Anyway, this paragraph/point could use clarification.

Response

The explicit 10 percent Margin of Safety (MOS) was incorporated into the TMDL to account for any uncertainties in the analysis of metals. Therefore, an explicit MOS is warranted. The choice of ten percent is not based on the amount of error in the data, nor on any scientific study that establishes that the CTR formulas may have a 10 percent error. Rather, the 10 percent MOS is based upon the size of the MOS found in other similar TMDLs. Please see the TMDL for Selenium in the Lower San Joaquin River in Region 5, the Clear Lake TMDL for Mercury in Region 5 and the TMDL for Toxic Pollutants in San Diego Creek and Newport Bay, California by the USEPA.

The Regional Board agrees that the last paragraph of section 7 needed clarification. The entire paragraph has been changed to the following:

> Another implicit MOS was not allowing for metal interactions with anions and negatively charged sites on particulates when calculating the loading capacity and allocations. Theoretically, an increase in bioavailability from these types of chemical interactions in water would only take place in waters with low pH levels. The increased aqueous acidity (low pH levels) would yield higher levels of free metal ions and thereby increase bioavailability to aquatic organisms. Such low pH levels in ambient waters are more likely to be observed in areas of high acid rain; these low pH conditions are not likely in San Diego. Therefore, metal interactions with negatively charged anions and particles

within the water were assumed to only decrease bioavailability. Not allowing for this interaction makes the TMDL concentration more conservative.

California Toxics Rule Inherent Margin of Safety

Comment

As stated above, the one peer-reviewed manuscript that described formulating site-specific CMC for copper concluded that including over 17 sensitive site-specific species to calculate the FAV did not significantly lower the CMC (Cherry et al., 2002). Also, the CTR are based on national ambient water quality criteria, for which the science has been validated through several updates over 20 years. It wasn't until recently that new approaches (i.e., BLM) gained favor. Given the defensibility and robustness of this approach coupled with the lack of evidence for extreme site-specific sensitivities another 10% MOS does not seem warranted.

Response

The explicit 10 percent Margin of Safety (MOS) was incorporated into the TMDL to account for any uncertainties in the analysis of metals. The CTR formulas provide conservative water quality criteria that are protective of aquatic life. However, since the equations are based upon available laboratory data, they may not be protective of all aquatic life in Chollas Creek. Therefore, the Regional Board believes that an explicit MOS is warranted.

Critical Conditions

Comment

The use of a concentration (mass/volume) based TMDL negates effects of variable flow on load allocations, since regardless of the amount (mass) of metals that are present, it is the CTR derived concentrations that must be maintained. Concentration based criteria have a long history of use and even the newly proposed BLM, which relate an amount of metal bound to a critical biotic ligand to toxicity, are still expressed as concentrations. The use of concentrations is an appropriate approach for Chollas Creek given the limited data available for Land Use Models and other methods used to estimate the metal load entering during wet and dry periods. Likewise, the use of CMC and CCC targets ensure critical exposure conditions (acute, chronic) are incorporated. Furthermore, the inclusion of measured rather than estimated hardness concentrations reduce seasonal variability, especially during critical conditions. Provisions are also made to revisit other stream chemistry parameters that were not included in this TMDL if/when the BLM for copper is adopted. Collectively, these measures stabilize the TMDL even over extreme/critical conditions that could be occurred within the basin.

Response

Comment noted.

Monitoring Details

Comment
With regards to additional scientific issues relating to the Technical Report, there was little mention of specific methods, especially for metal sampling and analysis. Most every question in this reviews asked the reviewer to comment on the scientific methods, so it would appear to be information useful this review. Inclusion of methods could be done in the form of references, but I think their inclusion in necessary to ensure appropriate sampling/measurement techniques are employed and thus, TMDLs are meaningful.

Response
The details of the monitoring plan can be found in sections 11 and 12 of this report. Please see the response to comment no. 5 above for more information regarding the monitoring requirements of this TMDL.

Specific comments regarding the Technical report are as follows

Comment A
Attachment 1, p. 1, second paragraph- There are more appropriate references than More and Ramamoorthy, 1984).

Response\
Please see the response to comment no. 2 above for a discussion on biomagnification and for the changes made to this TMDL Report.

Comment B
Technical Analysis, p.1, 1st paragraph, 1st sentence- insert 'and a' between County and tributary.

Response
This correction has been made.

Comment C
" ", p. 1, 1st paragraph, with regards to de-listing Cd, see question regarding synergistic effects above.

Response
The Regional Board still believes that Cd should be removed from the Clean Water Act List of Water Quality Limited Segments. Please see the response to comment no. 12 for a more in-depth discussion.

Comment D
Problem statement, p. 2, in the 1st paragraph inconsistencies with the use of lower and lowest.

Response

Paragraph has been updated to use 'lowest' in both instances.

Comment E

" ", same paragraph- Ceriodaphnia is misspelled.

Response

This correction has been made.

Comment F

" ", same paragraph- not exactly clear on the use of the sea urchin. I assume this is from test of Bay water? Also, in general toxicity data were not presented in clearly.

Response

The sea urchin test was run to see if Chollas Creek stormwater could be negatively impacting San Diego Bay. To avoid any confusion over the details of the Toxicity Identification Evaluation (TIE), the last sentence of the first paragraph of section 3 has been deleted. The full citation for the TIE study can be found in the reference section.

Comment G

Section 2.3, p. 8, 2nd paragraph, last sentence; it states that compliance shall be evaluated using a 96-hr acute bioassay. The Daphnia tests mentioned are 48-h tests.

Response

The italicized text in section 3.3 is taken verbatim from the Basin Plan. Therefore, we do not want to change this quotation as it appears in this TMDL Report. However, this correction will be considered during the drafting of the monitoring plan and during the next revision of the Basin Plan.

Comment H

Section 2.4., p. 8, 1st paragraph, poor reference for biomagnification of metals.

Response

The following reference has been added to that section:

Besser, J. M., W.G. Brumbaugh, T.W. May, S.E. Church and B.A. Kimball, Bioavailability of metals in stream food webs and hazards to brook trout (*Salvelinus fontinalis*) in the Upper Animas River Watershed, Colorado. *Arch Environ Contam Toxicol* **40** (2001), pp. 48–59.

Please see the response to the Comment A for further discussion.

Comment I

" ", toxins are natural compounds (i.e., snake venom, ammonia); toxicants is the appropriate word here.

Response
This change has been made.

Comment J
"   ". Next sentence; …same locations more commonly found at higher concentrations in ….

Response
This change has been made.

Comment K
"   ". P. 9, Better references than Buffle, 1989.

Response
The Regional Board appreciates the additional support for concepts put forth in section 3.4 and will be working to track down these references.

Comment L
"   ". P. 9. 2nd paragraph, last sentence, Unclear what is being referred to where the implementation plan is located?

Response
A reference to sections 11 and 12 has been added to this paragraph.

Comment M
Section 2.6. p. 10. In reference to the monitoring site, it is stated that this sampling station is representative of the entire watershed. How was this determination made?

Response
This determination was based upon the similarities in land use between the watersheds of the two forks of Chollas Creek. The last sentence of the first paragraph of section 3.6 has been changed to:

> This station samples run-off that is representative of the entire watershed because the land use distribution in the north fork portion of the watershed is nearly identical to the land use distribution of the entire watershed as shown in Table 3.5 below.

Comment N
"   ", next paragraph. Replace 1994.95 with 1994-95.

Response
This change has been made.

Comment O
"   ". Same paragraph. Provide methods for toxicity tests.

Response

The methods for these toxicity tests can be found in the original Stormwater Reports for the various years. These documents can be viewed at the Regional Board office.

Comment P

" ". Same paragraph. Sentence that states, "Reproduction of the water fleas was generally not impaired, even in individuals that died later in the test." Is not clear.

Response

The part that reads "*even in individuals that died later in the test*" has been removed from the text. The Stormwater Reports containing these toxicity test results can be reviewed at the Regional Board office.

Comment Q

Section 3, Numeric Targets, 1st paragraph. Reference the EPAs Metal Translator or whatever the source of the conversion factors was.

Response

References for the conversion factors are properly cited in section 4.3, where they are discussed in detail.

Comment R

" ". Same page, last paragraph, States that the targets given in table 3.1 were derived to be protective of marine aquatic life from toxicity. Should it read 'freshwater' aquatic life?

Response

This change has been made.

Comment S

" " p. 12, Equation 3.2; Where: make sure subscripts agree with acute target. I think they should be A instead of C. This also needs correcting in the descriptive sentence to follow.

Response

This change has been made.

Comment T

Section 3.2, Water Effects Ratios. 1st paragraph, 1st sentence, delete more

Response

This change has been made.

Comment U

" ". Last sentence. I would remove reference to the appendix if it will not be included.

Response

The reference has been maintained and the appendix will be included as part of the TMDL report.

Comment V

Section 3.6. last sentence. Replace biochemical with biotic. (the gill is not a biochemical site)

Response

This change has been made.

Comment W

Section 4.2.1.1. add period between next to last and last sentence.

Response

This change has been made.

Comment X

Section 4.3. p. 28. 2nd paragraph. Replace Creeks with Creek

Response

This change has been made.

Comment Y

Section 4.3.2. p. 31. 1st paragraph. I don't think the argument is strengthened with the inclusion of the 1984 lead reference (SEE Comments above.).

Response

Please see response to comment no. 10 above.

Comment Z

Section 4.4.3. p. 31. second sentence. Replace do with low.

Response

This change has been made.

Comment AA

In addition, there are a number of mis-labelings in the appendices.

Response

These corrections have been made.

Additional references provided by Dr. Shaw.

Barata, C., Markich, S.J., Baird, D.J., Taylor, G. and Soares, A.M.V.M., 2002. Genetic variability in sublethal tolerance to mixtures of cadmium and zinc in clones of *Daphnia magna* Straus. *Aquat. Toxicol.* 60, pp. 85–99.

K.F. Biesinger, G.M. Christensen, J.T. Fiandt. Effects of metal salt mixtures on Daphnia magna reproduction. *Ecotoxicol Environ Saf*, 11 (1986), pp. 9-14.

J.M. Besser, W.G. Brumbaugh, T.W. May, S.E. Church and B.A. Kimball, Bioavailability of metals in stream food webs and hazards to brook trout (*Salvelinus fontinalis*) in the Upper Animas River Watershed, Colorado. *Arch Environ Contam Toxicol* 40 (2001), pp. 48–59.

W.P., Borgmann, U., Dixon, D.G. and Wallace, A., 2003. Effects of metal mixtures on aquatic biota: a review of observations and methods. *Human and Ecological Risk Assessment* 9, pp. 795–811.

C.Y. Chen, R.S. Stemberger, B. Klaue, J.D. Blum, P.C. Pickhardt and C.L. Folt, Accumulation of heavy metals in food web components across a gradient of lakes. *Limnol Oceanogr* **45** (2000), pp. 1525–1536.

D.S. Cherry, J.H. Van Hassel, J.L. Farris, D.J. Soucek, R.J. Neves, Site-specific derivation of the acute copper criteria for the Clinch River, Virginia. *Human Ecolog Risk Assess* **8** (2002), pp. 591-601.

N.M. Franklin, J.L. Stauber, R.P. Lim, P. Petocz. Toxicity of metal mixtures to a tropical freshwater alga (Chlorella sp): the effect of interactions between copper, cadmium, and zinc on metal cell binding and uptake. *Environ Toxicol Chem.* **21** (2002), pp. 2412-22.

A. Jarvinen and G. Ankley, editors, *Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals.* (1999), SETAC press, Pensacola, FL. pp. 364.

M.H.S. Kraak, H. Schoon, W.H.M. Peeters and N.M. van Straalen, Chronic ecotoxicity of mixtures of Cu, Zn, and Cd to the zebra mussel *Dreissena polymorpha*. *Ecotoxicol. Environ. Saf.* **25** (1993), pp. 315–327.

D.D. MacDonald, C.G. Ingersoll, T. Berger. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch Environ Contam Toxicol* **39** (2000), pp. 20-31.

Gensemer, R.B. Naddy, W.A. Stubblefield, J.R. Hockett, R. Santore and P. Paquin, Evaluating the role of ion composition on the toxicity of copper to *Ceriodaphnia dubia* in very hard waters, *Comp. Biochem. Physiol.* **133C** (2002), pp. 87–97.

P.R., Gorsuch, J.W., Apte, S., Batley, G., Bowles, K., Campbell, P., Delos, C., DiToro, D., Dwyer, R., Galvez, F., Gensemer, R., Goss, G., Hogstrand, C., Janssen, C., McGeer, J., Naddy, R., Playle, R., Santore, R., Schneider, U., Stubblefield, W., Wood, C.M. and Wu, K., 2002. The biotic ligand model: a historical overview. *Comp. Biochem. Physiol.* **133C**, pp. 3–35.

R.G. Jak, J.L. Maas, M.C.Th. Scholten, Evaluation of laboratory derived toxic effect concentrations of a mixture of metals by testing fresh water plankton communities in exposures, *Water Res* **30** (1996), pp. 1215–1227.

E.A. Martinex, B.C. Moore, J. Schaumloffel, N. Dasgupta. Effects of exposure to a combination of zinc- and lead-spiked sediments on mouthpart development and growth in Chironomus tentans, *Environ Toxicol Chem*, **23** (2004) pp. 662-667.

S. Niyogi, C.M. Wood, Biotic ligand model, a flexible tool for developing site-specific water quality guidelines for metals, *Environ Sci Technol*, **38**(2004), pp. 6177-6192.

R.C. Playle, Using multiple metal-gill binding models and the toxic unit concept to help reconcile multiple-metal toxicity results. *Aquat Toxico*l, **67**(2004), 359-370.

M. R. Quinn, X. Feng, C.L. Folt and C.P. Chamberlain, Analyzing trophic transfer of metals in stream food webs using nitrogen isotopes, *The Science of The Total Environment* **317** (2003), pp. 73–89

K. Schiff, S. Bay, D. Diehl, Storm water Toxicity in Chollas Creek and San Diego Bay, California, *Environ Monit Assess*, **81** (2003), pp. 119-32.

B.C. Suedel, J.A. Boraczek, R.K. Peddicord, P.A. Clifford and T.M. Dillon, Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. *Rev Environ Contam Toxicol* **136** (1994), pp. 21–89.

Timmermans, K. R., van Hattum, B., Kraak, M. H. S. & Davids, C. Trace metals in a littoral foodweb: Concentrations in organisms, sediment and water. *Sci. of the Total Environ* **87-88** (1989), pp. 477-494.

V.P. Utgikar, N. Chaudhary, A. Koeniger, H. Tabah, J.R. Haines, R. Govind. Toxicity of metals and metal mixtures: analysis of concentration and time dependence for zinc and copper, *Water Res* **38** (2004), pp. 3651-8.

Response
The Regional Board appreciates these additional supporting references and will consider them as the need arises.

Response to Peer Review Comments from Dr. Garrison Sposito and Ms. Jasquelin Peña

Overall Summary

Comment

The draft report under review provides technical information related to the establishment of Total Maximum Daily Loads (TMDLs) for Chollas Creek, an intermittent stream that drains a highly urbanized watershed through two major tributaries in the San Diego area. Outflow from the creek, whose lower reach (see photo of the North Fork, below, taken by J. Peña, March 2005) has impaired water quality, is into San Diego Bay.

Response

Comment noted.

National Toxics Rule vs California Toxics Rule

Comment

Note, however, that the introductory statements on page 4 of the draft report appear to be contradictory in respect to the documentation of impaired water quality, implying that National Toxics Rule criteria are more often exceeded than California Toxics Rule criteria, while calling the latter "more stringent."

Response

The Regional Board did not intend to imply that the water quality criteria contained in the CTR are more "stringent" or lower than the values contained in the NTR. Water quality criteria in the CTR are based on dissolved metal concentrations for copper, lead and zinc, unlike water quality criteria in the NTR, which are based on total copper concentrations. Therefore, it is possible to exceed values contained in the NTR but not exceed the water quality criteria in the CTR because they are measuring different aspects of a metal. In order to avoid further confusion, the text on page 4 at the beginning of the second sentence, "While exceeding NTR criteria" was deleted.

Definition of TMDL

Comment

The TMDLs discussed in the report are for the metals, copper, lead, and zinc. As noted in the Introduction of the draft report, TMDLs are load allocations (mass per day) of pollutants to a waterbody, considering both point sources and nonpoint sources, such that the assimilative capacity of the waterbody in respect to applicable water quality objectives is not exceeded.

Response

Comment noted. For clarification purposes, in accordance with the applicable federal regulation [40 CFR 130.2(i)]: "TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure." The TMDLs for metals in Chollas Creek are concentration-based.

Numeric Targets

Comment

The methodology followed in the draft report for the three metals of concern is to apply the USEPA- California Toxics Rule (USEPA-CTR) to obtain numeric targets for dissolved metals in Chollas Creek. The dissolved metal concentrations are calculated for both acute (one-hour average) and chronic (four-day average) conditions from USEPA-CTR statistical regression equations that include factors for site-specific toxicity effects, total-to-dissolved metal concentrations, and direct hardness effects (Table 3.1 in the draft report). Hardness data for the waterbody will be required in order to implement these equations.

Response

The Regional Board agrees that hardness data will be necessary to monitor for compliance with the TMDLs. Water quality criteria in the CTR are expressed as a function of hardness. The Regional Board will require the dischargers to collect hardness data in addition to metals concentrations as part of the monitoring required to comply with the TMDLs. Please note that Table 3.1 is now labeled as Table 4.1.

Temperature and pH

Comment

It is possible to include direct effects of temperature and pH in the equations, but this was not done in the draft report.

Response

The equations in the CTR do not include the parameters of temperature or pH. The Regional Board will continue to use the equations defined in the CTR with the WER = 1.00 until it can be demonstrated that an alternative approach is appropriate based on further studies or information.

Site-Specific Objectives

Comment

Site-specific toxicity effects also were not considered [i.e. Water Effects Ratio (WER) = 1.0 in the regression equations] and the total-to-dissolved metal concentrations ratio for each metal was set equal to a fixed constant for all conditions using the default USEPA-CTR values.

Response

The passage of the CTR in 2000 by USEPA established legally applicable numeric water quality objectives for priority toxic pollutants including copper, lead and zinc in California. Water quality criteria in the CTR are based on dissolved metal concentrations. In the absence of site-specific data, a WER equals one and a constant total-to-dissolved metal conversion factor set in the CTR is appropriate for use in the equations that define the CTR water quality criteria.

Until sufficient information is available to justify a change, using a WER equal to one in the CTR and a constant total-to-dissolved metal conversion factor will ensure protection of beneficial uses in Chollas Creek. However, the Regional Board supports the collection of data and information necessary to determine if a modified WER value or some other site-specific criteria is appropriate and/or to establish a site-specific conversion factor for total-to-dissolved metal concentrations. Once data are available to change the WER or total-to-dissolved metal conversion factor, the State has the discretion to interpret the CTR water quality criteria and modify the TMDLs based on site-specific studies and information for Chollas Creek

CTR as Numeric Target

Comment

Although the draft report states that the numeric targets set by using the USEPA-CTR equations are a function of hardness, it does not justify why this choice is appropriate for Chollas Creek, other than its legal applicability in California for inland surface waters (draft report, page 11). Reference to CFR 40 Part 131 provides the following guiding commentary on the toxicological significance of hardness-based USEPA-CTR equations:

> *f. Hardness*
> *Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicities of some metals. Hardness is used as a surrogate for a number of water quality characteristics which affect the toxicity of metals in a variety of ways. Increasing hardness has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness, measured in milligrams per liter as calcium carbonate.*

Given the importance accorded in the draft report (page 14) to hardness sampling as part of compliance testing, it would be very useful to have more detailed discussion on the relevance of the above paragraph to water quality criteria for the three metals of concern in Chollas Creek.

Response
The Regional Board agrees that a more detailed discussion regarding the role of hardness to the water quality criteria is important. The above text under *"f. Hardness"* was added to the end of the first paragraph of section 4.4.

Site-Specific Toxicity Evaluation

Comment
Although the choice of WER = 1.0 in the draft report is a conservative one, procedures are available from USEPA for evaluating site-specific toxicity effects and modifying the Water Effects Ratio accordingly. This additional information may be of special value in respect to copper because of its strong tendency to form toxicity-reducing soluble complexes with dissolved organic matter. Similarly, the use of a constant total-to-dissolved metal concentrations ratio as given by USEPA is problematic, since the chemical forms of copper, lead, and zinc are likely to vary both spatially and temporally depending on streamflow variation and the changing composition of streamwaters, including suspended load. In the draft report, the assumption is made that the USEPA-CTR default values for the three metals are upper limits of the actual values in Chollas Creek, the implication being that actual total-to-dissolved metal concentrations are always larger than the default values used in the USEPA-CTR regression equations. Since toxicity effect should vary inversely with total-to-dissolved metal concentration, this assumption amounts to an implicit Margin of Safety imposed on the recommended dissolved metal concentrations. An alternative approach would be to evaluate total-to-dissolved metal concentrations as a function of turbidity and include turbidity sampling as a part of compliance testing.

Response
Implicit MOS are an allowable component of the TMDL process. TMDL design allows for limitless methodological and equation refinements that find their reasonable limit via best professional judgement. In this instance, the Regional Board will continue with the "WER = 1.0" approach until it can be demonstrated that an alternative approach significantly alters the final result

In addition, please see the response to comment no. 25 above.

Hydrologic Modeling

Comment
In the usual development of TMDLs for a waterbody, hydrologic data and pollutant source analyses are combined with the numeric targets to calculate waste load and load allocations. However, in the draft report under review, although spatial hydrologic modeling and a very thorough metal source analysis are presented, they are used only to determine TMDL Critical Conditions (Appendix D, Section 2.2).

Response
The model described in section 5 and in Appendix D was used to identify and quantify the relative sources of copper, lead and zinc to Chollas Creek for the Source

Analysis. Once the data deficiencies are overcome, the model will be used to more accurately quantify the mass loads of these metals from the creek to San Diego Bay. At that point, the TMDLs for copper, lead and zinc in Chollas Creek will be revised to contain both a concentration limit applicable at all times and a mass load limit that is not to be exceeded on an annual basis. This model refinement is expected to take place as part of the development of the TMDLs for the Mouths of Chollas and Paleta Creek in San Diego Bay.

Monitoring Needed

Comment

It appears that most of the data used to develop the TMDLs was collected during stormflows. Additional monitoring during low flow should be implemented since pools of slow-moving or standing water (see photo of Chollas Creek, below, taken by J. Peña) will have very different dynamics—and metal sources—from those associated with high-flow storm events. It is also possible that dissolved metal concentrations during low flow are greater than in the wet season because metal inputs are not diluted by large volumes of rainwater. Also, standing water can undergo evaporation, leading to the concentration of metals in sediments.

Response

The Regional Board agrees that additional monitoring should be conducted during low flow periods to more accurately characterize metals loading to Chollas Creek. The Regional Board will require the dischargers to monitor during dry weather metals concentrations to comply with the TMDLs. Information gathered as a result of this monitoring will be incorporated into the TMDLs as appropriate.

Editorial Clarification

Comment

Page 32, Section 4.4.5. In the last sentence, the reader should be reminded that this summary applies strictly to the Santa Clara Valley study.

Response

The draft Technical Report has been updated to reflect this change.

Treatment Plant Effluent

Comment

Page 33, Section 4.4.5.2. Quantify the difference between the "back of the envelope calculation" given here and the model results.

Response

As stated in the text, the quantities associated with the treatment plants have been determined to be insignificant because the treatment plants' effluents have little detectable copper, lead and zinc. Therefore no further analysis is necessary.

Pesticide Copper Concentrations

Comment
Page 37, Section 4.5.4. The percentage of copper contained in each pesticide should be included in Table 4.10.

Response
Comment noted. As stated in the text, only a percentage of the pesticide amount shown in Table 5.10 is actually copper or zinc and there is not enough information to quantify the actual amount of copper or zinc that would reach a water body in San Diego County.

Load and Waste Load Allcoations

Comment
Because waste load and load allocations were not made, the linkage analysis in the draft report (page 39) consists of identification of the most important metal sources and streamflows to be considered when sampling metal concentration and hardness for assessing compliance with the recommended dissolved metal concentrations. The final recommendations for the three metals are dissolved concentrations equal to 90 % of the dissolved concentrations (i.e. 10 % Margin of Safety) calculated using the USEPA-CTR hardness-based regression equations. These recommended concentrations are compared illustratively to measured concentrations in Appendix G of the draft report. The results in this appendix indicate that maximum observed concentrations of the three metals are significantly greater than the concentrations required to meet water quality objectives, with the discrepancies being much larger at lower hardness values.

Response
Comment noted. For clarification, waste load and load allocations were made in the draft Technical Report. These allocations are concentration–based, in accordance with federal regulations [40 CFR 130.2(i)], which state: “TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.”

Biomagnification

Comment
The use of dissolved metal concentrations as numeric targets presupposes that the metals do not increase in concentration at higher trophic levels (i.e. no biomagnification) and that they do not accumulate in sediments. Biomagnification of copper, lead, and zinc in test organisms (e.g. daphnia) has not been observed in laboratory studies, insofar as the reviewers are aware, nor is it expected. Biomagnification is associated with hydrophobic pollutants and hydrophobic chemical forms of pollutants (e.g. methyl mercury), whereas most toxic metals have hydrophilic chemical forms in aquatic ecosystems. It is possible that lead could take

on a hydrophobic chemical form under anaerobic conditions because it can be methylated by microorganisms, but this is very unlikely in well-aerated waterbodies. Accumulation in freshwater sediments is well established for the three metals of concern, which have strong sorption affinities for natural particles, especially those with organic matter content. The case is made in the draft report that metal concentrations in the creek sediments are typically below levels of probable toxic effect and that particle-bound metals are flushed from the creek within one year by winter flows. These conjectures are not unreasonable, but no database currently exists with which to evaluate them, bringing to mind the important possibility that particle-bound metals transported to San Diego Bay may pose a potential toxicity threat, thus making Chollas Creek a source of this threat.

Response
The existing data on sediment metals concentrations in Chollas Creek demonstrated that metals in the sediment are most likely not accumulating in Chollas Creek. Instead, metals adsorbed to particles in Chollas Creek are likely flushed out of the creek during wet weather events, acting as a source of metals loading to the mouth of Chollas Creek and San Diego Bay. A TMDL is currently under development for the mouth of Chollas Creek that will address this issue.

Concentration-based TMDL

Comment
Dissolved concentrations of copper, lead, and zinc for acute and chronic conditions calculated from USEPA-CTR regression equations dependent on water hardness are promulgated with a 10 % Margin of Safety instead of TMDLs, which typically combine allowable dissolved metal concentrations with hydrologic and metal source analyses to prescribe mass loadings that meet applicable water quality objectives.

Response
The TMDL is the combination of a total wasteload allocation (WLA) that allocates loadings for point sources, a total load allocation (LA) that allocates loadings for nonpoint sources and background sources and a MOS. For clarification, waste load and load allocations were made in the draft Technical Report. These allocations are concentration–based, in accordance with federal regulations [40 CFR 130.2(i)], which state: “TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.”

Scientific Justification for Using CTR

Comment
Detailed scientific justification of the USEPA-CTR hardness-based equations for applicability to Chollas Creek waters in determining allowable metal concentrations is not provided. However, assumptions of no metal biomagnification or accumulation in sediments, which underlie the use of numeric targets based on dissolved concentrations, seem justified.

Response

The CTR hardness-based equations are legally and scientifically applicable to Chollas Creek. The legal applicability is established by federal regulation [40 CFR 131.38] and is sufficient to warrant the use of the CTR for this TMDL. In addition, Chollas Creek is a freshwater system, with variable physical parameters that make the use of the hardness-based equations to prevent toxic conditions scientifically reasonable.

The comment regarding biomagnification is noted.

Summary of Current Problem

Comment

Compliance testing guided by TMDL Critical Conditions will require measurements of both metal concentrations and hardness (as calcium carbonate) for use with USEPA-CTR regression equations that, along with the 10 % Margin of Safety, define the numeric targets. Preliminary calculations indicate that current metal concentrations in Chollas Creek are in excess of these targets, particularly at low hardness values.

Response

The Regional Board agrees with this comment and is requiring hardness (as calcium carbonate) to be measured.

Hydrologic Modeling

Comment

Hydrologic modeling and metal source analyses are used to select TMDL Critical Conditions for compliance testing. Hydrologic modeling is not explicitly used in metal load and waste load allocations. All hydrologic and metal source effects are implicit in these allocations.

Response

Compliance sampling will not be based upon the critical conditions identified in the hydrologic model used in the Source Analysis. Sampling details can be found in sections 11 and 12 of the draft Technical Report.

Additional Monitoring

Comment

The current database for Chollas Creek can be improved by additional monitoring of both metal concentrations during lowflow periods and metal accumulation in creek sediments that may serve as a source of contamination for San Diego Bay.

Response
The Regional Board agrees that additional data should be collected to fully characterize the contribution of metals during dry weather. Monitoring of metals concentrations during dry weather will be required of the dischargers in order to comply with the TMDLs. Further data would also be useful to characterize the contribution of metals in sediment to metals loading into San Diego Bay. The Regional Board will address this issue in a TMDL currently under development for the mouth of Chollas Creek.

Additional Toxicity Testing

Comment
Additional laboratory toxicity testing using Chollas Creek waters would be useful in order to justify the Water Effects Ratio and to evaluate the accuracy of the default total-to-dissolved metal concentration factor assumed in the USEPA-CTR regression equations.

Response
The Regional Board supports the collection of data and information necessary to determine if a modified WER value or some other site-specific criteria is appropriate and/or to establish a site-specific translator for total-to-dissolved metal concentrations. Unfortunately, the Regional Board does not have the resources to actively engage in these investigations. The current WER value of one is appropriate for use in the equations that define the CTR water quality criteria. Until sufficient information is available to justify a change, the value of one is appropriate for all CWA uses, including the SIYB TMDL. In the meantime, using a WER equal to one in the CTR copper objective will ensure protection of beneficial uses in the water column of SIYB. Once data are available to change the WER, the State has the discretion to interpret the CTR copper criteria based on a site-specific WER for Chollas Creek.

Appendix M

Response to Comments

Chollas Creek Metals Total Maximum Daily Loads

California Regional Water Quality Control Board, San Diego Region

Table of Contents

LIST OF PERSONS SUBMITTING COMMENTS

- Brake Pad Partnership
- California Department of Transportation
- City of San Diego
- San Diego Coastkeeper
- Sierra Club
- John Stump
- Tershia d'Elgin

1. INTRODUCTION

This report provides responses to public comments received on the Total Maximum Daily Loads (TMDLs) for Copper, Lead, and Zinc in Chollas Creek. Draft TMDL documents distributed for public review and comment included the Technical Report, Resolution No. R9-2007-0043, and the Basin Plan Amendment. The draft documents were made available to the public for formal review and comment for two comment periods, through the website of the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) and at the San Diego Water Board office. The first public comment period opened July 25, 2006, and continued for 45 days. The second comment period opened March 9, 2007, and continued until the San Diego Water Board adopted this TMDL. Please note that these comments and responses are only for the Chollas Creek metals TMDLs documents dated July 25, 2006, and March 9, 2007. Comments and responses to the June 2005 Chollas Creek metals TMDLs documents are located in the case file for this project.

The San Diego Water Board received many new comments in testimony, letters, and emails from interested persons on the draft TMDL documents. The letters were not reproduced in this document. Individual comments were excerpted from the letters and testimony, and organized by the commenter. The comments are numbered sequentially in this report. Individual commenters are identified in the "List of Persons Submitting Comments" on page iii of this appendix.

2. COMMENTS ON JULY 25, 2006 TMDL DOCUMENTS

2.1. Comments from the City of San Diego (September 25, 2006)

The San Diego Water Board received comments from the City of San Diego (City) on September 25, 2006. following is the San Diego Water Board's response to those comments. However, because the City's comments were frequently repeated in various parts of the document, we have organized the comments into common groups to provide clarity and to facilitate better comprehension of both the comments and responses. The San Diego Water Board did not respond to comments the City made which concerned only the indicator Bacteria TMDLs Project I, Beaches and Creeks in the San Diego Region, or where the comment did not address the Chollas Creek Metals TMDLs specifically. The common groups include the following:

- Time Schedule and Integrated TMDL Implementation
- Lack of Detail
    - Design Storm
    - Significance Threshold
    - Substantial Evidence
    - Other Lack of Detail Comments
- Tiering

- Alternatives Analysis
- Tributary Rule
- Dry Weather
- Aerial Deposition
- Statement of Overriding Considerations
- Other Specific Comments

2.1.1 Time Schedule and Integrated TMDL Implementation

Comment No. 1: The City's biggest concern regarding the Chollas Creek metals TMDL is with the proposed compliance schedule. The TMDL Technical Report states the following regarding discharger activities to achieve the WLAs:

> Dischargers are expected to implement metal reduction [Best Management Practices or "BMPs"] during the first year after OAL approval of this TMDL, with all necessary metal load reductions being achieved within ten years. The first three years of the compliance schedule do not require a significant decrease from current conditions. These years will provide the dischargers time to develop plans and implement enhanced and expanded BMPs that should result in immediate decreases of metal concentrations in the Chollas Creek water column. Three years are provided for these measures to begin to lower Chollas Creek metal concentrations before the first reduction is required.

This compliance schedule is inconsistent with sound planning, engineering and public policy considerations because: (1) it assumes that non-structural BMPs will achieve a high level of reductions; and (2) it requires the most difficult reductions – the last 50 percent of metal loadings – to be achieved in the last three years of the compliance schedule. The second point is the most critical. If – as contemplated by technical report's compliance schedule and as set forth in detail in staff's April 7, 2006 letter to the State Water Resources Control Board – dischargers deploy the non-structural BMPs first, then the full measure of reductions will be achieved once those BMPs are operational. Hence, the only reason compliance would not be achieved upon implementation of all non-structural BMPs is that those BMPs are not capable of achieving the wasteload allocations [WLAs] on their own. This is implicit in staff's proposed compliance schedule. Hence, the only way the compliance schedule in the Technical Report makes sense is if the dischargers will know sufficiently in advance of the 10-year compliance deadline where structural BMPs will be required such that they can be constructed, operating and achieving the required reductions by Year 10. Based on the City's detailed analysis discussed later, this is unrealistic.

The first critique of staff's proposed compliance schedule is not as intuitive. The available data suggests that non-structural BMPs will reduce pollutant loads between 30 percent and 70 percent. Staff's proposal appears to "shoot for the middle" and requires a

50 percent reduction in WLA exceedences by Year 7. The City believes that this is a little too simplistic. This TMDL targets the ***toxicity*** of ***dissolved*** metals. Compliance with this TMDL is, therefore, affected by two separate factors: (1) the volume of metals that enter both urban runoff and the receiving waters; and (2) the hardness of the urban runoff and receiving waters (which affects the ability of the metals to be absorbed by organisms and hence be toxic). As detailed in the Weston Report, the effectiveness of the available non-structural BMPs cannot be predicted because there is a dearth of data at the subwatershed level regarding Chollas Creek's water hardness and metal loadings. Thus, assuming that – on average – non-structural BMPs will achieve the median level of pollutant reductions is too simplistic to ***mandate*** that level of compliance.

In addition to these flaws inherent in the proposed compliance schedule, there are other extrinsic matters that affect the actual time needed to achieve the WLAs proposed in this TDML:

The TMDL uses a non-integrated, TMDL approach. We recommend integrated watershed based TMDLs to allow for the development and implementation of more holistic, efficient programs to improve water quality.

The TMDL schedule does not allow for maximizing the use of non-capital and non-land intensive BMPs. The TMDL fails to allow sufficient time for the City to identify the most effective combination of BMPs and minimize dislocation of residents and businesses through an iterative approach to BMP implementation.

With these concerns in mind, the City proposes an alternative compliance schedule. As evidence of the City's commitment to improve water quality, the City has already retained a well-respected and experienced water quality consulting firm – Weston Solutions, Inc. – to evaluate the BMPs the City can implement to achieve the WLAs proposed in this TMDL. This consulting firm prepared a report (hereinafter referred to as "the Weston Report"), which the City submits with these comments, setting out the City's options for complying with this TMDL. The Weston Report concludes – consistent with the implication in the Technical Report – that it will be necessary to implement ***some*** treatment facilities to achieve compliance.[1] Based on Regional Board staff's claims that they are not required to analyze the environmental impacts associated with implementing structural BMPs, it is reasonable to conclude that Regional Board staff has not analyzed the planning and construction activities associated with implementing these BMPs. Again, this is reflected in the proposed compliance schedule that requires the last 50 percent of exceedence reductions to be achieved in Years 8 through 10, even though these pollutant reductions require the most resource-intensive BMPs. These types of BMPs require significant time to plan, conduct thorough environmental review, acquire land, let construction contracts, construct the treatment works, and then verify that the treatment works are operating as planned (i.e., achieving

[1] Despite the opportunity in its April 6, 2006 submittal to the State Water Resources Control Board, the San Diego Regional Board, on the other hand, has ***never*** claimed that achieving the reductions necessary to achieve the water quality objectives of the TMDL can be achieved ***solely*** through non-structural BMPs. The City is unaware of data that would support a conclusion that the WQOs can be achieved with only non-structural BMPs.

the required pollutant reductions) – a process the City will need to conduct ***for each treatment work that must be constructed.*** Moreover, this entire process requires adequate funding to be available for constructing new public works, or substantially altering the manner in which existing public works projects (e.g. pavement re-surfacing) are carried out. Based on the City's significant experience with public works projects, it is the opinion of the City of San Diego that accomplishing this in less than 10 years is an unrealistic expectation, short of making wild assumptions on the need for structural BMPs construction and undertaking a massive public works construction campaign that will displace significant numbers of residences and businesses, contrary to sound public policy.

In an effort to minimize the significant adverse impacts associated with such an outlandish compliance scenario, the City requests that the Regional Board consider an alternative compliance schedule to that proposed in the TMDL Technical Report. This alternative compliance schedule is graphically presented in the Weston Report as Figure ES-8 on page xxvi. While the waste-reducing activities employed under both plans are not fundamentally different – both maximize the use of non-structural source controls, such as education, product substitution, street sweeping, and low-impact treatment techniques such bioretenion and passive infiltration prior to implementing more land-intensive treatment trains – the critical difference is that the City's alternative presents a compliance schedule that is based on sound engineering, scientific, and public policy considerations. The foundation of this fundamental difference is that it is necessary to assess the effectiveness of non-structural BMPs with stakeholders before deploying land-intensive treatment trains, which allows the City to carefully implement these measures in a manner that will minimize the condemnation of private property.

As reflected in Figure ES-8 of the Weston Report, the City believes that it can deploy all Tier I BMPs within five years of OAL approval of this TMDL, and will have pilot data available on Tier II BMPs.[2] Based on existing data, the Tier I BMPs should achieve a 30 percent reduction in metal loading. Hence, the City proposes an interim compliance goal of a 30 percent reduction in metal loadings five years after OAL approval. After those BMPs are deployed, the City believes that there should be a one year evaluation period, where the City assesses the synergistic effect of all non-structural BMPs being implemented. During this initial six year period, the City would also use early monitoring data to site targeted structural BMPs, construct these projects, assess their effectiveness and use that data to develop a master plan for structural BMP deployment.

Once the data from targeted structural BMPs and the complete implementation of Tier I BMPs is collected, the City would begin the arduous task of planning, siting, designing, and constructing Tier II and III BMPs – where needed throughout the watershed – followed by monitoring to assess their effectiveness. Based on the City's extensive experience in constructing public works projects, it will take 14 years after the City has

[2] The distinction between the various BMP tiers is the amount of capital investment required. Tier I BMPs are labor intensive, with limited amount of capital required. The Tier II BMPs require significant capital investment; some can also be implemented in existing rights-of-way. Tier III BMPs require land acquisition and development.

all the Tier I data to fully construct and implement the capital and land intensive Tier II and Tier III BMPs. Thus, the City proposes to fully meet the WLAs in Year 20. Despite a desire to show good faith efforts at compliance, because of the dearth of data and the lack of a critical planning point that lies between full deployment of Tier I BMPs and the implementation of Tier II and Tier III BMPs – the City is unable to fashion a logical interim compliance goal – or at least one that is expressed as a percentage reduction in pollutant loading or as a reduction in WLA exceedences – that lies between a 30 percent reduction in metal loadings in Year 5 and full attainment of the WLAs in Year 20. The City is currently evaluating the feasibility of non-numeric interim compliance goals and will provide that information to the Regional Board when it is fully developed, hopefully well in advance of the public hearing on this TMDL.[3]

The compliance schedule, including the interim compliance goals, is inconsistent with the Technical Report's assessment of how dischargers will likely implement this TMDL because it requires the most difficult reductions in pollutant loading to occur in less than one-third of the compliance schedule. Because these pollutant reductions will require the most intensive BMPs, likely structural BMPs, it is unreasonable to expect these reductions to occur within three years after non-structural BMPs have been fully implemented because the data on where these BMPs will be necessary will not be complete.

The compliance schedule has interim compliance goals of a 15 percent reduction in wasteload allocation exceedences in Year 4 and a 50 percent reduction in wasteload allocation exceedences in Year 7. Please identify all considerations that served as the basis for suggesting these percentages and the compliance dates.

The TMDL uses a non-integrated, TMDL approach. We recommend integrated watershed based TMDLs to allow for the development and implementation of more holistic, efficient programs to improve water quality.

The TMDL schedule does not allow for maximizing the use of non-capital and non-land intensive BMPs. The TMDL fails to allow sufficient time for the City to identify the most effective combination of BMPs and minimize dislocation of residents and businesses through an iterative approach to BMP implementation.

The CEQA analysis needs to address all reasonably foreseeable future TMDLs for the Chollas Creek watershed in conjunction with the metals TMDL because the City must address all TMDLs in an integrated fashion. It is not reasonable to expect that the City will build BMPs to address the metals TMDL and then a second, separate set of BMPs to address the bacteria or other future TMDLs. The need to address both TMDLs affects the types of BMP that will lead to compliance and the location of the BMPs. The CEQA analysis should also incorporate City of San Diego plans and policies into its evaluation.

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[3] The City notes that, as described in the Technical Report at page 74, that the MS4 permit can be issued with a combination of numeric and non-numeric WQBELs. It is possible that a non-numeric WQBEL could be proposed as an interim compliance goal between Year 5 and Year 20.

Page 6 of the Regional Board's "Discussion Paper" indicates that implementation of TMDLs in Chollas Creek will not result in adverse cumulative impacts to Chollas Creek, in part due to the fact that the Chollas Creek MS4 dischargers are already required to implement BMPs.

When considering BMPs to address the TMDL, the City must consider the effectiveness of a BMP to address both TMDLs. The Regional Board should consider the bacteria and metals TMDL as a single, integrated TMDL with an appropriate implementation schedule similar to the dissolved metals TMDL adopted by the Los Angeles Region for Ballona Creek and the Los Angeles River. As suggested by the Stakeholders' Advisory Group for the Bacti-1 TMDL, the City suggests that a 20-year implementation schedule is more realistic.

Given the magnitude of BMPs that need to be built in order to comply with the TMDL, the proposed 10-year implementation schedule essentially guarantees non-compliance. Additional time is needed to evaluate the feasibility and effectiveness of the complex suite of BMPs that could be built in "treatment train" fashion to achieve TMDL compliance in some parts of the watershed. This "neighborhood friendly" compliance scenario is described in Attachment 3 and is proposed by the City in lieu of a more aggressive "infrastructure intensive" solution that would achieve compliance sooner.

Response: The San Diego Water Board agrees that an integrated BMP approach to encompass the requirements of various TMDLs is a preferable method of action on the part of the dischargers. Since Chollas Creek is impaired for diazinon, metals, bacteria, and trash dischargers should seek non-structural and structural BMPs that are effective at reducing these pollutants collectively. Therefore, the compliance schedule described in the Technical Report has been modified to allow 20 years, rather than 10 years, to achieve full compliance with the TMDLs (no allowable exceedances of the water quality objectives). As an interim milestone, the compliance schedule has an allowance for 20 percent exceedance of the water quality objectives after 10 years. The Technical Report was revised to reflect these changes. Please see section 11 for more details.

The City argued that an appropriate time schedule would extend to 20 years to reach full compliance, based on the recommendations of the *Chollas Creek TMDL Source Loading, Best Management Practices, and Monitoring Strategy Assessment*, or "Weston Report" (Weston Solutions, 2006), and the San Diego Water Board agrees that 20 years is adequate for achieving TMDLs. The City stated that they can deploy Tier 1 BMPs (source control and prevention from entering runoff) *within five years of OAL approval of the TMDLs*, which is the first step in achieving TMDLs within 20 years.

Chollas Creek was placed on the List of Water Quality Limited Segments for impairment due to metals in 1996. Subsequently, the San Diego Water Board has been developing the metals TMDLs, with City involvement, for over 5 years. Additionally, Receiving Water Limitation C.2.a of the City's MS4 NPDES requirements issued in 2001 (Order No. 2001-01) states that dischargers must report BMPs that are currently being implemented, and additional BMPs that will be implemented, to prevent or reduce any pollutants that are causing or contributing to the exceedances of water quality objectives. Given this information, 20 years is adequate time for achieving compliance with the TMDLs. There is no need for dischargers to delay action that would result in improved water quality until final approval of these TMDLs; action to reduce metals loading should have begun upon issuance of Order No. 2001-01.

2.1.2 Design Storm

Comment No. 2: *The TMDL does not provide adequate guidance for compliance.* Neither the technical report nor the CEQA analyses designate a design storm. Knowing the capacity required of a BMP is critical to designing facilities which will comply with the TMDL while minimizing acreage requirements and capital costs.

The magnitude of the impact associated with building BMPs to comply with the metals and bacteria TMDLs is based upon the amount of storm water that needs to be treated. To date, the Regional Board has declined to establish a "Design Storm" which would provide direction to the City on the size/capacity of BMPs required. Therefore, the City has relied on language in the California Toxics Rule which states, "Neither the Aquatic Life Chronic Criteria nor the Aquatic Life Acute Criteria can be exceeded more than once every three years (40 CFR 131.38 (c)(2)). For engineering purposes, this translates in the need to ensure that runoff from a maximum three-year storm meets to meet the Wasteload Allocations established for the metals TMDL. The bacteria TMDL is silent on the appropriate design storm; therefore, the assumptions in Attachment 3 are very conservative. However, this sizing criterion must be augmented by pollutograph data which shows how actual concentrations of metals and bacteria change during storms and during the storm season. Current data suggest that concentrations of dissolved metals increase through storms and over the storm season.

In order to provide an analysis of the impacts associated with building BMPs to address the metals and bacteria TMDL, the Regional Board must begin with a programmatic evaluation of the size of storm that must meet the Wasteload Allocations. What is the maximum storm size that the Regional Board expects to meet the Wasteload Allocations and how is that storm size factored into the Regional Board's analysis of the impacts of building BMPs? As can be seen in the Weston report, the decision on the size of storm that needs to be treated has a significant effect on the magnitude of public works required.

Response: The CEQA's provisions allow the San Diego Water Board to limit analysis in these substitute environmental documents to broad environmental issues which are ripe for decision at the TMDL adoption stage. At this stage, the San Diego Water Board is not required to evaluate environmental issues associated with specific projects undertaken to comply with the TMDLs. CEQA provisions allow for project level environmental considerations to be deferred so that more detailed examination of the effects of these projects in subsequent CEQA environmental documents can be made by the appropriate lead agency.

The San Diego Water Board does not need to designate the storm size for the design and construction of the BMPs to meet CEQA requirements for the TMDLs. The CEQA requires that the San Diego Water Board provide substitute environmental documents that contain sufficient information and analysis for the public to understand the potential adverse environmental impacts of the project, and to provide the San Diego Water Board with meaningful discussion and comment on these impacts. Our substitute environmental documents do that by describing a range of potential structural and non-structural controls the dischargers could construct or implement to meet the wasteload allocations (WLAs). The documents also discuss the potential adverse environmental impacts associated with those controls. Because the CEQA does not require the San Diego Water Board to speculate on the location or size of specific structural controls that the dischargers might choose to implement, we did not specify any sizing criteria such as a design storm.

The San Diego Water Board appreciates the City's efforts in moving forward with BMP planning, and is willing to discuss potential BMP siting and design issues, and different compliance monitoring approaches that could be used. However, the San Diego Water Board does not have the authority to delegate which methods or BMPs must be used to comply with the metals TMDLs. Additionally, it is not the purpose of the TMDLs to provide complete guidance for compliance. The San Diego Water Board has flexibility in making waste discharge requirements consistent with WLAs and establishing monitoring programs to gage compliance. That being said, for initial BMP planning purposes, the metals CTR criteria for an allowable exceedance every three years can be interpreted as a three year design storm.

However, the link between design storms and likelihood of water quality exceedances is a complicated issue that deserves more-detailed analysis than a simple recurrence interval specified in CTR. We have no evidence indicating a direct correlation between water quality concentrations and storm magnitudes. In other words, larger storms do not mean larger metals concentrations. Smaller storms can also exceed CTR metals objectives, or all storms could exceed CTR metals objectives. Much discussion and modeling analyses have been performed by SCCWRP to support the Los Angeles Water Board and stakeholders in the Los Angeles Region. This analysis has included model simulation of various design storms and comparison to model-predicted water quality and loads of metals and indicator bacteria. SCCWRP has provided additional modeling analysis of BMP implementation scenarios to evaluate practical solutions to provide the required TMDL load reductions. Following over a year and a half of meetings, analyses, and discussions, a design storm has not been determined for the Los Angeles Region. However, much of this information and lessons learned can be provided to the San Diego Region to inform discussions and focus efforts in selection of appropriate design storms. For more information on the Los Angeles Region studies, please contact Xavier Swamikannu of the Los Angeles Water Board.

To support development of TMDLs for the Chollas Creek watershed and the estuary, an LSPC watershed model was developed by Tetra Tech and SCCWRP. This model was used to test possible reduction of metals loads through implementation of various detention/infiltration BMPs. This analysis, requested by SCCWRP, was performed to provide information similar to that used in Los Angeles Region for discussion of design storms and BMP implementation. Results were presented by SCCWRP at a recent meeting with Chollas Creek stakeholders and the San Diego Water Board, and stakeholders were asked if they were interested in using the model for further analysis to test load reduction scenarios. Stakeholders showed no interest at that meeting, but SCCWRP plans to follow up with the City of San Diego at a later time. For more information, contact Ken Schiff of SCCWRP.

2.1.3 Significance Threshold

Comment No. 3: The CEQA analysis must draw conclusions regarding the "significance" of the impacts evaluated, not just whether they are "adverse".

The City has previously stated that the Regional Board must assess the impacts of building BMPs to comply with the TMDL. As noted above, the Regional Board does apparently concur to some degree with the City's position on this as the Regional Board has considered this impact with respect to aesthetics, air quality, biological resources, and noise. However, as noted in Attachment 1, there are a number of other issue areas that should be addressed because impacts are potentially significant. While the CEQA checklist provides no rationale for why the "no impact" box was checked for these issue areas, Attachment 1 includes substantial evidence that these impacts should be considered significant.

Response: New analysis was added to the March 9, 2007 version of Appendix I Environmental Analysis, Checklist, and Economic Factors. This analysis elaborates on levels of significance. In most cases the level of significance has been set equal to long term, lasting impacts. Short term impacts, such as those related to the construction of BMPs, are not considered significant due to their short durations. The checklist discussion includes potential mitigation for impacts that are determine to be significant, i.e., those impacts that could be long term. Additionally, explanations for the "no-impact" answer were provided in the checklist.

2.1.4 Substantial Evidence

Comment No. 4: PUBLIC RESOURCES CODE § 21080(e)

The following analyses in Chapter 13 and Appendix I are deficient because the conclusions are not supported by substantial evidence:

Aesthetics – Appendix I states that the creation of structural BMPs can create adverse aesthetic impacts. The Regional Board's analysis of this impact states:

> Depending on the controls chosen, the project may result in the installation of urban runoff storage, diversion, or treatment facilities and other structural controls that could be aesthetically offensive if not properly designed, sited, and maintained. Many structural controls can be designed to provide habitat, recreational areas, and green spaces in addition to improving urban runoff water quality. In-creek diversions should not be used as controls, therefore, there should be no adverse impacts on aesthetics resulting from construction of concrete-lined basins or treatment facilities within creeks.

This analysis is legally inadequate because it does not state what constitutes a significant aesthetic impact and how designing the treatment works to serve as habitat, recreational areas, or green spaces mitigates any adverse aesthetic impact, much less mitigating any significant, adverse impact below the level of significance. It addition, the analysis ignores the reasonably foreseeable size and location of the BMPs described above; the works would be too small and subject to too many edge effects to create sustainable habitat. Moreover, regular maintenance would require periodic removal of plant growth and sediments. Topographically, it is reasonable to assume that basins associated with the works will need to be excavated and that significant portions of the basins would consist of manufactured slopes, limiting recreational opportunities. Thus, the "analysis" is merely "speculation, unsubstantiated opinion or narrative" that does not support the conclusion that the listed impact will be reduced below the level of significance, and is not, therefore, supported by substantial evidence, as required by law.

Response: The levels of significance for aesthetic impacts were set at no long term impacts including among other considerations, no long term obstruction of any scenic vistas. New analysis of aesthetics was added to the March 9, 2007 version of Appendix I Environmental Analysis, Checklist, and Economic Factors that expanded the previous discussion and addressed the City of San Diego's concern.

Comment No. 5: Air Quality – Appendix I makes the following statement regarding Air Quality:

> The construction of structural controls might adversely affect air quality because construction might require the use of diesel fuel engines to operate equipment. Potential impacts are likely to be limited and mostly short-term in nature. Impacts may be mitigated through measures such as limiting hours and amount of construction, eliminating excessive idling when vehicles are not in use, limiting construction during periods of poor air quality, and/or using alternative fuel vehicles rather than diesel fuel vehicles. Any impacts to air quality, both short-term and long-term,

> would be subject regulation by the appropriate air pollution control agencies under a separate process.

This analysis is deficient because the analysis does not state what the threshold of significance for impacts to air quality from toxic air pollutants, nor does it have any basis for concluding that the programs implemented by air pollution control agencies will, in fact, reduce any impacts below the unstated threshold of significance. Thus, the "analysis" is merely "speculation, unsubstantiated opinion or narrative" that does not support the conclusion that the listed impact will be reduced below the level of significance, and is not, therefore, supported by substantial evidence, as required by law.

This analysis is also deficient because, to the extent that street sweeping is a reasonably foreseeable means of compliance, Appendix I incorrectly states that there is no impact to the applicable air quality plan.

Response: The levels of significance for air quality impacts were set at no long term impacts including among other considerations, no long term degradation of ambient air quality or long term ongoing problems with odor which can not be remedied. New analysis was added to the March 9, 2007 version of Appendix I Environmental Analysis, Checklist, and Economic Factors that expanded the previous discussion and addressed the City of San Diego's concern. Additionally, an analysis which includes the air quality impacts of street sweepers was added to the Checklist where the impact was determined to be less than significant with mitigation.

Comment No. 6: Biological Resources – Appendix I states that there are potential impacts to riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or US Fish and Wildlife Service, but that those impacts would be reduced below the level of significance through mitigation.

The analysis does not state what sensitive species are located within the project area. It does not mention the San Diego County Multiple Species Conservation Plan – a regional plan that addresses impacts to sensitive species. The cursory analysis seems to assume that the only manner in which habitat or species can be impacted is through urban runoff flow diversion; even though the construction of treatment works could displace non-riparian species. Given the experience with the Aliso Creek bacteria treatment facility, it is reasonable to assume that upland impacts may occur as a result of the need to intercept sheet flow runoff from canyon walls for treatment before these flows enter receiving waters. These interceptors would logically be located near and above the receiving waters - in areas where many canyons support native, upland vegetation and sensitive species. Accordingly, impacts would result not only from construction of the diversions, but also from construction of treatment works and the associated pumps that would be necessary to put the treated water back into the receiving waters at a location near its diversion point.

Once again, the analysis does not contain facts, reasonable assumptions predicated on facts, or expert opinion based on facts; it is merely “speculation, unsubstantiated opinion or narrative” that does not rise to the level of substantial evidence.

Response: Although the analysis does not list the sensitive species in the watershed, this information can be gotten from a search of the California Natural Diversity database or through surveys of the specific location chosen for BMP construction. Thank you for bringing the San Diego County Multiple Species Conservation Plan to our attention. Dischargers should consult this plan if sensitive species are present at BMP construction sites.

That sheet flow from the urban areas flowing over canyon walls will need to be treated is not reasonably foreseeable. First, the volume of this flow will be small compared to flow from storm drain outfalls. Second, the watershed model for Chollas Creek predicts minimal loading from open space areas such as canyon walls. This is because dissolved metals tend to bind to soil particles when stormwater contacts soil.

Comment No. 7: Cultural Resources – Appendix I completely fails to address potential impacts to cultural resources. There is ample evidence available from local land use agencies about the location of cultural resources in San Diego County.

The affected watersheds are located in parts of San Diego that are designated as “Urbanized” or “Urbanizing” by the City’s Progress Guide and General Plan because they are fully developed or in the process of being developed. Many structures within the watersheds were built prior to 1960, making them at least 45 years old and thus potentially significant historic resources under the criteria in 14 C.C.R. section 15064.5(a)(3)(C). Thus, with regard to checklist item V(a), the loss of an undetermined number of significant historic structures (located above storm drain outfalls/tributaries) should be considered a potentially significant effect.

With regard to checklist item V(b), it is generally accepted by land use agencies that because many older structures were built prior to or without the benefit of heavy earth-moving equipment, the soils underneath older structures have the potential to contain potentially significant archaeological resources. Therefore, the excavation of soils under potentially significant historic resources should be considered to have a potentially significant effect on archaeological resources.

Response: New analysis on potential impacts to cultural resources was added to the Appendix I Environmental Analysis, Checklist, and Economic Factors in the March 9, 2007 version of the Technical Report, which addresses the concerns in the comment.

Comment No. 8: Hydrology and Water Quality - Appendix I states that the diversion of storm flows and dry weather urban runoff would cause impacts to existing drainage patterns, but concludes that any such impact would be less than significant because “diversion of the entire stormflow of a creek is not required to meet wasteload allocations.”

This statement is not supported by facts, reasonable assumptions predicated on facts, or expert opinion based on facts. There is no technical way for an MS4 operator to ascertain what percentage of a storm flow must be diverted for a particular storm to ensure that the pollutant loads do not exceed the wasteload allocations. If treatment is necessary, all storm flow must be detained and treated to ensure that the standards are met. Thus, the conclusion that this impact will be less than significant is ; "speculation, or unsubstantiated opinion" that does not rise to the level of substantial evidence.

Response: New analysis on potential impacts to hydrology and water quality was added to the Appendix I Environmental Analysis, Checklist, and Economic Factors in the March 9, 2007 version of the Technical Report, which addresses the concerns in the comment.

Comment No. 9: Geology and Soils – Appendix I concludes that there will be no impacts to Geology and Soils. This conclusion is no supported by substantial evidence.

Excavating infiltration works in the vicinity of canyon rims has the potential to make canyon walls unstable (only basins serving an equalization purpose could be lined). Increasing infiltration increases instability even if the slope in question is already engineered. For slopes that aren't engineered (and this is the case in older neighborhoods – see above), this instability can lead to failure. Increasing the integrity of slopes downhill of detention works could also result in increased impacts to biological resources or, if retaining walls are used, aesthetic impacts. Therefore, as a result of the project change, checklist item V(c) should indicate that the geology impact from the project is potentially significant.

For purposes of revising the CEQA analysis, we suggest that the Board consider that works which involve any level of infiltration be setback from a canyon rim such that a 45 degree line drawn from the bottom of the basin nearest the canyon rim does not intersect the canyon wall.

Similarly, many formational materials within the watersheds are fossiliferous (Kennedy, 1977). Therefore, given that excavation of detention works could penetrate through surficial soils and into ungraded formational materials, the response to checklist item V(c) should indicate that this impact is potentially significant.[4] Because the environmental analysis does not discuss impacts to these resources or propose mitigation measures, the environmental analysis is inadequate.

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[4] The "Kennedy Maps" are maps of geologic formations that may contain specific paleontological resources, and are specifically used by planning and land use agencies to identify the potential for significant paleontolgical resources. Such resources occur within the City of San Diego, and therefore could occur within the Chollas Creek watershed. *See* Geology of the La Jolla, Del Mar, La Mesa, Poway, Point Loma, and Southwest Quarter of the Escondido Quadrangles, San Diego County, California, by Michael P. Kennedy, 1975; and Geology of National City, Imperial Beach, and Otay Mesa Quadrangles, Southern San Diego Metropolitan Area, California, by Michael P. Kennedy and Siang S. Tan, 1977.

Response: New analysis on potential impacts to geology and soils was added to the Appendix I Environmental Analysis, Checklist, and Economic Factors in the March 9, 2007 version of the Technical Report, which addresses the concerns in the comment.

Thank you for the comment concerning potential fossil finds. Additional discussion on impacts and mitigation has been added to explanation of the answer to question 20 (Archeological/Historical).

Comment No. 10: Land Use and Planning – Checklist Item IX(b) indicates that the project would not conflict with any applicable land use plan, policy or regulation of an agency with jurisdiction over the project adopted for purposes of avoiding or mitigating and environmental effect." This conclusion is not supported by substantial evidence; substantial evidence supports the opposite conclusion. The following examples are taken from the Chollas Creek watershed; a similar analysis should be made of all watersheds.

First, while the Regional Board's environmental analysis foresees the need to construct works, because no analysis was done on the required number or location of treatment works, the analysis does not discuss the need for the City to acquire and demolish hundreds of acres of developed land uses in order to construct the works. This is inconsistent with the only listed impact in the draft environmental analysis, where Regional Board staff discusses the impacts from operating a works that detains water – the works has to be constructed before it can be operated. Because the Regional Board did not properly analyze this impact, the Regional Board's analysis incorrectly concludes that the impacts will be less than significant or that they can be mitigated to below the level of significance. This conclusion is incorrect because it does not consider the following:

Housing
The Housing Element of the City's adopted General Plan and the position taken by the City Council when declaring a "Housing State of Emergency" both have as a basic objective an increase in the housing supply. According to Appendix E of the Technical Report, low and high density residential uses account for almost 64% of the land uses within the Chollas Creek Watershed. On average, this means that 64% of the 480-1400 acres if land that would be occupied by treatment works (307 to 896 acres) is currently developed with homes. Assuming an average of 10 dwelling units per acre (4,000 square foot lots are common in the watershed), this equates to the loss of 3,070 to 8,960 units. Removal of this number existing dwelling units would decrease the housing supply and is thus in conflict with adopted City policy.

Industrial Land
The Industrial Element of the City's adopted General Plan states that there is a serious shortage of large parcels suitable for industrial development exists in the City. Related goals and recommendations include:

"Insure that industrial land needs as required for a balanced economy and balanced land use are met consistent with environmental considerations" (p.286)

""Protect a reserve of manufacturing lands from encroachment by non-manufacturing uses." (p. 286)

"As mentioned earlier, in allocating additional land for industrial use it is imperative that sufficient acreage be designated to meet projected needs so that the existing market can operate effectively." (p.287)

The general theme of the existing Industrial element is precisely this shortage of industrial land, high industrial and prices, etc. and how the economy is negatively affected by the non-industrial use of industrial land. The supply increased only slightly since 1979 and has not increased since. In fact it is now at crisis level proportions.

According to Appendix E of Region 9's Technical Report, low and high density residential uses account for 3.12% of the land uses within the Chollas Creek Watershed. On average, this means that 3.12% of the 480-1400 acres of land that would be occupied by treatment works (15 to 43.7 acres) is currently developed with industrial uses.

The removal of housing and industrial acreage from the City's stock in order to build storm water treatment works required to comply with the TMDL would conflict with the City's General Plan and its declared Housing State of Emergency. Therefore, as a result of the project change, checklist item IX(b) should indicate that the Land Use and Planning impact from the project is potentially significant with respect to the loss of residential and industrial lands. The environmental analysis in inadequate because it failed to analyze this impact.

Given that none of the City's land use plans identify storm water treatment works and the nature of detention/infiltration works, the City believes that land use impacts would be significant and suggests that the Regional Board evaluate the City's plans to determine where and the extent to which inconsistencies would result.

Population and Housing – Checklist item XII(c) indicates that there would be no displacement of substantial numbers of people, necessitating the construction of replacement housing elsewhere. Within the Chollas Creek watershed alone, the number of dwellings that would be lost as a result of the project change (3,070 to 8,960) should be considered substantial. According to U.S. Census Data, the average dwelling unit in San Diego houses 2.6 people. The loss of 3,070 to 8,960 dwelling units would therefore result in the displacement of 7,982 to 23,296 people. This number of dwellings that would be lost as a result of the project change should be considered substantial. Therefore, as a result of the project change, checklist items XII (b) and XII (c) should indicate that the Population and Housing impact from the project is potentially significant.

The City believes that this is in and of itself a significant impact and suggests that the Regional Board conduct a similar impact evaluation in all of the watersheds that would be subject to the TMDL.

Response: The City based the sizing of the BMP equalization basins on a 3 foot depth, neglecting to analyze deeper equalization basins in order to avoid securing a dam permit (Weston, 2006).[5] Based on the decision not to secure dam permits, the City then concluded that private property must be condemned and demolished to make room for the large, shallow equalization basins. If equalization basin are required, the City could secure dam permits and design the basins deep enough to avoid condemnation and demolition of private property.

Comment No. 11: Utilities and Service Systems – Checklist item XVI (c) indicates that the project will not require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects. This is directly contradicted by the Technical Report, and given that the project change causes the additional significant impacts cited above, there is even more reason why this item should indicate that the Utilities and Service Systems impact from the project is potentially significant.

Response: New analysis on potential impacts to utilities and service systems was added to the Appendix I Environmental Analysis, Checklist, and Economic Factors in the March 9, 2007 version of the Technical Report. No long term negative changes to the environment are expected as a result of modifications to retrofit or reconfigure the storm water drainage system. However, because short term construction impacts are anticipated, the determination in the substitute environmental documents is “less than significant with mitigation.”

Comment No. 12: Given that the project change will result in previously undisclosed significant effects, CEQA compliance to date has deprived interested parties the opportunity to provide meaningful comment. In particular, we suggest that opportunity to comment be provided to historic preservationists, housing advocates, industrial developers, and those interested in public policy as it pertains to preservation of San Diego’s shrinking supply of industrial lands.

Response: Although we disagree that TMDL implementation will result in significant environmental impacts from the loss of housing, industrial lands, or cultural resources, two additional 45 day comment periods were provided since the City offered the above comment. All interested persons have had ample time to respond to the changes and new analysis in the Technical Report and Environmental Analysis, Checklist, and Economic Factors documents.

2.1.5 Other Lack of Detail Comments

Comment No. 13: The Regional Board Does Not Fully Comply With Public Resources Code Section 21159. Here, the Regional Board concedes that the provisions of Public Resources Code section 21159 apply. Having made that concession, the Regional Board

[5] Weston Solutions, Inc. Chollas Creek TMDL Source Loading, Best Management Practices, And Monitoring Strategy Assessment, Final Report, September 2006

does not have the option to ignore the other specific requirements of that section. Nevertheless, the Basin Plan Amendment completely ignores the requirements of subdivision (c) of section 21159, which states:

> The environmental analysis ***shall*** take into account a reasonable range of environmental, economic, and technical factors, population and geographic areas, and ***specific sites***.

PUBLIC RESOURCES CODE § 21159(c)(emphasis added)

Looking at each category of analysis specified in Public Resources Code section 21159, subdivision (c), the Regional Board's analysis is deficient because it fails to consider any of these factors. Thus, the record clearly reflects that the analysis does not satisfy all of the statutory requirements of an environmental analysis under Public Resources Code section 21159.

As respects site specific analyses, Public Resources Code section 21159(c) unambiguously states that an analysis shall take into account a reasonable range of specific sites. A contrary contention is simply an incorrect statement of the law.

Response: The analysis in the March 9, 2007 version of Appendix I, Environmental Analysis, Checklist and Environmental Factors was reorganized to make clear where all the section 21159(c) factors are discussed and considered. For example, a specific sites discussion was added and can be found in section 6 of the Appendix I.

Comment No. 14: The Regional Board has made two different contentions regarding the adequacy of the environmental analysis: (1) that treatment controls are not a reasonably foreseeable method of compliance; and (2) that the Regional Board is not required to do a site specific analysis. The first contention is not factually supported; the second is legally incorrect.

As respects treatment controls, the Regional Board ignores three critical facts in that regard:

- There is no evidence that compliance in all watersheds has been achieved in practice during both wet weather and dry weather conditions by using only non-structural controls;
- The Weston Report concludes, with supporting analysis, that treatment controls will be necessary;
- The Regional Board's April 7, 2006 letter to the State Water Resources Control Board implicitly concedes that treatment controls will be necessary because it states that the use of detention facilities is not a reasonably foreseeable means of compliance ***"to the extent suggested by the City."***

This later fact is particularly interesting. The April 7th letter states:

> Detentions facilities located outside of Chollas Creek and existing storm water management features are neither the only means of compliance with the TMDLs nor even a reasonably foreseeable means to the extent suggested by the City. Such facilities are unlikely to be implemented to the degree described by the City due to the associated costs and impacts to housing. Since condemning property is unlikely, the San Diego Water Board was not required to analyze this impact as reasonably foreseeable.

This comment puts the proverbial cart before the horse. The first question in the foreseeability of a means of compliance is whether it is ***necessary to achieve compliance***. The Regional Board's comment does not completely refute the contention that treatment facilities will be employed. Hence, detention facilities or treatment works are a reasonably foreseeable means of compliance. The Regional Board's analysis repeats this error in the next sentence; it concludes that the impacts to land use and other resources are not reasonably foreseeable because of the expense. It states that these means of compliance will not be used because of the impact to housing. That begs the question: what impact to housing? Neither Appendix I or Chapter 12 discuss impacts to housing. The April 7th letter concedes that the impacts will occur the impact is not identified in Appendix I or discussed anywhere in Technical Report. This thwarts one of the basic purposes of CEQA because neither the public nor the Regional Board members know the potential housing impact and is a prima facie prejudicial abuse of discretion. The second error is that, having concluded that the impact will occur, it assumes that it will not be significant. CEQA does not require analysis of only significant impacts, it requires analysis to determine the level of impact – once again something that was not done and is a prejudicial abuse of discretion.

Thus, the only facts that are available undercuts the Regional Board's contention that treatment controls are not a reasonably foreseeable method of compliance, which under Public Resources Code section 21159(a), must have its impacts analyzed.

Response: Treatment controls are a reasonably foreseeable method of compliance. For example, the substitute environmental document discusses BMPs such as Austin type sandfilters. What isn't reasonably foreseeable are detention basins and treatment works (requiring private property condemnation) on the size and scale that the City suggests.

The City based the sizing of the equalization basins on a 3 foot depth, neglecting to analyze deeper equalization basins in order to avoid securing a dam permit. Based on the decision not to secure dam permits, the City then concluded that private property must be condemned and demolished to make room for the large, shallow equalization basins. This option is not reasonably foreseeable, when deeper, smaller, albeit more expensive basins can be constructed to avoid the condemnation of private property.

The San Diego Water Board is not required to speculate about potential site specific impacts, because we do not know where the discharger will choose to construct specific BMPs. However, a "specific sites" analysis was added to the March 9, 2007 version of

Appendix I as required by Public Resources Code section 21159(c). The specific sites analysis describes potential BMPs, potential impacts, and mitigation at a specific site in each of the major land use categories.

Comment No. 15: The project description is also a critical component of an adequate environmental document. *See Santiago County Water District v. County of Orange*, 118 Cal.App.3d 818 (1981) (EIR inadequate because of failure to discuss construction of water delivery facilities in project description). The project description in this case is influenced by Public Resources Code section 21159, which provides the ***minimum*** requirements for an environmental analysis of a rule or regulation that requires the installation of pollution controls.[6] That statute requires certain state agencies to analyze the following:

> (1) An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
> (2) An analysis of reasonably foreseeable feasible mitigation measures.
> (3) An analysis of reasonably foreseeable alternative means of compliance with the rule or regulation.

Response: Analysis of the reasonably foreseeable environmental impacts of potential BMPs, analysis of reasonably foreseeable feasible mitigation measures, and analysis of reasonably foreseeable alternative means of compliance, were included in all versions of the substitute environmental document. However, we have reorganized and expanded the material in the March 9, 2007 version of Appendix I to make clear where these factors are discussed.

Comment No. 16: Thus, the methods of compliance are part of the project description because the impacts, mitigation measures, and alternatives to the methods of compliance must be analyzed.

With that in mind, it is easy to see that the project description in this case contained only a cursory discussion of the methods of compliance.

Response: This project is a Basin Plan Amendment to incorporate TMDLs for metals in Chollas Creek. Thus, methods of compliance are not a part of the project description, but must be evaluated for their potential environmental impacts. This evaluation can be found in the Appendix I, sections 4 and 5.

Comment No. 17: The TMDL document is devoid of evidence that suggests that the pollutant reductions required to achieve full compliance with the TMDL can be achieved by anything other than: (1) diversion or (2) detention and infiltration.

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[6] The statute clearly states that these topics are the minimum requirements for an adequate environmental analysis; other impacts must be identified if the impacts are a direct result or a reasonably foreseeable indirect result of the project.

Response: The substitute environmental documents indicate that a suit of BMPs will likely be required to achieve WLAs. However, the San Diego Water Board cannot mandate which specific BMPs will be implemented.

Comment No. 18: Having identified the types of facilities that could be constructed to achieve compliance (diversion and detention/infiltration), Public Resources Code section 21159, subdivision (c) kicks in to specify the details of the analysis that is required in terms of environmental, technical, and specific sites. Thus, issues that must be included to properly address these considerations in the scope of this TMDL include:

1. The "tributary rule," which subjects all receiving waters within the affected watersheds to the TMDL. The application of this rule in complying with this TMDL creates an interesting overlay in that the TMDL does not define "receiving waters, yet the San Diego County Municipal Storm Water NPDES permit states that in some instances receiving waters and the MS4 are the same;

2. Topography, which prevents BMP works from being built on canyon walls below storm drain outfalls but above receiving waters that are subject to the WQO in the TMDL;

3. The structural BMPs need to capture and treat a very high percentage of storm water due to the large level of loading reduction required by the TMDL; i.e., it is not reasonable to expect that works located far from the storm drain outfalls would, by themselves, meet the TMDL because significant amounts of storm water run into the conveyance system immediately above the outfalls.

4. Locating works some distance from the receiving waters would be infeasible because it would be necessary to construct a new, separate conveyance system to prevent the treated water from mixing with untreated water.

5. The number of control devices that may be required to achieve compliance is a technical consideration in complying with the TMDL. Because the TMDL defines the WLAs without regard to the size of a rain event, loading must be controlled in all storm events. Accordingly, certain assumptions must be made with respect to the size of the storm in order to design structural BMPs that will provide adequate contaminant reduction. Lacking a "design storm," or information on soil infiltration rates, the Regional Board's CEQA analysis must include assumptions regarding a design storm size and the acreage of detention/infiltration facilities that would be needed (including any manufactured slopes). Information is available from the City of San Diego, the California Department of Conservation, and the United States Soil Conservation Service on soil infiltration rates that would be necessary in this analysis. For purposes of revising the CEQA analysis, the Regional Board should consider that the Chollas Creek watershed has approximately 816 storm drain outfalls within the City of San Diego to determine the effectiveness of infiltration.

The project description in the CEQA analysis is devoid of any discussion or analysis of these issues, and thus is inadequate because the failure to include this information prevented a meaningful analysis of the impacts of compliance.

The City has previously note that it is reasonably foreseeable that the TMDL implementation could require the City to build a large number of relatively smaller sized works in areas immediately behind a geologically-safe setback above all existing storm drain outfalls which have receiving waters immediately below them. In the Chollas Creek watershed, these works could occupy 1,387 acres – almost 10 percent of the 16,273 total acres in the watershed.

Response: The CEQA does not require the San Diego Water Board to designate a design storm or speculate on the number of control devices that the dischargers might construct as discussed in the response to comment No. 2. The CEQA does not require the San Diego Water Board to speculate on the specific locations where the dischargers might construct BMPs. Where BMPs can be constructed with regard to receiving waters is discussed in the response to comment No 36.

Comment No. 19: The environmental analysis does not analyze all the impacts associated with construction of structural BMPs. Only when a meaningful discussion of the environmental setting is set forth and a thorough project description has been prepared can an adequate analysis of impacts and mitigation measures be prepared. *County of Inyo v. City of Los Angeles*, 71 Cal.App.3d 185 (1977). Here, the Regional Board has put itself in an "Catch-22." While the Regional Board contends that it is not reasonably foreseeable that treatment controls will be used as a compliance method, it nevertheless analyzed the impacts – albeit poorly – of diversion structures. Having analyzed some of the impacts to diversion structures, the Regional Board must ensure that the analysis is complete, and supported by substantial evidence. CEQA determinations related to quasi-legislative decisions must be supported by substantial evidence. *See* PUBLIC RESOURCES CODE § 21167.5; *Western States Petroleum Association v. Air Resources Board*, 9 Cal.4th 559 (1995).

Substantial evidence is defined in CEQA as:

> For the purposes of this section and this division, substantial evidence includes fact, a reasonable assumption predicated upon fact, or expert opinion supported by fact.
>
> Substantial evidence is not argument, speculation, unsubstantiated opinion or narrative, evidence that is clearly inaccurate or erroneous, or evidence of social or economic impacts that do not contribute to, or are not caused by, physical impacts on the environment.

Response: New analysis, including mitigation of the construction of treatment controls, was added to the March 9, 2007 version of Appendix I, Environmental Analysis, Checklist, and Economic Analysis. The expanded analysis addressed the concerns raised in the comment.

Comment No. 20: CEQA requires that cumulative impacts be assessed as part of determining whether a project may have a significant effect on the environment (CEQA Guidelines Section 15064(h)(1). A Lead Agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan (CEQA Guidelines Section 15064(h)(3). However, Section 15064(h)(3) also requires preparation of an EIR (meaning a finding that the cumulative impact is significant) if there is substantial evidence that the possible effects of a particular project are still cumulatively considerable, notwithstanding that he project complies with the specified plan. Cumulatively considerable means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects."

The initial study checklist indicates that cumulative impacts from the project will not occur, but no rationale is provided for that conclusion. CEQA Guidelines Section 15130(b) describes alternative lists of projects and projections that an agency is required to consider when evaluating significant impacts. Given that the Regional Board has a mandate to adopt TMDLs for receiving waters on the 303(d) list, the checklist should, at a minimum, consider the impacts of this project in the context of impacts that would result from reasonably foreseeable means of compliance with other TMDLs. One glaring omission in this analysis is the fact that the Regional Board has concluded that the Bacteria Project I TMDL, which affects Chollas Creek, will have individual project impacts. There is no analysis to show support the conclusion that the impacts of the Bacteria I TMDL and the Chollas Creek metals TMDL, though less-than-significant individually, will not be cumulatively considerable. See CEQA Guidelines § 15064(h)(3).

With the exception of a checkmark in the "no" box, the CEQA analysis is silent on cumulative impacts. The bacteria TMDL should be integrated with the metals TMDL for purposes of environmental analysis. To the extent that the watershed is listed as impaired for other pollutants, implementing BMPs for these future TMDLs should also be considered.

Response: New analysis, including a discussion on the cumulative impacts of addressing all TMDLs and other water quality projects such as metals, indicator bacteria, diazinon and trash, was added to the March 9, 2007 version of Appendix I, Environmental Analysis, Checklist, and Economic Factors. The expanded analysis addresses the concerns raised in this comment.

Comment No. 21: In addition, the City believes that the watershed could also be listed for pyrethroids, so implementing BMPs for that pollutant should also be considered. Finally, the CEQA analysis should also include an evaluation of TMDL-related impacts in the context of City plans and policies for the watershed.

Response: Pyrethroids are the likely replacement for the pesticide diazinon which was banned from use by the USEPA. Order No. R9-2004-0277 should be amended to require the dischargers to monitor for pyrethroids in Chollas Creek as part of the Diazinon TMDL Implementation Plan. If sample results show impairment, and if a TMDL is developed, the cumulative impact of implementing pyrethroid BMPs would need to be considered with all other TMDLs and water quality projects and programs. Nonetheless, pyrethroid pollution can be addressed through non-structural controls including implementing integrated pest management practices, education and outreach, or through ordinances which regulate and limit the use of pyrethroids. Therefore, no cumulative effects are likely.

The comments did not articulate specific plans and policies the City might change as a result of implementing the TMDLs, or environmental consequences of those changes. We foresaw that changes to the plans and policies would be in a direction to facilitate low impact redevelopment, or increase enforcement of the stormwater regulations. The environmental impacts of such policy change would be those impacts already described in our substitute environmental documents. In addition, we implicitly evaluated the effects of changes to plans and policies by reviewing the effects BMPs would have on Land Use (Appendix I, 8.a.), Public Services (Appendix I, 14.a-f.) and Utilities and Service Systems (Appendix I, 16.a-f.), Recreation (Appendix I, 19.a.)and the cumulative impact the TMDLS might have together with all construction projects in the Chollas Creek Watershed (Appendix I, 21). The City of San Diego may need to modifying its plans and policies to accommodate these TMDLs. Our substitute environmental documents provide the required discussion on the environmental impacts and potential mitigation of activities resulting from the changes to the City of San Diego's plans and policies as a result of these TMDLs.

Comment No. 22: The CEQA analysis and the Technical Report suggest a number of BMPs that can be used to comply with the TMDL. Regional Board documentation should include data references that documents the efficiency of these BMPs in dry and wet weather with respect to removing dissolved metals and bacteria. For example, the City believes that it is misleading to state that dissolved metals loading can be reduced significantly by increased educational efforts.

Response: The environmental documents state that education and outreach can be a *very effective tool* in reducing metals, and do not mislead, as the City of San Diego suggests, that dissolved metals loading can be reduced significantly by increased educational efforts. Information on BMP implementation and effectiveness is readily available and need not be included here in a discussion of impacts and mitigation. Further, new information for new BMPs is currently being generated. When the time comes for the City to actually implement and maintain BMPs, all new and most up-to-date information should be considered.

Comment No. 23: The CEQA analysis must assess the impacts of installing structural best management practices for both TMDLs, including the impacts to land uses that would be displaced by such installations. The CEQA document improperly limits its description of these impacts to aesthetics, air quality, biological resources, and noise. In addition to outright displacement of existing development for construction of BMPs, it is reasonably foreseeable that BMPs will be built adjacent to existing development. The CEQA analysis should assess the impacts of building BMPs on adjacent foundations and slopes. In its Discussion Paper, the Regional Board indicates that condemnation of land is unlikely. The Regional Board should programmatically evaluate the suitability of publicly owned land in the watershed for BMP construction. Public lands are mapped in Attachment 3.

Response: New analysis was added to the March 9, 2007 version of Appendix I, Environmental Analysis, Checklist, and Economic Factors. The expanded analysis addresses the impacts of installing structural BMPs to Earth, Water, Light and Glare, Land Use, Natural Resources, Risk of Upset, Population, Housing, Transportation, Public Services, Energy, Utilities and Service Systems, Human Health, Recreation, Archeological/Historical, and Mandatory Findings of Significance, in addition to Aesthetics, Air Quality, Biological Resources (Plant and Animal Life), and Noise. In general, all of the BMPs evaluated in the substitute environmental documents are suitable to incorporate into public lands. Site specific analysis must be done by the City to choose the exact location and suitability of BMPs. Because the size of BMPs can be minimized through the types of BMPs selected, and engineering solutions exist to minimize the footprint of structural BMPs, displacement of existing development is not likely to be on a scale that will cause significant environmental impacts.

Comment No. 24: The Board's CEQA analysis suggests that TMDL compliance may be at least partially achieved by preventing storm water and urban runoff from exiting the storm drains through infiltration. However, Attachment 3 includes substantial evidence, in the form of a map prepared by the Natural Resources Conservation Service, that soils in the watershed are mostly impermeable. Attachment 4 (Bauder) provides additional substantial evidence regarding the impermeability of soils in the watershed in the form of a paper which describes how vernal pools were located in the watershed prior to development.

While the City acknowledges that neither the Bauder map nor the Natural Resources Conservation Service map are site specific and that there may be opportunities for infiltration within the watershed, the CEQA document should state a programmatic basis for concluding that infiltration in areas upstream of receiving waters has wide-spread feasibility and is therefore a reasonably foreseeable means of compliance (see Comment 23 below regarding bacterial regrowth and the section entitled "Tributary Rule" below for a discussion on BMP siting constraints). In fact, the CEQA document should include a rationale or list of references that were used to draw conclusions regarding the potential significance of impacts in all issue areas. As written, the checklist is "naked" with respect to issues with which Board staff has found no potentially significant impact.

Response: At this point, all available BMPs are considered potential candidates for implementation. Clearly, the dischargers will not implement infiltration BMPs where soil conditions are not suitable. The substitute environmental document did not conclude that infiltration BMPs in areas upstream of recreational waters have wide spread feasibility.

Comment No. 25: As a mitigation measure associated with the potential for metals to accumulate in infiltration facilities and then contaminate groundwater, the CEQA checklist mandates regular maintenance and disposal of waste.

This requirement could limit the construction and/or reconstruction of public and private facilities over the infiltration facility. The CEQA document must assess this impact along with a description of how and for what purpose maintenance is expected to occur, and the limits of building or re-building improvements on top of at-grade and below-grade infiltration facilities.

Response: Minimal maintenance is generally required to keep infiltration systems un-plugged and functioning. Design and construction limitations must be considered on a case by case basis. Whether or not public and private facilities can be built over an infiltration facility is not an environmental impact of the BMP, because choosing not to build would potentially improve the surrounding environment by creating or improving habitat, reducing traffic, etc.

Comment No. 26: The failure of the CEQA analysis to address these issues leaves more questions that answers, including:

What is the potential for pollutants to travel through an infiltration facility and contaminate adjacent native soils or groundwater?

Response: The potential for groundwater contamination is not considered significant as discussed in the response to question 3.g of the Checklist. Metals that are removed from stormwater runoff by infiltration BMPs are typically inorganic and insoluble. They are positively charged and bind to fine and organic particles. Once bound, the metals have very low leachability. Most metals are less than 10 percent leachable. Lead has been typically less than 5 percent leachable. Zinc, in some cases is 20-30 percent leachable.

Metals that are removed by infiltration BMPs typically are retained in the upper 2 to 5 inches of soil or sediment. Typically, metals levels returned to background levels or non-detectable levels below about 5 inches depth.

There is a potential (given enough time) that metals may accumulate in the upper 2 to 5 inches of soil to levels that might be toxic to humans, plants, and/or animals. The mitigation measures that could be implemented would include proper and adequate cover materials that would limit the access to the soil that is being affected by metals in stormwater. Options could include planting grass or iceplant, covering with gravel or cobblestones, or covering with compost as a mulch. Any of these cover options would reduce the potential for exposure to soils with elevated metals concentrations. The added benefit that compost might have is a higher affinity to bind with metals (due to its high organic content), and that placement of compost on the soil surface will capture the metals before they bind with the soil As metals concentrations build, the mulch could be removed and replaced. Other options for minimizing exposure to soil could include putting the infiltration BMP underground or indoors, and/or restricting access. Finally, the metals-laden, top 2 to 5 inches of soil could be removed, disposed of and replaced.

The information on metals laden soils, above, was added to the discussion of the answers to questions 4.e, 5.d, and 17.a of the Checklist in Appendix I.

Comment No. 27: What is the potential for pollutants which have reached groundwater to reach receiving waters in concentrations in excess of the WLAs?

Response: The potential for groundwater contamination is not considered significant as discussed in Appendix I question 3.g. Therefore, groundwater is not a likely pathway for metals to reach surface water.

Comment No. 28: Will the Regional Board have subsequent regulatory authority over the construction of these facilities?

Response: The San Diego Water Board would have subsequent regulatory authority over facilities only if WDRs (or waivers) are required for discharges from a facility, or if a 401 certification is required to construct the facility.

Comment No. 29: If not, can mitigation be assured?

Response: No. This is the reason for including a statement of overriding considerations in the Determination section of Appendix I.

Comment No. 30: If mitigation cannot be assured, shouldn't this potential impact be considered significant?

Response: No, because mitigation is available for every significant impact.

Comment No. 31: Is there a concentration of any pollutant above which urban runoff cannot be infiltrated? If so, does urban runoff with the Chollas Creek watershed exceed this concentration at any time?

Response: Not that we are aware of. This will need to be addressed on a case by case basis if and when the BMP is designed and implemented.

Comment No. 32: The Regional Board should conduct a programmatic level of environmental analysis for the metals and bacteria TMDLs instead of deferring further analysis to the City. Issues that should be addressed are described in Attachment 1 and should also include impacts to public lands if the Regional Board believes that it is reasonably foreseeable for storm water to be pumped to public lands for infiltration as described in Attachment 3.

Response: The San Diego Water Board has conducted an adequate programmatic level environmental analysis as required by the CEQA. Attachment 1 were addressed by the San Diego Water Board in the Discussion Paper (the City's Attachment 2). Attachment 3 makes the argument for large scale detention and treatment BMPs which would include condemnation of private property. Because the size of BMPs can be minimized through the types of BMPs selected, and engineering solutions exist to minimize the footprint of structural BMPs, we disagree that the condemnation of private property at the scale envisioned by the City is likely. The environmental analysis discusses the potential environmental impacts of a suite of BMPs, whether or not constructed on public land.

Comment No. 33: The Regional Board's CEQA analysis should base its impact analysis on the delta between existing conditions on the ground and future conditions. It is not appropriate to reduce the delta by establishing as the existing conditions baseline an imaginary situation.

Response: The analysis is based on existing conditions as the baseline for assessing change, and cannot, per the CEQA guidelines, include speculation.

2.1.6 Tiering

Comment No. 34: The City maintains its position that the CEQA analysis contained in the technical report is inadequate. The environmental analysis begins with a discussion of the standards that apply to the Basin Plan amendment. The document states that the Regional Board has specific obligations under the Public Resources Code because the TMDL establishes performance standards or treatment requirements, and sets out an abbreviated list of those specific requirements. *See* Technical Report at 85. The document goes on, however, to state that the Regional Board "method of analysis" is similar to "tiering" and "limited its analysis in this document to the broad environmental issues at the Basin Plan amendment "performance standard" adoption stage." The documents then goes on to opine that "the Regional Board is not required, at the Basin Plan amendment adoption stage, to evaluate environmental issues associated with specific projects to be undertaken later to comply with the performance standards." *Id*. The document contains no citation to legal authority for these propositions. This is because these contentions are incorrect statements of the law.

The TMDL and environmental analysis do not satisfy the criteria for tiering. When applying statutes, specific statutes control over general. *See Cavalier Acres, Inc. v. San Simeon Acres Community Services District*, 151 Cal. App. 3d 798 (1984) (Where there is a specific provision requiring community services district to increase rates via ordinance, that specific statute controls over general provision allowing public entities to increase rates via resolution).

Here, the general provisions relate to tiered CEQA documents. *See* PUBLIC RESOURCES CODE § 21093 and 21094. The environmental analysis attempts to justify giving short-shrift to the topics required by Public Resources Code section 21159(c) under the guise of tiering; this violates the rule that specific provisions control over the general. Moreover, there are other problems with the Regional Board's reliance on the tiering provisions.

First, both Public Resources Code section 21093 and 21094 refer to the preparation of an environmental impact report as the first tier document. As the Regional Board readily notes, the environmental analysis for the basin plan amendment is **not** an EIR. *See* Remy, et al, *Guide to the California Environmental Quality Act*, 10th ed., at 495 (The definition of tiering "suggests that tiering must commence with the preparation of an EIR.") Thus, there is no authority for the proposition that the Regional Board may use a substitute document as a first tier CEQA document.

Further complicating this aspect of the Regional Board's environmental analysis are the specific provisions of CEQA Guidelines section 15253, which governs the use of an EIR substitute by a responsible agency. Specifically, subdivision (a) states a substitute document shall be used by another agency "granting an approval ***for the same project*** where the conditions in subdivision (b) have been met." Subdivision (c) of that same Guidelines section amplifies this limitation, stating:

> Where a certified agency does not meet the criteria in subdivision (b), any other agencies granting approvals ***for the project*** shall comply with CEQA in the normal manner.

Hence, the CEQA Guidelines make clear that the only permissible uses of a substitute document are with respect to that project, and not with subsequent related projects. Accordingly, it is inappropriate to treat the Basin Plan Amendment environmental analysis as a "first tier" document because no second tier document can legally flow from a "first tier substitute document."

It is also important to note that under CEQA Guidelines section 15253 subdivision (b), it is a responsible agency that may use the substitute document for subsequent approval of the project. Responsible agencies are "public agencies other than the lead agency which have discretionary approval power over the project." CEQA Guidelines section 15381. The only other California agency that has discretionary approval power over the Basin Plan amendment is the State Water Resources Control Board. Neither the Regional Board nor the State Board will issue subsequent approvals related to this project that will require CEQA compliance. Hence, the authorization in CEQA Guidelines section15253 does not apply to any subsequent activity that will involve site-specific impacts or any of the other analyses the Regional Board contends may be deferred until the second tier projects are implemented. Accordingly, the notion that the TMDL environmental analysis will serve as a first-tier analysis is nonsense.

In the April 7th letter, the Regional Board cites CEQA Guidelines section 15253 for the proposition that it need not change its CEQA processes to meet the needs of other agencies. This comment misses the point: if the analysis cannot be used by other agencies because it is not an adequate document for that purpose, then the Regional Board cannot justify its cursory analysis by contending that these agencies will tier off of the Regional Board's document. If the document is inadequate for use by other agencies, those agencies have to start from scratch and the Regional Board's document is of no value.

Second, Public Resources Code § 21093 states that the purpose of tiering is to expedite the construction of housing and other development projects by eliminating repetitive environmental review. Here, the project is not a development project; it is the imposition of performance or treatment standards. Thus, this activity does not fall within the type of projects the Legislature sought to expedite through tiering, and accordingly, there is no legal basis for the Regional Board to rely upon these principles in analyzing the impacts of the TMDL.

Regional Board staff has, in the past, stated that it need not conduct a detailed analysis because it contends that the TMDL environmental analysis functions as a "first tier document," or would be speculative These statements are inaccurate because:

- Tiering does not excuse the lead agency from adequately analyzing the reasonably foreseeable significant environmental effects of the project and does not justify deferring such analysis to a later tier EIR or negative declaration." 14 C.C.R. Section 15152(b).
- Lead agencies cannot hide behind an inadequate analysis and leave it to the public to produce the necessary substantial evidence regarding adverse impacts. *Gentry v. City of Murietta*, 36 Cal.App.4th 1359, 1379 (1995). While foreseeing the unforeeable is not possible, the agency must find out and disclose all that it reasonably can. 14 C.C.R. § 15144.
- To claim that an impact is speculative and terminate a discussion requires analysis – it does not excuse a failure to investigate and analyze. *See Marin Municipal Water District v. KG Land California Corporation*, 235 Cal.App.3d 1652 (1991) *and* 14 C.C.R. Section 15145. The record does not support a finding that the Regional Board has conducted this investigation.

Response: Appendix I, as revised in the March 9, 2007 version, does not equate the substitute environmental documents with a Tier I EIR. The appendix states that the San Diego Water Board has considered the pertinent requirements of state law,[7] and intends the analysis to serve as a tier 1 environmental review. The substitute environmental documents are not intended for others to tier off of, however, municipal entities can utilize all information included in the substitute environmental document when developing their own environmental documents.

2.1.7 Alternatives Analysis

Comment No. 35: The alternatives analysis is inadequate. The State Water Resources Control Board regulations for complying with CEQA require a substitute document to contain an analysis of reasonable alternatives to the proposed action. Here the only alternatives analyzed are the "no action" alternative, and the "reference system approach." This is an inadequate range of alternatives. *See Citizens of Goleta Valley v.*

[7] Public Resources Code section 21159 and 14 CCR section 15187

Board of Supervisors, 52 Cal.3d 553 (1990)[Requiring a reasonable range of feasible alternatives.

Here, the Regional Board has failed to explain why to the extent that the implementation plan is part of the project, whether a longer compliance schedule will result in pilot project technology becoming mainstream technology that can be deployed and reduce certain impacts.

The City has previously submitted comments on this proposal, including the Regional Board's efforts at CEQA compliance; this letter and its attachment addresses many of the issues previously raised and includes even more substantial evidence regarding the environmental impacts of the project. The City's most recent correspondence on TMDL was addressed to the State Water Resources Control Board and is dated January 6, 2006. That letter and Board staff's April 7, 2006 responses, a Discussion Paper entitled "Adequacy of the Environmental Review Documents for the Chollas Creek Metals TMDLs", April 6, 2006) are included as Attachments 1 and 2 so as to make them part of the administrative record for the current proceedings. As required by the State Water Resources Control Board's regulations, the City respectfully requests written responses to our January 6, 2006 letter (to the extent responses were not provided in Attachment 2) and this letter.

CEQA requires a discussion of project alternatives if the proposed project would result in potentially significant impacts, and the State Water Resources Board regulations (23 C.C.R. § 3777(a)(2) also requires the Regional Board's substitute documents to contain "reasonable alternatives to the proposed activity." Why does the CEQA analysis for the metals TMDL not include a discussion of project alternatives given that the CEQA analysis for the bacteria TMDL does include the discussion?

If the Regional Board includes a discussion of project alternatives in the metals TMDL, it should use the implementation protocol described as the City's preferred alternative in Attachment 3.

Response: The alternatives analysis was expanded in the March 9, 2007 version of Appendix I. Included in the expanded alternatives analysis are the no action alternative, the water quality standards action alternative, the 10-year compliance schedule for metals load reduction only alternative, and the 20-year compliance schedule for metals, bacteria, diazinon, and trash reductions alternative, the latter of which evaluates the protocol described in attachment 3, (i.e., the Weston Report).

A complete response to the City's January 6, 2006 letter was provided in the San Diego Water Board's Discussion Paper (the City's Attachment 2), which is part of the case file.

2.1.8 Tributary Rule

Comment No. 36: *Inappropriate application of the tributary rule.* The TMDL requires load reductions prior to discharge into any receiving water, including open concrete channels. Under this interpretation, the Regional Board would no longer provide an incentive to replace concrete channels with vegetation because the vegetation would not address the non-compliance of waters upstream of the revegetation site.

Would compliance with the metals and bacteria TMDLs be achieved if storm water discharged from a storm drain outfall exceeds the WLA if that water is treated to meet the WLA further downstream? In other words, does the WLA need to be met in receiving waters immediately below storm drain outfalls or somewhere further down the watershed? If the latter, how much further down?

The CEQA document should describe the reasonably foreseeable alternative in-stream BMPs that are consistent with the beneficial uses and [representative] natural aquatic ecosystems of the creek and describe the impacts of building and operating such BMPs. The City is unaware of any in-stream BMP that would achieve the WLAs and meet these criteria.

The City believes that the above statement from the "Discussion Paper" is contrary to other statements that have been made by Regional Board staff with regard to the application of the tributary rule and the resultant need to site BMPs upstream of storm drain outfalls. The City has relied on the following statements for its understanding of this issue:

Email from Julie Chan dated March 10, 2006:

> The tributary rule ascribes to a tributary, on which surface water quality standards have not yet been established, the water quality standards applicable to the downstream receiving water…Since the states are required to adopt water quality standards for tributaries, the San Diego Water Board has taken the approach that standards applicable to the downstream receiving water will be applied to the tributary in the absence of site specific standards. The Basin Plan has a footnote which accomplishes this purpose. The footnote states: "Beneficial uses apply to all tributaries to the indicated water body, if not listed separately".

Email from John Robertus dated May 3, 2006:

> I think that you can resolve the matter by considering that the Basin Plan designates both beneficial uses and water quality objectives by hydraulic units, areas and sub-areas. These apply to all waters of the state within each respective HU, HA and HSA. There are no "upstream, downstream or in-between waters".
>
> As for the reduction of pollutants, the industrial stormwater (including construction) discharges must be reduced to BAT/BCT, the MS4 discharges must be reduced to MEP with allowances for an iterative process, and the TMDL pollutant reductions must be accomplished in accordance with the TMDL Basin Plan amendment which is independent of MEP or BAT/BCT. I believe that the Regional Board could also

require that all water quality objectives be met immediately in receiving waters if it were to choose to do so. However, this is not what is expected at this time.

As for BMPs in waters of the state, you are correct that we do not embrace any BMPs located within waters of the state. Rather, we expect that pollutants will be reduced appropriately prior to the discharge into such waters. In some cases we have allowed projects that have "extended" the MS4 infrastructure to collect, divert or treat such discharges. Some of these are sites of CBI projects and others are just local pilot projects. In each case there was a case-by-case decision. With respect to "treatment wetlands", I can make no case for allowing assimilative capacity of waters of the state to be used as "treatment" to remove pollutants discharged from a MS4. Perhaps some day there will be mixing zones or some other construct, but this does not exist today. There can be treatment wetlands constructed to function as a pollutant reduction method anywhere except in the waters of the state.

Chollas Creek Dissolved Metals TMDL Technical Report (July 25, 2006, page 3)

These loading capacities, which are equal to the Numeric Targets, will apply to the entirety of Chollas Creek and during all times of the year. Regulated **discharges** [emphasis added] from each of the land uses identified in the Source Analysis portion of this TMDL will not be allowed to have dissolved metals concentrations that causes [sic] in-stream waters to exceed the loading capacities.

Chollas Creek Dissolved Metals TMDL Appendix M (July 25, 2006, page 21):

The 2002 List of Water Quality Limited Segments lists the lowest 1.2 miles as the estimated size effected [sic]. To ensure restoration of water quality standards in this portion of the creek, all upstream sources need to meet the Wasteload Allocations of this TMDL. This is consistent with the Diazinon TMDL, adopted in 2002. Wasteload Allocations were applied to **discharges** [emphasis added] throughout the entire watershed when only the lowest 1.2 miles was listed as impaired.

Chollas Creek Dissolved Metals TMDL, Appendix I (July 25, 2006, page 15)

The implementation of these TMDLs will result in improved water quality in Chollas Creek **and it** [sic] **tributaries** and will not have significant adverse effects to the environment (emphasis added).

Bacteria-1 TMDL, Technical Report (August 4, 2006)

Persons whose point source discharges contribute to the exceedance of WQOs for indicator bacteria (as discussed in section 10) will be required to meet the WLAs in their urban runoff before it is discharged from MS4s to receiving waters.

The following statements indicate a strong preference against diverting storm water or urban runoff from receiving waters for treatment, again leading to the unavoidable conclusion that Wasteload Allocations must be met in the receiving waters immediately below storm drain outfalls:

Chollas Creek Dissolved Metals TMDL, Appendix I (July 25, 2006, page 13)

> Since in-stream diversions should not be used as BMPs, there should be no adverse impacts on aesthetics resulting from construction of concrete-lined basins or treatment facilities within the creek.

Bacteria-1 TMDL, Appendix R (August 4, 2006)

> In-creek diversions should not be used as controls, therefore, there should be no adverse effects on aesthetics resulting from construction of concrete-lined basins or treatment facilities within the creeks.

Finally, since the CEQA document does not describe biological impacts of building structural BMPs in canyons or receiving waters, it was presumed that such construction would not be allowed.

In order to provide an adequate project description under CEQA, the metals and bacteria TMDL documentation should be explicit about where the Wasteload Allocations must be met. In order to provide an adequate environmental setting under CEQA, the metals and bacteria TMDL documentation should, at a programmatic level, describe where the MS4/receiving water interface is located. Based on the geography and topography of the watershed, the City has concluded that "Waters of the State" and receiving waters generally extend upstream to locations immediately downstream of storm drain outfalls throughout the watershed.

Location of BMPs and Tributary Rule
City comments have previously indicated that the bacteria and metals TMDLs will require the construction of storm water treatment facilities on currently developed private property. In its document entitled "Adequacy of the Environmental Review Documents for the Chollas Creek Metals TMDLs" (April 7, 2006), Regional Board staff writes that:

> "the City [improperly] interprets the tributary rule to require strict attainment of the most stringent downstream water quality objectives throughout Chollas Creek and its tributaries".

Further, above-referenced discussion paper states that,

> [w]hile all waters tributary to Chollas Creek should be of a quality consistent with the attainment in Chollas Creek of the water quality objectives necessary to support the beneficial uses designated for Chollas Creek and San Diego Bay, this policy does not, necessarily, preclude the installation of pollutant reduction BMPs in Chollas Creek or its tributaries. Source control is the preferred means of compliance with the [dissolved metals] TMDLs. However, in-stream structural BMPs may be reasonable, depending on the location and type of BMP, provided that they are

consistent with the beneficial uses of the creek and the natural aquatic ecosystem characteristics of the creek".

Response: TMDLs allocate wasteloads to MS4 discharges, as opposed to receiving waters. For this reason, discharges from MS4s are required to meet WLAs. The WLAs are designed to restore water quality in receiving waters as defined by applicable water quality objectives. Since the San Diego County municipal storm water requirements (Order No. R9-2007-0001 or its successor) will be used to implement the TMDLs at issue, the term "receiving waters" in this case refers to waters of the United States.

The conditions under which MS4s discharge to receiving waters are exceptionally diverse. This makes it difficult to define a precise "bright line" of demarcation for determining when MS4s end and receiving waters begin that will be applicable in every case. In fact, such determinations are often made on a case-by-case basis (such as with the 401 Water Quality Certification Program). While case-by-case determinations will continue to be necessary in many instances, generally speaking, where an outfall exists, receiving waters extend upstream to the outfall location.

The issues of where WLAs must be met and where receiving waters begin are important for determining where to locate BMPs. The San Diego Water Board's typical practice has been to discourage implementation of BMPs in receiving waters. For example, Order No. R9-2007-0001 states that "urban runoff treatment and/or mitigation must occur prior to the discharge of urban runoff into a receiving water" (Finding D.10). However, the issue of BMP location ultimately depends upon site specific circumstances and how compliance with WLAs is to be assessed.

There are many different monitoring approaches that the San Diego Water Board can use to determine compliance with WLAs. For example, the Chollas Creek diazinon TMDL, Order No. R9-2004-0227 requires monitoring two stations in Chollas Creek for compliance with the diazinon WLA. This relatively simple compliance monitoring was justified because the principal control, namely banning the pesticide, had been accomplished, and water quality in Chollas Creek was meeting the interim TMDL milestone at the time the new MS4 requirements were adopted. In the extreme, the San Diego Water Board could require monitoring at every storm drain outfall, and at numerous locations in Chollas Creek and its tributaries. The compliance monitoring the San Diego Water Board likely will require will be something between these two approaches, and may depend on the level of dischargers' efforts to reduce pollutant sources and loading before the San Diego Water Board issues implementing orders.

Another compliance assessment issue to be considered is how monitoring data are analyzed. Again, a wide range of approaches are available to the San Diego

Water Board to determine compliance. For example, a regression approach to analysis of monitoring data can be used, where the monitoring data must exhibit a certain regression slope over time to show compliance with WLA. Other approaches, such as averaging of data, can also be used if appropriate. For example, in making water quality assessments for listing and delisting purposes, the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List* states that "samples collected within 200 meters of each other should be considered samples from the same location."

These different monitoring and compliance assessment methods may provide MS4 dischargers with the opportunity to implement a wide range of strategies for complying with TMDL requirements, including strategies that rely on restoration of receiving waters. The methods to be used to determine compliance will be developed following adoption of TMDLs, as municipalities develop urban runoff management plans that will implement MS4 requirements and TMDLs.

Finally, we assumed that structural BMPs could be built anywhere in the watershed, and did not exclude any land type from our analysis of potential impacts.

2.1.9 Dry Weather

Comment No. 37: *The TMDL requires the City to maintain dry weather flows*. This is contrary to Municipal Permit Discharge Prohibition B.2, requires the MS4 operators to "effectively prohibit" these human-generated, flows. The Regional Board should explain how it sees the requirement to maintain dry weather flow in an urbanized area is consistent with the discharge prohibition in the MS4 permit. The City believe that these requirements are inconsistent and is one reason why the conclusion that there will be less-than-significant impacts to biological resources is unsupported by substantial evidence.

The TMDL requires the City to maintain dry weather flows. This is contrary to Municipal Permit requirements which seek to eliminate these human-generated, flows and would force the City to construct costly low-flow treatment systems in addition to parallel systems for wet weather flows.

Either compliance option, diversion via infiltration or treatment, will reduce sediment loading into Chollas Creek. The CEQA document should assess this impact.

The City estimates that dry weather flows exit from approximately 528 of the 800 storm drains outfalls in the watershed (66%). These dry weather flows support wetland vegetation in Chollas Creek and its tributaries that probably would not exist but for the flows and probably did not exist prior to urban development of the watershed. Eliminating these flows by infiltrating them would eliminate certain receiving waters and the associated aquatic and wetland life. Accordingly, the CEQA documents for both TMDLs require as mitigation the return of "treated water into the creek in the same location, and at the temperature and flow velocity to maintain the creek's hydrology (page 89 of the metals TMDL Technical Report, page 14 of the metals TMDL environmental checklist and page R-14 of the checklist for the bacteria TMDL). Assuming that the intent is not to discharge treated, potable water from the existing drinking water distribution system into receiving waters, the construction of urban runoff treatment facilities is required. Moreover, to prevent bacterial regrowth in the MS4 downstream of the treatment facilities, the treatment facilities must be built immediately above the storm water outfalls.

The mitigation measure which requires maintaining the hydrology of receiving waters and wetlands also necessitates the construction of treatment facilities for dry weather flows (immediately upstream of the storm drain outfalls to minimize the potential for bacterial regrowth above the outfall). Total compliance via infiltration is therefore infeasible. As an alternative to treating all flows, the requirement to maintain dry weather flows in receiving waters sets up another reasonably foreseeable means of compliance: that the City will treat dry weather flows and return them to the creek where they currently flow, that the City will infiltrate wet weather flows where it is practicable, and that the City will treat wet weather flows where it is impracticable. The CEQA document must address the impact of this reasonably foreseeable means of compliance.

Should treatment facilities designed to maintain creek hydrology and wetlands be designed to retain existing hydrology/wetlands (as affected by development) or should treatment facilities be designed to discharge water to mimic pre-development conditions? If the latter, what are the characteristics of pre-development hydrology and wouldn't this have an adverse impact on wetland vegetation that is dependent upon dry weather urban runoff?

The City is unclear as to the Board's overall policy with respect to hydrology and wetlands that are present only because of human-induced dry weather flows. Which does the Board see as more important – the maintenance of post-development hydrology/wetlands or the reduction of [clean] dry weather flows?

Response: As revised in the March 9, 2007 version, the substitute environmental documents make clear that the TMDLs do not require the City to maintain dry weather flows. Nowhere in the Technical Report does it state that TMDL implementation requires maintenance of the current flow regime. Ordinances prohibiting dry weather nuisance flows are evaluated as a reasonably foreseeable method of compliance.

2.1.10 Aerial Deposition

Comment No. 38: Page 57 of the Chollas Creek Dissolved Metals Technical Report states that the Regional Board's model estimated the potential load of each metal from the open space land use (9.73% of the Chollas Creek watershed, or over 1,583 acres) to be 0% of the total existing load for each metal. Contributions of loading from open space land uses in comparison to other sources were found to be insignificant. Page 59 of the Technical Report and the Regional Board's "Discussion Paper" conclude that Chollas Creek receives significant contributions of copper, lead, and zinc but that this source must travel through the MS4 and thus have already been accounted for [in the WLA for the MS4). The City has recently undertaken an aerial deposition study and interim results are presented in Attachment 4. In general, the amount of aerial deposition in the watershed is significant. Open spaces adjacent to Chollas Creek and its tributaries drain into receiving waters without first entering the MS4. In a future compliance scenario where wet weather flows in the MS4 above storm drain outfalls are diverted for infiltration, the only flows in the creek would be those from the adjacent open spaces. Given that the metals TMDL is concentration-based, this loading could result in non-compliance with the TMDL. The Regional Board's "Discussion Paper" concludes that "a very small percentage of the land area drains directly into Chollas Creek via sheetflow from canyon walls. What is this determination based on?

The City has submitted substantial evidence that concentrations of zinc, lead, and copper in runoff from open space lands will be significant. What is the reasonably foreseeable means for TMDL compliance given that runoff containing aerially deposited pollutants from open space lands that drain directly into receiving waters (never enter the MS4) will exceed the zero WLA for these lands?

Response: The City is not responsible for pollutants that enter receiving waters outside the control of its MS4. The "very small percentage of land area statement" was estimated based on a review of aerial maps.

The TMDL modeling predicted zero percent loading from open space. The canyons and stream banks are open space, and therefore the metal loading coming from storm water draining these areas will likely contribute no loading.

2.1.11 Statement of Overriding Considerations

Comment No. 39: Similar to how the Los Angeles Region revised its CEQA analysis for the Los Angeles River Trash TMDL, the San Diego Regional Board must address all the potentially significant impacts associated with building and maintaining the BMPs needed to comply with the metals and bacteria TMDLs.

In its' Discussion Paper entitled "Adequacy of the Environmental Review Documents for the Chollas Creek Metals TMDLs" (April 6, 2006) Regional Board staff reiterates its' position that it is not obliged to provide any additional level of detail with regard to the impacts associated with building BMPs to comply with the TMDLs. Regional Board staff position is that identifying the specific projects that might be implemented is speculative at this time and that future CEQA documents prepared for specific projects are the responsibility of the City. While the City agrees that it will likely be required to prepare additional CEQA documentation in the future in order to comply with the TMDL, it disagrees that the Regional Board has prepared an adequate analysis of the impacts associated with compliance with the TMDLs

The City believes that the Regional Board has improperly deferred additional environmental analysis. The City believes that the Regional Board has not defined the TMDLs with enough specificity to conduct a "programmatic" level of analysis of the reasonably foreseeable means of compliance, particularly with respect to required load reductions (which dictate the types of BMPs required), the tributary rule, and prohibitions on in-stream diversions (which dictate the possible locations of the BMPs), and failure to develop a design storm (which leaves open the acreage requirements of the BMPs). In accordance with Section 15187 of the State CEQA Guidelines this analysis could utilize numeric ranges and averages when specific data is not available. Section 15146 of the CEQ Guidelines addresses the level of specificity that is required for projects such as the TMDLs. For CEQA purposes, adoption of the TMDLs by the Regional Board is comparable to adoption of a General Plan or Community Plan by a jurisdiction's legislative body with land use powers. What is required is the production of information sufficient to understand the environmental impacts of the proposed project. The current analysis does not fulfill this requirement. The City further believes that unless mitigation to reduce potentially significant impacts to a level below significance is "guaranteed", the analysis must conclude that the impacts are significant (CEQA Guidelines, Section 15152(f)(3). In that case, "Findings" and a "Statement of Overriding Considerations" must be adopted.

To the extent that the CEQA analysis indicates that "[i]mpacts **may** be mitigated (e.g., Chollas Creek Dissolved Metals TMDL, Appendix I, pages 13 and 15, emphasis added) and not that they **will** be mitigated, the analysis should conclude that the impacts are significant. See also page 6 of the Regional Board's "Discussion Paper" which indicates that it is not clear whether impacts to aesthetics would be mitigated.

If it finds certain impacts to be significant, does the Regional Board intend to adopt "Findings" and a "Statement of Overriding Considerations" for either the metals or bacteria TMDL?

Paragraph 19 of Appendix J, the proposed resolution, contains a section that purports to be a statement of overriding considerations required by CEQA when a project may have a significant, unmitigated impact to the environment. Appendix I does not identify any significant, unmitigated impacts. Why does the resolution contain a statement of overriding considerations if the CEQA analysis does not identify a significant, unmitigated impact?

Response: Although the San Diego Water Board found that all potentially significant impacts could be reduced to less than significant with mitigation, we nonetheless incorporated a finding and statement of overriding consideration in the Technical Report and Resolution. It was incorporated because the San Diego Water Board may not have approval authority over specific implementation projects and therefore, cannot ensure that mitigation will be incorporated when the projects are built.

We disagree that we have improperly deferred environmental analysis. The substitute environmental documents contain adequate information and analysis for the public to understand the potential adverse environmental impacts of the project. The tributary rule and where the BMPs can be located are discussed in the response to comments No. 36. The design storm issue is addressed in the response to comment No. 2.

2.1.12 Other Specific Comments

Comment No. 40: Types of BMPs Attachment 3 to this letter is a report that the City has had prepared by Weston Solutions. This report provides substantial evidence that the City will have to undertake a massive public works program in order to implement the metals and bacteria TMDLs and that the implementation program has the potential to result in significant environmental effects. The Weston report clearly indicates that the only ways that the load reductions for bacteria and metals required by the TMDL in at least portions of the Chollas Creek watershed can be achieved are by 1) preventing urban runoff and storm water from exiting the 800 storm drains outfalls in the watershed or by 2) treating the water using advanced technologies. The Regional Board response to previous City comments on this issue is that the City is wrong with regard to the percent of load reduction required. Since the TMDL is a concentration-based WLA that applies to all waters of the state in the watershed, applying an average concentration to the required load reductions is scientifically correct. If the Regional Board is going to persist with this contention, the Technical Report should contain a detailed analysis as to how a discharger complies with a concentration-based WLA using average reductions. Further the use of chlorine, or other disinfectants, ozone or ultraviolet light will likely be necessary to achieve the Wasteload Allocations proposed in the Bacti-1 TMDL.

Please clarify how compliance with the TMDL will be measured in terms of percent reduction of dissolved metals. The City's understanding is that an "average 50% reduction" would not result in compliance. Expressing compliance as an average 50% reduction is misleading.

Response: The City has misinterpreted the Regional Board's previous response. Ultimately the City needs to meet the CTR criteria in Chollas Creek. That would mean reductions as high as 98 percent and as low as 0 percent depending on location. The concentration data for Chollas Creek do not support the City's assertion and comment that dissolved copper is 88.5 percent, dissolved lead is 98.7 percent, and dissolved zinc is 77.4 percent. Concentrations of these metals are not uniformly high throughout the watershed. Our statement that the average reduction required is closer to 50 percent is not a performance standard for compliance with the metals TMDLs. Our comment was a reasonable characterization of the overall watershed.

Comment No. 41: The City needs to know how exceedances of the TMDL will be evaluated by the Regional Board. Given the above discussion regarding the Tributary Rule, the City is operating under the assumption that a discharge in excess of the Wasteload Allocations at any one of the approximately 800 outfalls in the watershed would warrant a Notice of Violation. The TMDL Technical Report should explicitly state whether a Wasteload Allocation exceedance at any single outfall would warrant a Notice of Violation and, if not, how non-compliance would otherwise be assessed? For example, if monitoring showed concentrations of zinc, copper, or lead in excess of the Wasteload Allocations at 100 outfalls during one storm event would the Board have the basis for issuing 100 Notices of Violation or one Notice of Violation?

Response: A discussion of possible enforcement scenarios is beyond the scope of this TMDL project. Please see the response to comment No. 36 for a general discussion of possible compliance monitoring approaches.

Comment No. 42: The compliance schedule proposed by the Regional Board demands a 50% reduction in exceedances of Wasteload Allocations in Year 7. The City interprets this to mean that either 400 storm drain outfalls must have no exceedances or that none of the 800 outfalls may have exceedances more than 50% of the time (or some combination thereof) by Year 7. Shouldn't the compliance schedule be driven by load reductions rather than the percent reduction in exceedances? Please provide examples how compliance would be assessed.

The City noted in May, 2005 that the TMDL is written such that load reduction of 88.5% for copper, 77.4% for zinc, and 98.7% for lead is required. The City bases this contention on the historical maximum concentrations at the mass loading station. In its response, the Regional Board replied that the City is incorrect and that the "average reduction required is closer to 50%". Since the TMDL uses a concentration-based WLA that applies to all waters of the state in the watershed, applying an average concentration to the required load reduction is not scientifically correct. The historical range of reductions required to meet the WLA, based on mass loading station data, are from 3% to 87% for dissolved copper and from 14% to 92% for dissolved lead. While the reductions needed in different subwatersheds will vary, it is the City's understanding that the WLAs must be met in receiving waters at any time. To meet the concentration-based WLA reductions of greater than 50 percent would, therefore be needed where these maximum concentrations are observed.

Response: Data were inadequate to calculate mass loading of the metals, therefore the compliance schedule could not be based on load reductions. Although compliance assessment is beyond the scope of these TMDLs, either scenario posed by the City of San Diego is plausible for assessing compliance. Please see the response to comment No. 40 concerning our statement regarding an "average 50 percent load reduction."

Comment No. 43: The City believes that the Regional Board has significantly underestimated the cost of implementing the metals TMDL. See Attachment 3 and our previous letter for additional detail. In its discussion paper, Regional Board staff erroneously indicated that the City estimate for compliance is $1 billion for a 50-acre area. The City's estimate was $1 billion for the entire watershed. Please refer to Attachment 3 for more detailed cost estimates.

Response: Correction acknowledged. The San Diego Water Board has include new cost estimates in the economic analysis section of the Environmental Analysis. The San Diego Water Board's previous cost estimate underestimated the number and cost of the Austin (type) sand filters.

Comment No. 44: The California Toxics Rule includes a 10% Margin of Safety (MOS). Regional Board staff proposes to add an additional 10% MOS.

The additional 10% MOS is unnecessary and arbitrary. It is reasonable to assume that the additional load reductions required by this additional MOS will render certain BMPs ineffective in terms of compliance in some portions of the watershed, resulting in the need to build more costly and intensive BMPs. Please describe the need for the additional 10% MOS.

Response: The two margins of safety are for different purposes and are necessary and appropriate. The CTR MOS is included as a matter of CTR protocol to ensure adequate water quality by establishing the recommended limit below the limit of impairment. The TMDLs 10 percent MOS is included to address any potential errors in the methodologies utilized to calculate the TMDLs.

Comment No. 45: Please resolve the apparent inconsistency between the following adjacent sentences in the Chollas Creek Dissolved Metals TMDL, Appendix I (July 25, 2006, page 15):

> The implementation of these TMDLs will result in improved water quality in Chollas Creek and it [sic] tributaries and will not have significant adverse impacts to the environment. Specific projects employed to implement these TMDLs may have significant impacts, but these impacts are expected to be limited, short-term, or may be mitigated through design and scheduling.

The second sentence referenced appears to indicate that certain impacts, although they may be limited or short-term, will be significant. Which impacts are significant?

Response: The inconsistency was resolved in the March 9, 2007 version of the Technical Report.

Comment No. 46: Why is the use of tiering treated differently in the Bact-1 CEQA Checklist (page R-13) than in the "Adequacy of the Environmental Review Documents for the Chollas Creek Metals TMDLs" Discussion Paper dated April 6, 2006?

Response: Both the Bact-1 TMDL and Chollas Metals TMDLs were revised to treat tiering consistently. Please see the March 9, 2007 versions of the two TMDLs.

2.2. Comments from Caltrans (September 11, 2006)

Comment No. 47: General Comments. The purpose of this document is to disclose the types of environmental impacts that may result from the construction and operation of a "representative" example of each Best Management Practice (BMP) that may be chosen for use. The project description provides insufficient information about the types of structural mitigation that may be implemented as part of the metals control program.

While the document mentions the types of mitigation projects that may be implemented by permitted agencies, it does not clearly explain how these projects would be constructed and the actions necessary to install various mitigation projects. The frequency, magnitude and duration of each action are unknown, making it difficult to understand the severity of potential environmental impacts. The project description prepared by RWQCB staff should have provided some graphics showing what these various basins and filters look like and how a typical or representative BMP might be implemented. General descriptions, their construction, and a graphic for each BMP, would greatly enhance the layperson's understanding of how they might impact the environment. While site-specific analysis is beyond the scope of this study and not warranted at this stage of the regulatory program, the San Diego Regional Water Quality Control Board (RWQCB) has at minimum, a duty to disclose, at a programmatic level, the types of impacts that might occur from the construction and operation of various types of BMPs (detention basins, wet basins, infiltration basins, sand filters, and diversions systems) in the Chollas Creek watershed. The RWQCB has primary responsibility to properly disclose, at a programmatic level, the types of impacts that can reasonably be expected to occur from program implementation. Each of these pollution control systems will have potential impacts that should be disclosed. For example, the detention and infiltration of metal-laden storm water runoff could potentially cause shallow groundwater degradation. This issue, and how the RWQCB will deal with indirect impacts to groundwater, should have been addressed more fully in the document. More specificity about the various control devices and how they are constructed and installed will enable meaningful environmental analyses.

Response: New analysis was added to the March 9, 2007 version of Appendix I, Environmental Analysis, Checklist, and Economic Factors. This analysis addresses the concerns expressed in the comment.

Comment No. 48: This document should be functionally equivalent to a programmatic Environmental Impact Report (EIR) with the primary goal of disclosing the cumulative impacts of the regulatory program. As stated in the CEQA guidelines (14 CCR 15168), a programmatic EIR should be for projects that are related geographically, logical parts in a chain of contemplated actions, connected as part of a continuing program and carried out under same authorizing statute or regulatory program and have similar environmental impacts. It is clear this program meets these four tests. In addition, if this document was prepared properly identifying potential impacts and mitigation measures, subsequent projects proposed by the permittees could agree to adopt mitigation recommendations and might rely upon it for their CEQA compliance. In its current state, all BMP implementation projects will require at a minimum an initial study by the various cities and organizations that will be regulated by this program.

Response: Please see response to comment number 34.

Comment No. 49: The RWQCB needs to provide substantial evidence for each determination in the check box response in the initial study. The Board appears to only prepare responses for significant or potentially significant impacts and no response whatsoever for "No Impact" responses. The Board provides no factual information or substantial evidence to support many of these no impact conclusions. Mitigation measures, when discussed, are addressed only generically and not in a format that provides specificity regarding their timing, responsible party, standards of success and funding information as required by CEQA.

Response: New analysis and explanation for the "no impact" responses were added to the March 9, 2007 version of Appendix I, Environmental Analysis, Checklist, and Economic Factors. This analysis addresses the concerns expressed in the comment.

Comment No. 50: There is no information to support the No Impact claims for three out of four checklist questions [regarding scenic vistas, historic buildings, and scenic resources]. No Impact conclusions regard scenic vistas, historic buildings, or scenic resources. This section needs to provide documentation and evidence to support these conclusions.

Response: In the March 9, 2007 version of Appendix I, new analysis was added to the aesthetics and cultural resources sections of the Environmental Checklist in which the "no impact" designation was changed.

Comment No. 51: There is no information to support the No Impact conclusions regarding agriculture. It may be self-evident to Board staff, but no information is provided to the layperson to support this position.

Response: An explanation for the "no impacts" response was added to the March 9, 2007 version of Appendix I..

Comment No. 52: Construction of these various BMPs will undoubtedly generate short-term construction emissions from heavy equipment needed to grade areas for new basins or construction of sand filters. The RWQCB should disclose numerical estimates of the air emissions from a typical or representative BMP project and provide mitigation measures for those impacts. Various air quality predictive models, e.g., urban emissions (URBEMIS) and others, supported by the California Air Resources Board (CARB) should be used to make reasonable predictions. Again, no information is provided to support these conclusions.

Response: Specific numerical estimates are not discussed because of the variability of the potential BMP locations. Emission limits and tolerances may vary among municipalities and within specific land uses. The substitute environmental documents contain sufficient information and analysis for the public to understand the potential adverse environmental impacts of air pollutants, and to provide the San Diego Water Board with meaningful discussion and comment on these impacts. Site specific air emission controls and mitigation will have to be considered when the dischargers actually begin designing and constructing BMPs.

Comment No. 53: The mitigation measures discussed in this section do not meet CEQA requirements. Measures should be discussed in detail and describe various details including timing, agency responsible, funding and measures of success. These general concepts for mitigation do not provide guidance to the cities that will comply with the TMDL and CEQA. This section provides little documentation of impacts and provides only a generic discussion of mitigation. The document should have at least presented biological information and results from the California Natural Diversity Database (CNDD), and described where existing rare, threatened or endangered plants and animals are found in the Chollas Creek watershed. Creek diversion systems could have impacts on water resources and aquatic resources in Chollas Creek and should be disclosed as required. To defer this analysis and simply state that this will be done later by the cities and others is improper and presents inadequate disclosure under CEQA. The Board is required to document the potential impacts from this regulatory program at a general level and describe in sufficient detail measures that could be implemented to reduce impacts to less than significant levels. It is a highly urbanized environment, but there is always a possibility that species might be impacted from indirect activities associated with a mitigation project due to timing, proposed laydown, and vehicle parking. The document should have identified these areas within the watershed, as well as the range of mitigation measures that could be employed by project-level permittees.

Vector control, groundwater quality, and hazards are discussed in the biology section and are misplaced. These issues should be discussed in their appropriate sections of the checklist.

Response: The March 9, 2007 version of Appendix I was expanded to include more discussion on mitigation measures. Consequently, the proposed mitigation measures are described in adequate detail for this planning level environmental analysis. More detail with respect to the timing of mitigation was added to the March 9, 2007 version of the analysis. The agency responsible for mitigation depends on the jurisdiction in which the BMPs are implemented or constructed. This analysis did not speculate on the specific locations where agencies might or might not construct BMPs. CEQA does not require the San Diego Water Board to identify funding sources for mitigation measures or measures of success. However, a mitigation is successful if it lowers the impact below the significance threshold.

Additionally, new analysis that addresses the concerns of the comment was added to the March 9, 2007 version of the biological sections, both plant and animal, of the Environmental Checklist. Vector control was appropriately relocated.

Comment No. 54: No substantial evidence or citation of literature is provided to back up the No Impact determinations provided in the document. The explanations to the checklist questions need to be revised accordingly.

Response: New analysis was added to the March 9, 2007 version of the Environmental Checklist, and in many instances the "no impact" designation was changed. Explanation of the remaining "no impact" designations were also provided.

Comment No. 55: In general, the RWQCB should focus on the benefits that will be derived from removing metals from the drainages and tributaries in the Chollas Creek watershed in this section, since it is one of the primary goals of the TMDL. No substantial evidence or citation of literature is provided to backup the No Impact determinations provided in the document for the eight checklist questions. This section needs to be revised accordingly

Response: Although removing metals from the drainages and tributaries will provide an environmental benefit, the purpose of the Checklist is to disclose adverse environmental impacts. Therefore, the benefits of the TMDLs were not discussed. Explanations of the "no impact" designation were provided in the March 9, 2007 version of Appendix I.

Comment No. 56: As previously noted, the document should have presented data from the CNDD with regard to Rare, Threatened, or Endangered (RTE) wildlife within the Chollas Creek watershed and the Estuary. It is inadequate to defer this analysis to subsequent permittee projects.

This section needs to provide better descriptions of mechanisms of potential impacts and recommended mitigation measures that maybe adopted and implemented by Tier 2 permittees to address species protected by the Migratory Bird Treatment Act (MBTA). As currently written, the reader has no idea of the range of impacts to these species.

Response: New analysis that addresses the concerns expressed in this comment was added to the March 9, 2007 version of the animal life section of the Environmental Checklist. Also, please see response to comment number 34.

Comment No. 57: The noise section needs to provide more specificity with regard to potential impact and mitigation measures that would be used by those entities implementing mitigation projects. The document should have presented information about noise ordinances or policies in noise elements of general plans of the various cities in the watershed. Predictions of noise levels from various construction activities should have been estimated to provide the reader with a sense of noise impacts and mitigations.

Response: New analysis that addresses the concerns expressed in this comment was added to the March 9, 2007 version of the noise section of the Environmental Checklist.

However, specific municipal noise ordinances or policies are not discussed because of the variability of the potential BMP locations. Noise ordinances or policies may vary among municipalities and within specific land uses. The substitute environmental documents contain sufficient information and analysis for the public to understand the potential adverse environmental impacts of noise associated with this project, and to provide the San Diego Water Board with meaningful discussion and comment on these impacts. Site specific noise controls and mitigation will have to be considered when the dischargers actually begin designing and constructing BMPs.

Comment No. 58: This section should at least attempt to quantify traffic impacts from the proposed project using various assumptions for maintenance of these devices. No substantial evidence or citation of literature is provided to back up the No Impact determinations provided in the document for the seven checklist questions. This section needs to be revised accordingly

Response: In the March 9, 2007 version of Appendix I, new analysis that addresses the concerns expressed in this comment was added to the discussion of the transportation and circulation question (no. 13.a) in which the "no impact" designations were changed. However, quantifying specific traffic impacts due to assumptions for maintenance of BMPs devices is dependant on speculation on specific BMP implementation program, type and, location, which is beyond the level of detail included in the analysis.

Comment No. 59: This section does not provide any evidence or documentation to support their conclusions and needs to be revised. There are potentially many historical and cultural sites in the Chollas Creek region that could potentially be impacted by a future implementation project. RWQCB should have conducted a records search of the Information Center of the California Historical Resources Information System and presented an analysis of the range of impacts to could occur from implementation of the various devices on these cultural resources in the watershed.

Response: In the March 9, 2007 version of Appendix I, new analysis was added to the discussion of the archeological/historical question (no. 20.a) that expands the discussion of cultural resources. Site specific historical and cultural resources and mitigation will have to be considered when the dischargers actually begin designing and constructing BMPs. At that time, the dischargers should conduct the records search described in the comment.

2.3. Comments from the San Diego Coastkeeper (September 25, 2006)

Comment No. 60: Coastkeeper supported the proposed Basin Plan amendment (BPA) as submitted to the State Water Resources Control Board (State Board) in June 2005. We understand that the State Board remanded the BPA back to the Regional Water Quality Control Board (Regional Board) for recirculation and further public comment on changes

made to the Environmental Checklist after the close of the previous public comment period. The meeting minutes of the State Board meeting on May 2, 2006 state that while "the State Water Board *does not agree* that the San Diego Water Board failed to adequately consider the significant environmental points, the State Water Board remands this Basin Plan amendment so that the San Diego Water Board, in the first instance, can consider the comments of interested persons on the substitute environmental document." (SWRCB Meeting Minutes May 2, 2006 available at http://www.waterboards.ca.gov/agendas/2006/xminutes/mins050206.pdf**,** emphasis added**)**
The remand by the State Board requires the Regional Board to collect public comments only on the portions of the BPA that were unavailable for comment during the previous comment period.

Coastkeeper continues to support the proposed BPA, and strongly agrees with the State Board that further comment should be limited to the revised documents. In our work with the city of San Diego on this matter, we understand the City will be submitting a study on TMDL feasibility. Coastkeeper has commissioned comments on that study from Dr. Richard Horner. Please find Dr. Horner's comments in the attached letter.

Response: The environmental analysis was largely rewritten in September 2006 and again in March 2007. In light of the major rewrite, taking comments on the entire environmental document was prudent. Further, because the entire Technical Report is part of the substitute environmental documents, the San Diego Water Board is obligated to allow comments on the entire substitute environmental document, including the Technical Report.

Comment No. 61: Specifically, Dr. Horner's response to the City includes the usefulness of more hydrology and soil analysis data in assessing all possible strategies for implementing the TMDL. Also, greater geographic analysis would help address some future potential problems that may be encountered in meeting the proposed TMDL. For example, the possibility of using the Low Impact Development (LID) engineering strategies, which the City's report states would reduce metal loading problems by 40 percent, could be further researched. A more detailed analysis is contained in the attached letter by Dr. Horner.

Although Dr. Horner's comment letter expresses a few concerns about the BPA, we believe the BPA should go forward. The timeline set forth in the report is both realistic and proactive. Chollas Creek has been on the EPA's 303(d) list for over ten years. It is important that the application of the TMDL begins as soon as possible.
The State Board also expressed eagerness to begin implementation of the TMDL at the May 2, 2006 meeting at which Chairman Dudoc requested that the Regional Board act upon the TMDL within the next three months. The iterative process for implementing TMDL outlined in the BPA will allow for continuing improvement upon the plan. Delaying the adoption of the BPA in order to create the perfect plan does not promote the objective of the Clean Water Act or the spirit of the TMDL provision.

Coastkeeper recommends that the BPA be approved with the current timeline. The toxicity of metals in Chollas Creek cannot be decreased without the prompt implementation of the TMDL within the schedule proposed.

Response: To allow the discharger to integrate BMP planning for all TMDLs and water quality control programs in the watershed, the San Diego Water Board extended the Compliance Schedule from 10 years to 20 years. Integrated BMP planning and implementation should minimize construction related environmental impacts, while the 80 percent load reduction in 10 years will ensure aggressive load reductions in the first decade of the program.

2.4. Comments from John W. Stump (October 12, 2006)

Comment No. 62: Missing Partners: CALTRANS: In the Chollas Watershed we have many freeways that cross it. The Martin Luther King, I-5, I-15, and I-805 freeways dump road wash directly into Chollas creek. My favorite is the drain spout on the I-805 underpass for Home Avenue. CALTRAN's must be part of the clean up.

Response: Caltrans is included in the Chollas Metals TMDLs and received a WLA along with other MS4 dischargers.

Comment No. 63: COUNTY of SAN DIEGO Most City of San Diego residents forget that their is an incorporated portion of the County in the middle of the City next to Mt. Hope Cemetery and in the Chollas water shed. There is a doughnut hole in watershed. The County controls the Air Pollution Board and Environmental Services and these agencies need to sit with us on this clean up. One of these agencies is located in the watershed. The County should be helping with our clean up efforts.

Response: The County of San Diego is included in the Chollas Metals TMDLs and received a WLA along with other MS4 dischargers.

Comment No. 64: POLICE, FIRE, PARKS and REC. These three (3) Departments must review there procedures in the water shed that may be contributing to storm water pollution. Vehicle parking, equipment draining and washing, and animal exercise and relief. Pool maintenance and draining is a concern as are practices concerning fertilizers and grounds maintenance.

Response: The City of San Diego, including all services and development projects, are included in the Chollas Metals TMDLs.

Comment No. 65: MOUNT HOPE, CHOLLAS LAKE, CHOLLAS LAND FILL and OTHER SITES During yesterdays staff presentation infiltration was dismissed because of soil conditions of vernal pools. What needs Further consideration is use of City sites like Mount Hope, storage at Chollas Lake, use at Chollas Land Fill, Colina del Sol golf course, and other City sites. I was intrigued when faced with a Billion dollar price tag; by the San Pasqual brackish water project. We could explore a demonstration project of infiltration of brackish water as has been done in LA for downtown to begin to recover that aguafer.

Response: The San Diego Water Board cannot dictate the method of compliance with the TMDLs. The City of San Diego could consider the proposal in the comment, but we cannot compel them to do so.

Comment No. 66: REDEVELOPMENT AGENCIES & HOUSING & WORKFORCE PARTNERSHIP At least four redevelopment areas are involved in the Chollas water shed - City Heights, SEDC, Crossroads, and Barrio Logan. CCDC sends low income housing funds to these areas and is supported by its workers and infrastructure. The Housing Commission has more than 30% of its housing in the Chollas watershed. How much of the Housing Commission' Housing stock is threatened by the Westen study is unknown. These six (3) agencies could contribute to the planning process to a better solution to the water shed. They should also be asked to review their BMP's.

Response: The San Diego Water Board cannot dictate the method of compliance with the TMDLs. The City of San Diego could consider the proposal in the comment, but we cannot compel them to do so.

Comment No. 67: SDG&E , COX CABLE, SBC COMMUNICATION The Chollas watershed has for the most part above ground copper wire utilities on creosol wood poles. The impact of accelerating the schedule of undergrounding these utilities on storm water should be considered. Advancing the schedule for the Cholas community undergrounding would remove thousands of tons of copper and chemicals from Chollas water shed now.

Response: The San Diego Water Board cannot dictate the method of compliance with the TMDLs. The City of San Diego could consider the proposal in the comment, but we cannot compel them to do so.

Comment No. 68: San Diego City Schools, Community Colleges, Private Schools, Churches and Related. Absent from the staff report was the involvement of the San Diego City School representatives. San Diego City Schools may have more facilities and acres Chollas than the City. They and the others listed above should be at the table.

Response: All schools in the Chollas Creek watershed are scheduled to be regulated through the Phase II small municipal stormwater requirement, immediately upon adoption of these TMDLs. Please see the Technical Report section 11.5 for more details.

Comment No. 69: SAN DIEGO MILITARY COMMUNITY Absent from the staff report was the Military community. Most people are unaware the US military have extensive housing projects in the Mid City and City Heights. One project is over Auburn

Creek and several are directly adjacent to the Chollas Creek. The Milliarty needs to be at the table in several roles.

Response: The City US Navy is included in the Chollas Metals TMDLs and received a WLA along with other MS4 dischargers.

2.5. Comments from John W. Stump (October 13, 2006)

Comment No. 70: Chollas Creek Watershed Meetings. I also suggest that meetings regarding the Chollas Creek Watershed occur in the Chollas Creek Watershed. City Heights has several meeting facilities which are larger and better than your agency facilities which I can assist you in booking, This idea will facilitate community attendance and start saving the environment by eliminating road trips.

Response: The San Diego Water Board appreciates the willing assistance. However, at this late stage in the TMDL development, we anticipate only formal hearings and Board deliberations, which are best served by our facility. Implementation meetings could certainly take place in the watershed.

Comment No. 71: Street Sweeping Proposal - Nasty Little Bits of Evil - The City seems to be proposing as an alternate proposal to an more engineered and traditional storm water treatment facility plants demonstration programs of SPECIAL CHOLLAS CREEK STREET SWEEPING PROPOSAL.

The Devil is in the details of this SPECIAL CHOLLAS CREEK STREET SWEEPING PROPOSAL the problem faced in the movie "TIME BANDITS" they had to pick up all the "Nasty Little bits of Evils". In several places in the Chollas Creek watershed the City of San Diego already has signed special Maintenance Assessment Districts (MADs) Special Parking Permit Districts, and other controlled areas to promote regular and frequent street sweeping. The new greater program would have to be measured over this existing base line. Compliance now has been spotty. Investment would be expected to in addition to this effort. A Cost Benefit Analysis of this proposal should be made on this proposal against demonstrated program over its 20 year life for other real programs operated successfully in a comparable climate and watershed. I also suggest that this proposal only be deployed in limited areas and tributaries of this watershed until proven effective. For example, The 38th Street Canyon ,of City Heights, by the Copley YMCA may be ideal for proving up this concept because it has all of the elements discussed above. The SPECIAL CHOLLAS CREEK STREET SWEEPING PROPOSAL needs to be proven before it can delay the schedule for implementation for other proven traditional technologies.

Response: The San Diego Water Board cannot dictate the method of compliance with the TMDLs. The City of San Diego could consider the proposal in the comment, but we cannot compel them to do so.

Comment No. 72: NOTICE TRANSIT AGENCIES My comments yesterday neglected to include the transit agencies that serve the Chollas Creek watershed. As I am sure you are aware, City Heights has some of the highest ridership in the County of San Diego. Please bring the Transit agencies to the table in this matter. One solutions may to increase ridership and remove private automobiles from the roadways. Electric vehicles or trams route around the first mesa may also help.

Response: The City of San Diego, including all services and development projects, are included in the Chollas Metals TMDLs.

2.6. Comments from Brake Pad Partnership (November 3, 2006)

Comment No. 73: As the facilitator of the Brake Pad Partnership, it has come to my attention that the Total Maximum Daily Load (TMDL) for Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay, which is due to be approved by the San Diego Regional Water Quality Control Board on November 10, has important relevance to the work of the Brake Pad Partnership. I would like to convey two important concerns I have regarding the copper portion of the proposed TMDL. My first concern is that the implementation plan as currently written will encourage San Diego stormwater managers to take actions that would undermine the work of the Brake Pad Partnership, which provides an important benefit to the State of California. My second concern is that the implementation plan as currently written does not allow for adaptive implementation, which would allow Regional Water Quality Control Boards and stormwater managers to respond to new information that the Brake Pad Partnership is currently developing.

The Brake Pad Partnership
The Brake Pad Partnership is a multi-stakeholder effort to understand and address as necessary the impacts on stormwater and surface water quality that may arise from brake pad wear debris generated in the use of passenger vehicles. Since 1997, brake pad manufacturers, water quality regulators, stormwater managers, and environmental groups have been working together to evaluate the potential impacts of copper from brake pads on water quality in the San Francisco Bay.
The collaborative nature of the Partnership is grounded in several key foundational commitments: (1) brake pad manufacturers have committed to introducing new products, which would be available to all of California and the Nation, if the Brake Pad Partnership determines that brake pad wear debris is a significant source of copper to the Bay; (2) regardless of the Partnership's findings with respect to copper, brake pad manufacturers have committed to incorporating the evaluation approach developed by the Partnership into their existing practices for designing products that are safe for the environment while still meeting the performance requirements demanded of these important safety-related products; and (3) all stakeholders have agreed to work collaboratively within the Partnership, and to not simultaneously sponsor, pursue, or promote legislative or legal action relating to brake pads, prior to the completion of the Partnership's technical studies and resultant action plan.

Technical Studies Currently Underway
The Brake Pad Partnership is now conducting the technical studies needed to understand the role of copper from automobile brake pad wear debris on stormwater and surface water quality. These technical studies are supported by a State Water Resources Control Board Coastal Nonpoint Source Pollution Control Program Grant, pursuant to the Costa-Machado Water Act of 2000 (Proposition 13), and a grant that is currently pending from the California Department of Transportation (Caltrans). These grants support the Partnership's effort to carry out a set of interlinked laboratory, environmental monitoring, and environmental modeling studies to understand the fate and transport of copper from automobile brake wear debris in the environment. The Partnership initiated work on these studies in October 2003 and plans to complete them in December 2007, and will be followed immediately by the development and implementation of an action plan in early 2008.

Need for Incorporation of the Brake Pad Partnership into the Proposed TMDL Implementation Plan
As currently written, the implementation plan will encourage San Diego stormwater managers to take actions that could jeopardize the beneficial contributions of the Brake Pad Partnership in developing sound and effective strategies for addressing copper in brake pads as a source of copper in stormwater. Specifically, the pursuit of legislative or legal actions relative to brake pads and stormwater quality prior to the completion of the Brake Pad Partnership's work could likely lead to the collapse of the collaborative effort that has made our successes to date possible.[8] The result would be the abandonment of the current technical effort and loss of critical information, as well as the loss of important copper usage data that is made publicly available from brake pad manufacturers through the Brake Pad Partnership.
As an alternative, I recommend that the TMDL implementation plan be revised to specifically include the Brake Pad Partnership, and to encourage San Diego stormwater agencies to work in partnership with the brake pad manufacturing industry. This is the strategy that the San Francisco Bay RWQCB (Region 2) is taking with its permittees. The Brake Pad Partnership is a component of the implementation plans for addressing copper impairment listings in the San Francisco Bay Area. In June 2002, Region 2 promulgated site-specific objectives for dissolved copper in the San Francisco Bay south of Dumbarton Bridge and established requirements that local stormwater managers and point source dischargers implement a set of actions to prevent increases in dissolved copper concentrations.[9] The implementation actions are contained in the *Copper Action*

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[8] Information on the Brake Pad Partnership and its technical results to date are available on our website at: http://www.suscon.org/brakepad/index.asp. The "Documents" page contains all of our most current technical reports and the "Technical Reference Library" contains a compilation of abstracts of scientific and engineering publications relating to the transport and fate of copper from brake pad wear debris in the environment. Hard copies of these publications are available at the US Environmental Protection Library in San Francisco.
[9] San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) 2002. 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. Prepared by Richard Looker, May 15, 2002.

Plan,[10] and have subsequently been incorporated into discharge permits as appropriate. With regard to copper from automobile brake wear debris, discharger "support" of the Brake Pad Partnership is included as a baseline action for the copper control strategy. As a part of addressing the impairment listings for copper in the San Francisco Bay North of the Dumbarton Bridge, Region 2 is developing site-specific objectives for copper and a Bay-wide implementation plan supporting those objectives. The implementation plan will contain required actions for wastewater sources, shoreline activities, and for urban runoff management agencies. Region 2 is already developing permit provisions for urban runoff programs that will be consistent with the implementation plan for the copper objectives. These permit provisions address industrial copper sources, architectural and pesticidal uses of copper, and automobile brake pads. It is anticipated that these permit provisions will state that urban runoff management agencies have an affirmative responsibility to avoid or minimize the release of copper by controlling all sources in their program areas. However, it is also anticipated that the provisions will recognize that the Brake Pad Partnership is close to completing its work. Accordingly, the permittees will be encouraged to continue to support the Partnership efforts, and participate in the development and implementation of the resultant action plan for addressing copper from brake pad sources. The permit provisions will likely call for additional control measures for copper, including copper from brake pads, but the need for these additional measures will be determined, at least in part, by the nature and extent of Partnership outcomes. The Bay Area dischargers' participation in and support of the Brake Pad Partnership, in conjunction with the Bay Area Stormwater Management Agencies Association, has been critical to the progress we have made to date.

Need for Adaptive Implementation Provisions
The results of the Brake Pad Partnership's work will provide important information regarding copper control management strategies and timelines for source control actions. I recommend that the proposed TMDL implementation plan be revised to include an adaptive implementation provision that will allow for the incorporation of new information resulting from the Brake Pad Partnership and other sources that will have implications for the most effective means of meeting the TMDL requirements. Through the work of the Brake Pad Partnership, we have learned a tremendous amount about the transport and fate mechanisms for copper from brake pad wear debris in the environment that have important implications for stormwater management, and we are continuing to learn more through the remainder of our planned technical studies. In addition, the Brake Pad Partnership is focusing on understanding brake pad manufacturers' required timelines for technology and new product development and the deployment of new products on new vehicles (through original equipment suppliers) and used vehicles (through replacement pads). Both the technical and timing information will be critical to achieving an effective copper control strategy.

Response: The San Diego Water Board appreciates the efforts put forward by the Brake Pad Partnership, and encourages the Partnership to work together with all identified dischargers to reduce copper loading in the Chollas Creek watershed. The San Diego

[10] Tetra Tech, Inc., Ross & Associates Environmental Consulting, Ltd., and EOA, Inc. 2000. Copper Action Plan, Final Report, June 2000. Prepared for the City of San Jose.

Water Board is optimistic that the 20 year TMDL schedule will work well with the efforts outlined by the Partnership above.

3. COMMENTS FOR MARCH 9, 2007 TMDL DOCUMENTS

3.1. Comments from Tershia d'Elgin (March 30, 2007)

Comment No. 74: As We've been talking with Chris Zirkle about dead-end streets in canyons and what to do about them. I'm a bit fuzzy about the limitations, but as Chris explained to me, the board has discretion on where the TDML applies, but under the current scheme, the City is only motivated to repair above the outflow. I guess the board has put forward language
http://www.waterboards.ca.gov/sandiego/programs/programs.html
(http://www.waterboards.ca.gov/sandiego/programs/programs.html)
that states that killing wetland vegetation by eliminating dry weather flows is a less than significant impact.

I can provide visual and data evidence that the present flows are contributing to sedimentation, headcutting, and pollution. Eliminating dry weather flows will only increase degradation when storms occur. We would like to encouraging BMPs in canyons to treat runoff (not UV filtration facility, obviously).

Response: The environmental documents do not state that "killing wetlands" is a less than significant impact. Habitat conversion which restores natural non-wetland habitat and removes exotic species dependant on pollutant laden nuisance flows is a less than significant impact. Various structural BMPs, such as infiltration, diversion, and equalization basins, will likely be incorporated in the Chollas Creek watershed. A probable long term outcome is the attenuation of peak flows during storm events. This reduction of peak flow will probably result in less sedimentation and headcutting, and pollution will also likely be reduced by the pollution cleaning functions of the structural BMPs. Therefore, any increase of sedimentation, headcutting, and pollution, due to decreases in nuisance flow dependant non-native plant propagation, will likely be offset by the reduction of peak storm flows and the pollution cleaning functions of the structural BMPs.

3.2. Comments from City of San Diego (April 9, 2007)

Comment No. 75: The City of San Diego would like to take this opportunity to express our appreciation to the Regional Board for reviewing our compliance schedule concerns and modifying the compliance schedule. On page 72, the modified compliance schedule is for all pollutants listed in the watershed. The City of San Diego is concerned that new pollutants listed in at the end of the proposed compliance schedule will be required to achieve compliance is a condensed time schedule.

Response: The San Diego Water Board has modified the compliance schedule based on the City's recommendation, which included the strategy to incorporated all water quality projects under the twenty timeline. Where feasible, new pollutants that are listed during the 20 year implementation schedule should be included within this timeline. Feasibility will have to be determined on a case by case basis.

Comment No. 76: The City has previously submitted substantial evidence documenting expert opinion of this issue. The Regional Board is required to prepare environmental analyses for the TMDLs to assess the impacts of implementing a reasonable range of alternative means of compliance. By understating magnitude of structural treatment facilities needed to comply with the TMDLs, the City believes that the existing environmental analysis does not fulfill the Regional Board's obligation under CEQA.

In summary, construction of hundreds of acres of structural treatment facilities, in conjunction with maximizing infiltration opportunities, will be necessary to comply with the required bacteria and metals load reductions. No evidence has been presented by anyone to suggest that solutions other than infiltration/diversion or treatment of entire rain events can result in compliance. The TMDLs allow no exceedences of load reductions regardless of storm size or duration; therefore, regardless of the treatment mechanism selected (grass swales, retention, biofiltration, sand filters, etc.), treatment facilities will need to incorporate acreage-intensive detention/equalization facilities because storm water cannot be treated as fast as rain falls from the sky – certain contact times are required. The significant impacts to existing development from construction of these treatment and equalization facilities has been previously documented and was calculated based allowing one exceedence every three years. The City suggests that the TMDLs include an exceedence frequency and that the Regional Board's environmental analysis include an analysis of the acreage required for treatment based on the exceedence standard. What storm size or exceedence frequency was used by Regional Board staff to calculate the costs of implementing the TMDLs?

Response: The evidence, in the form of the Weston report, submitted by the City outlines some of the challenges which will be faced in complying with the TMDLs. However, the Weston report presented very few options as solutions to the challenges. Securing dam permits (to increase basin depth and decrease basin size) as discussed in the response to comment No. 14, may be more reasonable than private property demolition to make room for large equalization basins.

No storm size or exceedance frequency was used to estimate the cost of implementing the TMDLS. Estimates in the substitute environmental documents were generated utilizing observed annual stormwater volumes in Chollas Creek. Base on the average volume, a cost to treat the entire annual volume was determined. This annual cost was divide by ten as a broad and convenient tool to aid dischargers in estimating the total required cost based on the 10^{th} portion of the urbanized watershed needing treatment. For example, if the discharger determines that 36 percent of the urbanized watershed will require treatment, then the cost based on the 10^{th} portion can be multiplied by 3.6 to obtain as reasonable cost estimate. Please see section 7 (Economic Factors) of Appendix I of the Technical Report, for additional details. In addition, please see answers to comment numbers 36 and 37.

Comment No. 77: The environmental analysis for both TMDLs states that the construction of treatment BMPs has the potential to displace crops, native biota, and existing land uses but suggests that these impacts can be avoided or minimized by locating treatment BMPs where these things are not present. However, all evidence presented dictates that compliance via treatment requires treatment facilities to be located close to and upstream of storm drain outfalls. Even if treatment facilities are built underground, structures cannot be re-built on top of them. Instead of indicating where treatment BMPs should not be located, the City suggests that the environmental analyses focus on where treatment BMPs may reasonably be located and evaluate the impacts of building treatment BMPs at those locations.

Response: The CEQA requires the San Diego Water Board to consider a reasonable range of specific sites in its analysis, but does not require us to speculate on the specific locations where the dischargers may or may not choose to build BMPs. However, in evaluating potential impacts of BMPs, we considered what those impacts might be in all land use types present in the watershed. We disagree that structures cannot be built on top of underground detention basins. Please also see answers to comment numbers 36 and 37.

Comment No. 78: The environmental analyses for both TMDLs identifies as a reasonably foreseeable means of compliance the diversion of dry weather flows to infiltration or sanitary sewer facilities. The current environmental analyses analyze the effects of this compliance mechanism on native, downstream wetland vegetation which is dependent upon these flows; however, the conclusion regarding the significance of this impact is not clear. Overall, the conclusion seems to be that the loss of wetland vegetation which would occur after dry weather flows are diverted is less than significant because remaining and replacement vegetation would be more similar to that which persisted prior to development (i.e., native, upland vegetation). This conclusion that the loss of wetland vegetation is not significant is inconsistent with State policy and the Regional Board's own 401 certification requirements. Have trustee agencies such as the California Department of Fish and Game were consulted on this conclusion? The City suggests that this issue be clarified in revised environmental analyses.

Response: Wetland vegetation dependant on nuisance flows in Chollas Creek is likely not "native." The San Diego Water Board 401 requirements derive from the Army Corp of Engineer's 404 certification requirements. The San Diego Water Board, as a certifying agency for the 404 program, has broad leeway in certification and mitigation requirements. Ensuring nuisance flow dependant non-native pest species plant propagation is not consistent with the San Diego Water Board 401 requirements.

We requested consultation with the California Department of Fish and Game (DFG) and the Air Resources Board, both trustee agencies with pertinent potential interest in these TMDLS. In discussions with Kelly Fisher at the DFG, she stated that constructing TMDL BMPs could be a possible concern depending on each case, and that the DFG would be involved for streambed alteration agreements and comment during CEQA review when dischargers actually design and site specific BMPs.

Comment No. 79: Page R-5/page 4 of the environmental analysis for the Bacti-1 TMDL/Chollas Dissolved Metals TMDL indicate that the environmental analyses do not require an examination of every site but a reasonably representative sample of them. Please describe the sample set of sites that were examined in the analyses.

Response: The substitute environmental documents evaluated specific sites where BMPs could be located, in each of the major land use types in the watershed, including residential, industrial, commercial, roadways and open space land uses. Please see section 6 (Reasonably Foreseeable Methods of Compliance at Specific Sites) of the Appendix I of the Technical Report, for more details.

Comment No. 80: Page R-10/Page 7 of the environmental analysis for the Bacti-1/Chollas Dissolved Metals TMDL indicate that sand filters are a good options in densely developed urban areas since the filters occupy minimal space. The City has submitted evidence that sand filters and equalization facilities that would be needed to achieve the Chollas Dissolved Metals TMDL would in fact occupy hundreds of acres of space in order to treat a 3-year storm. Please provide a reference for this statement and quantify the meaning of "minimal".

Response: The storm drain sand filters, located at the storm drain inlet occupy minimal space compared to other structural treatment controls at the end of storm drains. For example, the City based the sizing of the equalization basins at the end of storm drains on a 3 foot depth, neglecting to analyze deeper equalization basins in order to avoid securing a dam permit. Deeper equalization basins will decrease the overall BMP footprints.

Comment No. 81: While both environmental analyses note where treatment BMPs should not be built (on Prime Farmland, in special status species habitat, in areas developed with privately-owned land uses), neither analyses identifies where treatment BMPs could reasonably be built. This listing of suitable locations is critical to a determination of whether construction of treatment facilities would result in significant impacts.

Response: Avoidance is a standard mitigation measure, thus the analysis discusses where treatment BMPs should not be built. The San Diego Water Board is not required to speculate on where the discharger may or may not choose to construct BMPs. However, in discussing potential impacts, we considered constructing BMPs in all land use types.

Comment No. 82: Please clarify where compliance would be measured for both TMDLs. How would an evaluation of compliance take into account pollutants such as feral animal excrement and aerially-deposited metals that are allowed into receiving waters downstream of storm drain outlets?

How will compliance take into account the aerial deposition from mobile sources and that has been documented by the City? Some of this deposition occurs and is introduced into the storm water stream below storm drain outfalls. Does the Regional Board intend to establish a Load Allocation for this pollutant source?

Response: Please see answers to comment numbers 36 and 38.

Comment No. 83: Page R-19/page 15 of the environmental analyses for the Bacti-1/Chollas Dissolved Metals TMDLs indicate that short term construction impacts are not considered to be potentially significant. Why are these impacts considered less than significant on these pages and answered “less than significant” in the discussion section when mitigation measures, in the form of mufflers and lighting plans are recommended?

Response: Thank you for the comment. The designation “less than significant” has been changed to “less than significant with mitigation” in the substitute environmental documents.

Comment No. 84: Please clarify the significance determination for changes in native flora and fauna that would result from diverting dry weather flows from storm drain outfalls where the flora and fauna are dependent upon dry weather flows. How would the loss of dry weather flows and the concurrent loss of wetland vegetation affect the habitat-related beneficial uses in the receiving waters? How would the loss of native and vegetation due to diversion of dry weather flows affect temperature in the receiving water?

Response: The significance thresholds used to assess potential impacts to plants and animals are as follows: 1) No net reduction in native or beneficial (high value) plant species. 2) No net loss of number of plant species or area of natural pre-development habitat. 3) No barriers to native or high value plant communities and no introduction of non native species. 4) No net loss of native or beneficial animal species. 5) No deterioration of high value beneficial animal habitat compared to current conditions.

Habitat-related beneficial uses for Chollas Creek include Warm Freshwater Habitat (preservation and enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates), and Wildlife Habitat (preservation and enhancement of terrestrial vegetation, habitat, wildlife, or wildlife water and food sources). A reduction or loss of dry weather flows may affect the present habitats found in and near Chollas Creek. Wildlife use of the creek as a drinking water source may be impacted with flow reduction; however, improvements in the water quality of the remaining water in the stream should be beneficial to wildlife.

A decrease in the flow volume and flow duration during dry weather conditions most likely would return the stream ecosystem to a more natural, pre-development condition, which may include a reduction in total plant biomass, a change in the plant diversity (increase or decrease), or a decrease in certain non-native or invasive plant species.

The changes in plant species could positively or negatively impact wildlife. Loss of invasive or non-native plant species will allow space for native plant species to grow. The native wildlife species are adapted to the native plant communities which comprise wildlife habitat. They use the plant community for food and shelter for themselves and indirectly as food and shelter for their prey. In addition, the opportunity for restoration/enhancement of native plant species could be developed to benefit wildlife. If native plant communities naturally do not overtake the areas where biomass was lost, then restoration efforts should be considered.

A detailed explanation of how plant and animal species may respond to changes in stream flow during dry weather can be found in Appendix I, in the explanations to questions 4a and 4d.

Summertime dry weather flow in Chollas Creek that existed before extensive urban development in the watershed likely was supported by groundwater seepage into the channel. Since there is no groundwater development in Chollas Creek to lower the water table, dry weather base flow from groundwater seepage is likely to be at or higher than under pre-development conditions, due to a rise in the groundwater table from irrigation water recharge. Eliminating nuisance flows should not alter the dry weather flow in Chollas Creek due to groundwater seepage. Thus, reaches of Chollas Creek with perennial stream flow and riparian or wetland habitats should not diminish below pre-development levels.

Assuming that some flow remains in the stream, loss of vegetation may affect the stream temperature in two ways: by reducing canopy cover (if the vegetation lost is tall enough to shade the stream), or by reduction in flow from evapotranspiration. Vegetation that provides canopy cover will shade the water thereby preventing an increase in water temperature due to direct sunlight. Similarly, the shading will reduce the amount of evaporation in the stream, thereby maintaining a lower water temperature. Conversely, vegetation in and near a stream will absorb water from the stream or water table, which would then reduce the amount of water in a stream and increase water temperatures.

These temperature effects from reduced flows will be less than significant for Chollas Creek because pre-development conditions would not provide aquatic habitat during the dry season, and therefore, instream habitat would naturally be minimal or nonexistent during the dry season. Presently, species native to San Diego County may occur in Chollas Creek, but would not occur without anthropogenic sources. Net loss of native habitats or loss of species diversity will not be tolerated, as defined by the significance thresholds in the first paragraph of this response. Mitigation is expected for any losses that may occur due to this project.

Comment No. 85: Mitigation measures in the environmental analyses for both TMDLs specify maintaining dry weather flows for purposes of maintaining certain animal populations. What is the reasonably foreseeable means for maintaining these flows given that the flows must also comply with the WLAs?

Response: The substitute environmental documents for the Chollas Creek metals TMDLs do not require maintaining dry weather nuisance flow.

Comment No. 86: Both TMDLs provide cost estimates for compliance using a variety of structural and non-structural BMPs based on data from EPA and CASQA. What is the design storm or exceedence frequency assumed in the cost estimates listed? In one example, page 70 of the environmental analysis for the Chollas Creek Dissolved Metals TMDL refers to treating 29,072,731 cubic feet of storm water, referring to this quantity as an annual "average". However, the TMDLs do not limit compliance to an average year. How does the lack of a design storm/allowable exceedence frequency affect the cost calculation?

Response: The cost estimates were based on average annual measured flow volumes for Chollas Creek. Until a design storm is selected, the two approaches cannot be compared. However, the City's high range cost estimate of 900 million dollars in the Weston Report is similar to ours. Please also see the answer to comment No. 76.

Comment No. 87: Both environmental analyses reference the costs and effectiveness of Caltrans' BMPs. What was the storm size that the Caltrans BMPs were designed to and are they effective in wet weather. If they are effective in wet weather, please extrapolate the acreage required for the BMP and its equalization facilities to give a fair representation of the acreage required in the watersheds affected by the TMDL.

Response: The Caltrans BMPs referred to above were not extrapolated into BMP acreage requirement because of the potential variability in BMP design. However, all construction related adverse environmental impacts and mitigation has been provided. Please also see answers to comment numbers 76 and 80.

Comment No. 88: Given known data regarding water quality in the affected watersheds, what approximately is the percentage of a typical storm event that would need to be treated in order to comply with the TMDL? In other words, would "first-flush" treatment likely achieve loading requirements throughout a typical storm?

Response: CEQA does not require this level of detail. For a discussion on design storm please see the answer to comment number 2.

Comment No. 89: In discussing impacts to population and housing, the environmental analysis for both TMDLs recommends evaluating and implementing more reasonable alternatives such as nonstructural BMPs and low impact and/or small scale BMPs before considering an alternative that would create considerable hardship for the community in the area. This is what the City proposed in its September, 2006 correspondence; however, the City concluded that such efforts would most likely not result in compliance. Please expand on how the Regional Board envisions that this means of compliance would roll out given the interim compliance goals.

Response: If the dischargers choose this BMP approach, how it would roll out depends on how quickly the dischargers conduct feasibility studies, select sites for implementation, and secure financing for construction. If this approach does not result in compliance, the City of San Diego would have to combine this approach with other BMP alternatives.

Comment No. 90: Is it possible to increase the WLAs for either TMDL (i.e., as a result of new Site Specific Objectives, change to beneficial uses, results of implementing a tiered approach, completion of the bacteria reference study) after the TMDL is incorporated into the San Diego Municipal permit?

Response: Yes it is possible to increase the WLA after the TMDLs are incorporated into the municipal stormwater requirements as a result of new site specific objectives, or a change to beneficial uses. TMDLs and WLA would be recalculated and incorporated into the Basin Plan, after which, the WQBELs in the municipal stormwater requirements would be revised. NPDES regulations [40 CFR section 122.44(l)(1)] prevent backsliding unless the circumstance upon which the previous permit was based have materially and substantially changed since the time the permit was issued. New site specific objectives, or a change to beneficial uses would qualify as a material and substantial change of circumstance so less stringent WQBELs could be allowed.

Comment No. 91: When is it anticipated that the TMDLs will be incorporated into the San Diego Municipal permit?

Response: No later than the next re-issue of those Waste Discharge Requirements.

Comment No. 92: The City requests that both TMDLs include a re-evaluation provision so that the need for the final WLAs can be formally re-evaluated after non-structural and less-intensive BMPs are evaluated for their maximum effectiveness.

Response: TMDLs are adaptive. Together with compliance monitoring, SCCWRP studies, TetraTech modeling studies, better characterization of hardness, and other new water quality information, we anticipate the need to re-evaluate the TMDLs, including the WLAs and changing from concentration based TMDLs to ones that are load based.

We recognize that it is in the City's best interest to re-evaluate pertinent concerns before capital resources are committed to design and build structural BMPs. However, because we don't know when we will have enough new data to justify re-evaluating the TMDLs, or what our TMDL priorities will be in the future, we do not include a re-evaluation provision in the Implementation Plan.

Comment No. 93: Page R-61/page 57 of environmental analyses for the Bacti-1/Chollas Dissolved Metals TMDLs indicates that the analyses do not analyze all possible means of compliance because alternative means of compliance consist of the different combinations of BMPs that dischargers might use and there are innumerable ways to combine BMPs. The preceding is correct in that the analyses not include combinations of BMPs that are not expected to result in compliance with the WLAs in the TMDLs. However, the analyses unfortunately do not list any single BMP or combinations of BMPs that 1) are documented to result in the required load reductions and 2) will not have significant impacts by displacing existing development. Please list a single combination of non-structural and less-intensive BMPs that will result in compliance with the Bacti-1 TMDL and, for the Chollas Creek watershed, both TMDLs.

Response: The substitute environmental documents contain sufficient information and analysis for the public to understand the potential adverse environmental impacts of the project, including the impacts from any possible combination of BMPs, and to provide the San Diego Water Board with meaningful discussion and comment on these impacts. The CEQA does not require the level of detail requested in the comment for a planning level analysis. The dischargers are responsible for determining the specific BMPs that will be implemented at specific locations, and for evaluating the potential site specific environmental impacts of those BMPs. Because the size of BMPs can be minimized through the types of BMPs selected, and engineering solutions exist to minimize the footprint of BMPs, displacement of existing development will not like be on a scale that will cause significant environmental impacts.

Comment No. 94: Why is there such a large discrepancy between the cost estimates in the Chollas Creek watershed to comply with the two TMDLs (Tables R-3 and I.2)? As suggested previously, the environmental analyses for the TMDLs should address the cumulative effects of both TMDLs (in terms of cost insofar as such an analysis is required, but certainly in terms of environmental impacts).

Response: Cost discrepancy between Tables R-3 and I.2 come from utilizing different sources for cost reference. Cost estimates can differ significantly. For example, a sand filter built by Caltrans is much more robust in design and construction (therefore more costly), compared to a small sand filter retrofit for a city street. Where the same sources were utilized in the two tables (i.e., diversion structures), the cost indicated for Chollas watershed are identical.

Comment No. 95: The City is requesting that San Diego State University and any other universities and colleges be notified to participate in these TMDLs and the Phase II Municipal Storm Water Permit program.

Response: The implementation plan was revised to require the enrollment of all small MS4 owners/operators in the Chollas Creek watershed, immediately upon adoption of these TMDLs. In Chollas Creek, these persons are the La Mesa, Lemon Grove, and San Diego School Districts. Please see section 11.5 of the Technical Report. This section states that the San Diego Water Board shall require the school districts to submit Notices of Intent to comply with the requirements of Order No. 2003-0005-DWQ, the General NPDES requirements for the discharge of stormwater from small MS4s.

Comment No. 96: Page 6 of the environmental analysis for the Chollas Dissolved Metals TMDL states that certain BMPs were not considered as an option because they would require condemnation and demolition of large areas of private property and that cheaper and smaller BMPs are available to meet the WLAs of the TMDL. A number of various BMPs are then listed. Please provide citations showing that the BMPs listed, or combinations of the BMPs listed, will achieve the WLA of the TMDL and the acreage required for their construction.

Response: Please see the response to comment No. 93.

Comment No. 97: Page 7 of the environmental analysis for the Chollas Dissolved Metals TMDL does list removal efficiencies for bioretention facilities that would appear to result in TMDL WLA compliance. City staff followed up with the professor who conducted the experiments referenced by Regional Board staff. In order to achieve metals removal in the range of 95%-97%, the flow rate through the bioretention facility was an order of magnitude slower than the flow rate estimated by the City for sand filters. Please provide the acreage required for bioretention facilities, including the required equalization facilities, to comply with the TMDL.

Response: As discussed in the response to comment no. 2 and elsewhere, specific BMP design features such as acreage requirements are beyond the scope of our analysis. The discharger will be responsible selecting appropriate site specific BMPs and for evaluating site specific environmental impacts.

Comment No. 98: At what point of the approval process does the implementation period (e.g., 20 years for the Chollas Dissolved Metals TMDL) begin?

Response: Upon approval of the metals TMDLs by the Office of Administrative Law.

Comment No. 99: Please resolve the discrepancy in the environmental analysis for the Chollas Creek Dissolved Metals TMDL on page 71 where compliance via sand filters is estimated at $1.19 billion and Table I.2 where compliance via sand filters (assuming 100% treatment) is estimated to cost $150 million.

Response: Cost estimate can vary. We have provided two estimates, for sand filters in Appendix I, one from USEPA, and one from Caltrans for the more expensive Austin sand filter. The actual cost estimates will have to be determined by the discharger based on site specific factors prior to BMPs construction.

Comment No. 100: Page 26 of the environmental analysis for the Chollas Creek Dissolved Metals TMDL describes flood hazards that could occur if BMPs are not properly designed and constructed to allow for bypass of storm water that exceed design capacity. What storm size is it expected that BMPs will be designed to?

Response: Please see the answer to comment No. 2.

Comment No. 101: Based on the City's recently-submitted aerial deposition study, we disagree that, aerial deposition is only a "potential" source of pollution (page 2 of the Chollas Creek Dissolved Metals Technical Report), that aerial deposition is "not considered significant at this time" (Ibid, page 7). The subject study, though not peer-reviewed, constitutes "substantial evidence" that aerial deposition plays a major role in Chollas Creek.

Response: The Technical Report concludes that direct aerial deposition of metals into Chollas Creek is not a significant source of metals because the surface area of Chollas Creek is so small compared to the rest of the watershed. Aerial deposition of metals throughout the watershed is likely a source of metals that are washed off the land surface and conveyed to Chollas Creek via MS4s.

3.3. Comments from Sierra Club (April 9, 2007)

Comment No. 102: We recommend that 10 year alternative compliance schedule be adopted instead of the preferred alternative 20 year compliance schedule for the metals in Chollas Creek for the reasons explained below.

The primary reason is that the extended schedule will conflict with the RWQCB Cleanup and Abatement Order for the shipyard site sediments. These sediments are just north of Chollas Creek and are highly contaminated with copper, zinc and other trace metals. We expect that the shipyard cleanup will be completed before the 20 year Chollas Creek compliance schedule. Cleanup of the shipyard sediment requires that recontamination by additional metals loading must not occur. The 20 year Chollas Creek metals TMDL compliance schedule would allow copper, lead, and zinc to be discharged into the bay, be transported to the shipyard site well after the shipyard sediments have been cleaned up, and re-contaminate the shipyard site. This is clearly not acceptable.

Response: Achieving 80 percent compliance with the WLAs by year 10 of the compliance schedule should ensure that dissolved copper concentrations in San Diego Bay at the sediment cleanup sites are low enough not to cause dissolved metals to flux from the water column into the sediment. Therefore, the extended compliance schedule likely will not impact sediment cleanup.

Comment No. 103: The second reason is that the 20 year compliance schedule has not been adequately justified. The Reasonable Alternatives to the proposed activity in are presented in Section 8 of Appendix I Environmental Analysis, Checklist, and Economic Factors. Two alternative compliance schedules are given; the ten year schedule alternative for metals load reduction only and the 20 year compliance schedule for metals, bacteria, diazinon, and trash. The reason provided for the longer 20 year compliance schedule is to allow time for the discharger to integrate BMP planning, design and implementation to reduce the bacteria, diazinon and trash loading. Table 16.1 lists the public participation milestones. The first workshop took place in August 1999 almost 8 years ago. The initial draft TMDL was released in March of 2005. We attended the May 18, 2005 informal meeting of interested parties to discuss the compliance schedule and supported the 10 year compliance schedule. We believe that there has been ample time already to begin planning. It does not seem reasonable that the time to implement the diazinon TMDL would justify some of the increased schedule because It EPA has ordered the phase out and stopped retail sales of diazinon effective on December 31, 2004. Just exactly how the trash TMDL justifies the extended compliance schedule is not given.

Response: The diazinon TMDL was included because opportunities may exist to coordinate education and outreach on integrated pest management, trash reduction, pet waste reduction, and elimination of nuisance flows. Likewise, compliance monitoring for all of these water quality programs could be integrated to increase efficiency and effectiveness and lower costs. Trash is a major concern for the Chollas Creek watershed, and coordinating BMP implementation to include trash abatement is consistent with the San Diego Water Board mission. The potential high cost of TMDL implementation estimated in the substitute environmental document, roughly agrees with that estimated in the City of San Diego's Weston report. Based in part on this, and the potential for BMP coordination to eliminate uncertainties, a 20 year compliance schedule is justified.

3.4. Comments from San Diego Coastkeeper (April 18, 2007)

Comment No. 104: Our organization wrote letters of concern dated September 25, 2006 and February 12, 2007 stating our sincere hope that the Regional Water Board would comply with the State Board's request for the Regional Board to comply with the remand for the noticing requirements within three months. Unfortunately the Regional Board has decided to forego our concerns and further postpone the TMDL adoption process by unexplained delays, creation of substantive changes, and doubling the compliance schedule.

Almost within the same breath of State Board Chair Doduc's request for the Regional Board to comply with the noticing requirements within three months, Boardmember Baggett's suggested amendment that the remand be amended to allow additional TMDL compliance time pursuant to similar TMDL time schedules was voted down. Again, this means that the Regional Board was only required to revise the remanded portions of the TMDL, specifically noticing and re-circulation under CEQA, and not reinvent the provisions or timeline for implementation.

Response: Although we were not required to revise the TMDLs' Technical Report in any way, only recirculate it to cure a deficit in our adoption process, we did so for two reasons. First, we revised Appendix I to be consistent with the Court of Appeals' interpretation of the CEQA requirements for certified regulatory programs in the Court's decision on the City of Arcadia vs. State Water Resources Control Board case. Second, in the fall of 2006, the City of San Diego proposed the 20 year compliance schedule for integrated bacteria and metals BMP planning and integration. Along with the proposal, the City of San Diego provided compelling evidence that integrated planning and implementation would be more effective and efficient, would help keep costs down, and would minimize adverse environmental impacts from construction projects. To minimize the water quality effect of extending the compliance schedule from 10 years to 20 years, the San Diego Water Board added the interim milestone of an 80 percent reduction in 10 years.

Comment No. 105: Coastkeeper is extremely concerned and disappointed as the Regional Board's revisitation and revision of the TMDL doubles the compliance schedule from ten years to twenty. Had the Regional Board adopted the TMDL as per the State Board's request, implementation could be beginning. It is in the interest of all parties to anticipate consistency and certainty of decisions. By revisiting the TMDL and fundamentally changing its temporal effect, the Regional Board's actions are only continuing to delay the cleanup process. We also fear the path this TMDL took will discourage the kind of collaborative process between stakeholders that led to the initial compliance timeline.

Response: Please see response to comment No. 104.

Comment No. 106: While we disagree with the expansion of the compliance schedule and though we still believe the ten year timeline was aggressive yet fair, we do take note of and appreciate that 80% of the implementation will be completed within the first ten years. We are working with the City of San Diego to help them find pilot projects and technical solutions to meet the required reductions. We look forward to the final adoption and implementation of the TMDL at the meeting on April 25th, and will be available to address concerns during the hearing.

Response: Thank you for the endorsement. The San Diego Water Board appreciates all efforts to move the Chollas Metals TMDLs forward.

3.5. Comments from Caltrans (April 24, 2007)

Comment No. 107: The California Department of Transportation (Department) believes that the proposed compliance schedule in the Basin Plan Amendment would be significantly improved if it implemented measures to investigate important issues that are not sufficiently understood. Below is the Department's proposed approach to meet the water quality targets for copper, lead and zinc. We suggest three phases – Investigation, Pilot BMP Research, and Implementation.

Investigation – The first phase is an investigation phase to allow the Department to work with other stakeholders to develop an approach that would achieve the largest impact without duplicating funds and efforts. The Department proposes to work cooperatively with the stakeholders in public education, source control BMPs, and studies to better understand the, source of metals loadings, transport of the loads, effect of aerial deposition, and relationship between the total recoverable and dissolved metals in storm water and within the bay, (and) assimilative capacity of Chollas Creek with respect to the listed metals.

The Department, along with stakeholders, will work cooperatively with the Air Quality Management District (AQMD), Air Resources Board (ARB), and the U.S. Environmental Protection Agency (USEPA) on programs to address atmospheric deposition within the watershed.

Pilot BMP Research – The second phase will consist of piloting new technologies within the watershed to find a technically feasible BMP that will reduce pollutant concentrations to the variable levels required in the TMDL. In this phase, the Department proposes to build upon and refine initial BMP design. Consistent with the Department's BMP evaluation protocol, a minimum of three years of pilot BMP Monitoring will be conducted to obtain sufficient information to evaluate the BMP to ensure effective reduction of metals to concentration levels required in the TMDL.

Implementation – After successful piloting of a technically feasible BMP, the third phase will consist of a three-part implementation plan. Each phase will consist of siting, design, and construction of BMPs to meet the Department's compliance needs. Implementation may begin with installation of BMPs within "hot spot" priority locations within the watershed.

Response: The San Diego Waterboard appreciates Caltrans' willingness to cooperate with the other dischargers in the Chollas Creek watershed. However, the proposal in the comment contains detail more appropriate for the pollution load reduction plan to be submitted by the dischargers following adoption of these TMDLs.

Comment No. 108: Clarification of impaired segments – The Department has concerns with the statement in the March 9, 2007 draft Technical Report that states:

While only the lowest 1.2 miles of Chollas Creeks comprise the actual impaired and listed segment of the waterbody, all upstream tributaries to this section are considered in this TMDL because they deliver metals loads to the lower segments.

The 2002 303(d) identified the lower 1.2 miles, and the 2006 303(d) list identified the lower 3.5 miles of Chollas Creek as impaired for copper, lead, and zinc. Consistent with the TMDL policy and guidance, TMDLs should address waters identified by the State as waters.

…for which the effluent limitations required by Section 1311(b)(1)(A) and Section 1311(b)(1)(B) of this title are not stringent enough to implement any water quality standard applicable to such waters. (Titlte 33, U.S.C.A., Section 1313(d) [Clean Water Act Section 303(d)])

The lower 3.5 miles of the Chollas Creek has been identified on the State's 303(d) list of impaired waters. The TMDL and WLAs for Chollas Creek should therefore only apply to the 3.5 miles in the watershed listed as impaired. In addition, the staff report statement provided above, that refers to the lower 1.2 miles should be revised to the 3.5 miles of Chollas Creek identified in the 2006 303(d) list as impaired.

Response: Thank you for the comment. The Technical Report was revised to include the additional 2.3 miles. However, applying the TMDLs and WLAs watershed wide is appropriate because metals sources causing the impairment in the lower 3.5 miles of Chollas Creek may originate upstream of the reach designated as impaired. If receiving water quality is meeting standards upstream of the segment listed as impaired, then focusing on reducing metals loading in the lower 3.5 miles of Chollas Creek may be appropriate.

Comment No. 109: Numeric Targets – Water Effects Ratio – Water effects ration is a site specific eco-toxicological coefficient. The TMDL assumes a water effects ratio of 1, meaning that all of the measured metals are biologically available and toxic. This assumption may drastically overstate the actual toxicity of the concentrations that are observed onsite. A site-specific eco-toxicological evaluation of the water effects rations at Chollas Creek should be undertaken to ensure the accuracy of the aquatic life criteria. Lee and Jones-Lee (2000) assert a basic problem with use of the USEPA water quality criteria to form discharge limits. The criteria fail to properly incorporate the aquatic chemistry of the constituents. Further, ambient waters and their sediments contain a wide variety of constituents that detoxify or immobilize the available toxic forms of pollutants, such as heavy metals.

Response: A site specific WER has not been developed for Chollas Creek. Until a site specific WER is available, the metals TMDLs must use a factor of 1 as detailed by USEPA. If a site specific WER for Chollas Creek were developed, these TMDLs could be recalculated. A WER for Chollas Creek could be proposed as a Basin Planning Project in the next Triennial Review of the Basin Plan, however, with our limited resources and Regional priorities, this project may not receive funding for some time. Alternatively, the dischargers are free to initiate the studies. Please see the Technical Report section 4.2 and Appendix H for more details.

Comment No. 110: Numeric Targets – Target Concentration – We are also concerned with the target concentration levels that are presented in the staff report. The target concentration levels are a function of the hardness values equating to lower target concentrations. Treatment technologies, however, have not been developed that will achieve the waste load allocations that are required for targets at low hardness values. To clarify our previous comment that the concentrations cannot be met with current technology, we are attaching four graphs to this letter.

Figure 1 – Copper Acute and Chronic Conditions, shows the concentration for copper that must be met for the range of hardness values for both acute and chronic conditions. The horizontal line shows the copper concentration of 10mg/L for the treated highway effluent from the sand filter. The sand filter will not meet the acute concentration when the hardness is less than 82 mg/L and will not meet the chronic condition when the hardness is less than 129 mg/L. For reference, a vertical line at 81 mg/L is shown for the average hardness within Chollas Creek (from Appendix A of the TMDL documents). At that hardness of 81 mg/L, available treatment technology for metals reduction, such as sand filters, will not adequately reduce copper concentrations to either of the TMDL limits.

In Figure 2 – Lead acute conditions, the horizontal line shows the lead concentration of 3 mg/L for sand filter effluent. The sand filter will not meet the lead acute concentration when the hardness is less than 8 mg/L.

Figure 3 – Lead Chronic Conditions, shows the concentration for lead that must be met for given hardness values for the chronic condition. The horizontal line shows the lead concentration of 3 mg/L for sand filter effluent. The sand filter will not meet the lead chronic concentration when the hardness is less than 130 mg/L. At average hardness of 81-mg/L sand filter will adequately reduce lead concentrations below acute conditions but not for chronic conditions.

Figure 4 – Zinc Acute and Chronic Conditions, shows the concentration for zinc that must be meet for given hardness values for both acute and chronic conditions. The horizontal line shows the zinc concentration of 47 mg/L for sand filter effluent. The sand filter will not meet the zinc acute or chronic concentration when the hardness is less than 39 mg/L. At the average hardness of 81-mg/L, sand filters will adequately reduce lead concentrations below both TMDL limits.

Response: The San Diego Water Board can not dictate what BMPs that will eventually be used by the dischargers. Whether or not to use sand filters is a determination at the project level, after the specific site has been fully investigated and evaluated. The potential significant cost estimated in the substitute environmental document roughly agrees with that estimated in the City of San Diego's Weston report. Based in part on this, and the potential for BMP coordination to eliminate uncertainties, the implementation schedule has been doubled from 10 years to 20 years.

Comment No. 111: BMP Cost Estimates – The staff report misrepresents the Department's report ID CTSW-RT-01-050 (2004) estimates of infiltration trench cost. Table E.6 of the staff report estimates that the cost to implement infiltration trenches to treat 10% of the load from Urbanized Areas would be $170 million (capital costs), with O&M costs of the infiltration trenches at $720,000 per year. In addition, the O&M costs for the Austin Sand Filters are estimated at $2,000,000 per year. These estimates are inaccurate. The calculations should be based upon the adjusted cost estimates presented in Table 3 of the Department's report that accounts for "generic retrofit costs that could reasonably applied to other BMP retrofit projects".

Response: Thank you for the comment. Corrections were made to the cost estimates in Appendix I.

3.6. Comments from John W. Stump (April 25, 2007)

Comment No. 112: John Stump, resident of the Chollas Lake area asserted in oral testimony that subsurface water from Chollas Lake is impacting the closed Chollas Landfill area and also potentially impacting Chollas Creek. Mr. Stump stated that staff should investigate this assertion from the available information.

Response: The Chollas Creek metals TMDLs already addresses the South Chollas landfill as a potential metals source and calls for a revision to Order No. 97-11 to require groundwater monitoring for metals below and near the landfill. Please see section E. 10 Implementation Plan, of the Technical Report. If the monitoring results show metals in groundwater in excess of the WLA, the next step would be an investigation to determine potential pathways from groundwater to Chollas Creek, and/or revisions to the WDRs for the landfill.

3.7. Comments from the City of San Diego (April 25, 2007)

Comment No. 113: Type of BMPs Required – Is it expected that compliance with both TMDLs can be achieved without using treatment BMPs or infiltration?

Response: Based on the current information we've reviewed, no.

Comment No. 114: Size of BMPs Needed to Comply – What treatment capacity should be assumed in designing and building treatment BMPs for bacteria and dissolved metals? Is the 85^{th} percentile storm adequate or should both TMDLs provide for a certain frequency of allowable exceedances?

Response: Designating design criteria for structural BMPs is an important consideration, but is beyond the scope of these TMDLs. This important topic should be investigated by the San Diego Water Board and stakeholders as early as possible in the TMDL implementation phase.

Comment No. 115: Potential Locations for BMPs – Where can treatment BMPs can be built – in receiving water or must they be built above storm drain outfalls? Are areas immediately below storm drain outfalls typically considered to be receiving water/Water of the State? If this answer can only be determined on a case-by-case basis, what factors will be analyzed and how will these factors be used?

Response: Please see the response to comment No. 36.

Comment No. 116: How did size and location fit into the Regional Board staff cost estimates for different BMPs identified?

Response: Size of BMPs and location were not considered in our cost estimates. The cost estimates were based on average annual observed flow volumes for Chollas Creek.

Comment No. 117: Compliance – Will compliance be monitored at outfalls, in areas of the watershed listed as impaired, or both?

Response: Designating where TMDL compliance will be measured is beyond the scope of these TMDLs. Please see the response to comment No. 36 for a discussion of some general approaches to compliance assessment that the San Diego Water Board could take.

Comment No. 118: Re-evaluation – Should both TMDLs include a “re-evaluation” provision so that we can evaluate the effectiveness of the City of San Diego’s preferred compliance strategy in five years?

Will anti-degradation provisions restrict us from relaxing the final Wasteload Allocations if future re-evaluations, reference studies, or Basin Plan amendments show that the Allocations should be increased. What is the policy for adopting TMDLs before these issues have been resolved?

Response: The San Diego Water Board can increase the WLA after the TMDLs are incorporated into the San Diego Municipal stormwater requirements as a result of new site specific objectives, a change to beneficial uses, or a refinement of the TMDLs based on new data. NPDES regulations [40 CFR section 122.44(l)(1)] prevent backsliding unless the circumstance upon which the previous permit was based have materially and substantially changed since the time the permit was issued. New site specific objectives, a change to beneficial uses, or a refinement of the TMDL based on new information would qualify as a material and substantial change of circumstance. Please also see response to comment No. 92.

3.8. Comments from the City of San Diego (May 29, 2007)

Comment No. 119: 1. The City continues to request that the Regional Board explicitly recognize in its CEQA documentation that treatment and/or diversion (e.g., via infiltration) of storm water will be required to comply with the proposed load reductions given the ubiquitous, legal, and uncontrollable sources of the pollutants. While Board staff has taken a step closer to doing this by listing these strategies as reasonably foreseeable, the impact analysis of this construction is inadequate.

Response: Our level of analysis, in the substitute environmental documents, is sufficient to disclose the level of impacts of the project and provide a forum for meaningful public discussion and comment on those impacts, including the impacts from any possible combination of BMPs. CEQA does not require the level of detail requested in the comment for a planning level analysis. The dischargers are responsible for determining the specific BMPs that will be implemented at specific locations, and for evaluating the potential site specific environmental impacts of those BMPs.

Comment No. 120: 2. The City continues to request that the Regional Board provide specificity on how compliance will be evaluated in terms of the number of Notices of Violation and/or fines that dischargers would be subject to if compliance is not obtained (e.g., one fine per outfall per day, one fine per tributary, one fine per gallon). I am pleased that the compliance issue with regard to where compliance would be measured (e.g., at storm water outfalls and/or locations downstream) as described in number 5 below.

Response: Please see the responses to comment Nos. 36 and 123.

Comment No. 121: 3. The City continues to request that the Regional Board dictate a design storm or allowable number of exceedences in the Bacteria-1 TMDL. Such an allowance is now recognized as at least a planning goal in the Chollas Creek Dissolved Metals TMDL as one exceedence every three years since this frequency is allowed by the California Toxics Rule; however, the Bacteria-1 TMDL provides no such guidance from the state or federal government. Without this direction, the City is unable to design with certainty towards compliance its treatment and infiltration facilities and the Regional Board is unable to evaluate the environmental impacts of building the facilities. Moreover, since the Technical Report for the Chollas Creek Dissolved Metals TMDL indicates that 99.7% of the metals loading occurs during wet weather (page 35) and since the bacteria TMDL allows for zero anthropogenic-related bacteria, it is clear that treatment and/or infiltration of wet weather flows will be essential to compliance.

Response: Please see response to comment No. 2.

Comment No. 122: 4. The City has prepared a reasonable ‘Tiered” approach to implement the TMDLs. The approach entails implementing, as experiments, various combinations of non-structural BMPs, and structural BMPs on public property and voluntary incentive programs for private property owners. The goal of this part of the approach is to 1) determine whether, contrary to existing data, widespread treatment and/or infiltration of storm water is not required to comply with the TMDLs and 2) determine the maximum effectiveness of these Tier I and II in order to minimize the impacts of constructing Tier III (infiltration and treatment) BMPs on developed and privately owned land. The City requests that the Regional Board commit to a formal re-evaluation provision in the TMDL to that final load reductions and compliance strategies can be re-assessed after collecting data from Tier I and Tier II efforts.

Response: Please see response to comment No. 92.

Comment No. 123: 5. Regional Board staff has made a number of statements (referenced in previous comments) which provide a de facto prohibition on building treatment or infiltration works below storm drain outfalls for purposes of complying with the TMDLs. The City asks that the Regional Board formally state its position on where BMPs can be located to comply with these TMDLs.

Response: Please see response to comment No. 36.