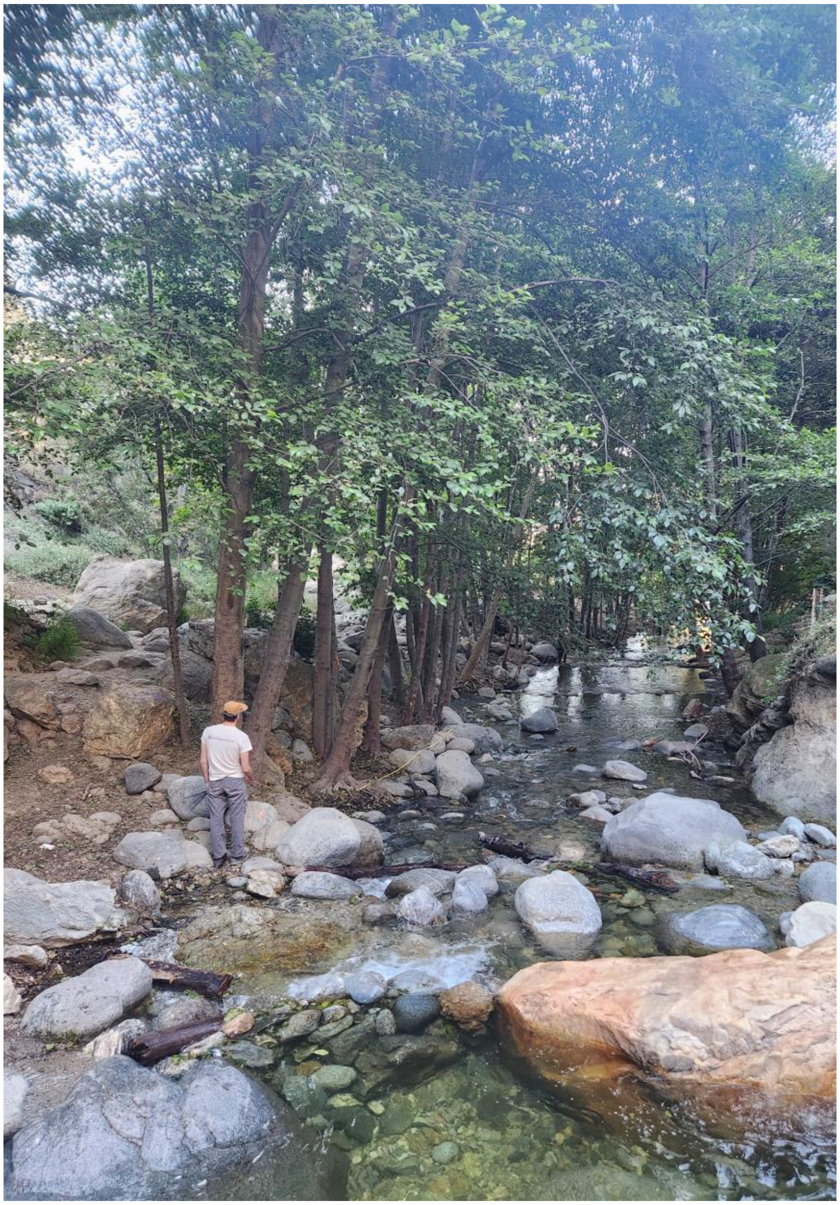
Los Angeles River Watershed Monitoring Program
2023 Annual Report



L.A. Regional Water Quality Control

Los Angeles County Flood Control District

Council for Watershed Health

City of Los Angeles Founded 1781

environment LA Sanitation City of Los Angeles

City of Burbank

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Agencies and Organizations
City of Burbank
City of Los Angeles
Los Angeles County Flood Control District
Los Angeles Regional Water Quality Control Board
Council for Watershed Health
Southern California Coastal Water Research Project
U.S. Environmental Protection Agency (USEPA)
U.S. Forest Service
Heal the Bay
Friends of the LA River (FOLAR)
L.A. Waterkeeper

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List of Acronyms

Algal IBI	Algal Index of Biological Integrity
ATL	Advisory Tissue Levels
ASCI	Algal Stream Condition Index
BMI	Benthic Macroinvertebrate
BOD	Biochemical Oxygen Demand
BWRP	Burbank Water Reclamation Plant
CIMP	Coordinated Integrated Monitoring Program
COD	Chemical Oxygen Demand
CRAM	California Rapid Assessment Method
CRM	Certified Reference Material
CSCI	California Stream Condition Index
CTR	California Toxics Rule
DCTWRP	Donald C. Tillman Water Reclamation Plant
DDT	Dichlorodiphenyltrichloroethane
DNQ	Detect, not quantifiable
DO	Dissolved Oxygen
DQO	Data Quality Objective
EWMP	Enhanced Watershed Management Plan
FCG	Fish Contaminant Goals
GM	Geometric Mean
GN	Glendale Narrows
IBI	Index of Biological Integrity
LAGWRP	Los Angeles Glendale Water Reclamation Plant
LARWQCB	Los Angeles Regional Water Quality Control Board
LARW	Los Angeles River Watershed
LARWMP	Los Angeles River Watershed Monitoring Program
LMP	Lewis MacAdams Park
MDL	Method Detection Limit
MLOE	Multiple Lines of Evidence
MQO	Measurement Quality Objective
MMI	Multi-Metric Index
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSE	Mean squared error
ND	Non-detect
OEHHA	Office of Environmental Health and Hazard Assessment (CA)
PAH	Polycyclic Aromatic Hydrocarbons
PCA	Principal Component Analysis
PCB	Polychlorinated Biphenyl
PHAB	Physical Habitat
POP	Persistent Organic Pollutant. The listed constituents, PCBs and DDTs, are both persistent organic pollutants under the Stockholm Convention.
POTW	Publicly Owned Treatment Works
PPM	Parts Per Million
RF	Random Forest model

RPD	Relative Percent Difference
SGRRMP	San Gabriel River Regional Monitoring Program
SMC	Stormwater Monitoring Coalition
SQO	Sediment Quality Objective
STV	Statistical Threshold Value
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
UEV	Upper Elysian Valley
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WER	Water-Effect Ratio
WQO	Water Quality Objective
WRP	Water Reclamation Plan

Executive Summary

The Los Angeles River Watershed Monitoring Program (LARWMP) conducts annual assessments to better understand the health of a dynamic and predominantly urban watershed. The guiding questions and corresponding monitoring framework of the LARWMP provide both the public and resource managers with an improved understanding of conditions and trends in the watershed.

Question 1. What is the condition of streams in the Los Angeles River Watershed?

Every year the LARWMP program assesses stream condition at random sites located in effluent, urban, and natural sub-regions. The LARWMP program began revisiting random sites to better understand trends across the entire watershed. The findings from the 2023 assessments are summarized below.

- A pattern of better biotic conditions, as demonstrated by higher scores, in the natural regions of the watershed compared to the effluent dominated and urban reaches is consistently seen across bioassessment indices designed to identify locations disturbed by human influence(California Stream Condition Index (CSCI), Algal Stream Condition Index (ASCI), Index of Physical Habitat Integrity (IPI), and California Rapid Assessment Methods (CRAM)). Water quality and physical habitat assessments mirror these patterns.
- The majority of sites are not in reference conditions and have altered biological conditions. Approximately 76% of all random sites were altered or were below the reference conditions for benthic macroinvertebrate communities (CSCI score ≤ 0.79). In addition, riparian zone habitat conditions (CRAM) was below the reference thresholds at roughly 67% of sites, while for algal communities (ASCI - Hybrid) approximately 90% of sites were altered.
- Trend analysis showed a significant downward trend for urban CSCI scores from 2009-2023.
- In 2023, plastic was the most common trash category (72.7%) across all sub-regions, followed by fabric, and metals.
- Wrappers, hard plastic pieces, and cigarette butts are the most common trash items in the watershed.

Question 2. Are conditions at areas of unique interest getting better or worse?

LARWMP conducts periodic monitoring at sites identified by the Technical Stakeholder Group (TSG) as unique areas of interest. In the past this included confluence sites, which were discontinued entirely in 2021 and replaced with soft bottom sites along the main-channel, and riparian areas. Regular and recurring assessment can help build upon our understanding of site conditions and how conditions are changing over time. Findings from this monitoring effort are summarized below.

Trends at Freshwater Target Sites

- A total of 62 samples and assessments have been completed at target sites.
- In 2023, the Lewis MacAdams Park (LMP) (LAR08599) and Glendale Narrows (GN) (LAR10210) were monitored. These sites are important because they are located near

potential Los Angeles River restoration construction projects and may help to resolve any improvements in biological and physical habitat conditions as a result of these projects.
- LMP nitrate-N and total nitrogen concentrations that showed a decline from the previous year.
- Between 2021 and 2023, concentrations of total organic carbon, nitrate, total nitrogen, orthophosphate, and total phosphorus have remained similar *between* LMP and GN sites, likely due to their proximity to each other.
- At LMP (LAR08599) some physical habitat metrics suggested a change in physical habitat conditions. For example, epifaunal substrate score and %sand/fines declined while % canopy cover, %concrete/asphalt, and sediment deposition score increased.
- GN site physical habitat metrics from 2021 and 2023 were generally stable.

High Value Sites

- The best riparian zone conditions have been consistently found at sites located in the upper watershed (prefix LAUT). Some sites in the lower watershed, particularly those downstream of recent fires and undergoing restoration, also have good riparian zone conditions.
- In 2023, Glendale Narrows (LALT400), Sepulveda Basin (LALT405), and Eaton Wash (LALT406) were assessed for riparian habitat condition. CRAM scores for all three sites were below the reference condition.
- CRAM scores at Glendale Narrows (LALT400) and Sepulveda Basin (LALT405) showed improvement since the sites were last assessed (scores improved by ≥ 6 points).
- CRAM scores at Eaton Wash (LALT 406) have remained stable between 2023 and its last assessment in 2021.

Question 3. Are receiving waters near permitted discharges meeting water quality objectives?

Donald C. Tillman Water Reclamation Plant (DCTWRP)

- The statistical threshold value (STV) water quality objective of 320 MPN/100mL for REC-1 beneficial use was attained for approximately 73% of upstream samples and 78% of the downstream samples during the 2023 sampling year.
- In 2023, both upstream and downstream samples of the DCTWRP effluent each exceeded the nitrate-N WQO once.
- There were no exceedances of the ammonia-N WQO.
- Downstream concentrations of arsenic, zinc, lead, copper, and cadmium were below both chronic and acute CTR criteria.
- All four samples upstream of the discharge exceeded the selenium chronic CTR criteria.
- Trihalomethanes concentrations above and below the DCTWRP discharge were below the EPA WQO = 80 µg/L.

Los Angeles Glendale Water Reclamation Plant (LAGWRP)

- Approximately 20% of the *E. coli* samples met the WQO at the upstream site, while approximately 61% of the samples met the WQO at the downstream site.
- In 2023, there was one exceedance of the nitrate-N WQO both upstream and downstream of the LAGWRP discharge point. There were no ammonia-N WQO exceedances.
- All metal concentrations were below the Water-Effect Ratio (WER) adjusted CTR thresholds both upstream and downstream of the LAGWRP outfall.
- Trihalomethanes concentrations above and below the LAGWRP discharge were below the WQO.

Burbank Water Reclamation Plant (BWRP)

- Approximately 18% of upstream and 2% of downstream *E. coli* samples met the WQO.
- BRWP met established nitrate-N WQO for the Burbank Channel. One upstream sample exceeded the ammonia-N WQO.
- Metal concentrations were below the CTR chronic and acute standards for all metals, on all occasions.
- Trihalomethanes concentrations above and below the BWRP discharge were below the WQO.

Question 4. Is it safe to recreate?

LARWMP monitors *E. coli* for permitted and informal recreational sites, including kayak sites. Monitoring occurs from Memorial Day to Labor Day at recreation sites and through September at permitted sites. Results are summarized below.

- During the summer of 2023, a total of 339 water samples were successfully collected from fourteen recreational swim sites popular with visitors and residents of the LA River watershed.
- We found that the Tujunga Wash site at Hansen Dam (LALT 214) and the Bull Creek site (LALT 200) exceeded the REC-1 STV standard of 320 CFU/100 mL for *E. coli* in all three months of sampling. The 6-week rolling geometric mean similarly showed Hansen Dam (LALT 214), and Bull Creek (LALT 200) have consistently higher bacteria concentrations compared to other recreation sites.
- Kayak sites were compared to the single sample LREC standard of 526 CFU/100 mL and were found that exceedances were generally low and infrequent across. The highest percentage of exceedances was 8% at both the Upper (LALT215) and Middle (LALT216) Sepulveda Basin Zones.
- Using the 30-day geometric mean based LREC WQO of 126 MPN, all sites showed exceedances in 2023:
  - Half of sites (LALT216, LALT217, LALT219) exceeded the WQO three (out of four total) sampling months
  - Two sites (LALT215, LALT218) exceeded the WQO two sampling months
  - One site (LALT221) exceeded the WQO one sampling month
- Plastic (56%), metal (16%), biodegradables (13%), and fabric (7%) were the most common categories of trash types across all sites. When analyzing more detailed trash

subcategories across all recreation sites, we found that plastic, wrappers, paper/cardboard, and metal bottle caps were the most common items.

- Like previous years, Vogel Flats (LAUT 220) had the highest total trash count.

Question 5. Are locally caught fish safe to eat?

The goal of this portion of the monitoring program is to improve our understanding of the health risks associated with consuming fish in water bodies popular among anglers.

- Fish tissue contaminant monitoring for 2023 took place at Lake Balboa.
- Species that were caught include common carp, largemouth bass, and tilapia.
- Sample analysis showed that largemouth bass and tilapia are safe for consumption up to three 8-oz servings per week.
- Common carp should be consumed at two 8-oz servings per week.

Introduction

1. Background: The Los Angeles River Watershed

The Los Angeles River watershed (LARW) is a highly urbanized watershed that encompasses western and central portions of Los Angeles County (Figure 0.1). Los Angeles River's headwaters originate in the Santa Monica, Santa Susana, and San Gabriel Mountains and bound the river to the north and west. The river terminates at the San Pedro Bay/Los Angeles and Long Beach Harbor complex, which is semi-enclosed by a 7.5-mile breakwater. The river's tidal prism/estuary begins in Long Beach at Willow Street and runs approximately three miles before joining with Queensway Bay.

The 824 mi^2 of the LARW encompasses forests, natural streams, urban tributaries, residential neighborhoods, and industrial land uses. Approximately 324 mi^2 of the watershed is open space or forest, located mostly in the upper watershed. South of the mountains, the river flows through highly developed residential, commercial, and industrial areas. From the Arroyo Seco, north of downtown Los Angeles, to its confluence with the Rio Hondo, rail yards, freeways, and major commercial development border the river. South of the Rio Hondo, the river flows through industrial, residential, and commercial areas, including major refineries and storage facilities for petroleum products, major freeways, rail lines, and rail yards. While most of the river is lined with concrete, the unlined bottoms of the Sepulveda Flood Control Basin, Glendale Narrows, Compton Creek, and LA River estuary provide riparian habitat that enhances the ecological and recreational value of these areas.

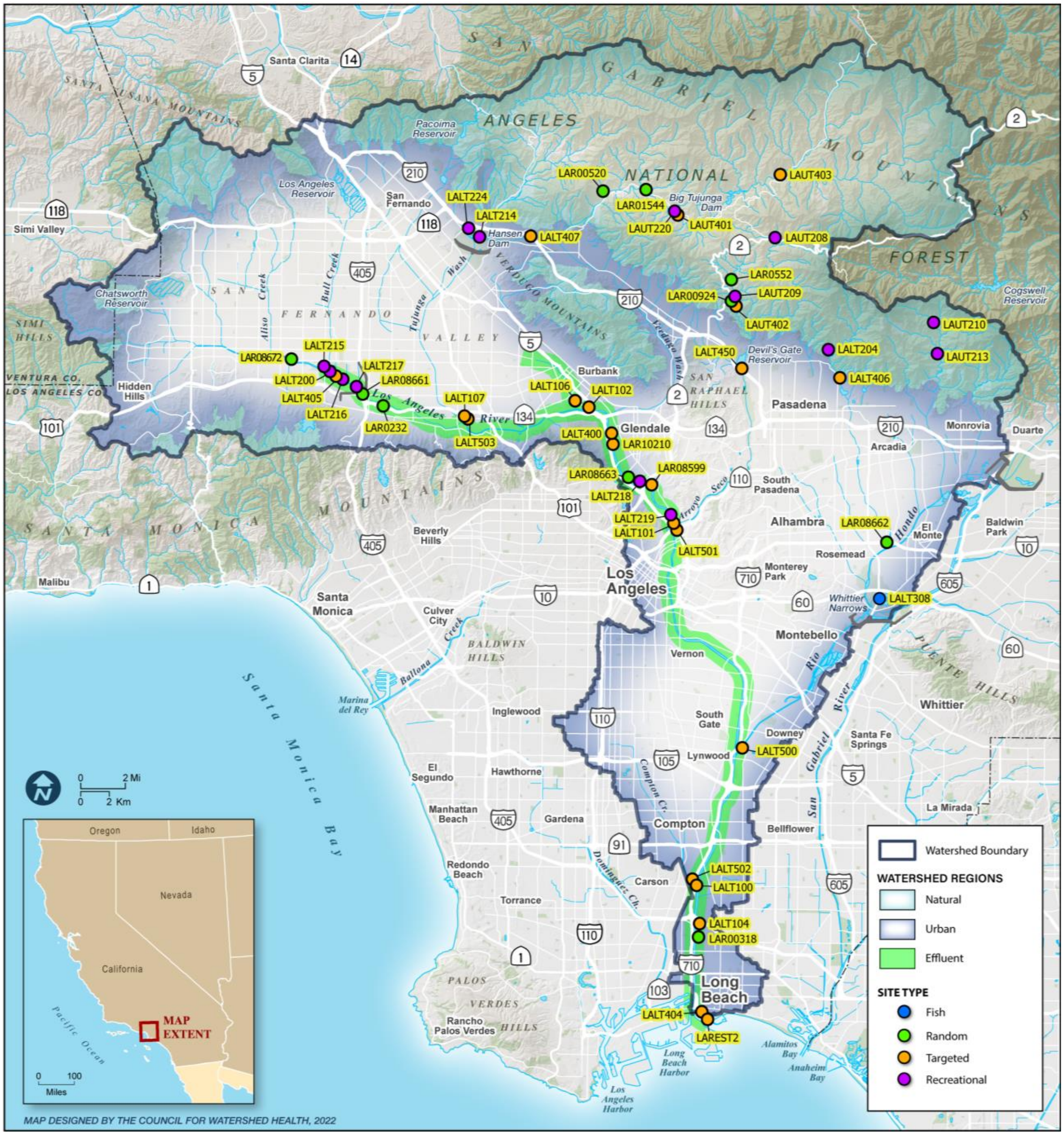


Figure 0.1 2023 Sampling sites in the Los Angeles River Watershed.
Map includes fish, random, targeted, recreational, and high-value sites. Note that targeted sites are sampled on a rotating basis. Not all targeted sites are sampled within a single year

2. The Los Angeles River Watershed Monitoring Program (LARWMP)

In 2007, local, state, and federal stakeholders formed LARWMP, a collaborative monitoring effort shared by partnering agencies, permittees, and conservation organizations. Partners lend technical expertise, guidance, and support monitoring efforts and lab analysis through funding or in-kind services. The 2023 monitoring efforts for bioassessments, habitat assessment, bacteria testing, and fish tissue bioaccumulation, detailed in this report, were supported by five sampling teams, three laboratories, funding from the Cities of Los Angeles and Burbank, and the Los Angeles County Flood Control District (Tables 0.1-0.3).

Prior to the implementation of the LARWMP, most monitoring efforts in the watershed were focused on point source NPDES compliance monitoring and little was known about the ambient condition of streams in the rest of the watershed. Recognizing this shortfall, the Los Angeles Regional Water Quality Control Board (LARWQCB) negotiated with the NPDES permittees to reduce their sampling efforts at redundant sampling sites and to lower sampling frequencies in exchange for greater sampling coverage throughout the watershed. LARWMP's sampling design provides the ability to assess ambient condition throughout the watershed using probabilistically chosen sites and to track trends at fixed (target) sites (Table 0.4). The watershed-scale effort improves the cost effectiveness, standardization, and coordination of various monitoring efforts in the Los Angeles region. LARWMP strives to be responsive to the River's evolving beneficial uses and impairments (Table 0.5) and to provide managers and the public with a more complete picture of conditions and trends in the LARW.

The objectives of the program are to develop a watershed-scale understanding of the condition (health) of surface waters using a monitoring framework that supports comprehensive and periodic assessments of sites along natural and urban streams, the main channel, estuarine habitats, and downstream of treatment works. The strategies of this program often mirror the activities of the larger region-wide monitoring program led by the Stormwater Monitoring Coalition (SMC). This report summarizes the monitoring activities and results for 2023. It is one of a series of annual monitoring reports produced for the LARWMP since 2008.

LARWMP is designed to answer the following five questions:

1. What is the condition of streams in the watershed?
2. Are conditions at areas of unique interest getting better or worse?
3. Are receiving waters near discharges meeting water quality objectives?
4. Is it safe to recreate?
5. Are locally caught fish safe to eat?

Each year, the technical stakeholder group guides the implementation of the program to ensure efforts are responsive to the priorities of both the public and managers. Stakeholders also ensure that the program is consistent in both design and methodology with regional monitoring and assessment efforts.

A more complete description of LARWMP regional setting, motivating questions, its technical design, and its implementation approach can be found in the Los Angeles River Watershed Monitoring Program Monitoring Plan, Annual Reports, the 2023 State of the Watershed, and Quality Assurance Project Plans, which are posted on the project webpage:

https://www.watershedhealth.org/reports.

Table 0.1 Sampling and laboratory analysis responsibilities for random and target sites for 2023

Spring/Summer 2023 Sampling	Site ID	Chemistry			Benthic Macroinvertebrates			Algae			CRAM	
		sampling	lab analysis	funding	sampling	lab analysis	funding	sampling	lab analysis	funding	assessment	funding
Targeted Sample												
Los Angeles River at Marsh Park	LAR08599	Weston	EMD	Cities	Weston	Weston	LACFCD	Weston	Weston	LACFCD	Weston	Cities
Los Angeles River, Glendale Narrows	LAR10210	Weston	EMD	Cities	Weston	Weston	LACFCD	Weston	Weston	LACFCD	Weston	Cities
Random Samples												
Natural (Arroyo Seco)	LAR08698	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Effluent (Los Angeles River)	LAR08695	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Natural (Arroyo Seco)	LAR08702	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Urban (Arroyo Seco)	LAR08694	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Trend Revisit Sites												
Effluent (Los Angeles River)	LAR00318	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Natural (Arroyo Seco)	LAR0552	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Revisit Sites												
Effluent (Los Angeles River)	LAR00436	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Urban (Los Angeles River)	LAR01208	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Natural (Big Tujunga Creek)	LAR0896	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities
Urban (Alhambra Wash)	LAR0020	ABC	EMD	Cities	ABC	ABC	Cities	ABC	Rhithron	Cities	ABC	Cities

Table 0.2 Sampling and laboratory analysis responsibilities for bacteria monitoring in 2023

Spring/Summer Sampling		Microbiology		
	Site ID	Sampling	Lab Analysis	Funding
Recreation Sites				
LA River/Bull Creek Confluence, Sepulveda Basin	LALT200	ABC	EMD	Cities
Eaton Canyon Natural Area Park	LALT204	CWH	EMD	Cities
Tujunga Wash, Hanson Dam	LALT214	ABC	EMD	Cities
Hanson Dam Recreation Lake	LALT224	ABC	EMD	Cities
Arroyo Secco, Oakwilde Campground or Switzer Falls	LAUT208	ABC	EMD	Cities
Arroyo Secco, Gould Mesa Campground	LAUT209	ABC	EMD	Cities
Tujunga Creek, Hidden Springs	LAUT211	ABC	EMD	Cities
Tujunga Creek, Delta Flat Day Use	LAUT206	CWH	EMD	Cities
Tujunga Creek, Vogel Flats	LAUT220	CWH	EMD	Cities
Kayak Sites				
LA River Sepulveda Basin at Balboa Blvd	LALT215	ABC	EMD	Cities
LA River Sepulveda Basin	LALT216	EMD	EMD	Cities
LA River Sepulveda Basin at Sepulveda Dam	LALT217	EMD	EMD	Cities
Los Angeles River at Fletcher Dr	LALT218	EMD	EMD	Cities
Los Angeles River at Steelhead Park	LALT219	EMD	EMD	Cities
Los Angeles River at Elysian Valley	LALT221	EMD	EMD	Cities

Table 0.3 Sampling and laboratory analysis responsibilities for fish tissue bioaccumulation monitoring

Fish Tissue Bioaccumulation Sites			Bioaccumulation		
	Year	Site ID	Sampling	Lab Analysis	Funding
Echo Park (Lake)	2018	LALT300	ABC/DFW	EMD	Cities
Balboa Lake	2017	LALT301	ABC/DFW	EMD	Cities
	2020		ABC/DFW	EMD	Cities
	2023		ABC/DFW	EMD	Cities
Peck Road Park (Lake)	2016	LALT302	ABC/DFW	EMD	Cities
Legg Lake	2021	LALT308	ABC/DFW	EMD	Cities
Belvedere Lake	2014	LALT310	ABC/DFW	EMD	Cities
	2022		ABC/DFW	EMD	Cities
Debs Lake	2015	LALT312	ABC/DFW	EMD	Cities
Reseda Lake	2015	LALT313	ABC/DFW	EMD	Cities
Sepulveda Basin (River)	2019	LALT314	ABC/DFW	EMD	Cities

Table 0.4 Monitoring design, indicators, and sampling frequency

Question	Approach	Sites	Indicators	Frequency
Q1: What is the condition of streams?	Probabalistic design with streams assigned to natural, effluent dominated, urban runoff dominated sub-regions	10 randomly selected each year including 4 new random sites, 4 random sites previously sampled and 2 random sites sampled annually.	Bioassessment using BMIs and attached algae, physical habitat, CRAM, water chemistry, trash	Annually, in spring/summer
Q2: What is the trend of condition at unique areas?	Fixed target sites located to detect changes over time	9 high value habitat sites	Riparian habitat condition: CRAM	2 to 4 sites rotating annually in summer
		2 Los Angeles River soft-bottom sites	Bioassessment, physical habitat, water chemistry	2 sites annually, in spring/summer
Q3: Are receiving waters below discharges meeting water quality objectives?	Use existing NPDES water quality data collected by LA River dischargers from receiving waters upstream and downstream of their discharge points.	Sites located upstream and downstream of discharges: - Los Angeles/Glendale - City of Burbank - Tillman Water Reclamation Plant	Constituents with established water quality standards, e.g. CTR for dissolved metals; *e. coli* bacteria; trihalomethane(s)	Varies depending on permit: monthly, quarterly, annual
Q4: Is it safe to swim?	Swim sites selected based on use by the public	16 sites located in ponds, reservoirs, streams and LA River	*E. coli* , trash	Weekly May to September
Q5: Is it safe to eat locally caught fish?	Focus on popular fishing sites; commonly caught species; measuring high-risk chemicals	1 to 2 sites located in streams, reservoirs, lakes, rivers and estuary	Measure mercury, selenium, DDT and PCB in commonly caught fish at each location	Annually in summer

[1] High-value sites are locations of interest to the TSG or relatively isolated, unique habitat

Table 0.5 Impairments (303d listed) along the main stem of the Los Angeles River by reach (select constituents)
Grey boxes indicate impairment.

Reach	Reach Segment	Ammonia	Benthic Community	Copper	Lead	Nutrients (algae)	Cadmium	Indicator Bacteria	Zinc	pH	Selenium	Toxicity	Trash
LA River Estuary	Queensway Bay											■	■
LA River Reach 1	Estuary to Carson St.	■			■	■	■	■		■			■
LA River Reach 2	Carson to Figueroa St.	■		■	■	■		■					■
LA River Reach 3	Figueroa St. to Riverside Dr.	■		■		■		■				■	■
LA River Reach 4	Sepulveda Dr. to Sepulveda Basin					■		■				■	■
LA River Reach 5	Sepulveda Basin	■	■	■	■	■						■	■
LA River Reach 6	Above Sepulveda Basin			■				■			■	■	

Table 0.6 Select beneficial uses of the main stem of the Los Angeles River
Grey boxes indicate impairment. Note that dots denote reaches where access is prohibited by LA County Department of Public Works. Only limited contact activities, such as fishing and kayaking, are allowed in the Recreation Zone (Reach 3 and 5).[1]

Reach	Reach Segment	IND	GWR	NAV	COMM	WARM	EST	MAR	WILD	RARE	MIGR	SPWN	WET	REC1	REC2
LA River Estuary	Queensway Bay	■		■	■		■	■	■	■	■	■	■	■	■
LA River Reach 1	Estuary to Carson St.		■			■		■	■	■				■ •	■
LA River Reach 2	Carson to Figueroa St.		■			■								■ •	■
LA River Reach 3	Figueroa St. to Riverside Dr.		■			■			■				■	■	■
LA River Reach 4	Sepulveda Dr. to Sepulveda Basin		■			■			■				■	■	■
LA River Reach 5	Sepulveda Basin		■			■			■				■	■	■
LA River Reach 6	Above Sepulveda Basin		■			■			■				■	■	■

[1] Beneficial uses include: IND = Inland ; GWR = Groundwater ; NAV = Navigation ; COMM = Commercial and Sport Fishing; WARM = Warm Freshwater Habitat, EST = Estuarine Habitat, MAR = Marine Habitat; WILD = Wildlife Habitat , RARE = Rare, Threatened, and Endangered, MIGR = Migration, SPWN = Spawn, Reproduction, and Early Development, WET = Wetland Habitat , REC1 = Water Contact Recreation, REC2 = Non-Contact Recreation

Question 1. What is the condition of streams in the Los Angeles River Watershed?

1. Background

To determine the condition of streams in the Los Angeles River watershed, data were collected at 101 random sites during 15 annual surveys from 2009 through 2023 (Figure 1.1). Sites are selected randomly to facilitate drawing statistically valid inferences about an area, rather than about just the site itself. Spatially, these sites are representative of three major sub-regions:

- Natural streams in the upper reaches of both the mainstream and tributaries (i.e., natural sites).

- Effluent-dominated reaches in the mainstream and the lower portions of the estuary (i.e., effluent dominated sites).

- Urban runoff-dominated reaches of tributaries flowing through developed portions of the watershed (i.e., urban sites).

Ambient surveys, which include both physical habitat assessments and bioassessments, can help identify and prioritize sites for protection or rehabilitation based on how sites compare to other regional sites. This type of data provides a measure of ecological health to help better understand whether streams support aquatic life and assigned beneficial uses. Biological communities at stream sites respond to, and integrate, multiple stressors across both space and time, which improves our understanding of the impact of stressors on stream communities (Mazor 2015).

In 2014, the Technical Stakeholder Group (TSG) agreed to modify the LARWMP sampling design based on design changes made by the Southern California Stormwater Monitoring Coalitions (SMC) Regional Monitoring Program. This design modification was made to help improve our ability to detect changing conditions not only in the Los Angeles watershed, but in the whole Southern California region. The design incorporates site revisits at random sites previously sampled by the SMC program. In addition, the program began to re-visit sites previously sampled through the LARWMP program, contributing more information that can help us detect changing conditions in the Los Angeles watershed. One random site known to be a non-perennial stream was also added to the program to help address a regional gap in assessment of non-perennial streams, which make up 25% of stream miles in the watershed (SMC 2015).

Figure 1.1 Map of sites sampled in 2023.

2. Methods

LARWMP employed benthic macroinvertebrates (BMIs), attached algae communities, and riparian zone condition to assess biotic condition. A complete list of biotic condition indicators and water chemistry analytes collected for this program, including methods, units, and detection limits can be found in Table C.1.

a. Benthic Macroinvertebrates and Attached Algae

The field protocols and assessment procedures for BMIs and attached algae followed the protocols described by Ode *et al.* (2016). Briefly, BMIs were collected using a D kick-net from eleven equidistant transects along a 150-m reach and were identified to Level 2 (generally genus) as specified by the Southwest Association of Freshwater Invertebrate Taxonomists, Standard Taxonomic Effort List (SAFIT; Richards and Rogers 2006). Algal samples were collected one meter upstream of where BMI samples were collected.

b. California Stream Condition Index

The California Stream Condition Index (CSCI) was used to assess the BMI community condition. The CSCI is a statewide biological scoring tool that translates complex data about benthic macroinvertebrates (BMIs) found living in a stream into an overall measure of stream health (Mazor *et al*. 2015). The CSCI incorporates two indices, the multi-metric index, helpful in understanding ecological structure and function, and the observed-to-expected (O/E) index, which measures taxonomic completeness (Rehn *et al.* 2015). The CSCI was developed with a large data set spanning a wide range of environmental settings. CSCI scores from nearly 2,000 study reaches sampled across California ranged from approximately 0.1 to 1.4 (Mazor *et al.,* 2015). For the purposes of making statewide assessments, three thresholds were established based on 30th, 10th, and 1st percentile of CSCI scoring range at reference sites according to Rhen (2015) (Figure 1.2). These three thresholds divide the CSCI scoring range into 4 categories of biological conditions. While these ranges do not represent regulatory thresholds, they provide a useful framework for interpreting CSCI results.

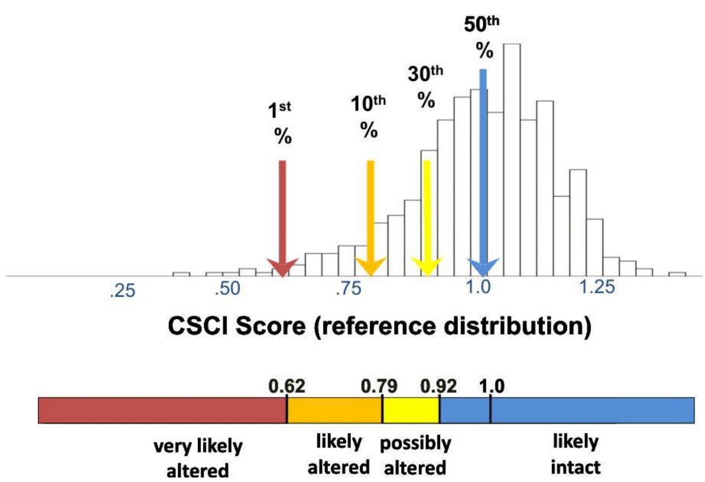


Figure 1.2 Distribution of CSCI scores at CA reference sites with thresholds and condition categories (Rhen et al., 2015)

c. The Algal Stream Condition Index

The Algal Stream Condition Index (ASCI) uses a multiple line of evidence approach to understand stream condition. The metric is a complement to the CSCI multi-metric index for BMI. Algae are useful indicators of stream condition because they are sensitive to water quality conditions, particularly nutrients, and can respond to management actions in locations where BMI are less useful (e.g. engineered channels) (Theroux et al., 2020). Like the CSCI, the ASCI captures the likelihood of biological degradation by comparing scores to the 1st, 10th, and 30th percentile of scores at reference sites located throughout the state (Table 1.1). The performance of indices based on soft algae, diatoms, and hybrid of both assemblages have been tested for responsiveness, accuracy, and precision. Multi-metric indices based on diatoms and a hybrid assemblage have been found to be the best performing (Theroux et al., 2020).

Table 1.1 Summary of CSCI, ASCI-H, CRAM, and IPI environmental condition score ranges.

Score	Very Likely Altered condition	Likely Altered Condition	Possibly Altered Condition	Likely Intact Condition
CSCI	≤ 0.62	0.63 to 0.79	0.80 to 0.91	≥ 0.92
ASCI – Hybrid	≤ 0.74	0.75 to 0.85	0.86 to 0.93	≥ 0.94
CRAM	≤ 63	63 to 72	72 to 79	≥ 79
IPI	≤ 0.70	0.71 to 0.83	0.84 to 0.93	≥ 0.94

d. California Rapid Assessment

Riparian wetland condition was assessed using the California Rapid Assessment Method (CRAM; Collins et al. 2008), a method developed by the USEPA and modified by SWAMP for use in California (Fetscher and McLaughlin 2008). The method was developed to allow evaluation of statewide investments in restoring, protecting, and managing wetlands. Briefly, the CRAM method assesses four attributes of wetland condition: buffer and landscape, hydrologic connectivity, physical structure, and biotic structure. Each of these attributes is composed of several metrics and sub-metrics that are evaluated in the field for a prescribed assessment area. The CRAM metrics are ecologically meaningful and reflect the relationship between stress and the high priority functions and ecological services of wetlands. The greater the CRAM score, the better the biotic, physical, hydrologic, and buffer zone condition of the habitat. Streams in reference condition are expected to have a CRAM score ≥72 (Mazor 2015). In addition, since CRAM scores provide insight into a stream's physical condition, they are often used as a surrogate for abiotic stress.

e. Physical Habitat

Physical habitat (PHAB) assessments were completed in conjunction with algal and benthic macroinvertebrate assessments to aid in the interpretation of biological data. Human alteration and the instream and topographical features that result in adverse impacts to habitat quality and structure are important factors that shape aquatic communities (Barbour *et al*., 1999). Briefly, the same 11 equidistant transects that were used for the collection of BMI and algal samples were used in the assessment of wetted width, bank stability, discharge, substrate, canopy cover, flow habitats, bank dimensions, human influence, depth, algal cover, and cobble embeddedness. Ten inter-transects, at the mid-point of the 11 transects used for sample collection, were also used to collect information related to wetted width, flow habitats, and pebble counts. All PHAB assessments were completed as specified by Ode *et al.* (2016).

In the 2021 report, we began reporting on the physical habitat condition of a stream site using the Index of Physical Habitat Integrity (IPI). The index is an easily interpretable measure of PHAB condition (Rehn et al., 2018). The index includes metrics that are broadly categorized into 5 thematic groups that capture different habitat elements including: substrate, riparian vegetation, flow habitat variability, in-channel cover and channel morphology. Scores for the IPI close to 0 indicate departure from reference condition and those greater than 1 indicate that a site has better physical habitat than is predicted based on environmental setting (Table 1.1). The thresholds for IPI are similar to the CSCI and are based on 30th, 10th, and 1st percentiles of scores at reference sites.

f. Aquatic Chemistry

Nutrients, total metals, major ions, and general chemistry analytes (pH, dissolved oxygen, suspended solids, alkalinity, and hardness) were monitored at each site. Data was collected in-situ using digital field probes that were deployed by field crews or via grab sample and lab analysis. Measured analytes and methods are described in the Appendices (Table B.1).

g. Variable Importance Plot

Evaluation of the strength of association of the environmental variables to the biological condition was conducted using a random forest model (RF) which was created using imputed PHAB data from 2009 – 2023 to predict both CSCI and ASCI scores. PHAB data were normalized before being used in the model. Several variables were removed from the analysis due to incomplete data. The relative importance of the constituent predictor variables for predicting CSCI and ASCI (Diatoms) scores was assessed using a RF model where, for a single variable, the values across all samples were randomly shuffled while the values for all other variables remained in their original state. The RF model was then recreated using this partially permuted data set. Mean squared error (MSE) is calculated using the unused (out-of-bag) data points for each tree within the forest. Out-of-bag data points generate a predicted CSCI score, and the squared error is computed against the real CSCI score for that site. This is done for both the original model and the partially permuted data model. The percent increase in MSE from the original to the permuted model gives the estimate of variable importance. This process is then repeated for each predictor variable used in the model. Non-detects (NDs) in the chemistry analysis were estimated at half the minimum detection limit (MDL)

Predictor variables that have weak relationship with the index scores cause little change with the model predictions when their data are permuted. For example, when unimportant data or variables are shuffled, the predictions the model makes will perform nearly as well as when actual data are used. In contrast, when important predictors are permuted, the model should perform much worse.

h. Trends in Random Site Ambient Condition – Bayesian Random Effects Regression

Assessing the ambient trend in watershed condition was done using Bayesian random effects regression models for each location where CSCI is regressed over time. The locations are urban, effluent, and natural for LARWMP. The trend is analyzed over 14 years (2009 to 2023) and only stations visited 2 or more times are included in the analysis. The location trend analysis is done via mixed – a combination of fixed and random – effects regression modeling. Random effects are useful for modeling hierarchical data like the watershed data where the total population (or watershed) can be broken down into locations and then further split into individual stations. It is particularly relevant to longitudinal data where it can be used in place of repeated measures analysis of variance models. A random effects model will build separate models for each category (location, in this case) while simultaneously quantifying the correlation between categories, which expands the data available to estimate all the parameters. In this case, the random effects model is fit using the Bayesian framework, which due to the prior distributions is good for hierarchical models, can handle small numbers of observations, and produces full parameter distributions rather than just point estimates.

i. Trash Assessments

Trash assessments began in 2018 at random sites using the SMC developed riverine quantitative tally method as reviewed in the trash monitoring playbook (Moore *et al.*, 2020). Trash items are tallied under broad categories of trash types (e.g. paper, plastic, cloth and fabric) into more detailed trash types (e.g. foam pieces, plastic bag pieces). A 30 meter stretch of each random site was visually assessed. The assessment area spans the thalweg to the bankfull width. The assessment also makes note of storm drain and homeless encampments within the assessment area (Moore *et al.,* 2020).

j. Data Analysis

The R statistical software (version 4.4.1, R Core Team, 2024) and Excel were used for most of the graphing and data analysis.

3. Results

a. Biotic Condition

Summary results for all biotic condition measurements and water quality analytes by watershed sub-region are presented in Table 1.2. A pattern of better biotic and physical habitat conditions is consistently seen in CSCI, ASCI, IPI, and CRAM, as demonstrated by higher scores, in the natural regions of the watershed compared to the effluent dominated and urban reaches (Figure 1.3). Compared to CSCI, less of the streams in the upper watershed are in the higher scoring "possibly altered" or "likely intact" categories based on ASCI hybrid scores, a proxy for water quality (Figures 1.4 & 1.5).

ASCI scores were lowest in effluent dominated sub-regions and highest in the natural sub-region (Figure 1.5). Hybrid and Diatom ASCI scores mirrored other biotic indicators, showing higher average scores for the natural sites than effluent-dominated or urban sites (Table 1.2 & Figure 1.3). Soft Algae ASCI did not differentiate the sub-regions as well as other bioindicators.

The CSCI incorporates two indices: the multi-metric index (MMI), which clarifies ecological structure and function; and the observed-to-expected (O/E) index, which measures taxonomic completeness. A lower O/E score indicates site degradation due to the loss of expected taxa. On average, effluent-dominated and urban sites exhibited lower MMI, O/E, and overall CSCI scores compared to natural sites, reflecting the poorer condition of benthic macroinvertebrates and greater taxa loss in urbanized areas (Figure 1.4).

The CRAM results underscore the contrast between the highly urbanized lower watershed and the relatively natural conditions found in the upper watershed (Figure 1.3). Each CRAM score is composed of four individual attribute scores that define riparian habitat condition. They include buffer zone, hydrology, and physical and biotic structure. Natural sites were characterized by wide, undisturbed buffer zones, good hydrologic connectivity, and a multilayer, interspersed vegetative canopy composed of native species. In contrast, the urban and effluent-dominant sites often had no buffer zones, highly modified concrete-lined channels, and lacked vegetative cover. Intermediate to these extremes are the effluent dominated, soft-bottom sites like the Glendale Narrows and Sepulveda Basin. These sites tended to have higher attribute scores for buffer and biotic condition, though overall habitat condition scores were still in the likely altered category. Development in the lower watershed has virtually eliminated natural streambed habitat and adjacent buffer zones and altered stream hydrology. In most cases, the natural riparian vegetation has either been eliminated or replaced by invasive or exotic species. These conditions have led to lower habitat condition scores.

Table 1.2 Summary statistics for biotic conditions and water quality analytes at all random sites combined, collected from 2009 – 2023.

	Watershed						Urban						Effluent						Natural					
Analyte	n=	Mean	±	Stdev	min	max	n=	Mean	±	Stdev	min	max	n=	Mean	±	Stdev	min	max	n=	Mean	±	Stdev	min	max
Biological Condition																								
Benthic Macroinvertebrates (CSCI)	155	0.72	±	0.25	0.21	1.35	52	0.49	±	0.15	0.21	0.80	36	0.60	±	0.14	0.33	0.84	67	0.95	±	0.14	0.65	1.35
MMI	155	0.65	±	0.25	0.18	1.43	52	0.45	±	0.13	0.23	0.69	36	0.52	±	0.16	0.18	1.04	67	0.88	±	0.18	0.43	1.43
O/E	155	0.78	±	0.29	0.12	1.32	52	0.53	±	0.21	0.12	0.99	36	0.69	±	0.17	0.19	0.89	67	1.02	±	0.17	0.70	1.32
Attached Algae																								
ASCI Hybrid	135	0.66	±	0.20	0.29	1.32	44	0.68	±	0.20	0.35	1.32	31	0.46	±	0.11	0.29	0.71	60	0.74	±	0.17	0.41	1.14
ASCI Diatom	135	0.63	±	0.20	0.25	1.21	44	0.64	±	0.18	0.34	1.21	31	0.44	±	0.10	0.25	0.68	60	0.73	±	0.17	0.38	1.08
ASCI Soft Algae	136	0.78	±	0.22	0.00	1.26	45	0.76	±	0.17	0.31	1.07	31	0.72	±	0.13	0.43	1.06	60	0.82	±	0.28	0.00	1.26
Index of Physical Habiat	115	0.63	±	0.37	0.04	1.21	35	0.32	±	0.22	0.04	1.04	30	0.38	±	0.22	0.13	1.07	50	1.00	±	0.12	0.75	1.21
Riparian Habitat (CRAM)	153	55	±	22	27	99	52	38	±	10	27	79	36	38	±	7	27	70	65	79	±	7	63	99
BioticStructure	153	47	±	24	22	97	52	30	±	12	22	72	36	28	±	9	22	69	65	71	±	14	39	97
BufferLandscape	153	73	±	20	25	100	52	56	±	17	25	88	36	61	±	12	25	75	65	92	±	5	75	100
Hydrology	153	57	±	25	25	100	52	38	±	11	25	83	36	36	±	10	25	75	65	83	±	10	58	100
PhysicalStructure	153	45	±	24	25	100	52	28	±	11	25	75	36	26	±	7	25	63	65	69	±	15	38	100
InSitu Measurements																								
Temperature (C°)	154	21.11	±	5.72	10.97	36.69	52	24.49	±	6.31	13.84	36.69	36	23.30	±	4.30	16.30	32.80	66	17.25	±	2.99	10.97	25.03
Dissolved Oxygen (mg/L)	155	9.37	±	2.49	3.72	20.34	52	10.37	±	2.77	5.30	16.81	36	10.04	±	3.11	3.72	20.34	67	8.24	±	1.04	5.46	10.48
pH	155	8.33	±	0.67	6.99	10.80	52	8.75	±	0.82	7.34	10.80	36	8.43	±	0.45	7.42	9.36	67	7.94	±	0.34	6.99	8.51
Salinity (ppt)	154	0.44	±	0.32	0.13	1.93	52	0.66	±	0.44	0.14	1.93	35	0.52	±	0.07	0.32	0.60	67	0.24	±	0.05	0.13	0.37
SpecificConductivity (us/cm)	155	881	±	598	8	3681	52	1291	±	805	8	3681	36	1043	±	118	736	1210	67	476	±	113	245	762
General Chemistry																								
Alkalinity as CaCO3 (mg/L)	155	213	±	353	40	4520	52	264	±	606	40	4520	36	140	±	27	93	206	67	212	±	38	119	276
Hardness as CaCO3 (mg/L)	149	302	±	278	94	2540	50	466	±	432	94	2540	36	242	±	54	166	368	63	207	±	43	96	370
Calcium (mg/L)	30	63.55	±	34.99	0.15	176.00	12	78.22	±	51.17	0.15	176.00	8	59.45	±	14.60	42.20	80.90	10	49.21	±	7.06	37.30	61.50
Chloride (mg/L)	150	87.73	±	92.24	2.30	554.42	51	150.99	±	108.06	11.20	554.42	36	135.15	±	18.33	94.60	162.68	63	9.41	±	3.08	2.30	18.40
Magnesium (mg/L)	30	24.34	±	16.42	0.01	74.20	12	30.79	±	23.70	0.01	74.20	8	25.58	±	7.21	16.30	35.90	10	15.62	±	0.77	14.50	16.70
Sodium (mg/L)	30	67.93	±	47.00	0.03	138.00	12	80.93	±	44.49	0.03	138.00	8	109.85	±	11.72	93.80	134.00	10	18.78	±	11.01	0.11	37.40
Sulfate (mg/L)	150	162.68	±	276.49	2.60	2360.00	51	324.08	±	420.10	17.00	2360.00	36	170.59	±	39.35	123.00	302.00	63	27.51	±	22.03	2.60	135.00
TSS (mg/L)	138	33.69	±	131.04	0.05	1330.00	45	77.74	±	221.75	2.00	1330.00	34	27.49	±	37.17	2.40	218.00	59	3.67	±	4.91	0.05	26.40
Nurtients																								
Ammonia as N (mg/L)	155	0.15	±	0.80	0.01	9.95	52	0.27	±	1.38	0.01	9.95	36	0.16	±	0.13	0.03	0.63	67	0.06	±	0.07	0.03	0.40
Nitrate as N (mg/L)	155	1.29	±	1.80	0.01	7.08	52	1.38	±	1.75	0.01	7.08	36	3.43	±	1.50	0.36	5.87	67	0.08	±	0.11	0.01	0.53
Nitrite as N (mg/L)	155	0.04	±	0.07	0.01	0.41	52	0.03	±	0.04	0.01	0.20	36	0.10	±	0.12	0.01	0.41	67	0.01	±	0.02	0.01	0.11
NitrogenTotal (mg/L)	155	3.14	±	4.36	0.00	38.84	52	4.90	±	6.15	0.23	38.84	36	5.60	±	1.59	2.56	8.41	67	0.46	±	0.86	0.00	6.46
OrthoPhosphate as P (mg/L)	155	0.09	±	0.13	0.01	1.06	52	0.12	±	0.14	0.01	0.77	36	0.10	±	0.11	0.01	0.48	67	0.07	±	0.13	0.01	1.06
Phosphorus as P (mg/L)	155	0.20	±	0.28	0.01	2.19	52	0.33	±	0.39	0.01	2.19	36	0.22	±	0.15	0.06	0.77	67	0.10	±	0.16	0.01	1.33
Dissolved Org Carbon (mg/L)	153	6.41	±	5.67	1.20	37.62	52	10.15	±	7.99	1.49	37.62	36	7.11	±	0.70	5.55	9.08	65	3.02	±	1.34	1.20	6.87
Total Organic Carbon (mg/L)	153	7.73	±	10.17	0.18	102.22	52	11.24	±	9.46	1.63	42.00	36	7.88	±	1.31	6.48	11.90	65	4.85	±	12.45	0.18	102.22
Algal Biomass																								
AFDM (mg/cm ^{2})	136	5.01	±	11.68	0.07	113.38	45	5.20	±	9.93	0.16	48.25	31	7.71	±	20.51	0.07	113.38	60	3.47	±	4.32	0.17	26.63
Chl-a (ug/cm ^{2})	136	6.24	±	7.18	0.15	43.90	45	6.38	±	6.47	0.41	34.00	31	11.04	±	10.10	0.50	43.90	60	3.66	±	3.99	0.15	25.00
Dissolved Metals																								
Arsenic (ug/L)	117	1.82	±	1.25	0.03	6.52	43	2.39	±	1.32	0.11	6.52	25	1.77	±	0.66	0.31	3.48	49	1.36	±	1.23	0.03	5.35
Cadmium (ug/L)	121	0.08	±	0.10	0.01	0.41	45	0.08	±	0.08	0.01	0.32	25	0.20	±	0.11	0.01	0.41	51	0.03	±	0.05	0.01	0.35
Chromium (ug/L)	119	1.20	±	1.29	0.02	7.50	43	1.64	±	1.54	0.15	7.50	25	0.92	±	0.55	0.41	2.46	51	0.97	±	1.25	0.02	7.26
Copper (ug/L)	121	5.48	±	6.11	0.04	30.60	45	9.79	±	7.63	0.58	30.60	25	6.19	±	2.65	1.47	13.10	51	1.32	±	0.69	0.04	3.12
Iron (ug/L)	121	112	±	833	0.003	9180	45	42	±	59	0.005	253	25	22	±	32	0.003	156	51	218	±	1281	0.003	9180
Lead (ug/L)	121	0.24	±	0.48	0.01	5.04	45	0.38	±	0.76	0.02	5.04	25	0.28	±	0.13	0.06	0.64	51	0.10	±	0.07	0.01	0.32
Mercury (ug/L)	121	0.01	±	0.01	0.001	0.05	45	0.01	±	0.01	0.001	0.05	25	0.00	±	0.01	0.001	0.02	51	0.00	±	0.01	0.001	0.04
Nickel (ug/L)	121	4.25	±	9.03	0.32	78.00	45	7.53	±	14.09	0.32	78.00	25	4.56	±	1.36	1.69	7.81	51	1.20	±	0.85	0.32	4.15
Selenium (ug/L)	121	1.22	±	2.11	0.05	11.50	45	2.33	±	3.07	0.10	11.50	25	1.33	±	0.55	0.22	3.06	51	0.19	±	0.15	0.05	0.70
Zinc (ug/L)	121	11.74	±	13.60	0.52	59.30	45	8.96	±	9.29	1.47	59.30	25	32.45	±	11.90	8.39	58.20	51	4.04	±	4.27	0.52	20.30

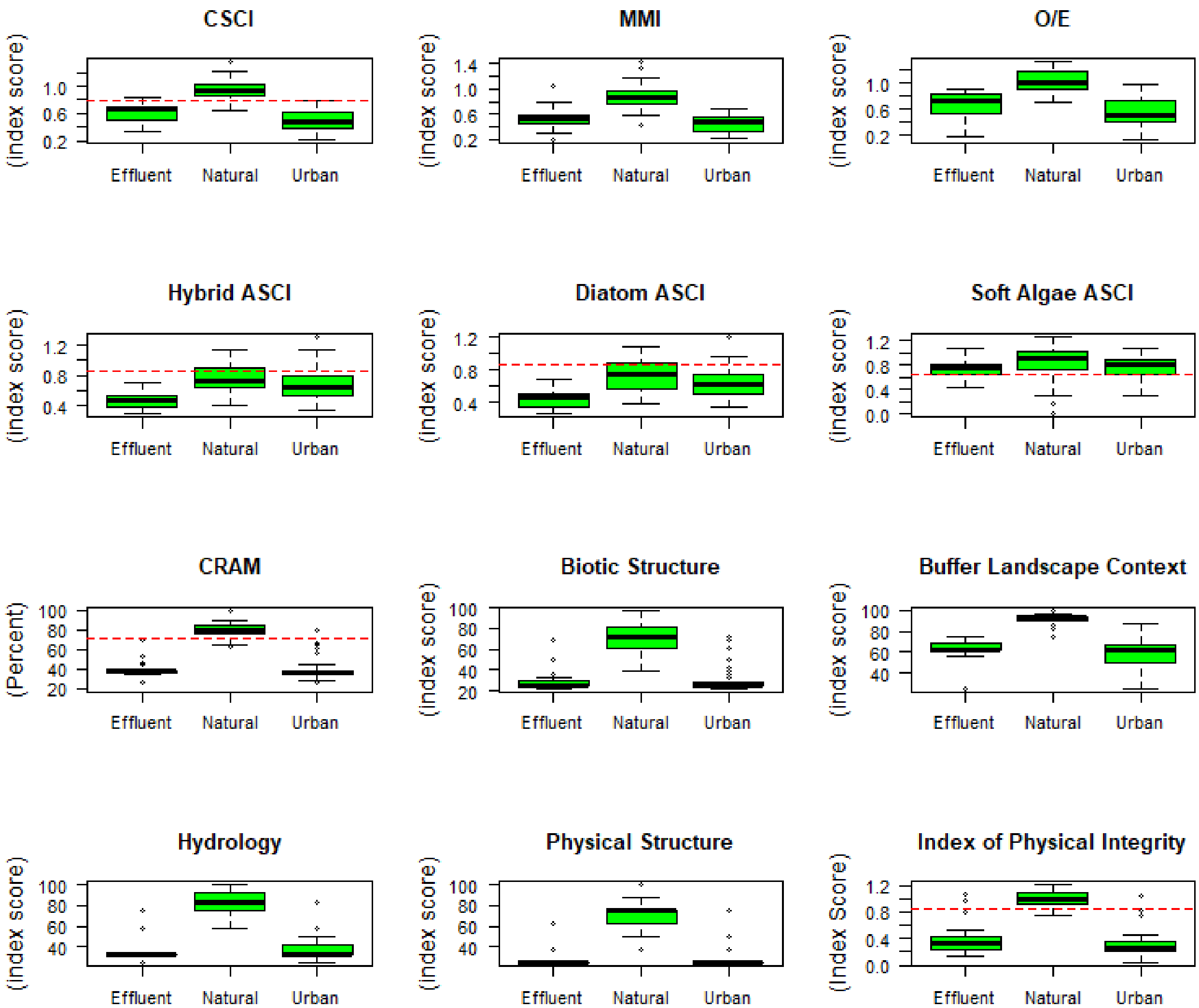


Figure 1.3 CSCI, ASCI (hybrid, diatom, and soft algae), CRAM, IPI, and attribute scores for effluent, natural, and urban random sites from 2009 - 2023.

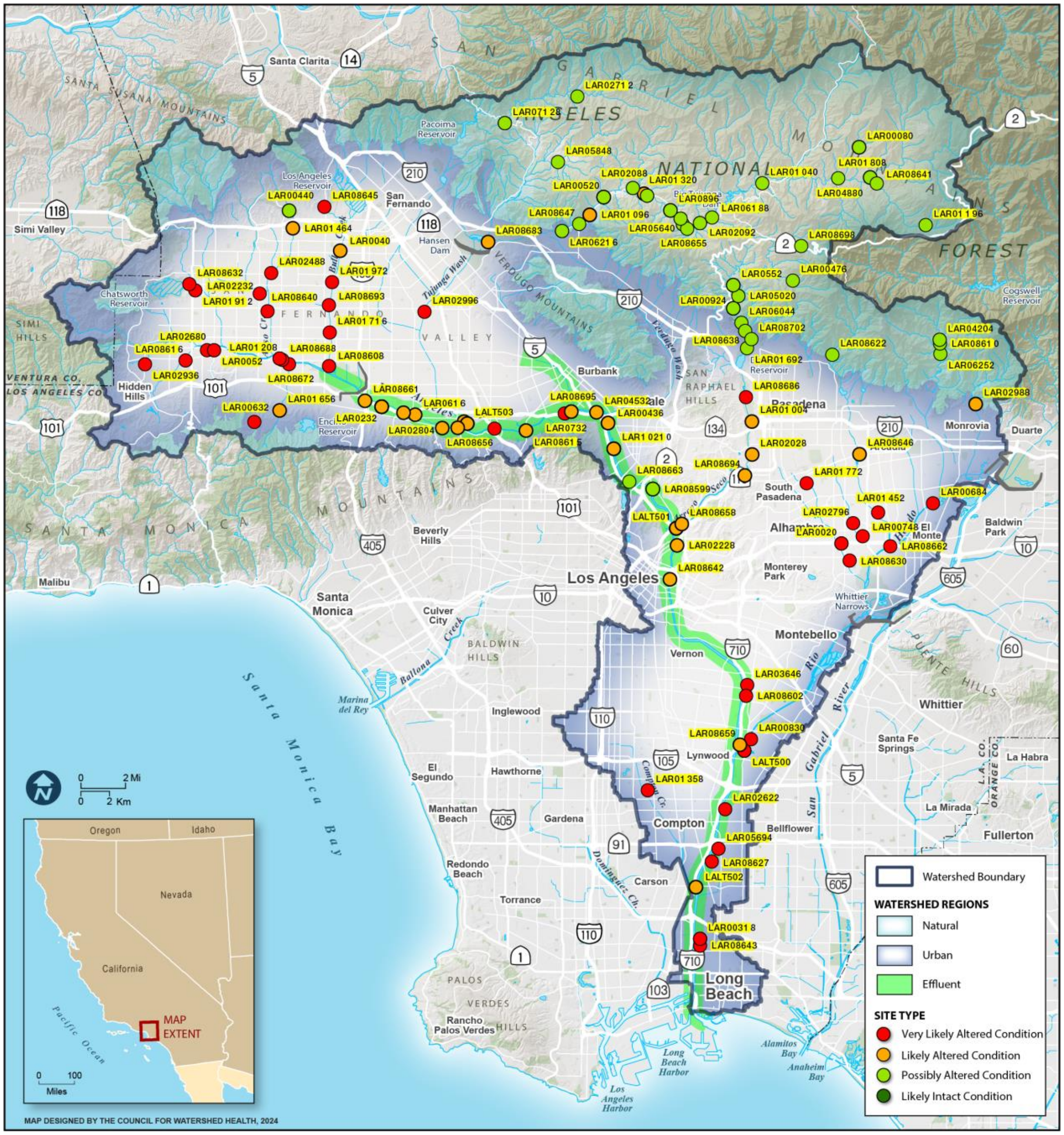


Figure 1.4 CSCI scores based on probabilistic sites sampled from 2009 – 2023.
Likely intact condition = CSCI ≥0.92; possibly altered condition = CSCI 0.91 to 0.80; likely altered condition = CSCI 0.79 to 0.63; very likely altered condition = CSCI ≤0.62. The trend at sites with 3 or more revisits are also symbolized with the direction of each triangle depicting positive, negative, or stable trends.

Figure 1.5 ASCI hybrid scores for LARWMP probabilistic sites sampled from 2009 – 2023.
Likely intact condition = ASCI ≥0.94; possibly altered condition = ASCI 0.93 to 0.86; likely altered condition = ASCI 0.86 to 0.75; very likely altered condition = ASCI ≤0.74.

Figure 1.6 CRAM scores based on probabilistic sites sampled from 2009 – 2023.
Likely intact condition = CRAM ≥79; possibly altered condition = CRAM 79 to 72; likely altered condition = CRAM 72 to 63; very likely altered condition = CRAM ≤63. Sites with 3 visits or more were examined for trends and are symbolized using triangles.

The cumulative frequency distribution for the biotic condition index scores provides insight into the percentage of streams that are in reference and non-reference condition according to three different indicators of ecological health (Figure 1.7). In the Los Angeles River watershed, most sites are not in biological reference condition and have altered biological condition. Over the 2009 – 2023 monitoring period, approximately 76% of all random sites were altered or were below the reference condition for benthic macroinvertebrate communities (CSCI scores). In addition, riparian zone habitat conditions (CRAM) were altered or were below the reference thresholds at roughly 67% of sites, while for algal communities (hybrid ASCI) approximately 90% of random sites were altered or below the reference thresholds. Most watershed sites are altered based on assessments that capture the quality of riparian and physical habitat, and water quality.

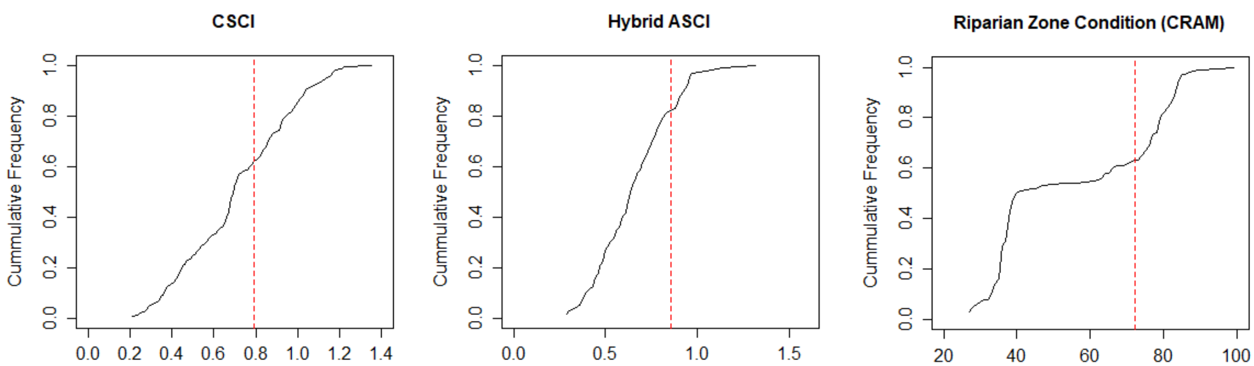


Figure 1.7 Cumulative frequency distribution of CSCI, Hybrid ASCI, and CRAM scores at random sites from 2009 – 2023. Vertical dashed line represents the 10th percentile of the reference distribution for each index.

Ash free dry mass, a measure of organic matter, was similar in three sub-regions (Figure 1.8). Chlorophyll a, on the other hand, was highest in effluent and urban sub-regions. Algal growth is encouraged by environmental conditions, such as nutrients, warm temperatures, and sunlight. These conditions are found in urban and effluent dominated regions due to reduced canopy cover and increased nutrient inputs (Table 1.2).

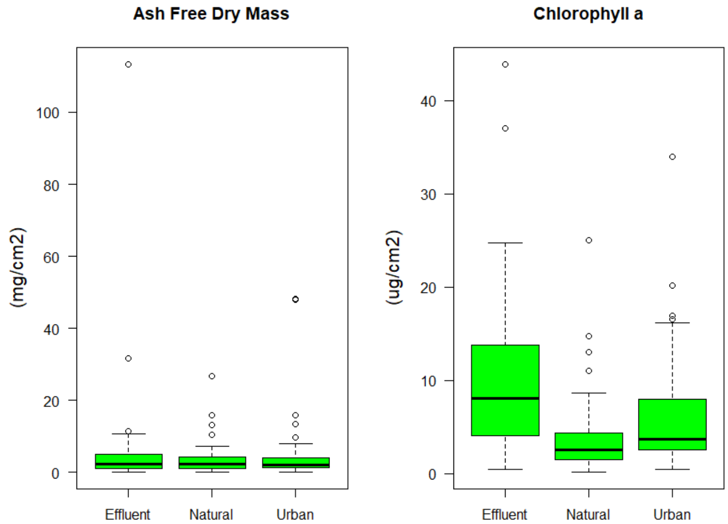


Figure 1.8 Ash free dry mass and chlorophyll A concentrations in effluent, natural, and urban regions in the watershed.

The proportion of BMI feeding groups represented in each of the three watershed sub-regions for all random sites from 2008 – 2023 is shown in Figure 1.9. Collectors, a feeding assemblage that feeds on fine particulate organic matter in the stream bottom, were the dominant group in each sub-region. Collectors make up a larger proportion of the total in the effluent-dominated and urban sub-regions of the watershed. Effluent dominated and urban sites are mostly concrete-lined with little or no canopy cover and substrate complexity, and hence have a smaller relative abundance of other feeding groups compared to natural sites. Natural sites in the upper watershed had a more balanced community assemblage represented by eight feeding groups, although still dominated by collectors. Filterers were also more prevalent in this sub-region, generally indicating better water quality conditions (Vannote et al. 1980).

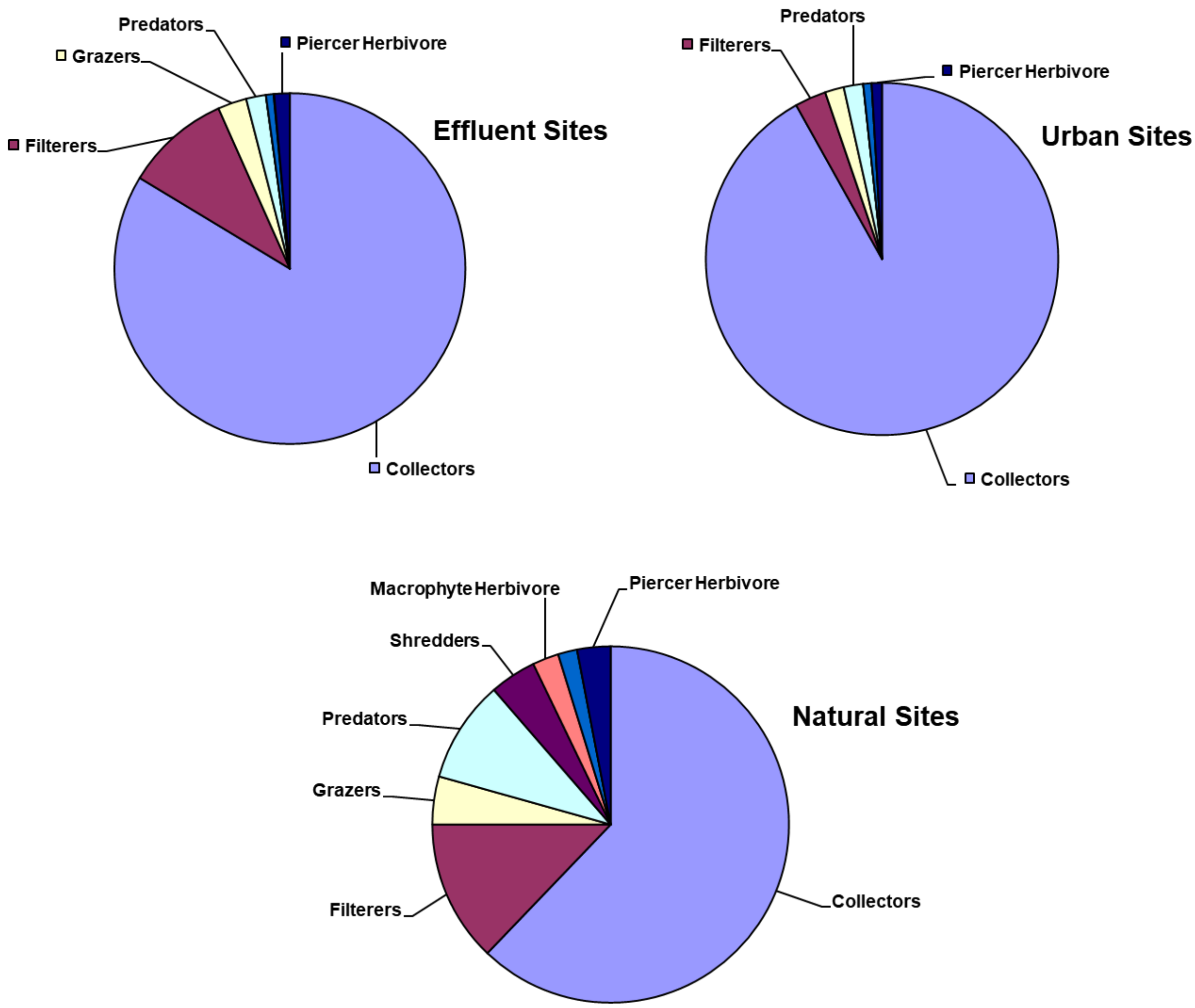


Figure 1.9 Relative proportion of benthic macroinvertebrate functional feeding groups in each watershed sub-region for 2008 - 2023 random sites.

b. Physical Habitat Assessments

Physical habitat was assessed using SWAMP protocols (Ode *et al.* 2016), which focus on streambed quality and the condition of the surrounding riparian zone out to 50 meters. Physical habitat conditions were best in the upper watershed compared to the lower watershed (Figures 1.10 & 1.101.111.101.10), specifically in terms of percent canopy, channel alteration, level of cobble and gravel, and epifaunal substrate cover. The epifaunal substrate, which was markedly higher in natural sub-regions, is a measure of the amount of natural streambed complexity due to the presence of cobble, fallen trees, undercut stream banks, etc. This complexity is important for healthy benthic macroinvertebrate and fish communities. Channel alteration was limited at natural sites, resulting in high scores. In contrast, effluent-dominated and urban sites are mostly channelized and concrete-lined which resulted in their poor scores. It is important to note that percent bank erosion and sediment deposition scores, where low sediment deposition is represented by high scores, should be interpreted cautiously in urban and effluent-dominated reaches due to the high degree of channelization and channel alteration limiting erosional processes. The Index of Physical Integrity (IPI), which incorporates several physical habitat metrics, showed the majority of natural sites had physical habitat condition that were in the possibly altered/likely intact categories compared to effluent and urban sites (Table 1.2 & Figure 1.3).

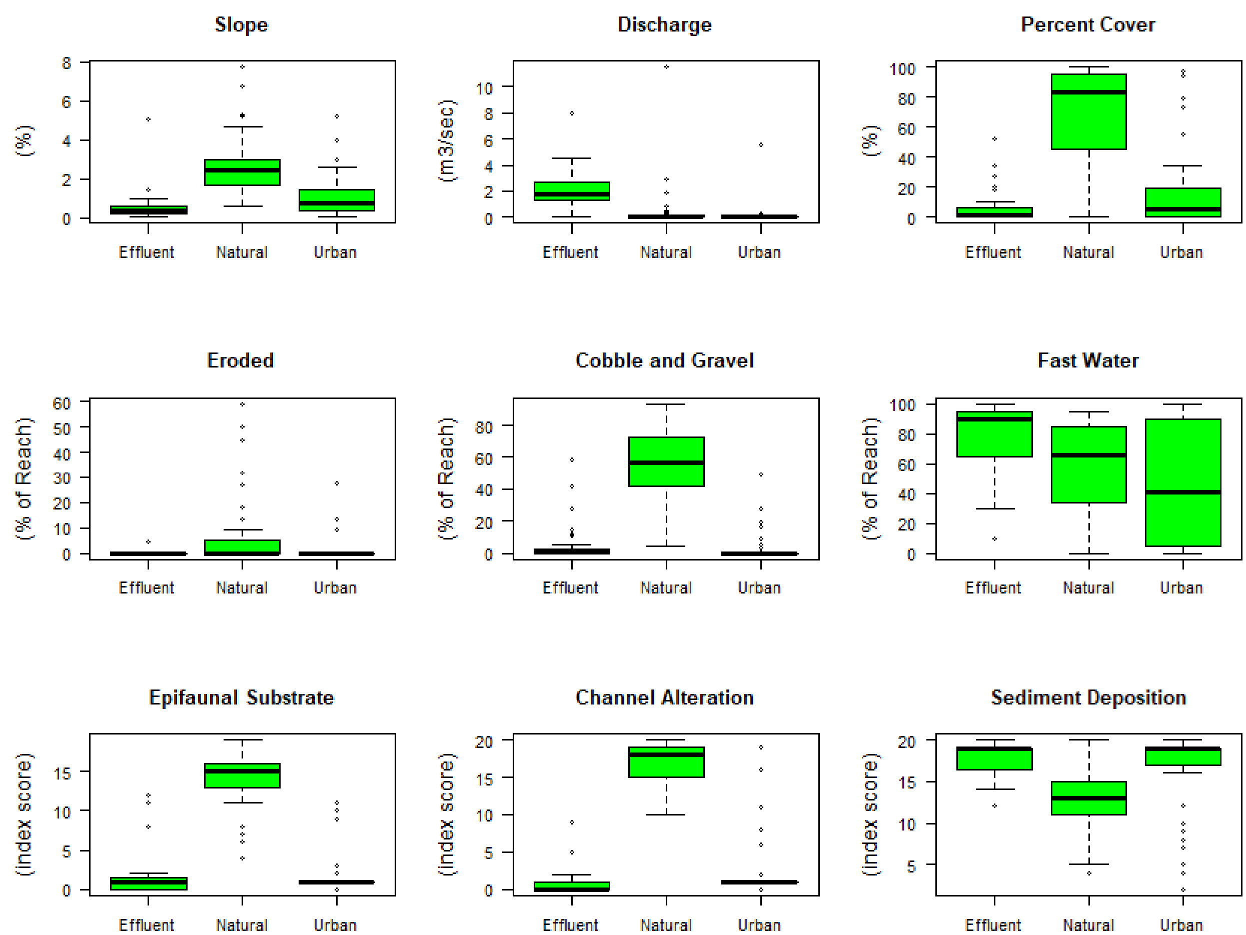


Figure 1.10 Box-and-whisker plots showing the median and range of representative physical habitat parameters measured in each of the three LARW regions from 2009 - 2023.

Channel alteration, epifaunal substrate cover, and sediment deposition are scored assessments, higher scores denote better conditions. Channelized streams are an exception. Channelization of streams decreases sedimentation, which results in higher sediment deposition scores. This does not indicate that these sites have better physical habitat.

Figure 1.11 IPI scores LARWMP probabilistic sites sampled from 2013 – 2023.
Likely intact condition = $\geq$0.94; possibly altered condition = 0.93 to 0.84; likely altered condition = 0.83 to 0.71; very likely altered condition = $\leq$ 0.70.

c. Aquatic Chemistry and Physical Habitat

The differences in nutrient concentrations between watershed subregions is shown in Figure 1.12. Like our previous report, effluent-dominated and urban sites had greater median concentrations of many nutrients compared to natural sites (CWH 2021). For example, median total phosphorus, nitrate-N, ammonia-N, and total nitrogen concentrations were highest in the effluent-dominated stream segments. The only exceptions to this pattern are for total organic carbon, which was higher in the urban subregion.

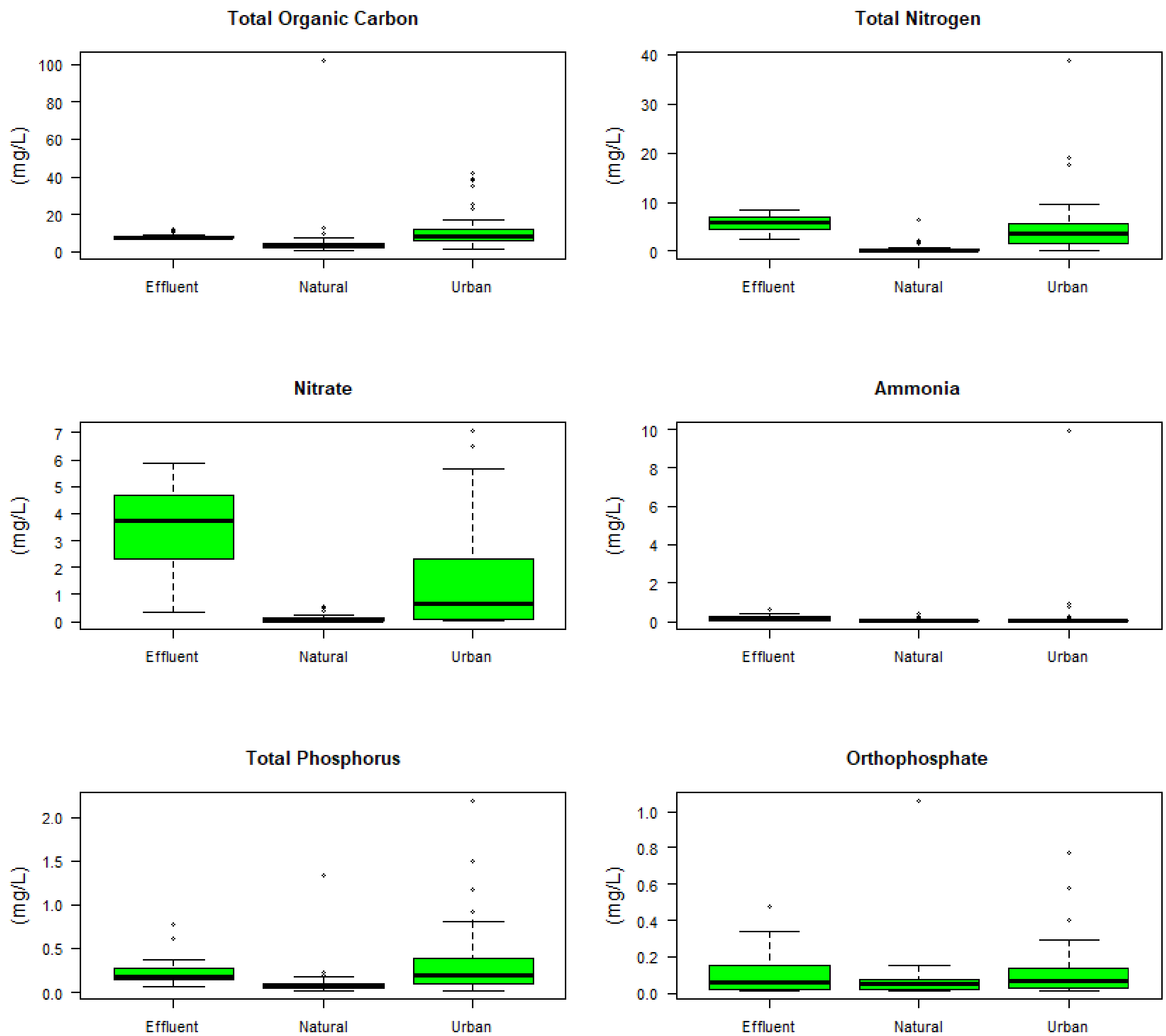


Figure 1.12 Box-and-whisker plots showing the median and range of representative nutrients measures in each of the three Los Angeles River watershed regions from 2009 - 2023

d. Variable Importance

The variables identified as being similar to the patterns in CSCI scores included nitrate, hydrology, CRAM overall score, temperature, and % concrete and asphalt (Figure 1.13). Each of these increased the model error rate by over 26%. In addition, each of these parameters are markedly different between the effluent and urban channels of the lower watershed in comparison to the natural upper watershed. Nitrate increased the model error rate by over 40% because it is present in the mainstem channel and lower tributaries due to discharge from the POTWs. In Chapter 3 of this report, we show that nitrate measured in the receiving waters below the POTW discharges generally do not exceed Water Quality Objectives (WQOs). CRAM provides an estimate of the quality of the stream riparian zone habitat, including the buffer zone, which is poor at most locations in the lower watershed. Water temperature is greater in the lower watershed where there is less canopy cover and most streambeds are concrete. This contrasts with the upper watershed where natural streambeds and canopy cover help keep water temperatures lower.

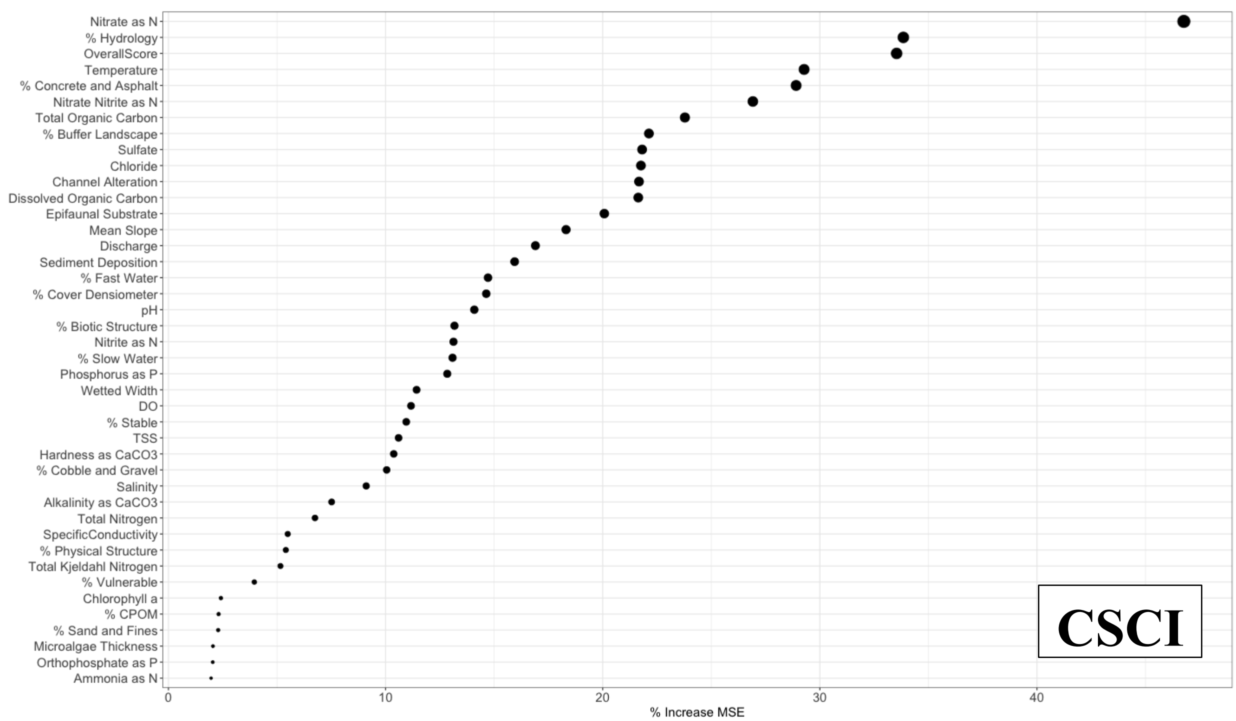


Figure 1.13 Variable importance plot showing an evaluation of the strength of association of the environmental variables to the biological condition to predict CSCI scores for the benthic macroinvertebrate community

The RF model was created using imputed PHAB data from 2009 to 2023. Overall Score = CRAM score.

Of the variables identified as being most important to the patterns in Hybrid ASCI scores, stream wetted width and nutrients were most important (Figure 1.14). The influence of streambed wetted width may be associated with drought conditions. As the streambed dries the channel narrows which can be pronounced in the upper watersheds. Nitrogen compounds including nitrate, nitrite, total nitrogen and dissolved organic carbon are generally greater in the lower watershed urban and effluent channels compared to the upper watershed. Other important variables included sulfate. Each of these increased the model error rate by at least 15%. Each of these constituents was greatest in the mainstem channel and lower tributaries, and least in the upper watershed.

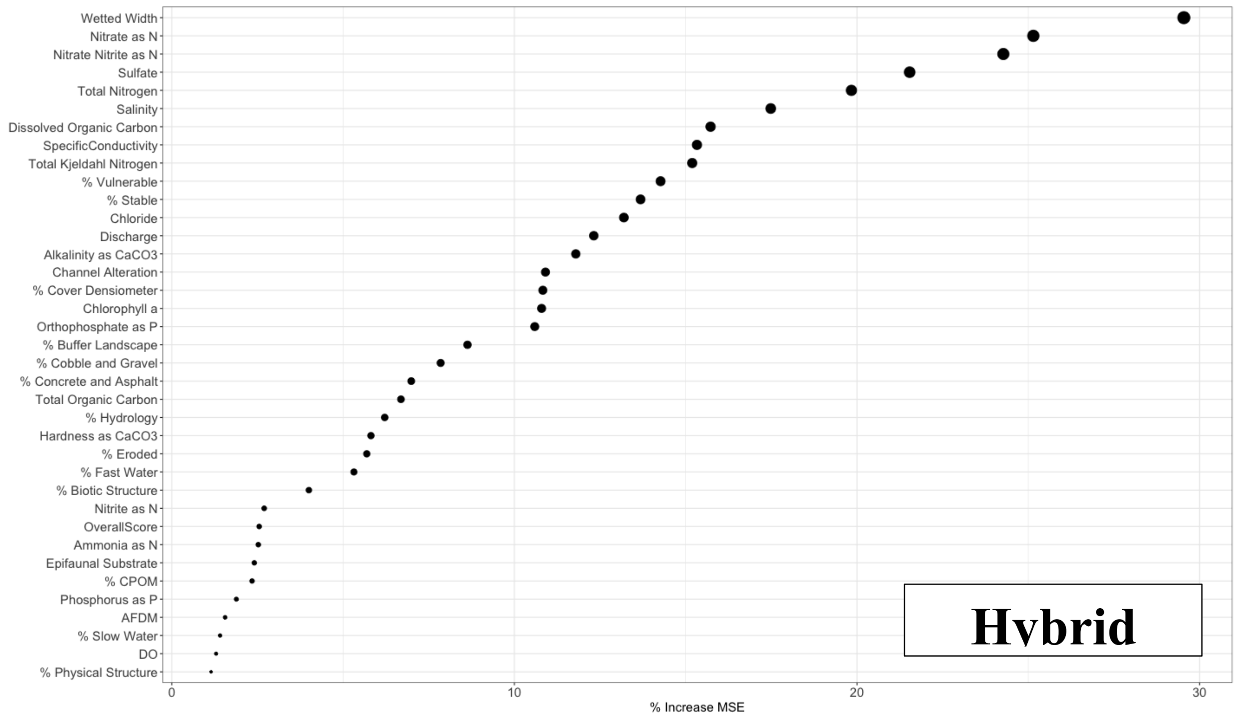


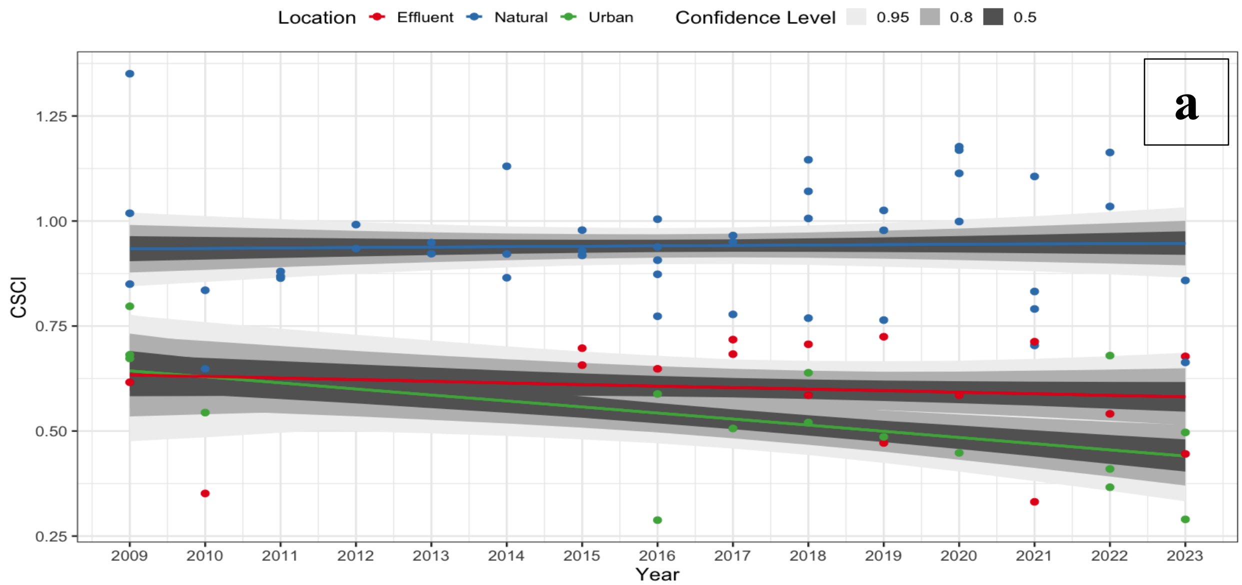
Figure 1.14 Variable importance plot showing an evaluation of the strength of association of the environmental variables to the biological condition to predict hybrid ASCI scores for the algal community

The RF model was created using imputed PHAB data from 2009 to 2023.

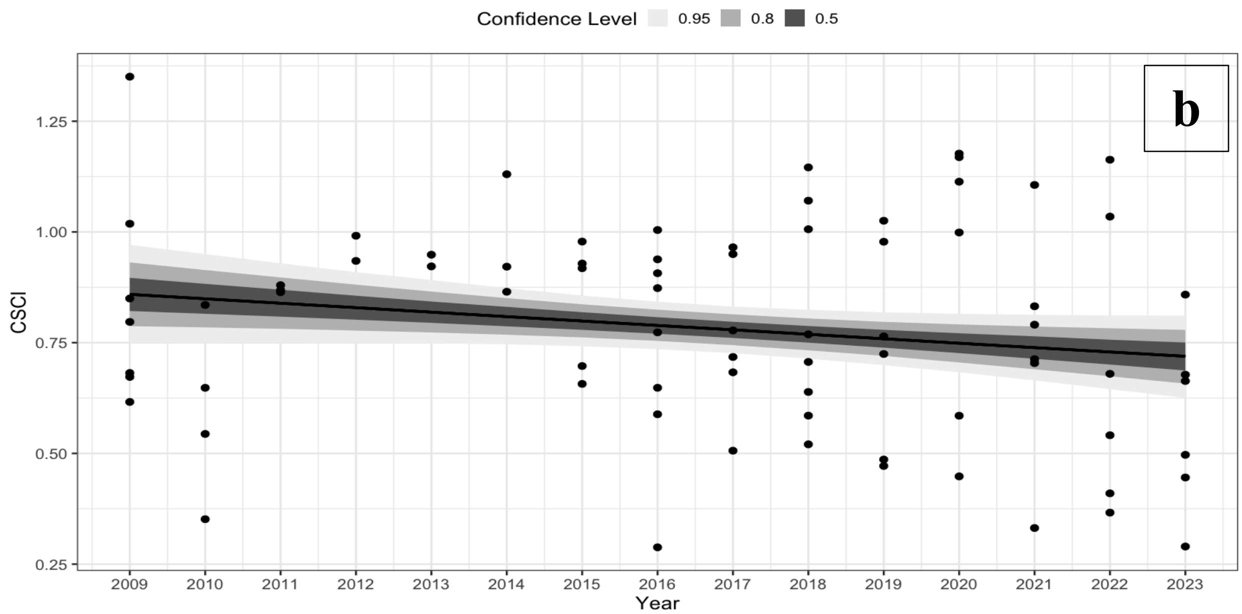
e. Trends in Random Site Ambient Condition

Ambient change in biotic condition was assessed using Bayesian random effects regression models for each location where CSCI is regressed on year. The trend is analyzed using 15 years of revisits (2009 to 2023) and only stations visited two or more times are included in the analysis. For each model, the slope is the quantification of the ambient trend. Confidence intervals are included for both the regression lines and the slope values. If the confidence interval contains zero, then the slope value is not statistically significant.

This approach showed a significant downward trend for urban CSCI scores over the 15-year period (Figure 1.15). The same approach was used to assess ambient change in algae communities by regressing hybrid ASCI scores against year (Figure 1.14). Slopes for the watershed as a whole and the effluent channels, urban tributaries and mainstem were all non-significant.



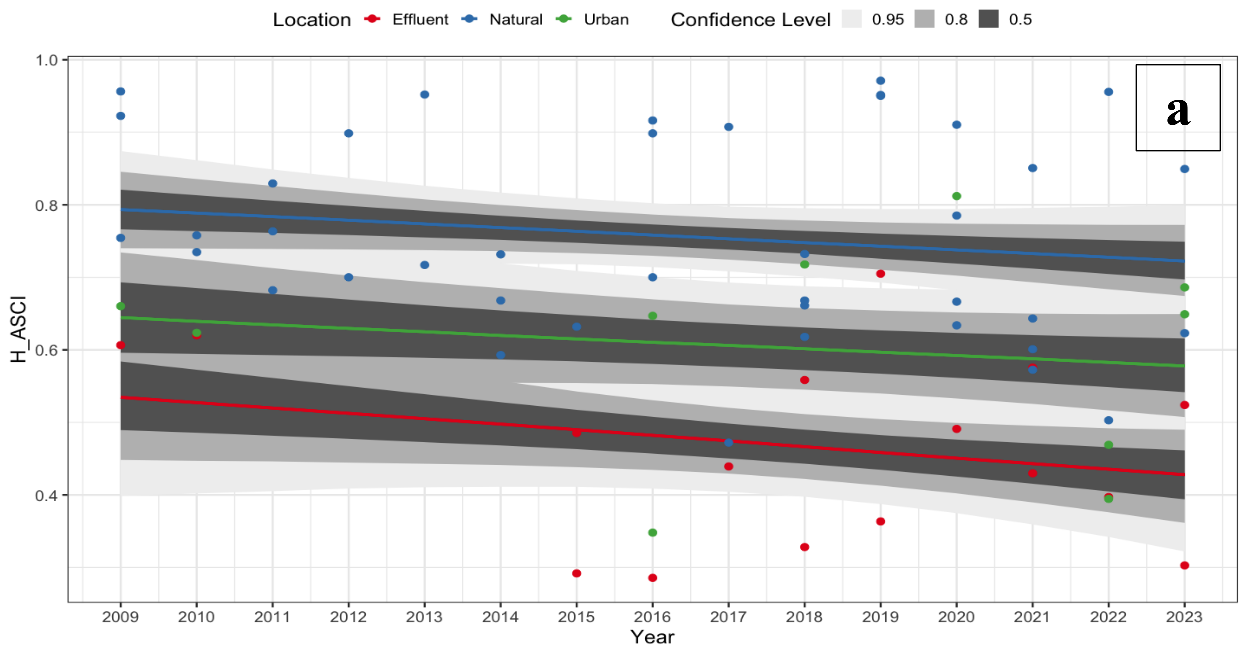
Location	Slope, Time Coefficient	95% Credible Interval
Effluent	-0.0036 *	[-0.0185, 0.0123]
Natural	0.0010 *	[-0.0091, 0.0118]
Urban	-0.0144 **	[-0.0286, -0.0006]



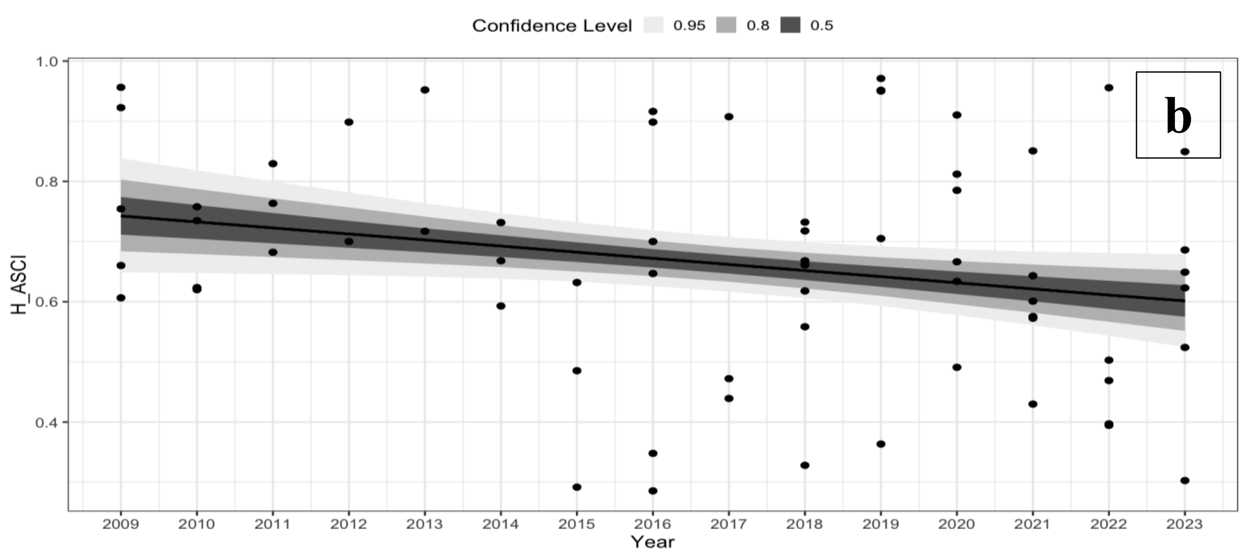
Location	Slope, Time Coefficient	95% Credible Interval
All	-0.0101 *	[-0.0226, 0.0021]

Figure 1.15 Ambient biotic condition trend analysis using Bayesian random effects regression models for the watershed with CSCI regressed against year.

(**a**) Model for each sub-region. (**b**) Model for the whole watershed. (**a-b**) * = Slope not significant; ** Slope significant



Location	Slope, Time Coefficient	95% Credible Interval
Effluent	-0.0079 *	[-0.0236, 0.0054]
Natural	-0.0050 *	[-0.0143, 0.0044]
Urban	-0.0046 *	[-0.0174, 0.0098]



Location	Slope, Time Coefficient	95% Credible Interval
All	-0.0101 *	[-0.0236, 0.0054]

Figure 1.16 Ambient biotic condition trend analysis using Bayesian random effects regression models for the watershed with hybrid ASCI regressed against year.

(**a**) Model for each sub-region. (**b**) Model for the whole watershed. The 95% credible interval is borderline significant. The upper bound of the credible interval is sitting right above 0. (**a-b**) * = Slope not significant; ** = Slope significant.

f. Trash Assessments

On average, plastic was the most prevalent trash type across all subregions in 2023 (Figure 1.17). Other common trash types included metal, fabric/cloth, and biodegradable items, which were consistently observed across the three subregions. Analysis from 2018 to 2023 revealed distinct characteristics in the trash profiles of each subregion (Figure 1.18). For example, natural areas frequently had a higher proportion of fabric in their trash compared to other subregions. While plastic consistently made up over 50% of the waste, effluent sites exhibited the greatest diversity in trash categories. Urban areas showed a higher prevalence of metal, glass, and construction materials.

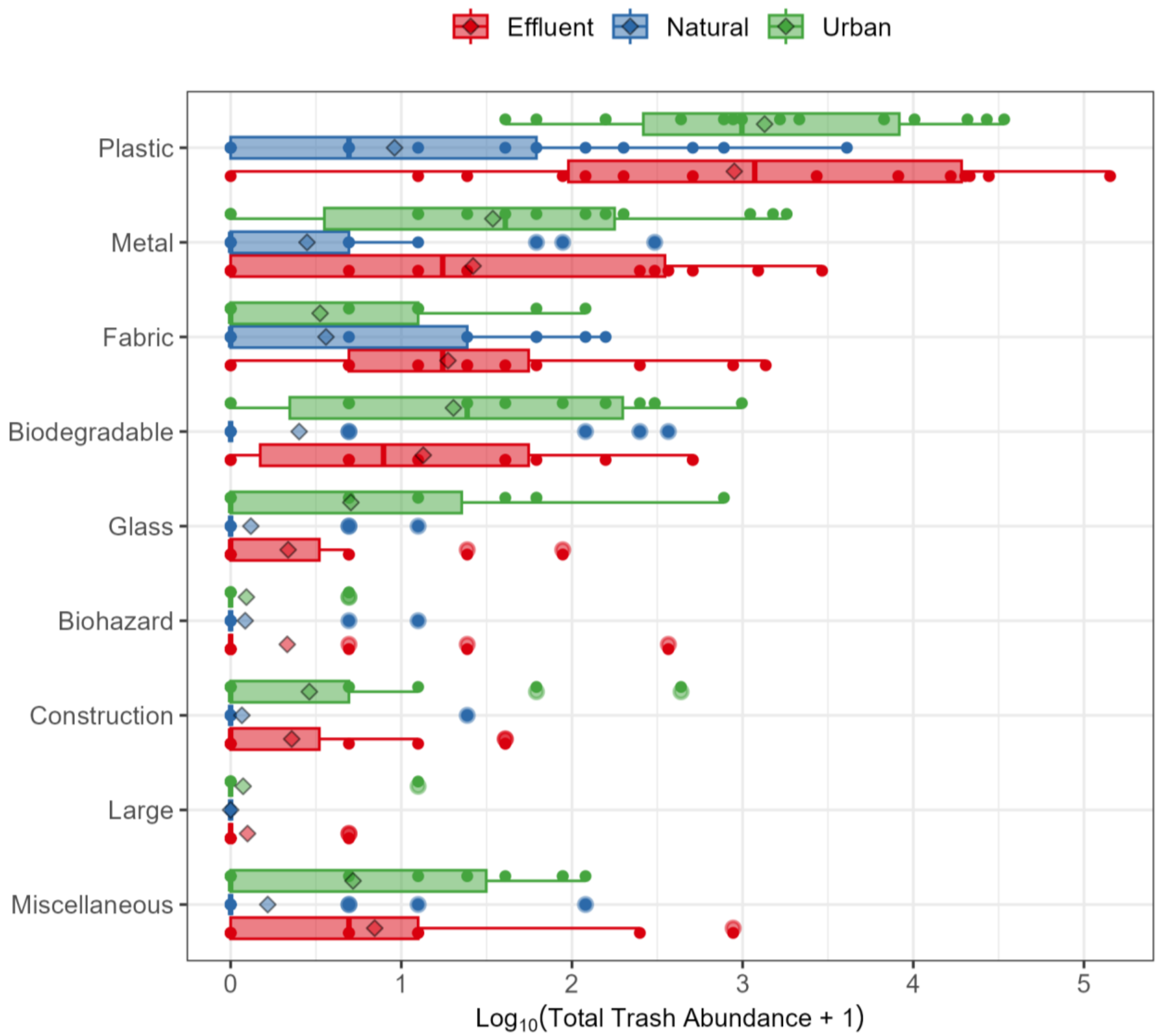


Figure 1.17 Distribution of total trash abundance (log_{10} transformed) for each trash category and subregion of LAWRMP sites sampled in 2023.

Diamonds represent averages.

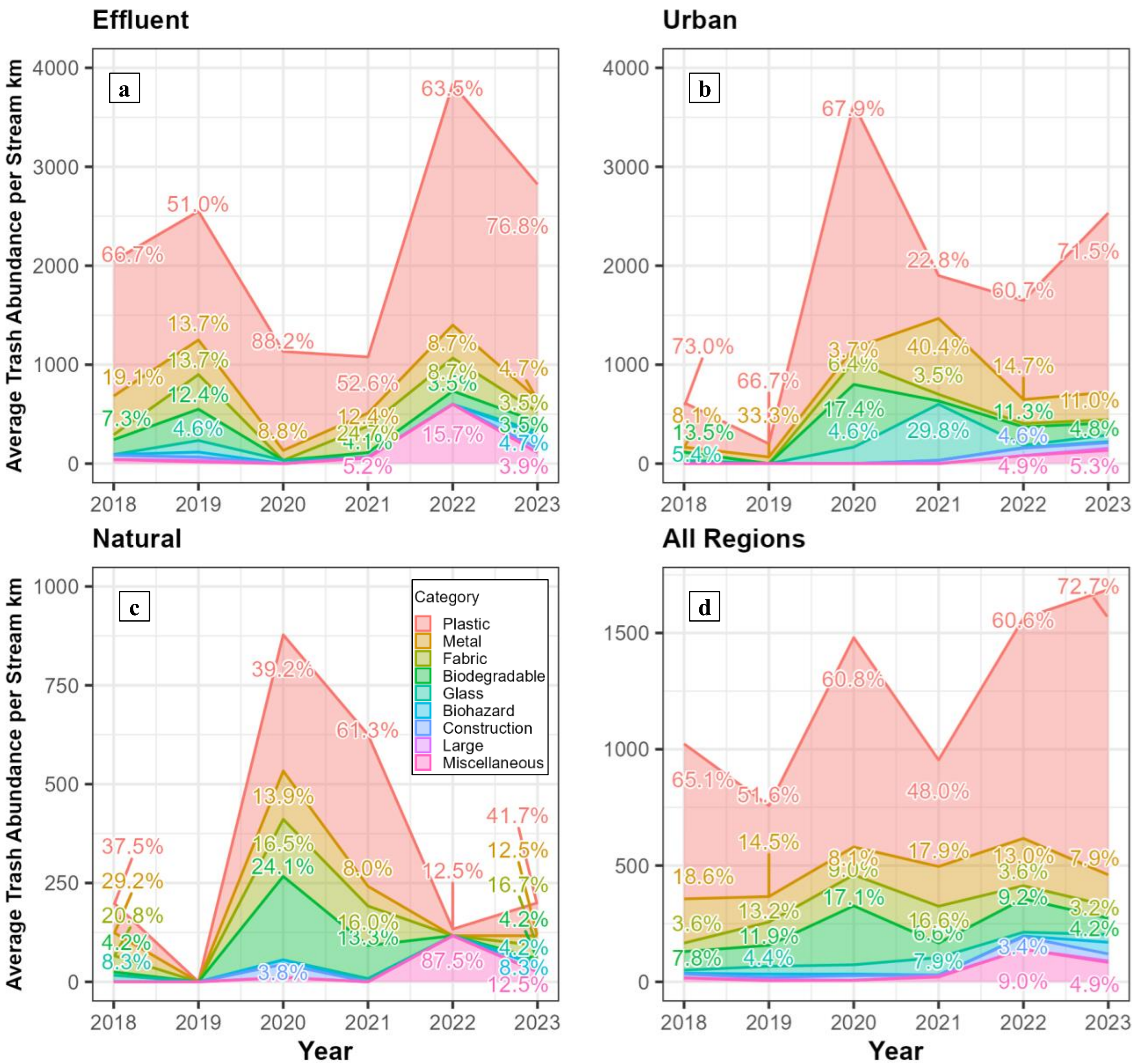


Figure 1.18 Timeline of trash category distribution for each sub-region and all watershed regions of LARWMP sites sampled from 2018 - 2023.

Annual percentage of total trash abundance (>3%) by category is shown. The scale for **(c)** natural areas and **(d)** all regions was reduced for readability. Natural areas consistently had the lowest trash abundance compared to the other subregions.

Figure 1.19 shows trash abundance for the top 20 sub-categories by subregion. Wrappers and wrapper pieces were common across all areas. Natural sites also had notable amounts of bag pieces, metal scraps, and synthetic fabric, but were lower than other subregions. Effluent sites were primarily affected by soft and hard plastics. In urban areas, cigarette butts were more prevalent than wrapper pieces. The differences in trash profiles across subregions can likely be attributed to the varying uses and activities in each area.

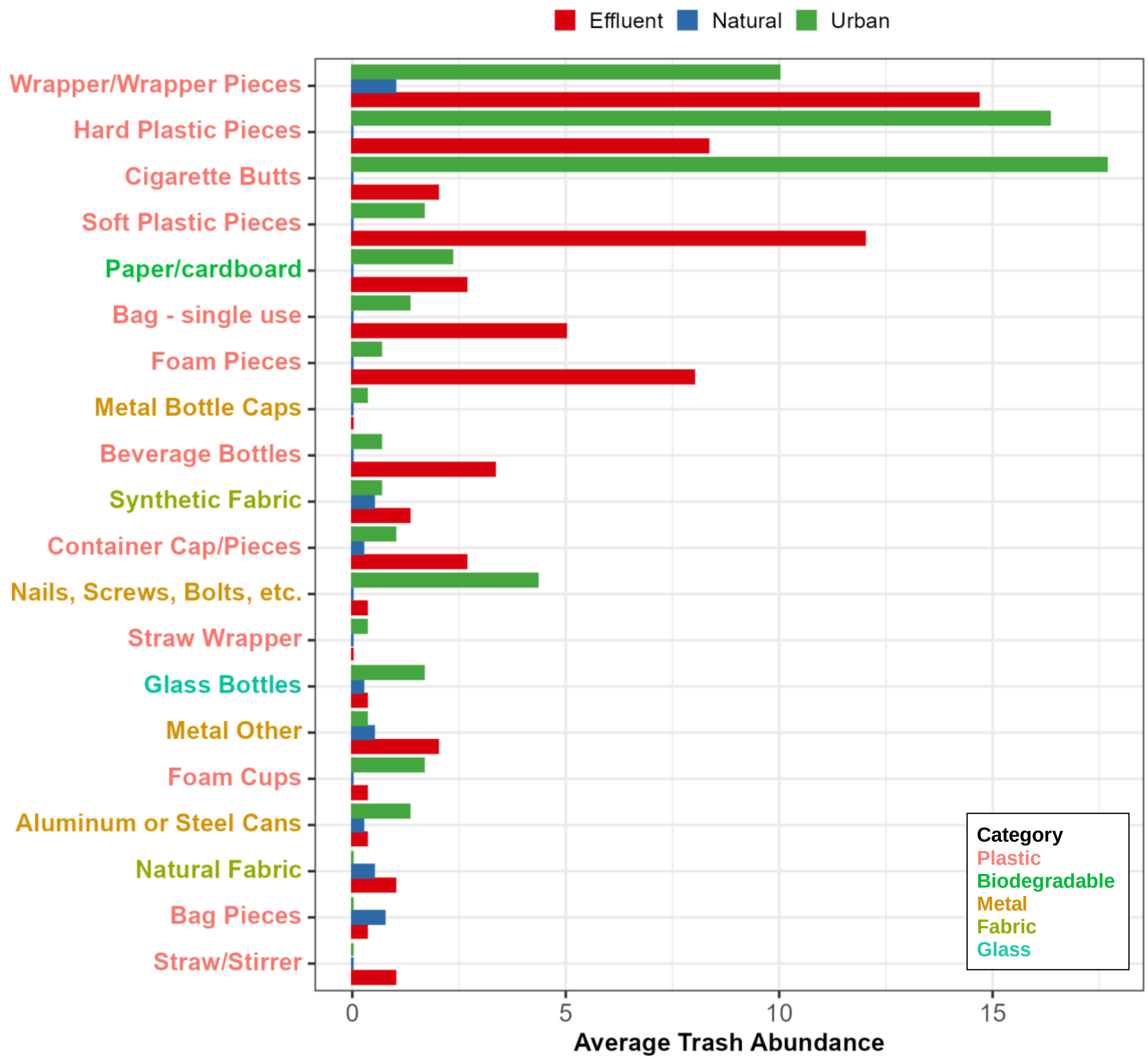


Figure 1.19 Average trash abundance of most common trash subcategories by sub-region for LARWMP sites sampled in 2023

Trash sub-types are color coded by their respective categories

Question 2. Are conditions at areas of unique interest getting better or worse?

1. Background

Question 2 monitoring efforts focus on specific locations in the watershed that represent unique areas of special concern to the workgroup. The methods that were used to better understand the conditions of sites that are unique areas of interest are consistent with those described in the previous chapter. These sites are monitored annually to help better understand how conditions in the watershed are changing over time and when protection or restoration is needed. For this purpose, two programs were created.

a. ***Freshwater Target Sites***

Originally, four target sites were established on lower watershed tributaries upstream of their confluence points with the Los Angeles River to monitor water chemistry and assess biological, riparian, and physical habitat conditions. These sites differ from the random sites used to assess ambient watershed conditions in that their locations are fixed and sites are sampled regularly. Over time these data are being used to assess trends and to determine if changes in these trends can be attributed to natural, anthropogenic, or watershed management changes.

In 2018, the TSG proposed a new site of interest: Lewis McAdams Park (LMP; LAR08599) (Table 2.1). This unlined location was a random site in 2015, dredged in 2018, and would became a revisit site in 2019.

In 2021, Los Angeles County Flood Control District began monitoring (LAR08599) a new site along Glendale Narrows (GN; LAR10210). This site was chosen due to GN (LAR10210)its soft bottom location on the main-channel in an area of the River that had few LARWMP sampling locations

These two sites are located in the Glendale Narrows section of the River within three miles of each other.

Table 2.1 Freshwater Target Sites
*To avoid confusion, LAR10210 will be referred to as "GN" throughout this report.

Site ID	Targeted Confluence Site	Channel Type	Latitude	Longitude
LAR08599	Lewis McAdams Park	Unlined	34.10603	-118.24338
LAR10210	Glendale Narrows*	Unlined	34.13224	-118.27407

b. ***High-Value Habitat Sites***

Nine locations were chosen to assess trends in riparian zone conditions at sites deemed by the workgroup to be unique (Table 2.2). The emphasis of these assessments is on riparian habitat conditions using CRAM. Riparian zone conditions at these sites provide trend data and valuable baseline data for potential habitat restoration or protection efforts. Since CRAM scores do not vary greatly from year to year, these sites are rotated and each site is sampled every 2-4 years.

Table 2.2 High Value Habitat Sites

Sites sampled in 2023 are highlighted. ***Not** to be confused with the target site of the same name (LAR10210).

Site ID	High Value Habitat Site	Channel Type	Latitude	Longitude
LALT450	Arroyo Seco USGS Gage	Unlined	34.18157	-118.17297
LALT400	Glendale Narrows*	Unlined	34.139368	-118.2752
LALT404	Golden Shores Wetlands	Unlined	33.76442	-118.2039
LALT405	Sepulveda Basin	Unlined	34.17666	-118.49335
LALT406	Eaton Wash	Unlined	34.17463	-118.0953
LALT407	Haines Creek Pools and Stream	Unlined	34.2679	-118.3434
LAUT401	Tujunga Sensitive Habitat	Unlined	34.28220	-118.22160
LAUT402	Upper Arroyo Seco	Unlined	34.22121	-118.17715
LAUT403	Alder Creek	Unlined	34.30973	-118.14190

Figure 2.1 Location of bioassessment and CRAM sites.

2. Trends at Freshwater Target Sites

A total of 10 samples were collected from the confluence locations annual surveys from 2009 to 2023 (Figure 2.1). The goal of repeated annual sampling at these locations is to monitor changing conditions. Samples were collected and analyzed for aquatic chemistry, biological and riparian habitat condition (CRAM), and physical habitat condition.

a. *Aquatic Chemistry*

In 2023, the LMP (LAR08599) and GN (LAR10210) sites were monitored. The general chemistry of these sites is nearly identical owing to how close they are to one another on this reach of the River. (Figure 2.2).

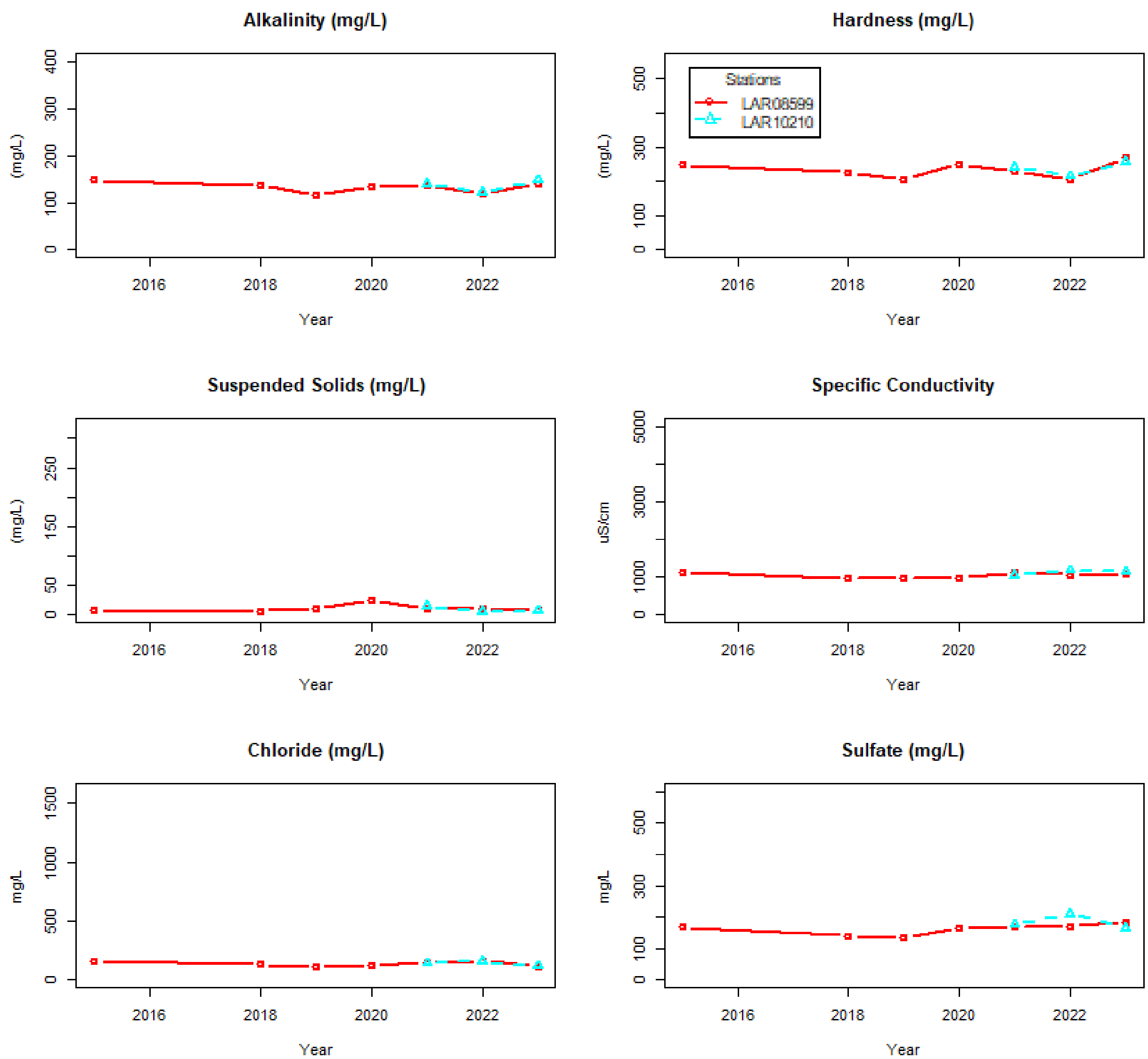


Figure 2.2 General chemistry at confluence sites sampled annually from 2015 - 2023.

Figure 2.3 summarizes the nutrient concentrations for the designated trend sites over the last few years. From 2015 - 2023, nitrate-N and total nitrogen concentrations have generally decreased at LMP. Both sites have consistently reported nitrate-N levels below the water quality thresholds set by the Los Angeles Basin Plan (<10 mg/L; LARWQCB 2019). Since monitoring at GN commenced in 2021, concentrations of total organic carbon, nitrate, total nitrogen, orthophosphate, and total phosphorus at both sites have remained closely aligned.

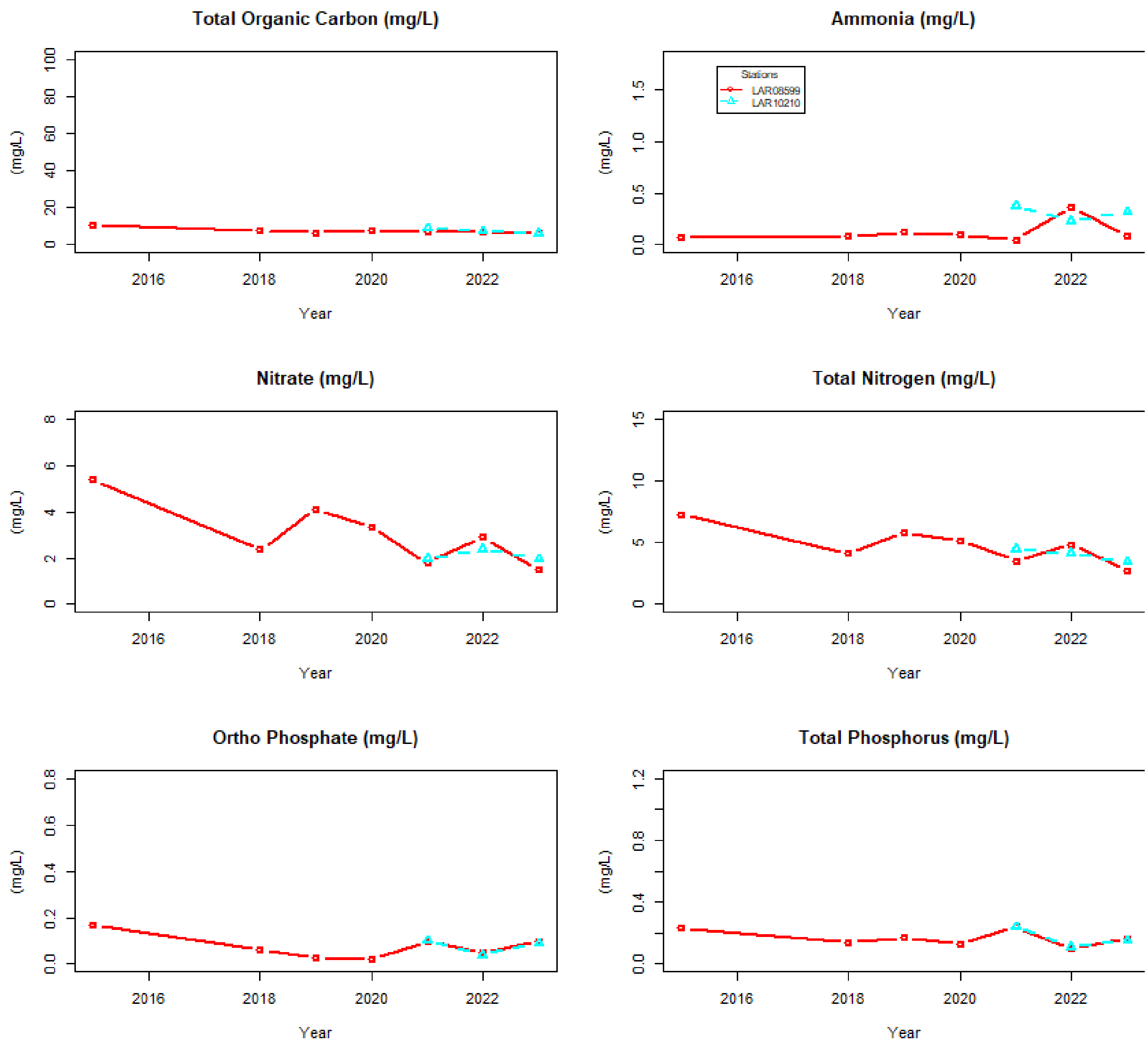


Figure 2.3 Nutrient concentrations at confluence sites sampled annually from 2015 - 2023.

b. ***Biological and Riparian Habitat (CRAM) Condition***

Figure 2.4 presents the 2023 biotic condition index scores for BMI (CSCI) and riparian habitat scores (CRAM) at GN (LAR10210) and LMP (LAR08599), both of which scored higher than other confluence sites previously monitored. After LMP scored below the reference threshold in 2022, the biotic condition improved in 2023 to within reference condition (CSCI = 0.80). GN (CSCI = 0.67) scored below LMP, but remains stable (CSCI = 0.67). At LMP, attribute scores increased somewhat for physical structure. Biotic structure, and buffer landscape context have remained stable from the previous year. Following dredging at LMP in 2018, biotic conditions have improved, as reflected by rising CSCI scores and stable CRAM metrics. Meanwhile, the GN site saw a decline in buffer landscape context but a significant increase in the hydrology score compared to previous years. CRAM scores at both sites remained stable overall, with the GN site comparable to LMP.

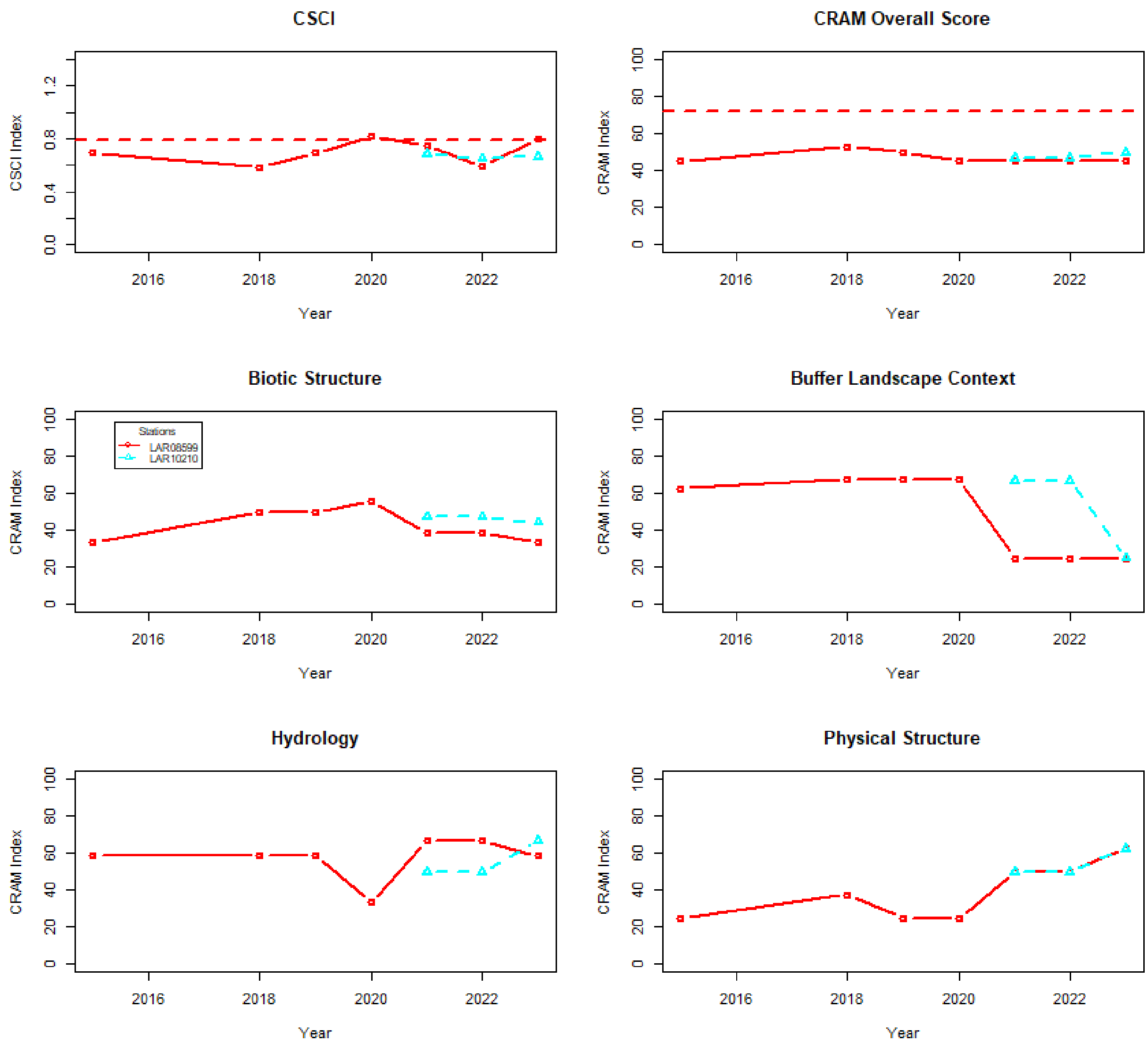


Figure 2.4 CSCI and CRAM scores (overall and attribute) at confluence sites and selected target sites sampled annually from 2015 - 2023.

The red dashed horizontal lines on the CSCI and CRAM Overall Score graphs indicate the threshold, below which the site is in non-reference condition (0.79 for CSCI and 72 for overall CRAM score).

c. ***Physical Habitat***

Figure 2.5 shows selected metrics of physical habitat condition. The three top plots show transect-based measurements recorded in conjunction with bioassessment sampling, while the three bottom plots show three visual physical habitat assessment scores. It is important to note that though visual physical habitat assessments are standardized as much as possible, they still may vary between users. As a result, only large changes in these assessments should be considered as reflecting changing conditions at a site. In 2023, the LMP physical habitat metrics saw dramatic changes from the previous year, including increases in percent concrete/asphalt and sediment deposition score, alongside decreases in percent sand & fines and epifaunal substrate score. Percent canopy cover and channel alteration change minimally. In contrast, physical habitat metrics at the GN site have remained stable. The changes at LMP are most likely due to the scouring of the stream bed during the historic rainfall events of the previous rain year. The scouring at this site is evident in the decrease in sand and fines, which were swept away, along with the increase in concrete which was exposed. Similarly, epifaunal substrate cover was lost.

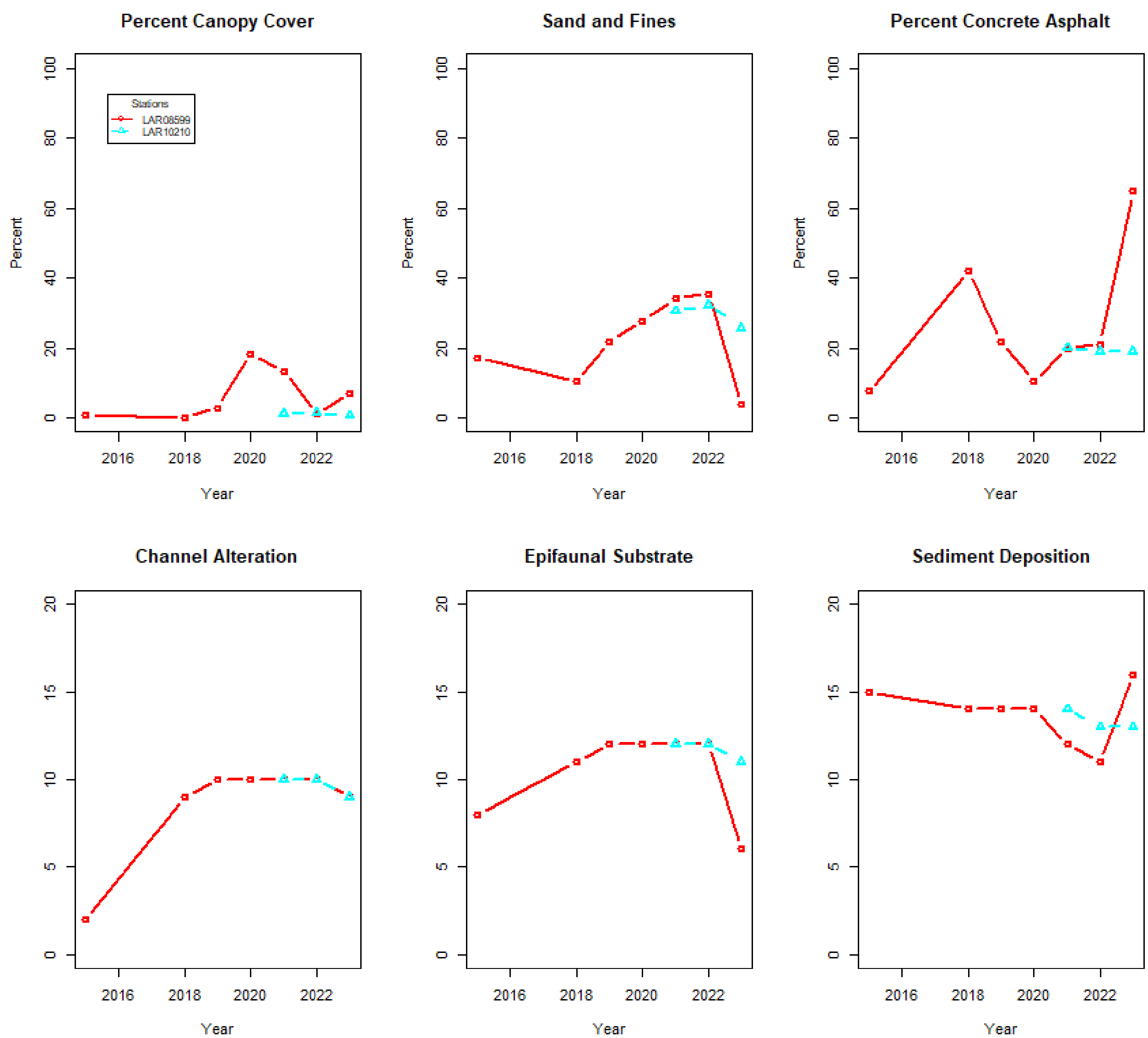


Figure 2.5 Physical habitat at confluence sites sampled annually from 2015 - 2023.

3. High-Value Habitat Sites

The condition of the riparian zone was assessed at nine sites deemed by members of the Workgroup to be minimally impacted, high-value, or sites at high risk of impact/loss in the watershed (Table 2.2). The goal of measuring site condition over time is to ensure that conditions are not degrading. CRAM assessments at the riparian zone sites commenced in 2009. The Workgroup determined that subsequent visits would occur every two to three years since conditions at these locations were not changing rapidly.

CRAM scores at lower watershed sites (prefix LALT) have usually fallen below the 10th percentile of the reference distribution of sites throughout California, indicating they are 'likely altered'. Some high value sites in the Lower Watershed have been an exception to this general trend of poorer condition at lower watershed sites. This may be because many urban high value sites are downstream of areas that were recently burned and/or are undergoing restoration activities. These sites include the Arroyo Seco USGS Gage (LALT450) and Haines Creek Pools and Stream (LALT407). However, Glendale Narrows (LALT400), Sepulveda Basin (LALT405), Eaton Wash (LALT406) are normally below the reference condition: a pattern that continued in 2023. Golden Shores Wetlands (LALT404) was above reference condition when it was last assessed in 2020.

The best riparian zone conditions have been found consistently at sites located in the upper watershed (prefix LAUT). The 2009 Station Fire created the opportunity for the LARWMP program to better understand the impact of fire to riparian habitats and recovery. Upper watershed sites that burned included: Tujunga Sensitive Habitat (LAUT401), Upper Arroyo Seco (LAUT402), and Alder Creek (LAUT403). All three sites have largely stayed above reference condition since the 2009 fire.

In 2023 Glendale Narrows (LALT400), Sepulveda Basin (LALT405), and Eaton Wash (LALT406) were assessed for riparian habitat condition. Figure 2.6 shows the individual CRAM scores from these sites for the period of 2009 - 2023. CRAM scores at Glendale Narrows (LALT400), Sepulveda Basin (LALT405) showed improvement since the sites were last assessed (scores improved by ≥ 6 points). Scores at Eaton Wash (LALT 406) have remained stable between 2021 and 2023.

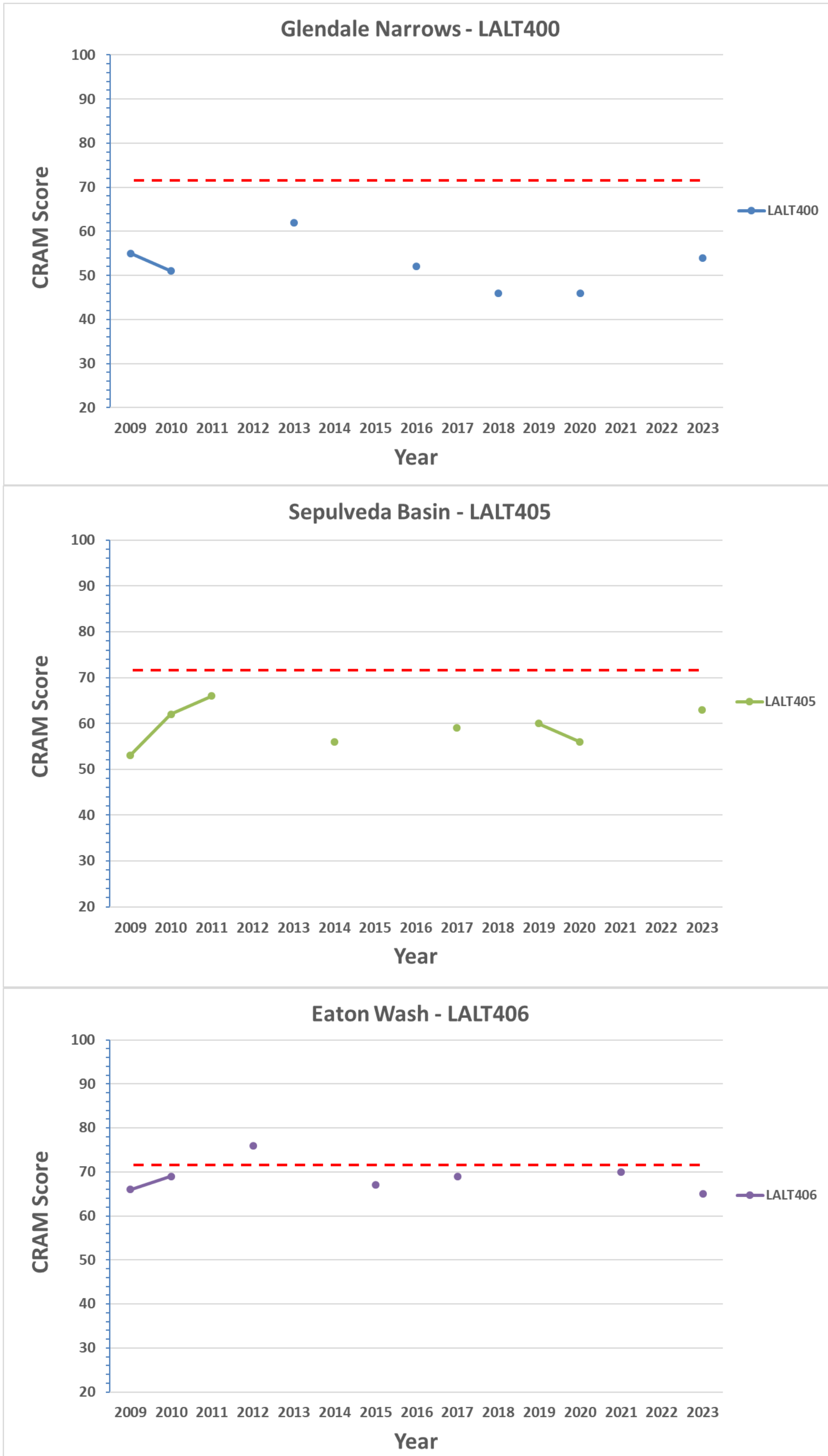


Figure 2.6 Riparian zone condition (CRAM scores) of selected high value sites monitored from 2009 - 2023
The red horizontal line represents the 10th percentile of the reference distribution of sites in California. Scores below this line represent 'likely altered' habitat.

Question 3. Are receiving waters near permitted discharges meeting water quality objectives?

1. Background

Question 3 addresses the potential impacts of permitted point-source discharges on the Los Angeles River, its tributaries, and receiving waters' ability to meet the Water Quality Objectives (WQOs) set forth in the Los Angeles Basin Plan (LARWQCB 2019). The data compiled by LARWMP include metals, bacteria (*E. coli*), nutrients, and trihalomethanes. These parameters are measured to provide a basic assessment of water quality and include the contaminants potentially introduced into a stream system via effluent from Publicly Owned Treatment Works (POTWs).

This chapter summarizes NPDES monitoring data for the period from January through December 2023 for three major POTWs that discharge into the Los Angeles River: The City of Los Angeles' Donald C. Tillman Water Reclamation Plant (DCTWRP), the City of Los Angeles' Glendale Water Reclamation Plant (LAGWRP), and the City of Burbank's Water Reclamation Plant (BWRP). Site codes for the receiving water stations upstream and downstream of each POTW's discharge and their locations are shown in Table 3.1 and Figure 3.1, respectively. These receiving water stations are monitored by the permittees as a requirement of their NPDES permits and were chosen to best represent locations upstream and downstream of the discharge locations. Values were compared to LARWQCB Basin Plan WQOs (Table 3.2).

Table 3.1 Station designations for NPDES monitoring sites

POTW	Upstream Site	Downstream Site
City of Los Angeles- Tillman	LATT612	LATT630
City of Los Angeles-Glendale	LAGT650	LAGT654
City of Burbank- Burbank	RSW-002U	RSW-002D

Table 3.2 WQOs for nutrients in the LARWQCB Basin Plan and amendments

WQOs table updated in May 2019

N Species	NO_3-N + NO_2-N	NO_3-N	NO_2-N
WQO	8.0 mg/L	10.0 mg/L	1.0 mg/L

Figure 3.1 Locations of NPDES receiving water sites monitored by the City of Los Angeles and the City of Burbank.

2. City of Los Angeles - DCTWRP

The distribution of *E. coli* concentrations above and below the City of Los Angeles' DCTWRP discharge location are shown in Figure 3.2. In 2020, new water quality objectives for *E. coli* were made effective in City of Los Angeles's permits to assess the water quality upstream and downstream of the discharge (LARWQCB 2020a; 2020b). The statistical threshold value (STV) WQO of 320 MPN/100mL for REC-1 beneficial use was attained for approximately 73% of upstream samples and 78% of the downstream samples during the 2023 sampling year.

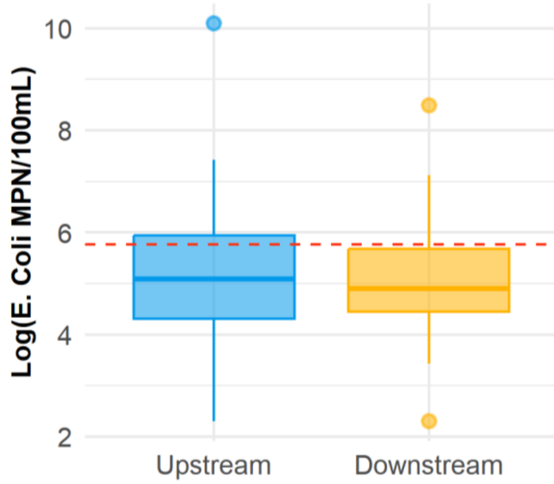


Figure 3.2 Log10-transformed distributions of *E. coli* concentrations upstream and downstream of DCTWRP discharge.
The red dashed horizontal line denotes the STV = 320 MPN/100mL ($\log_{10}$ transformed) for REC-1 beneficial use.

Table 3.3 shows the average concentrations of several nitrogen species observed at a site upstream and downstream of DCTWRP discharge. Nitrate-N, nitrite-N, and ammonia-N were tested weekly. Average downstream concentrations of nitrate-N and nitrite-N were higher than upstream locations. Both locations were below water quality objectives for all nutrients (Table 3.3).

Table 3.3 Range of nutrient concentrations upstream and downstream of DCTWRP discharge in 2023

Position	N-Species	Mean	Median	Max	SD
Upstream	NH_3 - N	0.14	0.11	1.44	0.22
	NO_3 - N	2.48	2.31	5.14	0.93
	NO_2 - N	0.10	0.06	0.57	0.12
Downstream	NH_3 - N	0.15	0.11	0.60	0.15
	NO_3 - N	3.56	3.37	5.49	0.96
	NO_2 - N	0.11	0.10	0.32	0.08

Ammonia is toxic to aquatic life and the proportion of toxic ammonia-N (NH_3) to total ammonium (NH_4) depends on pH and temperature. To account for this, the ammonia-N WQO ($[NH_3]_{WQO}$) under specific water quality conditions is determined using a function of pH and temperature (LARWQCB 2019).

The difference between the sample NH_3 value and its corresponding WQO is determined by the following equation:

$$[NH_3]_{Sample} - [NH_3]_{WQO} = \Delta NH_3$$

Where:
$[NH_3]_{Sample}$: Ammonia-N concentration (mg/L) of the sample
$[NH_3]_{WQO}$: Ammonia-N WQO (mg/L) under the Sample's water quality conditions
ΔNH_3 : ammonia-N sample-WQO difference (mg/L)

If $\Delta NH_3 < 0$, then the sample complies with the ammonia-N WQO. Conversely, if $\Delta NH_3 \geq 0$, then the sample exceeds the WQO. ΔNH_3 upstream and downstream of DCTWRP effluent are shown in Figure 3.3. In 2023, there were no ammonia-N WQO exceedances both upstream and downstream of the DCTWRP discharge point.

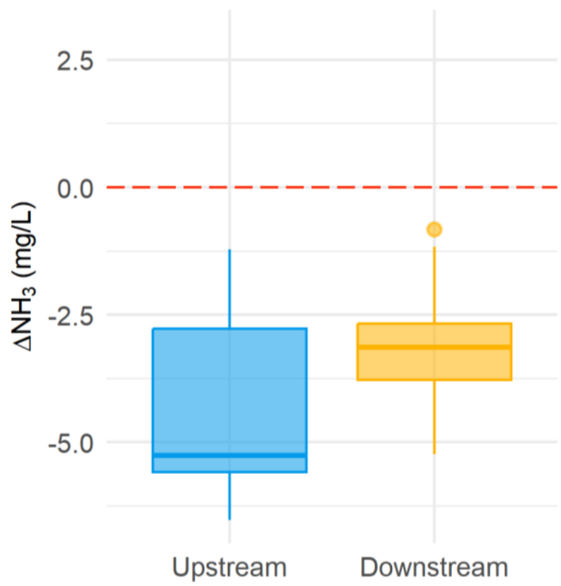


Figure 3.3 Ammonia-N WQO difference upstream and downstream of DCTWRP in 2023.
The horizontal dashed red line represents $\Delta NH_3 = 0$ mg/L. Values at or below the line ($\Delta NH_3 \leq 0$ mg/L) comply with WQOs, while values above the line ($\Delta NH_3 > 0$ mg/L) exceed WQOs.

The metals concentrations shown in Figure 3.4 were compared to the California Toxics Rule (CTR) chronic and acute standards. It is important to note that total recoverable metals, rather than dissolved metals, were measured by the City of Los Angeles as a requirement of their NPDES permit. Total recoverable concentrations from DCTWRP and LAGWRP were converted to dissolved concentrations, which represent the biologically active fraction of the total metal concentration, using a Metals Translator Guidance document written by the EPA (USEPA 1996).

Figure 3.4 shows the concentration of select metals upstream and downstream of the DCTWRP discharge location. Downstream concentrations of arsenic, zinc, lead, copper, zinc and cadmium were below both chronic and acute CTR criteria. Selenium concentrations upstream of the discharge exceeded the CTR chronic threshold during all four sampling events but were likely diluted by wastewater effluent at the downstream sampling location. Effluent from the DCTWRP does not contribute to metal exceedances downstream of the DCTWRP discharge.

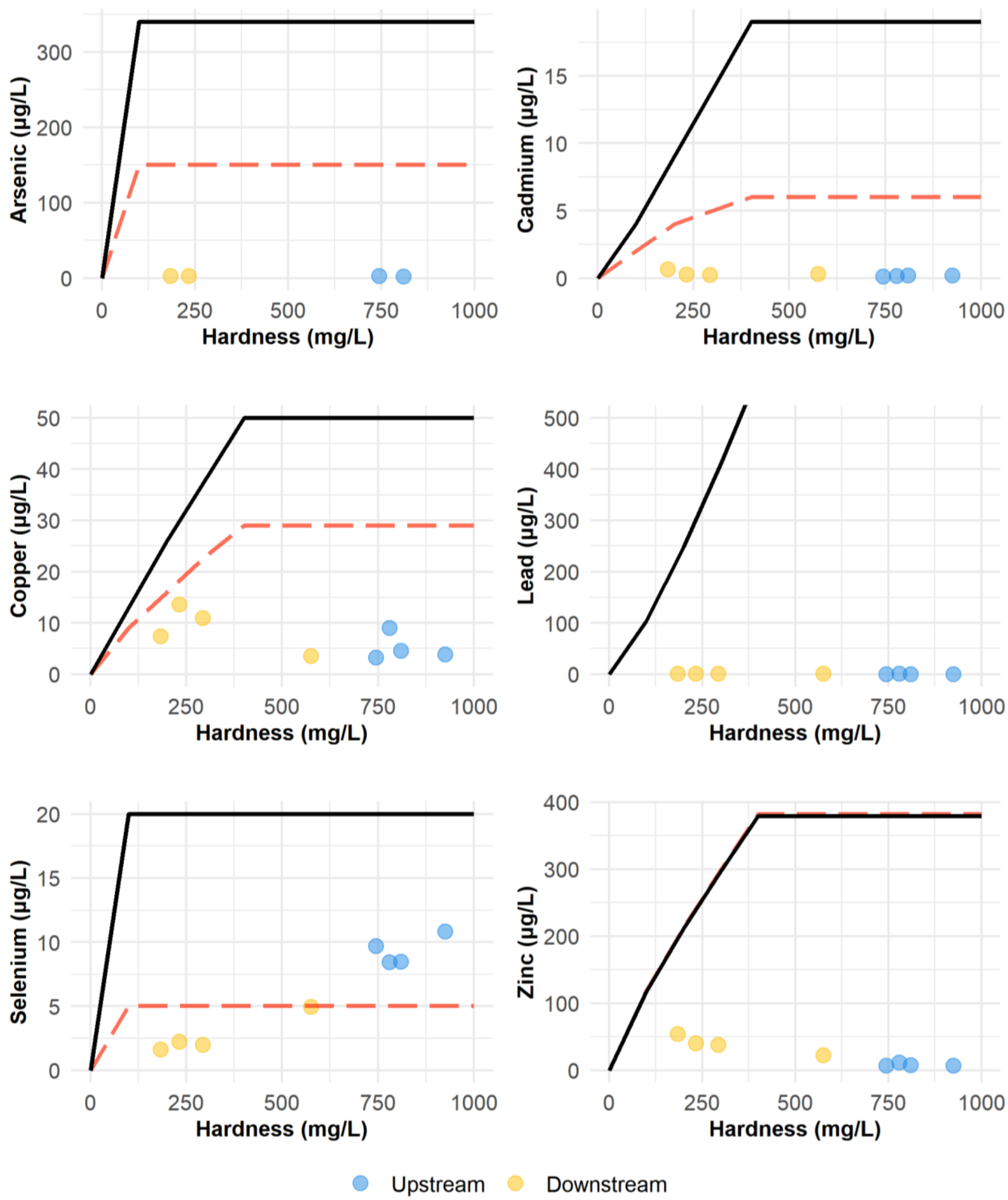


Figure 3.4 Dissolved metals concentrations above and below the DCTWRP discharge compared to hardness-adjusted, total recoverable CTR thresholds for acute and chronic effects.

Values are compared to hardness-adjusted, total recoverable CTR thresholds for acute (black line) and chronic (dashed red line) effects. Lead does not have an acute CTR threshold because the USEPA has not established a human health criterion for it. Lead is a harmful to human health even at low exposure levels. Values are estimated in instances where there were non-detects that did not meet the laboratory's reporting limit.

Total trihalomethanes, which are common disinfection by-products, were not detected above the discharge location. Disinfection byproducts are, as expected, higher downstream of DCTWRP but are well below the EPA water quality objective of 80 µg/L (Table 3.4).

Table 3.4 Trihalomethane concentrations above and below the DCTWRP discharge
Total trihalomethanes were calculated as the sum of bromodichloromethane, bromoform, chloroform, and dibromochloromethane concentrations in µg/L. "ND" indicates the analyte was not detected or the detected value was below the MDL. "DNQ" indicates the analyte was detected, but not quantifiable. The EPA water quality objective for total trihalomethanes is 80 µg/L (U.S. EPA 2002).

LOCATION	CONSTITUENT	2/7/23	8/1/23
Upstream	BROMODICHLOROMETHANE	ND	ND
	BROMOFORM	ND	ND
	CHLOROFORM	ND	ND
	DIBROMOCHLOROMETHANE	ND	ND
	Total	ND	ND
Downstream	BROMODICHLOROMETHANE	DNQ	DNQ
	BROMOFORM	ND	ND
	CHLOROFORM	8.84	DNQ
	DIBROMOCHLOROMETHANE	DNQ	ND
	Total	8.84	ND

3. City of Los Angeles – LAGWRP

Figure 3.5 shows the distribution of *E. coli* concentrations at sites upstream and downstream of the LAGWRP discharge point. Approximately 20% of upstream and 61% of downstream samples met the WQO. The average downstream *E. coli* concentration (362 MPN/100mL) was lower than the average upstream value (1431 MPN/100mL), indicating a dilution effect from the LAGWRP effluent.

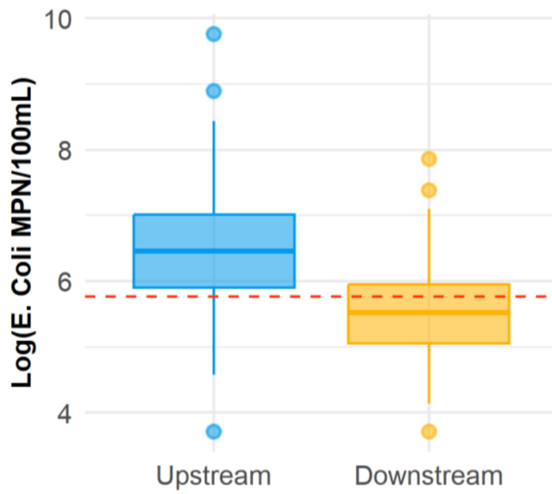


Figure 3.5 Log$_{10}$-transformed distributions of *E. coli* concentrations upstream and downstream of LAGWRP discharge

The red dashed horizontal line represents the WQO STV of 320 MPN/100mL (log$_{10}$ transformed) for REC-1 beneficial use.

Table 3.5 shows average concentration of regulated nitrogen species above and below the LAGWRP discharge. Nitrate-N, nitrite-N, and ammonia-N were tested weekly. Most of the nitrogen downstream and upstream of the POTW was in the form of nitrate-N. Table 3.5 shows the average concentrations of several nitrogen species observed at a site upstream and downstream of LAGWRP discharge. Nitrate-N, nitrite-N, and ammonia-N were tested weekly. Downstream concentrations of nitrate-N and nitrite-N were below WQOs (Table 3.3).

Table 3.5 Range of nutrient concentrations upstream and downstream of LAGWRP discharge in 2023

Position	N-Species	Mean	Median	Max	SD
Upstream	NH_3 - N	0.13	0.12	0.38	0.11
	NO_3 - N	2.98	2.82	5.32	1.02
	NO2 - N	0.13	0.10	0.41	0.10
Downstream	NH_3 - N	0.20	0.18	0.61	0.16
	NO_3 - N	3.19	3.13	5.58	1.06
	NO_2 - N	0.14	0.10	0.44	0.10

The ΔNH_3 distribution upstream and downstream of DCTWRP effluent are graphed in Figure 3.6. In 2023, there were no ammonia-N WQO exceedances both upstream and downstream of the discharge point.

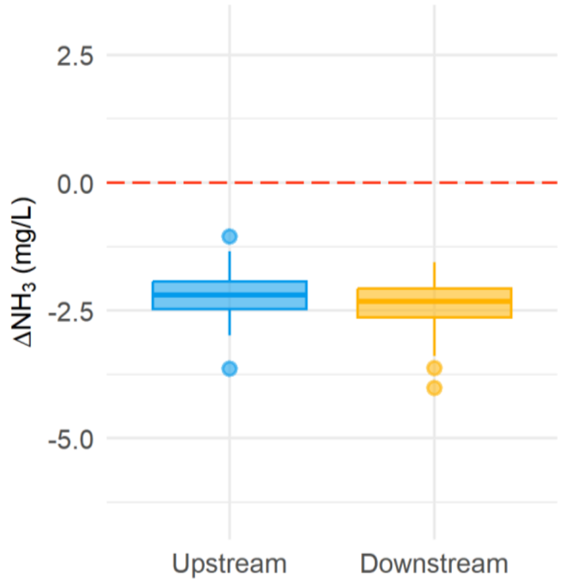


Figure 3.6 Ammonia WQO difference upstream and downstream of LAGWRP in 2023.
The horizontal dashed red line represents $\Delta NH_3 = 0$ mg/L. Values at or below the line ($\Delta NH_3 \leq 0$ mg/L) comply with WQOs, while values above the line ($\Delta NH_3 > 0$ mg/L) exceed WQOs.

Total recoverable metals were measured both upstream and downstream of the LAGWRP discharge (Figure 3.7). The copper WER ratio for Reach 3 of the river, where LAGWRP is located, is 3.97 and CTR criteria are adjusted accordingly. All metal concentrations were below the WER adjusted CTR thresholds both upstream and downstream of the LAGWRP outfall. Treated wastewater from LAGWRP is not causing elevated concentrations of metals downstream of discharge locations and metal concentrations are below regulatory objectives.

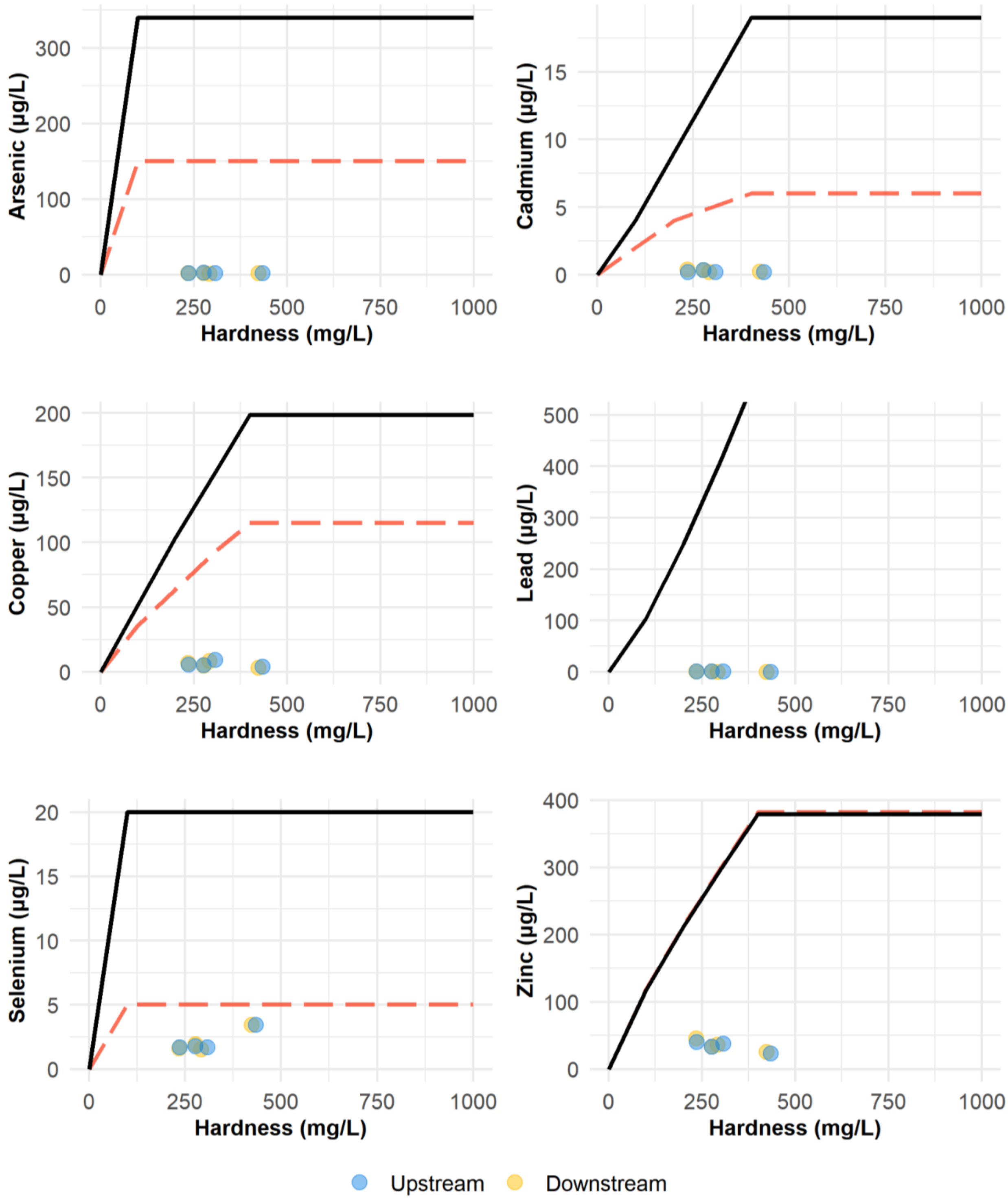


Figure 3.7 Dissolved metals concentrations above and below the LAGWRP discharge compared to hardness-adjusted, total recoverable CTR thresholds for acute and chronic effects.

Values are compared to hardness-adjusted, total recoverable CTR thresholds for acute (black line) and chronic (dashed red line) effects. Lead does not have an acute CTR threshold because the USEPA has not established a human health criterion for it. Lead is harmful to human health. Values are estimated in instances where there were non-detects that did not meet the laboratory's reporting limit. Note that downstream and upstream concentrations may be close in value, as a result it may be difficult to see overlapping yellow and blue points on the graph.

Total trihalomethanes were not detected above the LAGWRP discharge location, but were detected below the discharge location. The concentrations downstream of the discharge were well below the EPA water quality objective of 80 µg/L (Table 3.6).

Table 3.6 Trihalomethane concentrations above and below the LAGWRP discharge.
Total trihalomethanes were calculated as the sum of bromodichloromethane, bromoform, chloroform, and dibromochloromethane in µg/L. "ND" indicates the analyte was not detected or the detected value was below the MDL. "DNQ" indicates the analyte was detected, but not quantifiable. The EPA water quality objective for total trihalomethanes is 80 µg/L (U.S. EPA 2002).

LOCATION	CONSTITUENT	2/7/23	8/1/23
Upstream	BROMODICHLOROMETHANE	ND	ND
	BROMOFORM	ND	ND
	CHLOROFORM	DNQ	ND
	DIBROMOCHLOROMETHANE	ND	ND
	Total	ND	ND
Downstream	BROMODICHLOROMETHANE	DNQ	DNQ
	BROMOFORM	ND	ND
	CHLOROFORM	4.36	2.59
	DIBROMOCHLOROMETHANE	DNQ	ND
	Total	4.36	2.59

4. City of Burbank – BWRP

The distribution of *E. coli* values upstream and downstream of the City of Burbank's BWRP discharge location are shown in Figure 3.8. Approximately 18% of upstream and 2% of downstream locations met the WQO. Average *E. coli* concentration downstream (14794 MPN/100mL) was higher than the average upstream value (6376 MPN/100mL). Both upstream and downstream average values exceeded the REC-1 STV WQO (320 MPN/100mL).

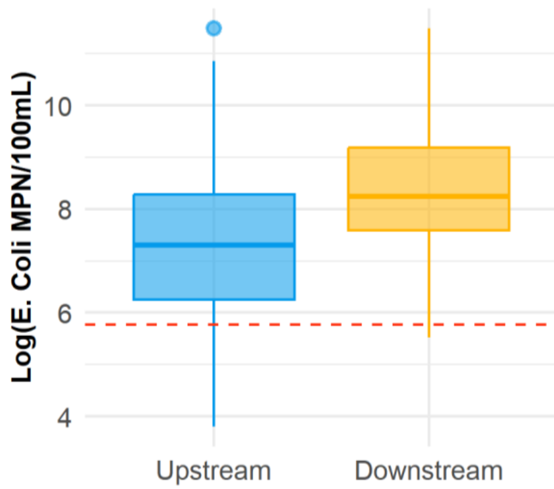


Figure 3.8 Log_{10}-transformed *E. coli* concentrations at upstream and downstream locations of DCTWRP discharge.

The red dashed horizontal line denotes the WQO STV of 320 MPN/100mL (log_{10} transformed) for REC-1 beneficial use.

Table 3.7 shows the range in nutrient concentration measured above and below the BWRP discharge. Nutrients were measured approximately every week. Average concentrations for all nitrogen species were higher downstream, and, on average, met WQOs.

Table 3.7 Range of nutrient concentrations upstream and downstream of BWRP discharge in 2023.

Position	N-Species	Mean	Median	Max	SD
Upstream	NH_3 - N	0.20	0.11	1.20	0.26
	NO_3 - N	2.97	2.90	5.10	1.21
	NO_2 - N	0.11	0.06	0.43	0.11
Downstream	NH_3 - N	0.77	0.79	1.30	0.26
	NO_3 - N	4.06	4.10	6.00	0.78
	NO_2 - N	0.14	0.15	0.31	0.09

Similar to other nitrogen species, upstream ammonia-N concentrations at BWRP were higher than downstream concentrations. ΔNH_3 upstream and downstream of the BWRP discharge are shown in Figure 3.9. In 2023, excluding one upstream sample, BWRP generally met WQOs for ammonia-N.

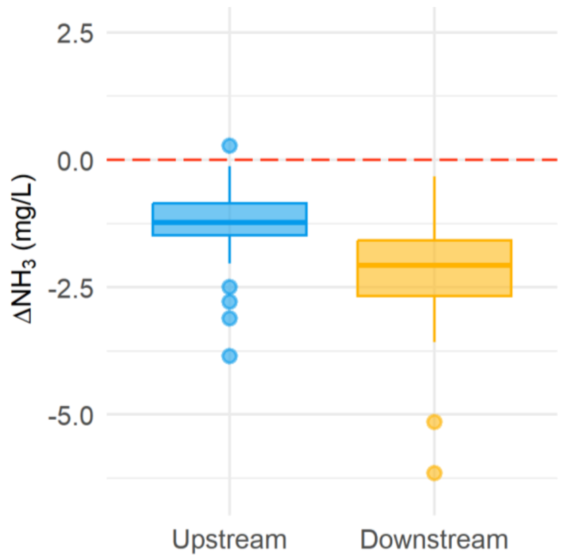


Figure 3.9 Ammonia WQO difference of samples collected upstream and downstream of BWRP in 2023. The horizontal dashed red line represents $\Delta NH_3 = 0$ mg/L. Values at or below the line ($\Delta NH_3 \leq 0$ mg/L) comply with WQOs, while values above the line ($\Delta NH_3 > 0$ mg/L) exceed WQOs.

Figure 3.10 shows the hardness adjusted dissolved metal concentrations compared to their CTR chronic and acute standards. The copper WER for this reach of the Burbank Channel is 4.75 and CTR criteria were adjusted accordingly. Metal concentrations were below the CTR chronic and acute standards for all metals, on all occasions. Wastewater discharge from BWRP is not causing downstream metal exceedances.

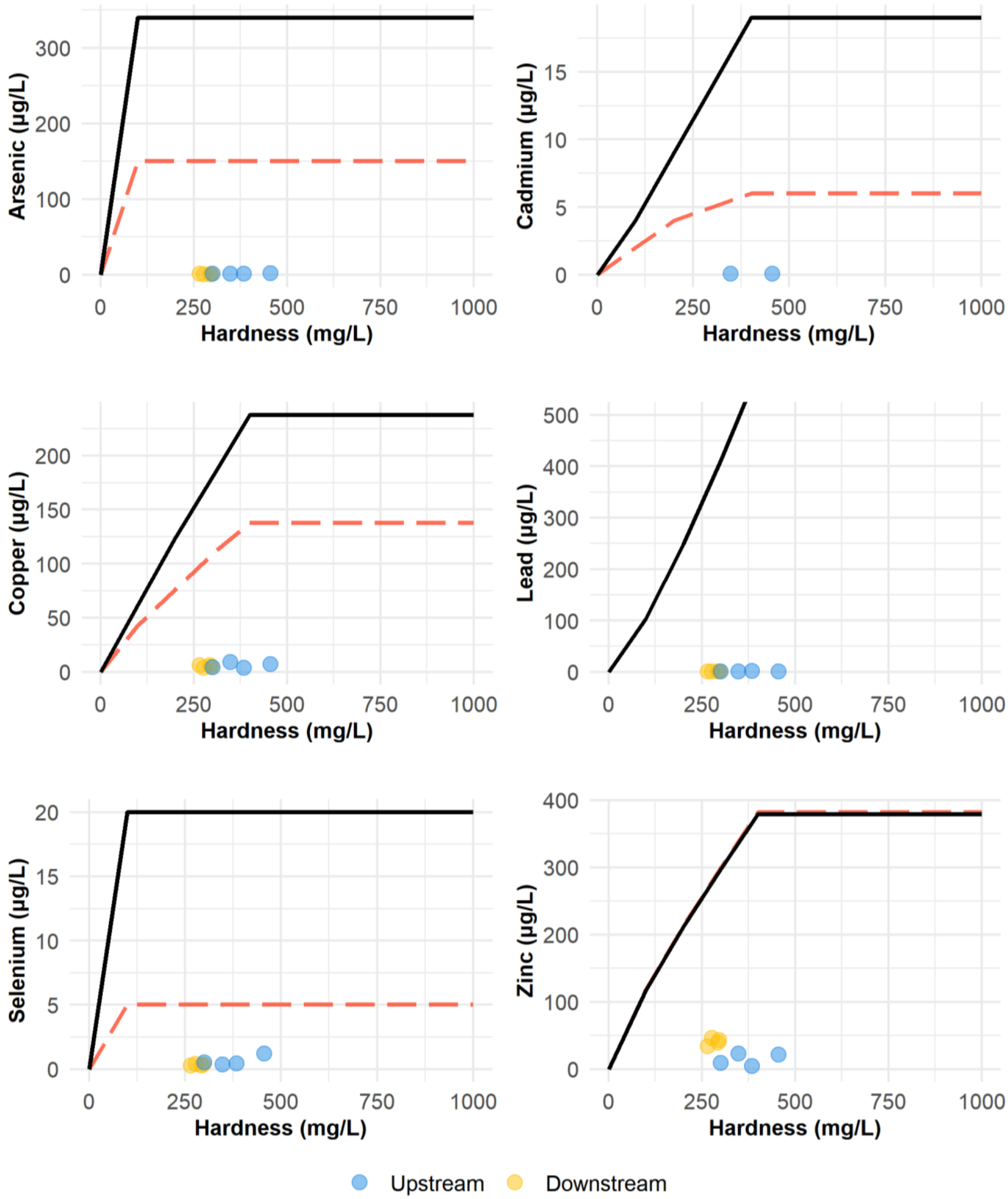


Figure 3.10 Dissolved metals concentrations above and below the BWRP discharge compared to hardness-adjusted, total recoverable CTR thresholds for acute and chronic effects.

Values are compared to hardness-adjusted, total recoverable CTR thresholds for acute (black line) and chronic (dashed red line) effects. Lead does not have an acute CTR threshold because the USEPA has not established human health criteria for this contaminant. Values are estimated in instances where there were non-detects that did not meet the laboratory's reporting limit. Note that downstream and upstream concentrations may be close in value, as a result it may be difficult to see overlapping yellow and blue points on the graph

Trihalomethanes were detected above and below the BWRP discharge locations. Concentrations upstream and downstream were well below the EPA water quality objective 80 µg/L (Table 3.8) and were, as expected, higher downstream of POTW effluent.

Table 3.8 Trihalomethane concentrations above and below the BWRP discharge.
Total trihalomethanes was precalculated and reported by the City of Burbank in µg/L. "ND" indicates the analyte was not detected or the detected value was below the MDL. The EPA water quality objective for total trihalomethanes is 80 µg/L (U.S. EPA 2002).

LOCATION	CONSTITUENT	2/1/23	8/2/23
Upstream	BROMODICHLOROMETHANE	ND	ND
	BROMOFORM	ND	ND
	CHLOROFORM	ND	ND
	DIBROMOCHLOROMETHANE	ND	ND
	Total	ND	ND
Downstream	BROMODICHLOROMETHANE	2.6	0.51
	BROMOFORM	ND	ND
	CHLOROFORM	6.7	2.1
	DIBROMOCHLOROMETHANE	1.2	ND
	Total	ND	ND

Question 4. Is it safe to recreate?

1. Background

Thousands of people swim at unpermitted sites within the Los Angeles River Watershed each summer. The fourth element of the monitoring program assesses the beneficial use of formal and informal sites in the Los Angeles River Watershed for Water Contact Recreation. Prior to the initiation of LARWMP, the concentrations of potentially harmful fecal pathogens and the bacteria that indicate their presence was not known. Monitoring at both permitted and informal recreational swim sites reflects concerns for the risk of gastrointestinal illness posed by pathogen contamination to recreational swimmers in streams of the Los Angeles River watershed and to kayakers in the recreation zones. Depending on the site, sources of indicator bacteria and pathogen contamination could include humans, dogs, wildlife, urban runoff, and refuse from campgrounds and homeless encampments.

Fecal indicator bacteria (FIB) tests are inexpensive and the body of literature shows *E. coli* to be a good predictor for gastrointestinal illness. Standards used by both EPA and LARWQCB are also based on *E. coli* cultivation methodology (EPA, 2010; Wade et al., 2003). However, several studies have found that no single indicator is protective of public health and that in some studies, FIB do not correlate well with pathogens (Hardwood et al., 2005). Studies have also highlighted the need to better understand whether faster and more specific microbial methods can better predict health outcomes (Wade et al., 2003), particularly since human fecal sources have an increased pathogenic risk. Many improved methods are in development but challenges related to performance, specificity, and sensitivity remain before they are applied to a regulatory realm (Harwood et al., 2013). Until methods improve and become cost-effective, the safe to recreate effort within the LARWMP will monitor FIB, specifically *E. coli*, at recreational sites in the watershed.

2. Methods

LARWMP's bacteria-monitoring program samples for *E. coli* about five times a month at each recreational swim site during the summer (Memorial Day to Labor Day) (Figure 4.1 and Table 4.1). The kayak sites are monitored from Memorial Day through the end of September. Sites sampled for swimming safety are selected based on the collective knowledge of the workgroup related to the most frequently used swimming locations in the watershed. To better understand the relationships between periods of heavy recreational swim use and *E. coli* concentrations, sampling is conducted on weekends and holidays to capture the occasions when the greatest numbers of people are swimming. This is because the San Gabriel River Watershed program, a similar program to LARWMP, found that indicator bacteria levels are higher on weekends and holidays when recreational swim use is greatest (SGRRMP 2009).

Field-monitoring teams deploy during the morning and collect grab samples at recreational sites. Observational data are also recorded at each site including information on flow habitats, number of visitors and swimmers, animals present, wind direction, and site refuse. Handheld meters and probes were used to collect data on dissolved oxygen, pH, water conductivity, and water temperature. The bacteria concentrations were compared against State of California REC-1 and LREC-1 standards (LARWQCB 2014; Tables 4.2 & 4.3).

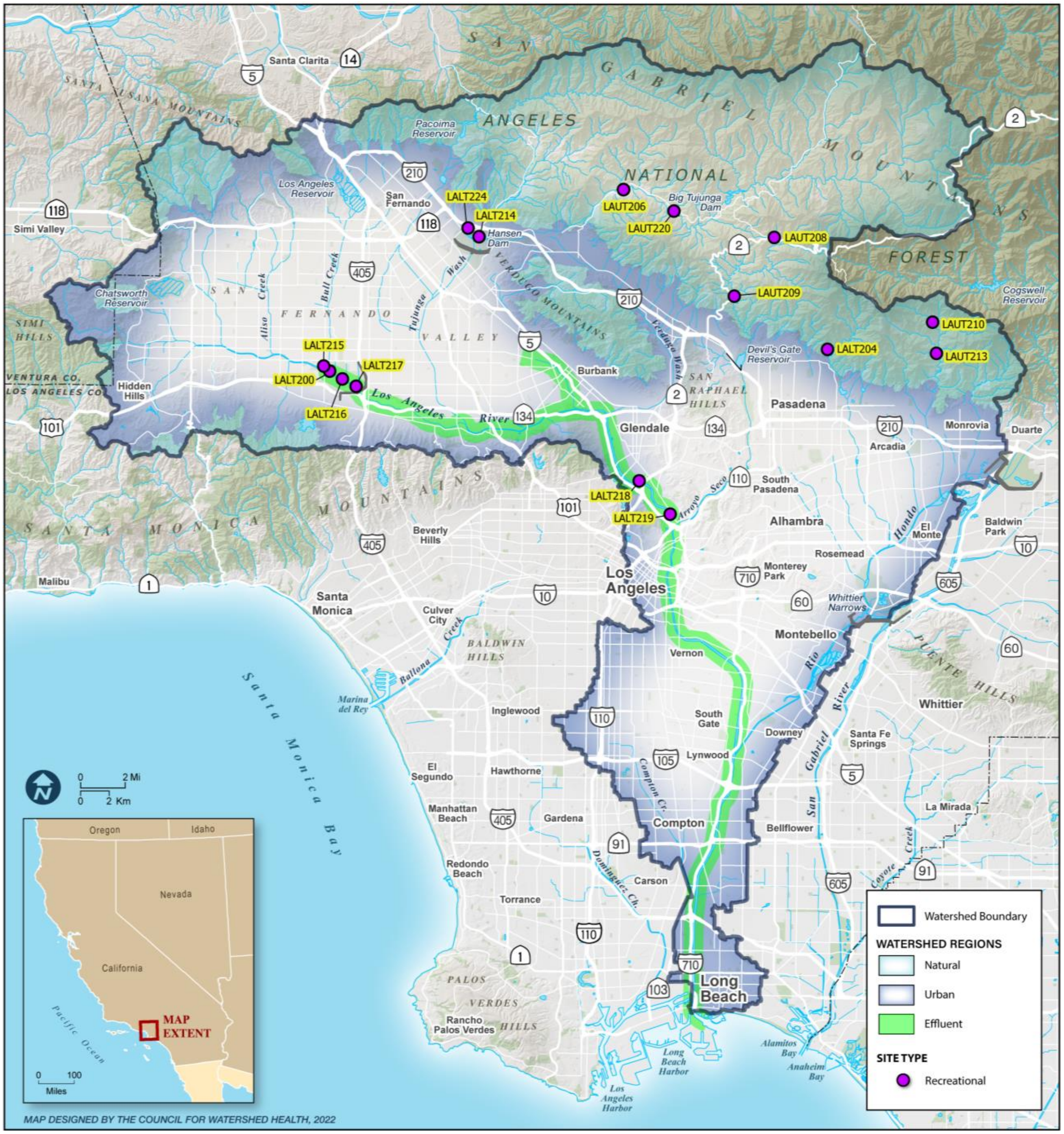


Figure 4.1 Recreational swim site locations sampled in 2023.

Table 4.1 Sampling locations and site codes for indicator bacteria

Program Element	Sampling Sites	Site Code
Recreational Swim Sites	Hansen Dam Recreation Lake	LALT224
	Bull Creek Sepulveda Basin	LALT200
	Eaton Canyon Natural Area Park	LALT204
	Tujunga Wash at Hansen Dam	LALT214
	Switzer Falls	LAUT208
	Gould Mesa Campground	LAUT209
	Sturtevant Falls	LAUT210
	Hidden Springs	LAUT211
	Hermit Falls	LAUT213
	Vogel Flats	LAUT220
	Delta Day Use	LAUT206
Recreational Kayak Sites	Upper Sepulveda Basin Zone	LALT215
	Middle Sepulveda Basin Zone	LALT216
	Lower Sepulveda Basin Zone	LALT217
	Upper Elysian Valley Zone	LALT218
	Middle Elysian Valley Zone	LALT221
	Lower Elysian Valley Zone	LALT219

Table 4.2 REC-1 indicator bacteria standards for freshwater
The statistical threshold value (STV) is not to be exceeded by more than 10% of samples collected in a calendar month. Whereas the geometric mean (GM) is calculated using a weekly rolling average.

Indicator	Statistical Threshold Value	Six Week Rolling Geometric Mean
E. coli	320 MPN/100 mL	100 MPN/100 mL

Table 4.3 LREC-1 indicator bacteria standards for freshwater
The Single Sample Maximum Value (SSMV) is not to be exceeded by any sample. Whereas the GM is calculated monthly (every 30 days).

Indicator	Single Sample Maximum Value	30-day Geometric Mean
E. coli	576 MPN/100 mL	126 MPN/ 100 mL

The State of California describes REC-1 (LARWQCB 2020a; 2020b) as they apply to recreational activities where ingestion is reasonably possible and LREC-1 standards as they apply to activities where ingestion is infrequent. A standard that makes use of the GM provides an indication of how persistent elevated bacterial concentrations are at a site. Recent updates to the basin plan required a 6-week rolling geometric mean be applied at REC-1 sites and STV applied to single samples. The REC-1 STV (320 MPN/100 mL) was applied to all informal recreation sites. The LREC-1 SSMV (576 MPN/100 mL) was applied to kayak sites since recreators have limited water contact when kayaking as opposed to swim sites, where full submersion in water is more likely to occur. To apply the GMs, at least 5 samples per month per site are required. During the summer survey in 2023, there was a goal to collect at least five samples per month at each of the swim sites. However, site closures and other barriers to access prevented the collection of samples at Gould Mesa Campground (LAUT209).

3. Results

a. ***Recreational Swim Sites (REC-1)***
During the summer of 2023, a total of 394 water samples were successfully collected from fifteen recreational swim and kayak sites popular with visitors and residents. Table 4.4 summarizes site observations at recreational swim sites during the 2023 monitoring year. The most popular sites were Hansen Dam Recreation Lake (LALT224), Eaton Canyon (LALT204), and Switzer Falls (LALT208), which all averaged ≥10 on-shore recreators. In addition, Switzer Falls stood out with the highest observed visitorship during the 2023 monitoring season, with 45 on-shore recreators counted on July 4. The most popular sites for swimming/bathing were Hansen Dam (LALT224) and Vogel Flats (LAUT220). The least popular site was Delta Day Use (LAUT 206), where no visitors were observed throughout the season. Refuse was prominent at all sampling locations and was observed at 96% of sampling events.

Table 4.4 Site usage summary for recreational swim sites sampled in 2023

Parameter		LALT200	LALT204	LALT214	LALT224	LAUT206	LAUT208	LAUT209	LAUT211	LAUT220
		Bull Creek	Eaton Canyon	Tujunga Wash at Hansen Dam	Hansen Dam Rec. Lake	Delta Day Use	Switzer Falls	Gould Mesa	Hidden Springs	Vogel Flats
No. Sample Days		20	19	20	20	18	20	13	20	19
Swim Site Usage Statistics										
On-Shore	mean ± stdev	0 ± 0	13 ± 10	1 ± 1	13 ± 8	0 ± 0	12 ± 13	3 ± 4	0 ± 1	7 ± 10
	median	0	10	1	14	0	9	2	0	3
	min	0	0	0	0	0	0	0	0	0
	max	1	35	4	36	0	45	15	2	40
Bathers	mean ± stdev	0 ± 0	2 ± 3	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 1	0 ± 0	2 ± 3
	median	0	0	0	0	0	0	0	0	0
	min	0	0	0	0	0	0	0	0	0
	max	0	8	1	1	0	2	2	2	10
Animals	mean ± stdev	0 ± 0	1 ± 2	1 ± 1	1 ± 1	0 ± 0	0 ± 1	1 ± 1	0 ± 0	0 ± 1
	median	0	0	1	1	0	0	0	0	0
	min	0	0	0	0	0	0	0	0	0
	max	2	5	4	3	0	3	2	1	2
Swim Site Observations										
Refuse		100%	74%	100%	100%	94%	100%	100%	100%	100%
Algae		25%	0%	5%	0%	44%	0%	31%	5%	0%
Oil		5%	0%	0%	0%	6%	0%	0%	0%	0%
Tar		0%	0%	0%	0%	0%	0%	0%	5%	0%
Sewage		0%	0%	0%	0%	0%	0%	0%	0%	0%
Upstream Storm Drain flow		0%	0%	0%	0%	0%	0%	0%	0%	0%

The concentrations of *E. coli* at swim sites and kayak sites were compared to their respective WQOs. The REC-1 STV standard was applied to recreational swim sites (Table 4.5). A site exceeds the STV standard if more than 10% of samples within a calendar month are above 320 CFU/100 mL. In 2023, Tujunga Wash at Hansen Dam (LALT214) and Bull Creek (LALT200) exceeded the STV during all three months of sampling. Tujunga Wash at Hansen Dam, a popular site for equestrian activities such as trail riding, has been noted by the field team for the presence of horses and large animal waste at the monitoring site. This may contribute to the elevated FIB levels observed; however, further microbial source tracking is necessary to confirm the primary source of the bacteria.

The two most popular recreation sites – Hansen Dam Recreation Lake (LALT224) and Eaton Canyon (LALT204) – met the WQO throughout the season. The next most popular site – Switzer Falls (LALT208) – exceeded the STV in the last month of sampling. All the other swim sites met the WQO.

Table 4.5 Single sample *E. coli* values at LARWMP recreation sites from May – Sept 2023
<10 MPN/100 mL = non-detect. NS indicates the site was not sampled on that date. Samples are compared to the REC-1 STV = 320 MPN/100mL. Exceedances are highlighted in red. If more than 10% of samples taken within a calendar month exceed this value, it is considered an exceedance. Monthly exceedances are red and underlined.

Sample Date		LALT200	LALT204	LALT214	LALT224	LAUT206	LAUT208	LAUT209	LAUT211	LAUT220
		Bull Creek	Eaton Canyon	Tujunga Wash at Hansen Dam	Hansen Dam Rec. Lake	Delta Day Use	Switzer Falls	Gould Mesa	Hidden Springs	Vogel Flats
May 25 - Jun 23, 2023	5/25/2023	1300	31	218	10	NS	<10	NS	<10	10
	5/29/2023	189	63	332	<10	31	<10	NS	10	<10
	5/30/2023	487	10	305	<10	20	20	NS	<10	10
	6/4/2023	246	31	457	<10	10	63	NS	31	<10
	6/10/2023	428	74	369	<10	10	75	NS	20	10
	6/16/2023	620	96	312	<10	10	<10	NS	<10	10
	6/18/2023	379	216	959	<10	10	10	NS	41	41
5/25 - 6/18 %Exceedance		**71%**	0%	**57%**	0%	0%	0%	0%	0%	0%
Jun 24 - Jul 23, 2023	6/28/2023	108	31	399	<10	NS	41	<10	<10	10
	7/4/2023	364	31	620	<10	31	63	<10	146	NS
	7/5/2023	435	NS	213	<10	63	74	20	<10	10
	7/10/2023	169	41	2910	<10	41	20	10	41	10
	7/15/2023	529	20	1017	10	20	20	<10	20	31
	7/23/2023	487	75	905	<10	41	31	<10	<10	20
6/28 - 7/23 %Exceedance		**67%**	0%	**83%**	0%	0%	0%	0%	0%	0%
Aug 6 - Sep 4, 2023	8/6/2023	439	20	1660	<10	10	20	74	<10	10
	8/12/2023	521	41	583	<10	10	<10	10	41	<10
	8/19/2023	565	121	5794	<10	31	74	10	41	<10
	8/26/2023	657	52	1782	<10	20	52	31	110	41
	8/29/2023	798	<10	616	<10	20	98	41	63	41
	9/3/2023	41	85	<10	10	52	345	41	86	10
	9/4/2023	10	292	<10	<10	10	146	<10	122	10
8/6 - 9/4 %Exceedance		**71%**	0%	**71%**	0%	0%	**14%**	0%	0%	0%

Similarly, the 6-week rolling geometric mean similarly showed Hansen Dam (LALT 214) and Bull Creek (LALT 200) had consistently high *E. coli* concentrations compared to other informal recreation sites (Table 4.6). All other sites met the 6-week rolling GM WQO.

Table 4.6 Geometric mean of *E. coli* concentrations (MPN/100 mL) at LARWMP recreation sites. Rolling 6-week GMs ≥100 MPN/100 mL are highlighted in red. At least 6 samples per 6-week period are required for analysis. * Indicates insufficient data (<6 samples).

6-week period	Site ID								
	LALT200	LALT204	LALT214	LALT224	LAUT206	LAUT208	LAUT209	LAUT211	LAUT220
	Bull Creek	Eaton Canyon	Tujunga Wash at Hansen Dam	Hansen Dam Rec. Lake	Delta Day Use	Switzer Falls	Gould Mesa	Hidden Springs	Vogel Flats
5/25 - 7/6	372	46	377	5	18	22	*	13	10
6/1 - 7/13	303	57	545	5	19	31	*	19	11
6/8 - 7/20	334	53	602	5	21	27	*	18	14
6/15 - 7/27	339	53	673	5	25	24	7	15	16
6/22 - 8/3	301	36	722	6	37	37	7	16	14
6/29 - 8/10	380	33	915	6	29	32	11	16	14
7/6 - 8/17	398	35	1210	6	20	17	11	15	13
7/13 - 8/24	506	43	1388	6	19	21	11	15	11
7/20 - 8/31	566	35	1331	5	19	32	19	26	14
7/27 - 9/7	223	49	285	6	18	57	21	48	12

b. ***Recreational Kayak Sites (LREC-1)***

Kayak sites were compared to the higher single sample LREC-1 SSMV standard of 526 CFU/100 mL (Table 4.3). We found exceedances at these sites were generally low and infrequent. The highest percentage of LREC-1 WQO exceedances was 8% at both the Upper (LALT215) and Middle (LALT216) Sepulveda Basin Zones (Table 4.6).

Table 4.7 Single sample *E. coli* concentrations (MPN/100 mL) at LARW kayak sites from May – Sep 2023
NS indicates the site was not sampled on that date. Samples are compared to the single sample LREC-1 SSMV standard of 576 MPN/100 mL. Exceedances are highlighted in red.

Sample Date		Sepulveda Basin Zones			Elysian Valley Zones		
		Upper	Middle	Lower	Upper	Middle	Lower
		LALT215	LALT216	LALT217	LALT218	LALT219	LALT221
5/23 - 6/22	5/23/23	134	1100	238	379	785	148
	5/25/23	187	905	414	384	216	122
	5/30/23	122	327	109	134	323	63
	6/1/23	226	388	288	86	75	74
	6/6/23	833	420	134	420	228	121
	6/8/23	420	384	85	109	98	110
	6/13/23	373	487	134	146	216	85
	6/15/23	187	318	154	160	160	134
	6/20/23	135	134	108	185	189	122
	6/22/23	98	160	75	187	97	156
6/27 - 7/27	6/27/23	74	135	52	187	75	173
	6/29/23	63	410	30	108	97	41
	7/4/23	122	152	41	86	145	75
	7/6/23	119	216	97	148	20	52
	7/11/23	108	63	31	110	146	98
	7/13/23	10	384	52	110	134	75
	7/18/23	110	31	146	110	63	109
	7/20/23	20	30	31	20	158	41
	7/25/23	20	51	63	75	122	62
	7/27/23	75	84	31	109	121	73
8/1 - 8/31	8/1/23	74	250	97	228	121	86
	8/3/23	41	134	75	52	63	20
	8/8/23	20	96	120	62	63	63
	8/10/23	20	201	96	41	96	98
	8/15/23	52	183	63	63	145	109
	8/17/23	41	31	41	51	85	110
	8/24/23	1150	631	1670	448	529	576
	8/25/23	414	404	383	NS	NS	NS
	8/29/23	75	233	121	158	189	148
	8/31/23	86	201	110	226	228	327
9/5 – 9/28	9/5/23	738	459	298	265	295	275
	9/7/23	175	145	199	201	134	231
	9/12/23	97	122	95	169	74	135
	9/14/23	52	171	169	121	75	213
	9/19/23	97	213	86	161	160	135
	9/21/23	31	185	75	203	161	218
	9/26/23	173	62	109	97	231	86
	9/28/23	571	134	211	122	216	122
% Exceedance		**8%**	**8%**	**3%**	**0%**	**3%**	**3%**

The 30-day GM of *E. coli* for each kayak site was compared to the LREC WQO 30-day GM standard of 126 MPN/100mL (Table 4.8). During the first sampling month, five kayaking sites exceeded the WQO. In the second month, bacteria concentrations across sites fell and met the WQO. However, in the third month, half of the sites exceeded the WQO. By the fourth and final month of sampling, all six sites exceeded the WQO.

Table 4.8 30-day Geometric means of *E. coli* (MPN/100 mL) at kayak sites from May – Sept 2023
30-day geometric means are compared to the LREC-1 GM objective of 126 MPN/100 mL. Values that were above the WQO are highlighted in red.

30-day period	Sepulveda Basin Zones			Elysian Valley Zones		
	Upper	Middle	Lower	Upper	Middle	Lower
	LALT215	LALT216	LALT217	LALT218	LALT219	LALT221
5/23 - 6/22	216	383	150	190	189	109
6/27 - 7/27	55	106	50	94	95	73
8/1 - 8/31	78	184	134	105	133	115
9/5 – 9/28	145	161	139	160	152	166

c. ***Trash Assessments***
Trash assessments were also completed at recreation sites, excluding kayak sites, from 2018 - 2023 using the methodology described under *Question 1: Methods*. In 2023, plastic, metals, and biodegradable materials were the most common trash categories (Figure 4.2). Plastic was the predominant material at every location, accounting for an average of 56% of the total trash. Vogel Flats (LAUT 220) had the highest total counts (Figure 4.3). In 2023, trash counts at recreation sites generally decreased compared to the previous two years (Figure 4.4).

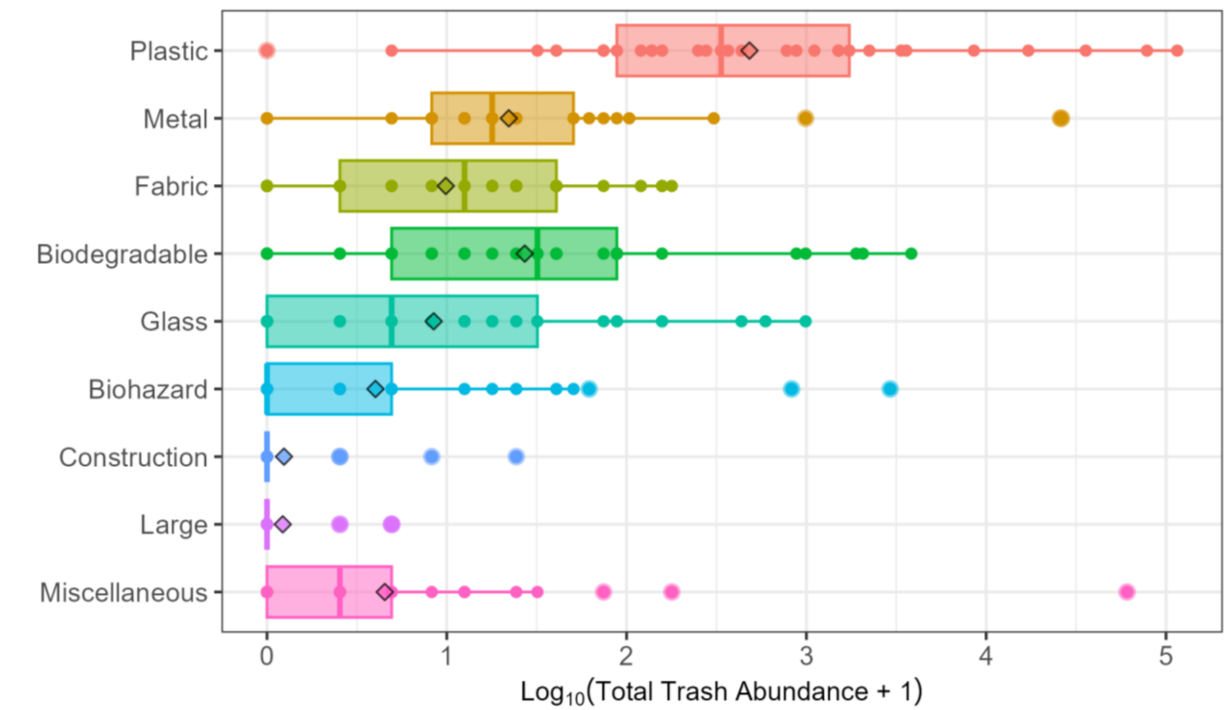


Figure 4.2 Boxplot of each trash category at LARWMP recreational swim sites in 2023.
Diamonds represent averages.

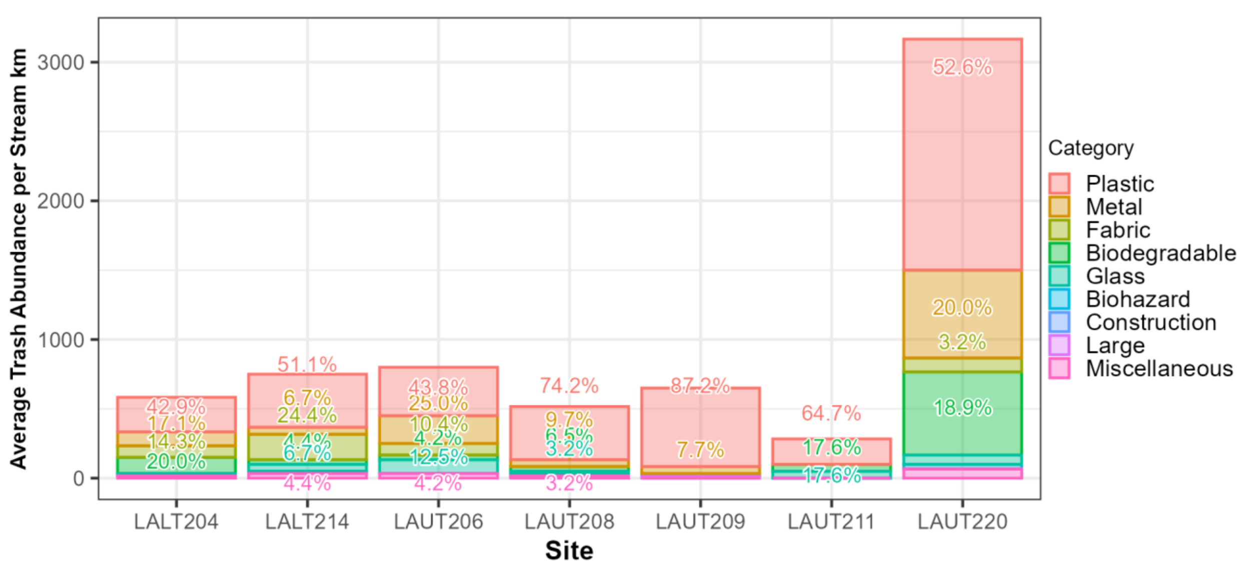


Figure 4.3 Average trash abundance of LARWMP recreational swim sites in 2023
Percentage of total trash abundance (>3%) by category is shown.

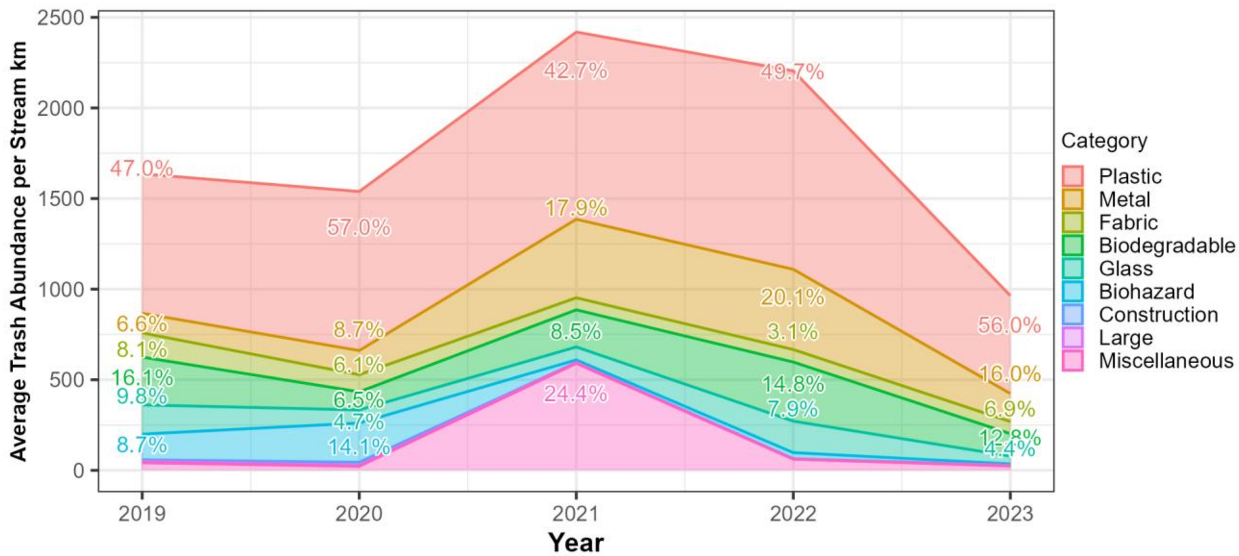


Figure 4.4 2018 – 2023 Timeline of trash category distribution for LARWMP recreational swim sites sampled
Annual percentage of total trash abundance (>3%) by category is shown.

When analyzing more detailed trash subcategories across all recreation sites, wrapper pieces, paper/cardboard, metal bottle caps, and straw wrappers were the most common (Figure 4.5). This pattern of common trash types reflects typical recreational activities at these sites, such as social gatherings and parties. These activities often involve food and beverages, leading to a higher frequency of items like food wrappers, beverage containers, and disposable utensils.

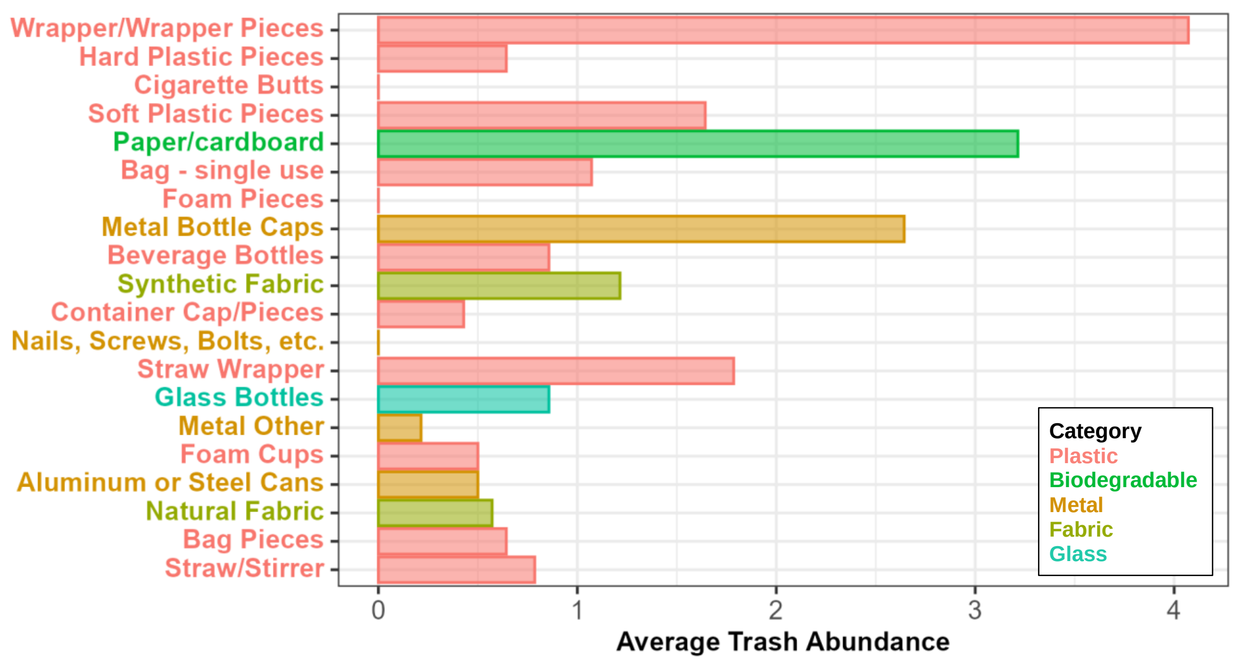


Figure 4.5 Average trash abundance of top 20 trash subcategories across LARWMP recreational swim sites in 2023
Trash subcategories are color coded by their respective categories.

Question 5. Are locally caught fish safe to eat?

1. Background

Question 5 addresses the human health risk associated with consuming contaminated fish caught at popular fishing locations in the watershed. The monitoring program focuses on one or two fishing sites each year with the goal of identifying the fish species and contaminant types that are of concern. Sites are selected based on the technical stakeholder group's input about sites that are popular with the angler community. Data will provide watershed managers with the information necessary to educate the public about the safety of consuming the fish they catch.

2. Methods

a. Sampling and Tissue Analysis

Sites for contaminant monitoring in fish populations revolve from year to year and have included various lake and river sites throughout the watershed. Lake and river sites are selected based on angler surveys conducted at recreational sites throughout the watershed by Allen et al. (2008) and the recommendations of the Technical Stakeholder Group.

Fish were collected using a boat outfitted with electroshocking equipment, in accordance to the Office of Environmental Health Hazards (OEHHA) sport fish sampling and analysis protocols, which allowed specific species and size classes to be targeted (OEHHA 2005). OEHHA specifies that the muscle filets from at least five individual fish of the same species and size class be combined to form a composite sample. LARWMP analyzed only the muscle tissue of the fish, which is common practice in regional regulatory programs. Other body parts, such as the skin, eyes, and organs of fish may contain higher levels of contaminants and are not recommended for consumption by the OEHHA. Four contaminants, mercury, selenium, total DDTs, and total PCBs, were selected for analysis based on their contribution to human health risk in California's coastal and estuarine fishes.

Mercury can transform in the environment, affecting its behavior and tendency for biological accumulation. It is widely assumed that nearly all (>95%) of the mercury present in fish is methyl mercury (Wiener et al. 2007). Consequently, monitoring programs usually analyze total mercury as a proxy for methyl mercury, as was done in this study. The U.S. EPA (2000) recommends using the conservative assumption that all mercury that is present is methyl mercury, since it is most protective of human health.

It is also important to note that this program component does not include rainbow trout, a popularly stocked and locally caught fish. Once rainbow trout are released to a waterbody they are caught very quickly and, therefore, have a very short residence time, reducing their potential to accumulate contaminants from that waterbody. There is still the potential for stocked fish to accumulate contaminants from the waterbody where they were raised, but that is not the focus of this study.

b. Advisory Tissue Levels

Concentrations of contaminants in each fish species were compared to State Fish Contaminant Goals (FCGs) and Advisory Tissue Levels (ATLs) for human consumption developed by the OEHHA (2008). The OEHHA Fish Contaminant Goals (FCGs) are estimates of contaminant levels in fish that pose no significant health risk to individuals consuming sport fish at a standard consumption rate of eight ounces per week (32 g/day), prior to cooking, and over a lifetime. This guidance assumes a lifetime risk level of 1 in one million for fishermen who consume an 8-ounce fish filet containing a given amount of a specific contaminant.

The OEHHA ATLs, while still conferring no significant health risk to individuals consuming sport fish in the quantities shown over a lifetime, were developed with the recognition that there are unique health benefits associated with fish consumption and that the advisory process should be expanded beyond a simple risk paradigm to best promote the overall health of the fish consumer (Table 5.1 & Table 5.2). ATLs protect consumers from being exposed to more than the average daily reference dose for non-carcinogens or to a lifetime cancer risk level of 1 in 10,000 for fishermen who consume an 8-ounce fish filet containing a given amount of a specific contaminant. For specific details regarding the assumptions used to develop the FCGs and ATLs, go to: http://oehha.ca.gov/fish/gtlsv/crnr062708.html (OEHHA, 2008).

Table 5.1 Fish contaminant goals (FCGs) for selected contaminants based on cancerous and noncancerous risk *using an 8-ounce/week (prior to cooking) consumption rate (32 g/day**).

	FCGs (ppb, wet weight)
Contaminant Cancer Slope Factor (mg/kg/day)-1	
DDTs (0.34)	**21**
PCBs (2)	**3.6**
Contaminant Reference Dose (mg/kg-day)	
DDTs (5x10-4)	1600
Methylmercury (1x10-4)[S]	**220**
PCBs (2x10-5)	63
Selenium (5x10-3)	**7400**

*The most health protective Fish Contaminant Goal for each chemical (cancer slope factor-
**g/day represents the average amount of fish consumed daily, distributed over a 7-day
[S]Fish Contaminant Goal for sensitive populations (i.e., women aged 18 to 45 years and children aged 1 to 17 years.)

Table 5.2 OEHHA (2008) advisory tissue levels (ATLs) for selected fish contaminants.
ATLs are based on cancer or non-cancer risk using an 8-ounce serving size (prior to cooking; ppb, wet weight).

Contaminant	Three 8-ounce Servings* a Week	Two 8-ounce Servings* a Week	One 8-ounce Servings* a Week	No Consumption
DDT[snc]**	≤520	>520-1,000	>1,000-2,100	>2,100
Methylmercury (Women aged 18-45 years and children aged 1-17 years)[nc]	≤70	>70-150	>150-440	>440
Methylmercury (Women over 45 years and men)[nc]	≤220	>220-440	>440-1,310	>1,310
PCBs[nc]	≤21	>21-42	>42-120	>120
Seleniumn[c]	≤2500	>2500-4,900	>4,900-15,000	>15,000

[c]ATLs are based on cancer risk
[nc]ATLs are based on non-cancer risk
*Serving sizes are based on an average 160 pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts (for
**ATLS for DDTs are based on non-cancer risk for two and three servings per week and cancer risk for one serving per week.

Figure 5.1 Fish tissue sampling location for the 2023 bioaccumulation survey.

3. Results

A total of 3 different types of fish were successfully collected from Lake Balboa (Figure 5.1). Species that were caught at Lake Balboa include common carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*), and tilapia (*Oreochromis sp.*). The largest fish captured in the lake was the common carp (6.7 kg), while the smallest fish caught was largemouth bass (0.9 kg; Table 5.3).

The feeding strategies for each of the three species are as follows:

- Largemouth bass: Carnivorous diet that include fish fry, benthic macroinvertebrates, and zooplankton.
- Common carp: Omnivorous bottom feeding diet.
- Tilapia: Juveniles are omnivorous, whereas adults are primarily herbivorous and have a diet consisting of phytoplankton, aquatic plants, and detritus.

Table 5.3 Number, average standard weight, and length of the individual and composite fish samples collected in 2023

Waterbody	Comp #	n	Species Name	Common Name	Avg. Weight (g)	Standard Length			Total Length		
						Avg. (mm)	Min (mm)	Max (mm)	Avg. (mm)	Min (mm)	Max (mm)
Lake Balboa (LALT301)	1	3	*Cyprinus carpio*	common carp	6697	820	645	2190	788	695	890
	1	3	*Micropterus salmoides*	largemouth bass	1587	505	390	1315	468	460	485
	2	3	*Micropterus salmoides*	largemouth bass	900	424	305	1089	397	350	435
	1	1	*Oreochromis sp.*	tilapia	910	340	340	340	500	500	500

Of the four contaminants measured in each of the composites of fish tissue, all fish types could be eaten based on ATL thresholds, but the concentration of PCBs indicate that common carp consumption should be limited to two 8 oz servings per week (Table 5.4).

The concentrations of harmful contaminants are generally consistent with predictions based on size, trophic position, and feeding ecology. According to the State Water Resources Control Board (SWRCB), contaminant concentration in fish tissue is often directly related to fish length and trophic position. The larger length may also explain why common carp had higher concentrations of DDTs, selenium, and PCBs than largemouth bass and tilapia. In addition, a higher trophic level and feeding ecology may explain why largemouth bass had higher concentrations of mercury than the other sampled species.

Additionally, while it is common for fish consumers to consume many parts of the fish they catch, it is important to note that the results of this report are based on the concentration of contaminants in fish filet. According to OEHHA, contaminants can be much higher in the eggs, guts, liver, skin, and fatty parts of fish. They do not recommend consuming these parts of the fish because of the increased risk of contaminant exposure. Interestingly, a study by Regine et al. (2006) found that fish who feed on bacteria and small benthic invertebrates had higher organ to muscle ratios of mercury in their liver and kidneys. Fish who fed on other fish had higher ratios of mercury in their muscle tissue.

Table 5.4 Sport fish Consumption chemistry results in 2023
Concentration of contaminants in fish tissues relative to the OEHHA ATL thresholds.

Fish Consumption					
Lake Balboa - LALT301					
Common Name	Comp. #	Mercury (ppb)	Selenium (ppb)	DDTs (ppb)	PCBs (ppb)
common carp	1	18	630	349.3	31.7
largemouth bass	1	61	290	2.8	ND
largemouth bass	2	50	360	2.8	ND
tilapia	2	7	310	2.7	ND

Three 8-oz servings a week ATL
Two 8-oz servings a week ATL
One 8-oz serving a week ATL
No consumption ATL

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Appendices

Appendix A. Quality Assurance/Quality Control

LARWMP includes an emphasis on QA/QC for each phase of the program including the standardization of data formats so that monitoring results can be shared with local, state, and federal agencies. The data quality objectives for the program are outlined in LARWMP's QAPP and were finalized prior to the 2009 survey and it was updated each year thereafter (https://www.watershedhealth.org/reports). Therefore, the data reported herein from the 2023 survey were based on field sampling and laboratory analysis protocols agreed upon by the participants.

Measurement or Data Quality Objectives (MQOs or DQOs) are quantitative or qualitative statements that specify the tolerable levels of potential errors in the data and ensure that the data generated meet the quantity and quality of data required to support the study objectives. The DQOs for LARWMP are detailed in the Program QAPP (CWH 2023b). The MQOs for the processing and identification of benthic macroinvertebrate samples are summarized in LARWMP's QAPP and detailed in the Southern California Regional Watershed Monitoring Program: Bioassessment Quality Assurance Project Plan, Version 1.0 (SCCWRP 2009). The DQOs and MQOs focused on five aspects of data quality: completeness, precision, accuracy, representativeness, and sensitivity.

Completeness

Completeness describes the success of sample collection and laboratory analysis (biology, chemistry, and toxicity) which should be sufficient to fulfill the statistical criteria of the project. One lake, 10 randomly selected sites, and 2 targeted sites were sampled in 2023.

Freshwater targeted and random analysis completeness was 100% for general chemistry, nutrients, major ions, and bioassessment (Table A-1).

Percent completeness for bioaccumulation samples analyzing organochlorine pesticides was 100% in 2020. PCB's were 100% complete for 43 congeners. Due to missing standards, 21 PCB congeners were reported 0% (Table A-2-2 and Table A-2-3). The sampling team and laboratories were notified of completeness deficiencies.

Accuracy

Accuracy provides an estimate of how close a laboratory or field measurement of a parameter is to the true value. Field sampling accuracy was assessed by calibration of the water quality probes with standards of known concentration. The accuracy of physical habitat measurements was assessed during a field audit conducted by the Southern California Coastal Water Research Project (SCCWRP) as part of the Stormwater Monitoring Coalitions (SMC) Southern California Regional Monitoring Survey, field calibration exercise. BMI sorting accuracy was assessed by a recount of 10% of sorted materials. The MQO of 95% was met for each lab reporting results for this program. Taxonomic identification accuracy was assessed through the independent re-identification of 10% of samples by the Department of Fish and Games Aquatic Biology Laboratory. MQOs for taxa count, taxonomic identification, and individual identification rates were met.

Analytical chemistry accuracy measures how close measurements are to the true value. For analytical chemistry samples Certified Reference Materials (CRM), matrix spike / matrix spike duplicates and laboratory control standards are used to assess method accuracy and precision. LARWMP followed SWAMP protocols, which allow one of these elements to fail in a batch and still be compliant. If data fails accuracy checks, it is noted in data and an accuracy qualifier is associated with that result.

Precision

Field duplicates were collected for chemistry, toxicity, and benthic macroinvertebrates at 10% of the random sites visited in 2023 The MQO for field duplicates was a relative percent difference (RPDs) <25%, except for benthic macroinvertebrates. At this time, no MQO has been developed for benthic macroinvertebrate duplicate samples. For analytical chemistry results matrix spike (MS), matrix spike duplicates (MSD), and laboratory duplicates (DUP) were used to assess laboratory precision. RPDs <25% for either the MS/MSD or DUPs were considered acceptable.

Of the analytes measured in 2023, two did not meet the precision criteria (Table A-4). Taxonomic precision was assessed using three error rates: random errors which are misidentifications that are made inconsistently within a taxon; systemic errors occur when a specific taxon is consistently misidentified; taxonomic resolution errors occur when taxa are not identified to the proper taxonomic level. Error rates of <10% are considered acceptable and all precision requirements were met.

Laboratory Blanks

Laboratory blanks were used to demonstrate that the analytical procedures do not result in sample contamination. The MQO for laboratory blanks were those with values less than the Method Detection Limit (MDL) for the analyte. During the 2023 surveys, laboratory blanks for Total Organic Carbon, nickel, and zinc were above the MDL (Table A-3).

Program Improvements and Standardization

Intercalibration studies will be ongoing as part of the Stormwater Monitoring Coalition (SMC) Regional Monitoring Program. This intercalibration included all participating laboratories and covered nutrient and metal analyses. Environmental Monitoring Division (EMD), City of Los Angeles is participating in an interlab calibration study involving nutrients, metals pesticides and PAH analysis methods in 2023. EMD uses all ELAP-approved methods and routinely participates in internal QC and Proficiency Test (PT) studies mandated by the SWRCB/ Environmental Laboratory Accreditation Program (ELAP).

Sampling procedures for each field team collecting samples for LARWMP were audited by biologists from the Southern California Coastal Water Research Project during summer surveys. The audit covered the SWAMP bioassessment and physical habitat protocols, including algae and benthic macroinvertebrate collection, and CRAM assessment (Ode, 2007, Fetscher *et al.,* 2009, CWMW 2012, and CWMW 2013). Each team passed their audit.

Table A.1 Percent completeness and non-detects by watershed sub-region for water chemistry samples collected in 2023

Analyte	2023					
	Number of Sites	Completeness (%)	Number of Non-Detects (<MDL)			
			Effluent (n=3)	Natural (n=5)	Urban (n=6)	Total
General Chemistry						
Alkalinity as CaCO3	12	100	0	0	0	0
Hardness as CaCO3	12	100	0	0	0	0
Total Suspended Solids	12	100	0	0	0	0
Turbidity	12	100	0	0	0	0
Chlorophyll a	12	100	0	0	0	0
Ash-Free Dry Mass	12	100	0	0	0	0
Nutrients						
Ammonia as N	12	100	1	4	1	6
Dissolved Organic Carbon	12	100	0	2	0	2
Nitrate as N	12	100	0	0	1	1
Nitrite as N	12	100	2	4	2	8
OrthoPhosphate as P	12	100	0	0	0	0
Phosphorus as P	12	100	0	0	0	0
Total Nitrogen (calculated)	12	100	0	0	0	0
Total Organic Carbon	12	100	0	0	0	0
Major Ions						
Chloride	12	100	0	0	0	0
Magnesium	12	100	0	0	0	0
Sodium	12	100	0	1	0	1
Sulfate	12	100	0	0	0	0
Metals						
Arsenic	12	100	0	0	0	0
Cadmium	12	100	2	4	1	7
Chromium	12	100	0	0	0	0
Copper	12	100	0	0	0	0
Iron	12	100	0	0	0	0
Lead	12	100	0	0	0	0
Mercury	12	100	3	4	1	8
Nickel	12	100	0	0	0	0
Selenium	12	100	0	4	0	4
Zinc	12	100	0	0	0	0
Bioassessment						
Benthic Macroinvertebrate ID	12	100	NA	NA	NA	NA
Algae ID	12	100	NA	NA	NA	NA

Table A.2 Percent completeness and non-detects for bioaccumulation samples collected in 2023.

2023			
Bioaccumulation	**Number of Samples**	**Completeness (%)**	**Number of Non-Detects (<MDL)**
Lipids	8	100	0
Metals			
Mercury	8	100	0
Selenium	8	100	0
Organochlorine Pesticides			
Aldrin	8	0	NA
Chlordane, cis-	8	0	NA
Chlordane, trans-	8	0	NA
DDD(o,p')	8	100	5
DDD(p,p')	8	100	3
DDE(o,p')	8	100	5
DDE(p,p')	8	100	0
DDT(o,p')	8	100	4
DDT(p,p')	8	100	5
Dieldrin	8	0	NA
Endosulfan I	8	0	NA
Endosulfan II	8	0	NA
Endosulfan Sulfate	8	0	NA
Endrin	8	0	NA
Endrin Aldehyde	8	0	NA
HCH, alpha	8	0	NA
HCH, beta	8	0	NA
HCH, delta	8	0	NA
HCH, gamma	8	0	NA
Heptachlor	8	0	NA
Heptachlor Epoxide	8	0	NA
Methoxychlor	8	0	NA
Mirex	8	0	NA
Nonachlor, cis-	8	0	NA
Nonachlor, trans-	8	0	NA
Oxychlordane	8	0	NA
Toxaphene	8	0	NA

Table A.2 Percent completeness and non-detects for bioaccumulation samples collected in 2023. (continued).

2023			
Bioaccumulation	**Number of Samples**	**Completeness (%)**	**Number of Non-Detects (<MDL)**
PCBs			
PCB 003	8	0	NA
PCB 008	8	0	NA
PCB 018	8	100	5
PCB 027	8	0	NA
PCB 028	8	100	5
PCB 029	8	0	NA
PCB 031	8	0	NA
PCB 033	8	0	NA
PCB 037	8	100	5
PCB 044	8	100	5
PCB 049	8	100	5
PCB 052	8	100	5
PCB 056	8	0	NA
PCB 056/060	8	0	NA
PCB 060	8	0	NA
PCB 064	8	0	NA
PCB 066	8	100	4
PCB 070	8	100	5
PCB 074	8	100	5
PCB 077	8	100	5
PCB 081	8	100	5
PCB 087	8	100	5
PCB 095	8	0	NA
PCB 097	8	0	NA
PCB 099	8	100	3
PCB 101	8	100	5
PCB 105	8	100	3
PCB 110	8	100	3
PCB 114	8	100	5
PCB 118	8	100	0
PCB 119	8	100	5
PCB 123	8	100	5
PCB 126	8	100	5
PCB 128	8	100	3
PCB 128/167	8	0	NA
PCB 137	8	0	NA

Table A.2 Percent completeness and non-detects for bioaccumulation samples collected in 2023. (continued).

2023			
Bioaccumulation	**Number of Samples**	**Completeness (%)**	**Number of Non-Detects (<MDL)**
PCBs			
PCB 138	8	0	NA
PCB 141	8	0	NA
PCB 146	8	0	NA
PCB 149	8	100	1
PCB 151	8	100	5
PCB 153	8	0	NA
PCB 156	8	100	5
PCB 157	8	100	5
PCB 158	8	100	5
PCB 167	8	100	5
PCB 168	8	0	NA
PCB 168/132	8	0	NA
PCB 169	8	100	5
PCB 170	8	100	3
PCB 174	8	0	NA
PCB 177	8	100	5
PCB 180	8	100	4
PCB 183	8	100	5
PCB 187	8	100	5
PCB 189	8	100	5
PCB 194	8	100	5
PCB 195	8	0	NA
PCB 198/199	8	0	NA
PCB 200	8	100	5
PCB 201	8	100	4
PCB 203	8	0	NA
PCB 206	8	100	5
PCB 209	8	0	NA

Table A.3 Lab Blanks

Analyte	Sampling Year	Sample Type	Batch ID	Result	Unit	Minimum Detection Limit	Reporting Limit
Ions							
Calcium	2021	LabBlank	5104	0.0244	mg/L	0.015	0.015
Metals							
Nickel	2021	LabBlank	5100	0.38	µg/L	0.31	0.31
Zinc	2021	LabBlank	5138	1.67	µg/L	0.95	0.95
Zinc	2021	LabBlank	5100	1.8	µg/L	0.95	0.95

Table A.4 QA/QC Table

Matrix spikes, matrix spike duplicates (MS), laboratory control samples, laboratory control sample duplicates (LCS), certified reference material (CRM), Laboratory Duplicates (Lab Dup), percent recovers (% R) and relative percent differences (RPD) that did not meet data quality objectives (DQO). Boldface type indicates values that did not meet quality control criteria.

Analyte	Station ID	Sample Date	Batch ID	Sample Type	Recovery DQO	% Recovery	Dup % Recovery	RPD	RPD DQO
Ions (Samplewater)									
Calcium	SMC00520	9-Jun-21	5112	Samplewater	80 - 120 %	90	54	50	< 25 %
Sodium	SMC00520	9-Jun-21	5112	Samplewater	80 - 120 %	91	69	28	< 25 %
Calcium	LAR08599	15-Jun-21	5128	Samplewater	80 - 120 %	70	46	41	< 25 %
Magnesium	LAR08599	15-Jun-21	5128	Samplewater	80 - 120 %	68	77	12	< 25 %
Sodium	LAR08656	14-Jul-20	5128	Samplewater	80 - 120 %	0	41	100	< 25 %

Appendix B. Analyte List, Reporting Limits and Methods

Table B.1 Analyte list and method for each program element in 2023

Analyte	Method	Units	Reporting Limit
Conventional Water Chemistry			
Temperature	Probe	°C	-5
pH	Probe	None	NA
Specific Conductivity	Probe	mS/cm	2.5
Dissolved Oxygen	Probe	mg/L	N/A
Salinity	Probe	ppt	N/A
Water Chemistry: freshwater			
Alkalinity as CaCO3	SM 2320 B	mg/L	10
Hardness as CaCO3	SM 2340 C	mg/L	5
Turbidity	SM 2130 B	NTU	0.3
Chemical Oxygen Demand	SM5220D	mg/L	10
Total Suspended Solids	SM 2540 D	mg/L	1
Nutrients			
Ammonia as N	EPA 350.1	mg/L	0.1
Nitrate as N	EPA 300.0	mg/L	0.1
Nitrite as N	EPA 300.0	mg/L	0.1
TKN	EPA 351.2 (1° Method) or SM4500-NH3 C (2° Method)	mg/L	0.1
Total Nitrogen	Calculated	NA	NA
Total Organic Carbon	SM 5310 C	mg/L	0.1
Dissolved Organic Carbon	SM 5310 C	mg/L	0.1
OrthoPhosphate as P	SM 4500-P E	mg/L	0.1
Phosphorus as P	SM 4500-P E	mg/L	0.1
Major Ions			
Chloride	EPA 300.0	mg/L	1.0
Calcium	EPA 200.7	ug/L	200
Magnesium	EPA 200.7	ug/L	200
Sodium	EPA 200.7	ug/L	200
Sulfate	EPA 300.0	mg/L	1.0
Metals (Dissolved)			
Arsenic	EPA 200.8	ug/L	1
Cadmium	EPA 200.8	ug/L	0.2
Chromium	EPA 200.8	ug/L	0.5
Copper	EPA 200.8	ug/L	0.5
Iron	EPA 200.7	ug/L	50
Lead	EPA 200.8	ug/L	0.5
Mercury	EPA 1631E	ug/L	0.2
Nickel	EPA 200.8	ug/L	1
Selenium	EPA 200.8	ug/L	1
Zinc	EPA 200.8	ug/L	1
Benthic Macroinvertebrate	SWAMP (2007), SAFIT STE	Count	NA
Quantitative Diatom	SWAMP (2019)	Count	NA

Table B.1 Analyte list and method for each program element in (cont.)

Quantitative Algae	SWAMP (2019)	Count; um3/cm3	NA
Habitat Assessments: Freshwater			
Freshwater Bioassessments	SWAMP (2016)	NA	NA
California Rapid Assessment Method (CRAM)	Collins et al., 2013	NA	NA
Tissue Chemistry: Fish			
Percent Lipids	Pes7209 Method developed by EMD	%	0.05
Metals			
Mercury	EPA 7471A	mg/kg ww	0.02
Selenium	EPA 6010B	mg/kg ww	1
Organics			
Organochlorine Pesticides (DDTs)	EPA 8081A	µg/kg ww	1.0-20
Polychlorinated Biphenyl (PCBs)	EPA 8082	µg/kg ww	0.5-1.0
Indicator Bacteria *E. coli*	SM 9223 B	MPN/100mL	10

** Southern California Regional Monitoring Program, 2008 Field and Laboratory Operating Procedures, SCCWRP.*

Appendix C. Biotic Condition Index Scores for the CSCI & CRAM

Table C.1 CSCI and CRAM scores, including sub-metrics, for each random station sampled from 2009 - 2023

Stratum	Station	Station Description	CSCI	CSCI Percentile	MMI	MMI Percentile	O/E	O/E Percentile	Overall CRAM Score	Biotic Structure	Buffer and Landscape Context	Hydrology	Physical Structure
2009													
Effluent	LAR00436	Los Angeles River	0.62	0.01	0.49	0	0.74	0.09	27	8	6	12	6
	LAR02228	Los Angeles River	0.70	0.03	0.55	0.01	0.84	0.21	27	8	6	12	6
Urban	LAR00440	Aliso Canyon Wash	0.80	0.1	0.60	0.01	0.99	0.48	64	25	21	18	12
	LAR00756	Tujunga Wash	0.68	0.02	0.51	0	0.85	0.21	37	8	15	12	6
	LAR01004	Arroyo Seco	0.67	0.02	0.51	0	0.83	0.19	29	8	8	12	6
Natural	LAR00476	Little Bear Canyon	1.22	0.92	1.16	0.82	1.28	0.93	99	34	24	36	24
	LAR00520	Big Tujunga Creek	1.02	0.55	0.77	0.1	1.27	0.92	80	33	20	21	21
	LAR00924	Arroyo Seco	1.35	0.99	1.43	0.99	1.27	0.93	87	33	20	30	21
	LAR01040	Big Tujunga Creek	1.21	0.91	1.10	0.72	1.32	0.95	89	33	24	27	21
	LAR06216	Big Tujunga Creek	0.85	0.17	0.73	0.07	0.97	0.43	64	23	20	21	12
2010													
Effluent	LAR00318	Los Angeles River	0.35	0	0.19	0	0.51	0.01	36	8	16	9	6
	LAR02622	Los Angeles River	0.44	0	0.37	0	0.52	0.01	36	8	16	9	6
Urban	LAR01208	Los Angeles River	0.54	0	0.58	0.01	0.50	0	38	8	16	12	6
	LAR01452	Eaton Wash	0.37	0	0.30	0	0.44	0	36	10	16	9	6
	LAR01716	Bull Creek	0.43	0	0.48	0	0.39	0	38	8	16	12	6
	LAR01972	Bull Creek	0.42	0	0.44	0	0.40	0	38	8	16	12	6
Natural	LAR00080	Lynx Gulch	0.75	0.06	0.64	0.02	0.86	0.23	55	17	18	21	9
	LAR00520	Big Tujunga Creek	0.75	0.06	0.73	0.07	0.76	0.11	63	15	22	24	12
	LAR00924	Arroyo Seco	0.68	0.02	0.55	0.01	0.81	0.16	70	20	24	27	12
	LAR01096	Big Tujunga Creek	0.65	0.01	0.59	0.01	0.71	0.06	63	15	20	27	12
	LAR01196	Big Tujunga Creek	0.82	0.13	0.79	0.12	0.85	0.21	65	21	22	21	12
	LAR01320	Big Tujunga Creek	0.69	0.03	0.62	0.02	0.77	0.12	66	21	22	27	9
	LAR01544	Big Tujunga Creek	0.84	0.15	0.77	0.1	0.90	0.3	66	18	22	30	9

Table C.1 CSCI and CRAM scores, including sub-metrics, for each random station sampled from 2009 - 2023 (cont.)

Stratum	Station	Station Description	CSCI	CSCI Percentile	MMI	MMI Percentile	O/E	O/E Percentile	Overall CRAM Score	Biotic Structure	Buffer and Landscape Context	Hydrology	Physical Structure
2011													
Effluent	LAR02804	Los Angeles River	0.72	0.04	0.55	0.01	0.88	0.27	39	13	15	12	6
Urban	LAR00632	Tarzana	0.44	0	0.33	0	0.55	0.01	32	15	7	12	6
	LAR00684	Rio Hondo Spillway	0.44	0	0.43	0	0.44	0	38	8	16	12	6
	LAR00748	Rubio Wash, Rosemead	0.25	0	0.27	0	0.24	0	35	10	15	9	6
	LAR00830	Rio Hondo	0.43	0	0.47	0	0.39	0	38	8	16	12	6
	LAR01358	Compton Creek	0.37	0	0.23	0	0.51	0.01	37	8	15	12	6
Natural	LAR00080	Lynx Gulch	0.89	0.25	0.81	0.14	0.98	0.45	78	20	22	36	15
	LAR00520	Big Tujunga Creek	0.80	0.1	0.75	0.08	0.85	0.21	71	15	20	30	18
	LAR00924	Arroyo Seco	0.79	0.1	0.80	0.13	0.79	0.13	76	19	22	30	18
	LAR01692	Arroyo Seco	0.83	0.15	0.67	0.03	0.99	0.48	63	16	18	30	12
	LAR01808	Alder Creek	0.87	0.21	0.80	0.14	0.93	0.37	86	26	23	36	18
	LAR02088	Big Tujunga Creek	0.86	0.2	0.71	0.05	1.02	0.54	66	14	20	33	12
	LAR02092	Big Tujunga Creek	0.88	0.23	0.72	0.06	1.04	0.58	77	21	22	30	18
2012													
Effluent	LAR04532	Los Angeles River	0.68	0.02	0.51	0	0.85	0.21	47	13	16	21	6
Urban	LAR01464	Aliso Canyon Wash	0.70	0.03	0.60	0.01	0.80	0.14	34	8	7	21	6
	LAR01656	Cabarello Creek	0.69	0.03	0.52	0	0.86	0.22	36	13	12	12	6
	LAR01772	Alhambra Wash	0.60	0.01	0.52	0	0.67	0.04	39	12	15	12	6
	LAR01912	Santa Susana Creek	0.36	0	0.32	0	0.39	0	34	8	13	12	6
	LAR02028	Arroyo Seco	0.68	0.02	0.57	0.01	0.78	0.13	34	10	12	12	6
Natural	LAR00080	Lynx Gulch	0.85	0.17	0.85	0.2	0.85	0.21	79	25	24	30	15
	LAR00520	Big Tujunga Creek	1.01	0.52	1.03	0.57	0.99	0.47	61	16	18	27	12
	LAR00924	Arroyo Seco	0.82	0.13	0.87	0.23	0.77	0.11	74	20	22	30	15
	LAR02568	Big Tujunga Creek	0.97	0.42	0.91	0.31	1.02	0.55	79	23	22	30	18
	LAR02712	Pacoima Canyon	1.04	0.59	0.84	0.18	1.24	0.89	77	21	24	27	18
	LAR04204	Santa Anita Wash	0.99	0.48	0.81	0.14	1.18	0.83	69	25	22	27	9
	LAR04880	Big Tujunga Creek	1.04	0.6	0.83	0.17	1.25	0.91	82	20	23	36	18

Table C.1 CSCI and CRAM scores, including sub-metrics, for each random station sampled from 2009 - 2023 (cont.)

Stratum	Station	Station Description	CSCI	CSCI Percentile	MMI	MMI Percentile	O/E	O/E Percentile	Overall CRAM Score	Biotic Structure	Buffer and Landscape Context	Hydrology	Physical Structure
2013													
Effluent	LAR03646	Los Angeles River	0.61	0.01	0.48	0	0.73	0.08	38	25	67.67	33.33	25
Urban	LAR02232	Limekiln Canyon Wash	0.24	0	0.30	0	0.18	0	40	25	50	58.33	25
	LAR02484	Tujunga Wash	0.56	0	0.55	0.01	0.56	0.01	30	36.11	25	33.33	25
	LAR02488	Wilbur Wash	0.21	0	0.30	0	0.12	0	40	25	50	58.33	25
	LAR02796	Rubio Wash	0.28	0	0.28	0	0.29	0	27	25	25	33.33	25
	LAR02936	Bell Creek Tributary	0.46	0	0.46	0	0.46	0	37	27.78	55.17	41.67	25
Natural	LAR05020	Arroyo Seco	0.95	0.37	0.90	0.29	1.00	0.49	84	69.44	93.29	100	75
	LAR05640	Big Tujunga Creek	0.92	0.31	0.95	0.39	0.89	0.29	81	77.78	93.29	91.67	62.5
	LAR05848	Gold Creek	0.91	0.28	0.87	0.23	0.95	0.4	84	77.78	100	83.33	75
	LAR06044	Arroyo Seco	1.13	0.79	1.10	0.72	1.15	0.79	84	75	93.29	91.67	75
2014													
Effluent	LAR05694	Los Angeles River	0.45	0	0.45	0	0.45	0	35	25	58.54	33.33	25
Urban	LAR02680	Los Angeles River	0.41	0	0.34	0	0.48	0	38	25	67.67	33.33	25
	LAR02988	Sawpit Wash	0.70	0.03	0.69	0.04	0.72	0.07	36	25	62.5	33.33	25
	LAR02996	Big Tujunga Wash	0.47	0	0.38	0	0.55	0.01	34	25	62.5	25	25
Natural	LAR00520	Big Tujunga Creek	0.86	0.2	0.81	0.14	0.92	0.34	74	61.11	90.29	83.33	62.5
	LAR00924	Arroyo Seco	1.13	0.79	1.02	0.55	1.24	0.89	81	86.11	93.29	83.33	62.5
	LAR06188	Big Tujunga Wash	1.11	0.75	0.95	0.38	1.27	0.92	83	97.22	93.29	66.67	75
	LAR06216	Big Tujunga Creek	0.92	0.31	0.84	0.18	1.01	0.51	81	88.89	90.29	83.33	62.5
	LAR06252	Santa Anita Wash	0.82	0.13	0.88	0.25	0.76	0.1	83	83.33	85.38	75	87.5
	LAR07128	Pacoima Canyon	1.05	0.63	0.99	0.48	1.11	0.72	90	97.22	96.54	91.67	75

Table C.1 CSCI and CRAM scores, including sub-metrics, for each random station sampled from 2009 - 2023 (cont.)

Stratum	Station	Station Description	CSCI	CSCI Percentile	MMI	MMI Percentile	O/E	O/E Percentile	Overall CRAM Score	Biotic Structure	Buffer and Landscape Context	Hydrology	Physical Structure
2015													
Effluent	LAR0232	Los Angeles River	0.66	0.02	0.50	0	0.82	0.17	36	25	62.5	33.33	25
	LAR08597	Los Angeles River	0.69	0.03	0.48	0	0.89	0.28	38	25	67.67	33.33	25
	LAR08599	Los Angeles River	0.70	0.03	0.51	0	0.89	0.28	45	33.33	62.5	58.33	25
	LAR08602	Los Angeles River	0.38	0	0.28	0	0.47	0	39	33.33	62.5	33.33	25
	LAR0616	Los Angeles River	0.68	0.02	0.58	0.01	0.77	0.12	36	25	62.5	33.33	25
	LAR0732	Los Angeles River	0.59	0	0.42	0	0.75	0.1	36	25	62.5	33.33	25
Natural	LAR0552	Arroyo Seco	0.98	0.45	0.89	0.27	1.07	0.64	79	75	93.29	83.33	62.5
	LAR00520	Big Tujunga Creek	0.92	0.3	0.83	0.17	1.01	0.51	77	80.56	82.92	83.33	62.5
	LAR0896	Big Tujunga Creek	0.93	0.33	0.87	0.24	0.98	0.47	85	77.78	100	75	87.5
2016													
Effluent	LAR0232	Los Angeles River	0.65	0.01	0.54	0	0.76	0.1	39	33.33	62.5	33.33	25
Natural	LAR0552	Arroyo Seco	0.91	0.28	0.91	0.31	0.91	0.31	75	69.44	93.29	75	62.5
	LAR00520	Big Tujunga Creek	0.94	0.35	0.90	0.28	0.98	0.46	76	63.89	82.92	83.33	75
	LAR00924	Arroyo Seco	1.00	0.51	0.96	0.42	1.05	0.59	84	63.89	93.29	91.67	87.5
	LAR01096	Big Tujunga Creek	0.77	0.08	0.71	0.05	0.84	0.2	84	88.89	90.29	83.33	75
	LAR01544	Big Tujunga Creek	0.87	0.21	0.72	0.06	1.02	0.55	85	77.78	90.29	83.33	87.5
	LAR08610	Santa Anita Wash	0.97	0.43	0.89	0.27	1.05	0.6	84	66.67	93.29	100	75
	LAR08622	Eaton Wash	1.01	0.52	0.90	0.3	1.12	0.73	77	52.78	93.29	75	87.5
Urban	LAR08608	Bull Creek	0.50	0	0.49	0	0.52	0.01	61	61.11	75	58.33	50
	LAR08615	Los Angeles River	0.67	0.02	0.56	0.01	0.77	0.12	39	33.33	62.5	33.33	25
	LAR08616	Arroyo Calabasas	0.53	0	0.63	0.02	0.43	0	34	25	62.5	25	25
	LAR0020	Alhambra Wash	0.29	0	0.30	0	0.28	0	34	25	62.5	25	25
	LAR0040	Bull Creek	0.59	0.01	0.55	0.01	0.62	0.02	39	25	62.5	41.67	25

Table C.1 CSCI and CRAM scores, including sub-metrics, for each random station sampled from 2009 - 2023 (cont.)

Stratum	Station	Station Description	CSCI	CSCI Percentile	MMI	MMI Percentile	O/E	O/E Percentile	Overall CRAM Score	Biotic Structure	Buffer and Landscape Context	Hydrology	Physical Structure
2017													
Effluent	LAR0232	Los Angeles River	0.72	0.04	0.60	0.01	0.83	0.19	36	25	62.5	33.33	25
	LAR00436	Los Angeles River	0.68	0.02	0.63	0.02	0.74	0.08	38	25	67.67	33.33	25
	LAR08627	Los Angeles River	0.35	0	0.20	0	0.51	0.01	38	25	67.67	33.33	25
Urban	LAR0052	Los Angeles River	0.51	0	0.43	0	0.58	0.01	39	25	62.5	41.67	25
	LAR08630	Alhambra Wash	0.27	0	0.31	0	0.24	0	33	25	50	33.33	25
	LAR08632	Santa Susana Pass Wash	0.41	0	0.54	0.01	0.27	0	36	25	62.5	33.33	25
Natural	LAR0552	Arroyo Seco	0.97	0.41	1.01	0.51	0.93	0.35	78	61.11	93.29	83.33	75
	LAR00520	Big Tujunga Creek	0.78	0.08	0.69	0.04	0.87	0.24	78	72.22	82.92	83.33	75
	LAR00924	Arroyo Seco	0.95	0.38	1.00	0.5	0.90	0.3	77	66.67	93.29	75	75
	LAR08638	Arryo Seco	0.99	0.48	1.07	0.65	0.91	0.32	77	66.67	93.29	75	75
2018													
Effluent	LAR0232	Los Angeles River	0.71	0.03	0.63	0.02	0.78	0.12	25	62.5	33.33	36	25
	LAR08599	Los Angeles River	0.59	0	0.65	0.02	0.52	0.01	50	67.67	58.33	53	37.5
	LAR08642	Los Angeles River	0.72	0.04	0.58	0.01	0.87	0.24	25	67.67	33.33	38	25
	LAR08643	Los Angeles River	0.33	0	0.18	0	0.48	0	33.33	67.67	33.33	40	25
Urban	LAR08640	Aliso Canyon Wash	0.33	0	0.31	0	0.35	0	25	62.5	33.33	36	25
	LAR00440	Aliso Canyon Wash	0.64	0.01	0.50	0	0.78	0.12	50	82.92	58.33	67	75
	LAR00756	Tujunga Creek	0.52	0	0.52	0	0.52	0.01	25	62.5	33.33	36	25
Natural	LAR0552	Arroyo Seco	0.77	0.07	0.58	0.01	0.96	0.41	66.67	93.29	91.67	79	62.5
	LAR02092	Big Tujunga Creek	1.07	0.67	0.88	0.24	1.27	0.92	72.22	93.29	75	79	75
	LAR02568	Big Tujunga Creek	1.13	0.79	1.03	0.56	1.24	0.89	69.44	93.29	83.33	83	87.5
	LAR02088	Big Tujunga Creek	1.01	0.52	0.89	0.27	1.12	0.74	83.33	93.29	91.67	80	50

Table C.1 CSCI and CRAM scores, including sub-metrics, for each random station sampled from 2009 - 2023 (cont.)

Stratum	Station	Station Description	CSCI	CSCI Percentile	MMI	MMI Percentile	O/E	O/E Percentile	Overall CRAM Score	Biotic Structure	Buffer and Landscape Context	Hydrology	Physical Structure
2019													
Effluent	LAR00318	Los Angeles River	0.47	0	0.43	0	0.51	0.01	38	25	67.67	33.33	25
	LAR0232	Los Angeles River	0.72	0.04	0.59	0.01	0.86	0.23	36	25	62.5	33.33	25
Natural	LAR01808	Alder Creek	0.76	0.07	0.62	0.02	0.90	0.31	83	80.56	90.29	75	87.5
	LAR04204	Santa Anita Wash	0.98	0.45	0.75	0.08	1.21	0.86	75	58.33	93.29	100	50
	LAR0552	Arroyo Seco	1.03	0.56	1.08	0.67	0.97	0.44	76	63.89	93.29	83.33	62.5
	LAR08641	Big Tujunga Creek	0.88	0.23	0.69	0.04	1.07	0.64	79	61.11	96.54	88.33	75
	LAR08647	Big Tujunga Creek	0.92	0.3	0.81	0.14	1.02	0.54	74	47.22	100	100	50
Urban	LAR01004	Arroyo Seco	0.49	0	0.40	0	0.57	0.01	36	25	62.5	33.33	25
	LAR08645	Bull Creek	0.62	0.01	0.44	0	0.80	0.14	56	69.44	67.67	50	37.5
	LAR08646	Eaton Wash	0.67	0.02	0.61	0.01	0.74	0.08	36	25	62.5	33.33	25
2020													
Effluent	LAR0232	Los Angeles River	0.59	0	0.59	0.01	0.58	0.01	36	25	62.5	33.33	25
	LAR08656	Los Angeles River	0.74	0.05	0.58	0.01	0.89	0.29	36	25	62.5	33.33	25
	LAR08659	Los Angeles River	0.66	0.02	0.58	0.01	0.74	0.08	38	25	67.67	33.33	25
Natural	LAR05020	Arroyo Seco	1.11	0.76	1.33	0.97	0.89	0.29	75	47.22	100	91.67	62.5
	LAR0552	Arroyo Seco	1.18	0.87	1.11	0.73	1.24	0.9	79	77.78	93.29	83.33	62.5
	LAR05640	Big Tujunga Creek	1.17	0.85	1.07	0.65	1.27	0.92	84	83.33	93.29	83.33	75
	LAR06216	Big Tujunga Creek	1.00	0.5	0.88	0.25	1.12	0.74	76	80.56	90.29	83.33	50
	LAR08655	Big Tujunga Creek	1.17	0.85	1.14	0.78	1.20	0.85	85	88.89	93.29	83.33	75
Urban	LAR01208	Los Angeles River	0.45	0	0.46	0	0.44	0	38	25	67.67	33.33	25
	LAR08658	Arroyo Seco	0.71	0.04	0.58	0.01	0.85	0.21	41	33.33	62.5	41.67	25
2021													
Effluent	LAR00318	Los Angeles River	0.33	0	0.19	0	0.47	0	38	25	67.67	33.33	25
	LAR0232	Los Angeles River	0.71	0.04	0.70	0.05	0.72	0.07	36	25	62.5	33.33	25
	LAR08661	Los Angeles River	0.68	0.02	0.57	0.01	0.78	0.12	36	25	62.5	33.33	25
	LAR08663	Los Angeles River	0.84	0.16	0.65	0.02	1.04	0.58	70	69.44	75	75	62.5
Natural	LAR00520	Big Tujunga Creek	0.70	0.03	0.71	0.05	0.70	0.06	79	72.22	82.92	75	87.5
	LAR00924	Arroyo Seco	1.11	0.75	1.20	0.87	1.01	0.52	80	80.56	93.29	83.33	62.5
	LAR01544	Big Tujunga Creek	0.79	0.1	0.70	0.05	0.88	0.27	83	75	90.29	91.67	75
	LAR0552	Arroyo Seco	0.83	0.15	0.78	0.11	0.88	0.27	80	80.56	93.29	83.33	62.5
Urban	LAR08662	Rio Hondo	0.34	0	0.28	0	0.39	0	38	25	67.67	33.33	25
	LAR08672	Los Angeles River	0.42	0	0.34	0	0.51	0	38	25	67.67	33.33	25