ADAPTATION TO THE LOAD REDUCTION STRATEGY

Presented to *Los Angeles Regional Water Quality Control Board*

Submitted by *Upper Los Angeles River Watershed Management Group*

UPPER LOS ANGELES RIVER: LOAD REDUCTION STRATEGY ADAPTATION PLAN

August 2, 2021
Revised: May 31, 2024

PRESENTED TO

Los Angeles Regional Water Quality Control Board

PRESENTED BY

Upper Los Angeles River Watershed Management Group

This page is intentionally left blank.

CONTENTS

Figures

Tables

Appendices

ACRONYMS AND ABBREVIATIONS

AOI	Area of Investigation
BMP	Best Management Practice
BSI	Bacteria Source Identification
CCTV	close-circuit television
Cfs	cubic feet per second
cfu	colony forming unit
CHWSRS	Comprehensive Human Waste Source Reduction Strategy
CIMP	Coordinated Integrated Monitoring Program
CIWQS	California Integrated Water Quality System
CREST	Cleaner Rivers through Effective Stakeholder-led TMDLs
E. coli	*Escherichia coli*
FIB	Fecal Indicator Bacteria
FOG	Fats, Oils, and Grease
GI	Gastrointestinal Illness
GIS	Geographic Information System
GM	Geometric Mean
HWSI	human waste source investigation
IC/ID	Illicit Connections/Illicit Discharges
LACPW	Los Angeles County Public Works
LACFCD	Los Angeles County Flood Control District
LARWMP	Los Angeles River Watershed Monitoring Program
LARWQCB	Los Angeles Regional Water Quality Control Board
LFD	Low Flow Diversion
LRS	Load Reduction Strategy
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NPDES	National Pollutant Discharge Elimination System
QAPP	Quality Assurance Program Plan
QMRA	Quantitative Microbial Risk Assessment
REC-1	Water Contact Recreation Beneficial Use
RV	Recreational Vehicle
RWQC	Recreational Water Quality Criteria
SAP	Sampling and Analysis Plan
SHS	Surfer Health Study
SSM	Single Sample Maximum
SSMP	sewer system management plans
SSO	Sanitary Sewer Overflows
STV	Statistical Threshold Value
SWRCB	State Water Resources Control Board
TMDL	Total Maximum Daily Load
ULAR	Upper Los Angeles River
USEPA	United States Environmental Protection Agency
WDR	Waste Discharge Requirements
WMA	Watershed Management Area
WWTP	Wastewater Treatment Plant

This page is intentionally left blank.

1 INTRODUCTION

The Upper Los Angeles River Watershed Management Group (Group) has developed this Load Reduction Strategy (LRS) Adaptation Plan to address the challenges encountered during implementation of the LRS and adapt towards a more efficient and effective strategy to address the Los Angeles River Bacteria TMDL (Bacteria TMDL).

1.1 Purpose

The LRS Adaptation Plan (Plan) was developed to guide the Group's efforts under the LRS, addressing the Bacteria TMDL, that better protect public health and support recreational beneficial use goals. The Bacteria TMDL was initially developed to protect the recreational beneficial uses in receiving waterbodies by establishing water quality objectives for fecal indicator bacteria (FIB) protective of human health. Although elevated concentrations of traditional FIB, may indicate a higher potential for human health risks, it is exposure to pathogens (microorganisms known to cause disease) that can cause illness in recreational water users and threaten or impair beneficial uses, see Section 1.3 for specific studies on this finding. Human waste typically contains a higher concentration of pathogens, as compared to other sources. Higher concentrations of pathogens in receiving waters increases the risk of gastrointestinal illness (GI) through recreational exposure.

This Plan provides an effective framework to address human health risk from pathogen exposure, by focusing on eliminating sources of human waste to the municipal separate storm sewer system (MS4). The Plan helps to streamline efforts across the Upper Los Angeles River (ULAR) agencies and other stakeholders in the watershed. Recent advancements in the development of human markers and other diagnostic tools are incorporated as well as an enhanced focus on targeted source control efforts. Focusing on reducing the sources of human waste maximizes the efficient use of limited resources and results in significant long-term pathogen reduction benefits.

1.2 Load Reduction Strategy Background

The Group has been pursuing the LRS to address the Bacteria TMDL as a compliance pathway to demonstrate attainment with the TMDL waste load allocations. The LRS includes a phased approach towards compliance, based on prioritization of Los Angeles River segments and tributaries. The TMDL prioritized 16 segments and tributaries, for the Group to conduct: (1) Phase I screening, (2) Phase I monitoring and follow-up, (3) implementation actions to control bacteria, and (4) submittal of the LRS. If bacteria exceedances continued based on follow up screening and monitoring, following implementation actions, Phase II would be initiated to determine additional actions and revise the LRS.

The Group is a responsible party for the five segments and eleven tributaries shown in Table 1-1. Figure 1-1 also displays the Los Angeles River segments and tributaries aligned with the Bacteria TMDL. The LRS efforts have catalogued or screened over 2,300 outfalls throughout the ULAR region. An LRS has been submitted for each of the 16 prioritized segments and tributaries. In these original LRS reports, screening data and modeling were utilized to evaluate *E. coli* loading rates from outfalls and endogenous generation within the receiving waters then prioritize implementation actions based on these loading rates. Monte Carlo modeling was used to identify priority and outlier outfalls, which were defined as follows:

Priority Outfalls: Outfalls with the highest loading rates of *E. coli* and consistent, problematic discharges.

Outlier Outfalls: Outfalls with episodic, high loading rate *E. coli* discharges.

The priority and outlier outfalls are those for which to apply implementation actions. The Group has successfully completed multiple projects, including construction of low flow diversions and continued extensive project planning and designs. However, the TMDL focused solely on water quality objectives, while the original LRS approach focused solely on *E. coli* loading rates at outfalls and neither considered potential sources, the feasibility of implementation actions, and the hydraulic connectivity to receiving waters that support the recreational beneficial use. The Group encountered numerous feasibility challenges pursuing LRS implementation. Examples of these implementation challenges include, but are not limited to, the following:

- *Inconclusive source investigations:* Initial source investigations were conducted based on limited information and tools available at the time. Investigation tools have significantly expanded over the past decade to tailor source investigations to targeted areas. An example of investigation challenges includes outfall AS-41 which conducted initial source investigations, televised storm drains, and other additional water quality monitoring with no conclusion at the time.
- *Soil contamination:* Historic soil contamination encountered can cause project delays and increased costs due to the required cleanup efforts. An example was at outfall LAR-B-R2-04, where lead contamination was indicated, and the Department of Toxic Substances Control had to cleanup before proceeding.
- *Utility conflicts:* Existing utilities can limit project extents or require increased effort to move to accommodate the project designs. An example was at outfall ARS-234, an existing underground storage tank was identified during feasibility investigations that could not be removed.
- *Impact to existing uses:* Given these areas are highly developed, almost all projects must integrate with existing uses on the site, which is not always possible. Existing traffic patterns, facility operations, required setbacks from existing infrastructure, or community uses can limit project designs or even deem a project location infeasible. This can also factor into construction and maintenance access limitations. An example was at outfall ARS-234, which looked at a project within the Caltrans facility that was determined to have disrupted daily activity of the yard.
- *Project type constraints:* Where infiltration and sewer diversion projects are shown to be the most effective structural approach to removing bacteria, versus less reliable treatment methods, certain sites have limited functionality for those options. Certain sites have limited infiltration opportunities due to the underlying soils or may have a high-water table. A location may not be near sewer infrastructure to pursue sewer diversions or there are often limitations on sewer capacity to consider. These site characteristics significantly limit structural project types that would be effective at long-term removal of bacteria.

Table 1-1. LRS Segments and Tributaries for the ULAR Group and Bacterial TMDL Deadlines for Submission.

LA River Segment	Mainstem or Tributary	TMDL Date for LRS Submittal
Segment B	Mainstem LA River	September 2014
	Arroyo Seco and Rio Hondo	March 2016
Segment A	Compton Creek	March 2018
Segment E	Mainstem LA River	September 2017
	Dry Canyon, McCoy Canyon, Bell Creek and Aliso Canyon Wash	September 2021
Segment C	Mainstem LA River	September 2023
	Tujunga Wash, Burbank Western Channel and Verdugo Wash	September 2023
Segment D	Mainstem LA River	September 2023
	Bull Creek	September 2023

Given the narrowed focus of the original LRS approach taken, the challenges the Group has encountered, as well as the ongoing advancements to inform more cost-effective strategies to address recreational human health risk (which is the driver behind the Bacteria TMDL) the Group developed this Adaptation Plan that applies substantially more data, information and guidance towards an effective and feasible strategy. The following section expands on the advancements in the scientific understanding of the relationship between bacteria presence and human health impacts as well as advancements in the tools and techniques available to support more successful source investigations. The Bacteria TMDL provides flexibility to demonstrate compliance via different options. This adaptation is geared towards evolving compliance strategies with the latest understanding, information and data available in the watersheds.

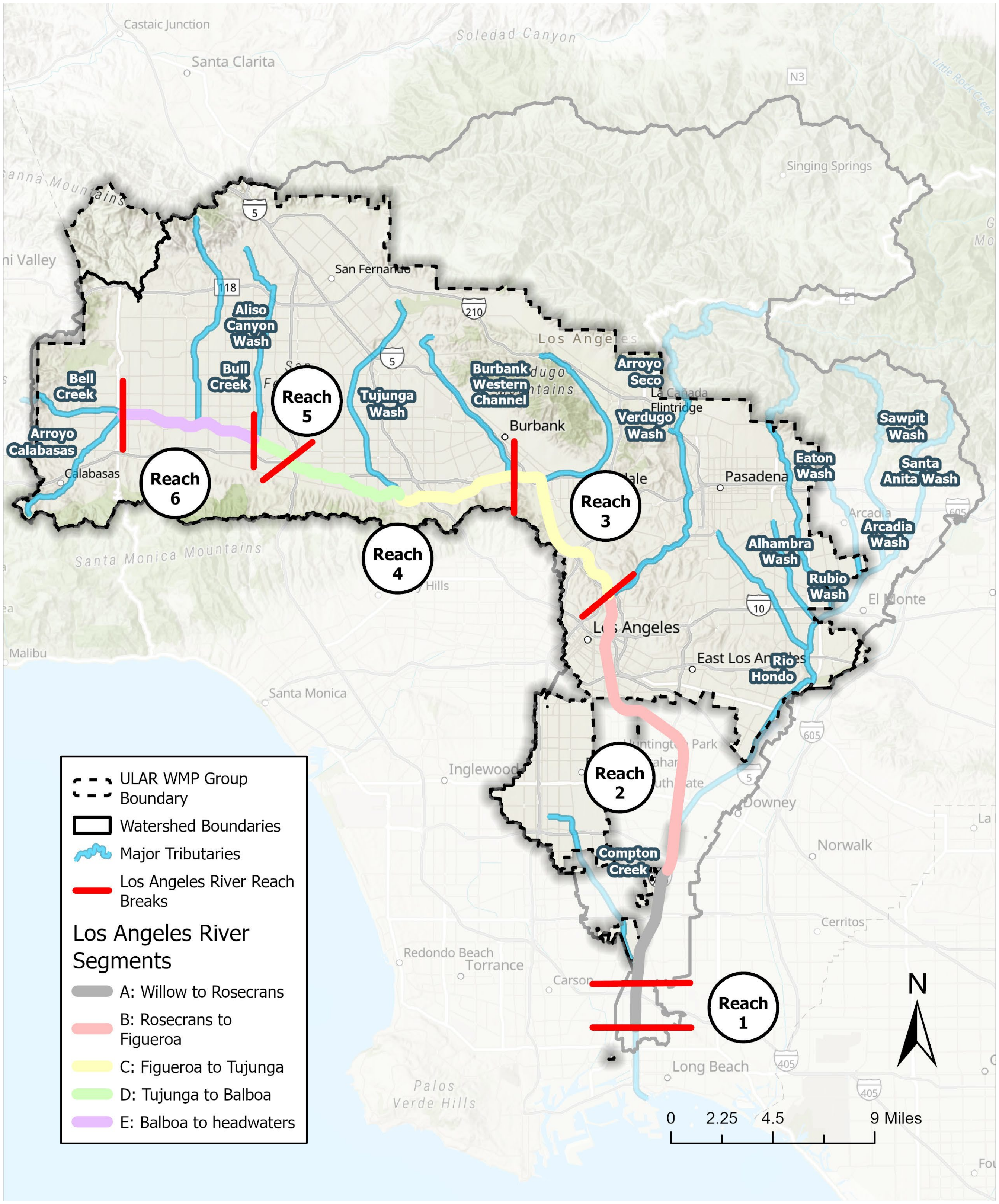


Figure 1-1. Los Angeles River Segments and Tributaries per the Bacteria TMDL and Associated Los Angeles River Reach Breaks per the Basin Plan.

1.3 Regulatory and Scientific Context

The Bacteria TMDL was adopted by the Los Angeles Regional Water Quality Control Board (LARWQCB) in 2010 and became effective on March 23, 2012. The TMDL was originally based on work under the Cleaner Rivers through Effective Stakeholder-led TMDLs (CREST) stakeholder group, that studied dry weather MS4 inputs to the Los Angeles River, established reference conditions, and developed a dry weather implementation plan. Since then, significant advancements have occurred in the state of the science and understanding of threats to the recreational beneficial use caused by bacteria. The following sections highlight key regulatory and scientific advancements, that have guided the development of the LRS Adaptation. Since September 2019, the Group has met on a regular basis with the Regional Board staff to discuss the intent, approach, and outcomes of the LRS Adaptation.

1.3.1 2012 USEPA Recreational Water Quality Criteria Recommendations

In 2012, USEPA adopted nationwide Recreational Water Quality Criteria (RWQC) in an effort to better protect public health and improve consistency (USEPA 2012). Specifically, USEPA recommended for states to adopt one of two numeric threshold values for illness rates: 36 excess illnesses per 1,000 recreators or 32 excess illnesses per 1,000 recreators, which were shown to be equally protective of the primary contact recreation designated use. Additionally, the RWQC recommended the use of either *Enterococci* or *E.coli* as indicators of fecal or pathogen contamination in freshwaters, and the use of only *Enterococci* as an indicator in marine waters. In making these recommendations to the states, USEPA explained these criteria do not take into account different sources of fecal contamination, believing that the science had not yet developed sufficiently to distinguish between human and non-human sources of fecal contamination (USEPA 2012), or apparently endogenous replication of FIB. However, USEPA recognized that some locations could have water quality characteristics that differ from those which the RWQC were based on (e.g. waterbodies impacted by treated wastewater effluent). Recognizing that various scientific studies indicate non-human sources of fecal contamination can pose less risk than human sources, USEPA provided flexibility so that states could address their waterbodies on a human health risk basis.

The sources of fecal contamination in Southern California recreational waters is typically different than those studied in the epidemiological studies that underpin the USEPA 2012 RWQC recommendations (i.e. those studies were generally carried out in waters impacted by secondary treated and disinfected wastewater effluent, whereas recreational waters in Southern California are impacted by other sources including non-point sources).

1.3.2 California Primary Contact Recreation Water Quality Objectives

States were required to adopt USEPA's 2012 RWQC recommendations, Table 1-2, into their respective state water quality standards. Table 1-2 denotes the translation from estimated illness rates to concentration thresholds for FIB. Accordingly, the SWRCB adopted California's Bacteria Provisions, selecting the 32 illnesses per 1,000 recreators threshold and revised its bacteria standards in Resolution No. 2018-0038 on August 7, 2018. The Resolution accomplished two things: (1) it protected Water Contact Recreation (REC-1) waters by revising state WQOs in the Bacteria Provisions of Part 3 of the Water Quality Control Plan of the Inland Surface Waters, Enclosed Bays and Estuaries of California (ISWEBE Plan), and (2) it maintained the fecal coliform objective contained in the existing Water Quality Control Plan for Ocean Waters of California (Ocean Plan) (SWRCB 2018). In the accompanying staff report, the SWRCB noted that while indicator bacteria are used as an indicator of fecal contamination, the actual risk to human health is caused by pathogenic microorganisms known to cause disease (SWRCB 2018). With the SWRCB's adoption of USEPA's 2012 RWQC in 2018, the Bacteria Provisions provide for consistent implementation of the new criteria on a statewide basis for waters designated with the REC-1 beneficial use. The LARWQCB amended the Los Angeles Region Basin Plan on February 13, 2020 through Resolution No. R20-001, to update the bacteria objectives for fresh, estuarine and marine waters designated for water contact recreation, based on the Statewide Bacteria Provisions.

Table 1-2. USEPA 2012 RWQC

Applicable Waters	Objective Elements	Estimated Illness Rate 32 per 1,000 water contact recreators	
		Magnitude	
	Indicator	GM (cfu/100 mL)	STV (cfu/100 mL)
All waters where the salinity is equal to or less than 1 ppt 95 percent or more of the time	*E. coli*	100	320
All waters where the salinity is greater than 1 ppt more than 5 percent of the time	*Enterococci*	30	110
Ocean Waters	*Enterococci*	30	110
	Fecal coliform density	200	400

cfu = colony forming unit
GM = geometric mean
STV = statistical threshold value
SSM = single sample maximum

1.3.3 Scientific Advancements

The scientific research on bacteria, characterizing the human health risk associated with bacteria in the environment, and development of tools to better target bacteria reductions that will be most protective of human health has been evolving over the past decades. The following information highlights key advancements that have guided the approach established in this Plan. While knowledge and data gaps still exist in this field, significant advancements to date warrant integration into the management approach to guide best practices based on the latest knowledge and tools. Many of the current gaps are actively being filled through numerous ongoing studies, which will be used to guide future adaptive management of this Plan.

Even though FIB rarely cause illness and they are ubiquitous in the environment, studies sometimes show a correlation between their presence in recreational waterbodies and GI in users of those waters, especially if the source is of human origin. Testing for pathogens may be more accurate, but measuring pathogens is an expensive and slow endeavor, as compared to analyses for FIB. When other sources are present, FIB measurements may include contributions from wild animals, birds, decaying vegetation, or biologically active surfaces, which may pose substantially less health risk than contributions from human sources (Soller et al. 2010). Speciation of bacteria through microbial source tracking (MST) studies has sometimes proven to be effective in identifying the relative contributions of bacteria from natural and anthropogenic sources in different waterbodies.

The use of human markers and other methods that correlate better with human health risk in Southern California has been motivated by recent scientific studies, which have revealed a greater understanding of the association between FIB and pathogens to actual human health risk.

One key special study was the surfer health study (SHS), conducted during the winters of 2013-14 and then again in 2014-15 by SCCWRP at Ocean and Tourmaline Beaches in San Diego, the goal of which was to measure illness rates among surfers exposed to bacteria during wet weather.

The SHS Quantitative Microbial Risk Assessment (QMRA) model was used to derive a human fecal marker (HF183) level in a manner that is consistent with the methodology that the USEPA used for deriving the 2012 RWQC. QMRA uses microbial measurements to determine where they can become a danger and estimates their risk to human health. Less expensive than an epidemiology study, risk models like QMRA can yield valuable risk assessment data by looking at the hazard posed by some microbes, the dose-response relationship, exposure, and finally a determination of human health risk. Based on the data collected under the SHS, the QMRA estimated an excess GI illness rate of 15 illnesses per 1,000 recreators for the conditions observed during the SHS. These results agree with the epidemiological component of the SHS, which reported an excess GI illness rate of 12 illnesses per 1,000 recreators. Through a series of numerical simulations and calculations, it was determined that a median value of 250 copies per 100 mL with a 90th percentile of 2,655 copies per 100 ml corresponds to 15 excess GI illnesses per 1,000 surfers, respectively during wet weather.

The SHS study confirmed the need to differentiate between sources of fecal contamination. This resulted in a number of MST studies that were conducted in recent years in Southern California to identify human and non-human sources of fecal pollution in several waterbodies. The MST studies that have been conducted in the region, are ongoing, or are planned in the future will provide beneficial information on the sources of fecal contamination and will help inform implementation of this Plan. The Southern California Bight Regional Monitoring Program has been advancing the use of quantitative polymerase chain reaction (qPCR) in recreational water quality monitoring. Its studies have shown that qPCR methods result in a more rapid measurement of FIB and can be used to identify sources of fecal contamination (SCCWRP 2017). Bight monitoring also included the collection of human marker data.

SCCWRP has also developed a Microbial Community Analysis (MCA) approach that is intended to provide information about the entire microbial community present in a sample. Using community fingerprinting, microarrays, and next generation DNA sequencing, MCAs could be created and used to match patterns to determine fecal sources and other microbial data. While MCAs are expensive, its potential to identify microbial sources is valuable and generally infeasible with single-marker methods.

Previous studies investigated potential HF183 thresholds that meet the recreational risk threshold of 32 illnesses per 1,000 recreators. *Can We Swim Yet? Systematic Review, Meta-Analysis, and Risk Assessment of Aging Sewage in Surface Waters,* Boehm et al. (2018), derived that 1,000 copies/100 mL for HF183 aligns with the median risk of approximately 30 illnesses per 1,000 recreators. This derivation is based on sewage contamination in the receiving water that has aged 2.5 days, which is considered a worst-case scenario for surface water contamination. Risk from exposure to HF183 concentrations increases with the age of contamination. Therefore, factoring in uncertainty in contamination age at the time of water recreator exposure, the study determined that 4,100 copies/100 mL corresponded to a media risk of approximately 30 illnesses per 1,000 recreators for contamination of unknown age. As human marker data and associated scientific understanding grows appropriate thresholds can be used to better assess local recreational risk.

A number of other scientific studies are ongoing that may lead to advancements in the understanding of the contribution of bacteria and pathogens from human sources. The San Diego River Investigative Order (Investigative Order No. R9-2019-0014) is intended to conduct multiple technical and monitoring studies to better understand the sources and transport pathways of human fecal material to the San Diego River. A driver of the order focused on recent research that viral pathogens associated with human fecal material are the primary cause of swimming associated GI in the United States. The order also identifies suspected sources and transport pathways of human fecal material, for which separate studies have been or are being conducted to better characterize specific to the San Diego River. These sources included the following: sanitary sewer overflows from publicly-owned sewer collection systems; sewage spills from privately-owned lateral sewer lines; exfiltration from publicly-owned sanitary sewer collection systems and privately-owned later sewer lines; faulty privately-owned on-site wastewater treatment systems; illegal connections to MS4s; illicit discharge to MS4s; and direct or indirect deposition from homeless encampments. Follow up technical studies identified specific to the San Diego River it appears sewer exfiltration is a major source via groundwater inputs, though surface sources such as from open defecation are not negligible, particularly during first flush (Pinongcos et al, 2022 and SDSU, 2020)

Laboratory methods are constantly being refined to improve the detection of human markers and pathogens, as well as develop new indicators (e.g., coliphage) that may provide additional tools that can be used in the future to help identify sources of human waste. USEPA and other organizations are striving to review and update these methods in order to provide guidance on their application. Under USEPAs second five-year review of the RWQC published in May 2023, it was determined that revisions were needed based on scientific advancements (USEPA, 2023). The key recommendations to improve public health protection through the RWQC included exploring new methods to determine if a waterbody is contaminated with human feces, given this presents the greatest risk of illness in recreational waters.

The South Orange County MS4 Permittees, the City and County of San Diego, and Ventura County MS4 Permittees are implementing similar approaches as the LRS Adaptation to address the bacteria issues in their regions. An emphasis has been placed on targeting and reducing bacteria associated with human waste source as a more efficient and effective method at reducing illnesses in recreational users.

Given the lessons learned since development of the original LRS, plus the significant regulatory and scientific advancements in the approach to addressing bacteria-related issues, the Group elected to pursue this adaptation of the existing LRS. The adaptation approach and implementation, leveraging these lessons learned and advancements, are detailed in the following sections.

2 ADAPTATION APPROACH

The Adaptation provides an improved approach to meeting the Bacteria TMDL objectives. The core refined elements include:

- Incorporation of more recent water quality data gathered through the LRS and other related programs along with characterization of the potential presence of human waste sources to reprioritize areas of concern to focus implementation actions;
- Identification of data gaps and additional monitoring needs, including monitoring locations and parameters, such as additional analyses for human markers and specific source identification monitoring; and
- Within areas of concern, identification of the most efficient and effective abatement efforts, focused on source control and feasible/effective locations for structural BMPs and dry weather controls designed to provide multiple benefits.

To implement these elements, the Plan orients around eight key steps (Figure 2-1):

1) Receiving Water Quality Condition Assessments
    - Impaired receiving waters for bacteria are assessed based on available water quality data. If conditions are meeting applicable water quality objectives, catchments draining to the receiving water are considered a low priority.
2) Outfall Water Quality Condition Assessments
    - Similar assessment of outfalls based on available water quality data. If conditions are meeting applicable water quality objectives, catchments draining to the outfall are considered a low priority. Additionally, assess connectivity of the MS4 network to receiving waters, where areas eventually draining to and potentially impacting impaired receiving waters are the focus for prioritization and subsequent investigation and abatement activities.
3) Potential Human Waste Source Evaluations
    - Vulnerability scores assigned to typical sources of human waste based on characteristics indicating the potential or likelihood of their presence in a catchment area.
4) Catchment Prioritization
    - Prioritize upstream catchments based on (1) - (3) related to the potential impact each catchment may have on water quality conditions in impaired receiving waters. Inform follow-up steps (5) - (7).
5) Areas of Investigation
    - Based on the results of (4), delineate clusters of highest and high priority catchments as areas of investigation to support effective and efficient source investigations (6) and implementation actions (7). Supplemental Monte Carlo analysis conducted to select sufficient areas to address to meet waste load allocations for each segment and tributary.
6) Source Investigations
    - Based on the results of (4) and (5) confirm highest priority catchments that may contribute to receiving water impairments through collection of additional receiving water and outfall monitoring data. Identify additional monitoring needs to locate sources within priority areas and guide abatement activities in step (7).
7) Source Abatement and Implementation Actions
    - Implement human waste control actions based on the findings of (6), tailored in different locations based on identified sources. Implementation actions may consist of source abatement, structural projects, verified non-MS4 contributions, or verified low risk to effectively reduce priority catchments contribution to receiving water impairments.
8) Performance Monitoring
    - Evaluate impact/success of abatement and implementation activities. Monitoring to confirm the source(s) identified were eliminated or successfully mitigated.

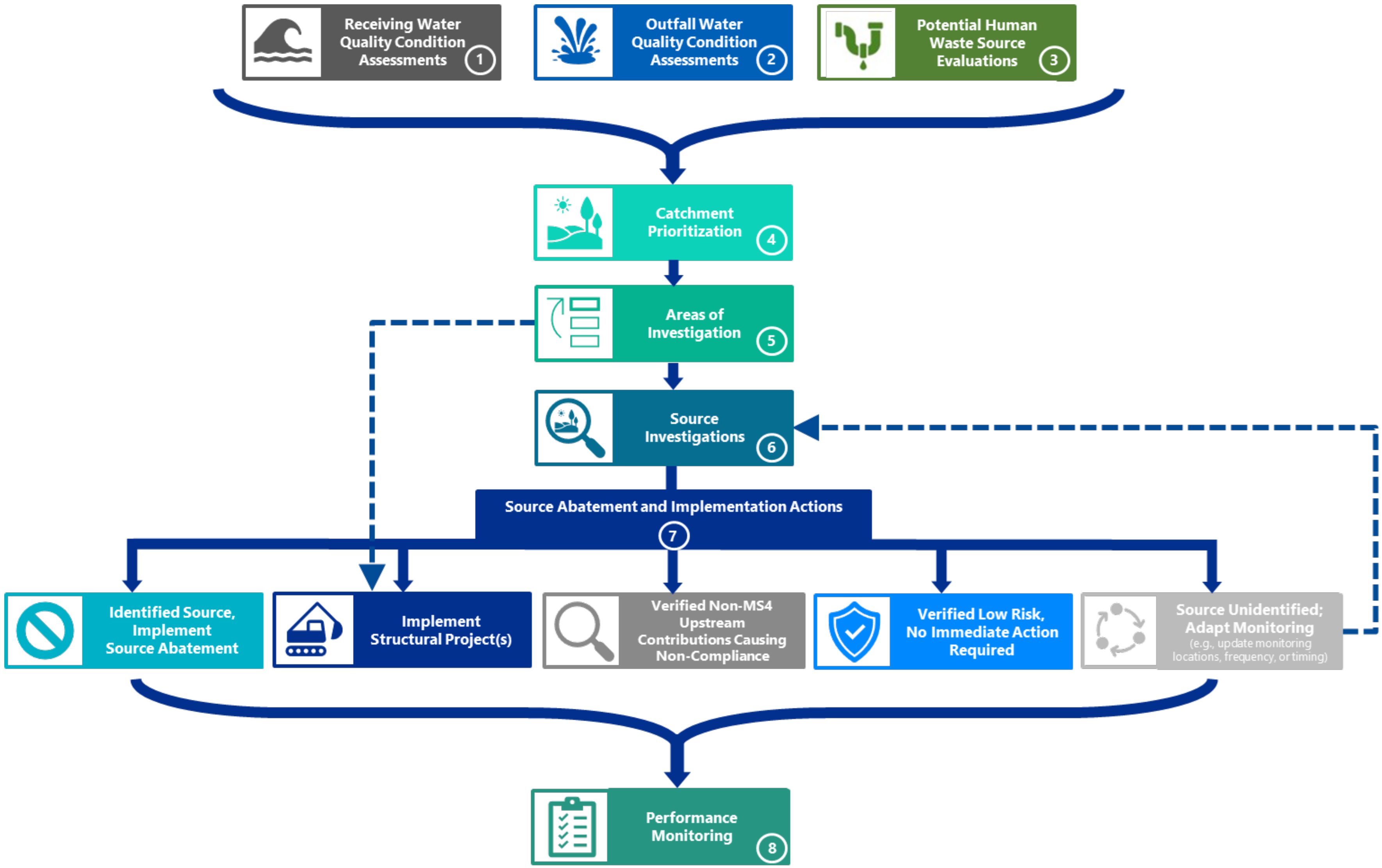


Figure 2-1. LRS Adaptation Plan Steps

2.1 Water Quality Condition Assessments

To assess the water quality conditions in the receiving waters and at outfalls (Steps 1 and 2) water quality data within the ULAR watershed was compiled and analyzed. Table 2-1 summarizes the data sources. Data was analyzed separately under dry and wet weather conditions. If the weather conditions were not already designated in the data provided, rainfall records at the Los Angeles County Department of Public Works rain gauge number 375 at the University of Southern California were used to denote wet versus dry weather conditions.

Table 2-1. Data Sources for the Receiving Water and Outfall Water Quality Condition Assessments.

Data Source		Period
FIB Data		
Coordinated Integrated Monitoring Program (CIMP)		2015 – 2023
Outfall Screenings (phased for each segment and tributary)		2008; 2014 – 2016; 2018 - 2023
City of Los Angeles' Status and Trends Monitoring Program		2001 – 2009
Los Angeles River Watershed Monitoring Program (LARWMP)		2009 - 2020
LARWMP Recreational/Unregulated Swim Zones		2011 – 2019
Water Reclamation Plant Monitoring and Reporting Programs	LA-Glendale	2012 – 2019
	Donald C. Tillman	2011 – 2019
	Burbank	2012 - 2016
Paired FIB and HF183 Data		
Human Waste Source Investigation (HWSI) (data collected for targeted Areas of Investigation (AOIs))		2022 – 2023
Strategic Wet Weather Risk-Based Monitoring		2021

Most water quality data available in the ULAR watershed at both receiving waters and outfalls are *E. coli*. Therefore, the initial water quality condition assessments conducted for the LRS Adaptation Plan compared the receiving water and outfall *E. coli* data to the STV value established in the Statewide Bacteria Provisions for waters with salinity equal to or less than 1 part per thousand (ppth) 95 percent or more of the time, 320 cfu/100 mL. Across the full available dataset at each receiving water and outfall station a weighted exceedance magnitude of the 320 cfu/100 mL established STV were calculated under dry and wet weather conditions. The weighted exceedance magnitude is based on the summation of how much each sample exceeds the 320 cfu/100mL threshold (only for samples that exceed the threshold), divided by the total number of samples taken, including dry observations or samples below the threshold.

$$Weighted\ Exceedance\ Magnitude = \sum \frac{Sample\ Concentration - Action\ Level}{Action\ Level} \Big/ Number\ of\ Samples$$

Table 2-2 provides the weighted exceedance magnitudes calculated for the previous priority outfalls from the original LRS reports. The results of the receiving water and outfall water quality assessments based on *E. coli* data under dry and wet weather are presented in Figure 2-2 through Figure 2-4. Figure 2-5 shows receiving water sites were HF183 data has also been collected. This data is currently referenced to deprioritize areas where there is consistently no detection of the human marker, HF183. As the database of similar human marker data in the region grows it is expected that this will be utilized further in the water quality condition assessments and catchment prioritization.

Notably, limited outfall bacteria-related water quality data is available in the watershed during wet weather. This data has not historically been collected; however, the Group is pursuing near-term strategic wet weather monitoring at outfalls to collect this data and further inform the wet weather prioritization and strategy. See Section 2.1.2 for additional details and Section 3.4 for the implementation schedule.

Table 2-2. Dry Weather Weighted Exceedance Magnitude for *E. coli* of Original LRS Priority Outfalls.

Segment/Tributary	Outfall	Outfall Weighted Exceedance Magnitude (E. coli—Dry)
Segment B	LAR-B-R2-A	3,520.6
	LAR-B-R2-K	218.7
	LAR-B-R2-02	17.1
	LAR-B-R2-04	32.3
Arroyo Seco	AS-21	155.9
	AS-22	17.4
	AS-15	14.5
	AS-41	5.0
	ARS-234	18.9
Segment E	LAR-E-058	35.1
	LAR-E-096	42.5
	LAR-E-081	193.4
	LAR-E-021	5.7
	LAR-E-110	29.6
	LAR-E-097	1,279.5
	LAR-E-077	5.7
	LAR-E-048	8.2
	LAR-E-065	3.0
Lower Rio Hondo (ULAR)	RH-078	589.8
	RH-090	25.7
	RH-092	34.7
	RH-095	8.5
	RH-072	32.8
	RH-093	3.6
Alhambra Wash	AlbWsh-179	44.1
	AlbWsh-213	23.9
	AlbWsh-RW-Up4	16.2
	AlbWsh-03	17.5

Segment/Tributary	Outfall	Outfall Weighted Exceedance Magnitude (E. coli—Dry)
Rubio Wash	RubWsh-Up	13.9
	RubWsh-86	11.0
	RubWsh-33	10.8
	RubWsh-91	25.3
	RubWsh-01	2.8
Eaton Wash	EtnWsh-132	122.9
	EtnWsh-131	5.6
	EtnWsh-203	7.4
	EtnWsh-162	22.8
	EtnWsh-166	5.2
	EtnWsh-175	22.3
	EtnWsh-206	10.6
	EtnWsh-155	5.3
	EtnWsh-103	148.6
Arcadia Wash	ArcWsh-03	72.6
Sawpit Wash	SptWsh-16	75.7
Compton Creek	LACC-155	60.3
	LACC-105	1,265.7
	LACC-021	175.3
	LACC-109	9.6
Aliso Canyon Wash	ACW-025	4.3
Bell Creek	BELC-035.5	3.8
McCoy Canyon Creek	MCC-008	3.2
	MCC-006	0.6
Burbank Western Channel	BWC-042	1,821.9
Tujunga Wash	TW-105	19.8
	TW-079	46.5
Bull Creek	BULC-064	3.0

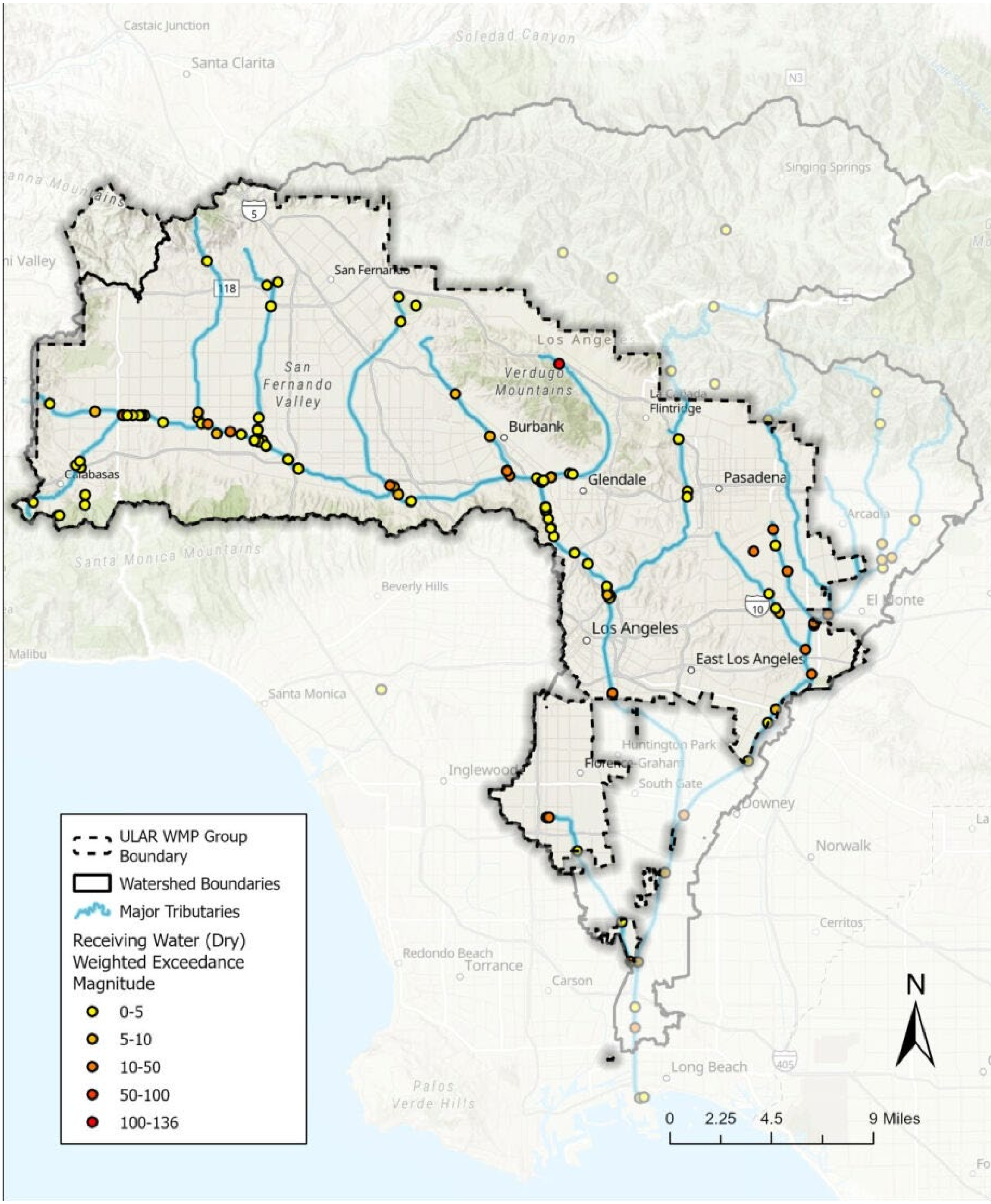


Figure 2-2. Weighted Exceedance Magnitude of *E. coli* WQOs at Receiving Water Monitoring Sites during Dry Weather.

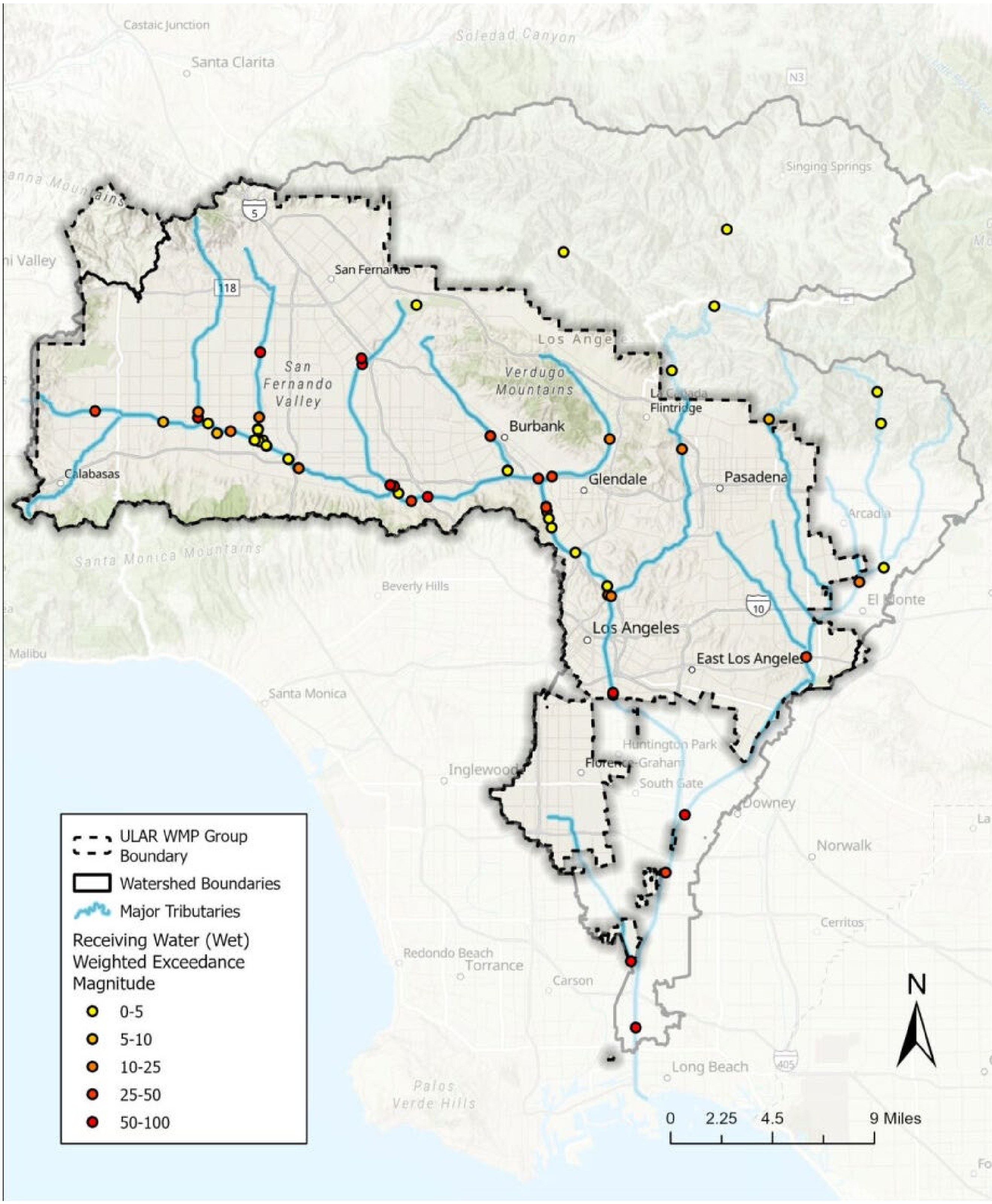


Figure 2-3. Weighted Exceedance Magnitude of *E. coli* WQOs at Receiving Water Monitoring Sites during Wet Weather.

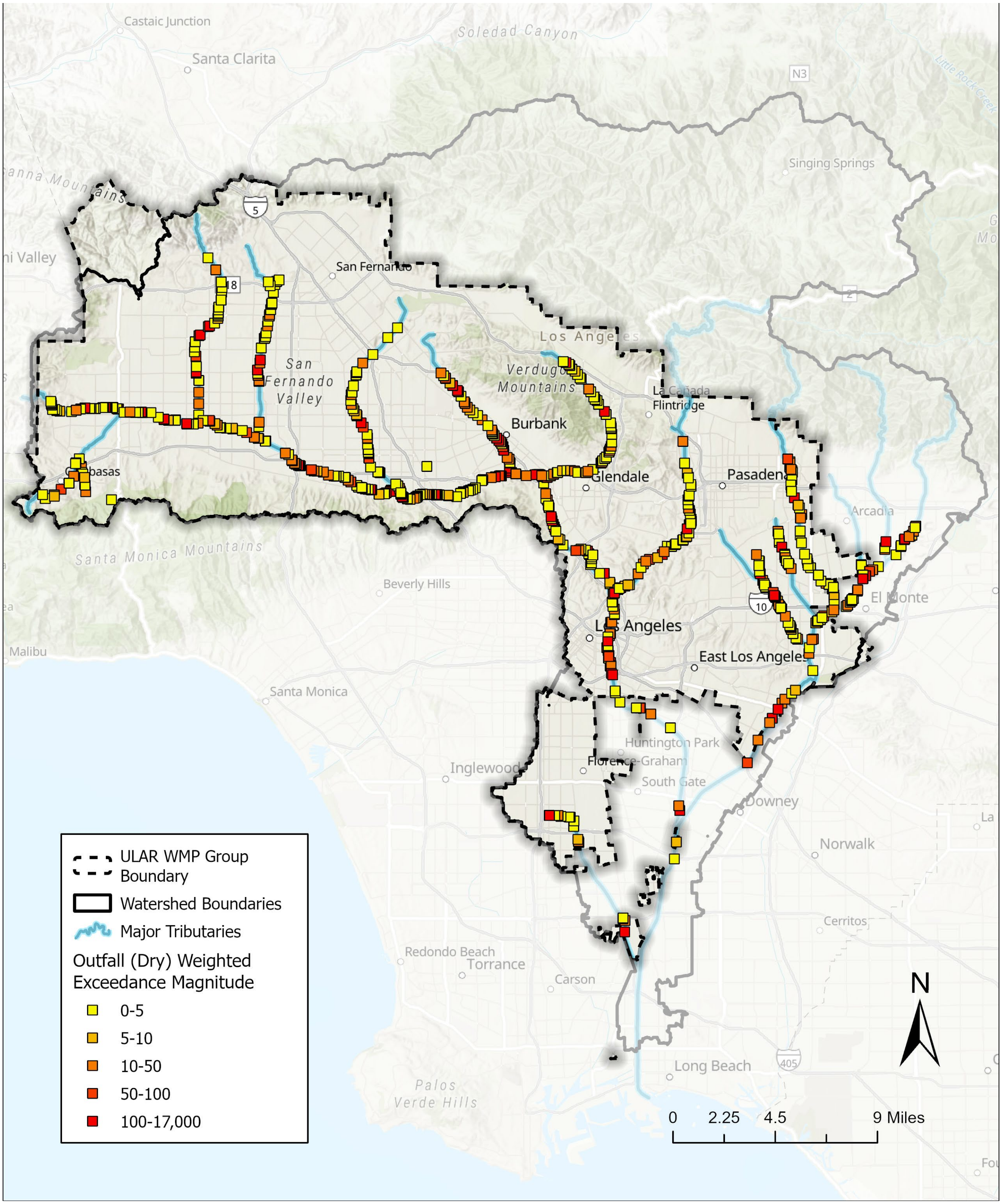


Figure 2-4. Weighted Exceedance Magnitude of *E. coli* WQOs at Outfall Monitoring Sites during Dry Weather.

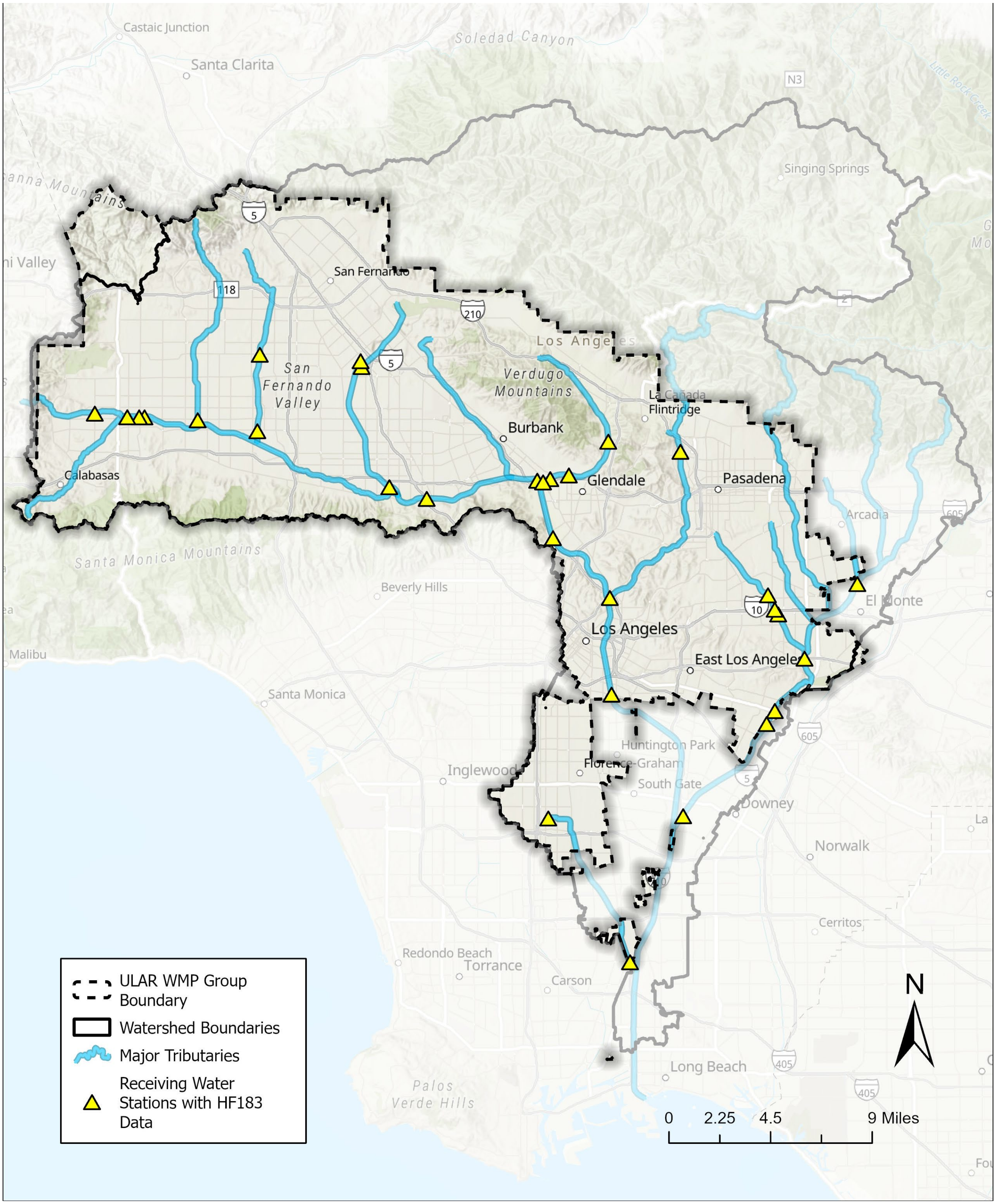


Figure 2-5. Receiving Water Monitoring Sites with HF183 Data.

2.1.1 Hydraulic Connectivity

Outfall water quality conditions are further assessed to evaluate potential hydraulic connectivity to impaired receiving waters. At this time, this is specific to dry weather only, based on two factors:

(1) If a catchment is upstream of a built low flow division (LFD) it is automatically assigned as the lowest priority during dry weather. All dry weather flows will be diverted without reaching a receiving water.
(2) If all the outfall screening events conducted showed no flow present at the outfall (with a minimum of 4 events collected required), the associated catchment is automatically assigned as the lowest priority during dry weather. These outfalls consistently demonstrate no discharges occurring during dry weather.

2.1.2 Strategic Risk-Based Monitoring Program

The LRS Adaptation Plan framework described herein is intended to provide the Group with the ability to maximize limited resources across the WMA through the synthesis of available data (water quality and human source information) in order to prioritize catchments for further investigation and support REC-1 beneficial use attainment. While a significant amount of water quality data was available at the time of conducting the water quality assessments described above in Section 2.1, a primary data gap is the lack of paired FIB and HF183 data for receiving waters and outfalls proximal to REC-1 impaired segments. During development of the LRS Adaptation Plan, the agencies have proactively collected paired FIB and HF183 data across three distinct efforts:

- Preliminary sampling was conducted at three outfalls and associated upstream/downstream receiving waters identified as priorities in the Segment B Mainstem (LAR-B-R2-04), Arroyo Seco (AS-17) and Rio Hondo (RH-078). This preliminary data collection is discussed further in Appendix A and Appendix B.
- Following the initial submittal of the LRS Adaptation Plan in August 2021, the Group proceeded with human waste source investigations in seven prioritized areas of investigation. The first year of investigations included areas in Compton Creek, Segment C, and Segment E. The second year of investigations included areas in Alhambra Wash, Eaton Wash, Rio Hondo, and Verdugo Wash. These investigations included sampling for paired FIB and HF183 data at bracketed receiving water sites, and outfalls or upstream catchment sites where triggered.
- Strategic risk-based monitoring was initiated by the Group at targeted receiving water sites to collect paired FIB and HF183 data. Three wet weather events were sampled during the FY21-22 wet season. Monitored sites are shown in Figure 2-6. Additional funding from the Safe, Clean Water Program is supporting collection of three more wet weather events and six dry weather events at the same monitoring locations for paired FIB and HF183 data.

The compilation of these activities is growing a database of paired FIB and HF183 data in the ULAR watershed to further guide priority actions. These data types are critical to evaluating water quality conditions in receiving waters and determining if elevated concentrations exist that may impact human health risk levels. The collection of additional REC-1 impaired receiving water and outfall data in areas where data are limited will help to improve future iterations of the outfall catchment prioritization and inform the targeting of source investigations.

It is expected that this list of monitoring stations will evolve over time based on recommendations from the Group, as additional data is gathered and assessed, or due to changes in impairment status and LRS Adaptation priorities. The duration of monitoring at a given location will be determined by the Group based on location-specific considerations but is generally expected to extend through a minimum of three years to determine trends. The monitoring results will be evaluated annually, and a site may be discontinued as needed (e.g., continued lack of flow) or remain active for a longer period. The Group will compile the monitoring results and use the data to refine the catchment prioritization presented in Section 2.3 through the adaptive management process and support future source investigations. This process has already been demonstrated since the initial submittal of the LRS Adaptation Plan in August 2021, as the catchment prioritization results presented herein are following two iterative updates that included utilization of the data referenced above.

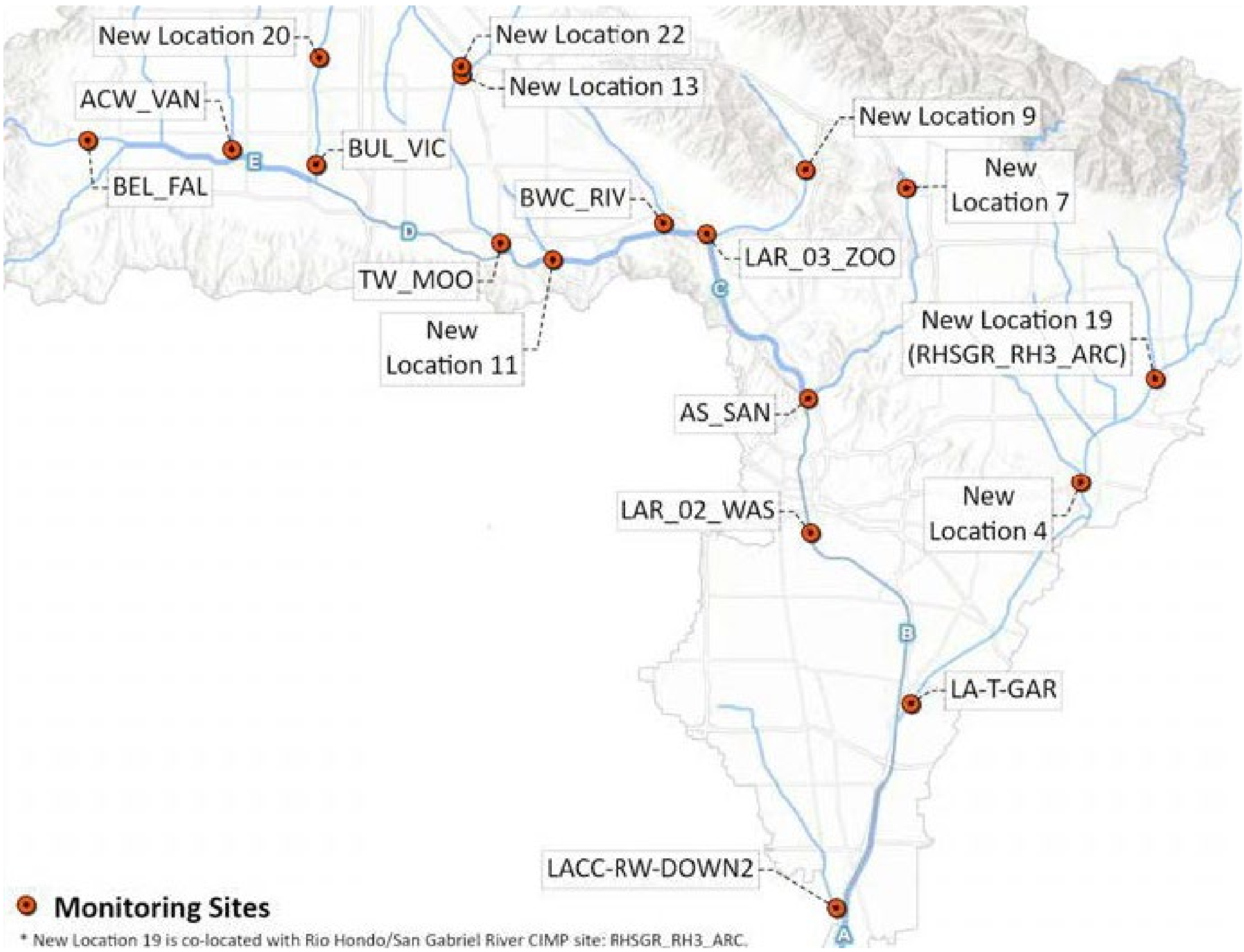


Figure 2-6. Strategic Risk-Based Monitoring Locations.

2.2 Potential Human Waste Source Evaluations

The vulnerability of a catchment to contribute pathogens through the MS4 and into receiving waters was evaluated in part by the potential presence of human sources in the catchment area. Figure 2-7 depicts potential sources of human waste investigated for the LRS Adaptation Plan, and associated transport pathways to receiving waters. The available data sources for the different sources are summarized in Table 2-3 and the scoring used to evaluate the potential vulnerability of each source is summarized in Table 2-4.

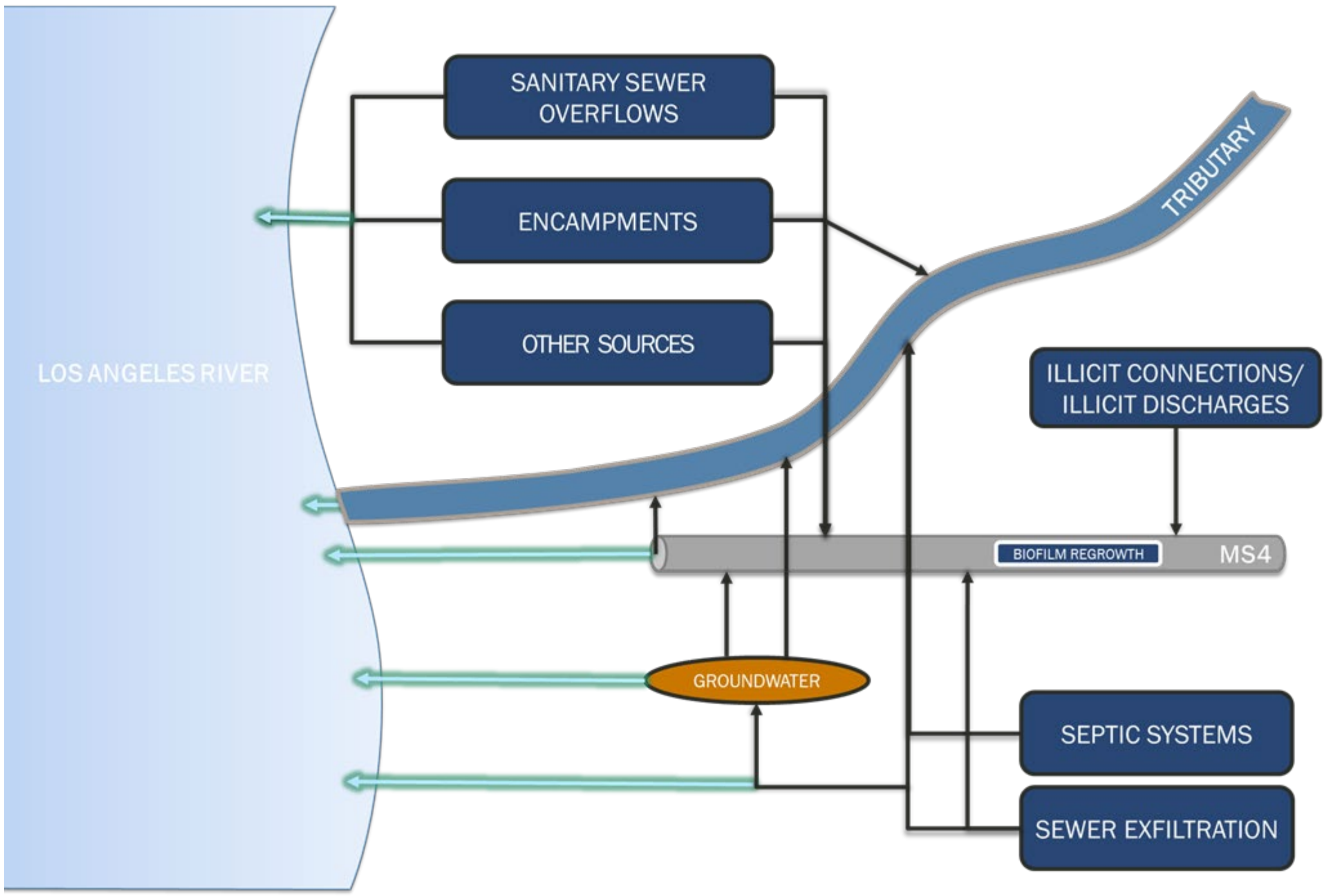


Figure 2-7. Potential Pathogen Sources and Transport Pathways.

Table 2-3. Available Data to Assess Potential Sources of Human Waste.

Source Criteria	Available Data Sources	Jurisdictions Covered by Data
Sewer Exfiltration/MS4 Infiltration	Sewer GIS Layers Sewer System Management Plans Storm Drain Infrastructure GIS Layers Soil Types based on SSURGO	Alhambra, County, Glendale, La Cañada Flintridge, Los Angeles, Pasadena, Rosemead, San Gabriel, South El Monte, South Pasadena, Temple City
Onsite Sewer System/MS4 Infiltration	Onsite Wastewater Treatment Systems GIS Layers (limited availability by jurisdiction) Onsite Wastewater Treatment Systems Inventories Parcels GIS Layers Storm Drain Infrastructure GIS Layers Soil Types based on SSURGO	Alhambra, Burbank, Glendale, Hidden Hills, La Cañada Flintridge, Los Angeles, Monterey Park, Rosemead, San Fernando, South Pasadena, Temple City
Private Lateral Exfiltration/MS4 Infiltration	Private Lateral GIS Layers (limited availability by jurisdiction) Storm Drain Infrastructure GIS Layers Soil Types based on SSURGO	Glendale, Los Angeles, Pasadena
Homeless Encampments	Hot Spot Encampment/Human Waste Locations based on Call Complaints, Databases, and Anecdotal Locations Los Angeles Homeless Services Authority 2016 – 2020 Homeless Counts by Census Tract	All ULAR WMG Agencies
Sanitary Sewer Overflows (SSOs)	California Integrated Water Quality System (CIWQS) Reports for 2015 - 2023	All ULAR WMG Agencies
Fats, Oils, and Grease (FOG) Impacts – related to SSOs	CIWQS Reports, with “Spill Cause” Flagged as FOG for 2015 – 2023 FOG Inspections and Violations Reported Los Angeles County Public Health Inspections for Food Facilities for 2015 - 2020 Restaurant Locations	All ULAR WMG Agencies
Illicit Connections/Illicit Discharges (IC/ID) and Illegal Dumping (associated with fecal matter)	Historic IC/ID or Illegal Dumping Cases from Call Complaints, Databases, and Reported Dumping Hot Spot IC/ID or Illegal Dumping Locations based on Anecdotal Information	Alhambra, Burbank, Calabasas, Glendale, Los Angeles, Montebello, Monterey Park, Pasadena, San Fernando, San Gabriel, South Pasadena, Temple City
Wastewater Treatment Plants (WWTP)	WWTP Facility Locations GIS Layers	All ULAR WMG Agencies
Other (not explicitly incorporated in the catchment prioritization approach at this time)	Recreational Vehicle (RV) Dump Stations Active NPDES Dischargers from Regional Boards Permit Tool Los Angeles County Public Health Outdoor Pool Inspections for 2015 - 2020	

Table 2-4. Source Criteria Scores Assigned to Catchments.

Source Criteria	Response Types	Median Response	Score
Sewer Exfiltration/MS4 Infiltration	Percent of vulnerable pipes[1]; determined based on (1) distance from storm drain; (2) soil type; (3) pipe diameter; (4) pipe age.	44%	1 + Percent of Vulnerable Pipes
Onsite Sewer System/MS4 Infiltration	Percent of vulnerable pipes[1]; determined based on (1) distance from storm drain; (2) soil type	69%	
Private Lateral Exfiltration/MS4 Infiltration	Percent of vulnerable pipes[1]; determined based on (1) distance from storm drain; (2) soil type; (3) pipe diameter; (4) pipe age.	27%	
Homeless Encampments	Average of the count of encampment locations and the area-weighted total unsheltered people from the Homeless Count, over the previous five years. If catchment area contains an identified hot spot, it is automatically assigned the maximum score.	8	None Present = 1 1 – Median Response Value = 1.5 > Median Response Value = 2
Sanitary Sewer Overflows	Number of incidents reported in the previous five years	2	
Fats, Oils, and Grease Impacts	Count of FOG hot spots and FOG-related spills. If catchment area contains an identified hot spot, it is automatically assigned the maximum score.	1	
Illicit Connections/Illicit Discharges and Illegal Dumping	Number of incidents associated with fecal matter in the previous five years. If catchment area contains an identified hot spot, it is automatically assigned the maximum score.	7	
Wastewater Treatment Plants	Count of WWTP facilities	1	

1: Pipe vulnerability was determined by calculated the Exfiltration Score for pipe segments based on the following table (CBA Steering Committee 2017). If a pipe was recently lined the Exfiltration Score was adjusted to a value of 1. A sanitary sewer pipe is considered vulnerable if scores greater than 2.5 and the onsite sewer systems and private laterals are considered vulnerable if score greater than 2.

Criteria	Weight	Values	Score
Distance from Storm Drain (nearest distance, vertical and horizontal)	35%	< 100 ft	3
		100 – 500 ft	2
		> 500 ft	1
Soil Types	15%	High Permeability (A)	3
		Moderate Permeability (B or C)	2
		Low Permeability (D)	1
Sanitary Sewer Pipe Diameter	15%	0 – 15 inch	3
		16 – 24 inch	2
		> 24 inch	1
Sanitary Sewer Pipe Age	35%	> 40 years (pre-1980)	3
		21 – 40 years (1980 – 2000)	2
		< 20 years (post-2000)	1

The source criteria composite score for each catchment is calculated as the average of the scores for all eight source criteria. If insufficient data is available for a source criteria category, the average is calculated excluding that category.

2.3 Catchment Prioritization

The foundation of the catchment prioritization starts with the outfall catchment delineations, which monitoring data are associated to and within which potential sources are evaluated. Catchments were delineated for monitored outfall stations, including from screening events for flow observations and sampling of bacteria-related data (Figure 2-8). A total of 1,835 catchments were delineated, with several having multiple outfalls. Previously developed outfall drainage areas from the original LRS report priorities were available for select areas and were verified during the development of watershed-wide catchments.

To develop drainage areas to the outfalls monitored in the ULAR watersheds, automated GIS analysis was initially used due to the large number of data points. The primary data sources for drainage area delineations were the storm drain network and 5-foot Digital Elevation Model (DEM). Because drainage area delineation is sensitive to very small differences in data locations and data resolution in combining different datasets to perform this analysis, a sensitivity analysis was performed using a range of geospatial parameters to select the most plausible set of drainage areas for the various points of study in the region. Data for the locations of storm drains, open channels, and culverts was utilized to recondition the DEM in these locations and enforce flow both to them and along them on their way to outfalls and receiving waters. This method helps delineate drainage areas using surface elevations data along subsurface storm drains and is acceptable for use with storm drains because these generally follow the overall hydrologic contours of surface elevations. The reconditioned DEM was then filled to eliminate any internally draining areas and processed to determine flow direction and flow accumulation prior to watershed delineation.

It should be noted that the final accuracy of drainage areas is ultimately a reflection of the accuracy of the input data. The chosen set of drainage areas represents the most plausible across the region based on the data received. Manual inspections were conducted for select areas, mostly focused on previous priority and outlier outfalls identified to confirm the delineated drainage areas. Many of the drainage areas were consistent with those previously provided. Where differences were noted, manual corrections were performed to ensure the most accurate representation was selected. As the LRS Adaptation process moves forward there are expected further refinements of these drainage areas based on additional manual inspections, field verification, and refinement of the MS4 network represented in the processing.

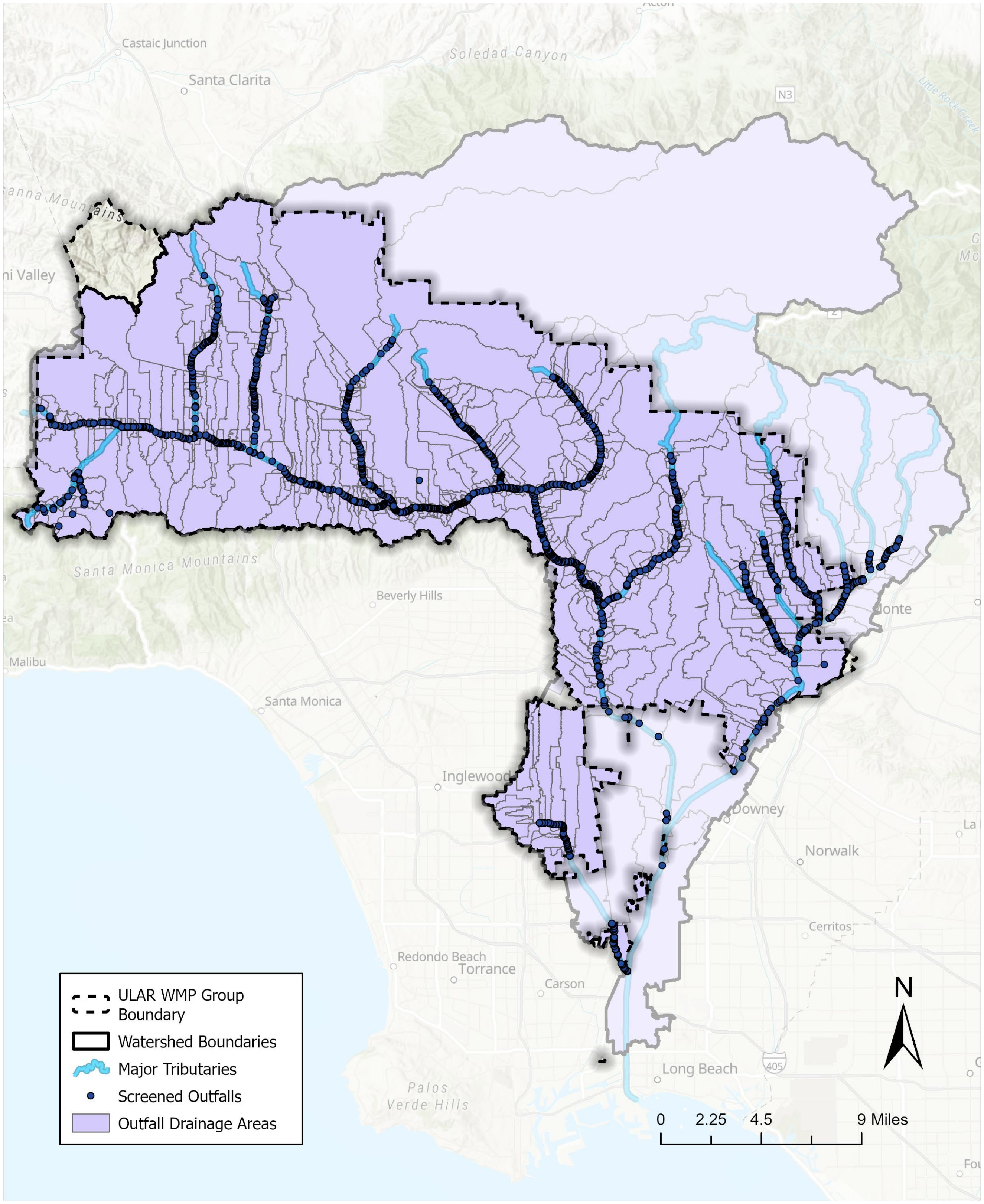


Figure 2-8. ULAR Outfall Catchment Delineations.

The catchment prioritization approach factors in the water quality conditions assessments discussed above in Section 2.1. Outfall water quality conditions assessments were assigned to the upstream outfall catchment area delineated. Receiving water stations were clustered where appropriate and water quality condition assessments were assigned to upstream outfall catchment areas for which they represent the most immediate downstream receiving water. Hydraulic connectivity of a catchment area to the downstream receiving water were also evaluated based on outfall observations and implementation of existing projects (Section 2.1.1). From there, potential human sources within the catchment areas were evaluated and scored based on potential presence (Sections 2.2). The water quality condition assessments and source criteria scores were then combined to assign an initial priority category to each catchment (Section 2.3.1). Section 2.3.2 presents the results of this analysis, identifying the highest priority catchments based on all the above factors.

2.3.1 Combining Water Quality Condition Assessments and Potential Human Waste Source Evaluations

To combine the water quality assessments and source criteria composite scores, the following steps are taken:

(1) Plot the receiving water weighted exceedance magnitude of water quality benchmarks versus the source criteria composite score for each catchment (Figure 2-9 and Figure 2-10).

Each dot represents a single catchment; however, note that some of the catchments were associated with the same source criteria composite score and receiving water quality data and thus are overlapping on these plots.

(2) Divide the plots into Low, Medium, and High priority groupings based on the priority lines shown in Figure 2-9 and Figure 2-10.

The priority lines were assigned a negative 20 slope. A y-intercept (interpreted here as the source criteria composite score equal to 1, as this is the minimum score indicating none of the potential sources are present) of 10 was selected for the medium priority line. A y-intercept of 20 was selected for the high priority line. These slopes and intercepts were set such that any catchment scoring the maximum source criteria composite score of 2 would automatically be high priority, and any catchment scoring above 1.5, as the median of the possible source criteria composite scores, is at least assigned medium priority. Multiple variations of the priority lines were investigated and ultimately selected based on a reasonable distribution of catchments across the priority categories. Catchments falling below the Medium Priority line were designated "Low" priority, catchments between the Medium Priority and High Priority lines were designated "Medium" priority, and catchments above the High Priority line were designated "High" priority.

(3) Repeat steps 1-2 replacing the receiving water weighted exceedance magnitudes with the outfall water quality weighted exceedance magnitudes of benchmarks versus the source criteria composite score for each catchment (Figure 2-11). The same priority lines and rationale used for the receiving water quality analysis were used for the outfall water quality analysis.

(4) Finally, the prioritization of catchments based on the receiving water quality and outfall water quality assessment plots were combined to assign the combined priority category as follows:

- ***Highest Priority:*** High Priority for both receiving water and outfall water quality assessment plots

- ***High Priority:*** High Priority for one of the receiving water or outfall water quality assessments plots and Medium Priority for the other
- ***Medium Priority***: Medium Priority for both receiving water and outfall water quality assessment plots
- ***Low Priority***: Medium Priority for one of the receiving water or outfall water quality assessments plots and Low Priority for the other
- ***Lowest Priority***: Low Priority for both receiving water and outfall water quality assessment plots

For wet weather, since no outfall water quality assessment has been completed due to lack of data, the priority category was assigned solely based on the receiving water quality assessment plot (steps 1 and 2).

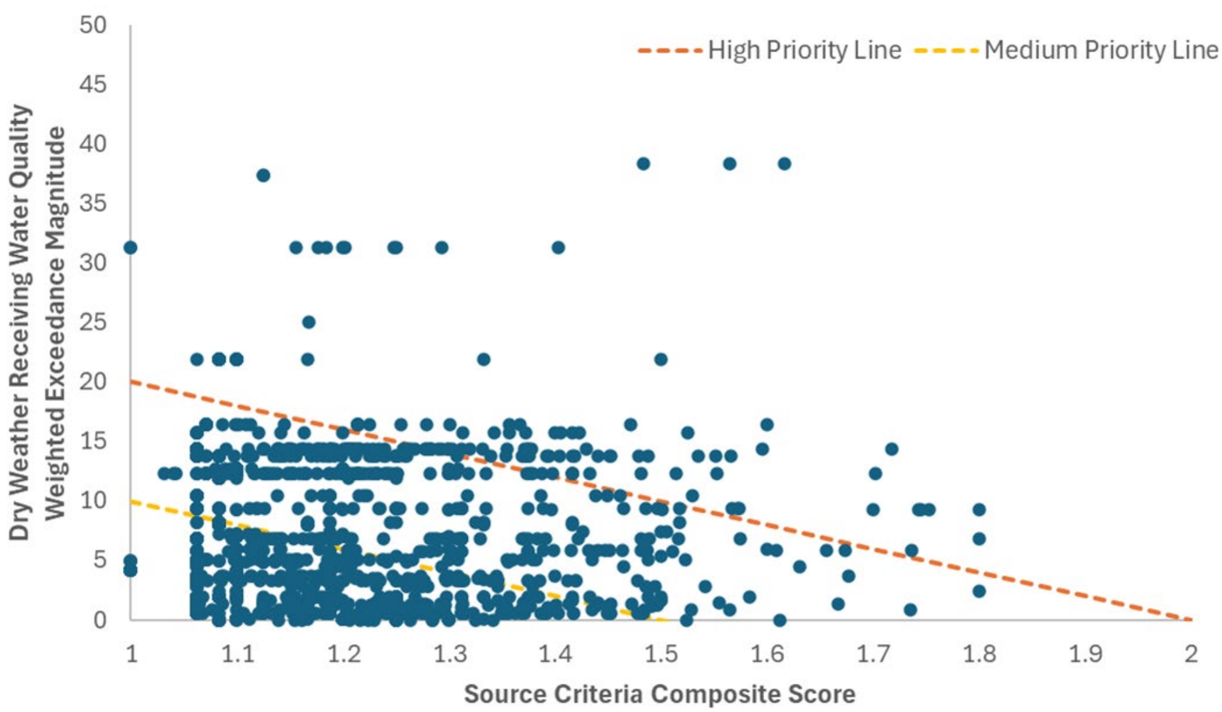


Figure 2-9. Receiving Water Quality Percent Exceedance of Benchmarks During Dry Weather versus Source Criteria Composite Scores.

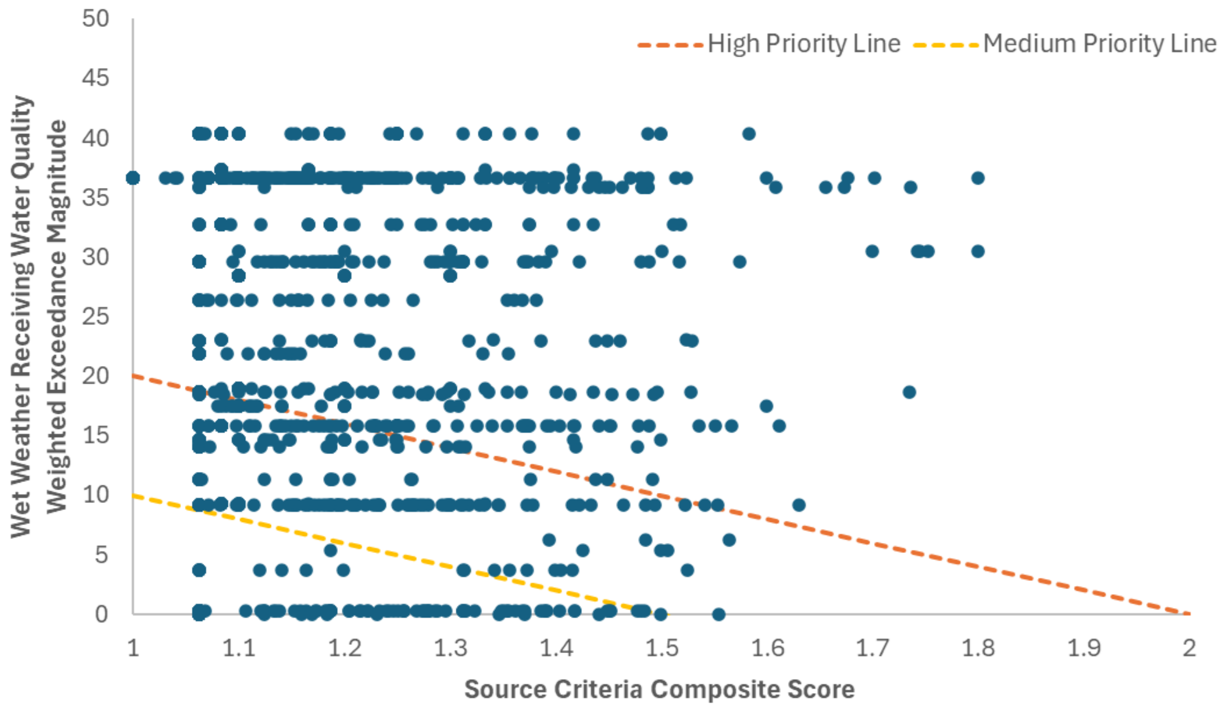


Figure 2-10. Receiving Water Quality Percent Exceedance of Benchmarks During Wet Weather versus Source Criteria Composite Scores. (note: weighted exceedance magnitudes above 50 not displayed)

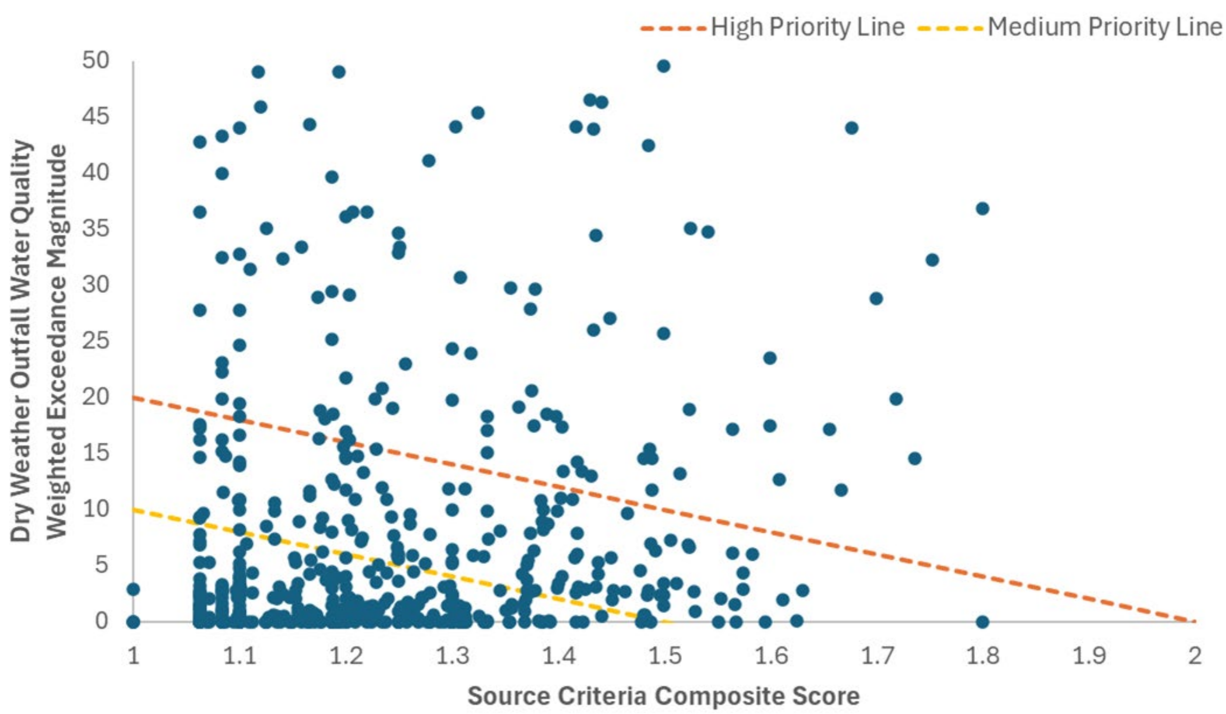


Figure 2-11. Outfall Water Quality Percent Exceedance of Benchmarks During Dry Weather versus Source Criteria Composite Scores. (note: weighted exceedance magnitudes above 50 not displayed)

2.3.2 Catchment Prioritization Results

During dry weather, a total of 35 catchments, distributed throughout the Los Angeles River watershed, were identified as highest priority. The distribution of catchment priorities under each weather condition are summarized in Table 2-5. Figure 2-12 presents the dry weather catchment prioritization results. Figure 2-13 presents the wet weather catchment prioritization results. Compared to the original LRS priority and outlier outfalls identified, certain catchments remained as high priorities, whereas others dropped to lower priorities. Conversely, areas not previously identified as a priority in the original LRS were identified as a higher priority under this revised framework, focused on addressing risk. The comparison to the original LRS priorities is shown in Figure 2-14 and Figure 2-15. Ultimately, the catchment prioritization results were used to define Areas of Investigation (AOIs) for each segment and tributary, for which implementation actions will be identified. The definition of the AOIs is discussed further in the below subsection.

Table 2-5. Distribution of Catchment Priorities in the ULAR Watershed.

Category	Number of Catchments	
	Dry Weather	Wet Weather
Highest Priority	35	NA[1]
High Priority	115	1,243
Medium Priority	181	374
Low Priority	196	148
Lowest Priority	1,241	NA[1]
Insufficient Data[2]	67	70

1: Not applicable due to lack of outfall water quality data during wet weather.
2: Insufficient data is primarily related to direct receiving water catchments, where no outfall discharges but samples were taken at receiving water sites from initial screening events. These are also considered lowest priority areas.

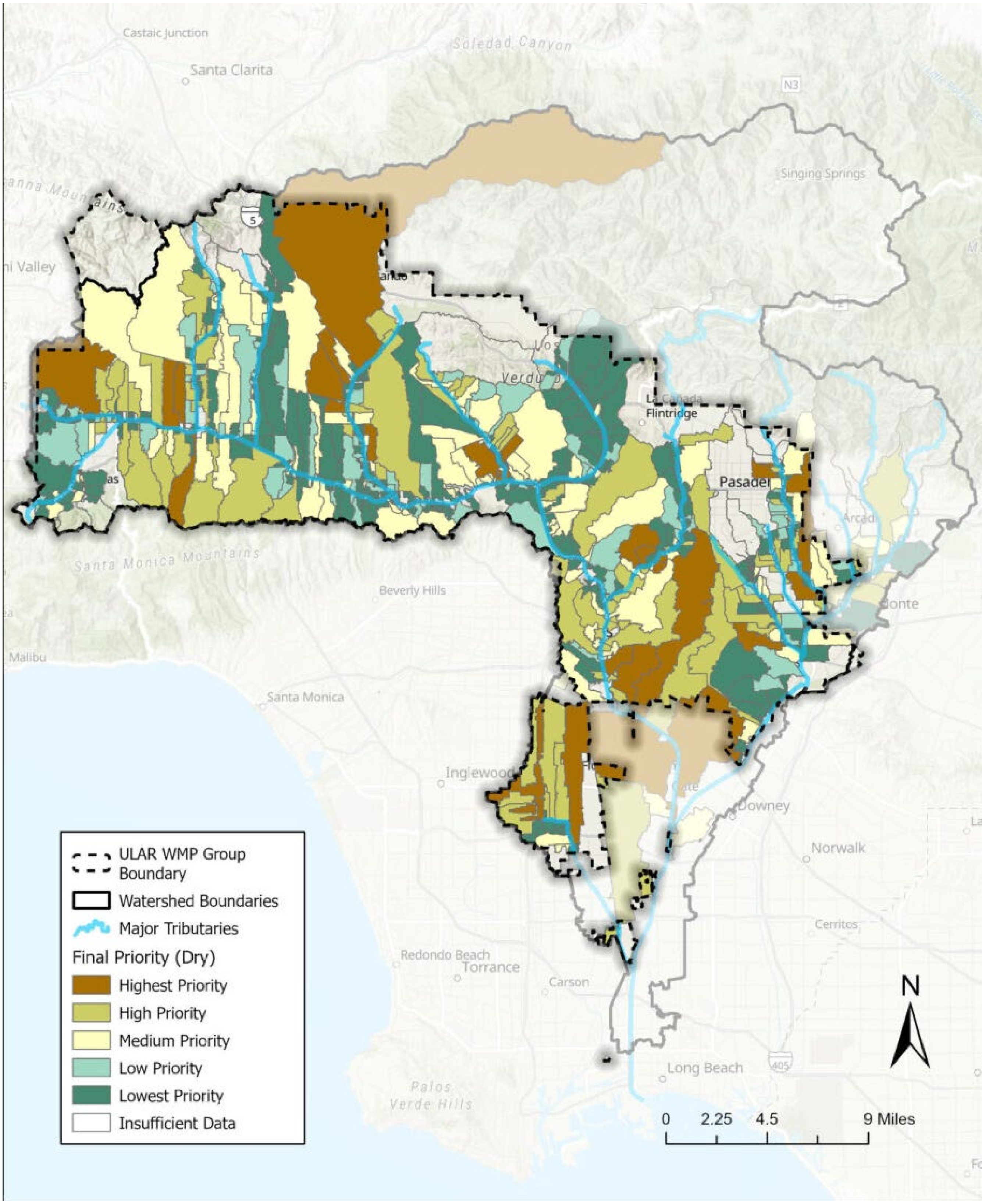


Figure 2-12. Catchment Prioritization Results for Dry Weather.

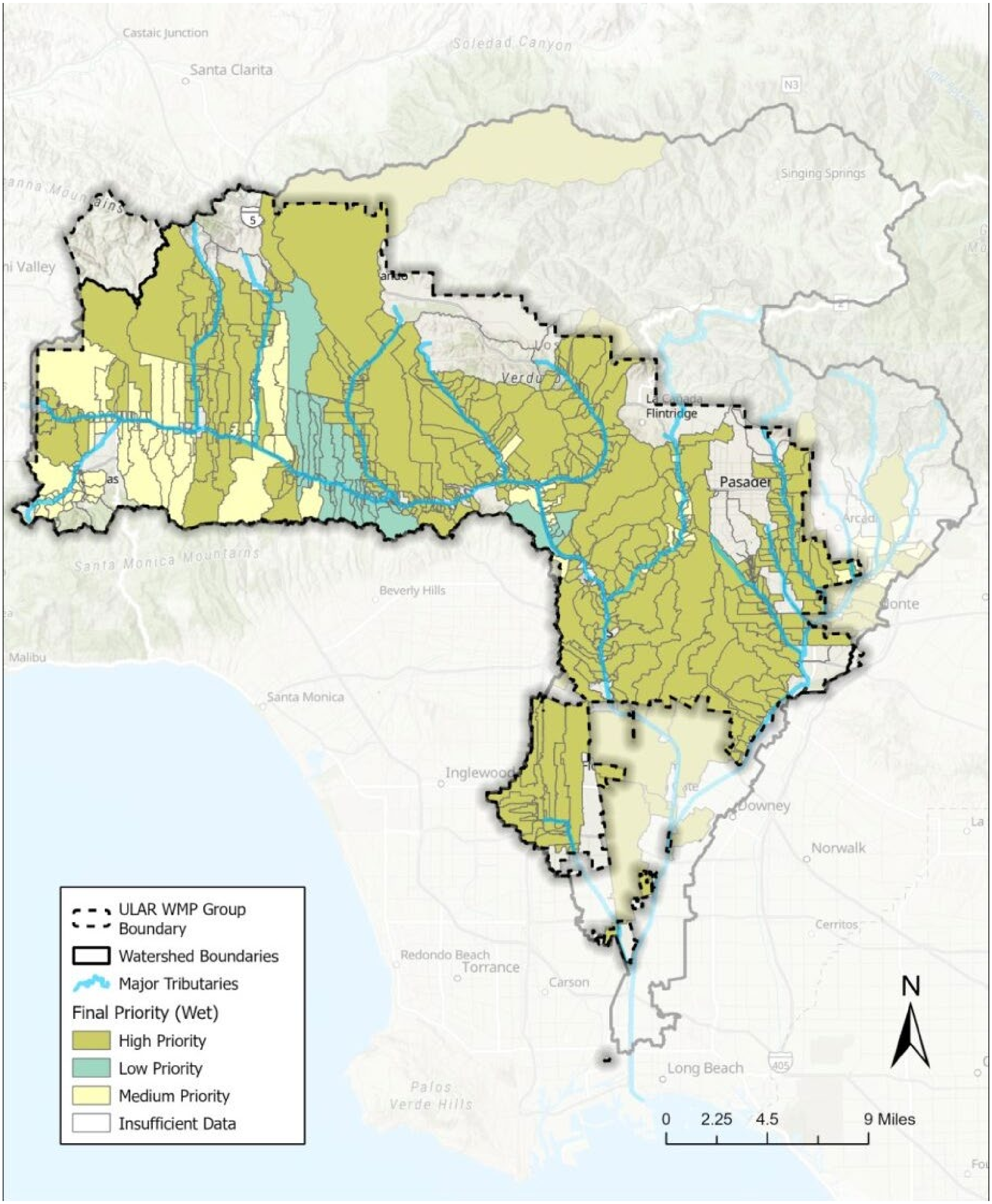


Figure 2-13. Catchment Prioritization Results for Wet Weather.

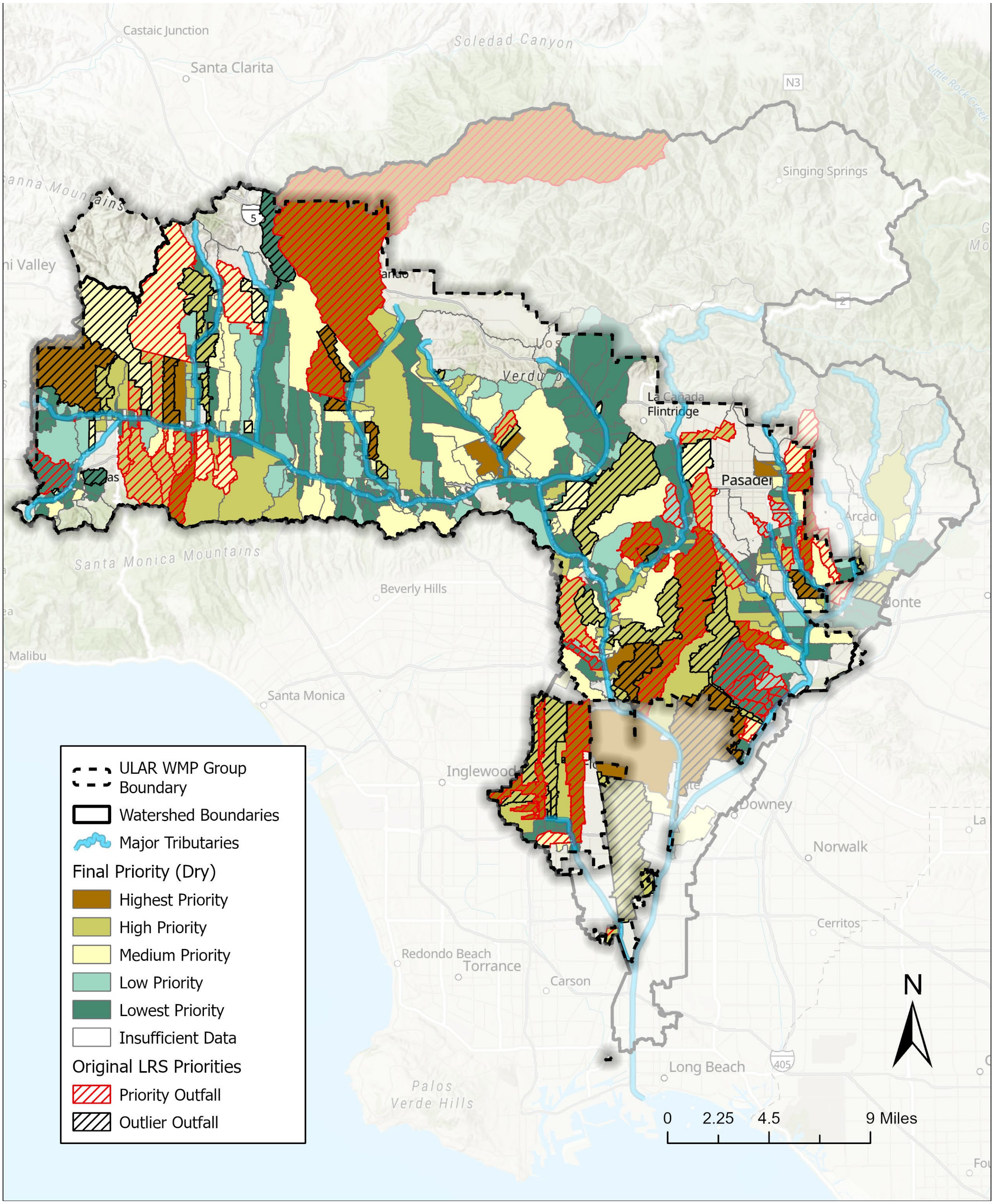


Figure 2-14. Catchment Prioritization Results for Dry Weather Compared to Original LRS Priority and Outlier Outfalls.

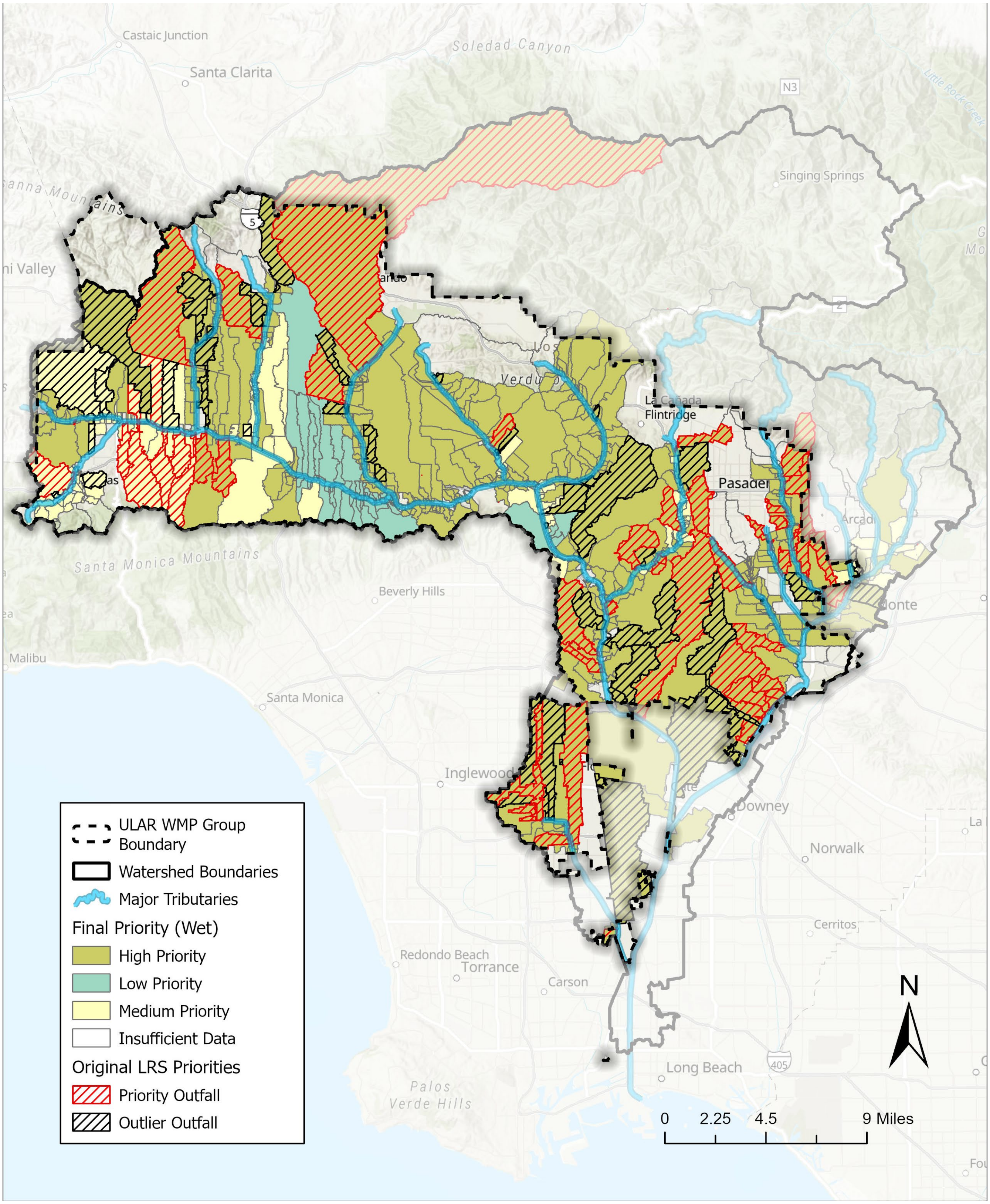


Figure 2-15. Catchment Prioritization Results for Wet Weather Compared to Original LRS Priority and Outlier Outfalls.

Alternative Scenarios

To provide greater confidence in the results of the catchment prioritization, alternative scenarios were investigated that adjusted the methods of the catchment prioritization approach and compared the results. Example scenarios investigated were:

- For the receiving water and outfall water quality condition assessments, only reference data collected within the past five years (rather than the full datasets available)
- If insufficient data available for a source criteria category, assign the average score across all catchments (rather than excluding from the source criteria composite score average)
- Assign the catchment priorities only based on the outfall water quality assessment plots (rather than a combination of the receiving water and outfalls)
- If a catchment is upstream of a planned/proposed LFD or other structural project that diverts flow, automatically assign as the lowest priority during dry weather (rather than only factoring in built projects)

Except for the scenario that factors in all planned/proposed structural projects, the results of the alternative scenarios were very consistent with the primary results of the catchment prioritization. This provides greater confidence in the clear highest priority areas to be addressed. Furthermore, it is encouraging that many of the catchments are upstream of a planned/proposed project that can further support progress towards attaining the recreational beneficial use objectives in downstream receiving waters.

2.4 Areas of Investigation (AOIs)

Based on the catchment prioritization results, AOIs were delineated for each segment and tributary. AOIs are clusters of the individual catchments primarily grouped for the purpose of implementing efficient and effective source investigations, discussed in Section 2.5. A combination of spatial analysis, considering the proximity of outfalls and the total area of the combined catchments, and best professional judgement were implemented to group the higher priority catchments. A Monte Carlo analysis was then conducted to identify which AOIs would need to be addressed to meet the TMDL-associated Waste Load Allocations (WLAs) for *E. coli*. The Monte Carlo analysis was consistent with the approach of the original LRS reports, based on the measured outfall *E. coli* concentrations and flows to estimate *E. coli* loading rates. Section 2.4.1 details the Monte Carlo analysis and results for each segment and tributary for the ULAR Group. From this process 24 total AOIs were identified, comprising 69 outfall catchments. Figure 2-16 shows the location of these AOIs and Table 2-6 summarizes the number of AOIs and number of outfall catchments comprising these AOIs within each segment and tributary. The details of each AOI, including the outfall catchment areas comprising the AOI, their respective dry and wet weather catchment priorities, and calculated segment or tributary *E. coli* loading after addressing an outfall based on the Monte Carlo model runs, are listed in Table 2-7. Table 2-7 also identifies if any portion of the outfall catchment area drains to a completed or proposed structural project that could contribute to reducing bacteria loads from the area. For AOIs with a significant portion of the area expected to be addressed by a structural project, these projects will be identified as the priority implementation action, while other areas will focus first on implementing the source investigations, as outlined in Section 2.5. As outlined in Figure 2-1, an AOI may be addressed through implementation of a structural project or through the source investigation and control framework detailed in Section 2.5. If project challenges arise or designs change impacting the effectiveness of a planned structural project, then agencies may pursue source investigation efforts in these areas as well as consider other structural project alternatives. Table 2-7 also identifies the responsible agencies and respective proportions of the jurisdictional area within the catchment. The catchment prioritization and delineating of AOIs was completed on a watershed-scale for consistency with the driving intent of the Bacteria TMDL to protect the REC-1 beneficial use in the receiving waters. Therefore, select AOIs include portions of jurisdictions outside the ULAR WMA. The ULAR agencies are only responsible for addressing their contributions to the AOI, but will notify adjacent cities of any findings of the AOIs and encourage a collaborative effort, as discussed further in Sections 2.5 and 3.5.

As additional information is gathered through these efforts, the catchment prioritization and defined AOIs are subject to refinement through the adaptive management process in order to reflect the best available information.

Table 2-6. Summary of AOIs Identified.

Segment/Tributary	Number of AOIs	Number of Outfall Catchments	Total Area (acres)
Segment B Mainstem	1	4	2,559.05
Arroyo Seco	2	4	2,065.58
Rio Hondo	5	18	8,540.85
Compton Creek	2	3	4,109.72
Segment E Mainstem	3	11	8,659.17
Aliso Canyon Wash	1	2	90.78
Bell Creek	1	1	26.24
Dry Canyon	*NA – baseline load below WLA*		
McCoy Canyon	2	4	1,932.89
Segment C Mainstem	*NA – baseline load below WLA*		
Burbank Western Channel	2	9	515.61
Tujunga Wash	4	11	40,435.84
Verdugo Wash	*NA – baseline load below WLA*		
Segment D Mainstem	*NA – baseline load below WLA*		
Bull Creek	1	2	39.46

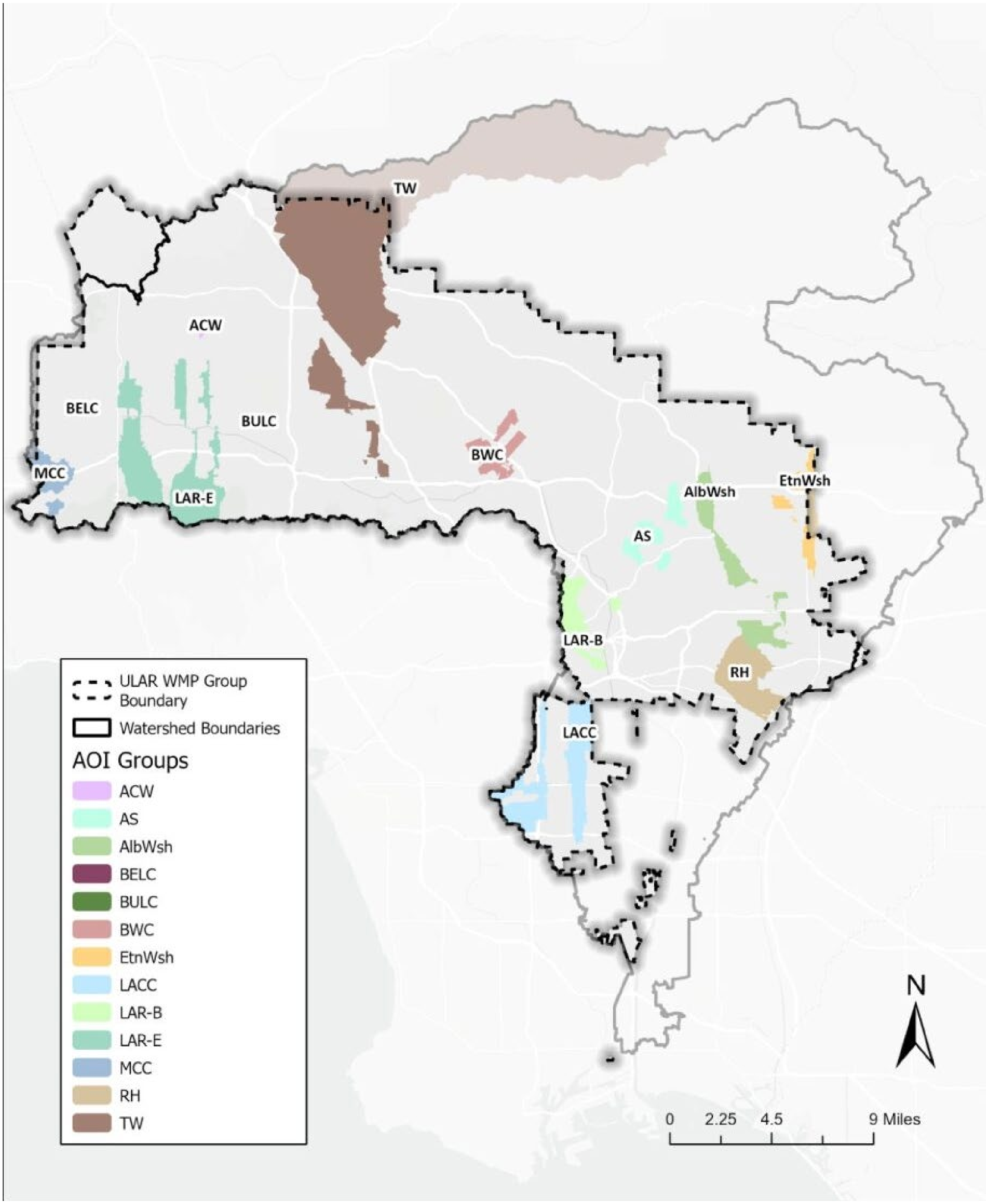


Figure 2-16. AOIs Identified based on the Catchment Prioritization.

Table 2-7. AOI Details.

AOI Number ID	Outfall ID	Dry Weather Catchment Priority	Wet Weather Catchment Priority	Segment/Tributary *E. coli* Load After Outfall Addressed (billion MPN/day)	Structural Projects in Catchment Area (Status)	Responsible Agencies (Percent of Catchment Area)	Drainage Area (acres)	Original LRS Priority/ Outlier
Segment B: *E. coli* WLA = 285 billion MPN/day; Baseline = 929 billion MPN/day								
LAR-B_AOI_1	LAR-B-R2-K	High Priority	High Priority	798.8	7th Street LFD (built)	Los Angeles (100%)	444.63	Priority
	LAR-B-R2-A	High Priority	High Priority	409.3	Ed P. Reyes (built) Albion Riverside Park (built)	Los Angeles (100%)	162.70	Priority
	LAR-B-R2-02	High Priority	High Priority	317.3	2nd Street LFD (built) City Hall North Lawn (built)	Los Angeles (100%)	1933.32	Priority
	LAR-B-R2-J	Medium Priority	High Priority	247.8	Palmetto Street LFD (built)	Los Angeles (100%)	18.40	
Arroyo Seco: *E. coli* WLA = 16.4 billion MPN/day; Baseline = 61 billion MPN/day								
AS_AOI_1	AS-15	Highest Priority	High Priority	44	Sycamore Grove Park (built)	Los Angeles (100%)	1133.93	Priority
	AS-21	Highest Priority	High Priority	28	Herman Dog Park (built)	Los Angeles (100%)	147.78	Priority
	AS-22	Highest Priority	High Priority	25	Herman Dog Park (built)	Los Angeles (100%)	86.59	Priority
AS_AOI_2	AS-41	Low Priority	High Priority	13	Garvanza Park (built) San Rafael Treatment Wetlands (design) Arroyo Seco Golf Course (design) Lower Arroyo Park (design)	Pasadena (98.8%) Los Angeles (1.2%)	697.28	Priority
Rio Hondo: *E. coli* WLA = 42.6 billion MPN/day; Baseline = 284.8 billion MPN/day								
RH_AOI_1	RH-078	Highest Priority	High Priority	228.7	East L.A. Sustainable Median (built)	Monterey Park (58.5%) Montebello (40.4%) Unincorporated County (1.2%)	2708.11	Priority
	RH-090	High Priority	High Priority	220.5	East L.A. Sustainable Median (built)	Montebello (100%)	949.81	Priority
	RH-092	High Priority	High Priority	217.0		Montebello (100%)	132.76	Priority
	RH-085	Medium Priority	High Priority	210.0		Montebello (100%)	23.79	

Upper Los Angeles River: Load Reduction Strategy Adaptation Plan

AOI Number ID	Outfall ID	Dry Weather Catchment Priority	Wet Weather Catchment Priority	Segment/Tributary *E. coli* Load After Outfall Addressed (billion MPN/day)	Structural Projects in Catchment Area (Status)	Responsible Agencies (Percent of Catchment Area)	Drainage Area (acres)	Original LRS Priority/ Outlier
EtnWsh_AOI_1	EtnWsh-132	Highest Priority	High Priority	188.6	Eaton Wash Dry-Weather Diversion (design) Sierra Madre Boulevard Green Street (design)	Pasadena (57.3%) Temple City (32.5) Unincorporated County (10.3%) Outside ULAR WMA (31.7%)	1780.13	Priority
	EtnWsh-155	Low Priority	High Priority	188.6	Eaton Wash Dry-Weather Diversion (design)	Pasadena (78.2%) Unincorporated County (21.8%)	183.79	Priority
	EtnWsh-112	Low Priority	High Priority	188.6	Eaton Wash Dry-Weather Diversion (design)	Unincorporated County (100%)	0.00	
	EtnWsh-133	Low Priority	High Priority	188.6	Eaton Wash Dry-Weather Diversion (design)	Unincorporated County (98.1%) Pasadena (1.9%)	19.70	
	EtnWsh-159	High Priority	High Priority	188.5	Eaton Wash Dry-Weather Diversion (design)	Pasadena (100%)	86.68	
AlbWsh_AOI_1	AlbWsh-101	Low Priority	High Priority	185.2	Alhambra Wash Dry Weather Diversion (design)	San Gabriel (78.3%) Rosemead (21.7%)	10.11	
	AlbWsh-143	Medium Priority	High Priority	155.1	Alhambra Wash Dry Weather Diversion (design)	San Gabriel (100%)	5.62	Outlier
	AlbWsh-64	Medium Priority	High Priority	155.1	Alhambra Wash Dry Weather Diversion (design)	Rosemead (100%)	2.17	
	AlbWsh-72	High Priority	High Priority	155.1	Alhambra Wash Dry Weather Diversion (design)	San Gabriel (100%)	156.31	
AlbWsh_AOI_2	AlbWsh-03	Highest Priority	High Priority	142.2	Alhambra Wash Dry Weather Diversion (design)	Monterey Park (63.5%) Unincorporated County (24.5%) Rosemead (12.0%)	865.77	Priority
	AlbWsh-36	High Priority	High Priority	139.6	Alhambra Wash Dry Weather Diversion (design)	Rosemead (100%)	69.85	
	AlbWsh-57	High Priority	High Priority	136.5	Alhambra Wash Dry Weather Diversion (design)	Rosemead (55.7%) Monterey Park (44.3%)	273.40	
	AlbWsh-19	High Priority	High Priority	136.5	Alhambra Wash Dry Weather Diversion (design)	Rosemead (100%)	2.82	
AlbWsh_AOI_3	AlbWsh-179	High Priority	High Priority	23.8	Alhambra Wash Dry Weather Diversion (design)	Pasadena (53.6) Alhambra (31.5%) South Pasadena (8.9%) San Marino (5.9%)	2221.68	Priority

Upper Los Angeles River: Load Reduction Strategy Adaptation Plan

AOI Number ID	Outfall ID	Dry Weather Catchment Priority	Wet Weather Catchment Priority	Segment/Tributary *E. coli* Load After Outfall Addressed (billion MPN/day)	Structural Projects in Catchment Area (Status)	Responsible Agencies (Percent of Catchment Area)	Drainage Area (acres)	Original LRS Priority/ Outlier
Compton Creek: *E. coli* WLA = 4.1 billion MPN/day; Baseline = 53 billion MPN/day								
LACC_AOI_1	LACC-155	Highest Priority	High Priority	29.7	Broadway Neighborhood Stormwater Greenway (built) Westmont/Vermont Avenue Green Improvement (design) Broadway-Manchester Green Streets Project (design)	Los Angeles (92.0%) Unincorporated County (5.6%) Outside ULAR WMA (2.4%)	1927.03	Priority
	LACC-154	High Priority	High Priority	28.6	Westmont/Vermont Avenue Green Improvement (design) Broadway-ManchesterGreen Streets Project (design)	Unincorporated County (50.9%) Los Angeles (48.4%) Outside ULAR WMA (0.7%)	898.40	
LACC_AOI_2	LACC-105	Highest Priority	High Priority	0	South Los Angeles Wetlands Park (built) Franklin D. Roosevelt Park Regional Project (built)	Los Angeles (54.5%) Unincorporated County (45.2%) Outside ULAR WMA (0.3%)	3136.06	Priority
Segment E: *E. coli* WLA = 24.4 billion MPN/day; Baseline = 194 billion MPN/day								
LAR-E_AOI_1	LAR-E-096	High Priority	Medium Priority	171.5	Pierce College NE Campus Stormwater Capture (design)	Los Angeles (100%)	2272.13	Priority
	LAR-E-110	High Priority	Medium Priority	157.6		Los Angeles (100%)	620.26	Priority
	LAR-E-097	High Priority	Medium Priority	128.5		Los Angeles (100%)	450.90	Priority
	LAR-E-101	Lowest Priority	Medium Priority	128.4		Los Angeles (100%)	56.94	
	LAR-E-099	Lowest Priority	Medium Priority	125.8		Los Angeles (100%)	51.39	
	LAR-E-109	High Priority	High Priority	122.2		Los Angeles (100%)	468.71	
LAR-E_AOI_2	LAR-E-050	High Priority	High Priority	115.9		Los Angeles (100%)	421.54	Outlier
	LAR-E-038	High Priority	High Priority	115.1		Los Angeles (100%)	11.73	
	LAR-E-036	High Priority	High Priority	112.5	Cabellero Creek Confluence Park (design)	Los Angeles (100%)	2219.17	
LAR-E_AOI_3	LAR-E-058	Highest Priority	Medium Priority	74.2	Cabellero Creek Confluence Park (design)	Los Angeles (100%)	1312.72	Priority

Upper Los Angeles River: Load Reduction Strategy Adaptation Plan

AOI Number ID	Outfall ID	Dry Weather Catchment Priority	Wet Weather Catchment Priority	Segment/Tributary *E. coli* Load After Outfall Addressed (billion MPN/day)	Structural Projects in Catchment Area (Status)	Responsible Agencies (Percent of Catchment Area)	Drainage Area (acres)	Original LRS Priority/ Outlier
	LAR-E-066	Highest Priority	Medium Priority	6.9		Los Angeles (100%)	785.42	
Aliso Canyon Wash: *E. coli* WLA = 23 billion MPN/day; Baseline = 34.6 billion MPN/day								
ACW_AOI_1	ACW-040	High Priority	High Priority	31.6		Los Angeles (100%)	90.77	
	ACW-048	High Priority	High Priority	0		Los Angeles (100%)	63.91	Outlier
Bell Creek: *E. coli* WLA = 14 billion MPN/day; Baseline = 15.2 billion MPN/day								
BELC_AOI_1	BELC-032	High Priority	High Priority	10.7		Los Angeles (100%)	26.24	
Dry Canyon Creek: *E. coli* WLA = 7 billion MPN/day; Baseline = 4.2 billion MPN/day								
Baseline loading already below WLA								
McCoy Canyon Creek: *E. coli* WLA = 7 billion MPN/day; Baseline = 35.9 billion MPN/day								
MCC_AOI_1	MCC-015.55	Medium Priority	Medium Priority	35.3		Calabasas (100%)	258.29	
	MCC-014	Medium Priority	Medium Priority	34.7		Calabasas (100%)	46.15	Outlier
MCC_AOI_2	MCC-008	Low Priority	NA	9.3		Los Angeles (100%)	0.03	Priority
	MCC-006	Lowest Priority	Medium Priority	1.1		Hidden Hills (50.8%) Calabasas (18.5) Unincorporated County (14.0%) Los Angeles (4.6%) Outside ULAR WMA (12.1%)	1628.41	Priority
Segment C: *E. coli* WLA = 463 billion MPN/day; Baseline = 423 billion MPN/day								
Baseline loading already below WLA								
Burbank Western Channel: *E. coli* WLA = 86 billion MPN/day; Baseline = 468 billion MPN/day								
BWC_AOI_1	BWC-020	Highest Priority	Medium Priority	463.8		Burbank (96.1%) Glendale (3.9%)	351.03	
	BWC-002	Highest Priority	High Priority	458.1		Los Angeles (100%)	56.96	
	BWC-001	Highest Priority	High Priority	449.0		Glendale (94.4%) Los Angeles (5.6%)	53.96	
	BWC-003	Highest Priority	High Priority	448.8		Burbank (98.5%) Los Angeles (0.9%) Glendale (0.6%)	981.82	

Upper Los Angeles River: Load Reduction Strategy Adaptation Plan

AOI Number ID	Outfall ID	Dry Weather Catchment Priority	Wet Weather Catchment Priority	Segment/Tributary *E. coli* Load After Outfall Addressed (billion MPN/day)	Structural Projects in Catchment Area (Status)	Responsible Agencies (Percent of Catchment Area)	Drainage Area (acres)	Original LRS Priority/ Outlier
	BWC-005	Highest Priority	Medium Priority	438.7		Burbank (72.4%) Glendale (27.6%)	34.80	
	BWC-013	Highest Priority	Medium Priority	438.8		Burbank (88.8%) Glendale (11.2%)	8.55	
	BWC-018	Highest Priority	Medium Priority	439.5		Burbank (100%)	10.29	
	BWC-025	Highest Priority	Medium Priority	437.7		Burbank (100%)	0.02	
BWC_AOI_2	BWC-042	High Priority	High Priority	19.3		Burbank (100%)	388.02	Priority
Tujunga Wash: *E. coli* WLA = 10 billion MPN/day; Baseline = 68.9 billion MPN/day								
TW_AOI_1	TW-110	High Priority	High Priority	68.6	San Fernando Gardens (built) David M. Gonzales Recreation Center Project (design)	Los Angeles (100%)	713.64	
TW_AOI_2	TW-040	Highest Priority	High Priority	66.3	Victory-Goodland Median (built) Valley Village Park Stormwater Capture Project (design)	Los Angeles (100%)	433.58	Outlier
	TW-034	Highest Priority	High Priority	65.5		Los Angeles (100%)	18.16	
	TW-018	High Priority	High Priority	63.3	Valley Village Park Stormwater Capture Project (design)	Los Angeles (100%)	201.09	Outlier
	TW-021	High Priority	High Priority	58.1		Los Angeles (100%)	3.62	
TW_AOI_3	TW-079	Highest Priority	High Priority	44.9	Woodman Avenue Multi-Beneficial Stormwater Capture (built) Metro Orange Line Infiltration Project (design)	Los Angeles (100%)	1732.87	Priority
	TW-075	Highest Priority	High Priority	43.5	Metro Orange Line Infiltration Project (design)	Los Angeles (100%)	291.40	Outlier
	TW-074	High Priority	High Priority	39.3		Los Angeles (100%)	17.23	Outlier
	TW-078	High Priority	High Priority	39.2	Metro Orange Line Infiltration Project (design)	Los Angeles (100%)	45.35	

Upper Los Angeles River: Load Reduction Strategy Adaptation Plan

AOI Number ID	Outfall ID	Dry Weather Catchment Priority	Wet Weather Catchment Priority	Segment/Tributary *E. coli* Load After Outfall Addressed (billion MPN/day)	Structural Projects in Catchment Area (Status)	Responsible Agencies (Percent of Catchment Area)	Drainage Area (acres)	Original LRS Priority/ Outlier
	TW-072	High Priority	High Priority	39.2	Valley Village Park Stormwater Capture Project (design)	Los Angeles (100%)	225.55	
TW_AOI_4	TW-105	Highest Priority	High Priority	0	Laurel Canyon Blvd Green Street (built) Canterbury Powerline Easement Stormwater Capture (built) Bradley Green Alley (built) San Fernando Gardens (built) San Fernando High School & Middle School (built) Haddon Ave Elementary School (built) Glenoaks-Filmore (built) San Fernando Regional Park Infiltration Project (design) David M. Gonzales Recreation Center Project (design)	Los Angeles (31.8%) San Fernando (4.1%) Unincorporated County (3.9%) Outside ULAR WMA (60.2%)	37408.81	Priority
Verdugo Wash: *E. coli* WLA = 51 billion MPN/day; Baseline = 41.7 billion MPN/day								
Baseline loading already below WLA								
Segment D: *E. coli* WLA = 454 billion MPN/day; Baseline = 197 billion MPN/day								
Baseline loading already below WLA								
Bull Creek: *E. coli* WLA = 9 billion MPN/day; Baseline = 9.1 billion MPN/day								
BULC_AOI_1	BULC-004	High Priority	Medium Priority	8.6		Los Angeles (100%)	15.95	
	BULC-002	Medium Priority	Medium Priority	8.6		Los Angeles (100%)	23.51	

2.4.1 Monte Carlo Analysis

A Monte Carlo model was used to evaluate if the identified AOIs are addressed that the associated segment or tributary would meet the WLA for *E. coli* associated with the Bacteria TMDL. The model followed a consistent approach as used in the development of the original LRS's. Simulated loading of *E. coli* from outfalls was based on the flows and *E. coli* concentrations measured during screening events. The log mean and log standard deviation of these measurements across events are used to simulate the cumulative loading from all outfalls in respective segments or tributaries of the LA River. The ULAR-specific WLAs and estimated baseline loadings were pulled directly from original LRS reports, previously submitted to the Regional Board. These are summarized in Table 2-8. To estimate load reductions expected by addressing an AOI (which can be addressed via structural projects and/or source investigations and abatement, as outlined in Figure 2-1), the associated outfalls are sequentially removed from the simulation and the cumulative loading for the segment or tributary is recalculated each time. The model simulations were based on 1,000,000 iterations. The order in which outfalls were sequentially removed was based on (1) catchments that are already addressed through built structural projects or completed source investigations/abatement, (2) highest priority catchments as identified in Section 2.3 and grouped catchments in the same AOI, and finally if additional needed to meet the WLA (3) remaining catchments with the highest estimated *E. coli* loading rates.

Results of the Monte Carlo analysis and the segment/tributary *E. coli* load after the associated outfall is addressed are shown above in Table 2-7. These results are further summarized for each segment and tributary in Figure 2-17 through Figure 2-31. Note for those Figures, the labeled outfall points represent the *E. coli* loading in the segment/tributary after addressing that outfall. Therefore, all labeled outfalls would need to be addressed to meet the final WLAs in respective segments/tributaries.

Table 2-8. *E. coli* Waste Load Allocations and Calculated Baseline Loads for the ULAR WMA.

Segment/Tributary	ULAR WMA Waste Load Allocation (billion MPN/day)[1]	ULAR Baseline Load (billion MPN/day)[1]	ULAR Required Reduction (billion MPN/day)
Segment B	285	929	644
Arroyo Seco	16.4	61.4	45
Rio Hondo[2]	42.6	284.8	242.2
Compton Creek	4.1	53	48.9
Segment E	24.4	194	169.6
Aliso Canyon Wash	23	34.6	11.6
Bell Creek	14	15.2	1.2
Dry Canyon Creek	7	4.2	0
McCoy Canyon Creek	7	35.9	28.9
Segment C	463	423	0
Burbank Western Channel	86	468	382
Tujunga Wash	10	68.9	58.9
Verdugo Wash	51	41.7	0
Segment D	454	197	0
Bull Creek	9	9.1	0.1

1: Based on original LRS reports submitted.

2: Includes Alhambra Wash, Arcadia Wash, Eaton Wash, Rubio Wash, Sawpit Wash, and Upper and Lower mainstems of Rio Hondo

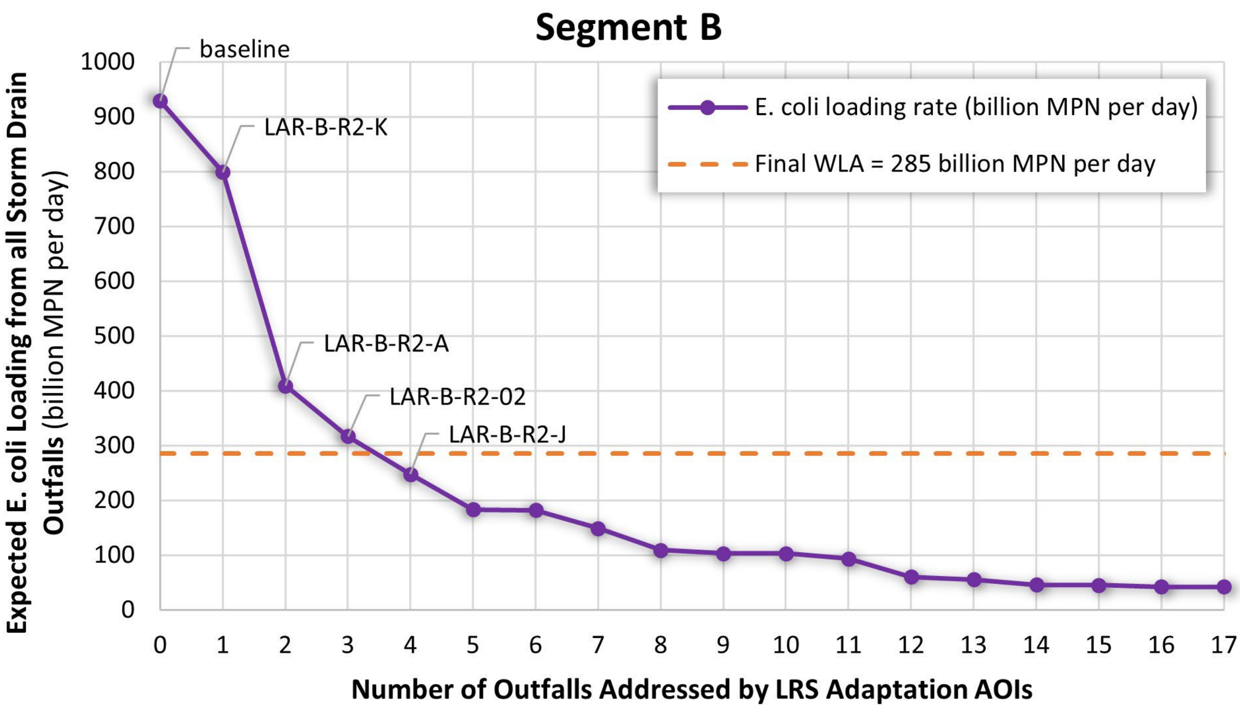


Figure 2-17. Expected *E. coli* Loading for Segment B Following AOI-associated Outfalls Addressed.

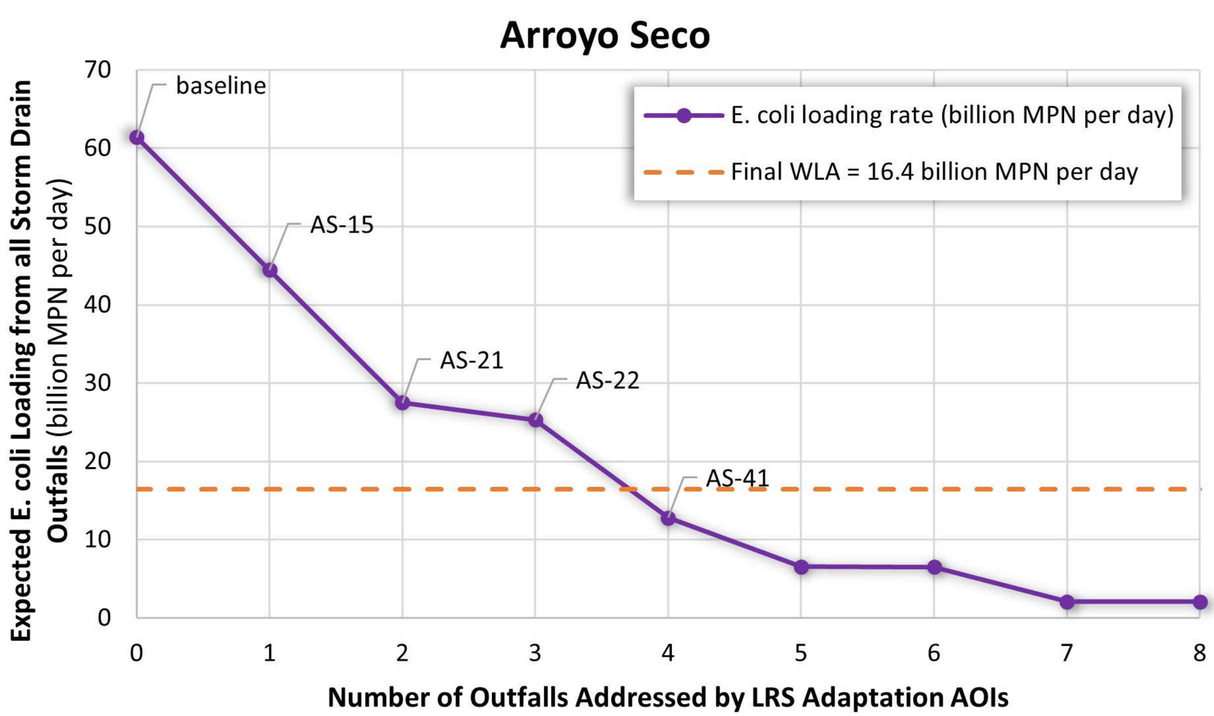


Figure 2-18. Expected *E. coli* Loading for Arroyo Seco Following AOI-associated Outfalls Addressed.

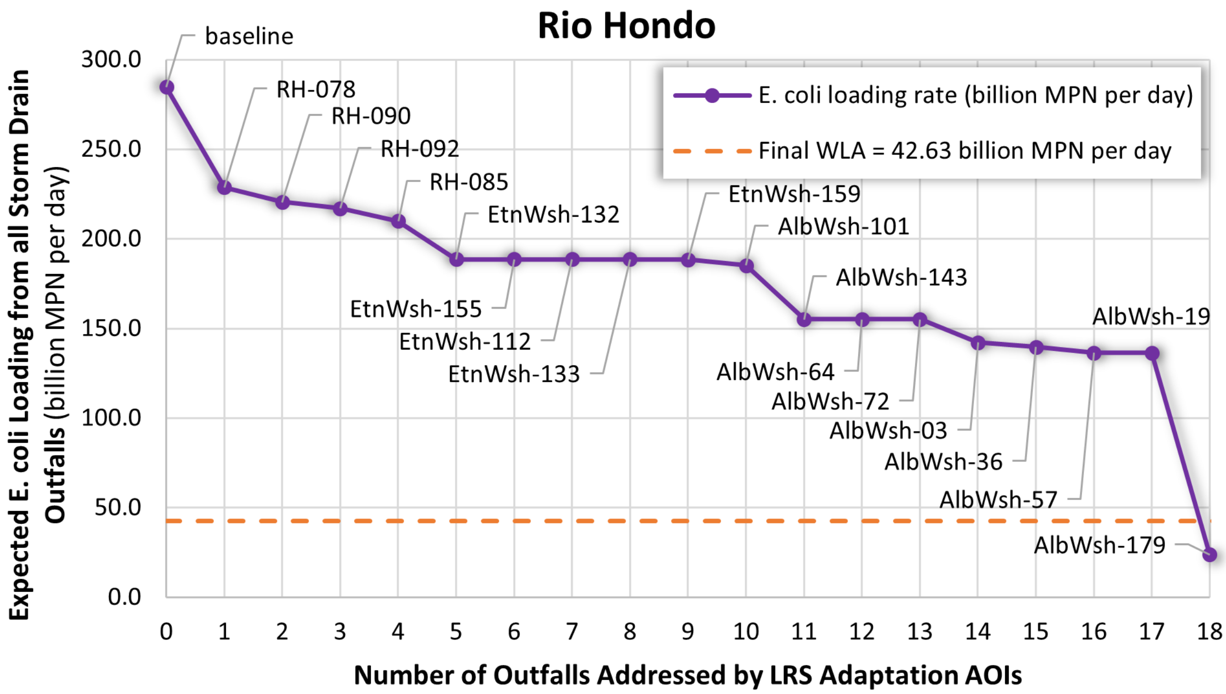


Figure 2-19. Expected *E. coli* Loading for Rio Hondo Following AOI-associated Outfalls Addressed.

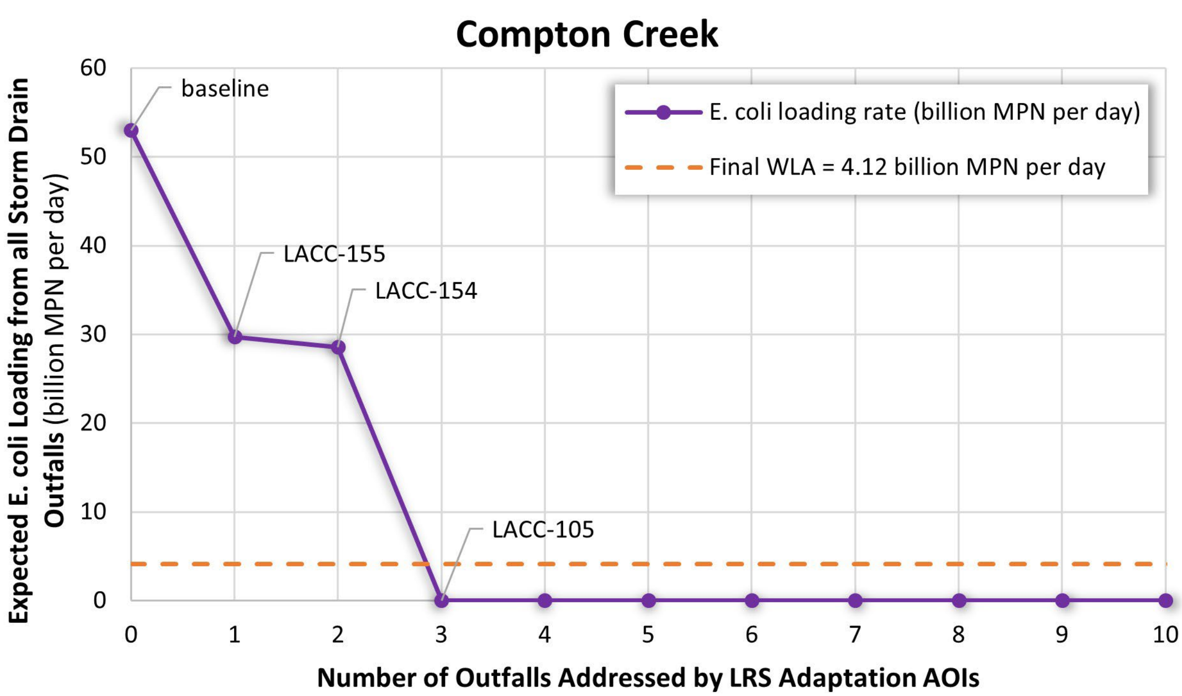


Figure 2-20. Expected *E. coli* Loading for Compton Creek Following AOI-associated Outfalls Addressed.

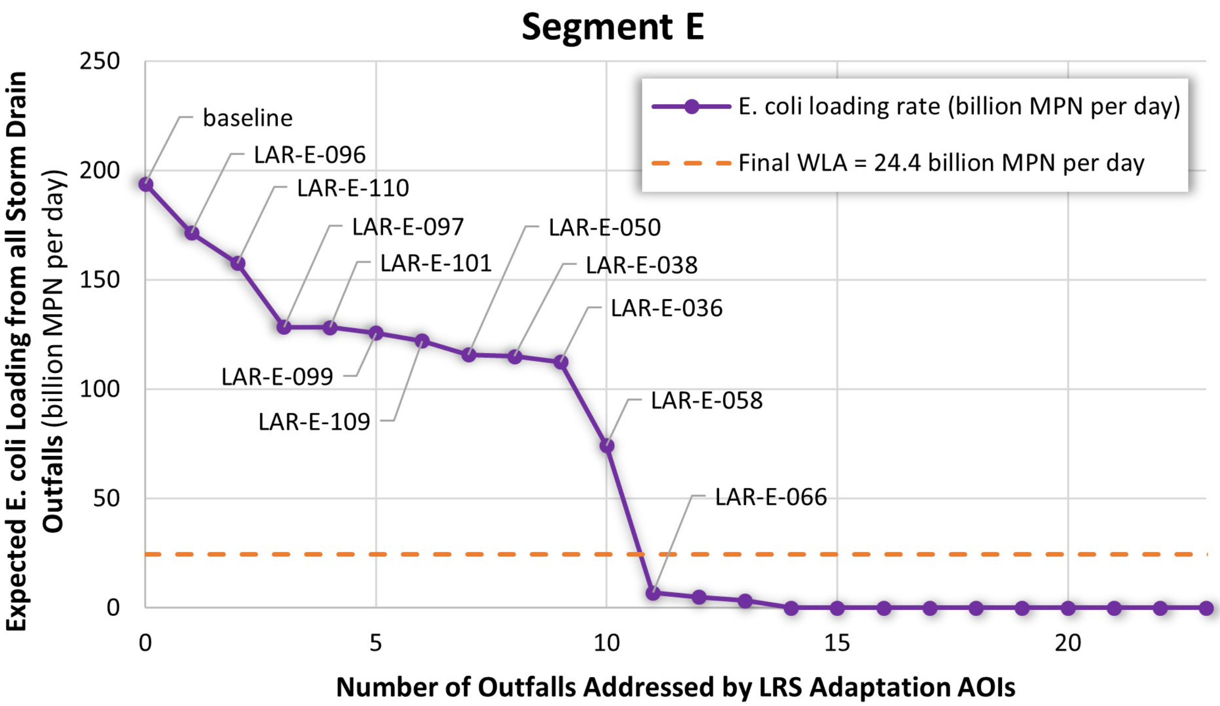


Figure 2-21. Expected *E. coli* Loading for Segment E Following AOI-associated Outfalls Addressed.

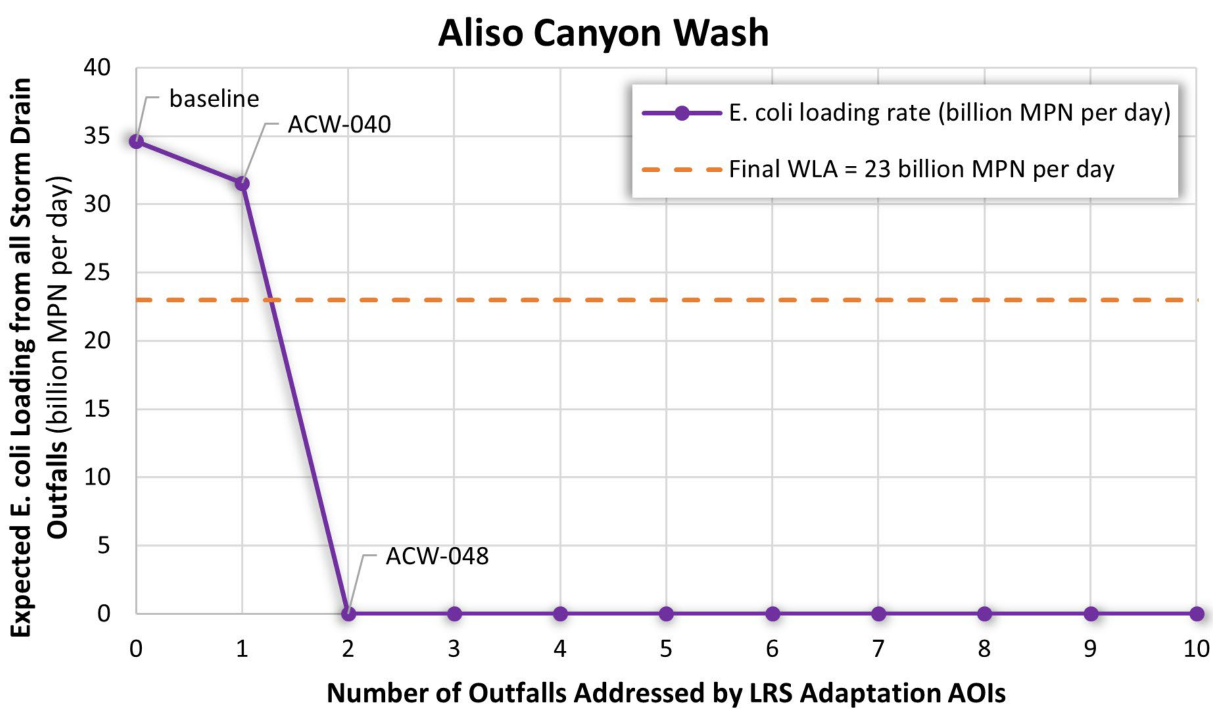


Figure 2-22. Expected *E. coli* Loading for Aliso Canyon Wash Following AOI-associated Outfalls Addressed.

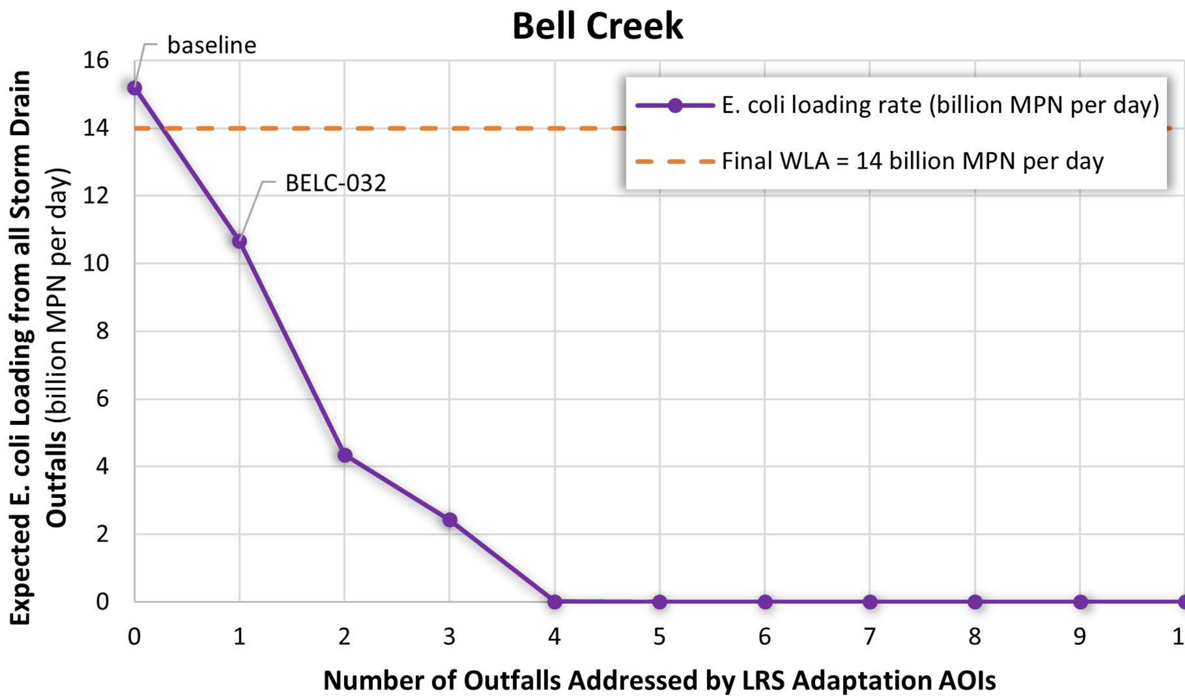


Figure 2-23. Expected *E. coli* Loading for Bell Creek Following AOI-associated Outfalls Addressed.

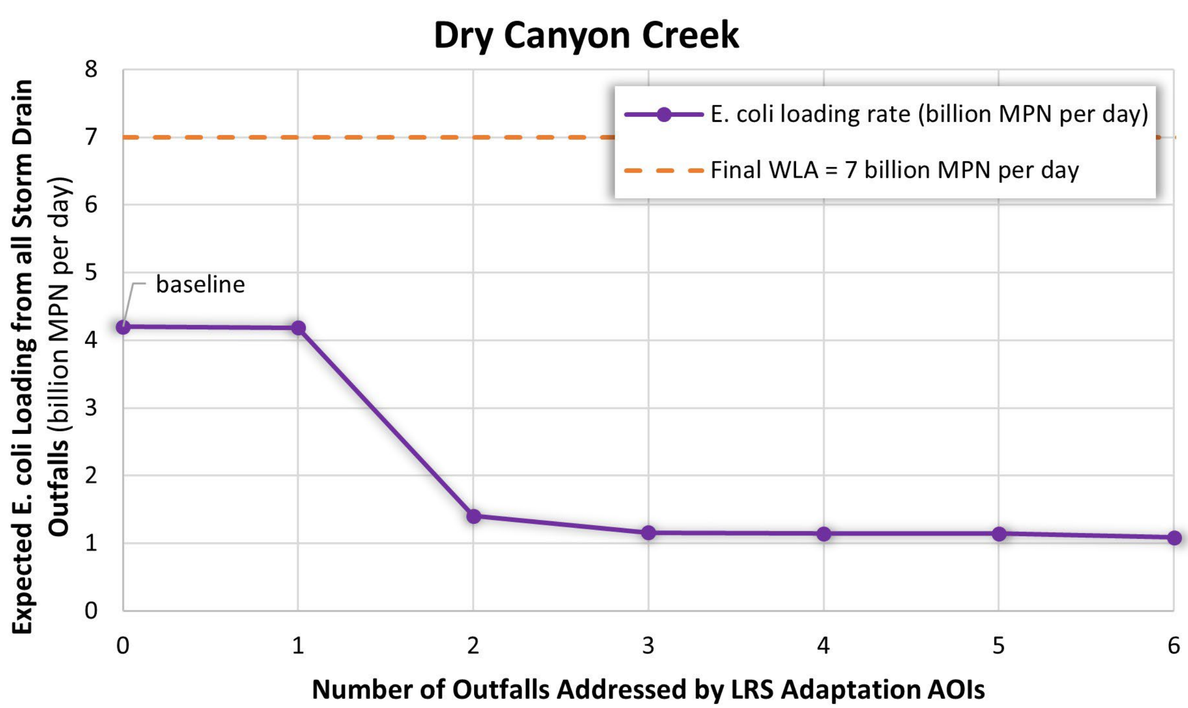


Figure 2-24. Expected *E. coli* Loading for Dry Canyon Creek Following AOI-associated Outfalls Addressed.

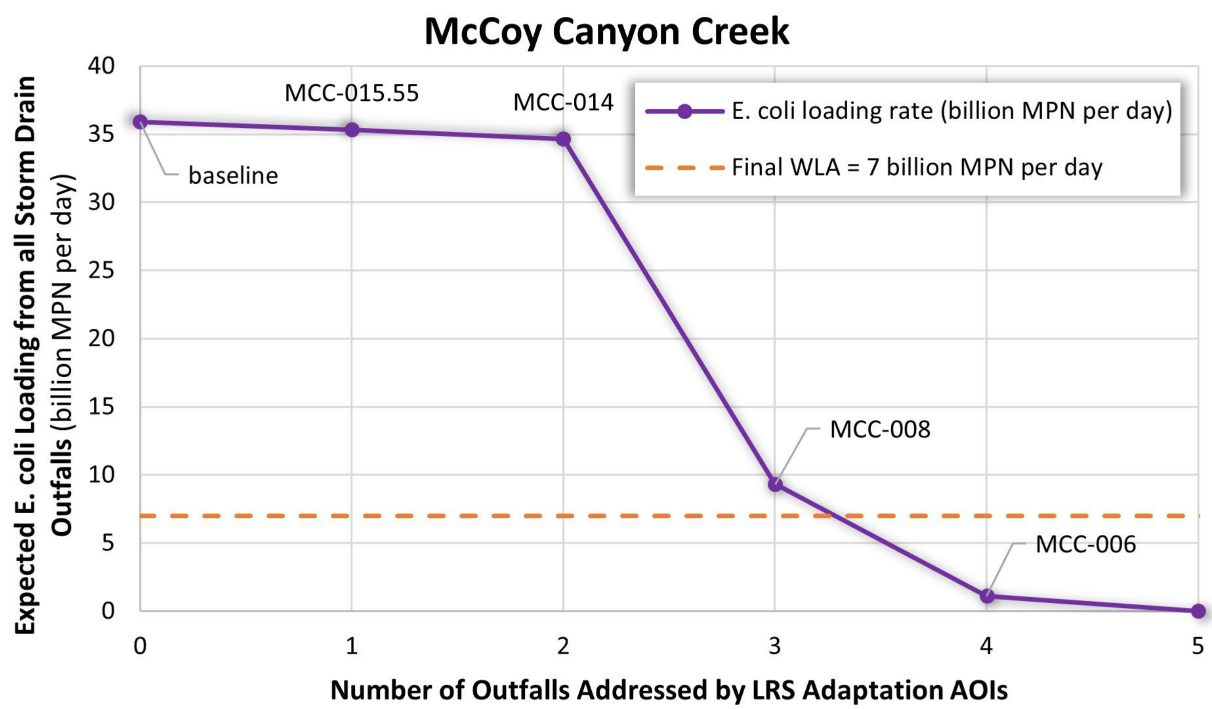


Figure 2-25. Expected *E. coli* Loading for McCoy Canyon Creek Following AOI-associated Outfalls Addressed.

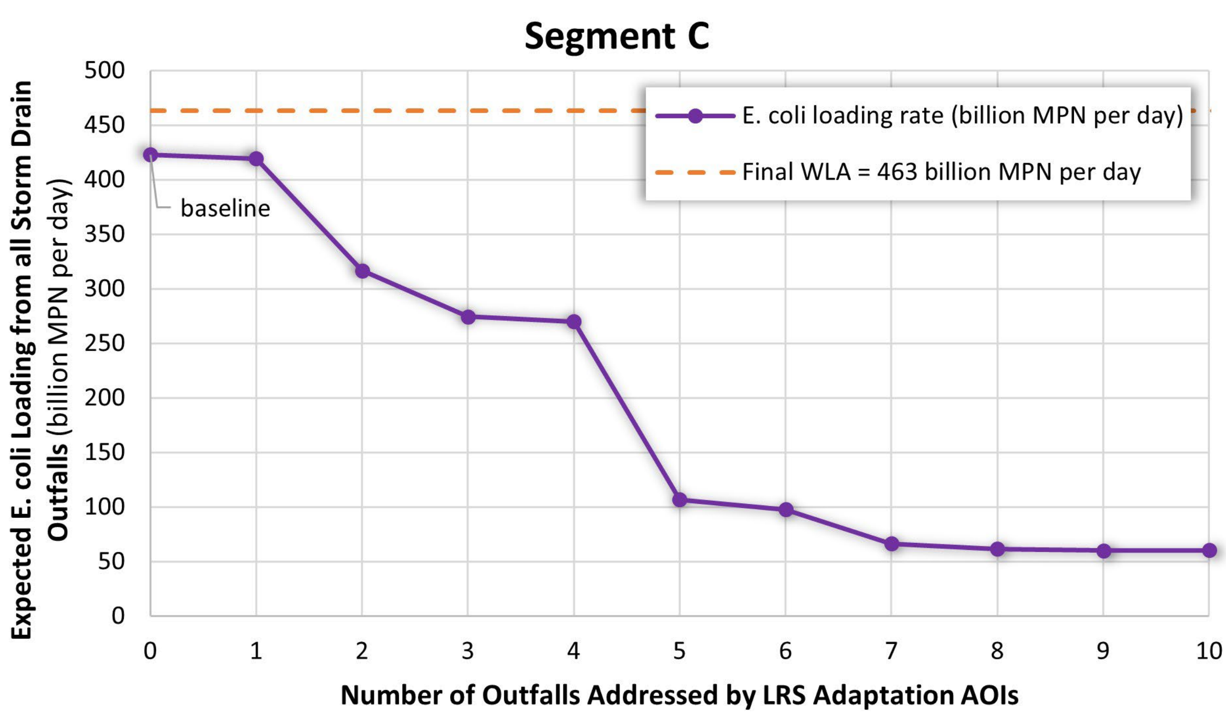


Figure 2-26. Expected *E. coli* Loading for Segment C Following AOI-associated Outfalls Addressed.

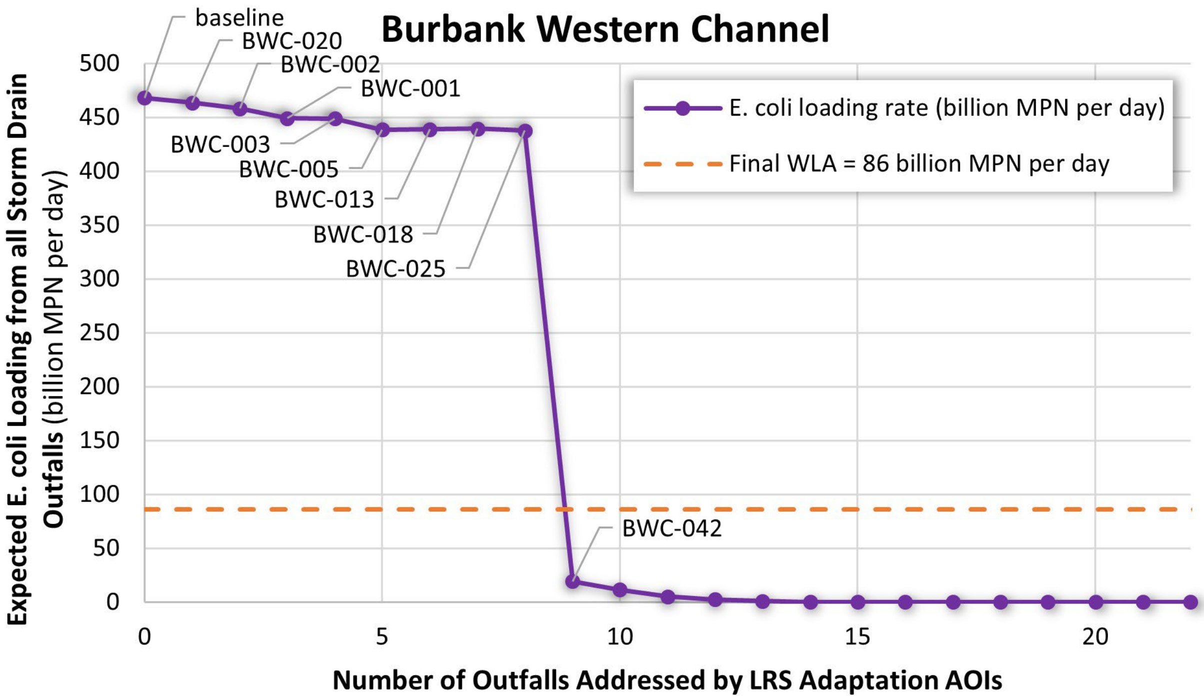


Figure 2-27. Expected *E. coli* Loading for Burbank Western Channel Following AOI-associated Outfalls Addressed.

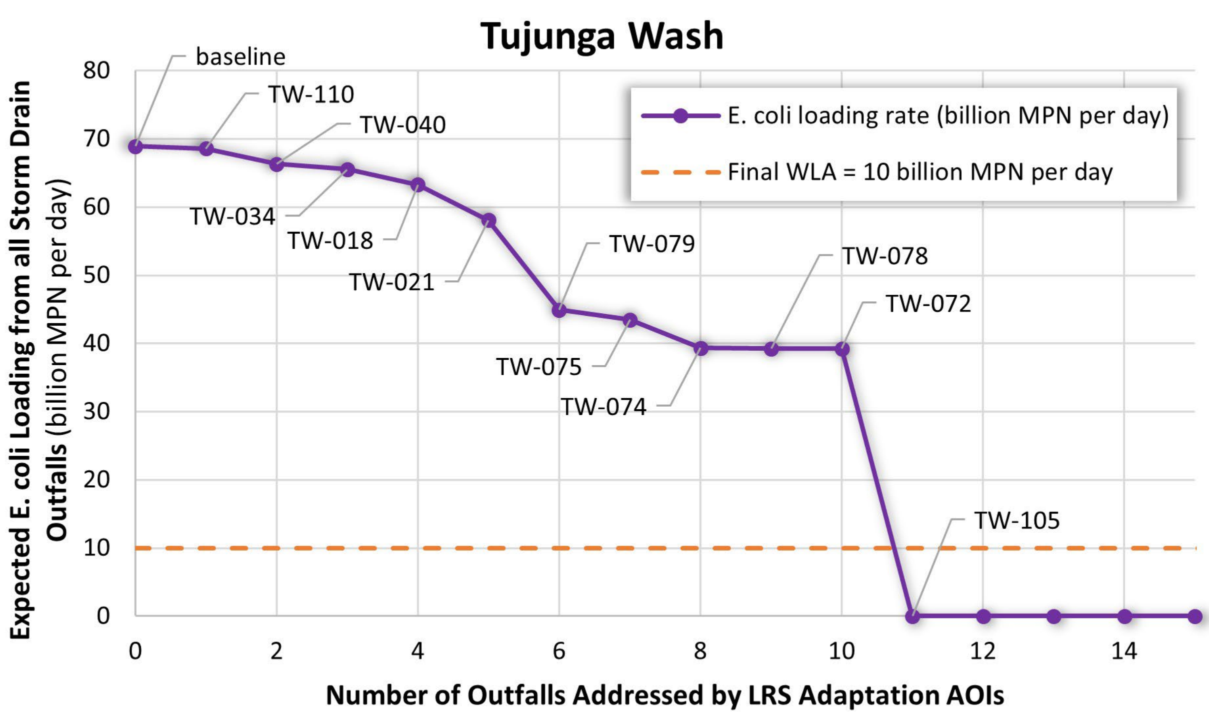


Figure 2-28. Expected *E. coli* Loading for Tujunga Wash Following AOI-associated Outfalls Addressed.

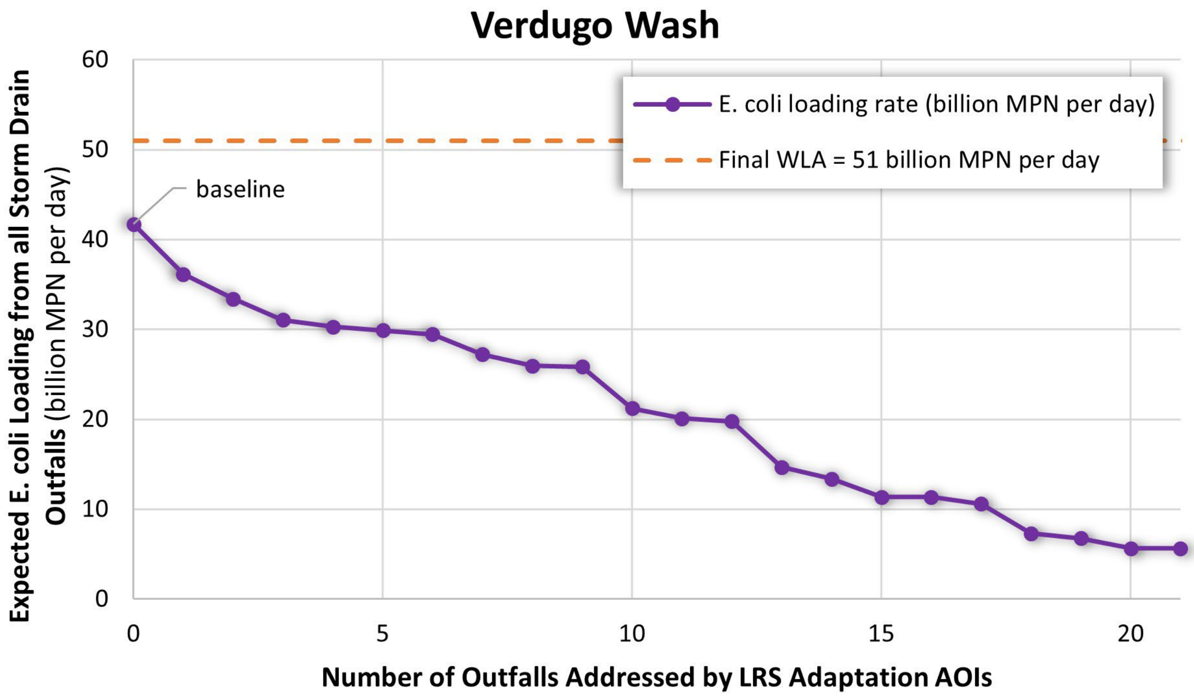


Figure 2-29. Expected *E. coli* Loading for Verdugo Wash Following AOI-associated Outfalls Addressed.

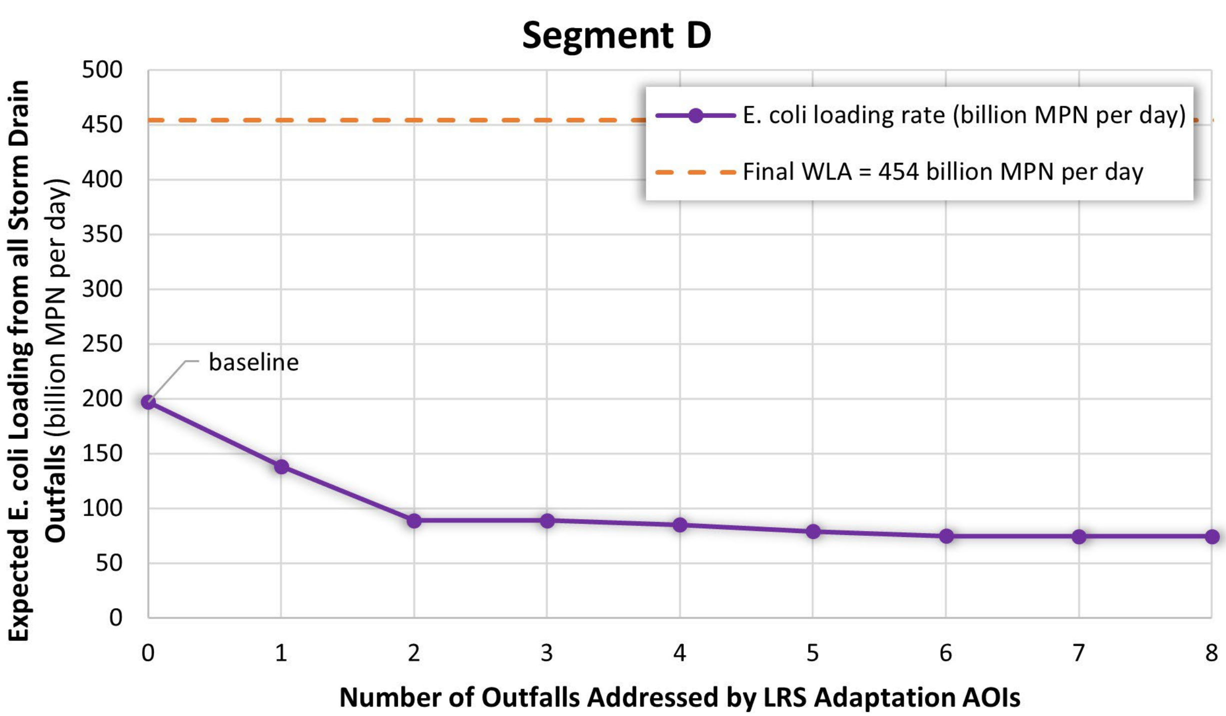


Figure 2-30. Expected *E. coli* Loading for Segment D Following AOI-associated Outfalls Addressed.

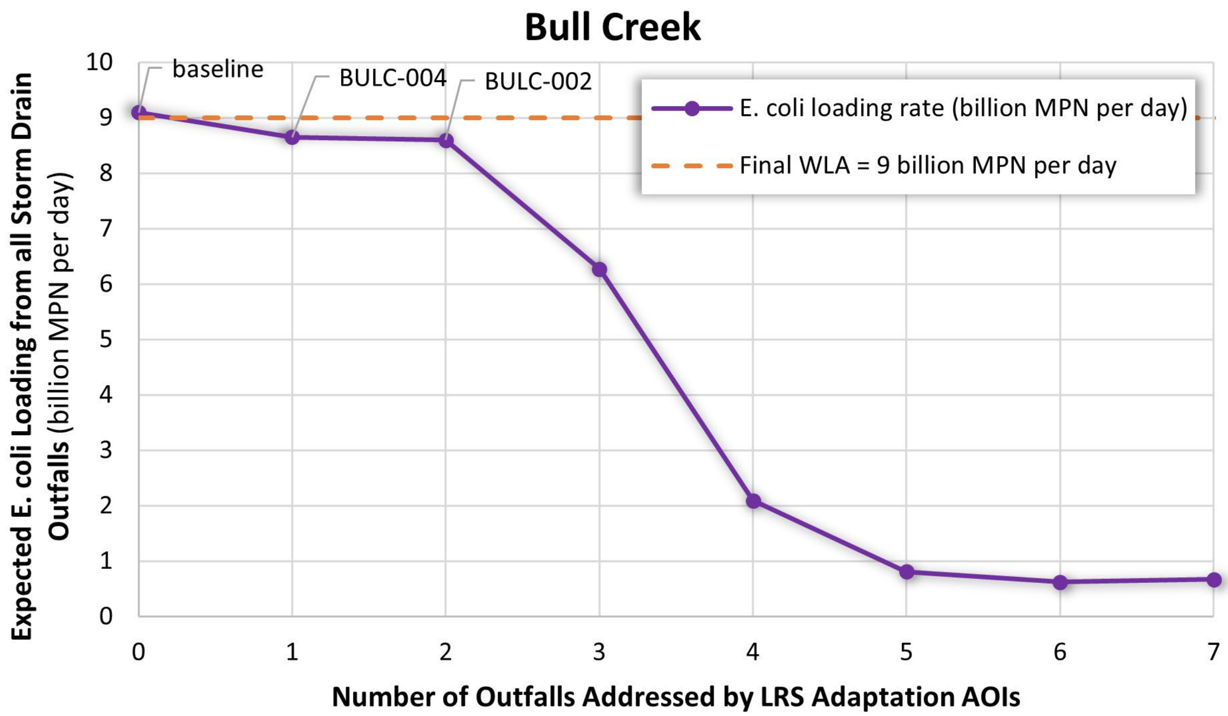


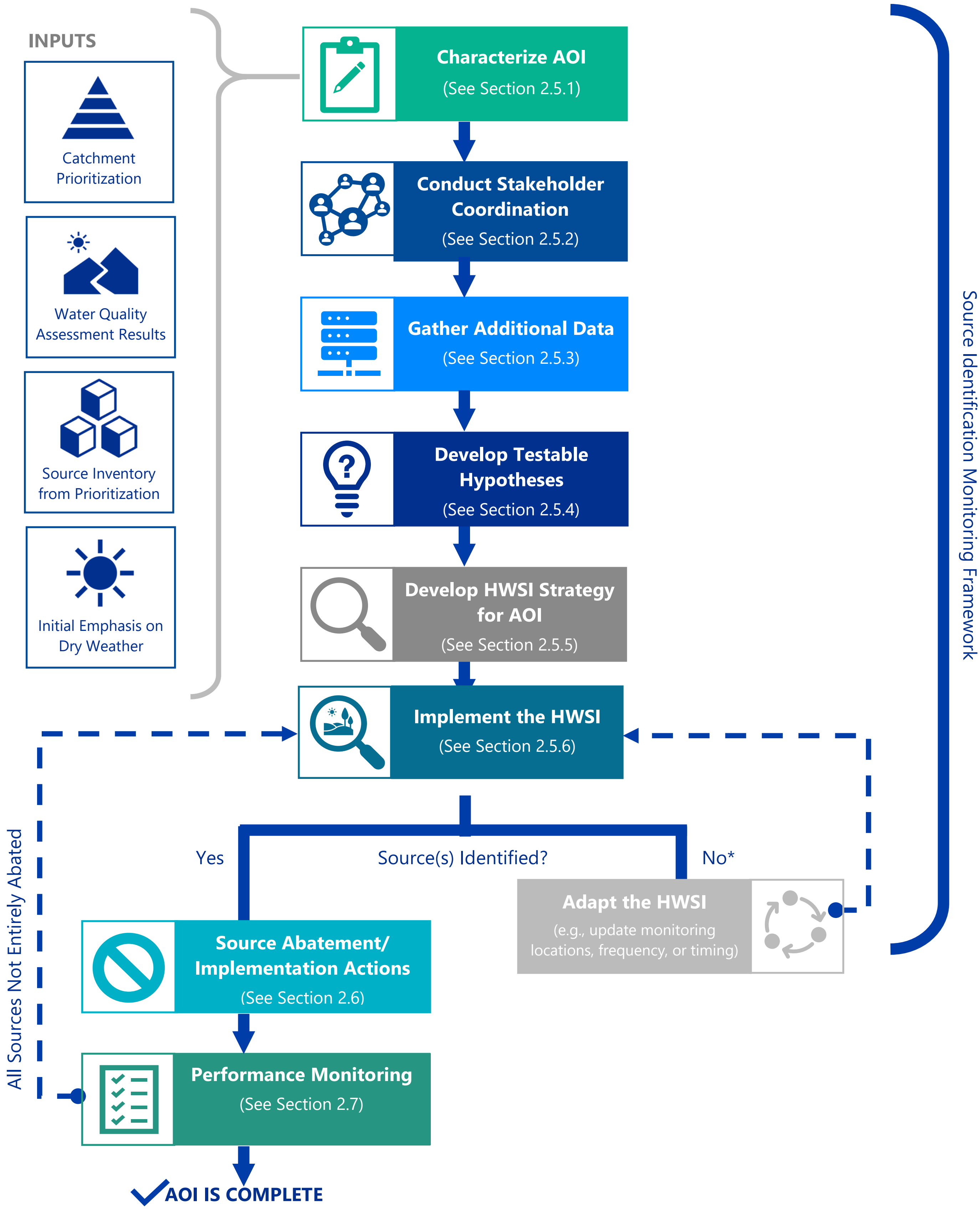
Figure 2-31. Expected *E. coli* Loading for Bull Creek Following AOI-associated Outfalls Addressed.

The WLAs and selected AOIs discussed herein are focused first on dry weather priorities, given the earlier deadlines and more robust data available. Wet weather catchment prioritization results were factored into the selection of AOIs; however, verifying attainment of the WLAs during wet weather will be integrated via adaptive management in future iterations of this Plan, as wet weather data at outfalls is collected.

2.5 Source Investigation Framework

If an AOI is to be addressed through source abatement, rather than a structural project, the following framework for source investigations will be implemented. To identify sources of human waste within an AOI, a human waste source investigation (HWSI) will be completed following an efficient and systematic approach. AOI Monitoring Plans will be developed in combination with the *ULAR LRS Sampling and Analysis Plan/Quality Assurance Program Plan* (SAP/QAPP, [ULAR WMG, 2020]) to guide future HWSIs in the ULAR WMA that will help to achieve the objectives of the LRS Adaptation Plan. This section describes the general steps the Group will use to identify human fecal sources, tracking tools, and key considerations that should be made at the time of developing a localized monitoring strategy. Figure 2-32 depicts the specific steps the Group will use to identify human fecal sources, which are shortened and adapted from *The California Microbial Source Identification Manual* (SCCWRP, 2013) and account for the significant compilation and assessment of source, monitoring, infrastructure, and BMP data that was completed during the development of this Plan. By leveraging the water quality condition assessments and catchment prioritization, the Group will be able to efficiently develop and complete HWSIs throughout the WMA.

Refer to Appendix B for an example of the application of the source identification monitoring framework for the AS-17 AOI.



**Reasons to adapt an HWSI can be driven by other factors (e.g., additional stakeholder input, additional data, new scientific techniques, etc.)*

Figure 2-32. Framework for Source Identification and Relationship to Source Abatement and Performance Monitoring Activities

2.5.1 Characterize AOI

As shown in Figure 2-33, following catchment prioritization and AOI selection, additional details about the AOI should be gathered that will inform the HWSI. Potential sources of human fecal contamination may be known but not represented in the prioritization. Examples include but are not limited to recreational vehicle dumping sites, conditional permits such as swimming pool discharges, WDRs for agriculture or recycled water, or other NPDES permits.

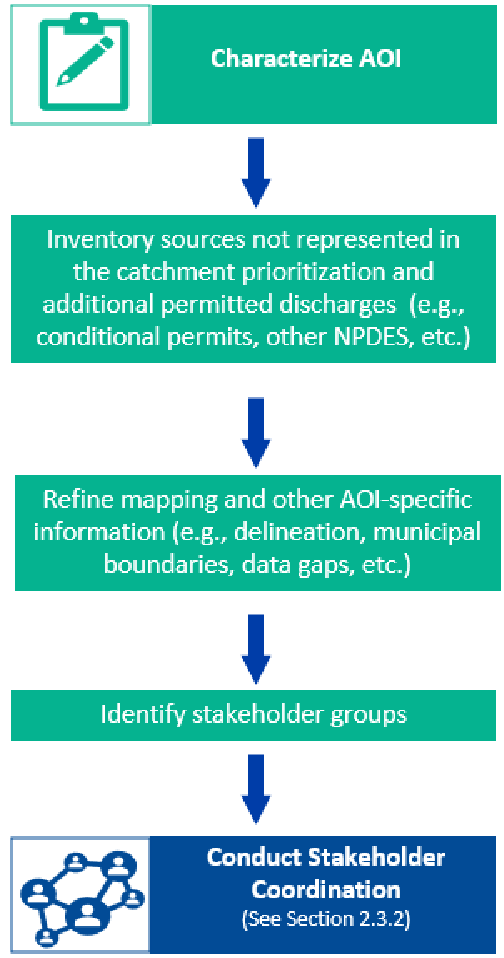


Figure 2-33. AOI Characterization Activities

Desktop GIS analysis to refine mapping for the AOI will also occur during this stage. Refinements may include identification of areas with data gaps, updates to municipal boundaries or parcel ownership, and catchment delineation for field investigations or other HWSI planning purposes. Maps summarizing the AOI-specific information may be used to assist with HWSI planning, stakeholder coordination, and monitoring site and methodology selection.

During AOI characterization, stakeholder groups will be identified, and an inventory developed so that coordination with can be initiated before developing the monitoring plan. Following the AOI characterization, stakeholder coordination will be conducted.

2.5.2 Conduct Stakeholder Coordination

Stakeholders may include both governmental and non-governmental organizations (water/wastewater agencies, Caltrans, Phase II Permittees, other permitted dischargers, etc.), regional monitoring groups such as the Southern California Monitoring Coalition, and others. The entities identified during the AOI characterization will be contacted as appropriate and additional data gathered from these partners may help to fill data gaps or provide additional support for HWSI efforts. In addition, during HWSI strategy development, the Group may work with various stakeholders for access, rights of entry, and other needed monitoring coordination. Depending on the size, location, and number of jurisdictions within an AOI, a Regional AOI Team may be formed and will include key stakeholder groups. Potential considerations for forming a Regional AOI team are presented in Figure 2-34.

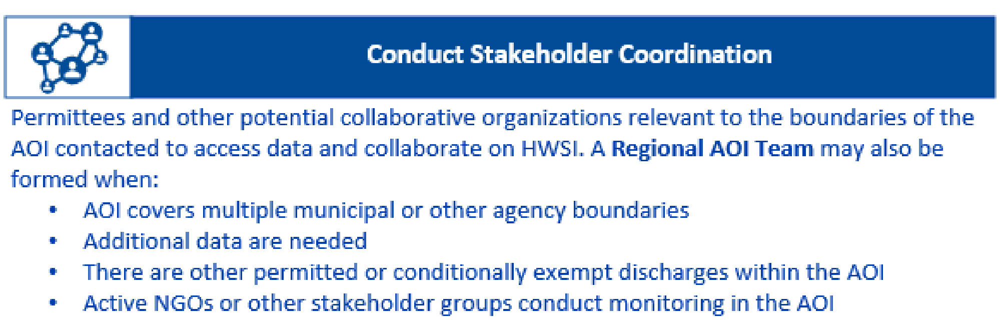


Figure 2-34. Stakeholder Coordination Considerations

2.5.3 Gather Additional Data

To address inherent site-specific characteristics and generate testable hypotheses for a particular AOI, the Group will complete more focused data collection within the boundaries of the AOI. Permittees will work with the local agencies identified in AOI characterization and associated with the Regional AOI Team to compile additional monitoring data (e.g., presence/ frequency/ locations of non-stormwater MS4 discharges, etc.), GIS data (e.g., sewer/storm drain locations, ages, material, condition at last inspection, invert elevation, etc.), source data, MS4 outfall dry and wet weather monitoring data, and other relevant information. Visual or sanitary surveys may also be conducted as needed during this stage to identify sources of pollution and gain more familiarity with conditions within the bounds of the AOI. Of particular importance for dry weather HWSIs will be verifying that the outfalls associated with an AOI have persistent non-stormwater discharges. While the catchment scoring and prioritization summarized in Section 2.3 leverages data produced by the dry weather outfall screening events, additional confirmation is needed prior to finalizing any HWSI strategy. Figure 2-35 lists potential additional data sources and activities to fill data gaps.

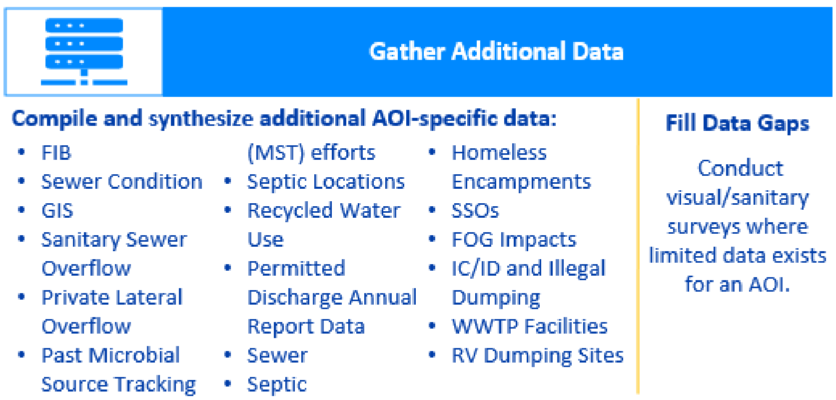


Figure 2-35. Potential Additional Data

2.5.4 Develop Testable Hypotheses

With the understanding that resources are limited, monitoring methods are expensive, and results are potentially highly variable, the Group will define testable hypotheses which tie back to the primary goals of the LRS Adaptation Plan and are specific to the targeted AOI. Well-defined hypotheses are the basis for designing an effective investigation that selects the most appropriate source tracking and identification methods. The goal for any monitoring design associated with the LRS Adaptation Plan would be to test the null hypothesis (e.g., that Catchment(s) X, Y, and Z are a source of human fecal contamination at a downstream impaired receiving water) and if the null hypothesis is rejected, to conclude with some level of confidence that the identified catchments are not a source of human fecal contamination (Figure 2-36). Accordingly, monitoring the variables (e.g., differing times of the day), pertinent locations (i.e., catchment outfalls), as well as monitoring close to the impaired receiving water will usually produce the data necessary to test the hypothesis. The following summarizes several typical hypotheses that the Group can expect to apply, as appropriate to specific site conditions, given the range of AOIs defined:

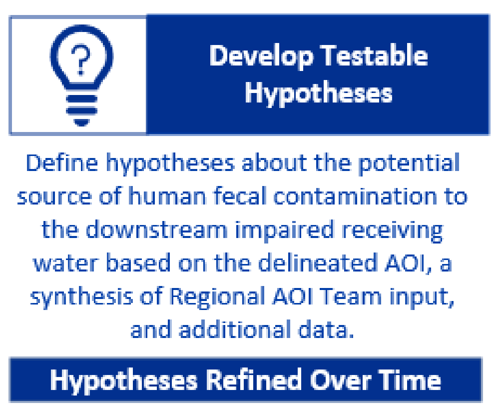


Figure 2-36. Description of Testable Hypotheses

- Catchments X, Y, Z within the AOI are a significant and continuing source of human fecal contamination at a downstream impaired receiving water.
- Encampments are a major source of human fecal contamination within the MS4 of Catchment X.
- Contaminated groundwater is infiltrating into the MS4 of Catchment Y.
- The sanitary sewer system is leaking, and raw sewage is infiltrating into the MS4.
- The creek is a major source of human fecal contamination at the downstream impaired receiving water.

The Group may define additional questions to help guide sequential evaluations, which depend on whether a previous, relevant hypothesis was accepted or rejected. After analyzing data collected pursuant to an AOI Monitoring Plan, the Group will revise the hypotheses, as needed, to further investigate the spatial and temporal patterns observed.

2.5.5 Develop Human Waste Source Identification Strategy

HWSIs must be accomplished in a systematic manner to ensure temporal and spatial relevance, sufficient data is collected for addressing testable hypotheses, and effective use of limited resources. This will be accomplished through the development of an AOI-specific Monitoring Plan. These plans will be used in combination with the ULAR LRS SAP/QAPP to establish site-specific parameters for HWSIs. The components and major considerations for developing these plans are presented in Figure 2-37 with additional details provided below. The following information is presented to guide HWSI efforts, but ultimately will be tailored based on AOI-specific Monitoring Plans.

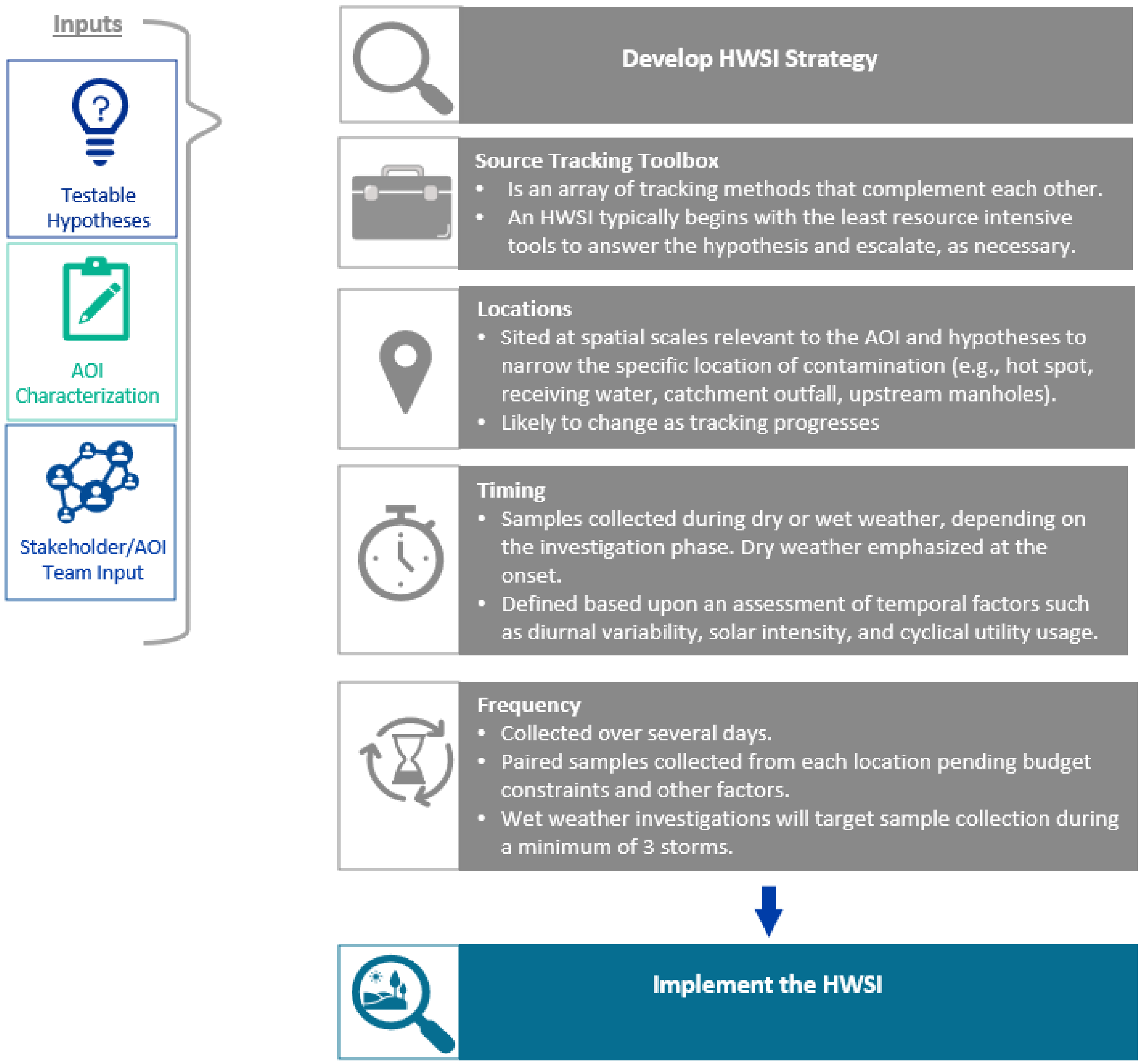


Figure 2-37. Considerations for Developing an AOI-Specific HWSI Strategy

Human Waste Source Tracking Toolbox

The HWSI Toolbox presented in the LRS SAP/QAPP describes a range of methods or techniques which can be used to identify sources of human waste. These include conventional methods, such as the collection of FIB data, dye and smoke testing, and close-circuit television (CCTV); as well as non-traditional indicators. Each tool has its own set of benefits and drawbacks and the added consideration of costs and availability. As such, a toolbox approach whereby multiple source identification tools are considered offers the best strategy for effectively identifying sources of human waste. Source identification tools can be generally categorized according to the type of indicator each uses to identify the presence of human waste. More specifically, bacterial markers include FIB and human source markers, such as HF183; viral markers use the presence of viruses; chemical markers rely on a variety of chemicals to indirectly track the presence of human waste, such as caffeine, fecal sterols, and optical brighteners; and physical markers such as dye testing, smoke testing, and CCTV represent more traditional methods historically used by municipalities.

The Group will develop each AOI-specific HWSI and monitoring plan using resources from the toolbox that complement each other to provide a dataset capable of definitively rejecting or accepting the testable hypotheses. Generally, a cost-effective and comprehensive source identification strategy follows a tiered approach that begins with relatively easy and low-cost tools, followed by increasingly complex and/or expensive tools. The easiest and most low-cost tool to be implemented first would include a desktop review of available GIS coverages followed by a “windshield” or visual survey of the catchments in question. This visual survey can be an informal assessment of potential sources or conducted according to a formal Sanitary Survey protocol. This initial approach serves to gather as much accurate data as possible about the AOI.

The next intermediate phase of the strategy would employ the use of paired sampling for traditional (i.e., *E. coli*) and non-traditional indicators (i.e., HF183). If existing information warrants it, dye or smoke testing, or CCTV/ electroscan could be used at this stage to identify any illicit connections or sewage leakages into the storm drain catchment. Depending on the phase of an investigation, another tool could be flow-paced sampling for bacterial indicators, if sporadic pulses of dry weather runoff are observed in the catchment or reported flowing to the receiving water. Similarly, chemical indicators could be used for the purposes of screening outfalls (note, they should not be used during receiving water investigations as they can quickly become diluted to non-detection levels). For additional details pertaining to the use of chemical markers for dry and wet weather outfall investigations, refer to the LRS SAP/QAPP.

At sites where FIB results indicate the presence of fecal contamination, it is important to pair this result with sampling that distinguishes between fecal sources to determine if human fecal material is present. It should also be noted though that if recycled water is used within the AOI, analytical results from the HF183 assay may yield false positives, since the current HF183 assays are predictive of all DNA material in the sample, regardless of treatment and subsequent viability of the target organisms (Urban Water Resources Research Council 2014; Aslan, et al. 2013; Nocker et al. 2006; Bae et al. 2009). Therefore, specificity should be confirmed by testing reference fecal pollution (e.g., raw sewage, aged sewage) and sources of treated wastewater (i.e., secondary and tertiary) in the watershed. Additional chemical indicators, such as caffeine, should also be sampled in catchments where recycled water is present to provide an additional line of evidence regarding the presence/absence of human fecal contamination (Urban Water Resources Research Council 2014). While there are several more expensive and complicated tools that can still be used (i.e., human-specific viral markers), this tiered approach strikes the right balance of effort and cost and should yield enough data and analytical insight to be able to answer the testable hypotheses.

Currently, HF183 is being used as a primary indicator of human sources of bacteria. HF183 as a human-associated fecal source marker has been increasingly used in source tracking studies. However, the source tracking approach is flexible to allow for adjustments to indicators used, as reflected in the LRS SAP/QAPP. The sampling and assessment methods for the human waste source identification strategy provide flexibility and options to tailor site-specific use from a suite of physical, bacterial, viral, and chemical markers.

Sampling Locations

The selection of monitoring sites at the time of developing a monitoring design will ultimately depend on the testable hypotheses derived by the Group and the specific phase of any source identification investigation. Early phases of the investigation will likely focus on narrowing down potential “hot spots” by way of receiving water and/or catchment outfall sites, whereas later phases of investigations will focus on locations within a Permittee's MS4.

To obtain a clear idea of where contamination may be greatest within an AOI, samples will be collected at relevant spatial scales to narrow the specific location of potential contamination. For a receiving water, sampling above and below the confluence of tributaries, as well as bracketing catchment outfalls, will allow for the Group to narrow down possible upstream urban sources. At a receiving water, this may involve sampling from stream banks at fixed intervals to determine where contamination is the highest (i.e., a "hot spot"). Note, locations may not be directly associated with the segment deemed impaired. Within the MS4, this may involve synoptic sampling (i.e., collection of samples from many locations during a short period of time) up-watershed to understand where in the MS4 the contamination begins or intensifies, similar to the Group's current approach to IDDE investigations. The Group will focus sampling in places that represent "worst-case conditions" so that if results come back negative for human source markers, it is more likely that contamination problems truly do not exist.

Sampling Timing and Frequency

The LRS Adaptation Plan focuses on the identification and abatement of dry weather sources followed by wet weather sources; therefore, source investigations will inherently include a seasonal component. However, as *The California Microbial Source Identification Manual* describes in detail, understanding the temporal variability (i.e., trends over time) of historical data will greatly assist with the design of a source investigation (SCCWRP 2013). Accordingly, the Group will consider temporal factors during the planning phase of an investigation to better define the timing of sample collection associated with human fecal source investigations, including:

1 Portions of the MS4 that may be physically diverted to the sanitary sewer system or a separate treatment system during certain times of the year.
2 Whether diurnal trends exist in the historical data. Diurnal trends associated with receiving waters may suggest the potential for bathers as a possible source or the impact of solar radiation.
3 Whether there is no temporal trend associated with receiving water impairments, which may suggest intermittent sources such as illegal dumping.

During dry and wet weather, sampling at a regular time scale over one or more days at all sampling locations should reveal if contamination is affected by solar intensity or affected by cyclical usage of utilities such as the sanitary sewer. The Group will also attempt to specify sample collection times that represent "worst-case conditions" so that if results come back negative for human-specific markers, it is more likely that contamination problems do not truly exist.

Samples should be collected over several days representing typical conditions to obtain a sufficient number of paired samples from each sample location; however, budgetary constraints and other monitoring design elements will ultimately specify the final target sample count per site. For wet weather investigations, the Group will look for confirmation of results over multiple storms, with a minimum of three storms sampled.

2.5.6 HWSI Implementation

Once the individual HWSI strategy and AOI Monitoring Plan have been developed, HWSI activities will be conducted in accordance with the LRS SAP/QAPP. The processes outlined in Figure 2-38 for dry and wet weather represent generalized HWSIs; however, based on the specific conditions of the AOI and the hypotheses, the methods may vary.

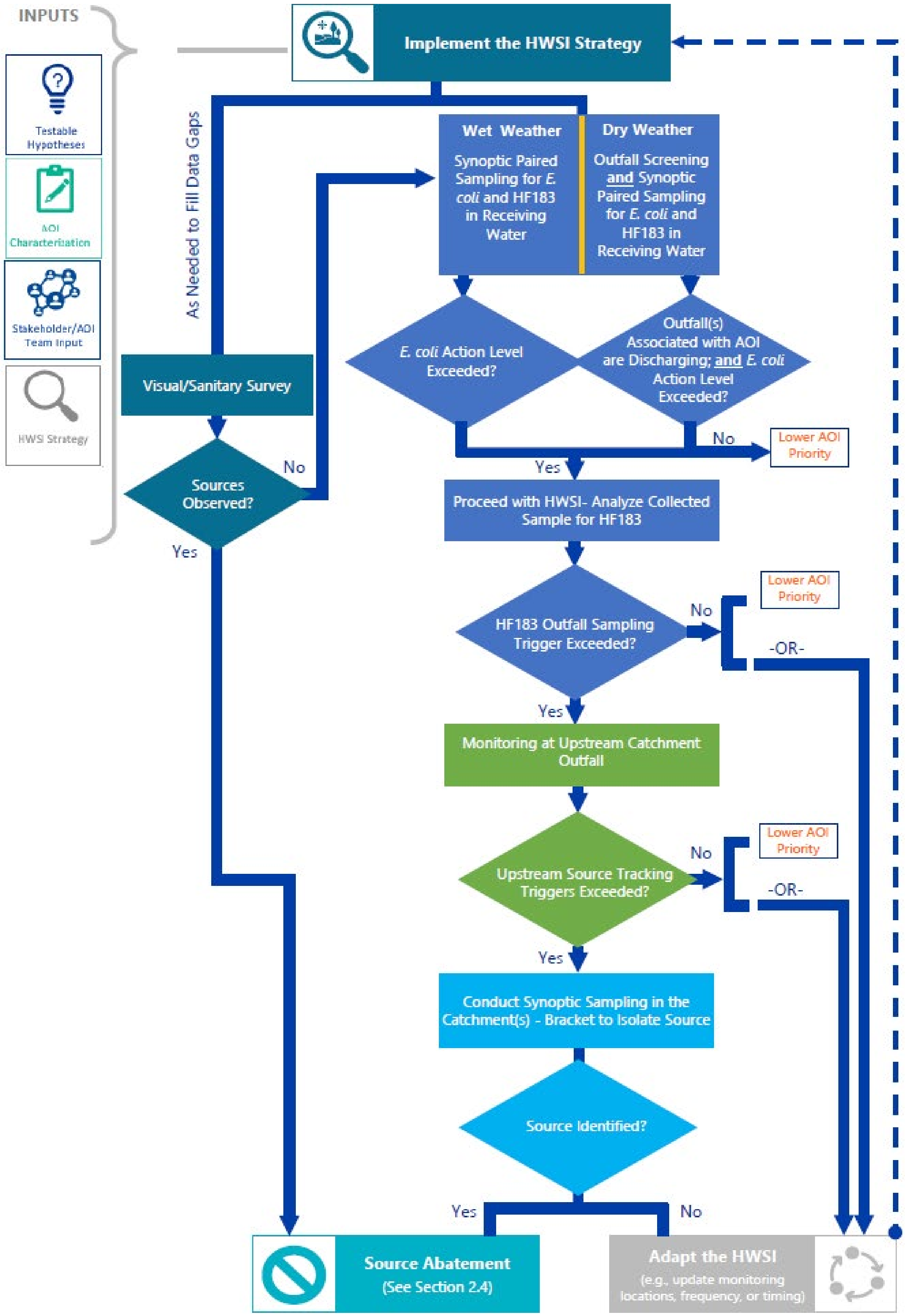


Figure 2-38 Conceptual Process of a Human Waste Source Investigation

Action Levels

The Group will utilize a combination of water quality and regulatory criteria and specific monitoring triggers to help guide source investigations. Dry and wet weather data assessment methods will generally consist of traditional quality assurance/quality control and statistical analysis techniques for the purpose of analyzing and describing monitoring results. The Group will consider three different triggers and associated action levels to guide decision making throughout the HWSI:

1. When to analyze paired Fecal Indicator Bacteria (FIB)/HF183 samples;
2. When to perform catchment outfall sampling; and
3. When to initiate catchment source tracking.

The action levels for the three triggers are presented in Table 2-9 below. For the catchment outfall sampling and source tracking triggers, when *E. coli* results are below the specified action levels, the paired HF183 sample will not be analyzed given that recreational health risks are expected to be low. In order to trigger catchment outfall and catchment source tracking, both the *E. coli* and HF183 concentrations must exceed the action levels.

Table 2-9: Summary of Action Levels Triggering HWSI Source Tracking Steps

Indicator	Action Level[1]	
1. Receiving Water FIB Action Level		
E. coli	>320 CFU/100 mL	>10% results exceed action level
2. Catchment Outfall Sampling Triggers- Determined from receiving water		
E. coli	>320 CFU/100 mL	>10% results exceed action level
HF183	>1,000 copies/100 mL	>10% results exceed action level
3. Catchment Source Tracking Triggers- Determined from catchment outfall and continuing up-catchment		
E. coli	>320 CFU/100 mL	>10% results exceed action level
HF183	>4,100 copies/100 mL	>10% results exceed action level

1: Action Levels are presented based on the best available, current science. Given the evolving science in this area, HWSIs are intended to be flexible to integrate adjustments to action levels as appropriate. If different threshold values are established through updated scientific findings or in regulatory changes, these will replace the referenced action levels.

The LRS SAP/QAPP describes the techniques Permittees will use to verify and validate the monitoring data is useful for its intended purposes (i.e., Section 18.0 of the SAP/QAPP and the specific action levels that will be used to guide HWSIs in SAP/QAPP Section 2.2.2). The following sections summarize each of these triggers and their application during a source investigation. Note, this focuses on the use of paired *E. coli* and HF183 sampling; however, as referenced above the sampling approach is flexible to allow for adjustments to indicators used, as reflected in the LRS SAP/QAPP. The sampling and assessment methods for the HWSI provide flexibility and options to tailor site-specific use from a suite of physical, bacterial, viral, and chemical markers. Paired *E. coli* and HF183 are presented below as a primary tool utilized.

Receiving Water FIB Action Level-Trigger for HF183 Sample Analysis

Paired *E. coli* and HF183 samples will be collected at the HWSI receiving water sites; however, it may not always be necessary to analyze for HF183 if low concentrations of *E. coli* are consistently detected. Both dry and wet weather FIB results at the receiving water sample sites will be evaluated relative to the relevant statistical threshold values (STV) defined in the *Bacteria Provisions and Variance Polic*y (adopted on August 7, 2018 [Resolution No. 2018-0038], which is a component of the SWRCB's *Water Quality Control Plan for Ocean Waters in California* (the California Ocean Plan) and Part 3 of the *Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries of California*. Table 2-10 presents the pertinent STV concentrations for receiving waters in the ULAR WMA. This STV, which was derived from values presented in USEPA's 2012 *Recreational Water Quality Criteria*, represents the predicted 90th percentile value for a water quality distribution corresponding to ~32 illnesses per 1,000 water contact recreators. Should an *E. coli* sample result exceed the STV, the paired HF183 sample (collected at the same time) will be analyzed.

Table 2-10: Receiving Water FIB Action Level

Receiving Water Conditions	Fecal Indicator Bacteria	Action Level (CFU/100 mL)
Receiving water where the salinity is equal to or less than 1 ppt 95 percent or more of the time	*E. coli*	320

Triggers for Catchment Outfall Sampling

Upon evaluating receiving water results, the Group will decide whether to perform catchment outfall sampling. This determination will be based on the combination of *E. coli* and HF183 sample results from the receiving water sampling. An action level derived from recent studies will be used as a reference point for making decisions about how to proceed with source investigations. Specifically, *E. coli* results will be compared to the STV presented in Table 2-9, and HF183 sample results will be compared to an action level of 1,000 copies/100 mL. This action level, derived from Boehm et al. (2018), is health-protective because it represents:

1. The density of HF183 corresponding to a median risk of approximately 30 illnesses per 1,000 recreators;
2. Assumes any sewage contamination in the receiving water is aged 2.5 days, which can be considered a worst-case scenario for surface water contamination; and
3. Is lower than the threshold derived for site-specific conditions associated with the Surfer Health Study (2,655 copies/100 mL).

More recently, new research indicates that for recreational health risk in receiving waters, 525 copies/100 mL of HF183 corresponds to a recreational risk threshold of 32 illnesses/1,000 recreators (Boehm and Soller, 2020). While in the future, the action level may be adapted to reflect this lower threshold, the 1,000 copies/100 mL action level allows the group to manage limited resources to implement a more streamlined and cost efficient HWSI while still effectively controlling risk. If additional investigation is needed to identify problem areas, the HWSI can be adapted to utilize a lower HF183 threshold. It is also expected that the values may change over time, and ultimately, the assessment of potential risk will be based on the most scientifically defensible data.

Concluding an HWSI and AOI closeout will occur based on performance monitoring (see Section 2.7). AOI completion will be determined by assessing risk from the MS4 system within the AOI to the receiving water based on the latest science. The thresholds used to assess risk are subject to change over time and will be adapted as appropriate based on the latest science and regulations.

Triggers for Catchment Source Tracking

If catchment outfall sampling is triggered, catchment outfall sample analysis for *E. coli* and HF183 will proceed using the same triggers presented in Table 2-9. Pursuant to these triggers, when *E. coli* results for a catchment outfall discharge are below the STV, the paired HF183 sample will not be analyzed as the discharge poses little risk to downstream recreators. However, when an STV is exceeded, the paired HF183 sample will be analyzed. The Group will use HF183 results to determine whether human fecal sources exist at levels that pose an elevated risk to recreators, and if so, will trigger source tracking within the catchment draining to the outfall.

At the catchment outfall, *E. coli* results will be compared to the action level presented in Table 2-9, and HF183 sample results will be compared to an action level of 4,100 copies/100 mL. This action level, derived from Boehm et al. (2018), represents the following:

1. The density of HF183 corresponding to a median risk of approximately 30 illnesses per 1,000 water contact recreators for contamination of unknown age.
2. Taking into account that risk from exposure to HF183 concentrations increases with the age of contamination, the 4,100 copies/100 mL threshold was established factoring in uncertainty in contamination age at the time of water recreator exposure.

Although the HF183 action level for triggering *catchment outfall sampling* uses a more health-protective assumption regarding the age of contamination, this source tracking phase uses a more robust and comprehensive assumption that the age of the contamination is unknown. Consistent with above statements this action level is based on the best available current science, but is flexible to adjustments through the adaptive management process, discussed further in Section 3.6, as advances in the science or regulatory updates occur.

Lowering the Priority of an AOI

During the course of a HWSI, the AOI may be deemed a lower priority when monitoring results at the receiving water or catchment outfall indicate that the risk to recreators from the discharge is below accepted risk-based thresholds (RBTs) (see Figure 2-38). The RBTs for the HWSI will consist of the *E. coli* and HF183 catchment outfall action levels identified in Table 2-9. Recent advancements in the state-of-the-science that identify lower HF183 concentrations (i.e., 525 copies/100 mL, [Boehm and Soller, 2020]) may be used in the future to reflect a more conservative determination of potential risk. As this body of research continues to expand, any advancements in established risk thresholds will be used to guide future adaptive management of HWSI methods. In the meantime, advancements to date warrant integration of current action levels referenced herein related to risk to better guide management practices most protective of human health. If the action levels are not exceeded at the receiving water or catchment outfall, the HWSI will be closed, or the AOI ranked a lower priority. The AOI may also be considered a lower priority or the AOI boundaries refined for dry weather HWSIs when catchment outfalls are determined to be dry during three visits, consistent with the Non-Stormwater (NSW) Outfall Program.

HWSI Adaptation

A HWSI can be adapted over time based on the monitoring results to update locations, frequency, timing, or tools to increase the effectiveness of the monitoring strategy in supporting or refuting the hypotheses. The HWSI may also be updated to reflect scientific advances, constructed structural projects, new permitted discharges, or regulatory updates that affect the AOI or appropriate action levels.

2.6 Source Abatement and Implementation Actions

Following identification of a source or sources of human waste through the HWSI, the applicable ULAR agencies will address via source control activities or implementation of structural projects to reduce or remove inputs. Implementation of human waste control actions to abate identified human sources may include activities such as coordinating with wastewater agencies or private lateral owners to address identified sewer leaks and/or illicit connections, referral to responsible departments on encampment waste sources, and addressing any other identified illicit discharges to the MS4. Coordination with wastewater agencies as well as other agencies is an important step in the process. Appendix C details specific source abatement strategies associated with typical human waste sources identified and highlights key coordinating agencies in the corrective actions.

There are many strategies which can be used to abate sources of human waste. The selection of appropriate strategies should be driven by data obtained during source investigation activities. Selected strategies will vary based on the identified source(s) within a catchment and the extent to which each source could be contributing to the human waste indicators within the catchment's discharge. Some strategies may be used to abate sources that are contributed during dry and wet weather conditions and others may only be effective in abating dry weather sources. It is also important to note that many of the investigation procedures outlined in Section Source Investigation Framework2.5 of this Plan will also trigger simultaneous abatement. For example, if an illicit connection/illicit discharge is discovered during investigation, that source will be immediately eliminated per Permit requirements. Likewise, any SSOs which occur during plan implementation would be abated.

The institutional control measures detailed in the ULAR EWMP remain key tools for the ULAR agencies to control sources prior to entering receiving waters. The following programs and activities in particular provide valuable human waste source abatement:

Illicit Connections and Illicit Discharges Elimination Program: Respond to sewage and other spills that may discharge into the MS4.

Public Agency Activities Program: Maintain the MS4, including catch basin cleaning, channel maintenance, and implementation of controls to prevent and eliminate infiltration of seepage from sanitary sewers to the MS4.

Industrial/Commercial Facilities Program: Conduct regular facility inspections and issue violations.

Progressive Enforcement: Conduct and track enforcement through (1) follow-up inspection; (2) enforcement action; (3) records retention; (4) referral of violations; (5) investigation of complaints; (7) assistance with Regional Board enforcement actions.

Public Information and Participation Program: Lead robust education and outreach efforts that measurably increases knowledge and changes behavior.

The State Water Resources Control Board (SWRCB) adopted an updated Statewide General Waste Discharge Requirements (WDRs) for Sanitary Sewer Systems, Water Quality Order No. 2022-0103 (Sanitary Sewer Systems WDR) on December 6, 2022 which was made effective on June 5, 2023. This Order supersedes the previous Order No. 2006-0003 which was adopted on May 2, 2006. The WDRs require public agencies that own or operate sanitary sewer systems to develop and implement sewer system management plans (SSMPs) and report all SSOs and private lateral overflows to the SWRCB's online California Integrated Water Quality System (CIWQS) Sanitary Sewer System database. The WDRs include directives for owners and operators of sanitary sewer systems to demonstrate adequate and efficient management, operation, and maintenance of the sanitary sewer system. Generally, the WDRs require that:

- In the event of an SSO or private lateral overflow, all feasible steps shall be taken to control the released volume and prevent untreated wastewater from entering storm drains, creeks, etc.
- If an SSO or private lateral overflow occurs, it must be reported to the SWRCB using the CIWQS, the online reporting system developed by the SWRCB.
- A SSMP, with all mandatory elements, must be developed and approved by the governing body that owns or is responsible for the operation of the sanitary sewer system.

Overflow Emergency Response Plans generally include provisions to ensure that:

- Sewage spill sites are thoroughly cleaned as soon as possible after an overflow. No residue will be left that may impact future water quality.
- Sewage spill sites are secured to prevent public contact until the site has been thoroughly cleaned.
- Wherever possible, the affected area is thoroughly flushed and cleaned of any sewage. Wash-down water shall be contained. Solids and debris shall be flushed, swept, raked, or picked-up by hand, and hauled away for proper disposal.
- Wherever appropriate (typically in areas with hard surfaces), the affected area will be deodorized. The materials used for this purpose shall be confined to the immediate area.

The updated Order expands upon the previous 2006 Order in the following ways:

- Update the existing statewide General Order with implementation of State Water Board regulations, resolutions, and memorandums of agreement adopted since the 2006 adoption of the existing Order, which includes:
- Provide increased public transparency of sewer spill data, SSMPs, and sewer system performance;
- Enhance Regional Water Board enforcement for General Order enrollees failing to proactively reduce sewage spills;
- Address sewer system resiliency through proactive planning to:
    - Identify system-specific impacts due to climate change, infrastructure age, population growth and other impacts, and
    - Prevent future spills.
- Clarify existing prohibition of untreated waste discharge to waters of the State;
- Increase coordination with other utility agencies in the sewer service area;
- Update monitoring and reporting requirements to address cost of compliance and data quality assurance;
- Incentivize system owner employment of certified collection system operators; and

- Expand Order coverage to allow discretionary regulation of privately owned systems, allowing a Regional Water Board to require a privately owned system to obtain coverage under the Order.

In addition, the State Water Resources Control Board implemented interactive GIS maps, which are updated nightly of certified spills from sanitary sewer systems (not including any spills from wastewater treatment plants. The maps include locations of the spills, amount, source, and name of the responsible agency for Category 1 through 3 spills.

Table 2-11 provides general abatement recommendations based on the source identified. Appendix C expands on specific recommended actions for each source type, as well as potential proactive actions related to typical sources. The specific abatement strategy and timing for implementation will vary based on conditions of the site and source(s) identified.

Table 2-11. Recommended Source Abatement by Source Type.

Source Type	Abatement Recommendation
Malfunctioning wastewater, water, or recycled water infrastructure	Maintain, repair, or replace the infrastructure
Homeless Encampments	Coordinate with appropriate city departments[1]. Removal of trash and debris
SSOs	Repair of emergent cause and maintenance and/or repair to limit recurrence
FOG Impacts	Education and issue notice of violation
Illicit connection/illicit discharge	Education, issue notice of violation, and removal of connection

1: Stormwater departments will refer the issue of homeless encampments to the appropriate departments, which will be subject to the latest legal policy on allowable actions to address. Management decisions will need to be made in line with the current legal approach.

In addition to the general abatement strategies discussed above and in Table 2-11, the Group will explore potential new abatement strategies, learning from other efforts in the region, further interpretation of monitoring data, and scaling abatement responses based on progress in the ULAR WMA. The following list describes potential new abatement strategies, including those that could require further collaboration between the ULAR MS4 Permittees and wastewater, or other, agencies:

- *Coordinate a ULAR WMA-wide sanitary sewer and MS4 vulnerability assessment which integrates pipe condition, rehabilitation efforts, and investigation outcomes;*
- *Develop a septic pump out rebate program for high priority areas;*
- *Develop a cost-share program to help pay for connecting residents to sanitary sewer;*
- *Develop a cost-share program to help pay for lateral repairs or replacements for properties which voluntarily inspect and discover deficiencies;*
- *Develop ordinances which require proactive private lateral inspections;*
- *Establish safe parking programs which provide sanitation services for transient communities;*
- *Provide "seasonal" public restrooms through the use of portable composting toilets;*
- *Contract with mobile dump station contractor to service transient community;*
- *Provide vouchers to the transient community to use existing dump stations;*
- *Fund and build new dump stations;*

- *Increase FOG inspections in high priority catchments;*
- *Coordinate ICID teams to focus on responding, identifying, tracking, and abating "incidents of human waste"; and*
- *Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities.*

If a source originates from a jurisdiction outside of the ULAR, the responsible party in the external jurisdiction will be notified so action may be taken to eliminate. If the responsible party is not responsive or otherwise does not eliminate the source in a timely manner, the ULAR agencies may notify the LARWQCB.

If source abatement actions are prohibitive, which could be due to timing, costs, and resources available, the ULAR agencies may pursue implementation of a structural project in the area to reduce bacteria loads. Structural projects to achieve reduction in bacteria should focus primarily on infiltration or sanitary sewer diversions to remove flows with elevated bacteria levels. These treatment methods provide greater confidence in long-term removal of bacteria from reaching receiving waters. A structural project may also be pursued if following a HWSI the source is unidentifiable. In addition, the ULAR WMG is constructing, designing, and planning structural projects throughout the WMA to help address other pollutants of concern per the Watershed Management Program (WMP). These projects will provide beneficial runoff reductions that are factored into the implementation strategies to address targeted AOIs, as referenced in Table 2-7.

2.7 Performance Monitoring Framework

Performance monitoring focuses on evaluating the effectiveness of abatement activities or structural projects for identified sources and expected bacteria reductions. After sources are abated or projects implemented according to the methods described in Section 2.6, the Group will conduct performance monitoring to assess the effectiveness of the actions. Performance monitoring will generally be conducted within 3 to 12 months of implementation actions, depending on the actions, and will primarily consist of collecting *E. coli* and HF183 samples at the catchment outfall according to locations, timing, and frequency defined in the AOI Monitoring Plan, for comparability. An exception may be necessary to expand or change the analytical suite based on the type of corrective action implemented or to change the frequency or type of sample collection to confirm reductions. For example, residual waste in sediment and groundwater may require more time to attenuate compared to repair of a private sewer lateral or sanitary sewer main. The action levels specified in Section 2.5.6 will be used to evaluate exceedances for AOI closeout, or more conservative values for HF183 may be used. As discussed in detail in Section 2.5.6, the AOI completion metrics may change over time with the state-of-the-science and regulatory updates. Should performance monitoring results indicate an exceedance of the specified action levels, source tracking will be re-initiated and additional corrective actions implemented as necessary.

The Group may reach a point after repeated attempts of identifying human fecal sources within the same receiving water reaches and AOIs that additional investigation is unlikely to yield any benefits. This may occur if there is a low, diffuse, and persistent source of contamination unrelated to the Permittee's MS4, such as groundwater contamination. Alternative compliance approaches will be examined in these situations.

Refer to Appendix B for an example of the application of performance monitoring for the AS-17 AOI.

3 PLAN IMPLEMENTATION

The LRS Adaptation Plan serves to update the ULAR Group's strategy to address the Bacteria TMDL for both dry and wet weather. This plan adapts previous LRS's submitted for Segments B, Arroyo Seco, Rio Hondo, Compton Creek, Segment E, Aliso Canyon Wash, Bell Creek, Dry Canyon, McCoy Canyon, Segment C, Burbank Western Channel, Tujunga Wash, Verdugo Wash, Segment D, and Bull Creek. The wet weather plan is also covered within this LRS Adaptation Plan. Addressing identified AOIs within each segment and tributary, via any of the source abatement or other implementation actions outlined in the Adaptation framework (Figure 2-1) are shown to attain the TMDL dry weather WLAs through the Monte Carlo Analysis conducted. Current priority areas for wet weather are established herein and demonstrating attainment of wet weather WLAs will be integrated via adaptive management in future iterations of this Plan, following wet weather data collection at outfalls.

The source investigations (Section 2.5) and source abatement and implementation actions (Section 2.6) provide the framework for ULAR agencies to implement. Each agency has the flexibility to address their responsible AOIs in the manner most appropriate to their needs and resources.

3.1 Reporting

Progress and findings in addressing the AOIs per the schedule in Section 3.4 will be reported to the LARWQCB through the ULAR Group's Annual Reports. These reports will clearly identify if an AOI is being addressed through a constructed structural project or with source abatement strategies. The culmination of the LRS Adaptation implementation process will be determining whether the constructed structural projects or source abatement strategies implemented are adequate to eliminate persistent human marker detections and FIB exceedances. If the performance monitoring demonstrates that persistent human marker detections and FIB exceedances have been eliminated, then the need for additional control measures to address human waste sources is eliminated. If persistent human marker detections have been eliminated, but FIB exceedances continue, then either additional structural projects or abatement actions for other lower priority FIB sources will continue to be pursued or an alternative compliance approach will be proposed. In addition, LRS reports will clearly flag any findings through the source investigation efforts where the identified source is outside of the MS4 responsibility. Upon approval of this Plan, data collected through HWSIs will be submitted to CEDEN and associated AOI Report Forms summarizing desktop analyses, source investigation methods and results, and AOI conclusions will be submitted with the Annual Report.

3.2 Cost Estimates

Based on investigations completed in the southern California region (including San Diego, Los Angeles, and Ventura County), the estimated costs for HWSIs can range from $150,000 to $300,000 per investigation. The breakdown of typical costs is displayed in Table 3-1. However, for more complex investigations, these costs can go up to $1 million per investigation. The costs of a HWSI varies depending on field conditions within catchments, total number of monitoring sites and spatial proximity, number and frequency of samples, type of potential human waste sources investigated, analyzed indicators, and personnel costs.

Table 3-1. Typical Cost Breakdown Associated with HWSIs.

Task	Low End	High End
Work Plan	$30,000	$40,000
Dry Human Waste Characterization Round 1	$40,000	$100,000
Wet Human Waste Characterization Round 1	$55,000	$120,000
Human Waste Characterization Reporting	$25,000	$40,000
TOTAL	**$150,000**	**$300,000**

3.3 Potential Funding Sources

Funding sources to support the cost of HWSIs and abatement of identified sources or other implementation actions (e.g., structural projects) are consistent with available funding identified in the Upper Los Angeles River Watershed Management Program (ULAR WMP). This includes the following:

- Safe, Clean Water Program (Los Angeles County)
- Clean Water State Revolving Fund (CWSRF)
- Los Angeles County Measures W, H, A, and M
- Federal and State Grants, such as;
    - Proposition 1 Stormwater Grant Program
    - Integrated Regional Water Management (IRWM) Grant Program
    - Section 319 of Clean Water Act
    - Proposition 68 Statewide Park Program, Green Infrastructure Grant Program
- General Fund

Additional details on the respective funding sources are available in the ULAR WMP. In addition, the nature of potential human waste sources to be targeted for abatement provides opportunities to collaborate with other funding sources and initiatives. For example, collaboration may be pursued with sanitary agencies on upgrades or repairs to malfunctioning infrastructure resulting in sewer exfiltration. There are numerous homeless services in Los Angeles County, including City-specific efforts as well as the Los Angeles Homeless Services Authority to potentially coordinate on abatement strategies, and associated funding, where homeless encampments are identified as a source of bacteria. Violations associated with discharge of human waste sources into the MS4 system such as SSOs, FOG Impacts, and Illicit Connections/Illicit Discharges are to be addressed and actions funded by the violator.

3.4 Schedule and Next Steps

Table 3-2 presents the milestones for the LRS Adaptation implementation. These milestones reflect the schedule necessary to comply with the Bacteria TMDL.

Table 3-2. LRS Adaptation Milestones.

Segment/Tributary	Action	Milestone
All	Approval of the LRS Adaptation Plan[1]	October 2024
All	Initiate wet weather strategic monitoring at outfalls	October 2024
Segment B Mainstem, Arroyo Seco, Rio Hondo, Segment E Mainstem, Compton Creek	*Actions completed prior to LRS Adaptation Plan approval that address AOIs to meet dry weather WLA*	
Aliso Canyon Wash, Bell Creek, Dry Canyon, McCoy Canyon	Complete dry weather source abatement[2] or implementation of structural controls to address AOIs identified in Table 2-7 for respective segment/tributary[3]	March 2026
	Complete performance monitoring to verify dry weather WLA attained, if not pursue Phase II of LRS	March 2029
Segment C Mainstem, Burbank Western Channel, Tujunga Wash, Verdugo Wash, Segment D Mainstem, Bull Creek	Complete dry weather source abatement[2] or implementation of structural controls to address AOIs identified in Table 2-7 for respective segment/tributary[3]	September 2027
	Complete performance monitoring to verify dry weather WLA attained, if not pursue Phase II of LRS	September 2030
All	Identify remaining AOIs to address to attain wet weather WLA	June 2027
All	Complete follow-on wet weather source abatement[2] or implementation of structural controls in remaining AOIs to meet wet weather WLA[3]	February 2037
All	Report progress on completed AOIs and implement adaptive management, as appropriate.	Annually

1: Milestones dependent on LARWQCB approval date of the LRS Adaptation Plan.
2: Completion of source abatement may be contingent on activities by others outside of the authority of the ULAR MS4 Permittees.
3: Through the adaptive management process, specific AOIs may be added or removed, based on findings of the source investigations and strategic monitoring, but maintained consistent with meeting the WLA for the segment or tributary of the LA River.

3.5 Stakeholder Collaboration

Stakeholders will be continuously involved in the process during the LRS Adaptation implementation and adaptive management. As the Group moves forward to address the AOIs identified, one of the first steps is identifying and engaging with local stakeholders. This will include collaboration with multiple jurisdictions as needed within an AOI, as well as engaging any jurisdictions outside of the ULAR identified. Upon initiation of a source investigation for an AOI involving multiple jurisdictions, all parties will be notified and encouraged to participate through all phases of the process.

Feedback from all stakeholders will be provided via the review of annual reports and periodic updates to the LRS Adaptation, as necessary, in collaboration with the LARWQCB and local stakeholders.

The ULAR Group is using additional methods to engage the general public during the LRS Adaptation implementation, including providing information and updates through the ULAR LRS Adaptation online Story Map: https://storymaps.arcgis.com/stories/466afe14077a436aabd8f072ed20ee2e.

3.6 Adaptive Management Process

The LRS Adaptation Plan will be adapted based on information obtained during implementation, in the results from source identification studies and key scientific and regulatory advancements. As such, the Plan may need to be updated whenever a related bacteria strategy, goal, or schedule is revised, this may also include updates to the AOIs identified to meet WLAs. Any data gaps identified during source investigations could result in an update as well. If sources are unidentifiable or the identified source cannot be addressed in a timely manner, approaches will be adapted to pursue other implementation actions to address the bacteria load in the segment or tributary, such as implementation of structural projects in the AOI or shifting to address an alternative AOIs with equivalent estimated bacteria loads that if reduced would meet the WLA. Changes to structural project implementation status in the WMA may also result in updates to the Plan. Future adaptations could be triggered by verification sampling of dry and wet weather human waste abatement activities, which will directly inform the Group about the progress and efficacy of abatement strategies.

To aid in these adaptive management efforts, data and information obtained during the Performance Monitoring will be used to track progress and identify any additional collaboration needed to maximize efficiency, reduce risk, use resources effectively and meet compliance determination requirements.

4 REFERENCES

Aslan, A., Kinzelman, J., Dreelin, E., Anan'Eva, T., & Lavander, J. 2013. Guidance Document for Testing Recreational Waters Using EPA Method 1611. http://www.cws.msu.edu/documents/qPCRmanual_final.pdf

Bae, Sungwoo and Stefan Wuertz. 2009. Discrimination of Viable and Dead Fecal Bacteroidales Bacteria by Quantitative PCR With Propidium Monoazide. May 2009.

Boehm, A.B. and Soller, J.A. 2020. Refined ambient water quality thresholds for human-associated fecal indicator HF183 for recreational waters with and without co-occurring gull fecal contamination. Microbial Risk Analysis. September 2020.

Boehm, Alexandria B., et al. 2018. Can We Swim Yet? Systematic Review, Meta-Analysis, and Risk Assessment of Aging Sewage in Surface Waters. Environmental Science & Technology. September 2018

California State Water Resources Control Board (SWRCB). 2018. Staff Report Including Substitute Environmental Documentation for Part 3 of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California – Bacteria Provisions and a Water Quality Standards Variance Policy and an Amendment to the Water Quality Control Plan for Ocean Waters of California – Bacteria Provisions and a Water Quality Standards Variance Policy. August 2018.

California Regional Water Quality Control Board – San Diego Region. 2019. Investigative Order No. R9-2019-0014. An Order Directing the City of San Diego, the City of Santee, the City of El Cajon, the City of La Mesa, the County of San Diego, the San Diego County Sanitation District, the Padre Dam Municipal Water District, San Diego State University, the Metropolitan Transit System, and the California Department of Transportation to Submit Technical and Monitoring Reports to Identify and Quantify the Sources and Transport Pathways of Human Fecal Material to the Lower San Diego River Watershed. June 2019.

CBA Steering Committee. 2017. Cost Benefit Analysis San Diego Region Bacteria Total Maximum Daily Loads. October 2017.

Larry Walker Associates, Black & Veatch, CH2M Hill, Paradigm Environmental. 2015. Coordinated Integrated Monitoring Program (CIMP) for the Upper Los Angeles River Watershed. August 2015.

Pinongcos, F., Mladenoc, N., Calderon, J., Verbyla M. E., Kinoshita, A. M., Gersberg, R., & Batikian, C. M. 2022. Chemical and Microbial Markers for Discriminating Sanitary Sewer Contamination in Coastal, Urban Streams. ACS ES&T Water. August 2022.

San Diego State University (SDSU). 2020. San Diego River Contamination Study: Increasing Preparedness in the San Diego River Watershed for Potential Contamination. July 2020.

Southern California Coastal Water Research Project (SCCWRP). 2013. The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches. Technical Report 804. December 2013.

Soller JA, Schoen ME, Bartrand T, Ravenscroft JE, Ashbolt NJ. 2010. Estimated human health risks from exposure to recreational waters impacted by human and non-human sources of fecal contamination. Water Res. 2010;44(16):4674-4691. doi:10.1016/j.watres.2010.06.049

United States Environmental Protection Agency. 2023. Report on the Second Five-Year Review of EPA's Recreational Water Quality Criteria. May 2023.

Upper Los Angeles River Watershed Management Group (ULAR WMG). 2020. Upper Los Angeles River Load Reduction Strategy Adaptation Plan: Preliminary Sampling and Analysis Plan / Quality Assurance Program Plan. Developed for the Upper Los Angeles River Watershed Management Group. December 2020. Developed by Tetra Tech, Inc. and Craftwater Engineering.

Urban Water Resources Research Council. 2014. Pathogens in Urban Stormwater Systems. August 2014.

APPENDIX A: PRELIMINARY PAIRED FECAL INDICATOR BACTERIA AND HF183 DATA COLLECTION

1 BACKGROUND AND PURPOSE

The Upper Los Angeles River (ULAR) Watershed Management Group (WMG) is adaptively addressing the Los Angeles River Bacteria TMDL and its Load Reduction Strategy (LRS), incorporating a more targeted framework for human source control to reduce pathogen health risks to downstream recreators, via the approach and implementation plan outlined in the main body of the LRS Adaptation Plan. A core tool of this plan and the ability to target human source control, is using indicators in source investigations that identify the presence of human sources. The presence of human sources may be indicated by the human-associated microbial source tracking (MST) marker HF183.

This appendix summarizes sampling that was conducted to start gathering this type of information in the ULAR watershed. Based on preliminary catchment prioritization results, focused in Segment B and associated tributaries watershed (which have the earliest LRS deadlines), the Group proactively identified three areas of investigation (AOIs), shown in **Figure 1**. The preliminary catchment prioritization approach was similar to that outlined in Section 2 of the main body of the LRS Adaptation Plan. The Group then conducted screening of paired FIB and HF183 concentrations at an outfall in each AOI and associated receiving waters. The outfalls were identified as highest priorities and further selected based on stakeholder input. Descriptions and locations of the sampled outfalls are summarized in **Table 1**.

Table 1. ULAR HF183-Sampled Outfalls.

Outfall Name	Site Description	Latitude	Longitude
AS-17	Arroyo Seco Priority #1 Outfall	34.10251	-118.19737
LAR-B-R2-04	Segment B Mainstem Priority #1 Outfall	34.0037	-118.196075
RH-078	Rio Hondo Priority #1 Outfall	34.001145	-118.102958

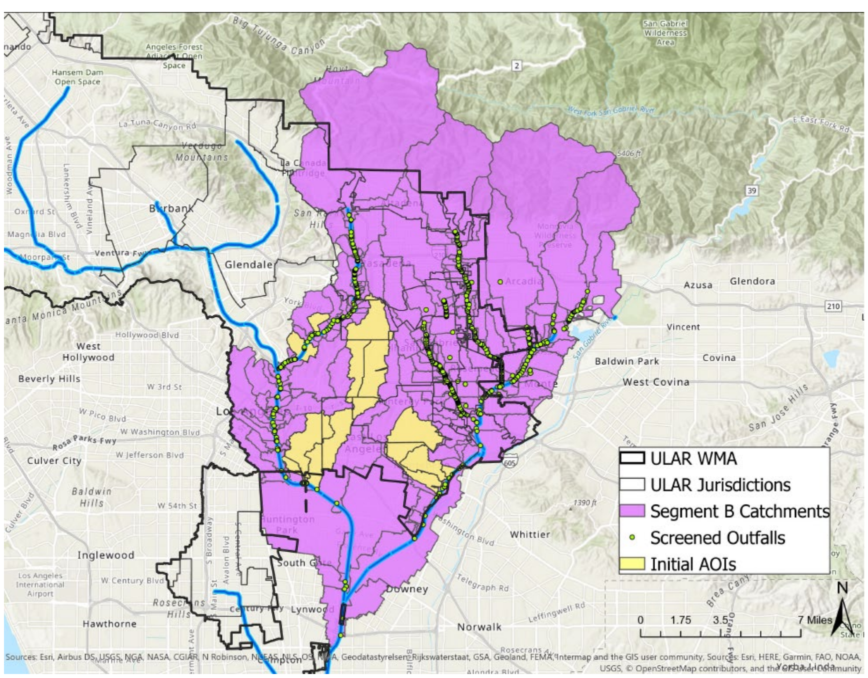


Figure 1. Initial AOIs identified in the Segment B watershed.

Figure 2, **Figure 3**, and **Figure 4** illustrate site photos taken at the outfall location and receiving water bodies for the AS-17, LAR-B-R2-04, and RH-078 outfalls, respectively.

Figure 2. AS-17 Outfall Taken on August 5, 2020 (Left) and Upstream View of AS-17 Outfall from Downstream Receiving Water Body Location Taken on November 6, 2020 (Right).

Figure 3. LAR-B-R2-04 Outfall Taken on January 13, 2021 (Left) and Downstream View from Downstream Receiving Water Body Location Taken on January 13, 2021 (Right).

Figure 4. RH-078 Outfall Taken on August 5, 2020 (Left) and Upstream View of RH-078 Outfall from Downstream Receiving Water Body Location Taken on August 5, 2020 (Right).

2 MONITORING ACTIVITIES

Monitoring activities of the selected outfalls took place on four sampling dates as detailed in **Table 2**. The following were monitored on each sampling date:

- Verification of flow status, estimation of flow rates, and visual observations
- Collection of samples for analysis of *Escherichia coli* (*E. coli*) and HF183

Table 2. Monitoring Activities Event Details and Comments.

Event	Date	Monitoring Notes
Event 1	August 5, 2020	Grab samples at 9 locations, including field quality assurance (QA) samples. The 9 locations included 3 outfalls plus paired upstream and downstream receiving water locations for each outfall[1].
Event 2	November 6, 2020	Grab samples at 7 locations, including field QA samples. The 7 locations included 3 outfalls, plus paired upstream and downstream receiving water locations for 2 out of 3 outfalls. The receiving water locations for the third outfall were dry.
Event 3	December 7, 2020	Grab samples at 8 locations, including field QA samples. The 8 locations included 3 outfalls, plus paired upstream and downstream receiving water locations for 2 out of 3 outfalls. The upstream receiving water location for the third outfall was dry, but the downstream receiving water location was sampled.
Event 4	January 13, 2021	Grab samples at 9 locations, including field QA samples. The 9 locations included 3 outfalls plus paired upstream and downstream receiving water locations for each outfall.

Samples were received and analyzed within holding times by laboratories, except for one Event 2 HF183 sample filtered outside of the recommended 8-hour hold time. Field QA samples, which included field duplicates (analyzed for *E. coli* only) and field blanks (analyzed for HF183 and/or *E. coli*), indicated field sampling procedures did not introduce contamination or bias[2].

[1] Paired receiving water samples were collected approximately 15 meters upstream or downstream from the outfall discharge at AS-17 and RH-078 and approximately 80 meters upstream and downstream from LAR-B-R2-04 to capture representative (e.g., well-mixed) downstream conditions.

[2] The field blanks analyzed for HF183 and *E. coli* were non-detect and the field duplicates analyzed for *E. coli* had results in the same order of magnitude as the corresponding primary samples.

3 MONITORING RESULTS

HF183 has not yet been assigned a water quality objective (WQO) or action level by federal, state, or regional regulators. Several prioritization thresholds for HF183 have been defined in the main body of the LRS Adaptation Plan as described in **Table 3**. These prioritization thresholds are triggers identified to accomplish the Human Waste Source Identification Strategy in a systematic manner to ensure temporal and spatial relevance, sufficient data is collected for addressing testable hypotheses, and effective use of limited resources. It is important to note that the science that would support development of a WQO for HF183 is actively and rapidly evolving[3].

Table 3. LRS HF183 Prioritization Thresholds.

Waterbody Type	HF183 Prioritization Threshold (copies/100 mL)	Additional Information	
		Relevance	Reference
Outfall	4,100	Catchment source tracking trigger – determined when >10% of paired *E. coli* and HF183 results in the receiving water exceed the 320 CFU/100 mL and > 1,000 copies/100 mL action levels, respectively (LRS Adaptation Plan, 2021). Corresponds to a median illness risk of 30 illnesses per 1,000 recreators in waters contaminated with contamination of unknown age.	Boehm et al., 2018
Receiving Water	1,000	Catchment outfall sampling trigger – determined when >10% of *E. coli* results in the receiving water exceed the 320 CFU/100 mL action level (LRS Adaptation Plan, 2021). Corresponds to a median illness risk of 30 illnesses per 1,000 recreators in waters contaminated with 2.5 day old sewage.	Boehm et al., 2018

[3] For example, the scientific experts that authored the thresholds presented in **Table 3** refined their thresholds in September 2020 (Boehm and Soller, 2020). These thresholds have not yet been incorporated at the regulatory level thus are not presented herein for comparison with sample concentrations.

Results of the monitored activities are summarized in **Table 4** for *E. Coli* and **Table 5** for HF183.

Table 4. *E. coli* Concentrations at Selected Outfalls and Representative Upstream/Downstream Conditions for Each Sampling Event.

Event	Outfall Flow Status (cubic feet per second)	Site Group	*E. coli* (MPN/100 mL)[1,2]		
			AS-17	LAR-B-R2-04	RH-078
Event 1 *August 5, 2020*	Outfalls were flowing. Flow rates ranged from 0.00085 to 0.21 cfs.	Upstream	**990**	**9,200**	41
		Outfall	200	**44,000**	**400**
		Downstream	**960**	**14,000**	220
Event 2 *November 6, 2020*	Outfalls were flowing or ponded. Flow rates from two flowing outfalls ranged from 0.00087 to 0.073 cfs.	Upstream	**880**	**9,200**	NS
		Outfall	**6,100**	200	*260*[3]
		Downstream	**960**	**6,500**	NS
Event 3 *December 7, 2020*	Outfalls were flowing or ponded. Flow rates from two flowing outfalls ranged from 0.01 to 0.07 cfs.	Upstream	134	**2,577**	NS
		Outfall	**3,654**	**12,033**	**441**[4]
		Downstream	107	**2,142**	**369**[4]
Event 4 *January 13, 2021*	Outfalls were flowing or ponded. Flow rates from two flowing outfalls were 0.001 cfs.	Upstream	**1,400**	**3,700**	41
		Outfall	*320*	**9,800**	20[3]
		Downstream	**1,200**	**930**	*300*

[1] 235/100 mL is the single sample limit for *E. coli* defined in the Los Angeles River Bacteria TMDL.
[2] 320/100 mL is the statistical threshold value for *E. coli* defined in California's recently adopted Bacteria Provisions.
[3] The outfall sample from RH-078 was collected from ponded water at the outfall to inform site conditions in the absence of receiving water flow.
[4] The outfall and downstream receiving water samples from RH-078 were collected from ponded water to inform site conditions in the absence of upstream receiving water flow.
Bolded *E. coli* values exceed 320/100 mL and 235/100 mL. Italicized *E. coli* values exceed 235/100 mL.
NS = not sampled due to lack of flow.

Table 5. HF183 Concentrations at Selected Outfalls and Representative Upstream/Downstream Conditions for Each Sampling Event.

Event	Outfall Flow Status (cubic feet per second)	Site Group	HF183 (copies/100 mL)		
			AS-17	LAR-B-R2-04	RH-078
Event 1 *August 5, 2020*	Outfalls were flowing. Flow rates ranged from 0.00085 to 0.21 cfs.	Upstream	524	196	ND
		Outfall	ND	ND	562
		Downstream	**1,895**	57	88
Event 2 *November 6, 2020*	Outfalls were flowing or ponded. Flow rates from two flowing outfalls ranged from 0.00087 to 0.073 cfs.	Upstream	**2,147**	524	NS
		Outfall	1,219	BLOQ	BLOQ[1]
		Downstream	**2,211**	253	NS
Event 3 *December 7, 2020*	Outfalls were flowing or ponded. Flow rates from two flowing outfalls ranged from 0.01 to 0.07 cfs.	Upstream	**3,537**	**10,926**	NS
		Outfall	**303,158**	ND	992[2]
		Downstream	**3,284**	**7,958**	259[2]
Event 4 *January 13, 2021*	Outfalls were flowing or ponded. Flow rates from two flowing outfalls were 0.001 cfs.	Upstream	**44,400**	**11,937**	ND
		Outfall	**10,295**	ND	**69,032**[1]
		Downstream	**95,432**	**9,211**	**72,063**

[1] The outfall sample from RH-078 was collected from ponded water at the outfall to inform site conditions in the absence of receiving water flow.
[2] The outfall and downstream receiving water samples from RH-078 were collected from ponded water to inform site conditions in the absence of upstream receiving water flow.
BLOQ = below the limit of quantification. Limits of quantification (LOQs) for BLOQ samples ranged from 36-39 copies/100 mL.
NS = not sampled due to lack of flow.
Bolded HF183 values exceed the relevant thresholds identified in **Table 3**.

The following subsections further summarize the results at each selected outfall and associated receiving waters. **Figure 5**, **Figure 6**, and **Figure 7** summarize HF183 sample concentrations observed during each event for AS-17, LAR-B-R2-04, and RH-078, respectively.

3.1 AS-17 Outfall

Concentrations of HF183 at the AS-17 upstream/downstream receiving water bodies consistently increased over the course of the four sampling events. While *E. coli* concentrations generally decreased after the confluence of the AS-17 outfall drainage, HF183 concentrations increased after the confluence. Nearly all the upstream/downstream HF183 concentrations were above the relevant 1,000 copies/100 mL action level. Because the majority of the upstream HF183 concentrations were already above the 1,000 copies/100 mL action level prior to the confluence of the AS-17 outfall catchment, this may indicate an upstream source of human fecal contamination not within the catchment; therefore, it may be of interest to strategically investigate potential consistent sources of human fecal pollution in upstream outfall catchments draining to the receiving water body location proximal to the AS-17 outfall.

The first two events at the outfall did not have HF183 concentrations above the 4,100 copies/100 mL action level whereas the last two outfall events had HF183 concentrations significantly above the 4,100 copies/100 mL action level. These outfall results may indicate an intermittent source of human fecal contamination within the outfall catchment, e.g., conditional discharge permits, illegal dumping, RV dumping, sanitary sewer overflow.

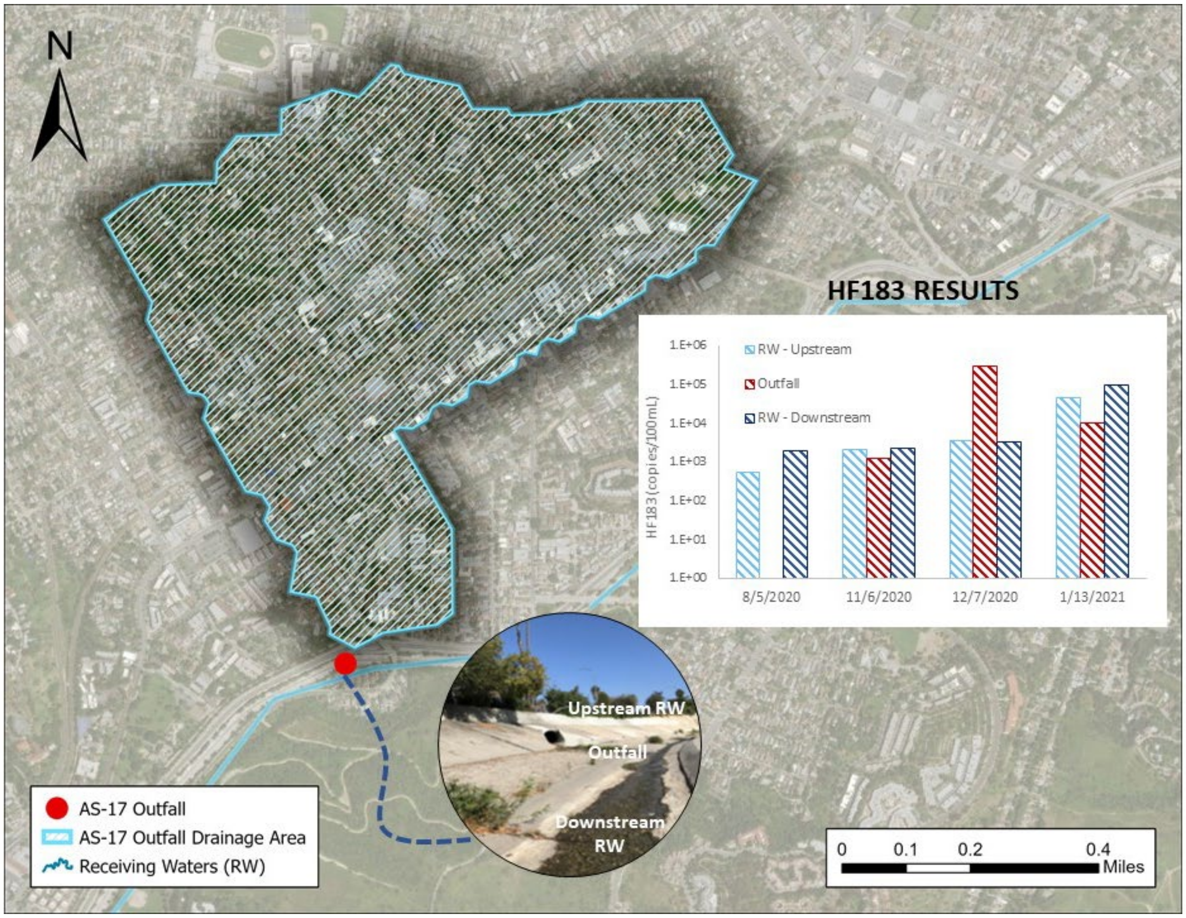


Figure 5. HF183 Results for AS-17 Outfall and Paired Receiving Water Sampling Locations.

3.2 LAR-B-R2-04 Outfall

Consistent lack of quantification of HF183 in the outfall indicates human sources of fecal pollution are likely not major dry weather contributors of fecal indicator bacteria upstream of the outfall.

Generally, the HF183 concentration downstream of the confluence of the LAR-B-R2-04 outfall was lower than upstream of the confluence, indicating that flows from the LAR-B-R2-04 outfall may be diluting the HF183 concentration downstream of the outfall. A similar trend was observed for paired *E. coli* concentrations in which *E. coli* concentrations were consistently elevated/of the same order of magnitude during all events in the upstream receiving water whereas *E. coli* concentrations in the downstream receiving water were generally lower by an order of a magnitude (except for Event 1). HF183 concentrations in the receiving water increased by two to three orders of magnitude over time and were above the 1,000 copies/100 mL action level for two of the sampling events in both the upstream and downstream receiving waters. This may indicate a potential human source of fecal pollution in outfall catchments upstream of the receiving water body location proximal to the LAR-B-R2-04 outfall.

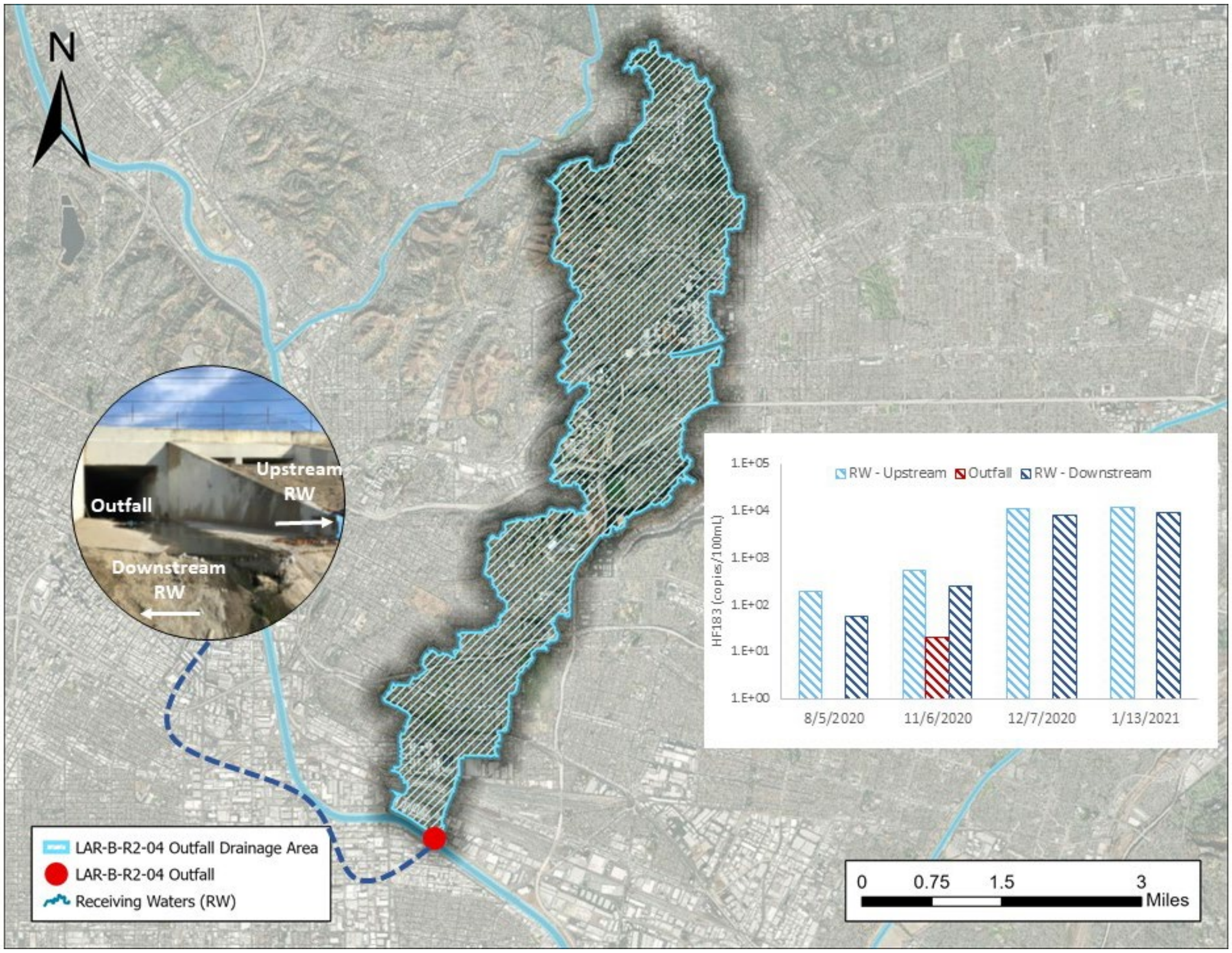


Figure 6. HF183 Results for LAR-B-R2-04 Outfall and Receiving Water Sampling Locations.

3.3 RH-078 Outfall

HF183 concentrations are variable in the outfall (ranging from BLOQ to 69,032 copies/100 mL, which is above the 4,000 copies/100 mL action level) and receiving water flow status is inconsistent, resulting in limited data for full receiving water characterization. The variable HF183 concentrations throughout the four sampling events may indicate a potential intermittent source of human fecal pollution within the catchment, e.g., conditional discharge permits, illegal dumping, RV dumping, sanitary sewer overflow. The upstream receiving water, when sampled, had very low *E. coli* concentrations and non-detect HF183 concentrations whereas the downstream receiving water, when sampled, had slightly elevated *E. coli* concentrations (between 200 to 400 MPN/100 mL) and variable HF183 concentrations (88 to 72,063 copies/100 mL). The elevated HF183 concentration in the downstream receiving water corresponded to the sample day with the elevated HF183 concentration in the outfall; the non-detect HF183 concentration in the upstream receiving water on the same sample day indicates that there is likely not a potential upstream source of human fecal pollution.

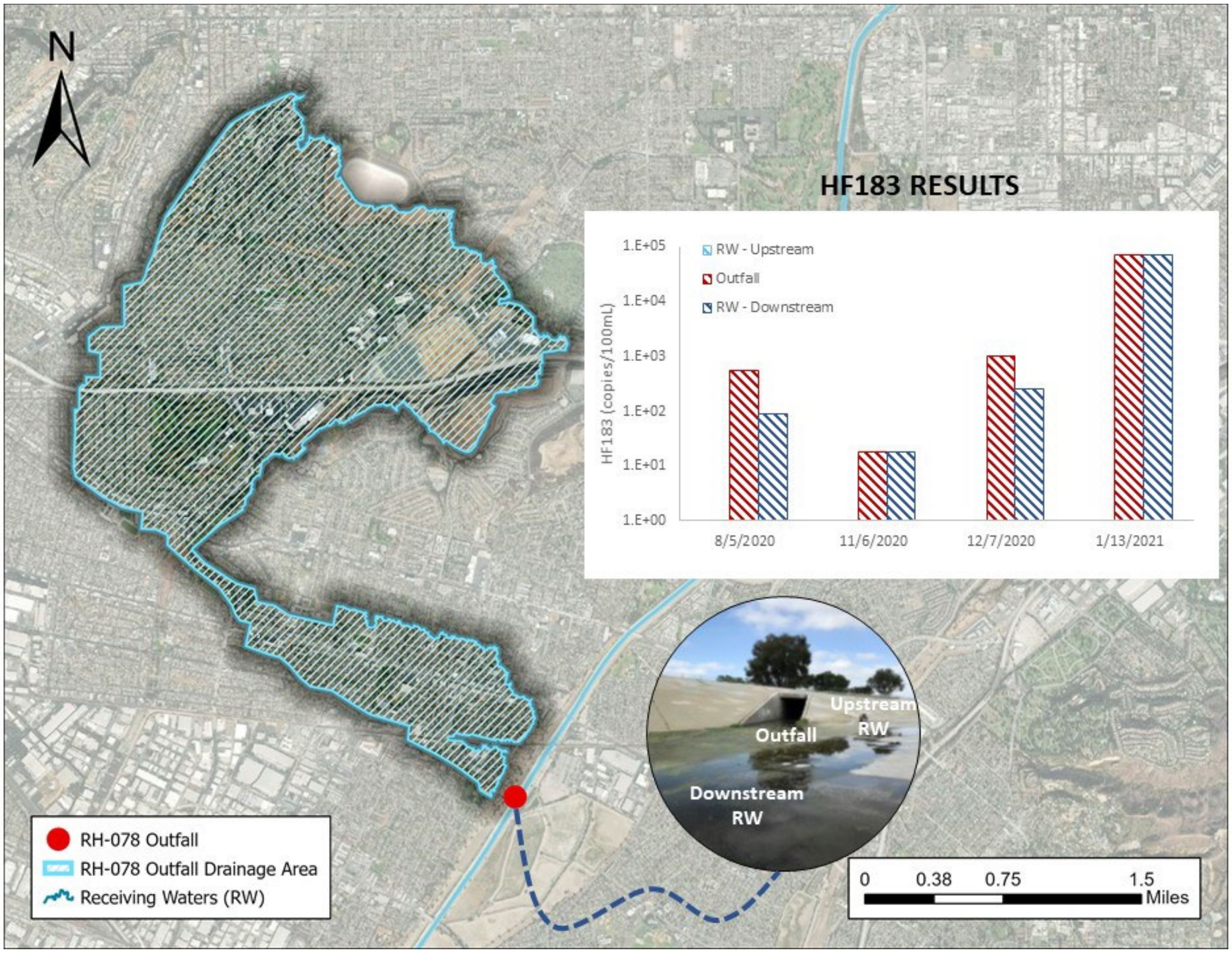


Figure 7. HF183 Results for RH-078 Outfall and Paired Receiving Water Sampling Locations.

4 PRELIMINARY TAKEAWAYS & NEXT STEPS

The preliminary samples only covered four sampling events at three separate outfalls and associated receiving waters, but already point towards the value human marker data can present to better understand risk. However, the sampling effort is still only a small sample size and for comprehensive conclusions on the outfall and receiving water conditions enhanced representation of sampling is required, following the framework outlined in Section 2 of the main body of the LRS Adaptation Plan. Specific follow-up sampling will be contingent on the identification of areas of investigation and human waste source investigation needs, as described further in the main body of the LRS Adaptation Plan.

The following summarizes recommended initial next steps based on the findings for each outfall.

4.1 AS-17

Timely follow up is recommended to address highly elevated Event 3 and 4 AS-17 outfall and receiving water concentrations. Additional sample collection at the outfall and/or inclusion of additional constituents indicative of sewage may provide more information. If sewage remains a potential source of the HF183, upstream source tracking in the MS4 is recommended to identify the source. Refer to Appendix B for additional information on the proof of concept and additional sampling conducted for the AS-17 catchment.

4.2 LAR-B-R2-04

Though HF183 was consistently not quantified in the LAR-B-R2-04 outfall, HF183 concentrations in the receiving water increased by two to three orders of magnitude over time. If increased understanding of the HF183 prevalence in the receiving water is desired, desktop analysis and additional monitoring would improve characterization of microbial water quality and may help identify other sources to the receiving water (e.g. permitted discharges that may contain HF183, upstream outfall discharges, illicit discharges, etc).

4.3 RH-078

HF183 concentrations in the RH-078 outfall were highly variable. Timely follow up is recommended to address highly elevated Event 4 RH-078 outfall and downstream concentrations. Additionally, lack of flow limited characterization of receiving water microbial water quality. Additional sampling is recommended to improve characterization of both the outfall and the receiving water at this location.

5 REFERENCES

Boehm, Alexandria B., et al. 2018. Can We Swim Yet? Systematic Review, Meta-Analysis, and Risk Assessment of Aging Sewage in Surface Waters. Environmental Science & Technology. September.

Boehm, Alexandria B. and Jeff A. Soller. 2020. Refined ambient water quality thresholds for human-associated fecal indicator HF183 for recreational waters with and without co-occurring gul fecal contamination. Microbial Risk Analysis. September.

Mayer, Rene E., et al. 2018. Global Distribution of Human-Associated Fecal Genetic Markers in Reference Samples from Six Continents. Environmental Science & Technology. May.

South Orange County Permittees. 2020. Comprehensive Human Waste Source Reduction Strategy (CHWSRS) Work Plan for the South Orange County (San Juan Hydrologic Unit) Water Quality Improvement Plan (WQIP). February.

Upper Los Angeles River Watershed Management Group, 2015. Coordinated Integrated Monitoring Program for the Upper Los Angeles River Watershed. August

APPENDIX B: SOURCE IDENTIFICATION MONITORING FRAMEWORK: AS-17 PROOF OF CONCEPT

1 AS-17 SOURCE IDENTIFICATION MONITORING BACKGROUND

The Upper Los Angeles River (ULAR) Watershed Management Group (WMG) is adaptively addressing the Los Angeles River Bacteria TMDL and its Load Reduction Strategy (LRS), incorporating a more targeted framework for human source control to reduce pathogen health risks to downstream recreators, via the approach and implementation plan outlined in the main body of the LRS Adaptation Plan. The Plan provides an effective foundation to address pathogen health risk and will help to streamline efforts across agencies and other stakeholders. The Plan helps to identify the most effective pathway towards improved public health and attainment of bacteria-related water quality objectives through an adaptive management process that incorporates significant advances in the state of the science.

A primary component of the Plan is conducting human waste source investigations (HWSI) within delineated Areas of Investigation (AOI). The Plan defines a model framework (see LRS Adaptation Plan Section 2.5 and Figure 2-19) for performing HWSIs including key considerations, a 'toolbox' of potential methods, and action levels for efficient and objective decision making. HWSIs developed based on this framework will be performed using traditional and non-traditional illicit discharge/illicit connection investigation techniques. The use of molecular techniques, such as human source marker HF183, to analyze samples are emphasized during HWSIs.

To identify sources of human waste within an AOI, a HWSI will be completed following an efficient and systematic approach. The inputs to this framework include catchment prioritization, water quality condition assessment results, and source inventory from prioritization. As outlined in the Plan, the framework steps are:

1. characterize the AOI,
2. conduct stakeholder coordination,
3. gather additional data,
4. develop testable hypotheses,
5. develop a HWSI monitoring plan, and
6. implement the HWSI Monitoring Plan.

The results of the HWSI will inform the recommended next steps that may include source abatement or other appropriate implementation actions to address if sources are identified, or designation of the AOI as a lower priority if monitoring results provide sufficient evidence that there is a low risk of the AOI impacting human health.

The AS-17 outfall and its associated catchment were selected by the ULAR Group as a proof-of-concept AOI for the source identification monitoring framework based on:

- historical concerns about illicit discharge/connections which led to an investigation by the LASAN Watershed Protection District in 2016;
- the catchment being identified as a high priority during the first draft catchment prioritization under the LRS Adaptation
- preliminary stakeholder input on potential human waste sources in the catchment; and
- outfall and receiving water monitoring performed between August 2020 and January 2021.

As shown in Figure B-1, the AS-17 outfall is located within the Segment B drainage of the Los Angeles River within the Upper Los Angeles River watershed. The following sections detail the considerations and activities involved in implementing the Source Identification Monitoring Framework for the AS-17 AOI.

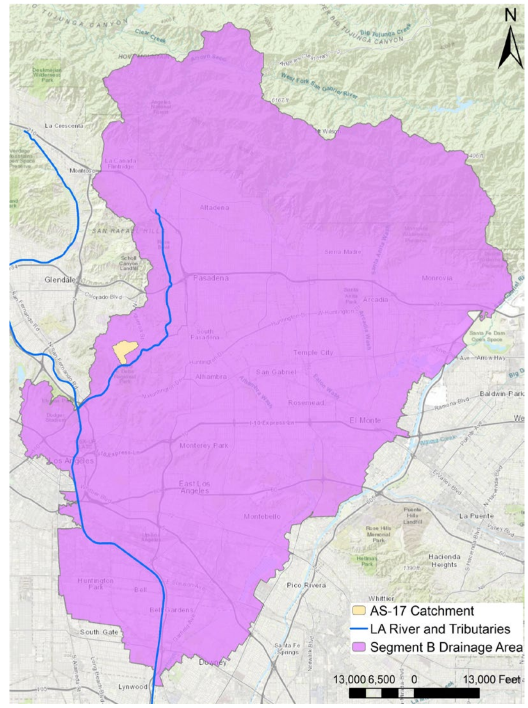


Figure B-1. Map of AS-17 Catchment within the Segment B Drainage Area

2 SOURCE IDENTIFICATION MONITORING FRAMEWORK STEPS

Characterize AOI

The AS-17 AOI is located entirely within the City of Los Angeles. Land use within the AOI is a mix of residential and commercial areas. At the upstream end of the catchment is the Highland Park Recreation Center (Rec Center), which includes a gym, baseball field, playground, pool, and other amenities. During the limited outfall and receiving water monitoring in 2020, flow was observed at manholes near the Rec Center. There was also an abundance of homeless encampments around the Rec Center area. Refer to Appendix A for additional details on the preliminary outfall and receiving water monitoring conducted at AS-17. Between the Rec Center and the outfall, the MS4 runs down Figueroa St., with lateral lines along the perpendicular avenues (e.g., N. Avenue 61) – see Figure B-2 for a map of the AS-17 AOI and MS4 Network. Figueroa St. is filled with a mixture of businesses, from retail to restaurants. Site reconnaissance of the AS-17 AOI was performed with the City of Los Angeles Department of Public Works Bureau of Sanitation (LASAN) on May 27, 2021 to additionally characterize the AOI ahead of sampling.

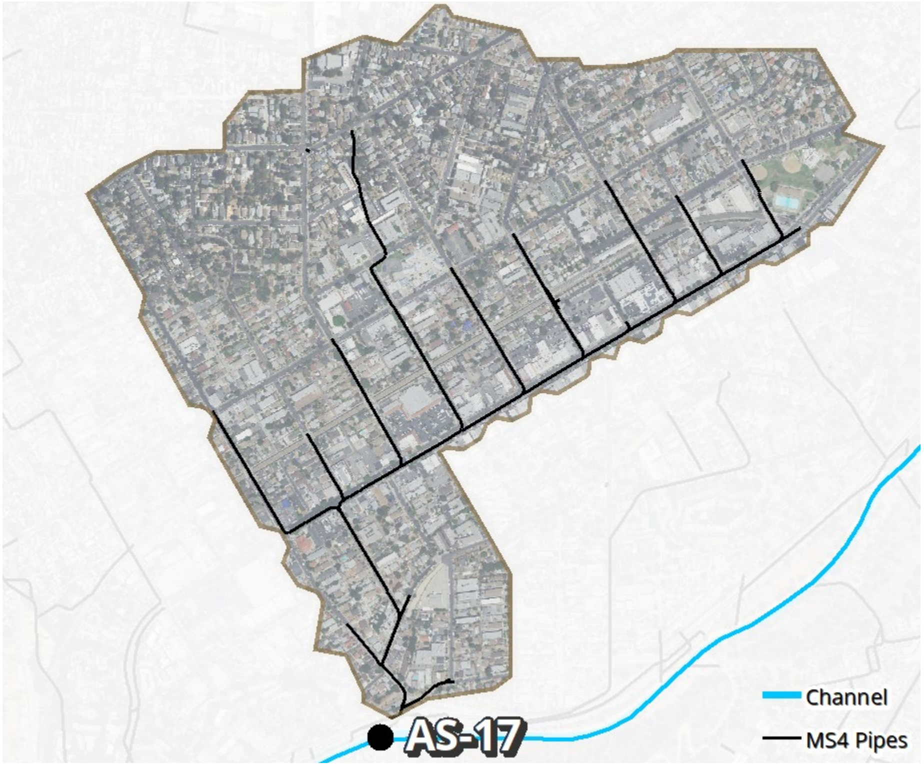


Figure B-2. Map of AS-17 AOI and MS4 Network

Conduct Stakeholder Coordination

Stakeholder coordination is crucial to conducting an effective HWSI as it provides for sharing of information/knowledge of a given AOI, as well as helps to build consensus about potential sources, and investigation objectives and methods. Important stakeholders for the AS-17 catchment included the LRS Technical Advisory Committee (TAC) and the ULAR Group. Additionally, because the AOI is relatively small and is located entirely within the boundaries of the City of Los Angeles, different City departments were also primary stakeholders. Other groups and agencies could potentially become part of the stakeholder coordination process, such as the Regional Board and wastewater agencies. Specific stakeholder interaction and important findings are noted below:

- The LRS TAC and ULAR Group are comprised of Permittees or their representatives, located in the ULAR WMA. LRS TAC and ULAR Group meetings served as key coordination and information sharing forums.
- LASAN representatives played a significant role in the AS-17 HWSI. The LASAN Watershed Protection Division guided the investigation based on their lead role with LRS implementation and awareness of past source investigations in the AS-17 catchment. The LASAN Watershed Protection Division also assisted with coordinating site reconnaissance and obtaining rights of entry/access. Finally, crews from the LASAN Clean Water Conveyance Division - South, provided traffic control each monitoring day.
- The City's Illicit Connection and Illicit Discharge (ICID) team presented recent ICID cases for reference, as well as shared details regarding a past source investigation within the catchment.
- The City's Department of Recreation and Parks, Aquatics Division, provided details regarding Highland Park Pool operations and maintenance, observations regarding homeless encampments, and parcel plans for the area.

Gather Additional Data

While detailed data are aggregated across the watershed during catchment prioritization, conditions within each AOI are variable. Collecting relevant scientific and anecdotal data is imperative to address AOI-specific characteristics and fill data gaps thereby developing a fuller picture of conditions and potential influences within the catchment. As a result of the aforementioned stakeholder coordination and other data gathering efforts with various City departments and the LRS TAC, the following additional data were obtained:

- AS-17 catchment-specific data from the catchment prioritization consisted of several geographic datasets including sanitary and MS4 networks; locations of homeless encampments; sanitary sewer overflows; private lateral sewer discharges; fats, oils, and grease (FOG) inspection locations and restaurants; and ICID hotspots.
- The ICID cases provided by the City's ICID team included the applicable zip code, and these were parsed out to identify the ones specifically in the AS-17 catchment area. Of particular note, three ICID cases flagged as "Biological Waste - Feces" were documented on 9/9/2020, 10/26/2020, and 11/8/2020 within the AS-17 AOI.
- Dry weather flows from the AS-17 outfall and the adjacent channel were sampled on four separate occasions between August 2020 and January 2021. Samples were analyzed for *E. coli* and HF183. HF183 was detected at the outfall during three of the four events (1,219 copies/100 mL, 303,158 copies/100 mL, and 10,295 copies/100 mL respectively), with two of these samples exceeding the HF183 outfall action level (4,100 copies/100mL) specified in the Plan. Refer to Appendix A for additional details on the preliminary outfall and receiving water monitoring conducted at AS-17.
    - Initial dry weather sampling at the AS-17 outfall was conducted in January through June 2015. Of the six screening events, five observed flows at the AS-17 outfall, ranging from 0.0001 cfs up to 0.035 cfs. *E. coli* concentrations for the five flowing events were 620 copies/100 mL, 640 copies/100 mL, 16,000 copies/100 mL, 82,000 copies/100 mL, and 3,100 copies/100 mL.
- Coordination with the City's Department of Recreation and Parks, Aquatics Division, resulted in new information regarding the status of the pool at the time of prior outfall sampling and analysis that yielded high *E. coli* and HF183 results. Specifically, the Highland Park Pool was empty during monitoring performed between August 2020 through January 2021, therefore it could not account for any discharges. The Aquatics Division also described a homeless encampment that was located at the south end of the Rec Center, including observations of human waste being dumped into nearby stormwater catch basins.
- During site reconnaissance on May 27, 2021, the homeless encampment that was once observed at the south end of the Rec Center was no longer present, there were no signs of dry weather runoff, and numerous manholes identified through desktop analysis as potential sampling sites were buried under asphalt and thus not accessible.

Develop Testable Hypotheses

To efficiently use resources and reduce variability in results, testable hypotheses allow the Group to ensure a HWSI is directly tied to LRS Adaptation Plan goals, and the hypotheses are targeted to the AOI. Based on stakeholder coordination and additional data gathering, two hypotheses were derived for the potential source of human waste in the AS-17 catchment.

1. Exfiltration from the sanitary sewer is a source of human waste in the AS-17 catchment; and
2. Homeless encampments at or near the Rec Center area are a source of human waste in the AS-17 catchment.

Develop HWSI Strategy for AOI

The HWSI synoptic monitoring was initially planned for two days in June 2021, with two rounds of monitoring per day – one round early in the morning, and the second round in the afternoon. Paired sampling of *E. coli* and HF183, along with discharge velocity measurements (i.e., to calculate discharge flow) were the selected monitoring methods from the source tracking toolbox.

After reconnaissance of the AS-17 catchment and due to previous observations pointing to potential sources centered around the Rec Center, two primary strategies for investigating human sources were created, Plan A and Plan B. The Plan implemented would be based on whether flow was observed at a manhole adjacent to the Rec Center (i.e., the top of the catchment). Plan A would be implemented if there was flow at the Highland Park Rec Center manhole, and Plan B would be carried out if there was low/no flow at the Rec Center manhole. These two options helped provide adaptability and flexibility in the field. At the start of each monitoring event, a flow check would be performed at the manhole near the Rec Center (located at the intersection of N. Avenue 61 and Figueroa St.), and depending on flow levels there, Option A or Option B would be selected as appropriate. Ultimately, monitoring would be performed according to conditions observed each day of monitoring including, but not limited to the presence/absence of flow and site accessibility.

Additionally, although Option A and Option B were created to drive the plan of action for the HWSI, ultimately, the sites monitored each day depended on flow, presence, and accessibility.

Implement the HWSI Monitoring Plan

Based on limited flow in the catchment, monitoring was ultimately expanded to a four-day period: June 1, June 3, June 7, and June 8, 2021. Tables B-1 through B-4 summarize each day of monitoring including the sites visited and associated conditions. Figure B-3 depicts the sites that were monitored over the four-day period.

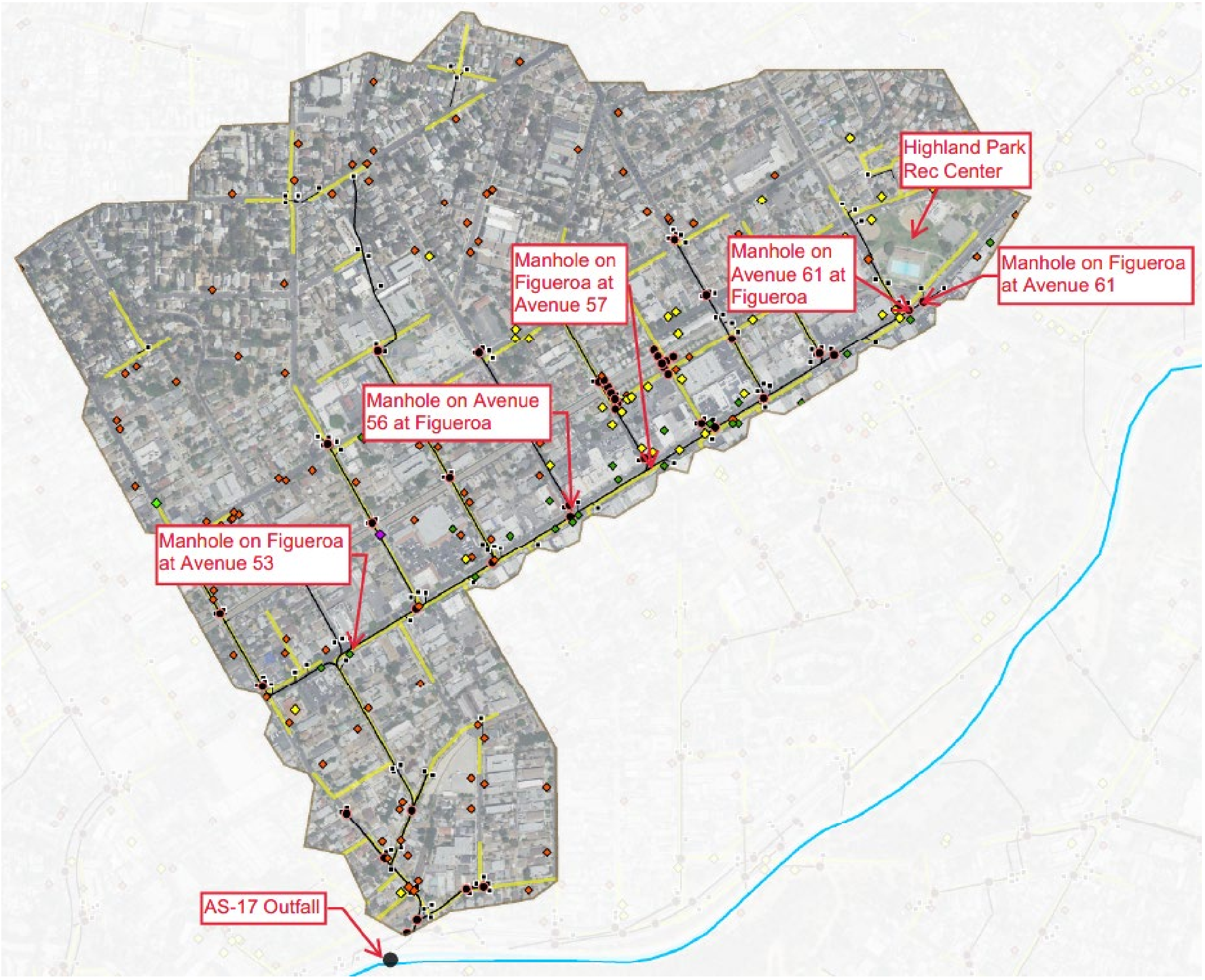


Figure B-3. Map of AS-17 HWSI Monitoring Sites

DAY 1

On Day 1, a greater number of sites were visited than other days to gather more information about the catchment. Some of these sites were deemed unsuitable for the HWSI and discontinued. Ultimately, none of the sites exhibited flow; thus, no samples were collected. Based on the field observations of the morning monitoring event, and upon coordination with the LASAN Watershed Protection District, it was determined that no separate afternoon monitoring event would be conducted. Table B-1 and Figure B-4 provide a summary and photos, respectively, of the first day of monitoring.

Table B-1. Monitoring Day 1 Summary

Date/Time (XXXX hrs)	Site	Wet or Dry	Flow Present?	Samples Collected?	Notes
6/1/21 0831	Manhole on N. Ave. 61 at Figueroa St.	Dry	No	No	
6/1/21 0842	Manhole on Figueroa St. at N. Ave. 61	Wet	No	No	
6/1/21 0907	Manhole on Longfellow St. at S. Ave. 53	N/A	N/A	N/A	Determined to be sewer manhole, not storm drain – site discontinued
6/1/21 0942	Manhole on Figueroa St. at N. Ave. 53	Wet	No	No	
6/1/21 1005	Manhole on N. Ave. 55 at Figueroa St.	N/A	N/A	N/A	Manhole buried under asphalt and could not be raised – site discontinued
6/1/21 1027	Manhole on Figueroa St. at N. Ave. 57	Wet	No	No	
6/1/21 1241	AS-17 outfall	Wet	No	No	Arroyo Seco flowing; no flow at AS-17 (i.e. no connectivity to the Arroyo Seco)

Site #5 (Manhole on N. Avenue 61 at Figueroa St.)

Site #4 (Manhole on Figueroa St. at N. Avenue 61)

Manhole on Figueroa St. at N. Avenue 53

Manhole on Figueroa St. at N. Avenue 57

AS-17 outfall

Figure B-4. Photos of Monitoring Sites on June 1, 2021

DAY 2

The sampling plan on Day 2 followed an adaptive approach based on the observations from the first day of monitoring. Monitoring began in the morning with a flow check at the AS-17 outfall. Since there was flow, paired *E. coli* and HF183 samples were taken at the outfall. Two manholes were subsequently monitored: the manhole on N. Avenue 61 at Figueroa St. and the manhole on Figueroa St. at N. Avenue 53. Both manholes were wet but were not flowing, so samples were not collected. Based on the field observations of the morning monitoring event, and upon coordination with the LASAN Watershed Protection District, it was determined that no separate afternoon monitoring event would be conducted. Table B-2 and Figure B-5 provide a summary and photos, respectively, of the second day of monitoring.

Table B-2. Monitoring Day 2 Summary

Date/Time (XXXX hrs)	Site	Wet or Dry	Flow Present?	Samples Collected?	Notes
6/3/21 0843	AS-17 outfall	Wet	Yes; 0.0000312 cfs	Yes	Water was slightly yellow and had floatables; homeless encampments in channel. AS-17 flow connected with Arroyo Seco. Arroyo Seco was flowing.
6/3/21 1000	Manhole on Figueroa St. at N. Ave. 61	Wet	No	No	Grass on N. Ave. 61 was wet, possibly from irrigation
6/3/21 1020	Manhole on Figueroa St. at N. Ave. 53	Wet	No	No	Grass nearby was dry

AS-17 outfall

Manhole on N. Avenue 61 at Figueroa St.

Manhole on Figueroa St. at N. Avenue 53

Figure B-5. Photos of Monitoring Sites on June 3, 2021

DAY 3

On Day 3, monitoring began with a flow check at the AS-17 outfall. Since there was flow, paired *E. coli* and HF183 samples were taken at the outfall. The manhole on N. Avenue 61 at Figueroa St. was monitored; it was wet but without flow, so samples were not collected. Based on the field observations of the morning monitoring event, and upon coordination with the LASAN Watershed Protection District, it was determined that no separate afternoon monitoring event would be conducted. Table B-3 and Figure B-6 provide a summary and photos, respectively, of the third day of monitoring.

Table B-3. Monitoring Day 3 Summary

Date/Time (XXXX hrs)	Site	Wet or Dry	Flow Present?	Samples Collected?	Notes
6/7/21 0800	AS-17 outfall	Wet	Yes; 0.000321 cfs	Yes	Water was light yellow; homeless encampments in channel. AS-17 flow connected with Arroyo Seco. Arroyo Seco was flowing.
6/7/21 0848	Manhole on Figueroa St. at N. Ave. 61	Wet	No	No	Private maintenance crews at Rec Center potentially related to pool repairs.

AS-17 outfall

Manhole on N. Avenue 61 at Figueroa St.

Figure B-6. Photos of Monitoring Sites on June 7, 2021

DAY 4

The fourth and final day of sampling consisted of two rounds of monitoring, one in the morning and the other in the afternoon. During the morning event, the AS-17 outfall was flowing and was sampled for *E. coli* and HF183. The manhole on N. Avenue 61 at Figueroa St. and the manhole on Figueroa St. at N. Avenue 53 were visited, and both were wet but not flowing; thus, samples were not taken. In the afternoon, the AS-17 outfall was flowing and was sampled for *E. coli* and HF183; the water was darker in color and more turbid than that morning. Afterward, when sampling personnel were driving to N. Avenue 61, they observed City tree trimming crews on Figueroa St. near N. Avenue 54. The next site, the manhole on N. Avenue 61 at Figueroa St., was observed to be wet but had no flow and was not sampled. At the Rec Center, sampling personnel spoke with a City of LA Rec and Parks employee and she stated the following about potential sources of flow in the area:

- Previously, people experiencing homelessness at and surrounding the Rec Center would urinate and defecate in buckets and dump them in the Arroyo Seco or storm drains. However, Port-a-Potties were setup at and around the Rec Center over the past year, and individuals now empty their buckets in the Port-a-Potties. The Port-a-Potties are emptied every morning before 0800 hours.
- Previously, there were homeless encampments at and near the Rec Center, but they have migrated elsewhere.
- Sprinklers at the Rec Center are turned on twice per week.
- Businesses in the area could be power washing their businesses, sidewalks, walls, etc. to remove graffiti.

The third site visited, the manhole on Figueroa St. at N. Avenue 53, was flowing and was sampled for *E. coli* and HF183. Sampling personnel observed a weekly farmers market at Marmion Way and N. Avenue 57, which could have contributed to flows. The final site visited, a manhole on N. Avenue 56 at Figueroa St., was slightly wet but was not flowing, so was not sampled. Table B-4 and Figure B-7 and Figure B-8 provide summaries and photos, of the fourth and last day of monitoring.

Table B-4. Monitoring Day 4 Summary

Date/Time (XXXX hrs)	Site	Wet or Dry	Flow Present?	Samples Collected?	Notes
6/8/21 0746	AS-17 outfall	Wet	Yes; 0.000289 cfs	Yes	Water was slightly yellow and had floatables; homeless encampments in channel. AS-17 flow connected with Arroyo Seco. Arroyo Seco was flowing.
6/8/21 0825	Manhole on Figueroa St. at N. Ave. 61	Wet	No	No	Grass on N. Ave. 61 had dew; a pile of belongings was observed near the Rec Center pump house, along with a City truck
6/8/21 0840	Manhole on Figueroa St. at N. Ave. 53	Wet	No	No	Grass nearby was dry
6/8/21 1313	AS-17 outfall	Wet	Yes; 0.000212 cfs	Yes	Water was light brown and very turbid; homeless encampments in channel. AS-17 flow connected with Arroyo Seco. See above narrative for additional notes.
6/8/21 1349	Manhole on Figueroa St. at N. Ave. 61	Wet	No	No	Pool was being filled and started at around 09:30. See above narrative for additional notes.

Date/Time (XXXX hrs)	Site	Wet or Dry	Flow Present?	Samples Collected?	Notes
6/8/21 1405	Manhole on Figueroa St. at N. Ave. 53	Wet	Yes; 0.0875 cfs	Yes	Water was light yellow and smelled slightly fishy
6/8/21 1451	Manhole on N. Ave. 56 at Figueroa St.	Wet	No	No	See above narrative for notes.

Morning

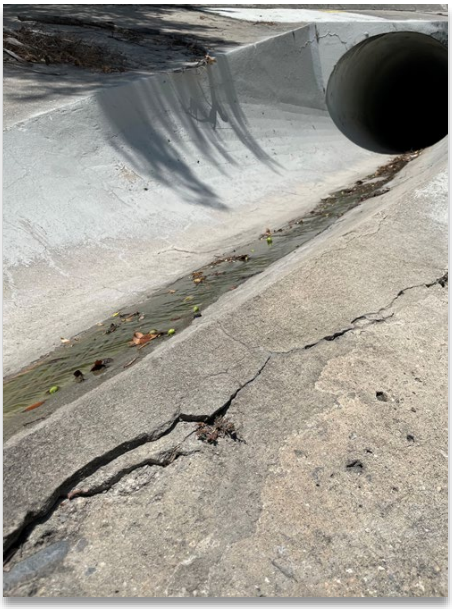
AS-17 outfall

Manhole on N. Avenue 61 at Figueroa St.

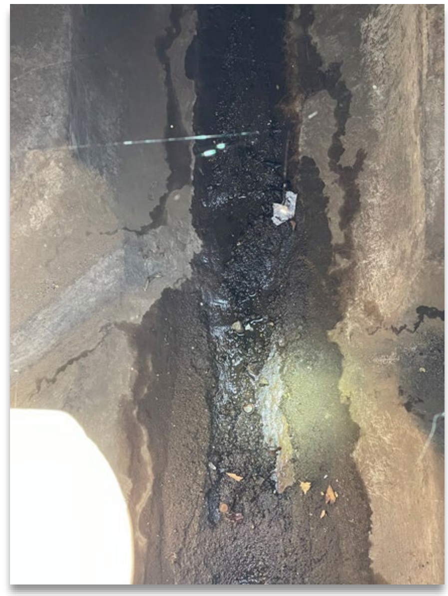
Manhole on Figueroa St. at N. Avenue 53

Figure B-7. Photos of Morning Monitoring Sites on June 8, 2021

Afternoon



AS-17 outfall



Manhole on N. Avenue 61 at Figueroa St.

Manhole on Figueroa St. at N. Avenue 53

Manhole on N. Avenue 56 at Figueroa St.

Figure B-8. Photos of Afternoon Monitoring Sites on June 8, 2021

HWSI Results

Over the course of the four days of monitoring, four samples of *E. coli* and HF183 were collected and analyzed; three of each of these samples were taken at the AS-17 outfall, while one was taken at the manhole on Figueroa St. at N. Avenue 53. Table B-5 provides a summary of these monitoring results.

Table B-5. Monitoring Results

Date/Time	Site	*E. coli* (cfu/100 mL)	HF183 (copies/100 mL)
6/3/21 09:05	AS-17	260	208
6/7/21 08:04	AS-17	6,100	625
6/8/21 07:50	AS-17	480	278
6/8/21 13:20	AS-17	7,700	152
6/8/21 14:25	Manhole on Figueroa St. at N. Avenue 53	5,000	19[1]

[1] Below level of quantification

The results were compared to the action levels and monitoring triggers identified in the Plan (see Plan Section 2.5.6 Table 2-7). Three of the four AS-17 outfall samples exceeded the action level for *E. coli* (i.e., 320 cfu/100 mL) that would trigger subsequent source tracking in the upstream catchment; however, all HF183 samples collected from the AS-17 outfall were below the action level for outfalls (4,100 copies/100 mL). Of particular note, on June 8 at AS-17, *E. coli* results increased greatly between morning and afternoon, but HF183 results decreased slightly. HF183 results were highest for AS-17 on June 7 out of all the sampling dates. Overall, only one manhole had flow and was sampled: the manhole on Figueroa St. at N. Avenue 53 on June 8 in the afternoon. Based on these limited results, further sampling upstream would not be required due to the low potential for human health risk. However, the samples collected to date represent a relatively small sample population, so additional dry weather investigation is warranted to confirm these preliminary findings and to rule out the AS-17 catchment as a potential pathogen health risk to downstream recreators.

3 NEXT STEPS

The current results indicate the AS-17 catchment poses no pathogen health risk to potential downstream recreators; however, given the limited number of dry weather observations, it is recommended additional dry weather monitoring (i.e., observations and possibly sampling) be conducted. If flow is observed at the outfall, collection of paired *E. coli*/HF183 samples at the outfall and possibly upstream manholes, should be performed. If additional dry weather monitoring yields similar results, then there will be sufficient evidence that dry weather pathogen health risk from the AS-17 catchment to recreators in the receiving water is low, and the catchment should be deemed a low priority for further dry weather investigation and load reduction. If the additional dry weather monitoring results indicate potential risk, further investigation efforts should target the potential sources previously identified during the source investigation process such as over-irrigation, power washing, and homeless encampments. Associated iterative changes to the source investigation framework may be needed to gather additional data, revise the testable hypotheses, and update monitoring strategies for the targeted sources.

APPENDIX C: SOURCE ABATEMENT STRATEGIES ADDENDUM

The Load Reduction Strategy (LRS) Adaptation Plan (Plan) employs a risk-based, data-driven approach to address the Los Angeles River Bacteria Total Maximum Daily Load (TMDL) requirements. The Plan was initially submitted in August 2021 and provides the foundation to address pathogen health risk and ensure beneficial use attainment by prioritizing limited resources on targeted source control efforts (Human Waste Source Investigations) to be most effective in areas posing the highest risks to human health from recreational uses. As sources of human waste are identified through investigations, human waste control actions will be implemented to abate. Section 2.6 of the Plan detailed potential source abatement strategies and included:

- A summary of programs and activities that provide valuable human source abatement,
- A summary of the State Water Resources Control Board's (SWRCB) Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (Sanitary Sewer Systems WDR),
- A summary of the draft of the SWRCB's Statewide Sanitary Sewer Systems General Order, and
- General abatement recommendations based on the source identified for the following sources:
    - Malfunctioning wastewater, water, or recycled water infrastructure
    - Homeless encampments
    - Sanitary sewer overflows
    - Fats, oils, and grease impacts
    - Illicit connection/illicit discharge
- A summary of proactive potential new abatement strategies

The purpose of this addendum is to expand on the abatement recommendations in Section 2.6 of the Plan. For each source identified in the following subsections, multiple specific corrective actions are detailed and suggests the primary responsible party and potential coordinating agencies for each action.

1.0 STRATEGIES FOR MALFUNCTIONING WASTEWATER, WATER, OR RECYCLED WATER INFRASTRUCTURE

Malfunctioning wastewater infrastructure can result in stormwater contamination when sewer exfiltration occurs that propagates into MS4 infiltration. If sewer pipes are defective or damaged to the extent it causes leaking, it is possible for raw sewage to seep through soil and enter the MS4 system or directly into nearby water bodies. Septic systems are also vulnerable to introducing raw sewage to the environment through leaking due to poor maintenance or design. Corrective and proactive actions, with the associated responsible parties to address contamination for malfunctioning infrastructure are presented in **Table 1-1**.

Table 1-1. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Potential Coordinating Agencies
Maintain the MS4, including catch basin cleaning, channel maintenance, and implementation of controls to prevent and eliminate infiltration of seepage from sanitary sewers to the MS4	MS4 Permittees	
Develop a SSMP with all mandatory elements and obtain approval from the governing body that owns or is responsible for the operation of the sanitary sewer system	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Maintain and annually update asset management database of sewer assets, including information on size/material/age of infrastructure, as-built drawings, recent rehabilitation efforts, and CCTV inspections	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Identify exfiltration problem areas within collection system using flow monitoring, smoke testing, and dye testing and follow-up with CCTV sewer inspection equipment within problem areas to prioritize rehabilitation and quantify severity of exfiltration	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

Proactive/Corrective Recommended Action	Primary Responsible Party	Potential Coordinating Agencies
Inspect all components of a collection system, including manholes and sewer mains	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Require anyone purchasing or selling a property to video, clean, repair, and certify that laterals are clear of damage or any need of repair (e.g., recommended anytime a new tenant is taking over a commercial facility, especially if there is a change of use, such as adding a restaurant, etc.)	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Develop an app for plumbers to ceritfy that laterals have been inspected, videoed, cleaned, etc.	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Coordinate a ULAR WMA-wide sanitary sewer and MS4 vulnerability assessment which integrates pipe condition, causes of defects (if any), rehabilitation efforts, and CCTV or other visual investigation outcomes	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

Proactive/Corrective Recommended Action	Primary Responsible Party	Potential Coordinating Agencies
Utilize results of ULAR WMA-wide sanitary sewer and MS4 vulnerability assessment to optimize cleaning and inspection schedules of assets in addition to identifying highest priority repairs and rehabilitation needs for Capital Improvement Plans (CIPs)	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Identify system-specific impacts due to climate change, infrastructure age, population growth and other impacts	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Increase coordination with other utility agencies in the sewer service area	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Update monitoring and reporting requirements to address cost of compliance and data quality assurance	Sanitary agencies within respective service area; Regional Board/State Board/EPA	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County • Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board (SWRCB) • US Environmental Protection Agency (USEPA)

Proactive/Corrective Recommended Action	Primary Responsible Party	Potential Coordinating Agencies
Incentivize system owner employment of certified collection system operators	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Research new design, construction, and monitoring techniques for reducing the future risk of sewer exfiltration/MS4 infiltration	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Develop a cost-share program to help pay for lateral repairs or replacements for properties which voluntarily inspect and discover deficiencies	Sanitary agencies within respective service area; private property owner	• The California Association of Homeowners Association
Develop ordinances which require proactive private lateral inspections	MS4 Permittees; Regional Board/State Board/EPA	• Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board (SWRCB) • US Environmental Protection Agency (USEPA)
Develop potential list of plumbers in each city for private residential owners to contact if there are problems with private sewer laterals	City Public Works departments	• Each city's public agencies department
Educate septic system owners on onsite wastewater treatment systems requirements and procedures before approving septic systems on properties	Septic system contractor and private property owner	• County of Los Angeles Department of Public Health Environmental Health Land Use Program

Proactive/Corrective Recommended Action	Primary Responsible Party	Potential Coordinating Agencies
Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

2.0 STRATEGIES FOR HOMELESS ENCAMPMENTS

Homelessness is one of the most challenging environmental justice issues faced in Los Angeles County. With its nexus to the human right to water, people experiencing homelessness often do not have any or adequate access to shelter, safe drinking water, or sanitation/hygienic services which can result in both public health problems and may contribute to water quality problems. Homeless encampments can lead to human waste entering nearby waterways through bathing or direct deposition.

Legal strategies to addressing homelessness may differ from jurisdiction to jurisdiction. Often, the criminalization of homelessness has long been seen in some communities as a strategy to address some of the more visible aspects of homelessness. For example, the City of Los Angeles updated its anti-camping law to have stricter rules on where the homeless population can legally sleep and camp to protect "sensitive" locations. While anti-camping laws such as these as well as encampment sweeps are encouraged by proponents to "prevent blight", these laws only move the homelessness problem around without addressing the root causes of homelessness or providing alternative places to live that are not on the street (e.g., permanent supportive housing). In effect, while moving the homeless around may help with the visible aspect in certain neighborhoods, it only exacerbates and extends the public health and water quality issues not only for the homeless, but also for the environment. One of the strategies presented in the Los Angeles County Homeless Initiative's Approved Strategies to Combat Homelessness report is to develop a decriminalization policy for use by the County and cities throughout the County.

The strategies presented in **Table 2-1** are not focused on the criminalization of homelessness, but rather offer recommendations that provide dignity and basic water, sanitation, and hygienic services to the homeless population (particularly on the streets) in alignment with California's Human Right to Water law (AB 685) that legislatively recognizes the human right to water, declaring that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." While the Los Angeles County Homeless Initiative's Approved Strategies to Combat Homelessness report provides a long-term planning effort for preventing homelessness, subsidizing housing, increasing income, providing case management and services, creating a coordinated system, and increasing affordable/homeless housing, it is recognized that permanent and stable housing and jobs may not be immediately built or offered to the homeless population due to political challenges and NIMBY-ism. Therefore, the strategies presented are more focused on positive co-existence with the homeless population. Overall, overarching strategies should be focused on community capacity building and providing consistent and continual care and support to the homeless population.

It is important to note that the Los Angeles County Permit Group is currently working on a strategy to engage the Regional Board in recognizing that the issue of homelessness may have a significant impact on water quality, but it is a much larger systemic problem that requires significant resources and collaboration that extends far beyond the scope of stormwater compliance programs.

Table 2-1. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Remove trash and debris	City/County Public Works Street Sweeping departments	• Los Angeles County Public Works (Street Sweeping) • Waste management agencies • Volunteer organizations
Mapping out locations of 24-hour publicly available restrooms, drinking water taps, and showers and determine areas to install more to provide basic human rights services to the homeless population	City/County Parks and Recreation, Los Angeles Homeless Services Authority	• Los Angeles County Parks and Recreation • Los Angeles Homeless Services Authority (LAHSA)
Increase accessibility to 24-hour service mobile dump stations or restrooms, showers, and water taps to service homeless community everywhere, not just hot spots	City/County Parks and Recreation, Los Angeles Homeless Services Authority	• Los Angeles County Parks and Recreation • Los Angeles Homeless Services Authority (LAHSA) • Los Angeles Regional Open Space + Affordable Housing Collaborative (LAROSAH) • Mobile dump station contractors
Establishing safe parking programs for homeless with vehicles in underutilized parking lots which provide sanitation services for transient communities	Safe Parking LA, Los Angeles Homeless Services Authority	• Safe Parking LA, City of Los Angeles • Los Angeles Homeless Services Authority (LAHSA)
Research installation of portable composting toilets (similar to pilot initiative in San Francisco) with minimal electrical or plumbing inputs and self-disinfecting capabilities (Bill and Melinda Gates Reinvent the Toilet Challenge)	City/County Parks and Recreation, Los Angeles Homeless Services Authority	• Los Angeles County Parks and Recreation • Los Angeles Homeless Services Authority (LAHSA)

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities	MS4 Permittees, sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

3.0 STRATEGIES FOR SANITARY SEWER OVERFLOWS

3.1 General Strategies for Sanitary Sewer Overflows

When sanitary sewer load exceeds sewer capacity, sewers overflow into the MS4 system and nearby water bodies. Load can exceed capacity if inappropriate materials enter the sewer and cause blockages, if sewers and/or treatment facilities are undersized, or if unexpected additional water enters the sewer system. Corrective and proactive actions, with associated responsible parties are presented in **Table 3-1**.

Table 3-1. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Lead robust education and outreach efforts that measurably increases knowledge about the effect of inappropriate materials (including FOGs) on sewer pipes	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Develop a septic pump out rebate program for high priority areas	Sanitary agencies within respective service area and private property owner	• The California Association of Homeowners Association

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Inspect, clean, and maintain sewer systems, especially where blockages have occurred previously	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Report SSO or private lateral overflow to the SWRCB using the CIWQS, the online reporting system developed by the SWRCB	Sanitary agencies within respective service area; Regional Board/State Board/EPA	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County • Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board (SWRCB) • US Environmental Protection Agency (USEPA)
Take feasible steps to control the released volume of sewer overflow	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Install overflow structures to prevent untreated wastewater from entering storm drains, creeks, etc.	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Thoroughly clean sewage spill sites as soon as possible after an overflow. Make sure that no residue is left that may impact future water quality. Secure sewage spill sites to prevent public contact until the site has been thoroughly cleaned. Wherever possible, thoroughly flush the affected area and clean any sewage. Contain wash-down water. Solids and debris shall be flushed, swept, raked, or picked-up by hand, and hauled away for proper disposal.	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County • Los Angeles County Department of Public Health
Provide increased public transparency of sewer spill data, SSMPs, and sewer system performance	Sanitary agencies within respective service area; Regional Board/State Board/EPA	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County • Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board (SWRCB) • US Environmental Protection Agency (USEPA)

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Enhance Regional Water Board enforcement for General Order enrollees failing to proactively reduce sewage spills	Regional Board/State Board/EPA	• Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board, SWRCB • United States Environmental Protection Agency (USEPA)
Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

3.2 Strategies for Fats, Oils, and Grease Impacts

Fats, oils, and grease (FOGs) can clog sewer systems and are a primary cause of sanitary sewer overflows. Sources of FOGs include commercial and residential kitchens and garages. Corrective and proactive actions, with associated responsible parties are presented in **Table 3-2**.

Table 3-2. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Research sources of FOGs in stormwater to inform future action	MS4 Permittees	
Conduct regular facility inspections and issue violations	City/County Environmental Health Departments	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Department of Public Health • US Environmental Protection Agency, USEPA

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Increase FOG inspections in high priority catchments	City/County Environmental Health Departments	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Department of Public Health • US Environmental Protection Agency, USEPA
Require workplaces with high likelihood of FOG spills to keep spill containment kits on site	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Require an annual video and cleaning of laterals for food facilities, in addition to maintenance of grease interceptors for the FOG program (require businesses to pay for it on their and certify the work completed)	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Develop an app for grease interceptor maintenance where photos and certification by the responsible party would be required (database should be formed containing the location and documentation of grease interceptors)	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Lead robust education and outreach efforts that measurably increases knowledge and changes behavior in commercial and household kitchens	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

4.0 STRATEGIES FOR ILLICIT CONNECTIONS/ILLICIT DISCHARGES

Illicit connections and illicit discharges (ICID) include any unauthorized connection or discharge to a MS4 that is not entirely composed of stormwater. Sources of ICID include wastewater piping deliberately or mistakenly connected to the storm drains, spills into drain inlets, and dumping into inlets. The County of Los Angeles and LACFCD produced the Illicit Connections and Illicit Discharges Elimination Program Manual (ICID Manual) in 2015 to mitigate ICID. Corrective and proactive actions, with associated responsible parties are presented in **Table 4-1**.

Table 4-1. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Coordinate ICID teams to focus on responding, identifying, tracking, and abating "incidents of human waste"	City ICID teams; police departments; waste management agencies	Los Angeles County Department of Public Works • Risk Management Division • Environmental Programs Division • Sewer Maintenance Division • Watershed Management Division
Develop a cost-share program to help pay for connecting residents to sanitary sewer	Sanitary agencies within respective service area	• The California Association of Homeowners Association • LA Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County
Lead robust education and outreach efforts that measurably increase knowledge and changes behavior regarding the hazards associated with illegal discharges (ICID Manual Section 1.3.5)	City ICID teams; police departments; waste management agencies	Los Angeles County Department of Public Works • Risk Management Division • Environmental Programs Division • Sewer Maintenance Division • Watershed Management Division

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Develop procedures for conducting investigations to prioritize and identify the source of all suspected illicit discharges, including procedures to eliminate the discharge once the source is located (ICID Manual Section 2.2.1)	City ICID teams; police departments; waste management agencies	Los Angeles County Department of Public Works • Risk Management Division • Environmental Programs Division • Sewer Maintenance Division • Watershed Management Division
Continue to implement enforcement procedures to eliminate illicit connections and discharges (ICID Manual Section 2.2.4, 3.2.4)	City ICID teams; police departments; waste management agencies	Los Angeles County Department of Public Works • Risk Management Division • Environmental Programs Division • Watershed Management Division
Continue to implement a record keeping system to document illicit connections and discharges (ICID Manual Section 2.2.5, 3.2.5)	City ICID teams; police departments; waste management agencies	Los Angeles County Department of Public Works • Risk Management Division • Environmental Programs Division • Watershed Management Division
Investigate and terminate illicit connections (ICID Manual Section 3.2.2, 3.2.3)	City ICID teams; police departments; waste management agencies; sanitary agencies within respective service area	Los Angeles County Department of Public Works • Risk Management Division • Land Development Division • Environmental Programs Division • Watershed Management Division
Introduce comprehensive public reporting program (ICID Manual Section 4)	City ICID teams, police departments, waste management agencies; Regional Board/State Board/EPA	Los Angeles County Department of Public Works • Environmental Programs Division • Information Technology Division • Watershed Management Division

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Respond to sewage and other spills that may discharge into the MS4	Sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County • Los Angeles County Department of Public Health • Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board (SWRCB) • US Environmental Protection Agency (USEPA)
Clarify existing prohibition of untreated waste discharge to waters of the State	Regional Board/State Board/EPA	• Los Angeles Regional Water Quality Control Board, LARWQCB • State Water Resources Control Board, SWRCB • US Environmental Protection Agency, USEPA
Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

5.0 STRATEGIES FOR ILLEGAL DUMPING

The disposal of trash, debris, and other contaminant-carrying substances into waterways is illegal. Such illegal dumping can be in the MS4 system or directly into waterways. The Los Angeles County Department of Public Works, Environmental Programs Division has produced a website with information and a confidential online form to report illegal dumping. Other corrective and proactive actions, with associated responsible parties are presented in **Table 5-1**.

Table 5-1. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Respond to sewage and other spills that may discharge into the MS4	City ICID teams; police departments; waste management agencies	• Los Angeles County Department of Public Works • Illegal Dumping Crime Tip Program, Bureau of Street Services, City of LA
Conduct and track enforcement through follow-up inspection, enforcement action, records retention, referral of violations, investigation of complaints, assistance with Regional Board enforcement actions	City ICID teams; police departments; waste management agencies	• Los Angeles County Department of Public Works • Los Angeles Regional Water Quality Control Board, LARWQCB
Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

6.0 STRATEGIES FOR OTHER HUMAN WASTE SOURCES

6.1 RV Parks

Most trailer parks offer waste dump stations in the form of communal septic tanks. These dump stations can often be a source of waste leakage due to lack of robust sewer infrastructure and human error in disposal. If RV parking spots do not offer waste dump stations nearby, waste is more likely to be deposited incorrectly, which may introduce raw sewage to the MS4 system or directly to nearby waterbodies. Corrective and proactive actions, with associated responsible parties are presented in **Table 6-1**.

Table 6-1. Proactive/Corrective Actions and Responsible Parties

Proactive/Corrective Recommended Action	Primary Responsible Party	Examples of Coordinating Agencies
Create GIS-based web map of RV dump stations within Los Angeles County	City/County Parks and Recreation	• Los Angeles County Parks and Recreation
Create GIS-based web map of RV parking spots within Los Angeles County	City/County Parks and Recreation	• Los Angeles County Parks and Recreation
Contract with mobile dump station contractor to service communities	City/County Parks and Recreation	• Los Angeles County Parks and Recreation
Provide vouchers to encourage use of existing dump stations	City/County Parks and Recreation	• Los Angeles County Parks and Recreation
Fund and build new dump stations	City/County Parks and Recreation	• Los Angeles County Parks and Recreation
Develop education outreach materials to distribute to facilities in high priority catchments which are likely to manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area	• Los Angeles Sanitation and Environment (LASAN), City of Los Angeles • Los Angeles County Sanitation Districts (LACSD), Los Angeles County • Consolidated Sewer Maintenance District (CSMD), LA County

7.0 SUMMARY

Table 7-1 summarizes corrective actions and primary responsible parties for each potential human waste source control category.

Table 7-1. Summary of Proactive/Corrective Actions and Responsible Parties

Potential Human Waste Source Category	Proactive/Corrective Strategies Summary	Primary Responsible Party
Malfunctioning wastewater, water, or recycled water infrastructure	Maintain the MS4	MS4 Permittees
	Develop an SSMP and obtain approval	Sanitary agencies within respective service area
	Maintain and update sewer asset management database	Sanitary agencies within respective service area
	Identify exfiltration problem areas within collection system	Sanitary agencies within respective service area
	Inspect all collection system components	Sanitary agencies within respective service area

Potential Human Waste Source Category	Proactive/Corrective Strategies Summary	Primary Responsible Party
	Require anyone purchasing or selling a property to video, clean, repair, and certify laterals are clear of damage or any need of repair	Sanitary agencies within respective service area
	Develop an app for plumbers to certify that laterals have been inspected, videoed, cleaned, etc.	Sanitary agencies within respective service area
	Coordinate ULAR WMA-wide sanitary sewer and MS4 vulnerability assessment	Sanitary agencies within respective service area
	Use ULAR WMA-wide sanitary sewer and MS4 vulnerability assessment to optimize cleaning and inspection schedules, identify high priority repairs	Sanitary agencies within respective service area
	Identify system-specific impacts of external factors such as population growth	Sanitary agencies within respective service area
	Increase coordination with other utility agencies in the sewer service area	Sanitary agencies within respective service area
	Update monitoring and reporting requirements to address cost of compliance and data quality assurance	Sanitary agencies within respective service area; Regional Board/State Board/EPA
	Incentivize system owner employment of certified collection system operators	Sanitary agencies within respective service area
	Research design, construction, and monitoring techniques for reducing future risk	Sanitary agencies within respective service area
	Develop cost-share program for lateral replacements for properties that voluntarily inspect sewer assets	Sanitary agencies within respective service area; private property owner
	Develop ordinances which require proactive private lateral inspections	MS4 Permittees; Regional Board/State Board/EPA
	Develop list of plumbers in each city for private residential owners to contact	City Public Works departments
	Educate septic system owners before approving septic systems on properties	Septic system contractor; private property owner
	Develop education outreach materials for high priority catchments that may manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area
Homeless encampments	Remove trash and debris	City/County Public Works Street Sweeping departments
	Determine locations for additional 24-hour public sanitation facilities	City/County Parks and Recreation; Los Angeles Homeless Services Authority

Potential Human Waste Source Category	Proactive/Corrective Strategies Summary	Primary Responsible Party
	Increase breadth of 24-hour public sanitation facilities locations	City/County Parks and Recreation; Los Angeles Homeless Services Authority
	Establish safe parking programs with sanitation services available	Safe Parking LA; Los Angeles Homeless Services Authority
	Research installation of portable composting toilets	City/County Parks and Recreation; Los Angeles Homeless Services Authority
	Engage the Regional Board in recognizing that the issue of homelessness may have a significant impact on water quality, but it is a much larger systemic problem that requires significant resources and collaboration that extends far beyond the scope of stormwater compliance programs	MS4 Permittees
	Develop education outreach materials for high priority catchments that may manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area
Sanitary sewer overflows (SSOs)	Lead education and outreach efforts	Sanitary agencies within respective service area
	Develop a septic pump out rebate program for high priority areas	Sanitary agencies within respective service area; private property owner
	Inspect, clean, and maintain sewer systems	Sanitary agencies within respective service area
	Report SSOs to the SWRCB using the CIWQS	Sanitary agencies within respective service area; Regional Board/State Board/EPA
	Control the released volume of SSOs	Sanitary agencies within respective service area
	Install overflow structures	Sanitary agencies within respective service area
	Properly clean SSO spill sites	Sanitary agencies within respective service area
	Increase public transparency of sewer spill data, SSMPs, and sewer system performance	Sanitary agencies within respective service area; Regional Board/State Board/EPA
	Enhance RWB enforcement for non-compliant General Order enrollees	Regional Board/State Board/EPA
	Develop education outreach materials for high priority catchments that may manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area
	Research sources of FOGs in stormwater	MS4 Permittees

Potential Human Waste Source Category	Proactive/Corrective Strategies Summary	Primary Responsible Party
Fats, oils, and grease (FOGs) impacts	Inspect facilities and issue violations where needed	City/County Environmental Health Departments
	Increase FOG inspections in high priority catchments	City/County Environmental Health Departments
	Require spill containment kits at workplaces with high likelihood of FOG spills	Sanitary agencies within respective service area
	Require an annual video and cleaning of laterals for food facilities, in addition to maintenance of grease interceptors for the FOG program	Sanitary agencies within respective service area
	Develop app for grease intercpetor maintenance where photos and certification by the responsible party would be required	Sanitary agencies within respective service area
	Lead education and outreach efforts	Sanitary agencies within respective service area
Illicit connections/illicit discharges (ICID)	Develop cost-share program for connecting residents to sewer	Sanitary agencies within respective service area
	Lead education and outreach efforts	City ICID teams; police departments; waste management agencies
	Develop investigation and elimination procedures	City ICID teams; police departments; waste management agencies
	Continue to implement enforcement procedures	City ICID teams; police departments; waste management agencies
	Continue record-keeping and documentation	City ICID teams; police departments; waste management agencies
	Investigate and terminate illicit connections	City ICID teams; police departments, waste management agencies; sanitary agencies within respective service area
	Introduce public reporting program	City ICID teams' police departments; waste management agencies; Regional Board/State Board/EPA
	Respond to sewage and other spills that may discharge into the MS4	Sanitary agencies within respective service area
	Clarify existing prohibition of untreated waste discharge to waters of the State	Regional Board
	Develop education outreach materials for high priority catchments that may manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area

Potential Human Waste Source Category	Proactive/Corrective Strategies Summary	Primary Responsible Party
Illegal dumping	Respond to sewage and spills that may enter the MS4	City ICID teams; police departments; waste management agencies
	Conduct and track enforcement	City ICID teams; police departments; waste management agencies
	Develop education outreach materials for high priority catchments that may manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area
RV parks	Create GIS-based web map of RV dump stations within Los Angeles County	City/County Parks and Recreation
	Create GIS-based web map of RV parking spots within Los Angeles County	City/County Parks and Recreation
	Contract with mobile dump station contractor to service communities	City/County Parks and Recreation
	Provide vouchers to encourage use of existing dump stations	City/County Parks and Recreation
	Fund and build new dump stations	City/County Parks and Recreation
	Develop education outreach materials for high priority catchments that may manage human waste disposal in outdoor facilities	MS4 Permittees; sanitary agencies within respective service area