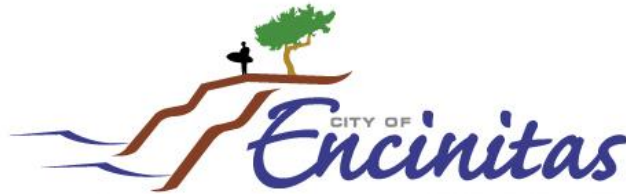


MOONLIGHT STATE BEACH

BACTERIA TOTAL MAXIMUM DAILY LOAD

FINAL 2022–2023 COMPLIANCE MONITORING REPORT

Submitted to the San Diego Regional Water Quality Control Board by:



Prepared by:



January 2024

IMPORTANT NOTICE

This report was prepared exclusively for the City of Encinitas by WSP USA Environment & Infrastructure. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in WSP's services and is based on (i) information available at the time of preparation, (ii) data supplied by outside sources, and (iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended to be used by the City of Encinitas only, subject to the terms and conditions of its contract with WSP. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

TABLE OF CONTENTS

	Page
ACRONYMS AND ABBREVIATIONS.....	iii
1.0 INTRODUCTION.....	1-1
1.1 Document Overview.....	1-2
1.2 Compliance Requirements for Bacteria Total Maximum Daily Load	1-3
2.0 MONITORING EVENT SUMMARY.....	2-1
2.1 Monitoring and Analytical Methods	2-1
2.1.1 Field Monitoring Requirement Completeness and Deviations from the Monitoring Plan.....	2-1
2.2 Wet Weather Compliance Monitoring	2-2
2.2.1 Wet Weather Monitoring Event Summary.....	2-2
2.2.2 Wet Weather FIB Concentrations	2-4
2.3 Dry Weather Compliance Monitoring	2-9
2.3.1 Dry Weather Monitoring Event Summary.....	2-9
2.3.2 Dry Season FIB Concentrations	2-10
3.0 COMPLIANCE EVALUATION.....	3-1
3.1 Compliance Evaluation Methods	3-1
3.1.1 Wet Weather Single-Sample Maximum Exceedance Frequency.....	3-1
3.1.2 Wet Season Geometric Mean and Exceedance Frequency	3-2
3.1.3 Dry Season Geometric Mean and Exceedance Frequency.....	3-2
3.1.4 Dry Weather Single-Sample Maximum Exceedance Frequency	3-3
3.2 Wet Weather Exceedance Rates and Compliance Evaluation	3-3
3.3 Wet Season Geometric Mean Exceedance Rates.....	3-0
3.4 Dry Season Geometric Mean Exceedance Rates and Compliance Evaluation.....	3-1
3.5 Dry Weather Single-Sample Maximum Exceedance Rates.....	3-2
3.6 Progress Toward Attaining Interim and Final Receiving Water Limitations	3-2
4.0 Summary	4-1
4.1 Characterization of Current FIB Concentrations	4-1
5.0 REFERENCES	5-1

TABLE OF CONTENTS (CONTINUED)

	Page
LIST OF TABLES	
Table 1-1. Moonlight State Beach Bacteria TMDL Compliance Monitoring Location	1-1
Table 1-2. Final Receiving Water Limitations for Beaches	1-3
Table 1-3. Moonlight State Beach Bacteria TMDL Compliance Reduction Milestones— Dry Weather.....	1-4
Table 1-4. Moonlight State Beach Bacteria TMDL Compliance Reduction Milestones— Wet Weather.....	1-4
Table 2-1. 2022–2023 Monitoring Requirement Completeness	2-2
Table 2-2. Wet Weather Monthly Rainfall Summary.....	2-3
Table 2-3. Total Rainfall for 2022–2023 Monitored Events	2-4
Table 2-4. Wet Weather Analytical Results for Moonlight State Beach	2-6
Table 2-5. Dry Season Monthly Rainfall Summary.....	2-10
Table 3-2. 2022–2023 Wet Weather Exceedance Rates and Compliance Reduction Milestones	3-0
Table 3-3. 2022–2023 Wet Season Geometric Mean Exceedance Rates.....	3-0
Table 3-5. 2023 Dry Season Geometric Mean Exceedance Rates	3-1
Table 3-6. Dry Season Exceedance Rates and Compliance Reduction Milestones.....	3-1
Table 3-7. 2022–2023 Dry Weather Single-Sample Maximum Exceedance Rates.....	3-2
Table 3-8. General Progress Toward Interim and Final Targets for Moonlight State Beach, 2022–2023	3-2
Table 4-1. 2022–2023 Bacteria TMDL Exceedance Frequency Results for Moonlight State Beach	4-2

LIST OF FIGURES

Figure 1-1. Moonlight State Beach Compliance Monitoring Location, EH-420.....	1-2
Figure 2-1. 2022–2023 Wet Weather Fecal Indicator Bacteria Concentrations – EH-420	2-7

LIST OF APPENDICES

Appendix A	QUALITY ASSURANCE QUALITY CONTROL SUMMARY
Appendix B	WET WEATHER ANALYTICAL RESULTS
Appendix C	DRY WEATHER FIELD AND ANALYTICAL RESULTS
Appendix D	BACTERIA TMDL AND MS4 PERMIT DISCREPANCIES

ACRONYMS AND ABBREVIATIONS

%	percent
303(d) List	Clean Water Act Section 303(d) List of Water Quality Limited Segments
Bacteria TMDL	<i>A Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) To Incorporate Revised Total Maximum Daily Loads for Indicator Bacteria Project I—Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek), 2010</i>
Bight '08	Southern California Bight 2008 Regional Monitoring Program
CEDEN	California Environmental Data Exchange Network
CFU	colony-forming unit
Compliance Monitoring Plan	<i>Moonlight State Beach Bacteria TMDL Compliance Monitoring Plan</i>
DW	dry weather
EH-420	Moonlight State Beach compliance monitoring location
ENCC1	NWS Encinitas Gauge
EWAL	Encina Wastewater Authority Laboratory
FIB	fecal indicator bacteria
ID	identification
mL	milliliters
MPN	most probable number
MQO	measurement quality objective
MS4	Municipal Separate Storm Sewer System
MS4 Permit	<i>National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Draining the Watersheds Within the San Diego Region, Order Number R9 2013-0001, 2013</i>
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
Ocean Plan	<i>California Ocean Plan, SWRCB Resolution No. 2012-0056, 2012</i>
RA	Responsible Agency
REC-1	water contact recreation beneficial use
Regional Board	San Diego Regional Water Quality Control Board
RL	reporting limit
RWL	receiving water limitation
SM	USEPA Standard Method
SSM	single sample maximum
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board

ACRONYMS AND ABBREVIATIONS (continued)

TMDL	total maximum daily load
USEPA	United States Environmental Protection Agency
UV	ultraviolet
WMA	Watershed Management Area
WQBEL	water quality-based effluent limitation
WW	wet weather

1.0 INTRODUCTION

This report presents the 2022–2023 Moonlight State Beach Bacteria Total Maximum Daily Load (TMDL)¹ (San Diego Regional Water Quality Control Board [Regional Board], 2010) compliance monitoring data, in accordance with Attachment E.6 of the Municipal Separate Storm Sewer System (MS4) Permit.² The Moonlight State Beach Bacteria TMDL Compliance Monitoring Plan (Compliance Monitoring Plan) (City of Encinitas, 2017) was developed to meet the Bacteria TMDL requirements of the MS4 Permit and to generate data to support the Carlsbad Watershed Management Area (WMA) Water Quality Improvement Plan (Carlsbad Watershed Management Area Responsible Agencies, 2016). Supporting information for this compliance monitoring report is in the Compliance Monitoring Plan and Carlsbad WMA Water Quality Improvement Plan located on the Project Clean Water website (www.projectcleanwater.org).

The Bacteria TMDL Compliance Monitoring Program is designed to assess the conditions of the receiving waters and has the following objectives:

- Characterize levels of bacteria concentrations at compliance monitoring locations.
- Track progress toward meeting the Bacteria TMDL numeric targets.

Following the Compliance Monitoring Plan, the Responsible Agencies (RAs) monitored the Pacific Ocean Shoreline at Moonlight State Beach (Moonlight State Beach compliance monitoring location, or EH-420). Table 1-1 provides the location name and coordinates for the compliance monitoring location, and Figure 1-1 presents a map of the compliance monitoring location within the WMA. Indicator bacteria sampling for the 2022–2023 compliance monitoring season was conducted during wet and dry weather at the Moonlight State Beach compliance monitoring location, and samples were analyzed for three fecal indicator bacteria (FIB) compliance constituents: total coliform, fecal coliform, and *Enterococcus*.

Table 1-1.
Moonlight State Beach Bacteria TMDL Compliance Monitoring Location

Site ID	Site Name	Site Type	Latitude	Longitude
EH-420 ^a	Moonlight State Beach	Pacific Ocean Shoreline	33.048	–117.298

Notes:

ID = identification; TMDL = Total Maximum Daily Load

a. Approximately 25 meters down current of creek outlet.

¹ A Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) To Incorporate Revised Total Maximum Daily Loads for Indicator Bacteria Project I—Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek), Resolution No. R9-2010-0001, Regional Board (Bacteria TMDL) (Regional Board, 2010).

² National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer System (MS4) Draining the Watersheds Within the San Diego Region, Order Number R9-2013-0001, as Amended by Order Nos. R9-2015-0001 and R9-2015-0100 (MS4 Permit) (Regional Board, 2015).

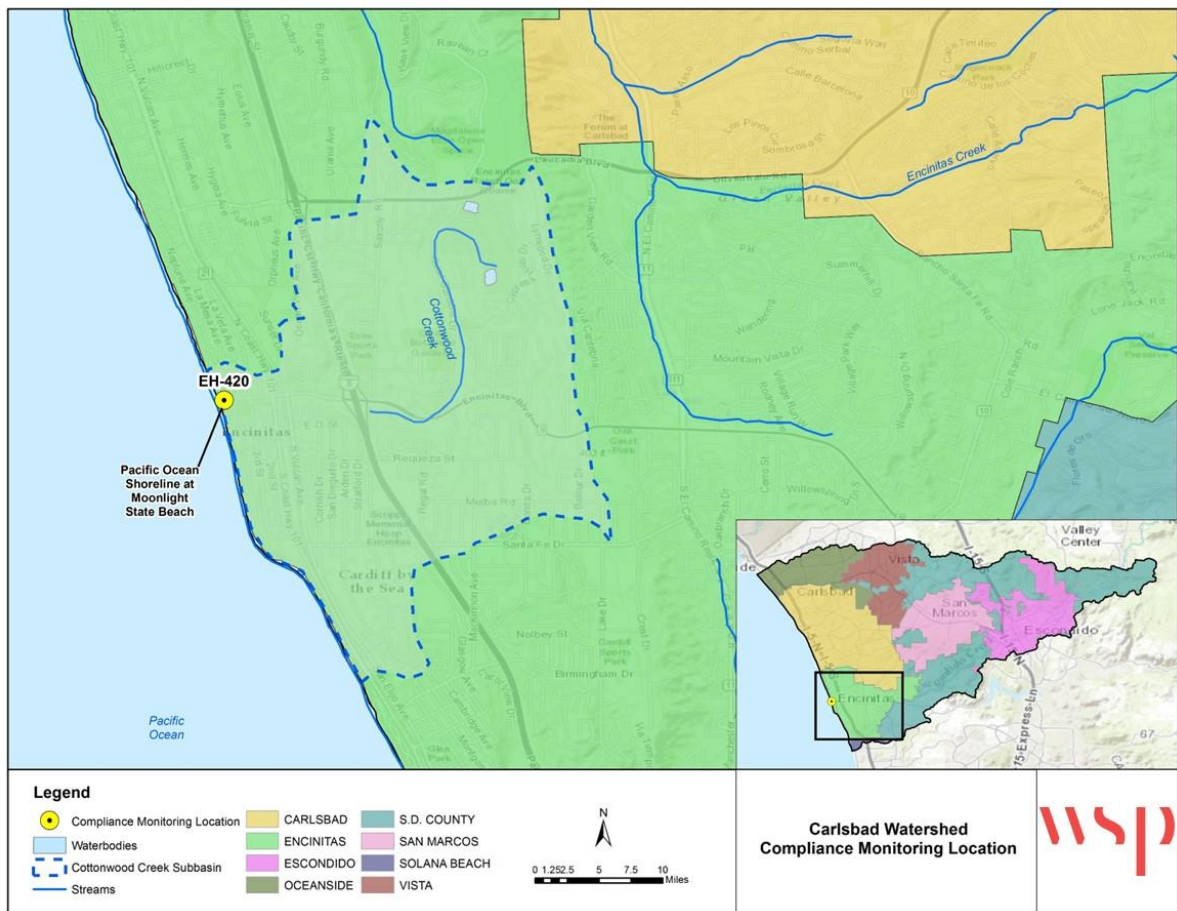


Figure 1-1.
Moonlight State Beach Compliance Monitoring Location, EH-420

1.1 Document Overview

The five sections of this report contain the following information:

- **Section 1—Introduction:** Information on the report's purpose, the Bacteria TMDL, compliance monitoring location, numeric targets, and schedule.
- **Section 2—Monitoring Event Summary:** Overview of the compliance monitoring conducted during the reporting period, including any monitoring or analytical deviations, hydrology summaries, event data and observations, and FIB concentrations in wet and dry weather during 2022–2023, along with an evaluation of seasonal patterns in FIB concentrations.
- **Section 3—Compliance Evaluation:** Evaluation of current receiving water conditions and a comparison with the Bacteria TMDL receiving water limitations (RWLs) based on 2022–2023 data.
- **Section 4—Summary:** Program objectives and ongoing efforts.
- **Section 5—References:** Sources used to prepare this report.

1.2 Compliance Requirements for Bacteria Total Maximum Daily Load

As described in the Carlsbad WMA Water Quality Improvement Plan, the basis for Bacteria TMDL compliance is demonstrated through interim and final water quality-based effluent limitations (WQBELs). The WQBELs include RWLs for the Moonlight State Beach compliance monitoring location and are provided in Table 1-2.

Table 1-2.
Final Receiving Water Limitations for Beaches
(Maximum Bacteria Densities and Allowable Exceedance Frequencies)

Constituent	Wet Weather Days		Dry Weather Days	
	Single-Sample Maximum ^a (MPN/100mL)	Single-Sample Maximum Allowable Exceedance Frequency ^b	30-Day Geometric Mean ^c (MPN/100mL)	30-Day Geometric Mean Allowable Exceedance Frequency
Total Coliform	10,000	22%	1,000	0%
Fecal Coliform	400	22%	200	0%
<i>Enterococcus</i>	104	22%	35	0%

Notes:

% = percent; mL = milliliters; MPN = most probable number

Source (including footnotes): MS4 Permit, Order Number R9 2015-0001, San Diego Regional Water Quality Control Board, November 18, 2015.

- During wet weather days, only the single-sample maximum receiving water limitations are required to be achieved.
- The 22 percent single sample maximum allowable exceedance frequency only applies to wet weather days. For dry weather days, the dry weather bacteria densities must be consistent with the single sample maximum REC-1 water quality objectives in the Ocean Plan.³
- During dry weather days, the single-sample maximum and 30-day geometric mean receiving water limitations are required to be achieved.

The Carlsbad WMA Water Quality Improvement Plan provides the compliance timeline for the Bacteria TMDL, which outlines the interim and final reduction milestones for both dry and wet weather. Full dry weather compliance requires a 0 percent (%) geometric mean exceedance frequency for dry weather periods by 2021, and full wet weather compliance requires a 22% single sample maximum exceedance frequency during wet weather periods by 2031. The "existing" or historical exceedance frequency is used to calculate 50% interim milestones for both wet and dry weather. The Water Quality Improvement Plan states that the dry weather interim milestone is to be met in 2020, and the wet weather interim milestone is to be met in 2028. Progress toward achieving dry weather and wet weather milestones is demonstrated by comparing interim and final allowable exceedance frequencies.

Table 1-3 presents dry weather historical, interim, and final allowable exceedance frequencies.

³ *California Ocean Plan* (State Water Resources Control Board [SWRCB], 2012).

Table 1-3.
Moonlight State Beach Bacteria TMDL Compliance Reduction Milestones—Dry Weather

Constituent	Historical Baseline Exceedance Rate	2020 Interim Milestone ^a (50% reduction over acceptable limit)	2021 Final Compliance (100% reduction over acceptable limit)
Total Coliform	28.2%	14.1%	0%
Fecal Coliform	35.0%	17.5%	0%
<i>Enterococcus</i>	78.6%	39.3%	0%

Notes:

% = percent; TMDL = Total Maximum Daily Load

a. Interim dry weather goals are a 50% reduction of existing dry weather exceedance frequencies, based on available historical data from 1996 to 2002. Source: Moonlight State Beach Bacteria TMDL Compliance Monitoring Plan (City of Encinitas, 2017).

Table 1-4 presents wet weather interim and final allowable exceedance frequencies.

Table 1-4.
Moonlight State Beach Bacteria TMDL Compliance Reduction Milestones—Wet Weather

Constituent	2028 Interim Milestone ^a (50% reduction over acceptable limit)	2031 Final Compliance ^b (100% reduction over acceptable limit)
Total Coliform	40%	22%
Fecal Coliform	40%	22%
<i>Enterococcus</i>	41%	22%

Notes:

% = percent; TMDL = Total Maximum Daily Load

a. Interim wet weather goals are provided in Attachment E of the MS4 Permit (Regional Board, 2013).

b. The final milestone is a 100% reduction from the existing exceedance frequency to the allowable exceedance frequency.

2.0 MONITORING EVENT SUMMARY

This section outlines hydrology summaries, event data and observations, and FIB concentrations for wet and dry weather conditions.

A summary of quality assurance and quality control data is provided in Appendix A. Analytical results for wet weather are presented in Appendix B. Field measurements and analytical results for dry weather are presented in Appendix C.

2.1 Monitoring and Analytical Methods

The Pacific Ocean Shoreline at Moonlight State Beach segment named in the Bacteria TMDL was removed from the Clean Water Act Section 303(d) List of water quality limited segments (303(d) List) for water contact recreation beneficial use (REC-1) impairment in 2010 and is now considered delisted. Per Attachment E of the MS4 Permit, because of their segment's delisted status, the RAs have the flexibility to propose alternative monitoring procedures (such as reduced monitoring frequency) for Bacteria TMDL compliance monitoring part of the Water Quality Improvement Plan and its updates. The City elected to monitor more frequently than the minimum monitoring requirements described in Attachment E of the MS4 Permit.

The Compliance Monitoring Plan describes the monitoring and analytical methods (Sections 3 and 4) and data management methods (Section 5.1).

2.1.1 Field Monitoring Requirement Completeness and Deviations from the Monitoring Plan

Completeness measures the total valid number of samples collected compared with the number of samples required or planned. The Surface Water Ambient Monitoring Program (SWAMP) completeness measurement quality objective (MQO) of 90% is used for the Bacteria TMDL monitoring programs.

Table 2-1 summarizes the Bacteria TMDL Monitoring Plan's field monitoring requirement and the monitoring events completed during the 2022–2023 monitoring year. The program met and exceeded the completeness MQO of 90% for both wet and dry weather programs.

Table 2-1.
2022–2023 Monitoring Requirement Completeness

Event Type		Minimum Monitoring Requirement ^a	Frequency MQO ^b	Number of Sampling Events ^d	% Complete
Wet	Storms	1	90%	13	> 100%
Dry	Wet Season (October – April)	7		18	> 100%
	Dry Season (May – September)	5		22	> 100%

Notes:

MQO = measurement quality objective

- Per Attachment E.6.d of the MS4 Permit, because of this segment's delisted status, the RAs have the flexibility to propose alternative monitoring procedures (such as reduced monitoring) for Bacteria TMDL compliance monitoring as part of the WQIP and its updates. The RAs defined a minimum monitoring frequency in their Compliance Monitoring Plan consistent with the minimum monitoring requirements described in Attachment E.6.d of the MS4 Permit.
- The SWAMP completeness MQO of 90 percent is used for the Bacteria TMDL monitoring programs.
- Minimum of one dry weather monitoring event per month
- Sampling Events include any time at least one sample was collected, including those events in which side-by-side samples were collected for the method

2.2 Wet Weather Compliance Monitoring

Wet weather monitoring was conducted by City of Encinitas field scientists at the Moonlight State Beach compliance monitoring location during 13 storm events in the 2022–2023 wet season, exceeding the minimum frequency of one storm annual event described in the Compliance Monitoring Plan. Storms resulting in greater than or equal to 0.1 inch of precipitation were targeted for wet weather sample collection. Bacteria grab samples were submitted to the Encina Wastewater Authority Laboratory (EWAL) for analysis.

2.2.1 Wet Weather Monitoring Event Summary

Precipitation data from the National Weather Service (NWS) Encinitas (ENCC1) rain gauge were used to track the total number of wet weather days as defined in the Compliance Monitoring Plan. To assess rainfall for the current monitoring year, measured precipitation values at ENCC1 were summarized monthly. These summaries may support future evaluations of annual precipitation and potential effects on FIB concentrations or exceedances' assessment.

The total precipitation recorded at ENCC1 for the 2022–2023 wet season was 19.45 inches. Table 2-2 summarizes wet weather monthly precipitation data for ENCC1 for the 2022–2023 wet season.

Table 2-2.
Wet Weather Monthly Rainfall Summary

Month	ENCC1 Rainfall (inch)
October	0.01
November	1.53
December	1.81
January	7.50
February	2.54
March	5.92
April	0.14
Total Rainfall	19.45

Thirteen storm events were successfully captured at the compliance monitoring location. A qualifying wet weather event is defined as greater than or equal to 0.1 inch of rainfall preceded by at least 72 hours of less than 0.1 inch of rainfall. Wet weather samples were collected within 72 hours after the end of precipitation per the Monitoring Plan. Samples were submitted to EWAL for analysis within prescribed holding times. Optional field measurements, when recorded, included pH, temperature, turbidity, dissolved oxygen and conductivity. The optional field measurements, where collected, are included in Appendix B (wet weather), Appendix C (dry weather), and the CEDEN deliverable to the Regional Board. Table 2-3 presents event date, duration, rainfall amount, and the estimated hours after rainfall when the sample was collected.

Table 2-3.
Total Rainfall for 2022–2023 Monitored Events

Wet Weather Event	Event Start Date	Event End Date	Sample Date	ENCC1 Rainfall (inch)	Post-Precipitation Collection Time (hrs)^a
Event 1	11/2/2022	11/6/2022	11/3/2022	0.14	3
Event 2	11/7/2022	11/11/2022	11/10/2022	1.39	31
Event 3	12/11/2022	12/15/2022	12/13/2022 12/14/2022 12/15/2022	0.80	25 47 70
Event 4	12/27/2022	1/8/2023	1/4/2023 1/5/2023	3.39	1 0
Event 5	1/10/2023	1/13/2023	1/11/2023 1/12/2023	0.41	4 28
Event 6	1/14/2023	1/22/2023	1/19/2023	4.02	63
Event 7	1/30/2023	2/2/2023	2/1/2023	0.59	41
Event 8	2/12/2023	2/15/2023	2/15/2023	0.21	57
Event 9	2/23/2023	3/4/2023	2/27/2023	2.49	12
Event 10	3/10/2023	3/18/2023	3/13/2023	3.41	8
Event 11	3/19/2023	3/25/2023	3/23/2023	1.78	3
Event 12	3/29/2023	4/2/2023	3/29/2023	0.49	0
Event 13	4/13/2023	4/16/2023	4/13/2023	0.10	2

Notes:

- a. Post-precipitation collection hours indicates the approximate number of hours that transpired between the end of precipitation and sample collection.

2.2.2 Wet Weather FIB Concentrations

At total of 17 wet weather samples were collected across 13 storm events during the 2022–2023 storm season. However, total and fecal coliform results for Wet Weather Event 3 (December 15, 2023) were reported as 'too numerous to count', potentially due to an abundance of non-target colonies during testing, rendering the results unquantifiable. Given the unquantifiable nature of this sample and the availability of two other samples collected during the same storm event (December 13 and 14, 2023), these results were excluded from wet weather compliance assessments. As such, a total of 16 sample results were used in the wet weather compliance assessments for total and fecal coliforms, and a total of 17 wet weather events were used in the wet weather compliance assessment for *Enterococcus*.

On May 4, 2023, a 14th wet weather event was sampled. However, these data were omitted from the wet weather analysis because the storm occurred outside the designated wet season timeframe, spanning from October 1 through April 30. The exclusion aligns with the criteria specified in Attachment E.6.d of the MS4 Permit. Notably, the results of this event did not exceed the single-sample maximum water quality objectives.

At EH-420 during wet weather, FIB compliance constituents fecal coliform and total coliform reported concentrations below the single-sample maximum threshold for the 16 wet weather samples reported. Concentrations for *Enterococcus* were below the single-sample maximum threshold for 14 out of 17 samples.

Table 2-4 presents 2022–2023 wet weather analytical results for compliance constituents (total coliform, fecal coliform, and *Enterococcus*). Figure 2-1 illustrates 2022–2023 wet weather bacteria densities compared with the single-sample maximum numeric targets.

Tables presenting wet weather FIB concentrations for the 2022–2023 monitoring year are provided in Appendix B. Wet weather laboratory data are also submitted to the California Environmental Data Exchange Network (CEDEN) database annually.

Table 2-4.
Wet Weather Analytical Results for Moonlight State Beach

Wet Weather Analytical Results				
Wet Weather Event	Sample Date	Total Coliform (CFU/ 100 mL)	Fecal Coliform (CFU/ 100 mL)	<i>Enterococcus</i> (CFU/ 100 mL)
		SSM: 10,000	SSM: 400	SSM: 104
WW Event 1	11/3/2022	100	28	12
WW Event 2	11/10/2022	76	34	56
WW Event 3	12/13/2022	3780	300	510
	12/14/2022	14	<4	<4
	12/15/2022 ^a	TNTC	TNTC	148
WW Event 4	1/4/2023	1090	46	265
	1/5/2023	80	8	28
WW Event 5	1/11/2023	40	8	12
	1/12/2023	137	3	12
WW Event 6	1/19/2023	100	8	12
WW Event 7	2/1/2023	124	2	18
WW Event 8	2/15/2023	20	4	4
WW Event 9	2/27/2023	40	4	6
WW Event 10	3/13/2023	20	8	<2
WW Event 11	3/23/2023	160	22	32
WW Event 12	3/29/2023	15	2	4
WW Event 13	4/13/2023	820	83	53

Notes: CFU = Colony Forming Unit; MDL = Method Detection Limit; RL = Reporting Limit; SSM = single-sample maximum; TNTC = Too Numerous To Count; WW = Wet Weather; WQO = Water Quality Objective

Bold values = value exceeds SSM WQO.

- a. Total and fecal coliform results for Wet Weather Event 3 (December 15, 2023) were reported as 'too numerous to count', potentially due to an abundance of non-target colonies during testing, rendering the results unquantifiable.

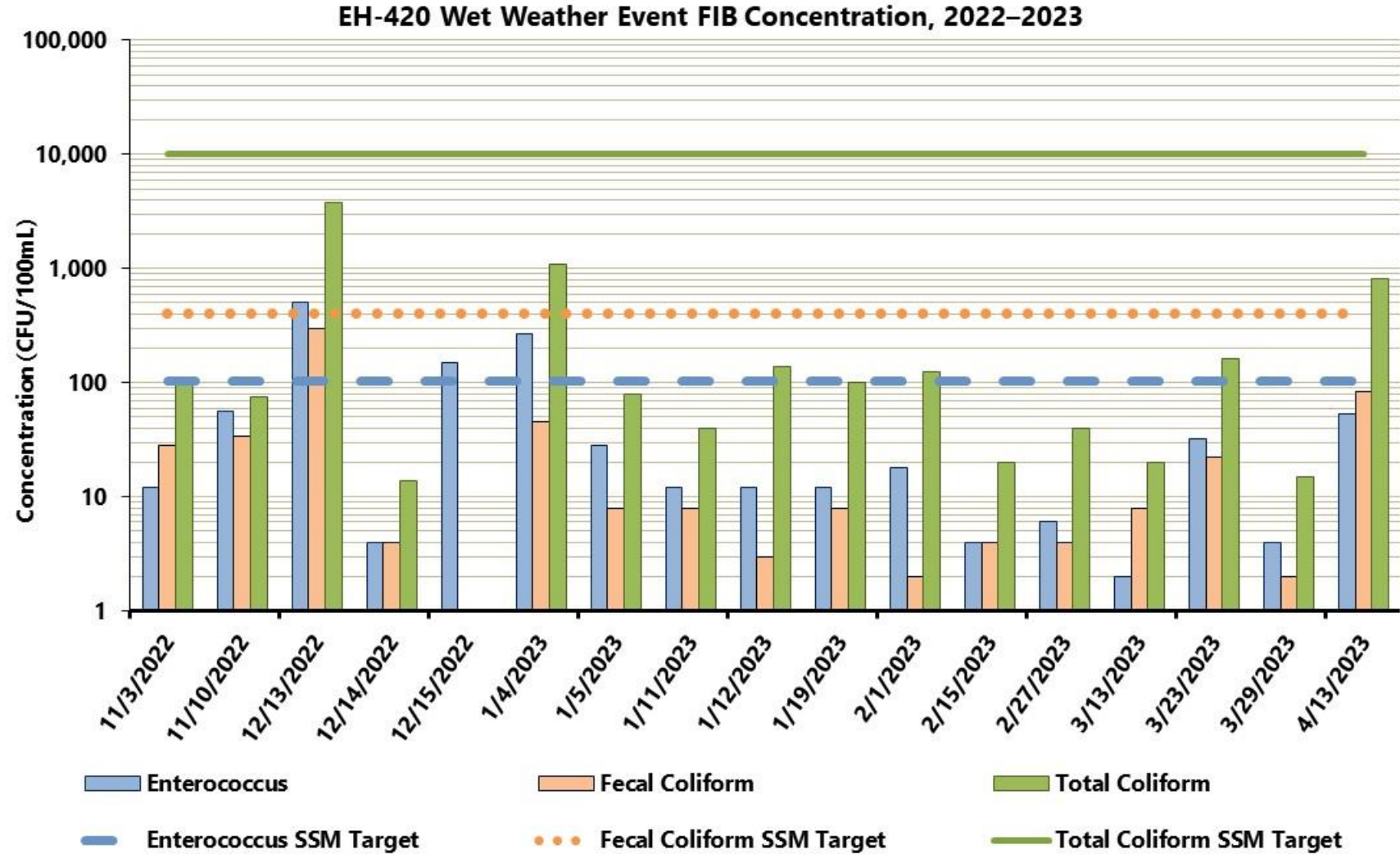


Figure 2-1.
2022–2023 Wet Weather Fecal Indicator Bacteria Concentrations – EH-420

This page intentionally left blank

2.3 Dry Weather Compliance Monitoring

Dry weather monitoring was performed during both the wet season (October 1, 2022, through April 30, 2023, and the dry season (May 1 through September 30, 2023) by the City of Encinitas. During the wet season (October through April), 18 dry weather events occurred at the compliance monitoring location, exceeding the minimum monthly sampling frequency described in the Compliance Monitoring Plan. During the dry season (May through September), 22 dry weather events occurred at the compliance monitoring location. Dry weather monitoring year-round was conducted on an approximately weekly basis above and beyond the requirements of Attachment E of the MS4 Permit, which requires a minimum of monthly sampling. Optional field measurements were recorded during the majority of dry weather sampling events and are presented in Appendix C. Bacteria grab samples were submitted to the Encina Wastewater Authority Laboratory (EWAL) for analysis.

2.3.1 Dry Weather Monitoring Event Summary

Dry weather monitoring was conducted from October 2022 through September 2023. During each dry weather event, water grab samples were collected by City of Encinitas field scientists in the receiving water at the compliance monitoring location. As defined by the Compliance Monitoring Plan, dry weather events may occur on dry weather days with an antecedent dry period of 72 hours with less than 0.1 inch of rainfall. Bacteria samples were submitted to the EWAL for analysis.

During dry weather, typical site conditions include the presence of seaweed, insects, and shorebirds. In general, flow from Cottonwood Creek reaches the receiving water year-round. Optional field measurements, when recorded, included pH, temperature, turbidity, dissolved oxygen and conductivity.

Tables presenting dry weather FIB concentrations and field measurements for the 2022–2023 monitoring year are provided in Appendix C. Dry weather laboratory data are also submitted to the CEDEN database annually.

From May 1, 2023, through September 30, 2023, a total of 2.69 inches were measured at the ENCC1 rain gauge. Table 2-5 summarizes total monthly rainfall for the 2023 dry season.

Table 2-5.
Dry Season Monthly Rainfall Summary

Month	ENCC1 Rainfall (inch)
May	0.20
June	0.11
July	0.00
August	2.29
September	0.09
Total Rainfall	2.69

2.3.2 Dry Weather FIB Concentrations

A total of 40 dry weather samples were collected during the 2022–2023 monitoring year. Of 18 FIB samples collected during the 2022–2023 wet season, concentrations of total coliform, fecal coliform, and *Enterococcus* remained below single sample maximum WQOs, with no exceptions. Of 22 FIB samples collected during the 2023 dry season, concentrations of total coliform, fecal coliform, and *Enterococcus* remained below single sample maximum WQOs, with no exceptions. The Moonlight Ultraviolet (UV) Treatment System is located just upstream of the Cottonwood Creek discharge point and uses UV light to reduce bacteria loads in the creek outflow by approximately 99%.

This page intentionally left blank

3.0 COMPLIANCE EVALUATION

This section presents the results of the compliance evaluation for dry and wet seasons in accordance with the assessment requirements of Attachment E of the MS4 Permit. Several inconsistencies were identified in Attachment E.6.d of the MS4 Permit that may affect the interpretation of compliance; these inconsistencies are explained in detail in Appendix D.

3.1 Compliance Evaluation Methods

Attachment E.6.d of the MS4 permit defines seasonal compliance evaluations for dry season geometric means (using dry weather data), wet season geometric means (using combined dry and wet weather data), and wet weather single-sample maximums (using wet weather data). Attachment E.6.d does not define a compliance evaluation for dry weather single-sample maximums. Compliance evaluations for 2022–2023 were completed using methodology described in Sections 3.1.1 through 3.1.4 using FIB data collected from October 2022 through September 2023.

3.1.1 Wet Weather Single-Sample Maximum Exceedance Frequency

Wet weather exceedances are based on comparing the rate of exceedances of the single-sample maximum numeric target with the allowable 22% exceedance frequency. Wet weather events include the storm day(s) (0.1 inch of rainfall or more) and the following 72 hours, resulting in a minimum wet weather event duration of four days. Per Attachment E of the MS4 Permit, for monitored storm events, the highest reported result from a storm event is applied to each non-monitored day for the duration of that event. An inferred exceedance rate must also be calculated to account for non-monitored storm events.

For the remaining wet weather days that are not associated with a monitored event, the average (interpreted as arithmetic mean) of the highest reported results from each of the monitored wet weather events is assigned to the remaining wet weather days in the wet season:

$$\text{Geometric Mean} = n^{\text{th}} \text{ root of } (X_1)(X_2) \dots X_n$$

where: n is the number of monitored storm events

X_n is sample n result (e.g., X_1 = Wet Weather 1 Result)

The wet weather exceedance frequency is then determined by dividing the number of wet weather days that exceeded the single-sample maximum numeric target by the total number of wet weather days observed during the 2022–2023 wet season.

$$\text{Wet Weather Exceedance Frequency (\%)} = 100 * \frac{\sum(\text{WWD} > \text{Wet Weather RWL})}{\sum \text{WWD}}$$

where: $\sum \text{WWD}$ is the sum of wet weather days (0.1 inch of rainfall or more) and the following 72 hours

A list of observed wet weather days for the 2022–2023 wet season, both monitored and observed, is presented in Appendix B.

3.1.2 Wet Season Geometric Mean and Exceedance Frequency

Per Attachment E of the MS4 Permit, a wet season exceedance frequency was calculated using all monitoring results collected between October 1, 2022, and April 30, 2023. Per the California Ocean Plan, geometric means require a minimum of 5 samples to be collected within a 30-day period to be statistically meaningful. During the wet season, there were instances where the required 5-sample threshold is not met during a given 30-day period due to storm events and the fact that only monthly dry weather sampling is required during the wet season. In these instances, a wet season geometric mean was not calculated. When the 5-sample threshold is met, both dry and wet weather monitoring results were included in the calculation. A rolling geometric mean was calculated from the five most recent wet season samples. With each subsequent sample collected, the first sample from the preceding five-sample geometric mean was dropped from the calculation. The wet season geometric mean is therefore calculated as follows:

$$30\text{-Day Geometric Mean} = n \sqrt{(X_1) (X_2) (X_3) (X_4) (X_5)}$$

where: n is the number of individual results used in the calculation

X_n is sample n result (e.g., X_1 = November result, X_2 = Wet Weather 1 Result)

A wet season exceedance occurs when a geometric mean exceeds the dry weather geometric mean numeric target. The first geometric mean was calculated after the fifth sample of the wet season was collected.

To determine the wet season exceedance frequency, the number of wet season geometric means that exceed the dry weather numeric target was divided by the total number of calculated wet season geometric means, expressed as follows:

$$\text{Wet Season Exceedance Frequency (\%)} = 100 * \frac{\text{Wet Season } G_n > \text{DW NT}}{\text{Wet Season } G_n}$$

where: Wet Season G_n is the number of wet season geometric means

DW NT is the dry weather numeric target

3.1.3 Dry Season Geometric Mean and Exceedance Frequency

Attachment E of the MS4 Permit states that the geometric mean calculation should be consistent with the Ocean Plan requirements (SWRCB, 2012). A 30-day rolling geometric mean calculation was based on a minimum of five samples for any 30-day period. Geometric means were calculated as follows:

$$30\text{-Day Geometric Mean} = \sqrt[n]{(X_1)(X_2)(X_3)(X_4)(X_5)}$$

where: n is the number of individual results used in the calculation
 X_n is week n result (e.g., X_1 = week 1 result)

Dry season dry weather monitoring began in early May 2023; the first geometric mean was calculated after the fifth sample collected in the dry season. With each subsequent sample collected, the first sample from the preceding five-sample geometric mean was dropped outside of a 30-day window. Samples collected between May 1 and September 30, 2023, are used in this calculation.

A dry weather exceedance occurs when the geometric mean exceeds the dry weather numeric target. The first exceedance rate was calculated after the first geometric mean calculation. The number of geometric means that exceed the dry weather numeric target is divided by the total number of calculated dry season geometric means to determine the dry season exceedance frequency, as follows:

$$\text{Dry Season Exceedance Frequency (\%)} = 100 * \frac{\text{Dry Season } G_n > \text{DW NT}}{\text{Dry Season } G_n}$$

where: Dry Season G_n is the number of dry season geometric means
 DW NT is the dry weather numeric target

3.1.4 Dry Weather Single-Sample Maximum Exceedance Frequency

A dry weather single sample maximum (SSM) exceedance frequency assessment is not defined in Attachment E.6 of the MS4 Permit. To determine exceedance frequencies, dry weather samples collected from October 1, 2022, and September 30, 2023, were compared with the SSM numeric target. The exceedance frequency was then calculated by dividing the number of dry weather sample results that exceeded the SSM numeric target by the total number of dry weather samples collected for the monitoring year (October 1, 2022, through September 30, 2023).

3.2 Wet Weather Exceedance Rates and Compliance Evaluation

Per MS4 Permit Attachment E.6.d assessment requirements, the wet weather exceedance rate is inferred for the wet season, based on the sampled wet weather events. A wet weather day is defined as any wet weather event with 0.1 inch of rainfall or more, plus the following 72 hours. Using this criterion, 84 wet weather days were observed during the 2022–2023 wet season, as recorded at the ENCC1 rain gauge. Results for wet weather days in 2022–2023 are presented in Appendix B. The assessment described in Section 3.1.1 applies the average of the wet weather sampling results to each day of non-sampled wet weather events. All of the 84 wet weather days were associated with sampled storm events, and the geometric mean of the highest results was assigned to the remaining 34 wet weather days from non-sampled events.

During wet weather, single-sample maximum exceedance frequencies observed at EH-420 for total coliform, fecal coliform, and *Enterococcus* were 0%, 0%, and 19%, respectively. Based on current monitoring, EH-420 meets interim and final RWLs for total coliform, fecal coliform, and *Enterococcus*.

Table 3-1 presents wet weather single-sample maximum exceedance frequencies for the compliance monitoring location. The arithmetic mean of the highest results from the respective sampled storm events is presented in the table to illustrate the average derived from samples applied to the remaining non-sampled wet weather days, as compared with the numeric target. However, since at least one sample was collected during each of the 13 wet weather events during the 2022–2023, wet season, the arithmetic mean was not applied to any non-monitored events. Table 3-2 compares 2022–2023 exceedance frequencies with interim and final RWLs.

Table 3-1.
EH-420 Wet Weather Single-Sample Maximum 2022–2023 Exceedance Rates

Analyte	Numeric Target (CFU/100mL)	Arithmetic Mean (CFU/100mL)	Number of Samples	Number of Results in Exceedance	Number of Wet Weather Days	Number of Wet Weather Days in Exceedance	2022–2023 Wet Weather Exceedance Rate
Total Coliform	10,000	499	16	0	84	0	0%
Fecal Coliform	400	42	16	0	84	0	0%
<i>Enterococcus</i>	104	76	17	3	84	16	19%

Notes:

% = percent; CFU = colony-forming unit; ID = identification; mL = milliliters

Site ID: EH-420 = Moonlight State Beach

Table 3-2.
2022–2023 Wet Weather Exceedance Rates and Compliance Reduction Milestones

Site ID	Analyte	2022–2023 Exceedance Rate	Interim Allowable RWLs	Interim Allowable RWL Achieved?	Final Allowable RWLs	Final Allowable RWLs Achieved?
EH-420	Total Coliform	0%	40%	Yes	22%	Yes
	Fecal Coliform	0%	40%	Yes	22%	Yes
	<i>Enterococcus</i>	19%	41%	Yes	22%	Yes

Notes:

% = percent; ID = identification; RWL = receiving water limitation

Site ID: EH-420 = Moonlight State Beach

3.3 Wet Season Geometric Mean Exceedance Rates

The overall wet season evaluation combines bacteria results during dry weather and wet weather events. Higher exceedance rates are expected during the wet season, with the inclusion of storm samples that reflect high-flow conditions and runoff from all land-use types. For the 2022–2023 wet season, geometric mean exceedance rates were 0%, 0%, and 10% for total coliform, fecal coliform, and *Enterococcus*, respectively.

It should be noted that this assessment is an MS4 permit-required assessment rather than a TMDL-required assessment; for additional details refer to Appendix D. While it will continue to be included in this and future Moonlight Beach Bacteria TMDL report for simplicity's sake, it is not currently a stated metric for TMDL compliance.

Table 3-3 presents the wet season geometric mean exceedance rates for all compliance constituents, based on the available data, including the number of geometric means calculated from the results, the number of geometric means that exceeded the numeric target, and the maximum geometric mean.

Table 3-3.
2022–2023 Wet Season Geometric Mean Exceedance Rates

Site ID	Analyte	Numeric Target (CFU/100mL)	Number of Geomeans	Number of Exceedances	2022–2023 Wet Season Exceedance Rate
EH-420	Total Coliform	1,000	30	0	0%
	Fecal Coliform	200	30	0	0%
	<i>Enterococcus</i>	35	31	3	10%

Notes:

% = percent; CFU = colony-forming unit; ID = identification; mL = milliliters

Site ID: EH-420 = Moonlight State Beach

3.4 Dry Season Geometric Mean Exceedance Rates and Compliance Evaluation

The overall dry season evaluation combines bacteria results during dry weather events from May 1, 2023, through September 30, 2023.

Dry season monitoring occurred approximately weekly, and exceedances were based on a 30-day geometric mean calculated from the preceding five samples. The geometric mean did not exceed dry weather numeric objectives at the compliance monitoring location during the 2023 dry season for the three FIB compliance constituents.

Table 3-5 presents the dry season geometric mean exceedance rates for all compliance constituents, including the number of geometric means calculated from the results, the number of geometric means that exceeded the numeric target, and the maximum geometric mean. Table 3-6 compares current dry season geometric exceedance frequencies with the existing dry weather exceedance rates and provides progress compared with final RWLs.

Table 3-5.
2023 Dry Season Geometric Mean Exceedance Rates

Site ID	Analyte	Dry Numeric Target (CFU/100mL)	Number of Geomeans	Number of Exceedances	2023 Dry Season Exceedance Rate
EH-420	Total Coliform	1,000	18	0	0%
	Fecal Coliform	200	18	0	0%
	<i>Enterococcus</i>	35	18	0	0%

Notes:

% = percent; CFU = colony-forming unit; ID = identification; mL = milliliters

Site ID: EH-420 = Moonlight State Beach

Table 3-6.
Dry Season Exceedance Rates and Compliance Reduction Milestones

Site ID	Analyte	Existing Exceedance Rate ^a	2023 Exceedance Rate	Final Allowable RWLs	Final Allowable Achieved?
EH-420	Total Coliform	28.2%	0%	0%	Yes
	Fecal Coliform	35.0%	0%	0%	Yes
	<i>Enterococcus</i>	78.6%	0%	0%	Yes

Notes:

% = percent; ID = identification; RWL = receiving water limitation

Site ID: EH-420 = Moonlight State Beach

a. Existing exceedance rate is based on available 1996–2002 historical data.

3.5 Dry Weather Single-Sample Maximum Exceedance Rates

Footnotes to Table 6.2a of Attachment E.6 of the MS4 Permit, which provides final RWLs for beaches, state that single-sample maximums are to be attained during dry weather days in addition to 30-day geometric means (Table 1-2, footnotes b and c). However, a dry weather single-sample maximum assessment is not defined in Attachment E.6.d of the MS4 Permit. Additional details regarding this discrepancy is provided in Appendix D.

Throughout the 2022–2023 monitoring year, EH-420 consistently met single-sample maximum numeric targets for all three compliance constituents during dry weather conditions. Table 3-6 presents the dry weather single-sample maximum exceedance rates, including the number of results that exceeded the numeric target.

Table 3-7.
2022–2023 Dry Weather Single-Sample Maximum Exceedance Rates

Site ID	Analyte	Single-Sample Maximum (CFU/100mL) Numeric Target	Number of Results	Number of Results in Exceedance	2022–2023 Dry Weather Exceedance Rate
EH-420	Total Coliform	10,000	40	0	0%
	Fecal Coliform	400	40	0	0%
	<i>Enterococcus</i>	104	40	0	0%

Notes:

CFU = colony-forming unit(s); EH-420 =Moonlight State Beach; ID = identification; mL = milliliter(s)

3.6 Progress Toward Attaining Interim and Final Receiving Water Limitations

Table 3-8 depicts the general progress toward meeting interim and final numeric targets by season for the Moonlight State Beach compliance monitoring location. This table indicates whether targets for collective FIB have been met (●), have been partially met (○), or have not yet been met (X). A partially met goal means that at least one of the FIB constituents meets the RWL.

Table 3-8.
General Progress Toward Interim and Final Targets
for Moonlight State Beach, 2022–2023

2022–2023 Wet Weather Single-Sample Maximum		2023 Dry Season Geometric Mean and Single Sample Maximum
Interim	Final	Final
●	●	●

Notes:

- = compliance targets fully met
- = compliance targets partially met
- X = compliance targets not met

4.0 Summary

This section describes the current receiving water conditions at Moonlight State Beach related to project goals. Dry weather data collected during the 2023 dry season were used to evaluate compliance based on current conditions.

4.1 Characterization of Current FIB Concentrations

Overall, compliance with interim and final wet weather RWLs was achieved for 2022–2023 wet weather samples.

- Wet weather single-sample maximum exceedance rates were below the final allowable wet weather exceedance rate of 22% for the three compliance constituents.
- During the dry season, a 0% geometric mean exceedance frequency was observed for all three FIB constituents, meeting the final allowable dry weather exceedance rate of 0% for all three compliance constituents.
- Dry weather single sample maximum exceedance rates were 0%.
- Table 4-1 presents the 2022–2023 exceedance rate frequency results by season for Moonlight State Beach.

These data collectively demonstrate that Moonlight State Beach monitoring location is meeting interim and final compliance goals and that REC-1 is supported at Moonlight State Beach year-round.

Table 4-1.
2022–2023 Bacteria TMDL Exceedance Frequency Results for Moonlight State Beach

Site ID	Bacteria TMDL Constituent	Wet Weather Single-Sample Maximum (CFU/100mL)			Dry Season 30-Day Geometric Mean (CFU/100mL)		Dry Weather Single-Sample Maximum (CFU/100mL)
		2022–2023 Exceedance Frequency	Interim Allowable Frequency	Final Allowable Frequency	2023 Exceedance Frequency	Final Allowable Frequency	2023 Exceedance Frequency
EH-420	Total Coliform	0%	40%	22%	0%	0%	0%
	Fecal Coliform	0%	40%	22%	0%	0%	0%
	<i>Enterococcus</i>	19%	41%	22%	0%	0%	0%

Notes:

% = percent; CFU = colony-forming unit; ID = identification; mL = milliliters; TMDL = total maximum daily load

Site ID: EH-420 = Moonlight State Beach;

5.0 REFERENCES

- Carlsbad Watershed Management Area Responsible Agencies. 2016. Carlsbad Water Quality Improvement Plan, Second Revised Draft. Accepted in November.
- City of Encinitas. 2017. Moonlight State Beach Bacteria TMDL Compliance Monitoring Plan. January.
- San Diego Regional Water Quality Control Board (Regional Board). 2010. Resolution No. R9-2010-0001, *A Resolution Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised Total Maximum Daily Loads for Indicator Bacteria Project I—Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)* (Bacteria TMDL). February 10.
- Regional Board. 2015. Resolution No. R9-2013-0001, *National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the MS4s Draining the Watershed in the San Diego Region, as Amended by Order Nos. R9-2015-0001 and R9-2015-0100* (MS4 Permit). November 18.
- State Water Resources Control Board (SWRCB), 2012. *California Ocean Plan, Water Quality Control Plan, Ocean Waters of California*. Resolution No. 2012-0056. Latest revision adopted August 2018. Effective, February 2019.
- Ferguson D.M., Griffith J.F., Mcgee C.D., Weisberg S.B., & Hagedorn C. (2013). Comparison of *Enterococcus* Species Diversity in Marine Water and Wastewater Using Enterolert and EPA Method 1600. *Journal of Environmental and Public Health*, 2013. <http://dx.doi.org/10.1155/2013/848049>.
- El-Magharaby M. (2008). Comparison of Standard Methods, MTF, and MF, by the Colilert Rapid test for the Enumeration of Coliform Bacteria in High Salinity Water, Arabian Gulf, Doha, Qatar. *Bulletin of High Institute of Public Health*, 2008. 38(3), 77-89.

This page intentionally left blank

APPENDIX A

QUALITY ASSURANCE / QUALITY CONTROL SUMMARY

This page intentionally left blank

A. QUALITY ASSURANCE/QUALITY CONTROL SUMMARY

This appendix describes in detail any deviations from the Moonlight Beach Bacteria TMDL Compliance Monitoring Plan (Compliance Monitoring Plan), as well as the quality assurance/quality control (QA/QC) activities associated with compliance monitoring for the 2022–2023 monitoring year. The QA/QC program includes both field and laboratory components.

A.1 Deviations from the Compliance Monitoring Plan

There were no deviations from the Compliance Monitoring Plan for the 2022–2023 monitoring year.

A.2 Field Sampling Quality Assurance and Quality Control (QA/QC)

Monitoring and analyses followed Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance (QA) guidelines. SWAMP requires the collection of field blanks in order to evaluate potential contamination and sampling errors, and recommends collection of field duplicates. These samples isolate errors related to grab sampling prior to submittal of the samples to the analytical laboratory. Field sampling protocols can be found in the Compliance Monitoring Plan.

A brief summary of each measurement type and 2022–2023 results are provided below:

Field Blanks

Field blanks verify that field conditions, field sampling activities, and aerial deposition are not sources of contamination. Field blanks were taken by filling sample bottles with reagent grade, analyte-free deionized water in the field during a sampling event. The samples were then submitted to the laboratory for analysis. The frequency outlined in the Compliance Monitoring Plan for field blanks is at least 5 percent (%) of the total sample count. Results of field blank analysis should be below the reporting limit for each analyte.

For the 2022–2023 monitoring year, field blank data met measurement quality objectives (MQOs) for accuracy and frequency. All field blank indicator bacteria concentrations were below the reporting limit, which fulfilled the accuracy MQO. Field blank samples were collected at a frequency of 5% for *Enterococcus*, fecal coliform, and total coliform, which met the frequency MQO of 5%. Field blank data are provided in Table A-1.

Table A-1.
Field Blank Results

Analyte	Accuracy MQO	Result	Accuracy MQO Met	Frequency MQO	Frequency Achieved	Frequency MQO Met
<i>Enterococcus</i>	<RL for target analyte	ND	Yes	5% of total project sample count	5%	Yes
Fecal Coliform		ND	Yes		5%	Yes
Total Coliform		ND	Yes		5%	Yes

Field Duplicates

Field duplicates measure precision and evaluate error introduced by field sampling. Duplicate samples consist of two replicates (an original and a duplicate) of the same matrix collected at the same time and location using the same sampling technique. The Compliance Monitoring Plan outlined frequency for field duplicates is at least 5% of the total sample count. The relative percent difference (RPD) was calculated to determine the precision between duplicate samples. This calculation is shown below:

$$RPD = \frac{abs[\log(x_1) - \log(x_2)]}{0.5 * [\log(x_1) + \log(x_2)]}$$

Where: abs is the absolute value

x1 is measurement 1 (primary sample, log-transformed)

X2 is measurement 2 (e.g., duplicate sample, log-transformed)

Field duplicate samples were collected at a frequency of 5% for *Enterococcus*, fecal coliform, and total coliform, which satisfied the MQO of 5%.

Field duplicate RPDs were as follows: average RPD results were 42% for *Enterococcus*, 10% for fecal coliform, and 25% for total coliform. Though the average RPD for *Enterococcus* did not meet the precision MQO of RPD<25%, the duplicate sample pairs responsible for the elevated RPDs were very close to the reporting limit, and the elevated RPD was a function of the low concentrations in the two duplicate samples, not error introduced in field sampling. For example, for one duplicate pair with an RPD of 120%, the primary sample did not have an *Enterococcus* detection, and was therefore reported as 1 CFU/100mL, while the field duplicate had a result of 4 CFU/100mL. For bacterial data, where results are direct counts of colony forming units and only positive integer results are possible, these results are in good agreement. Thus, the data should not be disqualified.

Field duplicate RPD and frequency data are provided in Table A-2 for wet and dry weather samples collected from October 1, 2022-September 30, 2023.

Table A-2.
Field Duplicate Results

Analyte	Accuracy MQO	Result	Accuracy MQO Met	Frequency MQO	Frequency Achieved	Frequency MQO Met
<i>Enterococcus</i>	RPD < 25% ^a	42%	No ^b	5% of total project sample count	5%	Yes
Fecal Coliform		10%	Yes		5%	Yes
Total Coliform		25%	No ^b		5%	Yes

Notes:

NA = not analyzed

a. USEPA studies suggest a RPD of less than or equal to 50% for field duplicates would be more appropriate for bacteriological methods given the spatial variability of bacteria concentrations in surface waters.

b. The precision MQO was not met because of one duplicate pair where both results were in good agreement, but low concentrations in the native sample caused the RPD percentage to be very high. Because the sample sets were all in agreement regarding the non-detect, the data are considered valid.

A.3 Laboratory Quality Assurance and Quality Control (QA/QC)

Laboratory QA/QC activities provide information needed to assess laboratory contamination, analytical precision, and analytical accuracy. Laboratory QC samples include positive and negative controls as described below. Table A-3 describes the planned frequency and types of quality control samples as outlined in the Compliance Monitoring Plan.

Positive and Negative Controls —A positive control is generated by analyzing a matrix known to contain the target bacteria (such as wastewater influent), which is filtered and incubated the same way as a sample. Target bacteria growth should be observed on the filter after incubation. A positive control is used to detect procedural errors or the presence of contaminants in the laboratory analysis that might inhibit bacteria growth (USEPA, 2012). A negative control is generated by analyzing the buffered rinse water, which is filtered and incubated the same way as a sample. There should be no growth on the negative control plates after incubation. A negative control is used to detect laboratory contamination of the analyses.

Table A-3.
Laboratory QC

Constituent Category	Method Blanks	
	Frequency	Acceptance Limits
Positive and Negative Controls	Per batch of bottles or reagents	Positive Control = Growth on filter; Negative Control = No growth on filter

Laboratory QC Results

Both dry and wet weather sample analyses were conducted in full by the Encina Wastewater Authority Laboratory (EWAL). Laboratory QC data were generated for each method, including an initial and final blank per sample batch as well as positive and negative controls for each batch of prepared media. Positive and negative controls consisted of *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* for total coliform media, *E. coli* and *Enterobacter aerogenes* for fecal coliform media, and *Enterococcus faecalis* and *E. coli* for *Enterococcus* media, respectively. If a given sample and/or batch does not pass this QC step, the sample is flagged, and Encina notifies the City. During the current monitoring year, all samples and batches passed this QC step.

APPENDIX B

2022-2023 WET WEATHER ANALYTICAL RESULTS

This page intentionally left blank

Table B-1.
2022–2023 Wet Weather Analytical Results and Optional Field Measurements for EH-420

Wet Weather Analytical Results									
Wet Weather Event	Sample Date	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Enterococcus (CFU/100mL)	pH	Temp. (°C)	Turbidity (NTU)	Specific Cond. (mS/cm)	Dissolved Oxygen (mg/L)
		SSM: 10,000	SSM: 400	SSM: 104					
Event 1	11/3/2022	100	28	12	N/A	N/A	N/A	N/A	N/A
Event 2	11/10/2022	76	34	56	8.15	16.60	6.7	46.6	10.6
Event 3	12/13/2022	3,780	300	510	8.25	14.97	15.2	45.2	7.49
	12/14/2022	14	<4	<4	8.26	13.40	5.8	46.9	9.13
	12/15/2022 ^a	TNTC	TNTC	148	8.35	13.73	1.0	46.1	11.21
Event 4	1/4/2023	1,090	46	265	7.84	15.83	0	39	NR
	1/5/2023	80	8	28	8.02	15.79	1.0	41.4	17.78
Event 5	1/11/2023	40	8	12	8.06	14.18	34.9	42.9	11.66
	1/12/2023	137	3	12	8.06	14.92	41.8	42.1	13.84
Event 6	1/19/2023	100	8	12	N/A	N/A	N/A	N/A	N/A
Event 7	2/1/2023	124	2	18	8.02	14.52	21.5	40.85	10.15
Event 8	2/15/2023	20	4	4	8.14	12.23	10.5	41.9	0.02
Event 9	2/27/2023	40	4	6	N/A	N/A	N/A	N/A	N/A
Event 10	3/13/2023	20	8	<2	8.37	16.03	0.7	39.6	15.26
Event 11	3/23/2023	160	22	32	8.15	14.25	18.6	40.5	12.69
Event 12	3/29/2023	15	2	4	8.2	15.6	6.3	41.2	5.46
Event 13	4/13/2023	820	83	53	8.32	14.55	3.5	38.4	5.05
Arithmetic Mean		499	42	76					

Notes:

°C = Degrees Celsius; DO = Dissolved Oxygen; CFU = Colony Forming Unit; MDL = Method Detection Limit; mg/L = milligrams per liter; N/A = Not Applicable; NTU = Nephelometric Turbidity unit; RL = Reporting Limit; SSM = single-sample maximum; TNTC = Too Numerous to Count; WQO = Water Quality Objective

Bold values indicate a value above the WQO.

 Green shaded indicates value used in arithmetic mean.

a. In Wet Weather Event 3 on 12/15/2022 Total Coliform and Fecal Coliform had a result of Too Numerous. These results were disqualified due to the uncertainty of the plate counts and Wet Weather Event 3 having two more mores on 12/13/2022 and 12/14/2022.

Table B-2.
2022–2023 Wet Season Wet Weather Days

Wet Weather Day No.	2022-2023 Wet Season Wet Weather Days (0.1 inches + 72 hours)	
	Date	Rainfall (inches)
1	11/2/2022	0.11
2	11/3/2022	0.03
3	11/4/2022	0
4	11/5/2022	0
5	11/6/2022	0
6	11/7/2022	0.63
7	11/8/2022	0.76
8	11/9/2022	0
9	11/10/2022	0
10	11/11/2022	0
11	12/11/2022	0.43
12	12/12/2022	0.37
13	12/13/2022	0
14	12/14/2022	0
15	12/15/2022	0
16	12/27/2022	0.41
17	12/28/2022	0.36
18	12/29/2022	0
19	12/30/2022	0
20	12/31/2022	0.21
21	1/1/2023	1.49
22	1/2/2023	0.02
23	1/3/2023	0.42
24	1/4/2023	0.08
25	1/5/2023	0.40
26	1/6/2023	0
27	1/7/2023	0
28	1/8/2023	0
29	1/10/2023	0.41
30	1/11/2023	0
31	1/12/2023	0
32	1/13/2023	0
33	1/14/2023	1.5
34	1/15/2023	0.98
35	1/16/2023	1.37
36	1/17/2023	0.05
37	1/18/2023	0.01
38	1/19/2023	0.1
39	1/20/2023	0
40	1/21/2023	0.01
41	1/22/2023	0
42	1/30/2023	0.59

Table B-2.
2022–2023 Wet Season Wet Weather Days (Continued)

Wet Weather Day No.	2022-2023 Wet Season Wet Weather Days (0.1 inches + 72 hours)	
	Date	Rainfall (inches)
43	1/31/2023	0
44	2/1/2023	0
45	2/2/2023	0
46	2/12/2023	0.21
47	2/13/2023	0
48	2/14/2023	0
49	2/15/2023	0
50	2/23/2023	0.16
51	2/24/2023	0
52	2/25/2023	1.93
53	2/26/2023	0.02
54	2/27/2023	0.01
55	2/28/2023	0.13
56	3/1/2023	0.24
57	3/2/2023	0
58	3/3/2023	0
59	3/4/2023	0
60	3/10/2023	0.97
61	3/11/2023	0.19
62	3/12/2023	0.02
63	3/13/2023	0.01
64	3/14/2023	0.25
65	3/15/2023	1.96
66	3/16/2023	0
67	3/17/2023	0
68	3/18/2023	0.01
69	3/19/2023	0.26
70	3/20/2023	0.11
71	3/21/2023	1.26
72	3/22/2023	0.10
73	3/23/2023	0.05
74	3/24/2023	0
75	3/25/2023	0
76	3/29/2023	0.29
77	3/30/2023	0.20
78	3/31/2023	0
79	4/1/2023	0
80	4/2/2023	0
81	4/13/2023	0.10
82	4/14/2023	0
83	4/15/2023	0
84	4/16/2023	0

Notes:

Blue shaded = Sampling events.

Non-shaded = Non-sampled wet weather days.

Wet Weather day is defined as precipitation greater than or equal to 0.1" + 72 hours

This page intentionally left blank

Table B-3.
2022–2023 Wet Weather Rainfall and Total Coliform SSM Exceedance Calendar

Year	2022					2023													
Month	October	November		December		January		February		March		April		May	June	July	August	September	
Day	Rainfall (in)		Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Rainfall (in)	Rainfall (in)	Rainfall (in)	Rainfall (in)	
1	-	-		-		1.49	1090	-	124	0.24	40	-	15	-	-	-	0.15	-	
2	-	0.11	100	-		0.02	1090	-	124	-	40	-	15	-	0.02	-	-	0.03	
3	-	0.03	100	-		0.42	1090	-		-	40	-		0.01	-	-	-	-	
4	-	-	100	-		0.08	1090	-		-	40	-		0.10	-	-	-	-	
5	-	-	100	0.02		0.40	80	Trace		-		-		0.08		-	-	-	
6	-	-	100	0.01		-	1090	-		-		-		-	-	-	-	-	
7	-	0.63	76	-		-	1090	-		-		-		-	-	-	-	-	
8	-	0.76	76	-		-	1090	-		-		-		-	-	-	-	-	
9	-	-	76	-		-		-		-		-		-	-	-	-	-	
10	-	-	76	-		0.41	137	-		0.97	20	-		-	-	-	-	-	
11	0.01	-	76	0.43	3780	-	40	-		0.19	20	-		-	-	-	-	-	
12	Trace	-		0.37	3780	-	137	0.21	20	0.02	20	0.04		-	-	-	-	-	
13	Trace	-		-	3780	-	137	Trace	20	0.01	20	0.10	820	-	0.06	-	-	-	
14	-	-		-	14	1.50	100	Trace	20	0.25	20	-	820	-	0.02	-	-	-	
15	-	-		-	3780	0.98	100	-	20	1.96	20	-	820	-	0.01	-	-	-	
16	-	-		-		1.37	100	-		-	20	-	820	-	-	-	-	0.02	
17	-	-		-		0.05	100	-		-	20	-		-	-	-	-	0.04	
18	-	-		-		0.01	100	-		0.01	20	-		-	-	-	-	-	
19	-	-		-		0.10	100	-		0.26	160	-		-	-	-	-	-	
20	-	-		-		-	100	-		0.11	160	-		-	-	-	2.14	-	
21	-	-		-		0.01	100	0.04		1.26	160	-		-	-	-	-	-	
22	-	-		-		-	100	0.04		0.10	160	-		-	-	-	-	-	
23	-	-		-		-		0.16	40	0.05	160	-		-	-	-	-	-	
24	-	-		-		-		Trace	40	-	160	-		-	-	-	-	-	
25	-	-		-		-		1.93	40	-	160	-		-	-	-	-	-	
26	-	-		-		-		0.02	40	-		-		-	-	-	-	-	
27	-	-		0.41	1090	-		0.01	40	-		-		-	-	-	-	-	
28	-	-		0.36	1090	-		0.13	40	-		-		-	-	-	-	-	
29	-	-		-	1090	0.07				0.29	15	-		0.01	-	-	-	-	
30	-	-		-	1090	0.59	124			0.20	15	-		-	-	-	-	-	-
31	-			0.21	1090	-	124			-	15			-		-		-	-
Total	0.01	1.53		1.81		7.50		2.54		5.92		0.14		0.2	0.11	0	2.29	0.09	
Wet Season Total Rainfall (inches): 19.45; Monitoring Year Total Rainfall (inches): 22.13																			

Table B-4.
2022–2023 Wet Weather Rainfall and Fecal Coliform SSM Exceedance Calendar

Year	2022					2023													
Month	October	November		December		January		February		March		April		May	June	July	August	September	
Day	Rainfall (in)		Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Rainfall (in)	Rainfall (in)	Rainfall (in)	Rainfall (in)	
1	-	-		-		1.49	46	-	2	0.24	4	-	2	-	-	-	0.15	-	
2	-	0.1	28	-		0.02	46	-	2	-	4	-	2	-	0.02	-	-	0.03	
3	-	0	28	-		0.42	46	-		-	4	-		0.01	-	-	-	-	
4	-	-	28	-		0.08	46	-		-	4	-		0.10	-	-	-	-	
5	-	-	28	0.02		0.40	8	Trace		-		-		0.08		-	-	-	
6	-	-	28	0.01		-	46	-		-		-		-	-	-	-	-	
7	-	0.6	34	-		-	46	-		-		-		-	-	-	-	-	
8	-	0.8	34	-		-	46	-		-		-		-	-	-	-	-	
9	-	-	34	-		-		-		-		-		-	-	-	-	-	
10	-	-	34	-		0.41	8	-		0.97	8	-		-	-	-	-	-	
11	0.01	-	34	0.43	300	-	8	-		0.19	8	-		-	-	-	-	-	
12	Trace	-		0.37	300	-	3	0.21	4	0.02	8	0.04		-	-	-	-	-	
13	Trace	-		-	300	-	8	Trace	4	0.01	8	0.10	83	-	0.06	-	-	-	
14	-	-		-	4	1.50	8	Trace	4	0.25	8	-	83	-	0.02	-	-	-	
15	-	-		-	300	0.98	8	-	4	1.96	8	-	83	-	0.01	-	-	-	
16	-	-		-		1.37	8	-		-	8	-	83	-	-	-	-	0.02	
17	-	-		-		0.05	8	-		-	8	-		-	-	-	-	0.04	
18	-	-		-		0.01	8	-		0.01	8	-		-	-	-	-	-	
19	-	-		-		0.10	8	-		0.26	22	-		-	-	-	-	-	
20	-	-		-		-	8	-		0.11	22	-		-	-	-	2.14	-	
21	-	-		-		0.01	8	0.04		1.26	22	-		-	-	-	-	-	
22	-	-		-		-	8	0.04		0.10	22	-		-	-	-	-	-	
23	-	-		-		-		0.16	4	0.05	22	-		-	-	-	-	-	
24	-	-		-		-		Trace	4	-	22	-		-	-	-	-	-	
25	-	-		-		-		1.93	4	-	22	-		-	-	-	-	-	
26	-	-		-		-		0.02	4	-		-		-	-	-	-	-	
27	-	-		0.41	46	-		0.01	4	-		-		-	-	-	-	-	
28	-	-		0.36	46	-		0.13	4	-		-		-	-	-	-	-	
29	-	-		-	46	0.07				0.29	2	-		0.01	-	-	-	-	
30	-	-		-	46	0.59	2			0.20	2	-		-	-	-	-	-	-
31	-			0.21	46	-	2			-	2			-		-		-	
Total	0.01	1.53		1.81		7.50		2.54		5.92		0.14		0.2	0.11	0	2.29	0.09	
Wet Season Total Rainfall (inches): 19.45; Monitoring Year Total Rainfall (inches): 22.13																			

Date sampled
 Date in compliance
 Date in exceedance

Table B-5.
2022–2023 Wet Weather Rainfall and *Enterococcus* SSM Exceedance Calendar

Year	2022					2023												
Month	October	November		December		January		February		March		April		May	June	July	August	September
Day	Rainfall (in)		Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Applied Conc.	Rainfall (in)	Rainfall (in)	Rainfall (in)	Rainfall (in)	Rainfall (in)
1	-	-		-		1.49	265	-	18	0.24	6	-	4	-	-	-	0.15	-
2	-	0.1	12	-		0.02	265	-	18	-	6	-	4	-	0.02	-	-	0.03
3	-	0	12	-		0.42	265	-		-	6	-		0.01	-	-	-	-
4	-	-	12	-		0.08	265	-		-	6	-		0.10	-	-	-	-
5	-	-	12	0.02		0.40	28	Trace		-		-		0.08		-	-	-
6	-	-	12	0.01		-	265	-		-		-		-	-	-	-	-
7	-	0.6	56	-		-	265	-		-		-		-	-	-	-	-
8	-	0.8	56	-		-	265	-		-		-		-	-	-	-	-
9	-	-	56	-		-		-		-		-		-	-	-	-	-
10	-	-	56	-		0.41	12	-		0.97	2	-		-	-	-	-	-
11	0.01	-	56	0.43	510	-	12	-		0.19	2	-		-	-	-	-	-
12	Trace	-		0.37	510	-	12	0.21	4	0.02	2	0.04		-	-	-	-	-
13	Trace	-		-	510	-	12	Trace	4	0.01	2	0.10	53	-	0.06	-	-	-
14	-	-		-	4	1.50	12	Trace	4	0.25	2	-	53	-	0.02	-	-	-
15	-	-		-	148	0.98	12	-	4	1.96	2	-	53	-	0.01	-	-	-
16	-	-		-		1.37	12	-		-	2	-	53	-	-	-	-	0.02
17	-	-		-		0.05	12	-		-	2	-		-	-	-	-	0.04
18	-	-		-		0.01	12	-		0.01	2	-		-	-	-	-	-
19	-	-		-		0.10	12	-		0.26	32	-		-	-	-	-	-
20	-	-		-		-	12	-		0.11	32	-		-	-	-	2.14	-
21	-	-		-		0.01	12	0.04		1.26	32	-		-	-	-	-	-
22	-	-		-		-	12	0.04		0.10	32	-		-	-	-	-	-
23	-	-		-		-		0.16	6	0.05	32	-		-	-	-	-	-
24	-	-		-		-		Trace	6	-	32	-		-	-	-	-	-
25	-	-		-		-		1.93	6	-	32	-		-	-	-	-	-
26	-	-		-		-		0.02	6	-		-		-	-	-	-	-
27	-	-		0.41	265	-		0.01	6	-		-		-	-	-	-	-
28	-	-		0.36	265	-		0.13	6	-		-		-	-	-	-	-
29	-	-		-	265	0.07				0.29	4	-		0.01	-	-	-	-
30	-	-		-	265	0.59	18			0.20	4	-		-	-	-	-	-
31	-			0.21	265	-	18			-	4			-			-	-
Total	0.01	1.53		1.81		7.50		2.54		5.92		0.14		0.2	0.11	0	2.29	0.09
Wet Season Total Rainfall (inches): 19.45; Monitoring Year Total Rainfall (inches): 22.13																		

This page intentionally left blank

APPENDIX C

2022–2023 DRY WEATHER FIELD AND ANALYTICAL RESULTS

This page intentionally left blank

Table C-1.

TMDL 2022–2023 Dry Weather Optional Field Measurements and Analytical Results at EH-420¹

Date	Optional Field Measurements / Observations						Compliance Constituents		
	Flow To Ocean (Y/N)	pH	Temp (°C)	Turbidity (NTU)	Sp. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Enterococcus (CFU/100mL)
10/5/2022	Y	8.14	22.23	58.6/4.1	44	8.44	18	7	6
10/12/2022	Y	8.32	21.78	3.1	45.5	10.45	26	6	12
10/19/2022	Y	8.1	20.9	2.2	45.4	5.72	14	4	<1
10/26/2022	Y	8.16	19.73	2	46.7	7.55	6	4	5
11/16/2022	Y	8.21	16.21	1	45.7	10.27	54	4	7
11/22/2022	Y	8.08	14.06	9.8	46.2	8.56	106	17	19
11/30/2022	Y	8.33	15.31	3.2	45.5	8.4	80	2	2
12/7/2022	Y	8.34	15	2	NA	11.2	6	1	7
12/21/2022	Y	NA	16.28	9.8	40.7	10.45	60	28	20
1/25/2023	N	8.08	12.96	49.3	42.4	NA	18	2	<1
2/8/2023	Y	8.17	13.31	28.8	40	14.79	151	39	35
2/21/2023	Y	NA	NA	NA	NA	NA	123	12	43
3/8/2023	Y	8.26	13.57	2.2	41.2	15.2	154	21	26
3/28/2023	Y	8.02	14.23	2.7	41.1	9.83	80	22	4
4/5/2023	Y	8.19	13.26	18.1	40.5	12.64	118	37	62
4/12/2023	Y	8.42	15.51	0	38.9	12.41	160	13	60
4/20/2023	N	8.41	15.87	5.5	41.1	11.6	13	5	<1
4/26/2023	N	8.43	18.45	0	40.9	11.52	38	8	2
5/3/2023	Y	8.5	18.19	1.5	40.6	10.56	604	16	16
5/11/2023	Y	8.27	19.8	0	40.3	7.33	58	2	9
5/17/2023	Y	8.2	18.73	1.9	39.8	12.13	29	1	2
5/24/2023	Y	8.38	18.5	0	40.7	4.88	20.5	2	2
5/31/2023	N	8.14	18.97	0	40.2	13.34	4	2	<1
6/7/2023	Y	8.03	20.08	7.5	40.8	0.38	8	2	2
6/14/2023	Y	6.31	19.08	0	39.5	0	4	4	2
6/21/2023	Y	8.13	19.5	0	410	14.2	4	1	1
6/28/2023	Y	8.19	19.52	0	40.2	5.88	18	7	7
7/5/2023	Y	8.38	20.47	0	40.2	NA	10	2	2
7/12/2023	Y	8.38	22.41	0	40.9	13.37	10	<1	2
7/19/2023	Y	8.35	23.9	0	41.4	14.95	64	3	3
7/26/2023	Y	8.4	22.97	0	41.2	15.71	4	2	12
8/2/2023	Y	NA	NA	NA	NA	NA	84	8	6
8/9/2023	Y	7.96	24.45	0	45.1	NA	<2	3	1

Table C-1.
TMDL 2022–2023 Dry Weather Optional Field Measurements and Analytical Results at EH-420¹
(Continued)

Date	Optional Field Measurements / Observations						Compliance Constituents		
	Flow To Ocean (Y/N)	pH	Temp (°C)	Turbidity (NTU)	Sp. Cond. (mS/cm)	Dissolved Oxygen (mg/L)	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Enterococcus (CFU/100mL)
8/17/2023	Y	7.94	21.19	1.1	44	NA	135	6	9
8/24/2023	Y	7.98	19.6	0.6	NA	NA	28	5	4
8/30/2023	Y	8.29	22.57	19.5	44.4	6.73	160	38	45
9/7/2023	Y	8.16	22.17	12.3	44.2	23.2	304	56	22
9/13/2023	Y	8.19	21.49	4.4	44.6	9.89	72	12	24
9/20/2023	Y	8.23	21.38	0	46.3	6.86	46	7	1
9/27/2023	Y	8.23	18.98	4.5	43	NA	20	4	9

1. Optional Field Measurements for previous TMDL monitoring years are presented in previous TMDL Annual Reports
μS/cm = microSiemens per centimeter; °C = degrees Celsius; CFU = colony-forming units; e = estimated value, plate count falls outside recommended reporting limits; EH-420 = Moonlight State Beach; mg/L = milligrams per liter; mL = milliliters; NA= Not analyzed; NTU = nephelometric turbidity units, Sp. Cond. = specific conductivity.

APPENDIX D

BACTERIA TMDL AND MS4 PERMIT DISCREPANCIES

This page intentionally left blank

D. Bacteria TMDL and MS4 Permit Inconsistencies

In May 2013, the San Diego Regional Water Quality Control Board (Regional Board) incorporated the Bacteria Total Maximum Daily Load (TMDL; Regional Board, 2010) into Attachment E.6 of the Municipal Separate Storm Sewer System (MS4) Permit (Regional Board, 2015). Attachment E.6 of the MS4 Permit supersedes the 2010 Bacteria TMDL; therefore, the Bacteria TMDL Compliance Monitoring Program and annual compliance monitoring report are designed to fulfill the monitoring and assessment requirements defined in Attachment E.6 of the MS4 Permit. A number of inconsistencies were identified between the Bacteria TMDL and MS4 Permit Attachment E.6, as well as within the documents themselves, and are summarized in this appendix.

D-1. Inconsistencies Between Bacteria TMDL and MS4 Permit Attachment E.6

D-1.1. Required Constituents

The Bacteria TMDL assigns load allocations (LAs), wasteload allocations (WLAs), and numeric targets for *Enterococcus*, fecal coliform, and total coliform with no caveats on applicability to TMDL-listed segments. However, the MS4 Permit eliminates total coliform as a TMDL compliance constituent for creeks (Table 6.2b—final *Receiving Water Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies for Creeks* [Regional Board, 2015, page E-33]).

D-1.2. Numeric Targets and Receiving Water Limitations

The Bacteria TMDL and Attachment E.6 of the MS4 Permit clearly identify the differences between wet and dry weather transport mechanisms driving bacteria loading during variable weather patterns; however, these fundamental differences are lost in practice, where dry weather goals are applied to results from wet weather samples and vice versa. Understanding the fundamental differences between wet and dry weather fecal indicator bacteria (FIB) loading characteristics is important because management strategies differ for these two types of sources. Several inconsistencies were identified that may affect interpretation of numeric targets and receiving water limitations (RWLs) in the Bacteria TMDL and Attachment E.6 of the MS4 Permit:

Bacteria TMDL

The Bacteria TMDL defined wet and dry weather numeric targets differently because fundamental transport mechanisms vary by conditions, which is consistent with how the TMDL was calculated (Regional Board, 2010, page A13). Numeric targets are defined as single-sample maximums (SSMs) for wet weather and 30-day geometric means for dry weather (Regional Board, 2010, page A16). The Bacteria TMDL stated that RWLs for Phase 1 MS4s would be based on the numeric targets, and that if RWLs are being met, Phase 1 MS4s have met their WLAs (Regional Board, 2010,

page A41-42).

The Bacteria TMDL defines RWLs for beaches and creeks on page A52 consistent with the numeric targets defined on page A16; however, footnotes were added that expanded the requirements beyond those defined in the numeric targets. The footnotes stated that for *“compliance with the wet weather TMDLs in the receiving water is based on the frequency that the wet weather days in any given year exceed the wet weather SSM numeric objective, but the 30-day geometric mean must also be met.”* No wet weather geometric mean numeric objective or allowable exceedance frequency is defined in the RWL tables, and no additional requirements for meeting dry weather receiving water limitations were noted.

After presentation of the RWL tables on page A52, the Bacteria TMDL then provides narrative text on pages A53—54 stating that at the end of the TMDL Compliance Schedules, *“receiving waters must meet RWLs above to be considered in compliance with these TMDLs, WLAs, and LA,”* but that determination of compliance with the TMDLs will be assessed differently (key detail paraphrased below):

1. Compliance with Dry Weather TMDLs

- a. At the end of the dry weather compliance schedule, receiving waters must meet dry weather RWLs on all dry weather days. In addition, bacteria densities must “be consistent with” the SSM REC-1 WQOs defined in the Ocean Plan or Basin Plan, as it applies to the specific waterbody. This statement indicates that the wet weather TMDL also applies to dry weather, undermining the key distinction between the fundamentally different transport mechanisms that define the differences between wet weather and dry weather TMDLs. It is explicitly stated that if at the end of the dry weather schedule the 30-day geometric mean is exceeded more than 0 percent of the time, dischargers must demonstrate that they are not causing or contributing to the exceedances or will be considered out of compliance. However, a definitive statement regarding assignment of compliance/non-compliance regarding SSM exceedances is not provided in this section. Other compliance pathways are not addressed in the section.

2. Compliance with Wet Weather TMDLs

- a. At the end of the wet weather compliance schedule, receiving waters must meet wet weather SSM RWLs on wet weather days, with a 22 percent allowable exceedance frequency. In addition, bacteria densities may not exceed 30-day geometric mean water contact recreation beneficial use (REC-1) water quality objectives (WQOs) during both dry and wet weather days. This statement indicates that the dry weather TMDL also applies to wet weather, once again undermining the fundamentally different transport mechanisms that define key differences between wet weather and dry weather bacteria loading. The assessment of

combined wet and dry weather samples is later described as a wet- weather 30-day geometric mean. The Bacteria TMDL also explicitly states that, if at the end of the wet weather schedule the wet weather SSM is exceeded more often than the allowable exceedance frequency or 30-day geometric mean exceeds more than 0 percent of the time, dischargers must demonstrate that they are not causing or contributing to the exceedances or will be considered out of compliance. Other compliance pathways are not addressed in the section.

The Bacteria TMDL indicates that FIB impairment associated with variable weather conditions was the primary driver for dry weather geometric mean and wet weather SSM WQOs. The use of dry weather 30-day geometric mean numeric targets, as noted in the Bacteria TMDL, is intended to indicate overall general water quality health as it relates to FIB during ambient conditions. Similarly, the SSM was determined to be more appropriate for wet weather with the addition of runoff and potential bacteria impairment from all surrounding land uses. The assessment of combined wet and dry weather samples (during the wet season) compared with dry weather WQOs with a 0 percent exceedance frequency undermines key distinctions between wet and dry weather bacteria loading. Attainment of the TMDL is also significantly affected by this assessment, because increased bacteria impairment is expected from samples during wet weather.

MS4 Permit Attachment E.6

MS4 Permit Attachment E.6, which incorporates the Bacteria TMDL, defines final RWLs for beaches and creeks in Tables 6.2a and 6.2b, respectively. The table itself defines an SSM numeric objective and allowable exceedance frequency for wet weather, and a 30-day geometric mean numeric objective and allowable exceedance frequency for dry weather, consistent with the RWL table in the Bacteria TMDL. However, the footnotes in Tables 6.2a and 6.2b of MS4 Permit Attachment E.6 are inconsistent with the footnotes defined in the Bacteria TMDL RWL table. The footnotes state that during wet weather days, only SSM RWLs must be met, and that during dry weather days, both geometric mean and SSM RWLs must be met.

D-2. Inconsistencies Within MS4 Permit Attachment E.6

D-2.1. Required Constituents

MS4 Permit Attachment E.6 clarified the Bacteria TMDL to eliminate total coliform as a TMDL compliance constituent for creeks (Table 6.2b—final *Receiving Water Limitations Expressed as Bacteria Densities and Allowable Exceedance Frequencies for Creeks* [Regional Board, 2015, page E-33]). However, Table 6.5—inter/m *Wet Weather Receiving Water Limitations Expressed as Interim Wet Weather Allowable Exceedance Frequencies* (Regional Board, 2015, page E-43) still includes a 41 percent interim wet weather allowable exceedance frequency for total coliform with no caveat on applicability.

D-2.2. Receiving Water Limitations and Required Assessments

There are inconsistencies between the RWLs defined in Tables 6.2a and 6.2b and assessment requirements defined in MS4 Permit Attachment E.6.d. The Bacteria TMDL Compliance Monitoring Program was designed to generate the data needed to complete the assessment requirements in MS4 Permit Attachment E.6.d.

Dry Weather SSM Assessments

There are inconsistencies regarding the use of a dry weather SSM:

1. The footnotes of Tables 6.2a and 6.2b of the MS4 Permit state that for *“dry weather days, the single sample maximum and 30-day geometric mean receiving water limitations are required to be achieved”* regional Board, 2015, page E-33).
2. However, the assessment section (MS4 Permit Attachment E.6.d.(1)(c) for beaches and Attachment E.6.d.(2)(c) for creeks) does not require a calculation of SSM exceedances for dry weather.

Combined Wet and Dry Weather Geometric Mean Assessments

There are inconsistencies regarding the use of a combined wet and dry weather geometric mean:

3. The footnotes of Tables 6.2a and 6.2b of the MS4 Permit state that for *“wet weather days, only the single sample maximum receiving water limitations are required to be achieved”* (Regional Board, 2015, page E-33).
4. However, the assessment section (MS4 Permit Attachment E.6.d.(1)(c) for beaches and E.6.d.(2)(c) for creeks) requires a calculation of a combined wet and dry weather geometric mean exceedance frequency under the wet weather assessment section.

D-2.3. Monitoring Frequency and Assessment

The sampling frequency defined in the monitoring procedures in MS4 Permit Attachment E.6.d would provide insufficient data to complete the dry weather geometric mean assessment requirement. The following are summaries of the MS4 Permit requirements:

5. The monitoring procedures of MS4 Permit Attachment E.6.d require dry weather samples at creeks to be consistent with those of receiving monitoring stations in accordance with Provision D of the MS4 Permit, as stated in Provision E.6.d(2)b.(i) (Regional Board, 2015, page E-49). Provision D of the MS4 Permit requires only three dry weather monitoring events at receiving water stations over the MS4 Permit cycle.
6. The monitoring procedures of MS4 Permit Attachment E.6.d require dry weather samples

at beaches to be collected monthly, at minimum.

7. The assessment requirements for dry weather geometric mean exceedance frequencies state that the method and number of samples must be consistent with the requirements of the California Ocean Plan or Basin Plan, which requires 5 samples per 30 days (Regional Board, 2010). The wet season geometric mean evaluation requirements do not stipulate that the Basin Plan methodology must be applied.

The Bacteria TMDL Compliance Monitoring Program was designed to generate the data needed to complete the assessment requirements at a higher frequency than the minimum Bacteria TMDL monitoring requirements of MS4 Permit Attachment E.6.d. Dry weather monitoring is conducted weekly during the dry season and monthly during the wet season to compare results with the dry weather geometric mean numeric targets. Table E-1 summarizes the Bacteria TMDL and MS4 Permit Attachment E.6 inconsistencies identified in this appendix.

This page intentionally left blank

Table D-1.
Summary of Key Inconsistencies Between the Bacteria TMDL and MS4 Permit

Element	Bacteria TMDL		MS4 Permit, Attachment E.6		Discrepancy	Impacts
	Dry Weather	Wet Weather	Dry Weather	Wet Weather		
Required Constituents ^a	<i>Enterococcus</i> Fecal Coliform Total Coliform	<i>Enterococcus</i> Fecal Coliform Total Coliform	<i>Enterococcus</i> Fecal Coliform	<i>Enterococcus</i> Fecal Coliform	MS4 Permit Page E-43 still includes a 41 percent interim allowable exceedance frequency for total coliform.	Compliance with the Interim exceedance frequency for total coliform is not currently evaluated to assess compliance with interim TMDLs.
Numeric Targets and RWLs	30-day geometric mean numeric targets, Page A-16 (footnotes add dry weather single sample maximum, Page A-52). RWLs achieved once numeric targets are met.	SSM numeric targets, Page A-16 (footnotes add 30-day wet weather geometric mean, Page A-52). RWLs achieved once numeric targets are met.	30-day geometric mean numeric targets (Table 6.2b footnotes and Page E-33 include SSM RWL for dry weather). RWLs achieved once numeric targets are met.	SSM numeric targets (Table 6.2b). RWLs achieved once numeric targets are met.	The Bacteria TMDL calculated wet and dry weather numeric targets differently because fundamental transport mechanisms that vary by weather conditions. Despite the fundamental differences, the footnotes indicate that the wet weather SSM applies to dry weather and the dry weather 30-day geometric mean applies during wet weather.	Bacteria TMDL footnotes (Page A-52), and MS4 Permit Table 6.2b footnotes and page E-33 require both SSM and 30-day geometric means to be achieved during both wet and dry weather. The 30-day dry weather geometric mean applied to wet weather and the wet weather SSM applied to dry weather undermine the fundamental differences previously defined by wet and dry weather TMDLs and impact TMDL attainability.
TMDL Compliance	At the end of the dry weather compliance schedule, receiving waters must meet dry weather RWLs on all dry weather days. In addition, bacteria densities must “be consistent with” the SSM REC-1 WQOs defined in the Ocean or Basin Plan, as it applies to the specific waterbody.	At the end of the wet weather compliance schedule, receiving waters must meet wet weather SSM RWLs on wet weather days, with a 22 percent allowable exceedance frequency. In addition, bacteria densities may not exceed 30-day geometric mean REC-1 WQOs during both dry and wet weather days.	Consistent with Bacteria TMDL.	Consistent with Bacteria TMDL.	Results from dry weather samples are compared with dry weather numeric targets, but must also achieve the wet weather SSM. Wet weather numeric targets are based on SSM, but must also achieve a wet weather 30-day geometric mean with a 0 percent allowable exceedance frequency.	TMDL compliance impacts are unclear if the following are not met: <ul style="list-style-type: none">SSM during dry weatherWet weather 30-day geometric
Monitoring Frequency	Minimum monthly, but may require increased frequency during the summer months (e.g., weekly).	Minimum 1 wet weather event during the wet season.	Monitoring procedures describe the minimum frequency consistent with MS4 Permit Provision D Long-Term Receiving Water Monitoring - 3 dry weather events per MS4 Permit cycle.	Minimum 1 wet weather event during the wet season.	The minimum dry weather monitoring frequency is insufficient to meet the assessment requirements for 30-day geometric mean calculations as described in the Basin Plan.	Monitoring frequency exceeds the minimum requirements detailed in the MS4 Permit to complete compliance assessments. Increased monitoring frequency implemented to meet assessment requirements.
Required Assessments	NA — Superseded by MS4 Permit.	NA — Superseded by MS4 Permit.	MS4 Permit Attachment E.6.d.(2)(c) requires 30-day geometric mean calculation of exceedances for dry weather in creeks. No dry weather SSM requirements are defined.	Wet weather SSM 30-day wet weather geometric mean — MS4 Permit Attachment E.6.d.(2)(c) for creeks requires a calculation of a combined wet and dry weather geometric mean exceedance frequency under the wet weather assessment section.	Dry weather numeric targets include SSM of REC-1 WQOs during dry weather but do not include an assessment requirement. Wet weather SSM — None Wet weather 30-day geometric mean — Results from wet and dry weather samples combined and compared with dry weather 30-day geometric mean REC-1 WOO.	Unclear whether dry weather SSM goal impacts compliance status because a dry weather SSM assessment is not defined. The assessment of the results from combined wet and dry weather samples compared with dry weather targets undermines key distinctions between wet and dry weather bacteria loading. Additionally, the wet season monitoring frequency is insufficient to complete a wet weather 30-day geometric mean assessment.

Notes:
MS4 = Municipal Separate Storm Sewer System NA = not applicable REC-1 = water contact recreation beneficial use RWL = receiving water limitation SSM = single-sample maximum TMDL = total maximum daily load WQO = water quality objective
a. The discrepancy noted for the required constituents is specific to creek locations and does not apply to the Moonlight State Beach Bacteria TMDL beach monitoring locations. Total coliform is a required constituent for beach sites in the MS4 Permit Attachment E.6

This page intentionally left blank