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FINAL:

Implementation Report for the
Recalculation of the Acute Zinc
Criterion in the Los Angeles River,
Ballona Creek, and Dominguez
Channel Watersheds

Developed for:

CITY OF LOS ANGELES SANITATION AND ENVIRONMENT

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science | policy | solutions

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Appendix 1. List of Study Waterbodies

List of Acronyms and Abbreviations

Basin Plan	Los Angeles Region Water Quality Control Plan
BLM	Biotic Ligand Model
BMP	Best Management Practice
CASQA	California Stormwater Quality Association
CCC	Criterion Continuous Concentration
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMC	Criterion Maximum Concentration
CTR	California Toxics Rule
FAV	Final Acute Value
FMB	Fixed Monitoring Benchmark
GLEC	Great Lakes Environmental Center
GMAVs	Genus Mean Acute Values
IWQC	Instantaneous Water Quality Criteria
LA	Los Angeles
LACFCD	Los Angeles County Flood Control District
LAs	Load Allocations
LASAN	City of Los Angeles Sanitation and Environment
MES	Mass Emission Station
MS4	Municipal Separate Storm Sewer System
NGO	Non-governmental Organization
NPDES	National Pollutant Discharge Elimination System
POTWs	Publicly Owned Treatment Works
RWLs	Receiving Water Limitations
Regional Board	Los Angeles Regional Water Quality Control Board
SC	Stakeholder Committee
SCCWRP	Southern California Coastal Water Research Project
SCWP	Safe Clean Water Program
SIP	State Implementation Policy
SMAVs	Species Mean Acute Values
SSD	Species Sensitivity Distribution
SSO	Site-Specific Objective
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
USEPA or EPA	United States Environmental Protection Agency
WER	Water Effect Ratio
WMPs	Watershed Management Programs
WQC	Water Quality Criteria

EXECUTIVE SUMMARY

Water quality and the protection of aquatic ecosystems are important priorities in the Los Angeles (LA) region. Regulatory requirements established by the Los Angeles Regional Water Quality Control Board (Regional Board), State Water Resources Control Board (SWRCB), and United States Environmental Protection Agency (USEPA) define the pollutants that need to be addressed to protect beneficial uses and determine how resources are prioritized and allocated. These regulatory requirements are based on water quality criteria (WQC) that establish the levels of specific pollutants that can be present in the LA region's creeks, rivers, and marine waters while still protecting beneficial (e.g., recreation, warm freshwater habitat). The strategies for managing water quality are therefore designed around meeting WQC, particularly when prioritized through Total Maximum Daily Loads (TMDLs) and National Pollutant Discharge Elimination System (NPDES) permits. Accurate and appropriate WQC are therefore critical to ensuring that resources are applied to the most important water quality issues and that the proper strategies and actions are taken to address these issues.

Exceedances of the California Toxics Rule (CTR) WQC for zinc are observed in multiple waterbodies in the LA region and indicate that aquatic life beneficial uses may be impaired. In response to these exceedances, TMDLs have been established that outline the reductions in zinc loading needed to meet WQC and protect beneficial uses in multiple watersheds, including the LA River, Ballona Creek, and Dominguez Channel watersheds. While the TMDL targets based on the CTR chronic zinc criterion are consistently met at the mass emission stations (MES) in these watersheds during dry weather, exceedances of the CTR acute dissolved zinc criterion are consistently observed during wet weather. Achieving the load reductions in stormwater runoff required to attain the CTR acute criterion and achieve the TMDLs during wet weather is a significant challenge and a key driver of implementation actions to improve water quality. Stormwater dischargers are actively implementing programs and projects identified in Watershed Management Programs (WMPs) to reduce the discharge of zinc and other pollutants from developed areas into LA region waterbodies. Additionally, efforts are underway to evaluate and potentially regulate the use of zinc in tires, which are believed to be a significant source of zinc in runoff from road surfaces (CASQA, 2015).

Existing TMDLs and the implementation actions planned to address exceedances, however, are based on an acute zinc water quality criterion that is over 25 years old. Since the existing criterion was developed, a significant amount of new, peer reviewed data have been collected pertaining to zinc toxicity to aquatic life. Based on the new data available and consideration of site-specific factors, changes to the zinc criterion may be appropriate. To support an evaluation of the existing acute zinc criterion, the City of Los Angeles Sanitation and Environment (LASAN) Watershed Protection Division recently completed a Scientific Study to evaluate and, if appropriate, propose an update to the acute zinc water quality criterion (henceforth, Study). The purpose of this *Implementation Report for the Recalculation of the Acute Zinc Criterion in the Los Angeles River, Ballona Creek, and Dominguez Channel Watersheds* (Implementation Report) is to provide information to document how the Study can be used to adopt a site-specific objective (SSO) for

zinc into the Water Quality Control Plan for the Los Angeles Region (Basin Plan), amend TMDLs in the Study watersheds, and modify the Municipal Separate Storm Sewer System (MS4) NPDES Permit (currently Order No. R4-2021-0105 herein referred to as the LA Regional MS4 Permit).

The zinc SSO was developed consistent with USEPA guidance, has been reviewed by an independent Technical Advisory Committee, received input from a Stakeholder Committee, and is as protective of aquatic life as intended by the CTR and the TMDLs addressing zinc in the Study watersheds. The USEPA developed and published national aquatic life WQC for zinc in 1980. The national zinc criteria was updated in 1987 (1987 Criteria) to be based on the dissolved fraction of zinc rather than the total fraction (USEPA, 1980; USEPA, 1987). The national zinc criteria were updated again through the “1995 Updates: *Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*” (USEPA 1996; herein referred to as the 1995 Criteria Update). The 1995 Criteria Update, which forms the basis of the CTR zinc criteria, only incorporated two new acute toxicity data points into the national dataset rather than incorporating all available toxicity data developed after the 1987 Criteria were developed. Studies not previously considered in the 1995 Criteria Update provide additional information for previously tested species, new information on additional species, and new information on how water quality conditions impact the toxicity of zinc to aquatic life. These studies and the additional knowledge they provide create a need to periodically update the criteria.

The zinc SSO was derived using the USEPA’s Recalculation Procedure. The Recalculation Procedure is a method for adjusting the national toxicity dataset by incorporating more recent studies and adjusting for species that are present in the waterbodies of interest. The Recalculation Procedure was used to develop water quality criteria for zinc in the urbanized portions of the freshwater waterbodies in the LA River, Ballona Creek, and Dominguez Channel watersheds. All toxicity data used to derive USEPA’s 1995 Freshwater WQC for zinc, which forms the basis for the CTR zinc WQC and the Metals TMDLs targets, were considered along with additional toxicity data developed after the USEPA WQC document was completed.

To gather the additional zinc toxicity data, a literature search was conducted using USEPA’s Ecotox database, Science Citation Index, and Google Scholar. Studies were reviewed to determine their relevance and assessed for quality consistent with USEPA guidance and practice. Accepted data were compiled into an updated acute zinc toxicity dataset. Biological community data for the Study Area were gathered from a variety of sources to 1) identify resident taxa in the Study Area to ensure they are represented in the toxicity dataset, and 2) support an evaluation to ensure the protection of “Species of Interest”¹. The species in the updated dataset were then compared to the biological community data. All tested species found in the acute dataset that are also resident in the Study Area were included in the site-specific toxicity dataset. All the resident species, which were not a tested species, were then matched with one or more surrogate species from the remaining tested species using the USEPA Deletion Process (USEPA, 2013).

¹ Commercially or recreationally important species, threatened or endangered species, and State Species of Concern and Candidate species are collectively referred herein as “Species of Interest”

The USEPA guidelines for criteria derivation state “*When enough data are available to show that acute toxicity to two or more species is similarly related to a water quality characteristic, the relationship should be taken into account*” (USEPA, 1985). Although historically, the consideration of a *water quality characteristic* for zinc has been limited to hardness, it has been well established that a variety of water quality factors can affect metals bioavailability, including pH and natural organic matter in addition to hardness (USEPA, 2007). To capture a broader range of water quality characteristics that more accurately reflects site-specific conditions (e.g., dissolved organic carbon) as compared to the current hardness-based acute zinc criterion, the acute zinc criterion was recalculated using both the traditional hardness based approach and the biotic ligand model (BLM). The BLM provides a relatively new approach for calculating metals criteria based on the most recent science and the various site-specific factors that influence the aqueous bioavailability and toxicity of metals. The BLM has already been incorporated into federal WQC recommendations for copper by USEPA (2007) and the incorporation of the copper and zinc BLM-based criteria into the Basin Plan was included in the Los Angeles Regional Water Quality Control Board’s (Regional Board) 2020-2022 Triennial Review process. Additionally, the State Water Resources Control Board (SWRCB) is evaluating BLM-based criteria and the potential for statewide application.

In comparison with the CTR, the recalculated criterion provides a significant increase in the amount of zinc toxicity data that have been considered, and greatly expands the number of species considered in derivation of the criterion. The CTR is based on literature published in the 1980s and earlier and considers 175 toxicity tests representing 44 species in 36 genera (USEPA, 1987; USEPA, 1996). In contrast, the Recalculation Report presents two site-specific recalculated criteria that considered either 434 tests representing 81 species in 65 genera (hardness-based), or 429 tests representing 80 species in 64 genera (BLM-based) from literature published through 2021. Species of interest were identified for the areas where the zinc SSO would apply, and based on the available data, the SSO is protective of those species.

The hardness-based CTR equation is limited to only considering variation in hardness, while the BLM considers pH, DOC, and changes in major ions (e.g., calcium and chloride) composition. As a result, the BLM can more accurately predict variation in metal toxicity with changing chemistry. For example, a comparison of the hardness-based equation and BLM-based predictions for *Daphnia magna* effects concentration (e.g., effects concentration 50 where mortality is observed in 50% of test organisms) values from studies included in the Recalculation Report show that the BLM can more accurately predict the effects of water chemistry to *D. magna* toxicity ($R^2 = 0.52$) compared with the hardness-based equation ($R^2 = 0.41$).

Furthermore, USEPA, in the 2007 update to the copper criteria, stated that in comparison with the hardness-based equation, the BLM provided “*improved guidance on the concentrations of copper that will be protective of aquatic life*” (USEPA, 2007). Recent reviews of bioavailability approaches have stressed the need to consider multiple toxicity modifying factors in metal risk assessments and that current awareness of factors affecting bioavailability goes well beyond

hardness alone (Schlekat et al, 2020). A recent review of bioavailability approaches for zinc concluded that the zinc BLM is more accurate than hardness-based approaches for considering the effects of toxicity modifying factors on zinc toxicity to a wide range of aquatic life (Van Genderen et al, 2020). Lastly, the Regional Board concluded in their 2023-2025 Triennial Review that the BLM is more appropriate for California than other calculation methods.

For all these reasons, the zinc BLM is proposed as the zinc SSO to replace the acute zinc CTR hardness-based criterion. The BLM itself would be adopted as the SSO rather than establishing a single value to represent a protective level during all wet weather conditions across the Study watersheds. The following presents language that could be incorporated into the Basin Plan:

For the waterbodies in the Los Angeles River, Dominguez Channel, and Ballona Creek watersheds identified in Table x, the dissolved zinc acute water quality objectives (in µg/L) shall be derived using the Biotic Ligand Model (BLM).

The BLM version 3.41.2.45 was used to conduct the recalculation and can be found at the following link: <https://www.windwardenv.com/biotic-ligand-model>. Note that an updated version of the BLM software may be available prior to consideration of an SSO. Table x referenced in the Basin Plan text italicized immediately above is intended to reference the list of waterbodies in the Study Area. The adoption of a WQC calculation methodology rather than a singular WQC value is consistent with the hardness-dependent metals criteria in the CTR, the Basin Plan hardness-dependent objective for lead in the Los Angeles River watershed, and the Basin Plan ammonia objectives, which use pH and temperature to calculate the 30-day average objective and pH to calculate the one-hour average. Additionally, this approach is consistent with how other states (e.g., Oregon, Delaware, Idaho, Kansas, Vermont) have incorporated USEPA's currently recommended freshwater copper criteria (USEPA 2007), which is based on the BLM, into their water quality standards.

The proposed SSO is appropriate for updating the targets, loading capacities, and waste load allocations (WLAs) in the Metals TMDLs for the three Study watersheds. The proposed approach to modifying the TMDLs is to calculate the targets based on the SSO, and the loading capacities and WLAs would be updated based on the new targets. Unlike the current TMDL targets, which only consider one parameter (hardness), the SSO considers multiple parameters. Given that the multiple parameters utilized in the SSO can co-vary, an alternative to the current approach of calculating the wet weather TMDL targets based on median hardness values could be utilized to more robustly reflect variations in the parameters. The alternative approach proposed is to utilize a fixed monitoring benchmark (FMB). The FMB is a probability-based method that incorporates time variability in BLM-predicted instantaneous water quality criteria (IWQC) and instream zinc concentrations. As described in Ryan et. al, 2018, the FMB approach provides benchmarks that can be used to simplify implementation of time-variable WQC that results in the same level of protection as intended by the criteria. It also provides a more robust approach to ensuring the protectiveness of the TMDL target than provided by the current approach of using a 50th percentile hardness.

The FMB considers variability in the SSO and metal concentrations as well as co-variation between them to determine a single concentration that will meet USEPA's recommended limit on exceedance frequencies of once every three years (USEPA, 1996). Variability in criteria values can be significant, whether the criteria were derived using the SSO (using the BLM) or the CTR (using the hardness equation). As identified in the user guide for the BLM version used to develop the SSO (Windward 2019), in order to perform the probabilistic analysis for the FMB, at least 10 samples with SSO parameters and in-stream dissolved zinc concentrations are needed. While this may be an adequate sample size for determining the distributional parameters used by the FMB, it may not be sufficient to characterize year to year variability in surface water quality. In states where guidance has been developed for the application of BLM based criteria, the recommended sample size is typically 12 to 24 monthly samples².

Consistent with the current TMDLs, the dissolved wet weather TMDL targets would be calculated utilizing the SSO and data collected at the three MES sites in the lower parts of the Study watersheds. The conversion of the dissolved targets to total targets is expected to be conducted consistent with the current approach in the TMDLs, which is to utilize a site-specific regression of dissolved and total zinc concentrations calculated based on measurements of dissolved and total zinc at the MES sites during wet weather.. Given that additional data have been collected since the TMDLs were developed, an update to the conversion factors may be warranted using the same method, but with additional data. The loading capacities and allocations would be updated based on the new targets consistent with the TMDLs and would be assigned to point sources (i.e., MS4s, POTWs, Caltrans, industrial, construction, and minor NPDES permits) as WLAs and to non-point sources (i.e., open space and direct air deposition) as load allocations (LAs). The TMDLs would be expected to retain the existing approach to incorporating a margin of safety. **Figure ES-1** presents a summary overview of the TMDL update process.

Additionally, the TMDLs would acknowledge that conditions can vary from storm to storm and the targets, loading capacities, and WLAs can be recalculated using ambient conditions at the time of sampling, similar to the TMDL in the Dominguez Channel watershed. Lastly, the SSO is based on the dissolved form of zinc, consistent with the CTR. As such, similar to the Ballona Creek Metals TMDL, all three TMDLs would acknowledge that permittees may be deemed in compliance with water quality-based effluent limitations (WQBELs) if the dissolved numeric target is not exceeded in the applicable receiving water. Ultimately, the revised WLAs in the updated TMDLs would be incorporated into the LA Regional MS4 Permit.

² For example, 12 to 24 monthly samples were recommended in the following state implementation guidance documents: CDPHE, 2015; IDNR, 2017; ODEQ, 2016.

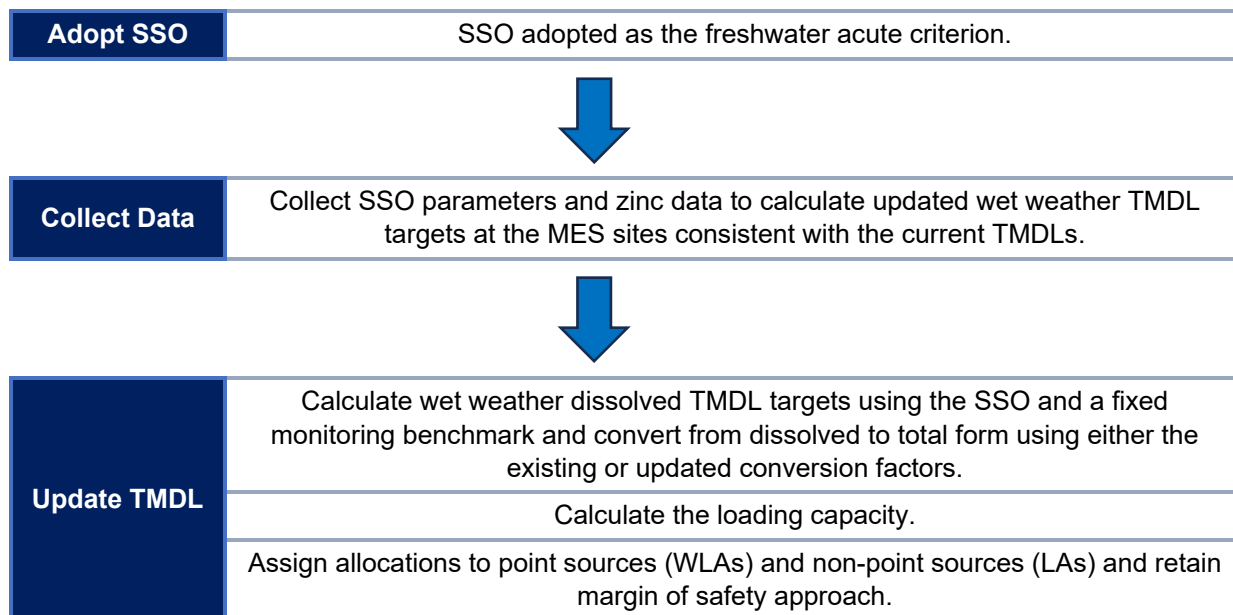


Figure ES-1. Overview of TMDL Update Process

Incorporating the SSO into the Basin Plan (and ultimately in the TMDLs and NPDES permits) is not expected to increase the risk of zinc impacts to resident organisms based on an updated understanding of zinc toxicity. Utilization of the SSO will result in changes to WLAs in the TMDL and WQBELs in NPDES permits. However, stormwater permittees will still be required to meet revised zinc limits to ensure protection of receiving waters. As described below, regardless of the adoption of a zinc SSO, MS4 Permittees will need to implement new control measures (i.e., best management practices [BMPs]) during wet weather. Implementation of new control measures addressing zinc and other water quality issues (e.g., bacteria) will result in reductions in zinc concentrations in wet weather urban runoff and receiving waters. Control measures include both non-structural source control based BMPs (e.g., street sweeping) which remove pollutants prior to transport via urban runoff and structural BMPs which remove pollutants after they have been transported via urban runoff. Structural BMPs can be applied at the parcel level, typically through low impact development practices, at the street level through green streets³, or at a larger scale through regional projects which are centralized facilities located near the downstream ends of large drainage areas. The expected outcome of implementation of the SSO is a reprioritization of management efforts to focus BMP implementation on 1) areas where zinc concentrations are more likely to impact aquatic life and 2) higher priority water quality issues.

When developing the Watershed Management Programs (WMPs) for the Study watersheds, zinc was determined to be one of two limiting pollutants (along with *E. coli*). As a limiting pollutant, attainment of zinc TMDL targets, which are currently based on the acute zinc CTR water quality

³ Green streets are distributed structural practices that are installed parallel to roadways to receive runoff from the gutter via curb cuts or curb extensions and infiltrate it through native or engineered soil media.

criterion, is expected to drive the size and number of control measures. The WMPs identify the size and number of structural BMPs needed to reduce pollutants to meet TMDL requirements (e.g., attaining zinc TMDL targets in receiving waters). The WMPs primarily rely on infiltration BMPs (e.g., permeable pavement, infiltration basins, etc.) to reduce loadings from urban runoff, but also utilize detention basins and treatment BMPs (e.g., biofiltration, constructed wetlands, etc.). An evaluation was conducted to illustrate the potential impacts of the SSO on BMP capacity (i.e., the volume of water a BMP can manage based on a design storm, which for the WMPs in the Study watersheds is a 24-hour period under the 90th percentile storm condition), and associated implementation costs, as well as the prioritization of BMPs in the Study watersheds. The purpose of the evaluation is to illustrate the implications of potentially updating the acute zinc criterion through the incorporation of new data and consideration of site-specific factors. It is important to illustrate the implications so that regulators, MS4 Permittees, and the public can make informed decisions regarding the level of control measures needed to ensure water quality is protected and limited public resources are effectively used.

To conduct the evaluation to illustrate the potential impacts of the SSO on BMP capacity, acute criterion values were calculated using the SSO. To simplify the evaluation, a range of DOC concentrations were used with all other parameters held constant to USEPA's moderately hard recipe except for hardness which was set at 75 mg/L which is in the range of the hardness used to calculate the acute TMDL targets in the Study watersheds. The range of DOC values was based on the available wet weather receiving water data collected at the three MES sites located in the lower parts of the Study watersheds, DOC was selected as the one parameter to vary as it can have a significant effect on the potential for toxicity to aquatic life due to zinc. The range of values calculated using the SSO were then divided by hardness based acute zinc CTR criterion calculated using the same hardness (75 mg/L) to generate a ratio. A ratio was used to simplify the calculation of different BMP capacities and associated costs across the range of potential SSO values using the available modeling tools. The SSO based criteria presented herein are intended for use in conducting this evaluation and do not represent proposed TMDL targets.

The ratios are used as the basis for determining the zinc load reductions required, which in turn provide an end point to estimate the BMP capacity and associated costs to meet the different TMDL targets. The Reasonable Assurance Analysis (RAA) contained in each of the WMPs follow a similar process for determining the number and sizes of structural BMP and resulting treatment capacities required to meet water quality standards, including utilizing a limiting pollutant approach. To determine the total BMP capacities and then costs, the RAAs generally utilize the same process:

- 1. Determine the critical condition and Exceedance Volume:** The RAAs use the 90th percentile daily flow rate to define the wet weather critical condition and analyze the volume of runoff during each rolling 24-hour period of a 10-year simulation when water quality targets were exceeded, referred to as the "Exceedance Volume". The storm that

produces the 90th Percentile Exceedance Volume⁴ is the critical condition for metals and the overall primary critical condition for management⁵ of stormwater in the WMPs. The Exceedance Volume differs for each metal (zinc, copper and lead) and for different subwatersheds (end-of-pipe) and assessment areas (instream) depending on land use, imperviousness, slope, etc. The WMP manages (retains and treats) the Exceedance Volume from each of the modeling subwatersheds to achieve zinc receiving water limitations (RWLs).

2. **Determine the cost-effective BMP solutions for each subwatershed in the WMP area:** The model analyzes thousands of scenarios considered for an individual subwatershed in the WMP area. The scenarios are based on the available opportunity (e.g., the available footprints for regional BMPs and length of right-of-way for green streets) and predicted performance for controlling zinc if BMPs were implemented at those opportunities with varying sizes. The most cost-effective BMP solutions for each of the subwatersheds provide the basis for cost optimization.
3. **Determine the cost-effective scenarios for each jurisdiction in the WMP Group:** By rolling up the BMP solutions from the subwatershed level to a jurisdictional level, the most cost-effective scenarios for each jurisdiction can be determined for a wide range of required zinc reductions. These “cost optimization curves” provide a potential WMP Implementation Strategy for a range of required reductions. Each scenario is a “recipe for compliance” for all the subwatersheds in the jurisdictional area (for a given percent reduction).
4. **Extract the cost-effective scenarios for the required reduction:** The required zinc reductions determine the specific scenario that is selected from the cost optimization curves. All jurisdictions within the assessment areas are held to the same percent reduction. The selected scenarios become the WMP Implementation Strategy. The extracted control measures comprise a detailed recipe for compliance with RWLs for metals and other Water Quality Priorities for each subwatershed in the jurisdictional area.
5. **Route the critical bacteria storm through the control measures in the extracted scenario:** The effectiveness of the selected control measures for retaining the critical bacteria storm is evaluated.⁶ The additional capacity (if any) to retain the critical bacteria storm is determined for each subwatershed.

⁴ The Exceedance Volume is the metric used for the RAA critical conditions because the *volume* of stormwater to be managed ultimately drives the capacity of control measures in the WMPs. The Exceedance Volume allows the volume to be defined based on applicable RWLs and assures attainment of RWLs. For example, a storm that generates a large volume of stormwater runoff with pollutant concentrations slightly above the RWLs is more difficult to manage than a storm that generates a small volume of runoff with concentrations that greatly exceeds the RWLs. Also, the Exceedance Volume reflects the effect of varying water quality targets / RWLs – if a target / RWL is increased then the volume of stormwater to be managed is decreased.

⁵ The term “manage” incorporates both retention and treatment approaches. Retention of the Exceedance Volume ensures attainment of RWLs. Treatment of the Exceedance Volumes to concentrations below the RWLs also assures RWL attainment. Furthermore, institutional control measures reduce pollutant build-up on watershed surfaces and thus can also decrease the Exceedance Volume.

⁶ For addressing bacteria impairments, BMP capture volume is based on capturing the “critical bacteria storm”, which is the 90th percentile wet day when bacteria RWLs apply.

If there is a decrease in the required reductions to meet the zinc RWLs, then Step 5 has to be repeated to assure that the critical bacteria storm is addressed. A reduction in capacity related to addressing zinc can necessitate an increase in the volume required to address bacteria, which is the case in the examples provided herein.

Figure ES-2 and **Figure ES-3** show total BMP capacity and capital cost, respectively, for final compliance through WMP implementation based on the ratios of SSO calculated criterion to the CTR hardness-based criterion for the Ballona Creek, Dominguez Channel, and ULAR WMPs. The potential SSO-based dissolved acute criterion and the corresponding ratios are applied across the Study watersheds equally for the purposes of this analysis. This results in an assumption that the SSO will result in similar changes to the criterion in each Study watershed. However, it is likely that there will be differences in how the SSO changes the criterion in each Study watershed due to differences in the parameters used by the SSO to calculate the acute criterion (such as DOC), which is similar to how the hardness-based criterion varies across the watersheds. The assumption that the SSO would result in similar changes across the Study watersheds was made to simplify the presentation of the information. Regardless of the assumption, the effect of the SSO would still be expected to reduce the required capacity and costs for zinc but somewhat increases capacity and costs for bacteria with a net effect of reducing the overall capacity and costs. Overall, the BMP capacity required to achieve zinc TMDL targets progressively decreases as potential criteria calculated using the SSO increases (**Figure ES-2**). As BMP capacity to address zinc decreases, the amount of additional capacity needed to address bacteria generally increases. The distribution of structural BMP capacity also changes with the SSO. In general, planned low impact development (LID) associated with redevelopment and Public Regional BMPs remain unchanged, while Green Streets and Private Regional BMPs capacity progressively decrease as the SSO value increases. BMP capital costs were calculated for each potential criterion calculated using the SSO and show a similar trend to capacity (**Figure ES-3**).

Capital costs for the WMPs could be reduced by **\$2 to \$3 Billion** overall and capital costs specific to controlling zinc could be reduced by **\$3.8 to \$5.7 Billion** (**Figure ES-3**). These results show that the zinc SSO could have major cost and feasibility impacts on implementation of the WMPs in the Study watersheds while still requiring major investments in BMP capacity to address other water quality issues. In short, the zinc SSO will not change the need to continue to heavily invest in stormwater infrastructure, but nevertheless, it will significantly reduce the overall capacities and costs.

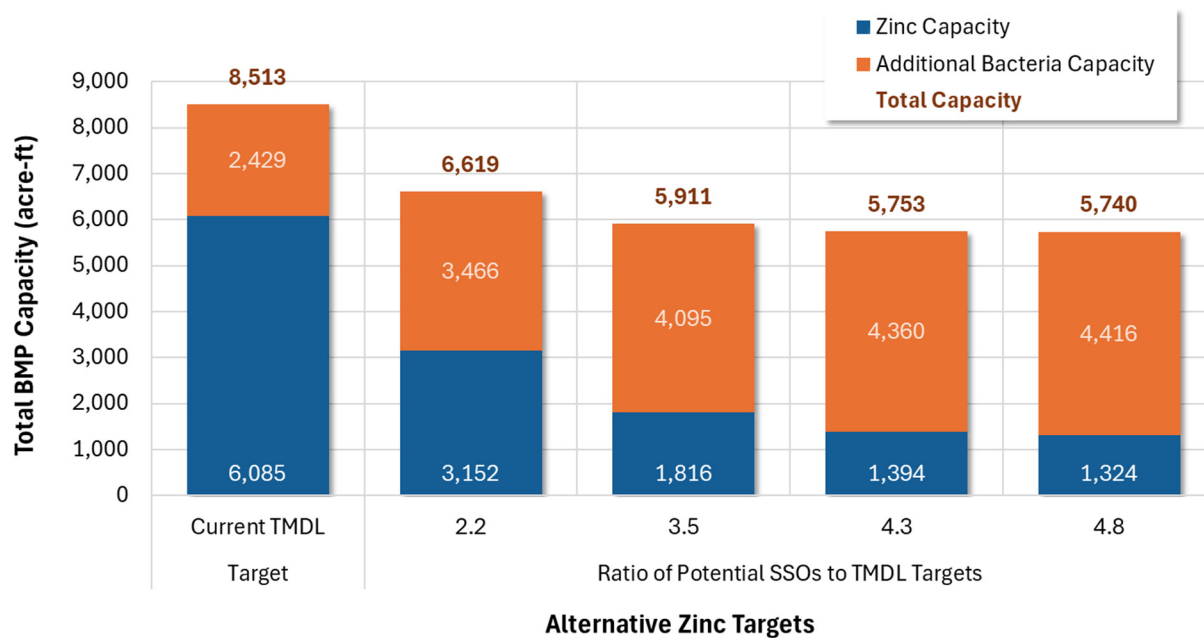


Figure ES-2. Comparison Between Total BMP Capacity Necessary to Address Metals and Bacteria for the Current Criteria and Several Potential SSOs as Identified in the 2023 Ballona Creek, Dominguez Channel, and Upper Los Angeles River Watershed Management Programs

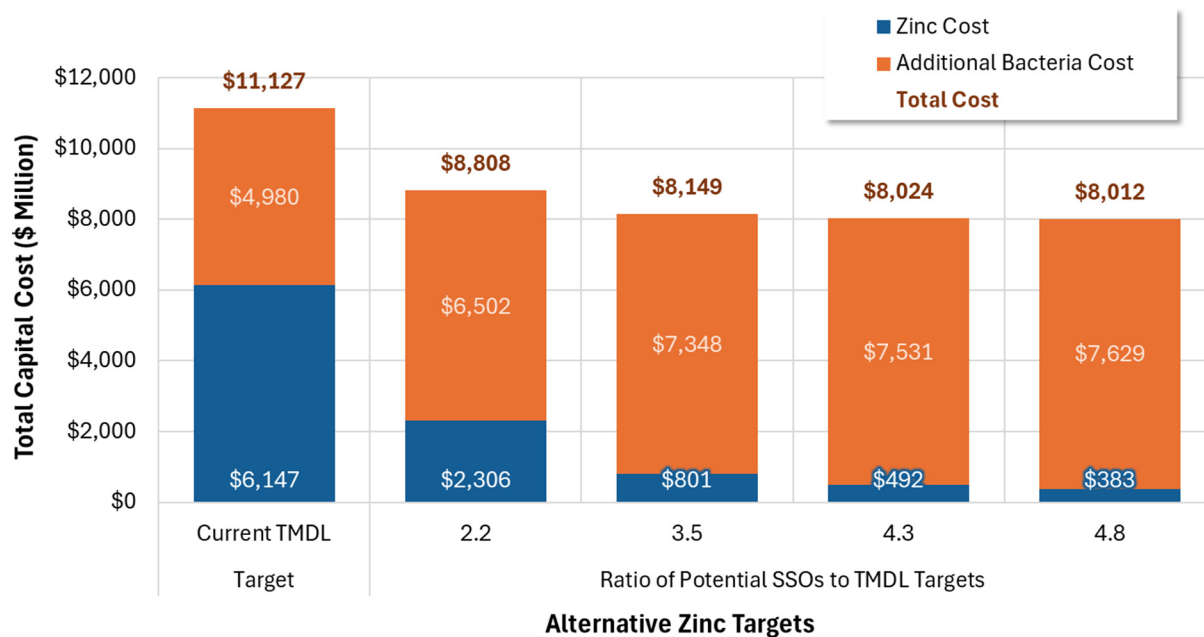


Figure ES-3. Comparison Between Total Capital Cost Necessary to Address Metals and Bacteria for the Current Criteria and Several Potential SSOs as Identified in the 2023 Ballona Creek, Dominguez Channel, and Upper Los Angeles River Watershed Management Programs

The results from this Study can support setting priorities for implementation actions to reduce zinc loads from urban runoff. The SSO is expected to reduce the required capacities across the Study watersheds. However, the reduction in capacities across waterbodies within each Study watershed differ, with some waterbodies impacted more significantly by zinc than others. A close examination of Burbank Western Channel and Compton Creek in the Los Angeles River watershed clearly illustrates this point. While the SSO could reduce the necessary BMP capacities in both waterbodies, the target reductions for zinc do not decrease as significantly in Compton Creek and new BMP capacity continues to be significant (**Figure ES-4**). A comparison of Burbank Western Channel and Dominguez Channel shows a similar situation (**Figure ES-4**). As such, an agency which discharges to all three waterbodies (e.g., the City of Los Angeles) could use this information to prioritize zinc reduction efforts through source control or BMPs in Compton Creek and Dominguez Channel over the Burbank Western Channel to maximize the benefits of zinc reduction efforts on aquatic life.

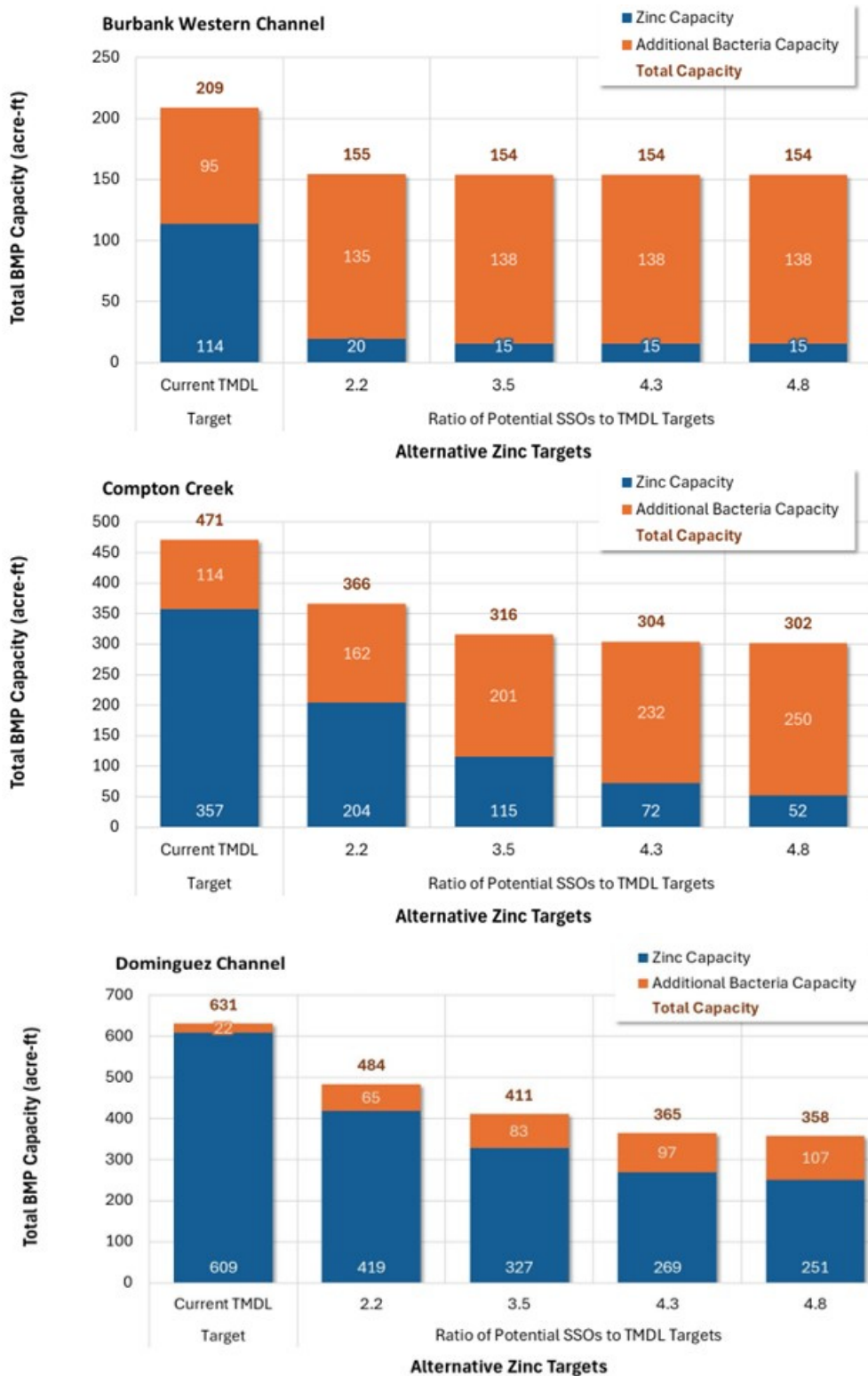


Figure ES-4. Comparison Between Total BMP Capacity Necessary to Address Metals and Bacteria for the Current Criteria and Several Potential SSOs for the Burbank Western Channel, Compton Creek, and Dominguez Channel Subwatersheds as Identified in the 2023 Ballona Creek, Dominguez Channel, and Upper Los Angeles River Watershed Management Programs

Prior to incorporating the SSOs into the Basin Plan, the impacts of the SSOs, the factors contained in the California Water Code (CWC) Section 13241, and anti-degradation must be considered. Implementation of the SSOs is expected to continue to provide the intended protection of the criteria under future conditions. The proposed changes to the TMDL targets, loading capacities, and WLAs do not fundamentally change the level of protection provided by the TMDLs. Consistent with previous SSO adoptions within the Los Angeles Region, the six factors contained in CWC Section 13241 were considered, and it was determined that the requirements are met.

The proposed SSO is consistent with the State's anti-degradation policy (SWRCB Resolution 68-16) and federal anti-degradation requirements. This finding is consistent with the adoption of previous SSOs in the region for copper in the Calleguas Creek Watershed (LARWQCB Resolution 2006-003); ammonia in the San Gabriel, Los Angeles, and Santa Clara River watersheds (LARWQCB Resolution 2007-005), and copper and lead in the Los Angeles River watershed (LARWQCB Resolution R15-004). Similar to the adoption of the copper, lead, and ammonia SSOs, the proposed SSO will not lower the water quality of the waterbodies relative to existing conditions because additional loadings of zinc are not anticipated. USEPA's Recalculation Procedure is designed to result in SSOs that are equally protective of aquatic life (and as a result equally protective of all other beneficial uses) as intended for the national criteria.

Anti-backsliding requirements apply when an NPDES permit is reissued and requires an assessment of whether interim effluent limitations, standards or conditions are at least as stringent as the final effluent limitations, standards, or conditions in the previous permit or revised effluent limits are consistent with the anti-backsliding provisions of the Clean Water Act (CWA) and associated regulations. Section 402(o) of the CWA (33 U.S.C. §1342(o)) allows revisions to effluent limitations based on State water quality standards if one of the exceptions in section 402(o)(2) is met or if the revision is consistent with CWA section 303(d)(4). Sections 402(o)(2) and 303(d)(4) provide independent exceptions. Thus, backsliding is allowed if either of these two CWA provisions are met.

The applicable water quality standard for zinc has not been attained and revised effluent limitations would be expected to be based on an updated TMDL that considers the cumulative effect. Therefore, the section 303(d)(4)(A) exception would be met. Alternatively, if, based on using the SSO, the water quality standards are being attained, the exception under section 303(d)(4)(B) would be met since the requirements of the Antidegradation Policy are met. The exception contained in section 402(o)(2)(B) would also apply as backsliding would be allowed since "information is available which was not available at the time of permit issuance ...which would have justified the application of a less stringent effluent limitation at the time of permit issuance." The SSOs provide such new information. As acknowledged on page 14 of the Staff Report for the Revisions to the TMDL for Nitrogen Compounds and Related Effects in the Los Angeles River (LARWQCB 2012), which incorporated the updated ammonia Basin Plan objectives into the TMDL, "the WER based SSOs provide new information and therefore the POTWs may meet the backsliding exception under CWA section 402(o)(2)." Lastly, section 402(o)(3) contains what is considered the maximum allowed amount of backsliding, which prohibits revisions of effluent

limitations that would result in a violation of applicable water quality standards. As the revised effluent limitations would be based on the revised water quality standard, and the resultant modified TMDL WLAs, there would be no violation of water quality standards to trigger this section. In summary, it is expected that at least one of the statutory exceptions allowing backsliding would be met.

Multiple input parameters are required to calculate a water quality criterion using the SSO: temperature, pH, dissolved organic carbon, calcium, magnesium, sodium, potassium, sulfate, chloride, and alkalinity. To support updates to the TMDLs, and evaluate TMDL attainment this suite of parameters should be sampled and analyzed along with dissolved and total zinc consistent with standard monitoring and analytical procedures and include quality assurance and quality control (QA/QC) samples such as field duplicates and field blanks. The receiving monitoring sites selected for sample collection and the sampling frequency, which is typically three wet events per year based on the MS4 Permit monitoring requirements, should be consistent with requirements for assessing attainment of the TMDLs in the Study watersheds. Monitoring and analytical procedures as well as QA/QC requirements should be documented in a monitoring plan or program document such as a Coordinated Integrated Monitoring Program (CIMP).

As identified in the user guide for the BLM version used to develop the SSO (Windward 2019), in order to perform the probabilistic analysis for the FMB, at least 10 samples should be collected during wet weather over multiple seasons at the MES sites located in the three Study watersheds to support calculation of updated TMDL targets. Use of data collected at the MES sites to calculate targets is consistent with the approach currently used in the TMDLs. More than 10 samples collected over multiple wet seasons may be needed to evaluate year to year variability. The potential for year to year variability to impact TMDL targets should be considered when developing monitoring approaches and evaluating data. To determine attainment of the SSO and TMDL targets during wet weather, the suite of parameters needed to calculate the SSO should be collected at the same time dissolved and total zinc samples are collected at receiving water monitoring sites utilized to evaluate attainment of the TMDLs.

1 INTRODUCTION

Water quality and the protection of aquatic ecosystems are important priorities in the Los Angeles (LA) region. Regulatory requirements established by the Los Angeles Regional Water Quality Control Board (Regional Board), State Water Resources Control Board (SWRCB), and United States Environmental Protection Agency (USEPA) define the pollutants that need to be addressed to protect beneficial uses and determine how resources are prioritized and allocated. These regulatory requirements are based on water quality criteria (WQC) that establish the levels of specific pollutants that can be present in the LA region's creeks, rivers, and marine waters while still protecting beneficial uses (e.g., recreation, warm freshwater habitat). The strategies for managing water quality are therefore designed around meeting WQC, particularly when prioritized through Total Maximum Daily Loads (TMDLs) and National Pollutant Discharge Elimination System (NPDES) permits. Accurate and appropriate WQC are therefore critical to ensuring that resources are applied to the most important water quality issues and that the right strategies and actions are taken to address these issues.

Exceedances of the California Toxics Rule (CTR), located at 40 Code of Federal Regulations (CFR) 131.38, WQC for zinc are observed in multiple waterbodies in the LA region and indicate that aquatic life beneficial uses may be impaired. In response to these exceedances, TMDLs have been established that outline the reductions in zinc loading needed to meet WQC and protect beneficial uses in multiple watersheds, including the LA River, Ballona Creek, and Dominguez Channel watersheds. While the TMDL targets based on the CTR chronic zinc criterion are consistently met at the mass emission stations (MES) in these watersheds during dry weather, exceedances of the CTR acute dissolved zinc criterion are consistently observed during wet weather (see **Section 1.4**). Achieving the load reductions in stormwater runoff required to attain the CTR acute criterion and achieve the TMDLs during wet weather is a significant challenge and a key driver of implementation actions to improve water quality. Stormwater dischargers are actively implementing programs and projects identified in Watershed Management Programs (WMPs) to reduce the discharge of zinc and other pollutants from developed areas into LA region waterbodies. Additionally, efforts are underway to evaluate and potentially regulate the use of zinc in tires, which are believed to be a significant source of zinc in runoff from road surfaces (CASQA, 2015).

Existing TMDLs and the implementation actions planned to address exceedances, however, are based on an acute zinc water quality criterion that is over 25 years old. Since the existing criterion was developed, a significant amount of new, peer reviewed data have been collected pertaining to zinc toxicity to aquatic life. The existing criterion also does not consider site-specific factors impacting zinc toxicity, including the unique aquatic life community that is resident to the subject waterbodies and differences in chemical factors between subject waterbodies and the assumptions used to generate the national zinc criteria. Based on the new data available and consideration of site-specific factors, changes to the zinc criterion may be appropriate. To support an evaluation of the existing acute zinc criterion, the City of Los Angeles Sanitation and Environment (LASAN) Watershed Protection Division is leading a Scientific Study, primarily funded by the Safe Clean

Water Program (SCWP), to evaluate and, if appropriate, propose an update to the acute zinc water quality criterion (henceforth, Zinc Recalculation Study or Study). The cost estimate to conduct the Study is \$500,000 with funding coming from the Upper Los Angeles River Watershed Area (70.6%/\$353,000), the South Santa Monica Bay Watershed Area (11.6%/\$58,000), and the City of Los Angeles Municipal funds for the Ballona Creek Watershed (17.8%/\$89,000). The Study costs represent approximately 0.02% of the total estimated costs for Best Management Practice (BMP) implementation to attain the current zinc criterion, which is estimated at no less than \$6 Billion.

A Study Work Plan (LWA, 2023b) was developed to guide the recalculation and was circulated for comment as described in **Section 1.6**. The Recalculation of the Acute Zinc Criterion in the Los Angeles River, Ballona Creek, and Dominguez Channel Watersheds (LWA, 2024) (referred to herein as the Recalculation Report) was developed consistent with the Study Work Plan. The purpose of this document (referred to herein as the Implementation Report) is to provide information to document how the results of the Recalculation Report can be used to adopt site-specific objectives (SSOs) into the Water Quality Control Plan for the Los Angeles Region (Basin Plan), amend the TMDLs which address zinc in each watershed, and modify the Municipal Separate Storm Sewer System (MS4) NPDES Permit (currently Order No. R4-2021-0105 herein referred to as the LA Regional MS4 Permit). The Implementation Report is intended to provide information needed to satisfy the State of California’s policy requirements for implementing SSOs. The elements addressed in the Implementation Report are presented in **Figure 1**. Detailed information on the technical analysis and results supporting the acute zinc SSO presented herein are contained in the Recalculation Report.

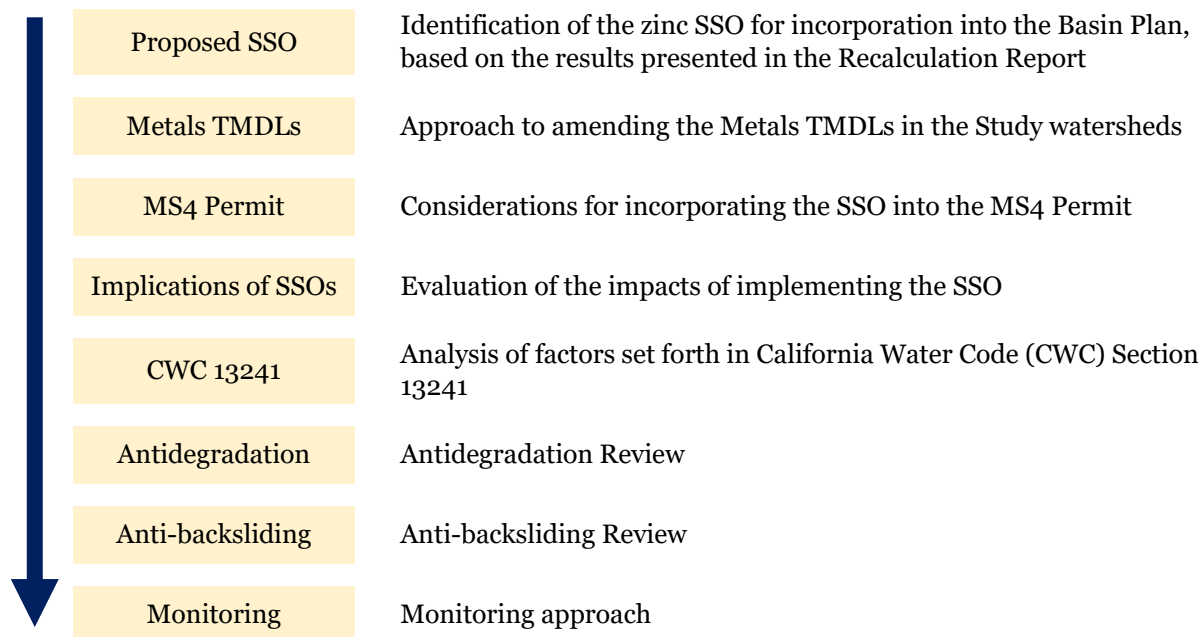


Figure 1. Implementation Report Regulatory and Policy Elements

1.1 Zinc Overview

As detailed in the metals TMDLs adopted for the LA River, Ballona Creek, and Dominguez Channel watersheds (collectively referred to herein as the Metals TMDLs)⁷, sources of zinc in the region's waters are both natural and anthropogenic. Natural sources of zinc include soil, bedrock, and other geologic deposits. Anthropogenic sources of zinc include municipal, industrial, and construction stormwater dischargers as well as direct atmospheric deposition of zinc to waterbodies. Within developed landscapes, industrial stormwater discharges are believed to be particularly important, as a study conducted in southern California between 2001 and 2005 found that industrial land use sites contributed substantially higher fluxes of zinc than other land uses (Stein et al., 2007). Major sources contributing zinc in stormwater discharges from industrial and urbanized areas include galvanized metal surfaces (e.g., roofing, siding, fencing, gutters, guard rails) and outdoor rubber, particularly automobile tires (CASQA, 2015). Zinc-containing paints, tire shred and crumb products (e.g., used in road base and asphalt, artificial turf infill), anti-corrosion chemicals, and various automobile components (e.g., wheel weights, brake pads) may also be locally important sources of zinc.

Mobilization and transport of zinc to waterbodies by stormwater runoff can increase zinc concentrations in waterbodies and impact aquatic life. While zinc is an essential micronutrient it can negatively impact biological processes when present at high concentrations, resulting in acute and chronic impacts on the growth, survival, and reproduction of aquatic organisms, including invertebrates, fish, and plants. Zinc toxicity is heavily influenced by water chemistry, particularly pH and hardness (USEPA, 1987). As pH changes, zinc is partitioned differently between various dissolved (e.g., Zn^{+2} , $\text{Zn}(\text{OH})_4^{-2}$) and insoluble (e.g., $\text{Zn}(\text{OH})_2$, ZnS) species. These species vary in their capacity to sorb to tissue, with insoluble species generally less able to sorb and impact biological processes. Hardness also has a strong influence on toxicity because the mineral species that comprise hardness (calcium and magnesium) compete with zinc in binding to the tissue of aquatic organism, limiting the effective exposure to zinc. Zinc toxicity also depends on the tolerances of the aquatic organisms present (USEPA, 1987). Different phylogenetic groups have evolved different metabolic processes for accumulating and excreting zinc. Different populations of the same species may also develop different tolerances based on the zinc concentrations to which they have historically been exposed.

1.2 Zinc Criteria Background

The USEPA has developed and published national WQC for zinc that are intended to protect aquatic life. The national zinc criteria became legally applicable in California through the promulgation of the CTR. Like all WQC, the national zinc criteria consist of a concentration, an averaging period, and a return frequency. The national zinc criteria were developed using toxicity

⁷ The TMDL for Metals in the Los Angeles River and Tributaries (LA River Metals TMDL; R2007-014), Ballona Creek Metals TMDL (R2007-015), and TMDL for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters (Dominguez Channel Toxics TMDL; R11-008) for the LA River, Ballona Creek, and Dominguez Channel watersheds, respectively (collectively referred to as the Metals TMDLs).

data from USEPA-validated studies, primarily conducted in laboratory dilution water, for a wide range of species. Criteria were developed from the compiled data using the approach outlined in *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (Criteria Guidelines; USEPA, 1985). The Criteria Guidelines provide methods for calculating freshwater and saltwater criteria expressed as a Criterion Maximum Concentration (CMC), also known as acute criterion, and a Criterion Continuous Concentration (CCC), also known as chronic criterion. Acknowledging the impact of ambient water quality on zinc toxicity, the national zinc criteria are expressed as a hardness dependent equation. Table 1 presents CCC and CMC criteria at a range of hardness values.

National zinc criteria were first published by the USEPA in 1980 but were updated in 1987 (1987 Criteria) to be based on the dissolved fraction of zinc rather than the total fraction (USEPA, 1980; USEPA, 1987). The national zinc criteria were updated again through the “1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water” (USEPA 1996; herein referred to as the 1995 Criteria Update). The 1995 Criteria Update only incorporated two new acute toxicity data points into the national dataset rather than incorporating all available toxicity data developed after the 1987 Criteria were developed. No new acceptable chronic data were identified for the update. The 1995 CMC (i.e., the acute criterion) for zinc in freshwater was calculated based on the four lowest genus mean acute values (GMAVs) out of a total of 36 species mean acute values (SMAVs). The CCC (i.e., the chronic criterion) for zinc in freshwater contained in the 1987 Criteria was calculated based on data for nine freshwater species.

Studies not previously considered in the 1995 Criteria Update provide additional information for previously tested species, new information on additional species, and new information on how water quality conditions impact the toxicity of zinc to aquatic life. These studies and the additional knowledge they provide create a need to periodically update the criteria. The acute zinc criterion has not been revised since the 1995 Criteria Update, which did not consider all available toxicity data at the time, and, for the reasons described above, warrants re-evaluation.

Table 1. California Toxics Rule Dissolved Zinc Criteria Based on a Range of Hardness Values

Hardness (mg/L)	Criterion Continuous Concentration/Chronic Criterion (µg/L)	Criterion Maximum Concentration/Acute Criterion (µg/L)
50	66	65
100	118	117
200	213	211
300	300	297
400	382	379

1.3 TMDL Background

TMDLs have been developed to address dry and wet weather impairments caused by zinc, as well as other metals, in the LA River, Ballona Creek, and Dominguez Channel watersheds. Reaches subject to wet weather zinc allocations in each of these watersheds are shown in **Figure 2**. Each of these TMDLs included the following components common to TMDLs:

- Numeric targets associated with beneficial use attainment;
- Source and Linkage Analyses that evaluated existing loading with respect to numeric targets;
- LAs and WLAs limiting the amount of pollutant that can be discharged by each identified source, including permitted stormwater dischargers; and,
- An Implementation Plan outlining the nature and schedule of actions and milestones that named responsible parties are required to complete.

Table 2 provides an overview of the key dates, waterbodies, and the numeric targets established in each TMDL for wet weather. Additional information on each TMDL is provided in the following subsections.

Table 2. Summary of Wet Weather TMDLs Addressing Zinc in Study Watersheds

		LA River Metals TMDL	Ballona Creek Metals TMDL	Dominguez Channel Toxics TMDL
Final Compliance Date		January 11, 2028	July 15, 2026	March 23, 2032
Water Bodies Addressed		LA River and Tributaries	Ballona Creek and Sepulveda Channel	Dominguez Channel and Torrance Lateral
Wet Weather Numeric Target	<i>Total (µg/L)</i>	159	104.77	69.6
	<i>Dissolved (µg/L)</i>	97	99	65.13 ^[1]

1. As noted in this TMDL, the freshwater targets for zinc are expressed as a function of total hardness in the waterbody. The zinc target presented corresponds to a hardness of 50 mg/L.

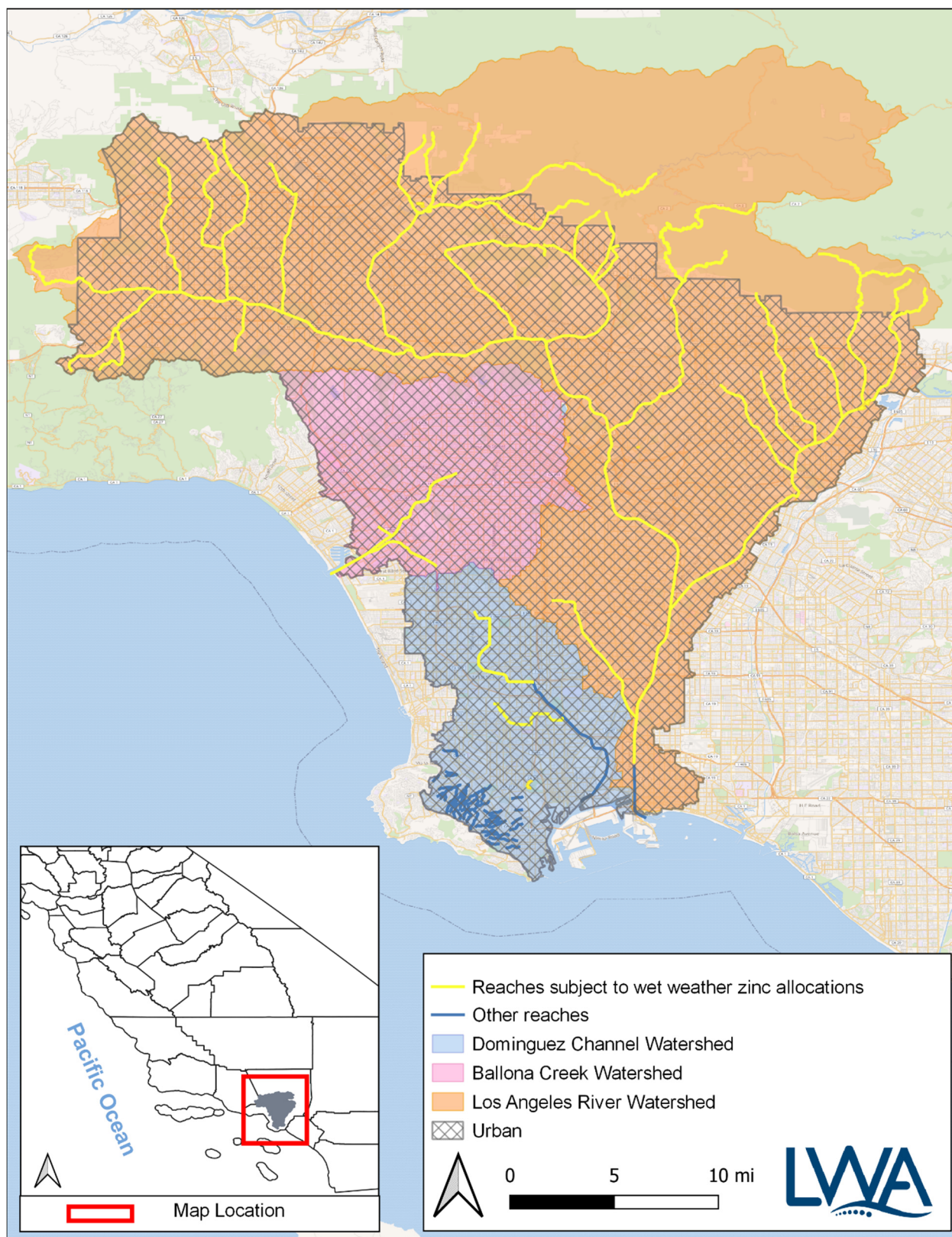


Figure 2. Reaches Assigned Zinc Wet Weather Allocations in the Los Angeles River, Ballona Creek, and Dominguez Channel Metals TMDLs

1.3.1 LA River Metals TMDL

The LA River Metals TMDL was adopted by the Regional Board on September 6, 2007 and became effective on October 29, 2008. The LA River Metals TMDL addressed impairments in the LA River and its tributaries caused by metals during wet and dry weather.^{8,9} Zinc impairments addressed by the LA River Metals TMDL include wet weather impairments throughout the watershed and a dry weather impairment in Rio Hondo Reach 1.

Wet weather numeric targets for total zinc in the LA River Metals TMDL were developed based on hardness dependent dissolved CTR criteria, with chronic and acute criteria applicable during dry and wet weather, respectively. Numeric targets were calculated based on the 10th percentile hardness value during dry weather (ranging from 141 to 702 mg/L as CaCO₃ depending on the waterbody) and the 50th percentile hardness value during wet weather (80 mg/L as CaCO₃) based on data collected in LA River Reach 1 at Wardlow Avenue (MES S10). CTR criteria for dissolved zinc were converted to numeric targets for total zinc using the default CTR conversion factor during dry weather and a site-specific regression of dissolved and total zinc concentrations at Wardlow Avenue during wet weather. Watershed-wide WLAs were developed to meet the numeric target in LA River Reach 1 during wet weather.

The TMDL acknowledges the potential for special studies to refine the estimate of loading capacity, wasteload and/or load allocations, and other studies that may serve to optimize implementation efforts. The LA River Metals TMDL has been revised on two occasions to incorporate the findings of special studies. In 2010, the Regional Board revised the TMDL to include modified numeric targets for copper based on a site-specific water effect ratio (WER) in Reaches 1-4 of the LA River and in Burbank Western Channel (Resolution R10-003). The CTR allows for adjustment of criteria for certain metals based on site-specific factors impacting metals toxicity through the use of a WER, which is computed as a pollutant's toxicity in water from a particular site divided by that pollutant's toxicity in laboratory dilution water. Guidance on developing WERs is provided in the USEPA's Interim Guidance on Determination and Use of Water-Effect Ratios for Metals (Interim Guidance; USEPA, 1994a). Between 2005 and 2008 the City of LA and City of Burbank implemented a study following this guidance to collect the data needed to develop WERs for the specified reaches (LWA, 2008). The developed WERs were subsequently incorporated into the numeric targets in the LA River Metals TMDL. WLAs for Publicly Owned Treatment Works (POTWs) were adjusted to reflect the modified numeric targets but allocations for other sources were not changed.

⁸ The LA River Metals TMDL addressed discharges of copper (wet/dry), lead (wet/dry), zinc (wet), and cadmium (wet) in the LA River and its tributaries. Additionally, the LA River Metals TMDL addressed discharges of selenium in LA River Reach 6 during wet and dry weather and discharges of zinc in Rio Hondo Reach 1 during dry weather.

⁹ The LA River Metals TMDL defined wet weather as days when the maximum daily flow measured at the Los Angeles County Flood Control District's (LACFCD) Wardlow Avenue gage (Station F319-R) meets or exceeds 500 cubic feet per second (cfs). All other days are defined as dry weather.

In 2015, the Regional Board adopted further revisions to the LA River Metals TMDL that modified numeric targets and allocations for copper and lead throughout the watershed. Targets and allocations for copper were updated to incorporate WERs that were developed through an expanded WER study completed by the LA River Metals TMDL Implementation Group that included waterbodies addressed in the 2008 WER study as well as additional reaches and tributaries (LWA, 2014). Targets and allocations for lead were updated to reflect lead criteria that were recalculated using new lead toxicity data collected after the publication of USEPA's aquatic life criteria for lead. Recalculation of lead criteria followed USEPA's Recalculation Procedure, which is contained in Appendix B of the Interim Guidance. It should be noted that the implementation of previous SSOs does not, on its own, set precedent for implementation of future SSOs.

1.3.2 Ballona Creek Metals TMDL

The Ballona Creek Metals TMDL was adopted by the Regional Board on September 6, 2007 and became effective on October 31, 2008. The Ballona Creek Metals TMDL addressed impairments in Ballona Creek and Sepulveda Channel caused by copper, lead, selenium, and zinc during wet and dry weather. Numeric targets for total zinc in the Ballona Creek Metals TMDL were developed based on the hardness dependent CTR criteria for dissolved zinc, with the chronic and acute criteria applicable during dry and wet weather, respectively. Numeric targets for dry and wet weather were calculated using the 50th percentile hardness value during each weather condition (300 and 77 mg/L as CaCO₃ for dry and wet weather, respectively) based on data collected in Ballona Creek at Sawtelle Boulevard (MES S01). CTR criteria for dissolved zinc were converted to numeric targets for total zinc using the default CTR conversion factor during dry weather and a site-specific regression of dissolved and total zinc concentrations recorded at Sawtelle Avenue during wet weather. Mass-based WLAs for wet and dry weather were developed for permitted stormwater dischargers to meet the numeric target for zinc in Ballona Creek and Sepulveda Channel.

Subsequent to adoption, the Ballona Creek Metals TMDL was revised by the Regional Board in 2013 (R13-010) to incorporate multiple changes. First, the definition of wet weather, which is based on the 90th percentile of flows observed at Sawtelle Boulevard, was updated using more recent flow data. The 50th percentile hardness values used to calculate CTR acute and chronic criteria were also updated to reflect new data and the updated definitions of wet weather (396 and 82 mg/L as CaCO₃ for dry and wet weather, respectively). Selenium was removed from the TMDL because data indicated that selenium was not exceeding existing numeric targets and impairing the designated beneficial uses. Finally, the conversion factors used to translate between the dissolved and total metals fractions were updated to reflect the 90th percentile of the dissolved to total ratio for each metal based on updated data. The updated weather definition, hardness values, and conversion factors were then used to calculate revised numeric targets and allocations.

The Ballona Creek Metals TMDL acknowledges the potential for special studies to refine estimates of loading capacity, wasteload and/or load allocations, and other studies that may serve to optimize implementation efforts.

1.3.3 Dominguez Channel and Greater Harbor Waters Toxics TMDL

The Dominguez Channel Toxics TMDL was adopted by the Regional Board on May 5, 2011 and became effective on March 23, 2012. The Dominguez Channel Toxics TMDL addressed impairments caused by organic and inorganic pollutants, including zinc during wet weather.¹⁰ Numeric targets for total zinc in the Dominguez Channel TMDL were developed based on the hardness-dependent acute CTR criterion for dissolved zinc using the 50th percentile hardness value (50 mg/L as CaCO₃) and a site-specific conversion factor based on data collected in Dominguez Channel at Artesia Boulevard (MES S28). Numeric targets for zinc were also developed for sediment. Mass-based WLAs were developed for permitted stormwater dischargers to meet the numeric target for zinc in Dominguez Channel during wet weather. The Dominguez Channel Toxics TMDL was amended by the Regional Board on October 13, 2022 and approved by the SWRCB on January 17, 2024. However, at the time this report was drafted, the amended TMDL had not been approved by USEPA and is not effective.

Similar to the LA River Metals and Ballona Creek Metals TMDLs, the Dominguez Channel Toxics TMDL recognizes that as work to understand these waters continues the targets, allocations, and the flow threshold for wet-weather conditions and the implementation actions to reach those targets and allocations may need to be adjusted.

1.4 Summary of Zinc Water Quality

Data has been collected at MES in the lower parts of the freshwater reaches of the LA River, Ballona Creek, and Dominguez Channel watersheds for over 20 years. To provide an understanding of water quality conditions relevant to the Study, hardness and zinc data were compiled. Data are summarized in this section for the most recent 12 years of available data (July 2011 – June 2023), as well as the most recent 5 years (July 2018 – June 2023), to better represent current conditions. **Table 3** presents a summary of the hardness data collected at the MES in each watershed during wet weather, including the number of samples, minimum, maximum, and average values. **Table 4** provides a summary of the zinc data collected at the MES in each watershed during wet and dry weather, including the number of samples, minimum, maximum, average, and standard deviation values, and the number and percentage of samples that exceeded the applicable TMDL numeric targets. While the Zinc Recalculation Study is focused on the acute zinc criterion applied to wet weather conditions, dry weather zinc results are summarized in **Table 4**. The results of this evaluation indicate that wet weather TMDL targets are consistently exceeded. The data demonstrate that there are no exceedances of dry weather TMDL targets or chronic CTR criteria at the MES in any of the Study watersheds during dry weather.

¹⁰ The Dominguez Channel Toxics TMDL defined wet weather as days when the maximum daily flow meets or exceeds 62.7 cfs. All other days are defined as dry weather.

Table 3. Typical Hardness at LA River, Ballona Creek, and Dominguez Channel Mass Emissions Stations During Wet and Dry Weather

Watershed	Weather Condition	Hardness (mg/L)							
		Last 12 Years (July 2011 – June 2023)				Last 5 Years (July 2018 – June 2023)			
		<i>N</i>	<i>Min</i>	<i>Max</i>	<i>Avg</i>	<i>N</i>	<i>Min</i>	<i>Max</i>	<i>Avg</i>
LA River Watershed (S10 – LAR Reach 1 at Wardlow)	Wet	50	26 ⁽¹⁾	200 ⁽²⁾	81 ⁽³⁾	18	26 ⁽¹⁾	134 ⁽²⁾	65 ⁽³⁾
	Dry	23	160 ⁽¹⁾	331	242 ⁽³⁾	9	210 ⁽¹⁾	331	281 ⁽³⁾
Ballona Creek Watershed (S01 – BC Reach 2 at Sawtelle)	Wet	63	26	235	70	15	24	69	42
	Dry	75	210 ⁽¹⁾	529	376 ⁽³⁾	15	275	529	398
Dominguez Channel Watershed (S28 – DC at Artesia)	Wet	43	16	190	52	15	16	61	31
	Dry	24	157	450	302	10	157	450	299

1. Lower hardness values were reported during a few events, but these results were anomalously low, flagged as outliers, and may be the result of a reporting or data entry error.
2. Higher hardness value reported during one event, but was anomalously high, flagged as an outlier, and may be the result of a reporting or data entry error.
3. Anomalously low and/or high hardness values removed from average calculation.

Table 4. Summary of Total and Dissolved Zinc Water Quality Data Collected During Wet and Dry Weather at the Los Angeles River, Ballona Creek, and Dominguez Channel Mass Emission Stations

Waterbody	Fraction	Target ^[1] (µg/L)	Last 12 Years (July 2011 – June 2023)						Last 5 Years (July 2018 – June 2023)					
			N	Min	Max	Avg.	Std Dev	% Exceed	N	Min	Max	Avg.	Std Dev	% Exceed
				µg/L						µg/L				
Wet Weather														
LA River Reach 1 (S10 – LAR at Wardlow)	Total	159	50	48	1,280	306	263	66%	18	48	870	210	201	39%
	Dissolved	97	50	4	988	173	223	44%	18	4	248	60	55.0	11%
Ballona Creek Reach 2 (S01 – BC at Sawtelle)	Total	104.8	63	47	1,780	464	331	95%	15	130	1,180	443	302	100%
	Dissolved	99	63	15	970	141	174	37%	15	15	110	59	27.0	7%
Dominguez Channel (S28 – DC at Artesia)	Total	69.6	43	107	1,850	436	354	100%	15	122	854	328	203	100%
	Dissolved	65.13	43	35	1,510	235	312	72%	15	35	128	68	105	47%
Dry Weather														
LA River Reach 1 ^[2] (S10 – LAR at Wardlow)	Total	CTR	23	22	134	51	29.1	0%	9	22	46	33	7.7	0%
	Dissolved		23	18	94	35	18.1	0%	9	19	35	26	6.0	0%
Ballona Creek Reach 2 (S01 – BC at Sawtelle)	Total	446.55	74	ND	362	42	64.1	0%	15	ND	130	32	31.2	0%
	Dissolved	379.16	75	ND	196	15	24.1	0%	15	ND	21	10	6.7	0%
Dominguez Channel ^[2] (S28 – DC at Artesia)	Total	CTR	24	10	169	49	40.0	0%	10	10	65	25	15.8	0%
	Dissolved		24	3	123	28	26.3	0%	10	3	47	16	13.1	0%

N = Number of samples

1. Target as presented in the TMDLs applicable to each watershed. As noted in the zinc TMDL in the Dominguez Channel Watershed, the freshwater targets for zinc are expressed as a function of total hardness in the waterbody. The zinc target presented corresponds to a hardness of 50 mg/L.
2. The LA River Metals TMDL and Dominguez Channel Toxics TMDL did not establish dry weather numeric targets. Exceedance frequency was determined by comparing each zinc result to the hardness-dependent California Toxics Rule (CTR) criteria value calculated using the corresponding sample hardness. The target for the Ballona Creek Watershed is based on the applicable TMDL.

1.5 Study Goal

To support a long-term vision of enhanced water quality in the Study watersheds, it is essential to establish criteria that appropriately protect beneficial uses. The results from this Study will ultimately help the community set priorities for implementation actions, such as structural and non-structural BMPs to reduce zinc loads from urban runoff. This Study utilizes USEPA guidance in support of the implementation efforts for the Metals TMDLs. Site-specific criteria developed consistent with USEPA guidance will maintain the level of protection of beneficial uses intended by the CTR and the Metals TMDLs. As such, the primary goal of the Study is to:

Update the acute zinc criterion consistent with USEPA guidance by utilizing new data and consideration of site-specific factors within the urbanized areas of the Study watersheds, shown in **Figure 2**, to allow for a re-evaluation of wet weather targets and allocations in the Metals TMDLs, propose National Pollutant Discharge Elimination System (NPDES) permit limits, and/or evaluate wet weather water quality data in the context of 303(d) listings, if appropriate.

1.6 Public Participation

Technical review and public participation for this Study was an open process. Public participation in the development and implementation of this Study consisted of two components:

1. Stakeholder input solicited through workshops and existing public review processes.
2. Technical review by a Technical Advisory Committee (TAC).

Stakeholders were encouraged to participate in the Study process by reviewing and providing comments on the Draft and Final Work Plans, reviewing and commenting on analyses and conclusions presented in subsequent reports, and participating in meetings to discuss work products. The Stakeholder Committee (SC) is open to any interested party or person. Invitations to participate were sent to staff from the Regional Board, SWRCB, USEPA Region 9, as well as other local, state, and federal agencies, and non-governmental organizations (NGOs). Stakeholders can join the process at any time and identification of new participants by existing Stakeholders is welcomed.

A Kickoff Meeting with the SC was held on October 6, 2022 to provide background on the Study watersheds, outline the expected technical approach, summarize the Study work products and schedule, and discuss the stakeholder process and potential TAC members. Stakeholders were encouraged to ask questions and provide feedback during the meeting as well as following the meeting. Additionally, Stakeholders were encouraged to provide contact information for any additional persons or organizations they thought might be interested in participating in the Study.

A second SC Meeting was held on December 13, 2022 to provide an overview of the Draft Work Plan, answer questions, receive input, and discuss next steps related to submittal of comments. The Draft Work Plan was provided to the SC and TAC on December 12, 2022 and comments were requested back from the SC and TAC by January 4, 2023. The comment deadline was extended to January 13, 2023 at the request of a Stakeholder. Comments were received from a member of the public, MS4 Permittees, environmental NGOs, and the three TAC members. Comments were incorporated into the Revised Draft Work Plan and a response to comments table was developed and distributed to the SC and TAC.

The third SC Meeting was held on March 16, 2023 to discuss comments received and revisions made to the Draft Work Plan as well as to answer questions, receive input, and discuss next steps related to submittal of comments on the Revised Draft Work Plan. The Revised Draft Work Plan was provided to the SC and TAC on March 9, 2023 and comments were requested back from the SC and TAC by April 6, 2023. Comments on the Revised Draft Work Plan were received from a member of the public and an environmental NGO. Comments were incorporated into the final Work Plan (LWA 2023b) and a response to comments table was developed and distributed to the SC and TAC.

The fourth SC Meeting was held on June 27, 2023 to provide an overview of the Draft Recalculation Report, answer questions, receive input, and discuss next steps related to submittal of comments. The Draft Recalculation Report was provided to the SC and TAC on June 22, 2023 and comments were requested back from the SC and TAC by September 12, 2023. Comments were received from a member of the public, environmental NGOs, and the three TAC members. Comments were incorporated into the Revised Draft Recalculation Report and a response to comments table was developed and distributed to the SC and TAC.

The fifth SC Meeting was held on December 12, 2023 to discuss comments received and revisions made to the Draft Recalculation Report as well as to answer questions, receive input, and discuss next steps related to submittal of comments on the Revised Draft Recalculation Report. The Revised Draft Recalculation Report was provided to the SC and TAC on December 4, 2023 and comments were requested back from the SC and TAC by January 19, 2024. The comment deadline was extended to January 26, 2024 at the request of a Stakeholder. Comments were received from environmental NGOs and a virtual meeting was held on February 29, 2024 to discuss the comments. Comments were incorporated into the Final Recalculation Report and a response to comments table was developed and distributed to the SC and TAC.

The sixth SC Meeting was held on June 11, 2024 to provide an overview of the Draft Implementation Report, answer questions, receive input, and discuss next steps related to submittal of comments. The Draft Implementation Report was provided to the SC and TAC on May 21, 2024 and comments were requested back from the SC and TAC by June 24, 2024. Comments were received from environmental NGOs and the three TAC members. Comments were incorporated

into the Revised Draft Recalculation Report and a response to comments table was developed and distributed to the SC and TAC.

The seventh and final SC Meeting was held on December 4, 2024 to provide an overview of the Revised Draft Implementation Report, answer questions, receive input, and discuss next steps related to submittal of comments. The Revised Draft Implementation Report was provided to the SC and TAC on November 13, 2024 and comments were requested back from the SC and TAC by December 13, 2024. Comments were received from environmental NGOs and the one TAC member. Comments were incorporated into the Final Recalculation Report and a response to comments table was developed and distributed to the SC and TAC.

The TAC provided technical review and insight that supported implementation of the approach presented in the Work Plan, evaluation of data, and final conclusions. The roles and responsibilities of the TAC include:

- Review and provide comment on the draft and final versions of the Work Plan and Work Plan Reports described in Sections 3 and 4 of the Work Plan.
- Review preliminary data generated through the implementation of the Work Plan and discuss potential modifications, as appropriate.
- Provide independent peer review of technical recommendations from stakeholders.

The TAC members were provided draft and final versions of work products at the same time as the SC. Additionally, the TAC members were provided with the comments submitted by other TAC members and the SC for review and consideration. Although the TAC was not asked to “approve” work products, consensus amongst the TAC on the appropriateness of responses to TAC and SC comments will be sought. Instances where TAC consensus cannot be attained was to be documented in response to comments materials.

To develop the three-member TAC, independent experts with relevant experience were identified by LASAN and input was solicited from the SC. The following five potential TAC members identified by LASAN were presented to the SC during the October 6, 2022 Kickoff Meeting:

- David Buchwalter, PhD (North Carolina State University)
- Charles Delos (Great Lakes Environmental Center)
- Jim McGeer, PhD (Wilfrid Laurier University - Canada)
- David John Riecks-Soucek, PhD (University of Illinois Urbana Champaign)
- Ken Schiff (Southern California Coastal Water Research Project)

Meeting participants were asked to provide feedback during and following the Kickoff Meeting on the potential TAC members identified as well as to identify any additional potential TAC members for consideration. No objections to the five potential TAC members were raised during or following the Kickoff Meeting. After the SC Kickoff Meeting, feedback was received via email from Regional Board staff, GEI Consulting, and Heal the Bay. Regional Board staff indicated they

did not have further suggestions on potential TAC members. Robert Gensemer (Vice President of GEI Consulting) expressed interest in participating on the TAC. Heal the Bay proposed three additional potential TAC members for consideration: Pete Ode (formerly with California Department of Fish and Wildlife), Jenny Jay (Professor at the University of California, Los Angeles), and Charles Hawkins (Professor at Utah State University).

Background information was reviewed for all nine potential TAC members to support the selection of a TAC comprised of three experts. A TAC comprised of three experts was considered preferable and would allow for the inclusion of a range of experience and perspectives, while also being manageable within the schedule and budget of the study (TAC members are compensated for their participation). As the Study is focused on updating a water quality criterion for zinc using USEPA guidance, related experience was considered crucial to their selection. The three TAC members were selected based on their extensive experience working on issues related to toxicity in the aquatic environment with a focus on metals, WQC development and associated guidance, and their availability to commit to participating through the duration of the project. All of the potential TAC members had significant experience in the environmental field, but a number of them had limited experience with metals toxicity in the aquatic environment and/or with USEPA guidance related to the development of aquatic life WQC for metals. **Table 5** provides a list of the TAC members selected.

Table 5. Technical Advisory Committee Members

Member	Affiliation	Expertise
David Buchwalter, PhD	Professor and Coordinator of the Environmental Toxicology Concentration in the Graduate Toxicology Program	Research focused on contaminant bioaccumulation and toxicity and physiological responses to other abiotic stressors (temperature, salinity, hypoxia) in freshwater environments. Research focuses on aquatic insects because of their ecological importance and widespread use as ecological indicators in water quality monitoring programs. Research examines the differential susceptibilities of species based on their physiological diversity. Experienced working with USEPA on metals water quality criteria issues.
	North Carolina State University Department of Biological Sciences	
Charles Delos	<i>Senior Research Scientist</i> Great Lakes Environmental Center (GLEC)	40 years with the USEPA's Office of Water where he was the senior scientist in the aquatic life criteria program, applying his expertise in aquatic toxicology, exposure modeling, and risk assessment. At USEPA, he was instrumental in developing and implementing national water quality criteria and conducting large scale and site-specific pollutant exposure and risk assessments. Charlie was key in developing USEPA's selenium, ammonia, copper, and cadmium criteria, and a copper saltwater biotic ligand model criterion. He wrote the most recent versions of USEPA's site-specific procedures for bioavailability adjustment (Water-Effect Ratio) and species assemblage adjustment (Recalculation Procedure).
Ken Schiff	<i>Deputy Director</i> Southern California Coastal Water Research Project (SCCWRP)	Research cuts across several scientific disciplines and agency departments to assess both environmental and human health risk. The outcome of his research has been widely used in environmental management actions including remediation prioritization and implementation, assessment tool development, testing new technology, and regulatory responses such as NPDES permit conditions, developing TMDLs, and setting water quality standards.

2 STUDY APPROACH

National WQC are intended to protect all waters of the United States. However, 40 CFR 131.11(b)(1)(ii) allows States to establish WQC that are “... modified to reflect site-specific conditions.” The Water Quality Standards Handbook (USEPA 1994b) states that:

Site-specific criteria, as with all water quality criteria, must be based on a sound scientific rationale in order to protect the designated use. Existing guidance and practice are that Environmental Protection Agency (EPA) will approve site-specific criteria developed using appropriate procedures.

Site-specific criteria are intended to provide the level of protection intended by national criteria to support aquatic life of a specific site. Hence, derivation of site-specific criteria does not change the intended level of protection of beneficial uses. A “site” may be defined as a state, region, watershed, waterbody, or segment of waterbody. The USEPA has developed three procedures for deriving site-specific criteria that are described in the Water Quality Standards Handbook:

1. Recalculation Procedure
2. Water-Effect Ratio Procedure
3. Resident Species Procedure

The Zinc Recalculation Study utilizes the Recalculation Procedure to evaluate the wet weather zinc criterion in the urbanized portions of the freshwater waterbodies in the LA River, Ballona Creek, and Dominguez Channel watersheds. The urbanized portions of the Study watersheds are depicted in **Figure 2** and specific waterbodies are listed in **Appendix 1**. The urbanized portions of the Study watersheds encompass the areas subject to the MS4 Permit, which is considered the “Site” for the Study (also referred to as the “Study Area”). As discussed in **Section 1.3.1**, the Regional Board previously approved modifications to the numeric targets and allocations for lead in the LA River Metals TMDL based on SSOs developed using the Recalculation Procedure. The USEPA has also approved modifications to WQC based on the Recalculation Procedure elsewhere in California (e.g., cyanide in San Francisco Bay) and nationally (e.g., cadmium in Colorado). The Recalculation Procedure is therefore a proven approach for developing SSOs based on updated data and local conditions. However, it should be noted that the implementation of previous SSOs does not, on its own, set precedent for implementation of future SSOs.

See the Recalculation Report for detailed discussions on how the Recalculation Procedure was utilized to update the acute zinc criterion.

3 PROPOSED SITE-SPECIFIC OBJECTIVE

Proposed SSO	The proposed SSO for the acute zinc water quality criterion presented in this section is based on the Recalculation Report. The waterbodies and reaches in which these SSO will apply are depicted in Figure 2 and specific waterbodies are listed in Appendix 1 . The CTR contains federally promulgated WQC applicable to California waters for 126 priority pollutants for the protection of aquatic life and human health. WQC for most metals in the CTR are expressed as a function of a WER and hardness. The dissolved zinc acute CTR criterion is expressed as follows:
Metals TMDLs	
MS4 Permit	
Implications of SSOs	
CWC 13241	
Antidegradation	
Anti-backsliding	
Monitoring	

$$Acute = WER * 0.978 * e^{0.8473 * \ln(hardness) + 0.884}$$

The WER has a default value of 1.0 unless there is a site-specific WER that has been approved. No zinc WER has been developed for the three Study watersheds. Rather, as described in **Section 2** and in the Work Plan (LWA, 2023a), the approach for this Study was to recalculate the criteria following USEPA’s Recalculation Procedures. Based on Stakeholder input and as outlined in the Recalculation Report, the acute zinc criterion was recalculated using both the hardness-based approach utilized in the 1995/CTR criteria and the Biotic Ligand Model (BLM) approach. The BLM provides a newer approach for calculating metals criteria based on the most recent science and the various site-specific factors that influence the aqueous bioavailability and toxicity of metals.¹¹ The BLM has already been incorporated into federal WQC recommendations for copper by USEPA (2007). Incorporation of the copper and zinc BLM-based criteria into the Basin Plan has been included in the Regional Board’s Triennial Review process since 2018. Additionally, the SWRCB is evaluating BLM-based criteria and the potential for statewide application.

In comparison with the CTR, the recalculated criterion provides a significant increase in the amount of zinc toxicity data that have been considered, and greatly expands the number of species considered in derivation of the criterion. The CTR is based on the 1995 USEPA update to the 1987 zinc criteria. However, the 1995 update only added a 1988 study on the frog, *Xenopus laevis*, and a 1984 study on *Daphnia magna* to the literature already considered in the 1987 zinc criterion. Therefore, the CTR is based on literature published in the 1980s and earlier and considers 175 toxicity tests representing 44 species in 36 genera (USEPA, 1987; USEPA, 1996). In contrast, the Recalculation Report presents two site-specific recalculated criteria that considered either 434 tests representing 81 species in 65 genera (hardness-based), or 429 tests representing 80 species in 64 genera (BLM-based) from literature published through 2021.

¹¹ Complete chemistry for the BLM considers temperature, pH, dissolved organic carbon, major cations (calcium, magnesium, sodium, and potassium) and major anions (chloride, sulfate, and alkalinity).

The USEPA guidelines for criteria derivation state “*When enough data are available to show that acute toxicity to two or more species is similarly related to a water quality characteristic, the relationship should be taken into account*” (USEPA, 1985). Although historically, the consideration of a *water quality characteristic* has been limited to hardness, it has been well established that a variety of water quality factors in addition to hardness can affect metals bioavailability including pH and natural organic matter (USEPA, 2007 or see the papers reviewed related to zinc bioavailability in Santore et al., 2002; Deforest et al, 2023). The use of the BLM when deriving WQC allows for the consideration of a broader range of water quality factors in the assessment of the reported toxicity data. A BLM-based approach to calculating WQC can be used in a manner that is analogous to that of a hardness-based approach. With either methodology, bioavailability relationships are first used to normalize toxicity data to a consistent set of conditions, and then those same relationships are used to apply the derived criterion to site conditions. The steps in this process are outlined in **Table 6** for both methods.

Table 6. Steps in the Derivation of a Water Quality Criterion Using Either the Hardness-Based Equation or BLM

Steps	Hardness-Based Approach	BLM-Based Approach
1: Collect toxicity data	Record the hardness of the test water used to generate toxicity test result.	Record the pH, dissolved organic carbon (DOC), and major ion concentrations of the test water used to generate toxicity test result.
2: Identify bioavailability relationships	Derive the hardness slope	Calibrate BLM parameters
3: Normalize toxicity data to a reference condition	Normalize to a consistent hardness value (e.g. 100 mg/L)	Normalize to consistent pH, DOC, and major ion concentrations
4: Calculate the Final Acute Value (FAV) from the normalized species sensitivity distribution (SSD)	Calculate the intercept associated with the FAV	Calculate the critical accumulation associated with the FAV
5: Apply the FAV to site conditions	Use the hardness equation to adjust the FAV to site hardness	Use the BLM to adjust the FAV to site pH, DOC, and major ion concentrations
6: Determine the CMC	Divide the FAV by 2	Divide the FAV by 2

With the application of these two approaches, the recalculated acute dissolved zinc criterion at a hardness of 80 mg/L¹² resulted in a CMC of 122.1 µg/L using the hardness equation, and a CMC of 114.9 µg/L using the BLM. Differences between the hardness and BLM approaches reflect the fact that the BLM considers a wider variety of water quality factors, and therefore the

¹² A hardness of 80 mg/L was utilized for presentation purposes the value is similar to the hardness values used to set wet weather TMDL targets in the Study watersheds.

normalization step (Step 3 in **Table 6**) can result in different GMAVs, and different ranks for a specific genus. For example, zinc toxicity data measured in waters with high DOC will be normalized to a lower value using the BLM than with the hardness equation because the hardness equation does not consider DOC.

A comparison of the 1995 WQC, which is the basis of the CTR, to the recalculated acute zinc criteria is shown in **Table 7**. The acute criteria are presented over a range of hardness and DOC values to illustrate how the criteria vary based on potential varying conditions in the Study Area.

Table 7. Comparison of Dissolved USEPA 1995/CTR and Recalculated Acute Zinc Criteria

Hardness (mg/L)	USEPA 1995/CTR Criteria (ug/L)	Recalculated Criteria (ug/L)				
		Hardness Based	BLM Based ⁽¹⁾			
			DOC=1	DOC=2	DOC=5	DOC=10
50	65	82	82	106	179	302
100	117	147	122	146	220	343
200	211	265	199	224	301	429

1. Normalized BLM chemistry at the specified hardness and DOC, and a pH of 7.6 based on USEPA's recipe for moderately hard water.

Since the recalculated hardness equation uses the same hardness slope as the CTR, the difference between the 1995 WQC and the recalculated WQC is due to the much more robust toxicity data available for the recalculated criteria. The greatly expanded SSD used for the recalculated WQC (64 genera compared with 36 for the CTR) means that the recalculated criterion is based on a more accurate representation of species sensitivity

Differences between the hardness-based and the BLM-based recalculated criteria are also evident with the BLM producing lower CMC values in waters with low DOC, and higher CMC values in waters with higher DOC (**Table 7**). The hardness-based equation, of course, is limited to only considering variation in hardness, while the BLM can consider pH, DOC, and changes in major ion composition. As a result, the BLM can more accurately predict variation in metal toxicity with changing chemistry. For example, a comparison of the hardness-based equation and BLM-based predictions for the effects concentration values for several organisms (e.g., effects concentration 50 where mortality is observed in 50% of test organisms) from studies included in the Recalculation Report (**Figure 3**) show that the BLM can more accurately predict the effects of water chemistry compared with the hardness-based equation. Comparisons in **Figure 3** are shown for *Daphnia magna*, *Ceriodaphnia dubia*, and *Oncorhynchus mykiss* (rainbow trout) with r-squared values shown on the figures for the BLM and hardness equation. This improved performance with the BLM is evident even though most of the toxicity data were from studies using synthetic water¹³, where DOC concentrations were low and invariant (see Appendix 2 of the

¹³ Synthetic water is water created for use in toxicity testing based on a recipe outlined in USEPA toxicity testing manuals with the intention of creating a standardized set of conditions and may be prepared with a commercially

Recalculation Report). This result is consistent with other evaluations of the zinc BLM relative to the hardness equation and the improvement is not limited to *D. magna* (DeForest and Van Genderen, 2012; Santore et al, 2002).

A comparison in natural waters shows an even more pronounced advantage of the BLM because while the typical laboratory tests using synthetic waters tend to focus on hardness additions to a base recipe, natural waters have greater variability in water chemistry, with multiple toxicity modifying factors acting simultaneously. The subset of tests from **Figure 3** that were measured in natural waters are shown in **Figure 4** and, as expected, the improvement in performance with the BLM in these samples ($R^2 = 0.79$) compared with the hardness-based equation ($R^2 = 0.50$) is even more pronounced. Similar large improvements in predictive accuracy using the zinc BLM have been demonstrated in natural waters with high DOC for organisms sensitive to zinc (e.g. Besser et al., 2021; Hoang and Tong, 2015). Ultimately, the goal of an SSO is to work well when applied to natural waters.

available mineral water (e.g. Perrier) or with reagent grade salts added to ultra-pure water in order to make a water with a prescribed composition that is suitable for culturing and testing organisms.

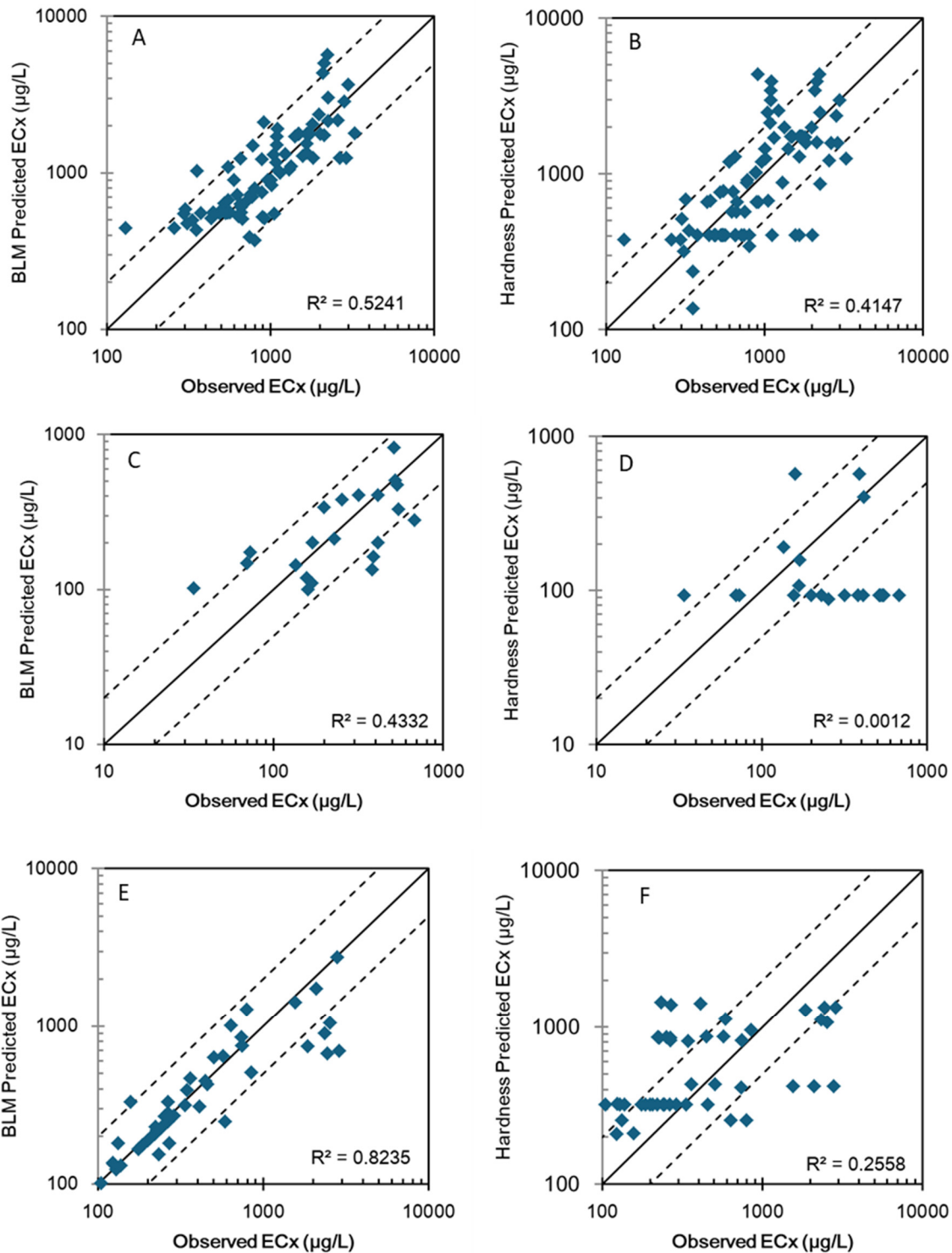


Figure 3. Comparison of the Hardness-Based and BLM-Based Approaches for Predicting Toxicity with Data from the Recalculation Report for *D. magna* (panels A, B), *C. dubia* (panels C, D), and Rainbow Trout (panels E, F)

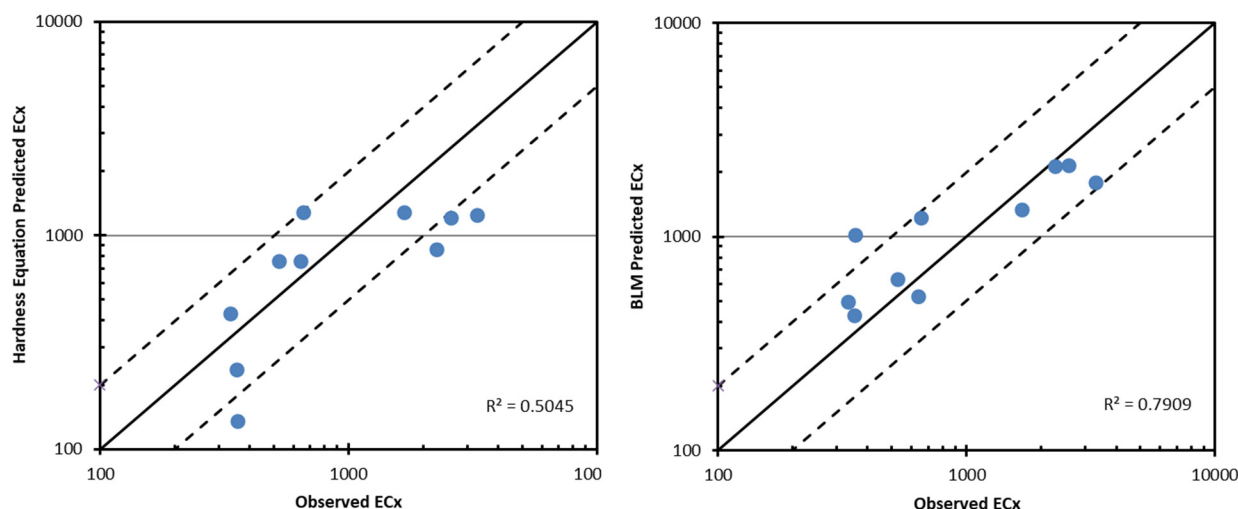


Figure 4. Comparison of the Hardness-Based and BLM-Based Approaches for Predicting the *D. magna* SMAV compared with *D. magna* Toxicity Data from the Recalculation Report (Natural Water Samples Only)

The better performance of the zinc BLM in this comparison is consistent with past evaluations of the BLM in comparison with hardness-based approaches. USEPA, in the 2007 update to the copper criteria, stated that in comparison with the hardness-based equation, the BLM provided “*improved guidance on the concentrations of copper that will be protective of aquatic life*” (USEPA, 2007). Recent reviews of bioavailability approaches have stressed the need to consider multiple toxicity modifying factors in metals risk assessments and that current awareness of factors affecting bioavailability goes well beyond hardness alone (Schlekat et al, 2020). A recent review of bioavailability approaches for zinc concluded that the zinc BLM is more accurate than hardness-based approaches for considering the effects of toxicity modifying factors on zinc toxicity to a wide range of aquatic life (Van Genderen et al, 2020). Lastly, the Regional Board concluded in their 2023-2025 Triennial Review that the BLM is more appropriate for California than other calculation methods.

For all these reasons, the zinc BLM is proposed as the zinc SSO to replace the acute zinc CTR hardness-based criterion. Similar to the acute zinc CTR criterion, which utilizes hardness to calculate numeric criteria values, the BLM requires the following parameters: temperature, pH, DOC, major cations (calcium, magnesium, sodium, and potassium) and major anions (chloride, sulfate, and alkalinity). The BLM itself would be adopted as the SSO rather than establishing a single value to represent a protective level during all wet weather conditions across the Study watersheds. The following presents language that could be incorporated into the Basin Plan:

For the waterbodies in the Los Angeles River, Dominguez Channel, and Ballona Creek watersheds identified in Table x, the dissolved zinc acute water quality objectives (in µg/L) shall be derived using the Biotic Ligand Model (BLM).

The BLM version 3.41.2.45 was used to conduct the recalculation and can be found at the following link: <https://www.windwardenv.com/biotic-ligand-model>. Note that an updated version of the BLM software may be available prior to consideration of an SSO. Table x referenced in the Basin Plan text italicized immediately above is intended to reference the list of waterbodies in the Study Area presented in **Appendix 1** of this report. The adoption of a WQC calculation methodology rather than a singular WQC value is consistent with the hardness-dependent metals criteria in the CTR, the Basin Plan hardness-dependent objective for lead in the Los Angeles River watershed, and the Basin Plan ammonia objectives, which use pH and temperature to calculate the 30-day average objective and pH to calculate the one-hour average. Additionally, this approach is consistent with how other states (e.g., Oregon, Delaware, Idaho, Kansas, Vermont) have incorporated USEPA's currently recommended freshwater copper criteria (USEPA, 2007), which is based on the BLM, into their water quality standards.

4 UTILIZING THE SSO IN THE METALS TMDLS

Proposed SSO
Metals TMDLs
MS4 Permit
Implications of SSOs
CWC 13241
Antidegradation
Anti-backsliding
Monitoring

The proposed SSO is appropriate for updating the targets in the Metals TMDLs, loading capacity, and waste load allocations (WLAs). The Metals TMDLs in the Study watersheds utilized hardness data collected within each of the Study watersheds and the CTR criteria to characterize the number of exceedances by calculating instantaneous water quality criteria (IWQC) and comparing those to measured zinc concentrations (i.e., a zinc result collected on a given date is compared to the corresponding IWQC calculated using hardness collected on that same day to determine if an exceedance occurred). Additionally, the Metals TMDLs used hardness data to calculate TMDL targets using the CTR criteria, which formed the basis for the zinc loading capacity and WLAs. The LA River Metals TMDL and Ballona Creek Metals TMDL utilize the 50th percentile hardness value measured during wet weather to calculate targets, loading capacity, and WLAs. The Dominguez Channel

Toxics TMDL, which is the most recently adopted metals TMDL in the region, also utilizes the 50th percentile hardness value to calculate the TMDL target, but acknowledges that hardness and flow can vary from storm to storm and states that WLAs can be recalculated using ambient hardness and flow rate at the time of sampling.

The proposed approach to modifying the TMDLs is to calculate wet weather TMDL targets based on the SSO. Unlike the current TMDL targets, which are based on the acute zinc CTR criterion, only consider one parameter (hardness), the SSO, which is based on the BLM, considers hardness as well as additional parameters. Given that the multiple parameters utilized in the SSO can co-vary, an alternative to the current approach of calculating the wet weather TMDL targets based on median hardness values could be utilized to more robustly reflect variations in the parameters. The alternative approach proposed is to utilize a fixed monitoring benchmark (FMB). The FMB is a probability-based method that incorporates time variability in BLM-predicted IWQC and instream zinc concentrations. As described in Ryan et. al, 2018, the FMB approach provides benchmarks that can be used to simplify implementation of time-variable WQC that results in the same level of protection as intended by the criteria. It also provides a more robust approach to ensuring the protectiveness of the TMDL target than provided by the current approach of using a 50th percentile hardness.

The FMB considers variability in the SSO and metal concentrations as well as co-variation between them to determine a single concentration that will meet USEPA's recommended limit on exceedance frequencies of once every three years (USEPA, 1996). Variability in criteria values can be significant, whether the criteria were derived using the SSO (using the BLM) or the CTR (using the hardness equation). As identified in the user guide for the BLM version used to develop the SSO (Windward 2019), in order to perform the probabilistic analysis for the FMB, at least 10 samples with SSO parameters and in-stream dissolved zinc concentrations are needed. While this may be an adequate sample size for determining the distributional parameters used by the FMB, it

may not be sufficient to characterize year to year variability in surface water quality. In states where guidance has been developed for the application of BLM based criteria, the recommended sample size is typically 12 to 24 monthly samples¹⁴. **Section 10** presents monitoring considerations.

Consistent with the current TMDLs, the dissolved wet weather TMDL targets would be calculated utilizing the SSO and data collected at the three MES sites in the lower parts of the Study watersheds. The conversion of the dissolved targets to total targets is expected to be conducted consistent with the current approach in the TMDLs, which is to utilize a site-specific regression of dissolved and total zinc concentrations calculated based on measurements of dissolved and total zinc at the MES sites during wet weather. Given that additional data have been collected since the TMDLs were developed, an update to the conversion factors may be warranted using the same method, but with additional data. The loading capacities and allocations would be updated based on the new targets consistent with the TMDLs and the allocations would be assigned to point sources (i.e., MS4s, POTWs, Caltrans, industrial, construction, and minor NPDES permits) as WLAs and to non-point sources (i.e., open space and direct air deposition) as load allocations (LAs). The TMDLs would be expected to retain the existing approach to incorporating a margin of safety. **Figure 5** presents a summary overview of the TMDL update process.

Additionally, the TMDLs would acknowledge that conditions can vary from storm to storm and the targets, loading capacities, and WLAs can be recalculated using ambient conditions at the time of sampling, similar to the Dominguez Channel Toxics TMDL. Lastly, the SSO is based on the dissolved form of zinc, consistent with the CTR. As such, similar to the Ballona Creek Metals TMDL, all three TMDLs would acknowledge that permittees may be deemed in compliance with WQBELs if the dissolved numeric target is not exceeded in the applicable receiving water.

¹⁴ For example, 12 to 24 monthly samples were recommended in the following state implementation guidance documents: CDPHE, 2015; IDNR, 2017; ODEQ, 2016.

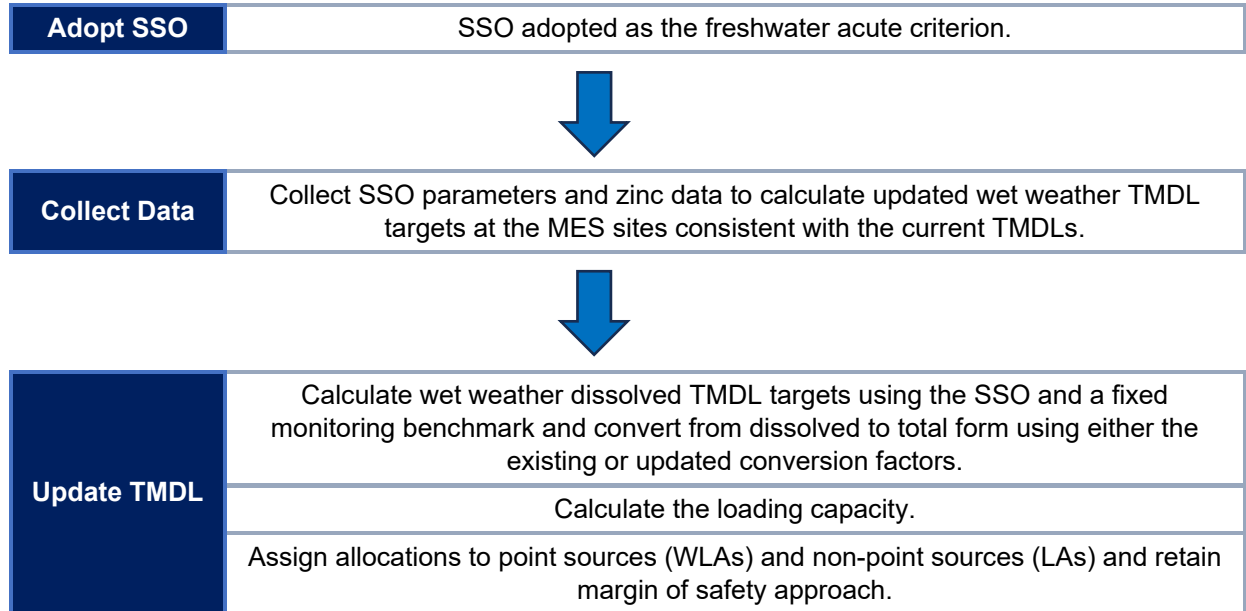


Figure 5. Overview of TMDL Update Process

5 UPDATING LIMITATIONS IN THE MS4 PERMIT

Proposed SSO	Part C of Attachments O, P, and Q to the LA Regional MS4 Permit (Order R4-2021-0105) presents requirements associated with the Metals TMDLs addressing the LA River, Ballona Creek, and Dominguez Channel watersheds, respectively. The attachments include interim and final water quality-based effluent limitations (WQBELs). Attachments O, P, and Q would need to be updated based on the SSO and resulting changes in the Metals TMDL as outlined in Section 4 above.
Metals TMDLs	
MS4 Permit	
Implications of SSOs	
CWC 13241	The following paragraph provides example language that could be incorporated into the LA Regional MS4 Permit to clarify how responsible parties can comply with the WQBELs:
Antidegradation	
Anti-backsliding	
Monitoring	MS4 dischargers can demonstrate compliance with the interim and final WQBELs by demonstrating one of the following conditions:

- There are no exceedances of the WQBELs at the point of discharge from the MS4; or
- There are no exceedances of the dissolved receiving water limitation in the receiving water; or
- There is no direct or indirect discharge from the MS4.

6 IMPLICATIONS OF IMPLEMENTING THE SSOS

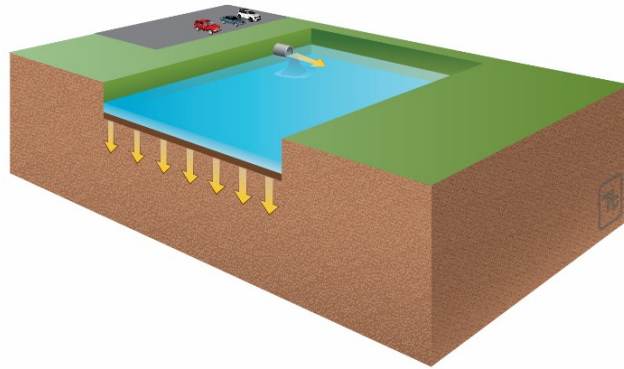
Proposed SSO	Incorporating the SSO into the Basin Plan (and ultimately in the TMDL and NPDES permits) is not expected to increase the risk of zinc impacts to resident organisms based on an updated understanding of zinc toxicity. Utilization of the SSO will result in changes to WLAs in the TMDL and WQBELs in NPDES permits, as described previously. However, stormwater permittees will still be required to meet revised zinc limits to ensure protection of receiving waters. As described in the following subsections, regardless of the adoption of a zinc SSO, MS4 Permittees will need to implement new control measures (i.e., best management practices [BMP]) during wet weather. Control measures include both non-structural source control based BMPs (e.g., street sweeping) which remove pollutants prior to transport via urban runoff and structural BMPs which remove pollutants after they have been transported via urban runoff. Structural BMPs can be applied at the parcel level, typically through low impact development practices, at the street level through green streets¹⁵, or at a larger scale through regional projects which are centralized facilities located near the downstream ends of large drainage areas. The WMPs identify the size and number of structural BMPs needed to reduce pollutants to meet TMDL requirements (e.g., attaining zinc TMDL targets in receiving waters). The WMPs primarily rely on infiltration BMPs (e.g., permeable pavement, infiltration basins, etc.) to reduce loadings from urban runoff, but also utilize detention basins and treatment BMPs (e.g., biofiltration, constructed wetlands, etc.). Figure 6 provide examples of the various regional structural BMPs that are considered in the WMPs for the Study watersheds.
Metals TMDLs	
MS4 Permit	
Implications of SSOS	
CWC 13241	
Antidegradation	
Anti-backsliding	
Monitoring	

Implementation of new control measures addressing zinc and other water quality issues (e.g., bacteria) will result in reductions in zinc concentrations in wet weather urban runoff and receiving waters. The expected outcome of implementation of the SSO is a reprioritization of management efforts to focus BMP implementation on 1) areas where zinc concentrations are more likely to impact aquatic life and 2) higher priority water quality issues.

¹⁵ Green streets are distributed structural practices that are installed parallel to roadways to receive runoff from the gutter via curb cuts or curb extensions and infiltrate it through native or engineered soil media.

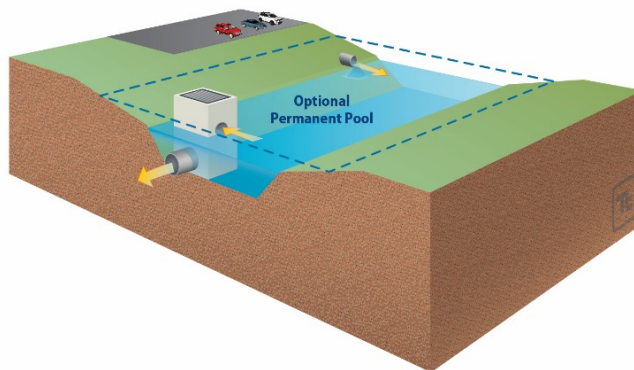
Infiltration Basins

Infiltration facilities are designed to decrease runoff volume through groundwater recharge and improve water quality through filtration and sorption. Infiltration facilities can be open-surface basins or subsurface galleries.



Detention Basins

Detention facilities are designed to detain runoff and improve water quality primarily through pollutant settling. Detention facilities can be open-surface practices or subsurface galleries and can be dry during non-rainy seasons or wet year-round.



Constructed Wetlands

Constructed wetlands are engineered, shallow-marsh systems designed to control and treat stormwater runoff. Particle-bound pollutants are removed through settling, and other pollutants are removed through biogeochemical activity.

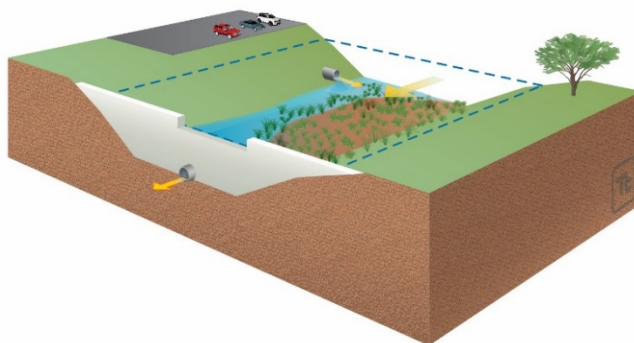


Figure 6. Example Structural Best Management Practices
Source: 2023 Upper Los Angeles River Watershed Management Program

6.1 Implications of SSOs for Watershed Management Programs

When developing the WMPs for the Study watersheds, zinc was determined to be one of two limiting pollutants (along with *E. coli*). As a limiting pollutant, attainment of zinc TMDL targets, which are based on the acute zinc CTR water quality criterion, is expected to drive the BMPs) needed to comply with the MS4 Permit. This section presents an evaluation of the potential impacts of the SSO on BMP capacity (i.e., the volume of water a BMP can manage based on a design storm, which for the WMPs in the Study watersheds is a 24-hour period under the 90th percentile storm condition), and associated implementation costs, as well as the prioritization of BMPs in the Study watersheds. The purpose of the evaluation is to illustrate the implications of potentially updating the acute zinc criterion through the incorporation of new data and consideration of site-specific factors. It is important to illustrate the implications so that regulators, MS4 Permittees, and the public can make informed decisions regarding the level of control measures needed to ensure water quality is protected and limited public resources are effectively used.

To conduct the evaluation to illustrate the potential impacts of the SSO on BMP capacity, acute criterion values were calculated using the SSO. To simplify the evaluation, a range of DOC concentrations were utilized based on the available wet weather receiving water data collected at the three MES sites in the lower parts of the Study watersheds (**Table 8**). All other parameters were held constant to USEPA's moderately hard recipe except for hardness which was set at 75 mg/L to be representative of the range of hardness values used to calculate the acute TMDL targets in the Study watersheds. DOC was selected as the one parameter to vary as it can have a significant effect on the potential for toxicity to aquatic life. The zinc BLM has been shown to accurately predict DOC effects in toxicity tests with DOC ranging as high as 40 mg C/L (Besser, et al 2021). The range of values calculated using the SSO were then divided by hardness based acute zinc CTR criterion calculated using the same hardness (75 mg/L) to generate a ratio. A ratio was used to simplify the calculation of different BMP capacities and associated costs across the range of potential SSO values using the available modeling tools. **Table 9** presents the range of potential SSO and CTR based acute criterion values. **Table 9** also presents the ratios of the current CTR acute zinc criterion to the SSO criterion at varying DOC concentrations. The ratios in **Table 9** are used as the basis for the evaluation presented in the following subsections. The SSO based criteria presented in the following subsections are intended for use in conducting this evaluation and do not represent proposed TMDL targets.

Table 8. Summary of Dissolved Organic Carbon (DOC) Data Collected During Wet Weather at the Los Angeles River, Ballona Creek, and Dominguez Channel Mass Emission Stations

Watershed	Ballona Creek	Dominguez Channel	Los Angeles River
Number of Samples	4	3	15
Date Range	1/2018-1/2024	12/2023-2/2024	2/2006-3/2022
Min (mg/L)	4.9	3.7	5.1
Max (mg/L)	19.0	5.1	53.0
Average (mg/L)	12.3	4.3	18.7
Median (mg/L)	12.6	4.1	15.0

Table 9. Potential Range of SSO Values Based on the Range of Dissolved Organic Carbon (DOC) Measurements in the Study Watersheds During Wet Weather

Hardness (mg/L)	USEPA 1995/ CTR Dissolved Acute Criteria (ug/L)	SSO-Based Dissolved Acute Criteria (ug/L) ⁽¹⁾				Ratio of SSO to CTR Criteria			
		DOC Values (mg/L)							
		5	10	13	15				
75 ⁽²⁾	92	199	321	395	444	2.2	3.5	4.3	4.8

1. Normalized BLM chemistry at the specified hardness and DOC, and a pH of 7.6 based on USEPA's recipe for moderately hard water.
2. TMDL targets were calculated using the 50th percentile hardness values in each of the Study watersheds: 82 mg/L in Ballona Creek, 50 mg/L in Dominguez Channel, and 80 mg/L in the Los Angeles River. 75 mg/L hardness is utilized in this table for illustrative purposes.

6.1.1 Implications of SSOs for BMP Capacity and Costs

To determine the associated BMP capacities and costs, the ratios presented in **Table 9** are used to identify alternative optimized BMP solutions associated with each example load reduction target selected from the respective cost optimization curves within each assessment area addressed in the Ballona Creek, Dominguez Channel, and ULAR WMPs last updated in 2023. The WMPs provide detailed information on the approach to conducting water quality modeling, calculating pollutant load reductions, and determining the BMP capacities and costs. A brief overview of the process for determining BMP capacities and costs is provided in this report. Please see the 2023 WMPs for more detailed information on the approaches for water quality modeling, BMP capacity and location determination, and development of costs. Note that there are additional WMPs in the Los Angeles River watershed; however, this analysis was not completed for those WMPs as those areas are not within the SCWP Watershed Areas funding this Study.

The Reasonable Assurance Analysis (RAA) contained in each of the WMPs follow a similar process for determining the number and sizes of structural BMPs and resulting treatment capacities required to meet water quality standards, including utilizing a limiting pollutant approach. To determine the total BMP capacities and associated costs, the RAAs generally utilize the same process:

1. **Determine the critical condition and Exceedance Volume:** The RAAs use the 90th percentile daily flow rate to define the wet weather critical condition and analyze the volume of runoff during each rolling 24-hour period of a 10-year simulation when water quality targets were exceeded, referred to as the “Exceedance Volume”. The storm that produces the 90th Percentile Exceedance Volume¹⁶ is the critical condition for metals and

¹⁶ The Exceedance Volume is the metric used for the RAA critical conditions because the *volume* of stormwater to be managed ultimately drives the capacity of control measures in the WMPs. The Exceedance Volume allows the volume to be defined based on applicable RWLs and assures attainment of RWLs. For example, a storm that generates a large volume of stormwater runoff with pollutant concentrations slightly above the RWLs is more difficult to manage than a storm that generates a small volume of runoff with concentrations that greatly exceeds the

the overall primary critical condition for management¹⁷ of stormwater in the WMPs. The Exceedance Volume differs for each metal (zinc, copper and lead) and for different subwatersheds (end-of-pipe) and assessment areas (instream) depending on land use, imperviousness, slope, etc. The WMP manages (retains and treats) the Exceedance Volume from each of the modeling subwatersheds to achieve zinc receiving water limitations (RWLs).

- 2. Determine the cost-effective BMP solutions for each subwatershed in the WMP area:** The model analyzes thousands of scenarios considered for an individual subwatershed in the WMP area. The scenarios are based on the available opportunity (*e.g.*, the available footprints for regional BMPs and length of right-of-way for green streets) and predicted performance for controlling zinc if BMPs were implemented at those opportunities with varying sizes. The most cost-effective BMP solutions for each of the subwatersheds provide the basis for cost optimization.
- 3. Determine the cost-effective scenarios for each jurisdiction in the WMP Group:** By rolling up the BMP solutions from the subwatershed level to a jurisdictional level, the most cost-effective scenarios for each jurisdiction can be determined for a wide range of required zinc reductions. These “cost optimization curves” provide a potential WMP Implementation Strategy for a range of required reductions. Each scenario is a “recipe for compliance” for all the subwatersheds in the jurisdictional area (for a given percent reduction).
- 4. Extract the cost-effective scenarios for the required reduction:** The required zinc reductions determine the specific scenario that is selected from the cost optimization curves. All jurisdictions within the assessment areas are held to the same percent reduction. The selected scenarios become the WMP Implementation Strategy. The extracted control measures comprise a detailed recipe for compliance with RWLs for metals and other Water Quality Priorities for each subwatershed in the jurisdictional area.
- 5. Route the critical bacteria storm through the control measures in the extracted scenario:** The effectiveness of the selected control measures for retaining the critical bacteria storm is evaluated.¹⁸ The additional capacity (if any) to retain the critical bacteria storm is determined for each subwatershed.

If there is a decrease in the required reductions to meet the zinc RWLs, then Step 5 has to be repeated to assure that the critical bacteria storm is addressed. A reduction in capacity related to addressing zinc can necessitate an increase in the volume required to address bacteria, which is the case in the examples provided herein. As BMP capacity to address zinc generally decreases, the amount of additional capacity needed to address bacteria increases. Overall, the BMP capacity

RWLs. Also, the Exceedance Volume reflects the effect of varying water quality targets / RWLs – if a target / RWL is increased then the volume of stormwater to be managed is decreased.

¹⁷ The term “manage” incorporates both retention and treatment approaches. Retention of the Exceedance Volume ensures attainment of RWLs. Treatment of the Exceedance Volumes to concentrations below the RWLs also assures RWL attainment. Furthermore, institutional control measures reduce pollutant build-up on watershed surfaces and thus can also decrease the Exceedance Volume.

¹⁸ For addressing bacteria impairments, BMP capture volume is based on capturing the “critical bacteria storm”, which is the 90th percentile wet day when bacteria RWLs apply.

required to achieve zinc TMDL targets progressively decreases as the potential TMDL target calculated using the SSO increase. This trend is consistently maintained across all waterbodies. The distribution of structural BMP capacity also changes with the SSO. In general, planned low impact development (LID) associated with redevelopment and Public Regional BMPs remain unchanged, while Green Streets and Private Regional BMPs capacity progressively decrease as the SSO value increases. BMP capital costs were also computed for each potential criterion calculated using the SSO and show a similar trend to capacity. Capital costs for green streets, Public Regional BMPs, and Private Regional BMPs were included in the WMP; however, the cost for planned LID associated with redevelopment was zero because it is implicit with redevelopment. For this reason, some of the solutions may include capacity and/or cost for those planned BMPs even though no additional management was required to meet the reduction target.

The methodology for how the SSO-based zinc criterion was translated into alternative solutions from the RAA cost-optimization curves is as follows:

1. At each assessment point, modeled instream wet weather concentrations for the current TMDL critical condition, along with each alternative zinc target (i.e., Current TMDL target Zinc concentration of 92 ug/L $\times$ SSO Ratios of 2.2, 3.5, 4.3, and 4.8), were compared against the TMDL critical condition to determine the required load reduction. **Figure 7** illustrates this process using the Dominguez Channel assessment point as an example.
2. Alternative solutions for each SSO were selected from the RAA cost-optimization curve for the contributing area upstream of each assessment point. **Figure 8** illustrates how the zinc load reductions for the TMDL critical condition were used to identify optimized solutions for each alternative solution.
3. The individual BMPs that comprise each alternative zinc solution were selected from the same menu of BMPs needed to address bacteria in each of the Study watersheds. The individual BMPs optimized for both management objectives were compared to assess how much *additional* capacity was needed to address bacteria.
4. In addition to BMP capacities, capital costs associated with each zinc SSO and for additional bacteria BMPs were rolled up for each waterbody assessment point and across WMPs that were part of the SCWP funding this study.

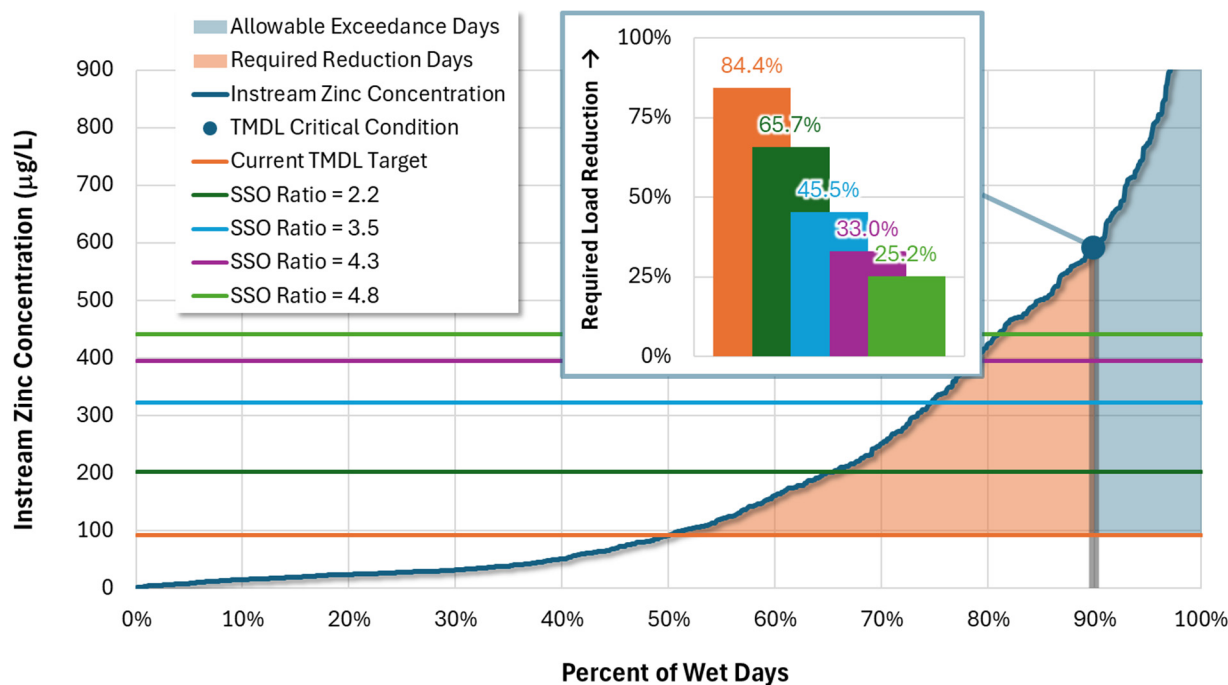


Figure 7. Example Application of Alternative Zinc SSO Values to Instream Wet-Weather Timeseries at the Dominguez Channel Assessment Point

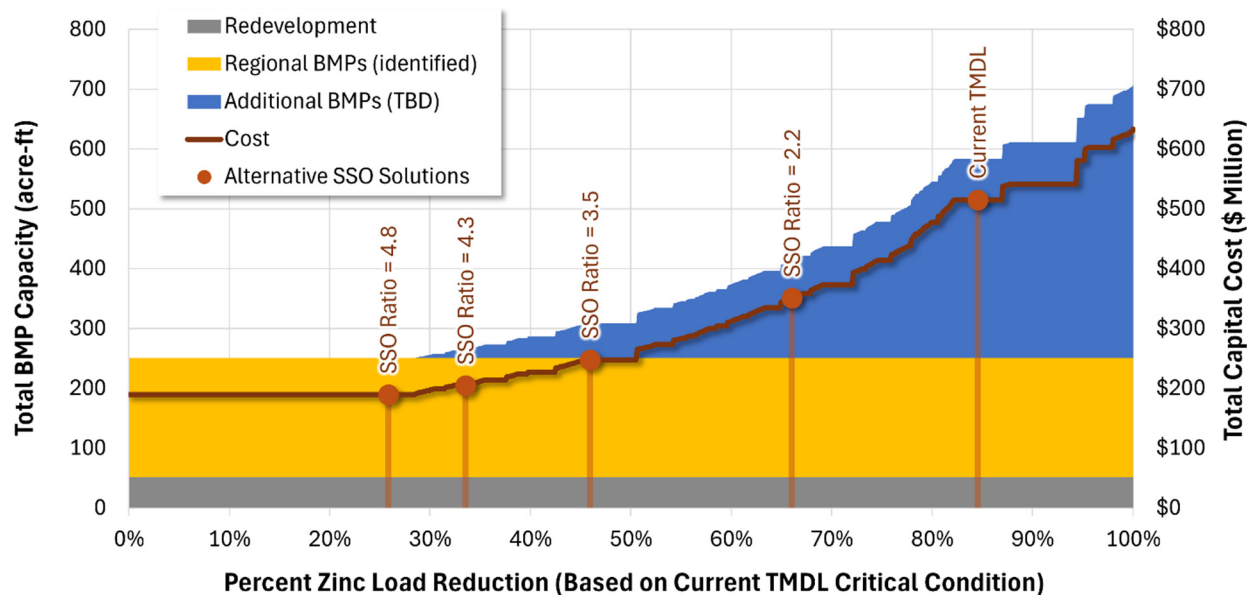


Figure 8. Example Cost-Optimization Curve Showing the Effects of Alternative Zinc SSO Values on the Selected Optimal BMP Solution in Dominguez Channel

(Note: Planned Redevelopment and Identified Regional BMPs appear in every solution regardless of the Zinc SSO)

Figure 9 and **Figure 10** show total BMP capacity and capital cost, respectively, for final compliance through WMP implementation based on the ratios of SSO calculated criterion to the CTR hardness-based criterion for the Ballona Creek, Dominguez Channel, and ULAR WMPs. The potential SSO-based dissolved acute criterion and the corresponding ratios presented in **Table 9** are applied across the Study watersheds equally for the purposes of this analysis. This results in an assumption that the SSO will result in similar changes to the criterion in each Study watershed. However, it is likely that there will be differences in how the SSO changes the criterion in each Study watershed due to differences in the parameters used by the SSO to calculate the acute criterion (such as DOC, see **Table 8**), which is similar to how the hardness-based criterion varies across the watersheds. The assumption that the SSO would result in similar changes across the Study watersheds was made to simplify the presentation of the information. Regardless of the assumption, the effect of the SSO would still be expected to reduce the required capacity and costs for zinc but somewhat increases capacity and costs for bacteria with a net effect of reducing the overall capacity and costs. Capital costs for the WMPs could be reduced by **\$2 to \$3 Billion** overall and capital costs specific to controlling zinc could be reduced by **\$3.8 to \$5.7 Billion (Figure 10)**. These results show that the zinc SSO could have major cost and feasibility impacts on implementation of the WMPs in the Study watersheds while still requiring major investments in BMP capacity to address other water quality issues. In short, the zinc SSO will not change the need to continue to heavily invest in stormwater infrastructure, but nevertheless, it will significantly reduce the overall capacities and costs.

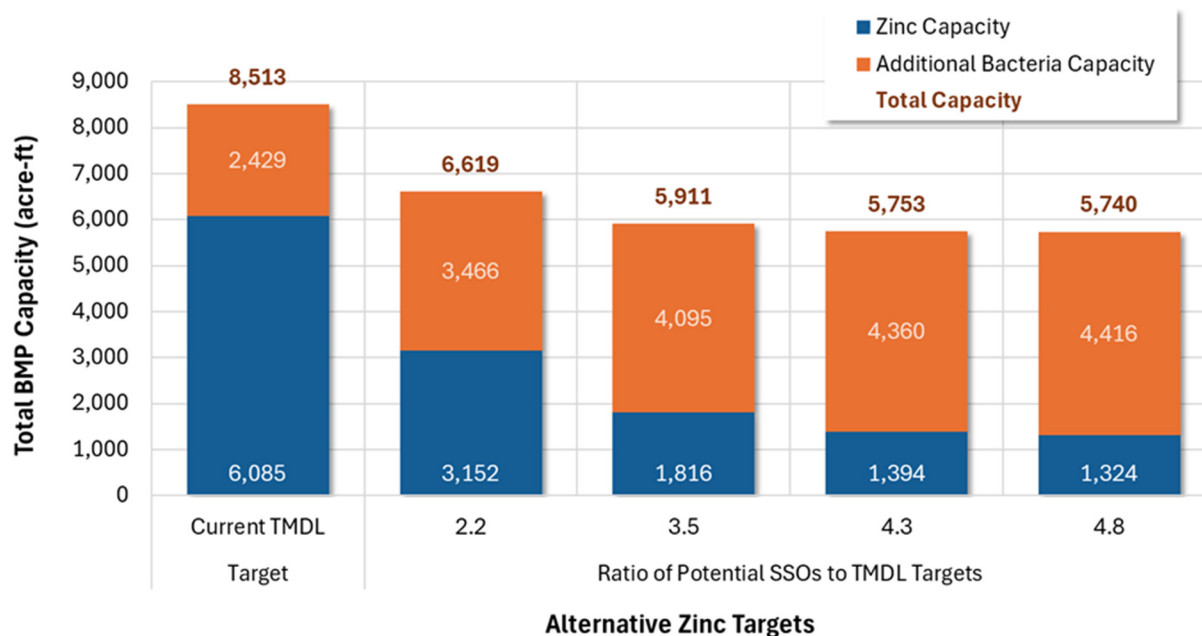


Figure 9. Comparison Between Total BMP Capacity Necessary to Address Metals and Bacteria for the Current Criterion and Several Potential SSOs as Identified in the 2023 Ballona Creek, Dominguez Channel, and Upper Los Angeles River Watershed Management Programs

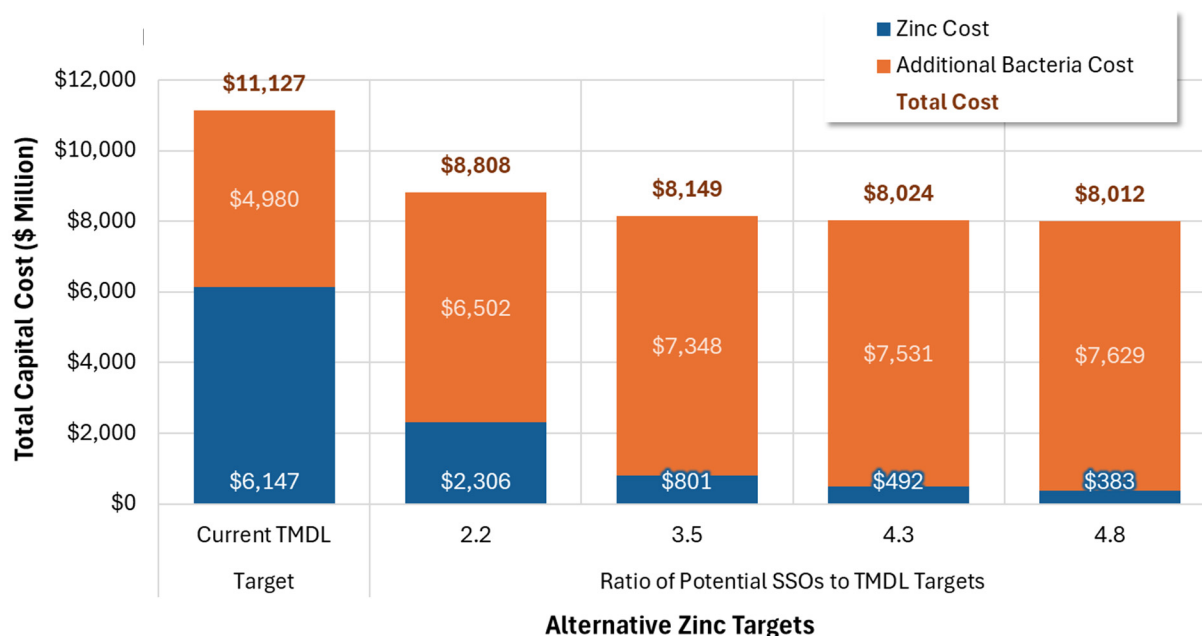


Figure 10. Comparison Between Total Capital Cost Necessary to Address Metals and Bacteria for the Current Criterion and Several Potential SSOs as Identified in the 2023 Ballona Creek, Dominguez Channel, and Upper Los Angeles River Watershed Management Programs

6.1.2 Implications of SSOs for BMP Prioritization

The results from this Study can support setting priorities for implementation actions to reduce zinc loads from urban runoff. As discussed in the preceding section, the SSO is expected to reduce the required capacities across the Study watersheds. However, the reduction in capacities across waterbodies within each Study watershed differ, with some waterbodies impacted more significantly by zinc than others. A close examination of Burbank Western Channel and Compton Creek in the Los Angeles River watershed clearly illustrates this point. While the SSO could reduce the necessary BMP capacities in both waterbodies, the target reductions for zinc do not decrease as significantly in Compton Creek and new BMP capacity continues to be significant (**Table 10** and **Figure 11**). A comparison of Burbank Western Channel and Dominguez Channel shows a similar situation (**Table 11** and **Figure 11**). As such, an agency which discharges to all three waterbodies (e.g., the City of Los Angeles) could use this information to prioritize zinc reduction efforts through source control or BMPs in Compton Creek and Dominguez Channel over the Burbank Western Channel to maximize the benefits of zinc reduction efforts on aquatic life.

Table 10. Potential Changes in BMP Capacity to Address Zinc in the Burbank Western Channel and Compton Creek Based on the Ratio of the Current TMDL Target to Potential Zinc SSO Values

Ratio	Burbank Western Channel			Compton Creek		
	Target Load Reduction (lbs of zinc) ^[1]	Acre-Feet Capacity ^[2]	% Reduction from Capacity to meet Current Criteria	Target Load Reduction (lbs of zinc) ^[1]	Acre-Feet Capacity	% Reduction from Capacity to meet Current Criteria
Current Criteria	65.6	114		82.3	357	
2.2	10.5	20.0	83%	61.0	204	43%
3.5	0.0	15.0	86%	37.6	115	68%
4.3	0.0	15.0	86%	23.3	72.0	80%
4.8	0.0	15.0	86%	14.3	52.0	86%

1. The target load reduction is the amount of zinc that needs to be reduced to meet the TMDL target during the critical storm.

2. Note that while the target reduction goes to zero acre-feet, capacity does not go to zero because of existing BMP capacity and new capacity from low impact development practice requirements for redevelopment.

Table 11. Potential Changes in BMP Capacity to Address Zinc in the Burbank Western Channel and Dominguez Channel Based on the Ratio of the Current TMDL Target to Potential Zinc SSO Values

Ratio	Burbank Western Channel			Dominguez Channel		
	Target Load Reduction (lbs of zinc) ^[1]	Acre-Feet Capacity ^[2]	% Reduction from Capacity to meet Current Criteria	Target Load Reduction (lbs of zinc) ^[1]	Acre-Feet Capacity	% Reduction from Capacity to meet Current Criteria
Current Criteria	65.6	114		84.5	609	
2.2	10.5	20.0	83%	66.0	419	31%
3.5	0.0	15.0	86%	45.9	327	46%
4.3	0.0	15.0	86%	33.5	269	56%
4.8	0.0	15.0	86%	25.8	251	59%

1. The target load reduction is the amount of zinc that needs to be reduced to meet the TMDL target during the critical storm.

2. Note that while the target reduction goes to zero acre-feet, capacity does not go to zero because of existing BMP capacity and new capacity from low impact development practice requirements for redevelopment.

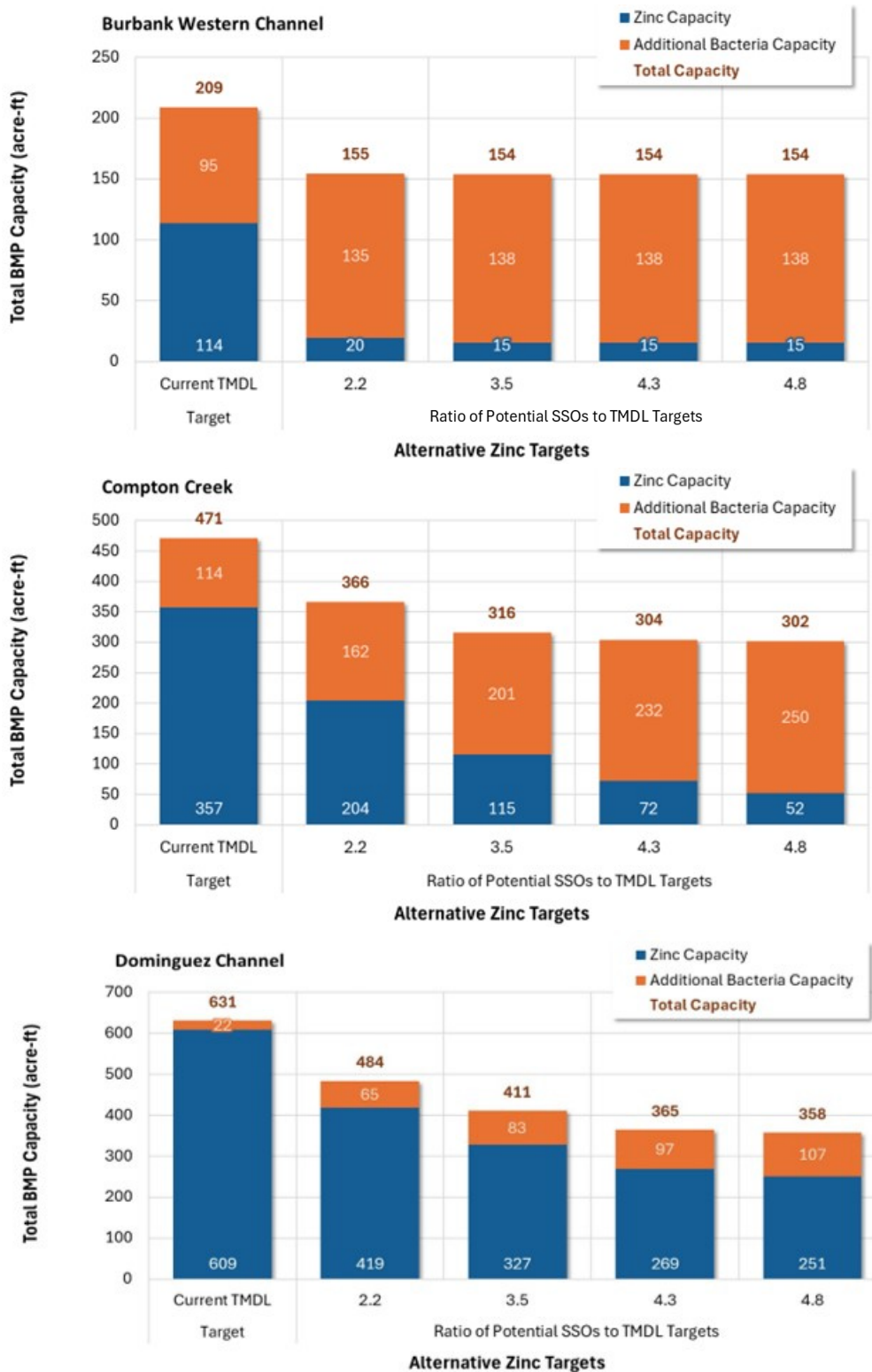


Figure 11. Comparison Between Total BMP Capacity Necessary to Address Metals and Bacteria for the Current Criteria and Several Potential SSOs for the Burbank Western Channel, Compton Creek, and Dominguez Channel Subwatersheds as Identified in the 2023 Ballona Creek, Dominguez Channel, and Upper Los Angeles River Watershed Management Programs

7 CALIFORNIA WATER CODE SECTION 13241 FACTORS

Proposed SSO	When establishing water quality objectives in water quality control plans, Regional Water Quality Control Boards are required to consider the following six factors identified in CWC Section 13241: • Past, present and probable beneficial uses of water. • Environmental characteristics of the hydrographic unit under consideration; including the quality of water available thereto. • Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area. • Economic considerations. • The need for developing housing within the region. • The need to develop and use recycled water.
Metals TMDLs	
MS4 Permit	
Implications of SSOs	
CWC 13241	
Antidegradation	
Anti-backsliding	
Monitoring	

These six factors must be considered in the context of the zinc SSO, and are evaluated in the following subsections. The following analysis is consistent with previous SSO adoptions within the Los Angeles Region (e.g., *Site Specific Objectives for Ammonia in the San Gabriel, Los Angeles, and Santa Clara River Watersheds* (LARWQCB, 2007) and revisions to copper and lead objectives in the LA River Watershed (LARWQCB, 2015).

7.1 Beneficial Uses of Water

Definitions of the designated beneficial uses for waterbodies can be found in Chapter 2 of the Basin Plan. The proposed zinc SSO primarily protects beneficial uses of freshwater related to aquatic life beneficial uses that may include, but not limited to, warm freshwater habitat (WARM), cold freshwater habitat (COLD), wildlife habitat (WILD), rare, threatened or endangered species (RARE), migration of aquatic organisms (MIGR), spawning, reproduction, and/or early development (SPWN), wetland habitat (WET), estuarine habitat (EST), aquaculture (AQUA), commercial and sport fishing (COMM), and shellfish harvesting (SHELL). For zinc, the objectives to protect aquatic life beneficial uses are the most restrictive (lowest) objectives that apply in these waters because these are the uses that are most sensitive to concentrations of trace metals. This will remain the case if the proposed SSO is implemented. Consequently, an SSO for these metals which are protective of aquatic life beneficial uses will also be protective of all other existing and potential beneficial uses.

The goal of developing a zinc SSO for the Study watersheds is to take into account site-specific conditions in these waterbodies to modify the acute water quality objective for zinc such that the objectives will still be fully protective of the aquatic life present. The Recalculation Procedure, developed by USEPA and used as the basis for the proposed SSO, is designed to ensure that the modified water quality objectives are as protective of aquatic life as the national criteria. The

Criteria Guidelines (USEPA, 1985) sets forth procedures to ensure that USEPA's recommended national criteria are protective. The Recalculation Procedure is designed to achieve this same standard of protection for local water quality objectives, while taking into account site-specific characteristics of the waterbodies. Based on the characteristics of the underlying criteria and the fact that the procedure to develop the SSO is based on updating the toxicity data underlying a criterion or reflecting site-specific conditions (the recalculation of the acute criterion did both) and the aquatic life beneficial use is recognized as the most sensitive use to these metals, all past, present, and probable future beneficial uses are as protected by the acute zinc SSO as by the acute CTR criterion for zinc.

7.2 Environmental Characteristics of the Hydrographic Unit Under Consideration

The environmental characteristics of the relevant hydrographic units under consideration are described in Chapters 1 through 3 of the Basin Plan. The toxicity of a metal to aquatic life is influenced by a variety of physical and chemical characteristics of both the site water and the metal itself. Bioavailability and toxicity of zinc is dependent on site-specific factors such as pH, hardness, suspended solids, dissolved carbon compounds, salinity, and other constituents. If there is a difference in toxicity due to the local site water and it is not taken into account, the aquatic life criteria for the waterbody will be more or less protective than intended by the Criteria Guidelines (USEPA, 1985).

In the case of the Recalculation Procedure for developing SSOs, the method is intended to take into account relevant differences between the sensitivity of species in the national dataset and those present in local waterbodies (instead of differences in water quality conditions) or can also consist simply of updates or revisions in the data set (not necessarily site-specific updates). Both updates to the data set and species present in local waterbodies were considered for the acute zinc SSO.

Because of the potential for site-specific conditions to vary from the conditions used to derive the national aquatic life criteria, USEPA provided guidance for three procedures that may be used to modify national criteria to account for site-specific characteristics (USEPA, 1994).

7.3 Water Quality Conditions that Could Reasonably be Achieved

The environmental setting of the watershed and the environmental factors affecting water quality and beneficial uses in these watersheds are described in Chapters 1 through 3 of the Basin Plan. As described in the LARWQCB Staff Reports incorporating SSOs for ammonia (LARWQCB 2008) and metals (LARWQCB 2015) into the Basin Plan, the adopted water quality standards are considered as the baseline or benchmark of water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the affected waters. This same assessment applies equally for SSOs, and no additional analysis beyond that set forth is required.

7.4 Economic Considerations

Municipalities, Caltrans, and other entities are regulated under stormwater permits to discharge to the waterbodies affected by the SSO and are expected to be the primary parties involved in compliance with the revised objective. Implementation of the SSO is not expected to require additional management or control for stormwater management agencies beyond what is currently required. Rather, the requirements are expected to decrease as discussed in **Section 6.1**. Additional monitoring, in addition to current stormwater permit required monitoring, will be necessary (**Section 10**), but is relatively minor in comparison to management or control measures. Based on these findings, the incremental economic cost of implementation of the SSOs beyond what has already been required to meet existing objectives is expected to decrease for the regulated community. Additionally, there is no cost expected due to environmental degradation because the BLM-based acute zinc criterion, which is the basis for the proposed modifications, is designed to result in an SSO that is equally protective of aquatic life (and as a result equally protective of all other beneficial uses) as intended for acute zinc CTR criterion. Therefore, while the proposed SSO is expected to result in higher criterion than the current acute zinc CTR criterion, the change will not result in a decrease in the level of protection below the national standard.

7.5 The Need to Develop Housing Within the Region

The adoption and implementation of an SSO for the acute zinc criterion is not expected to affect the development of housing in Los Angeles County. Modification of the objective is not expected to require additional treatment of wastewater or additional management of stormwater that could result in increased county or municipal costs that would in turn be transferred as increased cost to homeowners. The SSO will not result in increased pollution with the potential to make the area undesirable for new housing development. Instead, implementation of the SSO would provide an appropriate level of protection to support a healthy aquatic environment.

7.6 The Need to Develop and Use Recycled Water

The SWRCB adopted the Policy for Water Quality Control for Recycled Water (Recycled Water Policy) in 2009 (Resolution No. 2009-011) and amended it in 2018 (Resolution No. 2018-0057). As described on the SWRCB's website¹⁹, the Recycled Water Policy encourages the safe use of recycled water sources in a manner that implements state and federal water quality laws and protects public health and the environment. The difference in the allowable zinc concentrations with or without an SSO is not significant relative to potential impacts on the development or use of recycled water because recycled water requires specified minimum water quality treatment technologies that depend on the end use of the recycled water. The concentrations required by the acute zinc CTR criterion and the proposed SSO are both acceptable for application of the specified treatment technologies for recycled water. Adopting the proposed SSO should not affect dischargers ability to recycle their effluent and comply with the Recycled Water Policy.

¹⁹ https://www.waterboards.ca.gov/water_issues/programs/recycled_water/ visited on March 26, 2024.

8 ANTIDEGRADATION REVIEW

Proposed SSO	The purpose of this section is to evaluate the implementation of the recommended SSO for consistency with the Federal and State antidegradation policies. Antidegradation policies adopted at both the Federal and State levels are intended to protect and maintain existing water quality. The antidegradation analysis herein is conducted for the SSO presented in Section 3 . It is assumed that the SSO will be adopted into the Basin Plan.
Metals TMDLs	
MS4 Permit	
Implications of SSOs	
CWC 13241	
Antidegradation	The findings presented in this section are consistent with the adoption of previous SSOs in the region for copper in the Calleguas Creek Watershed (LARWQCB Resolution 2006-003); ammonia in the San Gabriel, Los Angeles, and Santa Clara River watersheds (LARWQCB Resolution 2007-005), and copper and lead in the Los Angeles River watershed (LARWQCB Resolution R15-004). Similar to the adoption of the copper, lead, and ammonia SSOs, the proposed SSO will not lower the water quality of the waterbodies relative to existing conditions because additional loadings of zinc are not anticipated. Additionally, USEPA’s Recalculation Procedure is designed to result in SSOs that are equally protective of aquatic life (and as a result equally protective of all other beneficial uses) as intended for the national criteria. Therefore, the modifications are consistent with the State’s antidegradation policy (State Board Resolution 68-16) and federal antidegradation requirements.
Anti-backsliding	
Monitoring	

The Federal antidegradation policy, originally adopted in 1975, is expressed as a regulation in 40 CFR 131.12 and requires that “water quality shall be maintained and protected”. More specifically, this Federal regulation requires States to develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy (i.e., to protect existing water quality). The State’s antidegradation policy and implementation methods shall, at a minimum, be consistent with ensuring that existing water uses and the water quality necessary to protect these uses shall be maintained and protected. Where the quality of waters exceeds that necessary to support beneficial uses, measures shall be taken to ensure that water quality is maintained and protected unless the State finds that allowing degradation of water quality is necessary to accommodate important economic or social development in the area in which the waters are located.

The State’s policy for maintaining high quality waters in California was adopted in 1968 as a resolution of the SWRCB (Resolution No. 68-16). State policy requires that changes in water quality do not unreasonably affect beneficial uses, and sets forth the following requirements:

“Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and

anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.”

“Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.”

Essentially, the State’s antidegradation policy applies specifically to constrain activities that may result in lower water quality (e.g., substantially increased discharge volumes, new discharges, decreased discharge quality), and conversely does not restrict proposed activities that are not expected to change water quality. If a proposed activity does not change water quality, the State’s requirement to demonstrate that the change is “consistent with the maximum benefit to the people of the State” is not triggered. Water Quality Standards (described as *water quality criteria + beneficial use designations + antidegradation provisions*) define the water quality needed to protect beneficial uses. Changes in the water quality objectives or criteria (including SSOs) that are part of the water quality standards will affect permits and TMDL targets and allocations, *but do not change (or degrade) the actual water quality*. Consequently, implementation of the proposed SSO does not require the State to demonstrate that degradation of water quality is necessary to accommodate important economic or social development.

The Study watersheds are not considered high-quality waters as defined in State and federal antidegradation policies. The Study watersheds have been listed on California’s 303(d) List for impairments, including for zinc, for numerous listing cycles. Because the Study watersheds are not considered high-quality waters, existing beneficial uses and the water quality necessary to protect the uses must be maintained or achieved to meet the requirements of the State and federal antidegradation policies. The proposed SSO and subsequent TMDL revisions are not expected to lower the water quality in the Study watersheds and, therefore, comply with the requirement to be consistent with the maximum benefit to the people of the State. Adopting the proposed SSO reflect on-site water conditions. Since the SSO is not expected to lower water quality, there will be no effects on present and anticipated beneficial uses in the Study watersheds nor will implementation of the SSO through TMDL amendments and NPDES permits result in water quality less than prescribed in State and federal antidegradation policies.

9 ANTI-BACKSLIDING REVIEW

Proposed SSO	Anti-backsliding requirements apply when an NPDES permit is reissued and requires an assessment of whether the newly proposed effluent limitations, standards or conditions are at least as stringent as the final effluent limitations, standards, or conditions in the previous permit. If less stringent, then the revised effluent limits must be reviewed for consistency with the anti-backsliding provisions of the Clean Water Act (CWA) and associated regulations. As no effluent limits are proposed as part of the Implementation Report, an anti-backsliding analysis cannot be completed at this time. However, this section provides a summary of anti-backsliding requirements for informational purposes.
Metals TMDLs	
MS4 Permit	
Implications of SSOs	
CWC 13241	
Antidegradation	
Anti-backsliding	Section 402(o) of the CWA (33 U.S.C. §1342(o)) prohibits specific backsliding, provides exceptions to this general prohibition, and includes a floor that provides a limitation on how far a limit can backslide. Section 402(o) allows revisions to effluent limitations based
Monitoring	

on State water quality standards if one of the exceptions in section 402(o)(2) is met or if the revision is consistent with CWA section 303(d)(4). Sections 402(o)(2) and 303(d)(4) provide independent exceptions. Thus, backsliding is allowed if either of these two CWA provisions are met.

CWA section 303(d)(4) contains two parts and the applicable part depends on whether the water quality standards have been met in the receiving waters.

- Section 303(d)(4)(A) – Where the applicable water quality standard has not yet been attained, a TMDL-based effluent limitation or other WLA may be revised only if (1) the cumulative effect of the revised effluent limitations based on the TMDL or WLA will assure the attainment of the water quality standard, or (2) the designated use which is not being attained is removed or modified in accordance with regulations established under this section.
- Section 303(d)(4)(B) – Where the applicable water quality standard has been attained, an effluent limitation may be revised only if such revision is subject to and consistent with the State’s antidegradation policy.

The applicable water quality standard for zinc has not been attained (see **Table 4**). Additionally, revised effluent limitations would be expected to be based on an updated TMDL that includes revised WLAs that considers the cumulative effect, which are intended to attain the applicable water quality standards. Therefore, the requirement that revised effluent limitations assure the attainment of the applicable water quality standard that has not yet been attained, is met under the section 303(d)(4)(A) exception to the anti-backsliding prohibition.

Alternatively, under the SSO, if the water quality standards are being attained, the exception under section 303(d)(4)(B) would be met since the requirements of the Antidegradation Policy are met as described in **Section 8**.

Additionally, under section 402(o)(2), a permit may be renewed, reissued, or modified to contain a less stringent effluent limitation applicable to a pollutant if any of the exceptions are met. The exception contained in section 402(o)(2)(B) would apply in this instance as backsliding would be allowed since “information is available which was not available at the time of permit issuance ...which would have justified the application of a less stringent effluent limitation at the time of permit issuance.” The SSOs provide such new information. As acknowledged on page 14 of the Staff Report for the Revisions to the TMDL for Nitrogen Compounds and Related Effects in the Los Angeles River (LARWQCB 2012), which incorporated the updated ammonia Basin Plan objectives into the TMDL, “the WER based SSOs provide new information and therefore the POTWs may meet the backsliding exception under CWA section 402(o)(2).”

Lastly, section 402(o)(3) contains what is considered the maximum allowed amount of backsliding, which prohibits revisions of effluent limitations that would result in a violation of applicable water quality standards. As the revised effluent limitations would be based on the revised water quality standard, and the resultant modified TMDL WLAs, there would be no violation of water quality standards to trigger this section.

In summary, it is expected that at least one of the statutory exceptions allowing backsliding would be met.

10 MONITORING

Proposed SSO	As described previously, multiple input parameters are required to calculate a water quality criterion using the SSO. Table 12 presents the water quality parameters needed to utilize the SSO, support updates to the TMDLs, and evaluate TMDL attainment. Table 12 also presents suggested analytical methods and reporting limits. This suite of parameters should be sampled and analyzed consistent with standard monitoring and analytical procedures and include quality assurance and quality control (QA/QC) samples such as field duplicates and field blanks. The receiving water monitoring sites selected for sample collection and the sampling frequency, which is typically three wet events per year based on MS4 Permit monitoring requirements, should be consistent with requirements for assessing TMDL attainment in the Study watersheds. Monitoring and analytical procedures and QA/QC requirements should be documented in a monitoring plan or program document (e.g., Coordinated Integrated Monitoring Program [CIMP]).
Metals TMDLs	
MS4 Permit	
Implications of SSOs	
CWC 13241	
Antidegradation	
Anti-backsliding	
Monitoring	

As identified in the user guide for the BLM version used to develop the SSO (Windward 2019), in order to perform the probabilistic analysis for the FMB, at least 10 samples should be collected during wet weather over multiple seasons at the MES sites located in the three Study watersheds to support calculation of updated TMDL targets. Use of data collected at the MES sites to calculate targets is consistent with the approach currently used in the TMDLs. More than 10 samples collected over multiple wet seasons may be needed to evaluate year to year variability. The potential for year to year variability to impact TMDL targets should be considered when developing monitoring approaches and evaluating data. To determine attainment of the SSO and TMDL targets during wet weather, the suite of parameters needed to calculate the SSO should be collected at the same time dissolved and total zinc samples are collected at receiving water monitoring sites utilized to evaluate attainment of the TMDLs.

Table 12. Water Quality Parameters and Suggested Methods and Reporting Limits for Utilization of the Acute Zinc Site Specific Objective

Constituents	Method ⁽¹⁾	Units	Reporting Limit
Temperature	High stability thermistor	°C	NA
pH	Electrometric	pH units	NA
Dissolved Organic Carbon	SM 5310B	mg/L	0.6
Calcium	EPA 200.8	mg/L	0.1
Magnesium	EPA 200.8	mg/L	0.1
Sodium	EPA 200.8	mg/L	10
Potassium	EPA 200.8	mg/L	10
Sulfate	EPA 300.0	mg/L	1
Chloride	EPA 300.0	mg/L	2
Alkalinity	SM 2320B	mg/L	2
Zinc (<i>dissolved and total</i>) ⁽²⁾	EPA 200.8	µg/L	1

1. Methods may be substituted by an equivalent method that is lower than or meets the project Reporting Limit.
2. Although dissolved and total zinc data are not required to calculate the SSO, dissolved zinc data can be used to compare against the SSO calculated water quality criterion and support calculation of a fixed monitoring benchmark and total zinc data can be used to compare against the total TMDL targets and allocations, and if appropriate, to update the dissolved to zinc conversion factor.

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Appendix 1. List of Study Waterbodies

Watershed	Waterbody	WBD No.	In the Study Area?
Ballona Creek	Ballona Creek Reach 1 (above National Blvd.)	180701040300	Yes
	Ballona Creek Reach 2 (Estuary to National Blvd.)	180701040300	Yes
	Centinela Creek	180701040300	Yes
	Sepulveda Canyon	180701040300	Yes
Dominguez Channel	Dominguez Channel	180701060102	Yes
	Dominguez Channel (above 135th St)	180701060101	Yes
	Dominguez Channel (Estuary to 135th St.)	180701060102	Yes
	Machado Lake	180701040701	Yes
	Torrance Lateral	180701060102	Yes
LA River	Alhambra Wash	180701050303	Yes
	Aliso Canyon Creek (above State Hwy 118)	180701050203	Yes
	Aliso Canyon Wash (Los Angeles River Reach 6 to State Hwy 118)	180701050203	Yes
	Arcadia Wash (405.33)	180701050302	Yes
	Arcadia Wash (405.41)	180701050302	Yes
	Arroyo Calabasas	180701050201	Yes
	Arroyo Seco Reach 1 (Los Angeles River Reach 2 to Holly St.)	180701050209	Yes
	Arroyo Seco Reach 2 (Holly St. to Devils Gate Dam)	180701050209	Yes
	Arroyo Seco Reach 3 (above Devils Gate Dam)	180701050209	Partially Yes
	Bell Creek	180701050105	Yes
	Big Tujunga Canyon Creek (Hansen Flood Control Basin to Big Tujunga Reservoir)	180701050105	Partially Yes
	Browns Canyon Creek (above State Hwy 118)	180701050202	Yes
	Browns Canyon Wash (Los Angeles River Reach 6 to State Hwy 118)	180701050202	Yes
	Bull Creek	180701050204	Yes
	Burbank Western Channel	180701050208	Yes
	Caballero Creek	180701050208	Yes

Watershed	Waterbody	WBD No.	In the Study Area?
LA River	Compton Creek	180701050402	Yes
	Dry Canyon Creek	180701050201	Yes
	Dunsmore Canyon Creek	180701050207	Partially Yes
	Eaton Wash (above dam) (Eaton Dam to Mount Wilson Toll Rd.)	180701050301	Partially Yes
	Eaton Wash (below dam) (Rio Hondo Reach 3 to Eaton Dam)	180701050301	Yes
	Haines Canyon Creek	180701050105	Partially Yes
	Halls Canyon Channel	180701050207	Yes
	Kagel Canyon Creek	180701050104	Partially Yes
	La Tuna Canyon Lateral and Creek	180701050208	Yes
	Limekiln Canyon Wash	180701050203	Yes
	Little Tujunga Canyon Creek	180701050104	Partially Yes
	Lopez Canyon Creek	180701050105	Partially Yes
	Los Angeles River Reach 1 (Estuary to Carson St.)	180701050402	Yes
	Los Angeles River Reach 2 (Carson St. to Rio Hondo Reach 1)	180701050402	Yes
	Los Angeles River Reach 2 (Rio Hondo Reach 1 to Figueroa St.)	180701050401	Yes
	Los Angeles River Reach 3 (Figueroa St. to Riverside Dr.)	180701050402	Yes
	Los Angeles River Reach 4 (Riverside Dr. to Sepulveda Dam)	180701050208	Yes
	Los Angeles River Reach 5 (Sepulveda Dam to Balboa Blvd.)	180701050208	Yes
	Los Angeles River Reach 6 (above Balboa Blvd.)	180701050208	Yes
	McCoy Canyon Creek	180701050201	Yes
	Millard Canyon Creek	180701050209	Partially Yes
	Monrovia Canyon Creek	180701050302	Partially Yes
	Pickens Canyon	180701050207	Partially Yes
	Rio Hondo Reach 1 (Los Angeles River Reach 2 to Santa Ana Freeway)	180701050303	Yes
	Rio Hondo Reach 2 (Santa Ana Freeway to Whittier Narrows Dam)	180701050303	Yes
	Rio Hondo Reach 3 (above Whittier Narrows Dam)	180701050302	Yes
	Rubio Wash	180701050303	Yes

Watershed	Waterbody	WBD No.	In the Study Area?
LA River	Santa Anita Wash (lower) (Rio Hondo Reach 3 to Elkins Ave.)	180701050302	Yes
	Santa Anita Wash (upper) (Elkins Ave. to Big Santa Anita Reservoir)	180701050302	Partially Yes
	Sawpit Canyon Creek	180701050302	Partially Yes
	Sawpit Wash	180701050302	Yes
	Snover Canyon	180701050207	Yes
	Tujunga Wash	180701050208	Yes
	Verdugo Wash Reach 1 (Los Angeles River Reach 3 to Verdugo Rd./Towne St.)	180701050207	Yes
	Verdugo Wash Reach 2 (above Verdugo Rd. @ Towne St.)	180701050207	Yes
	Hansen Flood Control Basin & Lakes	180701050105	Yes
	Echo Park Lake	180701040200	Yes
	Lincoln Park Lake	180701050403	Yes
	Peck Road Park Lake	180701050302	Yes