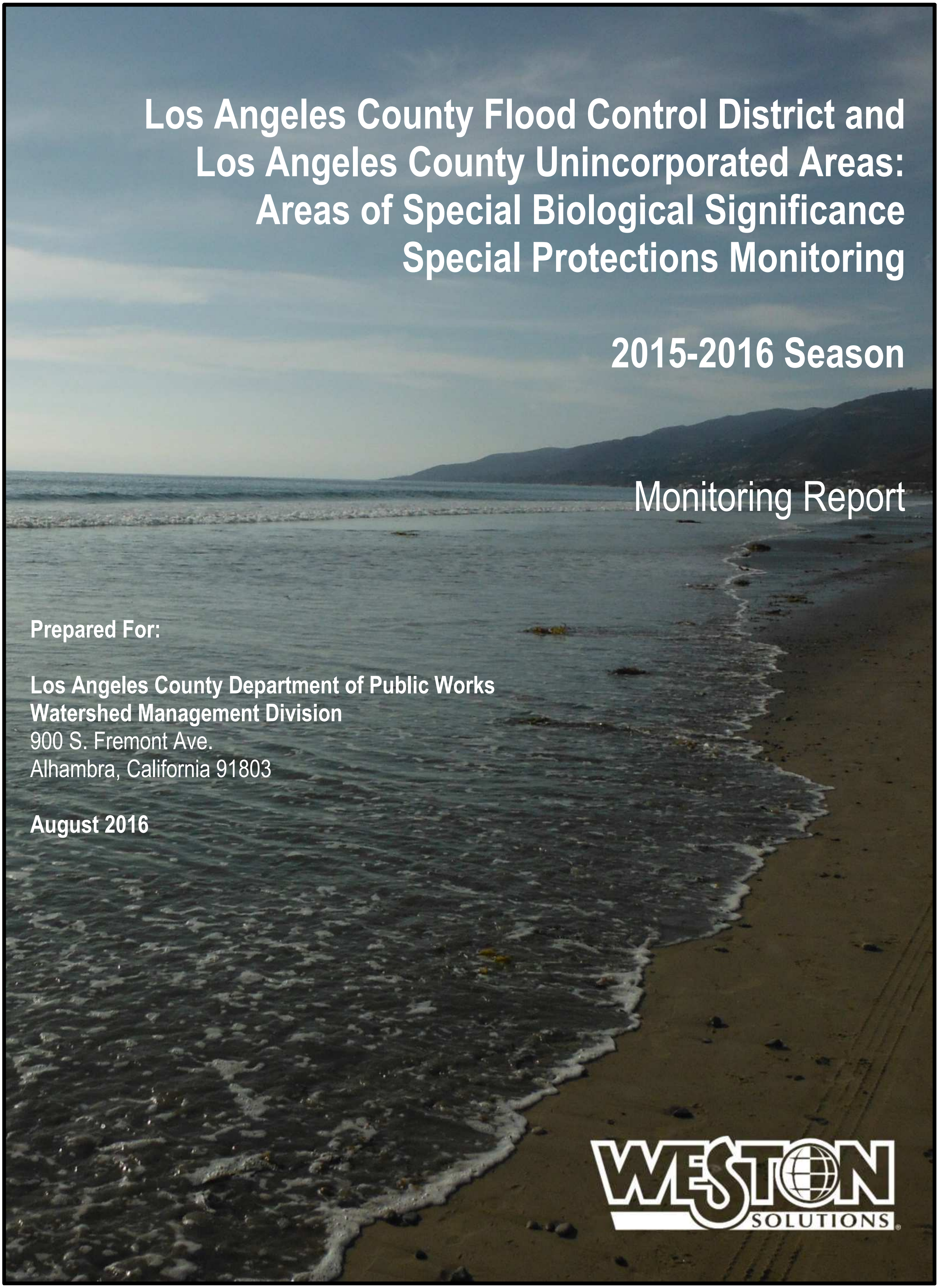

Los Angeles County Flood Control District and Los Angeles County Unincorporated Areas: Areas of Special Biological Significance Special Protections Monitoring

2015-2016 Season

Monitoring Report

Prepared For:

Los Angeles County Department of Public Works
Watershed Management Division
900 S. Fremont Ave.
Alhambra, California 91803

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August 2016

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

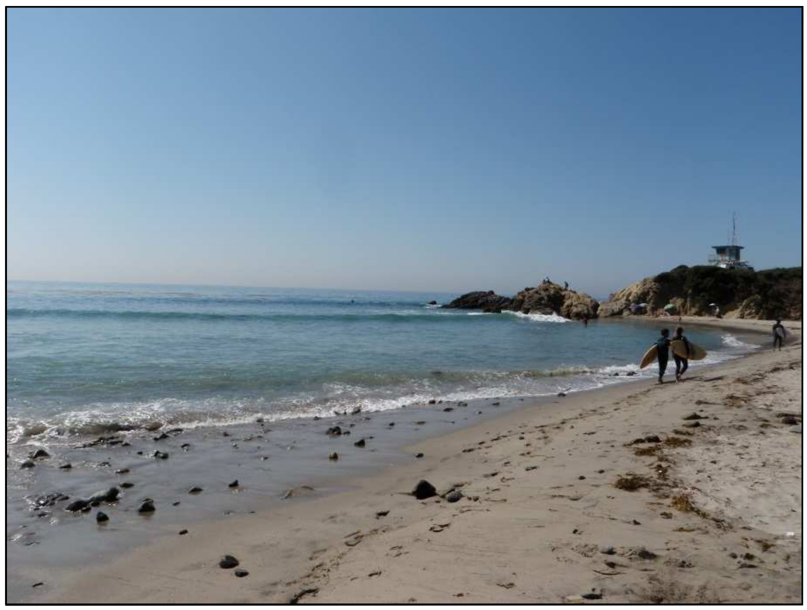
ABC Labs	Aquatic Bioassay and Consulting Laboratories, Inc.
ASBS	Area of Special Biological Significance
BMPs	best management practices
Caltrans	California Department of Transportation
COP	California Ocean Plan
County	Los Angeles County Unincorporated Areas
DO	dissolved oxygen
EC_{25}	effect concentration 25: concentration which causes an effect in 25% of test organisms
EC_{50}	effect concentration 50: concentration which causes an effect in 50% of test organisms
Imax	Instantaneous Maximum concentration in California Ocean Plan
LACFCD	Los Angeles County Flood Control District
LC_{50}	median lethal concentration: concentration which kills 50% of bioassay test organisms
LOEC	lowest observed effect concentration
NOEC	no observed effect concentration
OP	organophosphorus
PAH	polynuclear aromatic hydrocarbons
Public Works	Los Angeles County Department of Public Works
SCCWRP	Southern California Coastal Water Research Project
Special Protections	*Attachment B - Special Protections for Areas of Special Biological Significance, Governing Point Source Discharges of Storm Water and Nonpoint Source Waste Discharges*
State Board	State Water Resources Control Board
Storm 1	storm event of February 19, 2013
Storm 2	storm event of March 8, 2013
Storm 3	storm event of February 28, 2014
Storm 4	storm event of January 6, 2016
Storm 5	storm event of March 6, 2016
TSS	total suspended solids
TUc	toxic units chronic
USEPA	United States Environmental Protection Agency
Weston	Weston Solutions, Inc.
WQOs	water quality objectives

LIST OF SYMBOLS AND MEASUREMENTS

>	greater than
<	less than
%	percent
^{o}C	degrees Celsius
ft	feet
L	liter
m	meter
mg	milligram
mS	microSiemens
ng	nanogram
NTU	nephelometric units
ppt	parts per thousand
μg	microgram

1.0 INTRODUCTION

The Area of Special Biological Significance (ASBS) 24, also referred to as the Laguna Point to Latigo Point ASBS or Malibu ASBS, was established in 1974 by the State Board to preserve sensitive marine habitat (State Water Resources Control Board [State Board], 1976). The ASBS stretches 24 miles, contains 11,842 marine acres, and is the largest ASBS along the mainland of Southern California. Approximately 500 direct discharges and 31 natural streams drain to ASBS 24. The boundary of ASBS 24 extends out from the mean high tide line at Laguna Point in Ventura County to either 1000 feet (ft) from shore or to the 100-ft isobath (whichever is greater) in a southwesterly direction to Latigo Point in Malibu, Los Angeles County. Water depth within the conservation area ranges from 0 ft to approximately 100 ft and includes sloping sandy habitat, a rocky intertidal reef complex, and subtidal reef and kelp forest habitat. A wide range of sandy substrate, rocky reef, and coastal pelagic species can be found within the Laguna Point to Latigo Point ASBS.



Since 1983, the California Ocean Plan (COP) has prohibited the discharge of waste into ASBS along the California Coast, unless the State Board grants an exception to dischargers. The southern and central portions of ASBS 24 that are located in Los Angeles County are subject to direct discharges from roads, urban landscape runoff, homes, and small businesses. In general, the near coast storm water runoff along ASBS 24 within Los Angeles County is conveyed through storm drain systems before it is discharged at multiple locations along the beach. On December 30, 2004, the Los Angeles County Department of Public Works (Public Works) requested an exception for storm water discharges to ASBS 24 from the State Board on behalf of the County and the Los Angeles County Flood Control District (LACFCD). The State Board received applications from numerous other applicants for an exception to the Ocean Plan. In 2012 the State Board adopted a General Exception to the COP. As part of the General Exception, the State Board produced guidance for monitoring discharges to ASBS entitled *Attachment B - Special Protections for Areas of Special Biological Significance, Governing Point Source Discharges of Storm Water and Nonpoint Source Waste Discharges* (Special Protections) (State Board, 2012) (Appendix A). The *Special Protections* document is intended to define the terms and conditions that limit storm water discharges to the ASBS for applicants along the California Coast (34 ASBSs have been designated throughout the state). Storm drain discharge pipes along the Malibu coastline fall under various jurisdictions including LACFCD, the Los Angeles County Unincorporated Areas (County), City of Malibu, and the California Department of Transportation (Caltrans).

There are 31 storm drain outfalls 18 inches in diameter or larger located in the County. Nine outfalls are operated by the LACFCD and 12 are operated by the County. The storm drain outfalls discharge storm water runoff that reaches ASBS 24; therefore, in accordance with the Special Protections document, the 21 outfalls under the jurisdiction of the County and LACFCD were identified for monitoring during the 2012-2013 and 2013-2014 storm seasons by Public Works. Additionally, two ocean receiving water stations, located on Zuma Beach and Escondido Beach, were also monitored during this time (Figure 1-1). The full report of the results from this monitoring is provided in Appendix B (2014 Malibu ASBS Special Protections Monitoring-Final Report).

Additional ASBS Special Protections monitoring was conducted during the 2015-2016 wet weather season at the two ocean receiving water stations and their respective beach outfalls. This monitoring was performed to satisfy comments from the State Board regarding the *ASBS 24 Draft Compliance Plan for the County of Los Angeles and City of Malibu* (Weston Solutions, Inc. [Weston], 2014). In their *Compliance Plan* comments, the State Board requested that additional monitoring be conducted at the two designated ocean receiving water stations (located on Zuma Beach and Escondido Beach) to more fully understand any potential water quality impacts from storm water runoff to the ocean receiving water of ASBS 24. Monitoring was conducted in accordance with the methods and requirements set forth in the Special Protections document.

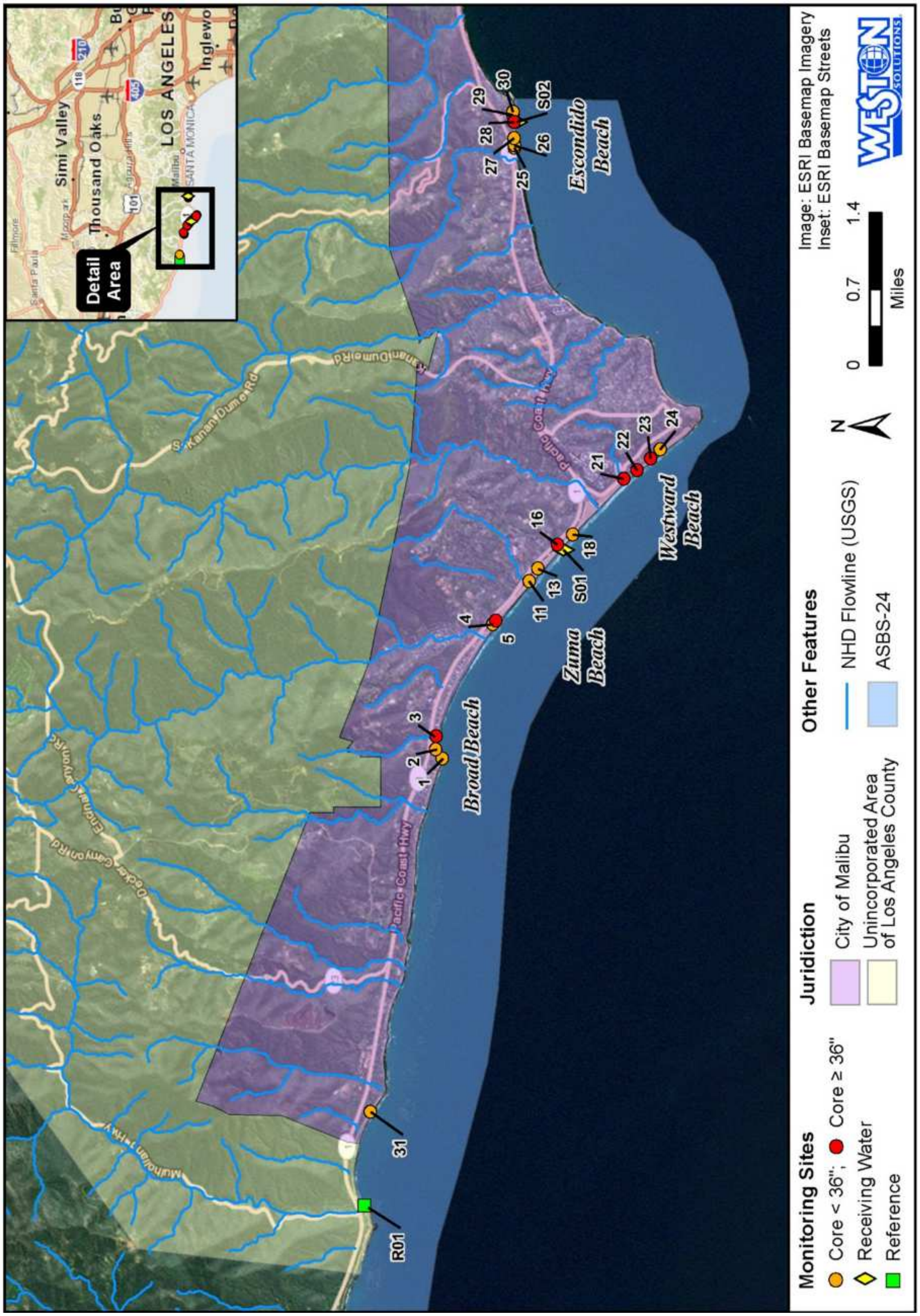


Figure 1-1. Core, Ocean Receiving Water, and Reference Monitoring Locations along ASBS 24 in Malibu, CA

1.1 Study Objectives

The ASBS 24 Special Protections Monitoring Study was designed to comply with the storm water monitoring requirements set forth in Attachment B of the State Water Resources Control Board Resolution No. 2012-0012, Special Protections for Areas of Special Biological Significance, Governing Point Source Discharges of Storm Water and Nonpoint Source Waste Discharges. The Special Protections document provides descriptions of the following two types of monitoring programs:

1. **Core Discharge (Outfall) Monitoring –** collecting and analyzing wet weather runoff from the discharge during a storm event.
2. **Ocean Receiving Water Monitoring –** collecting and analyzing samples from the ocean before and after a storm event at two locations (i.e., directly in front of the discharge and at a reference site removed from the discharge).

Monitoring requirements set forth in the Special Protections document are intended to help answer the following questions.

1. **What are the conditions of storm water effluent in the storm drains prior to being discharged into the ocean receiving waters? And what is the range of natural conditions at reference locations?**
2. **What are the conditions of the ocean receiving water directly in front of large storm drain outfalls both prior to, and immediately following, storm events? And how do these conditions compare to natural conditions at reference locations?**
3. **What are the estimated pollutant loads that are being transported into ASBS 24 from storm drains that fall under the jurisdiction of the County and the LACFCD?**

Specifically, Study Questions 1 and 2 can be answered by monitoring water quality in ocean receiving water (ASBS 24) and in storm drain effluent associated with storm drains proximal to the monitored receiving water location in ASBS 24. Flow monitoring equipment installed into two of the largest storm drains that flow into ASBS 24 during the 2012-2013 storm season provided information that was used to help answer Study Question 3 by accurately estimating the volume of storm water runoff flowing to the beach and into the receiving water during storm events. Pollutant loads entering ASBS 24 were calculated based upon flow measurements and flow modeling in combination with results of chemical analyses from three storm events during the 2012-2013 and 2013-2014 wet weather seasons.

Results from this study will enable the County and LACFD to conform to regional compliance monitoring requirements and will help prioritize potential best management practices (BMPs) for the purpose of reducing pollutant loading to the ASBS.

This report presents and summarizes data collected from sampling events that occurred during the 2015-2016 storm season and evaluates compliance with natural water quality based on these data in combination with previous data collected during the 2012-2013 and 2013-2014 storm seasons. Details of the monitoring design are provided in the following section.

2.0 STUDY DESIGN

The ASBS Compliance Monitoring Program was designed to be consistent with a broader Regional ASBS Work Plan created by a planning committee as part of the Southern California Bight 2013 Regional Monitoring Survey and the State Board Special Protections document. The study design for the 2015-2016 storm season was intended to supplement previous data collected during the 2012-2013 and 2013-2014 wet weather seasons, and therefore was limited in scope. Monitoring for the 2015-2016 study consisted of monitoring one large outfall and its paired ocean receiving water location at Zuma Beach and one large outfall and its paired ocean receiving water location at Escondido Beach.

2.1 Core Discharge and Ocean Receiving Water Monitoring

Core Discharge Monitoring during the 2012-2013 and 2013-2014 storm seasons consisted of sampling and analysis (water chemistry and toxicity) of wet weather discharges from 20 storm drains (greater than 18 inches in diameter) that discharge to ASBS 24. For storm drain outfalls that were greater than 18 inches and less than 36 inches in diameter, oil and grease and TSS were measured for each storm event, whereas for storm drains that are either 36 inches or larger in diameter or are linked with an ocean receiving water site, oil and grease, TSS, total metals, PAHs, pyrethroids, OP pesticides, ammonia, nitrate as N, and total phosphorus were analyzed for each storm event. Additionally, during one storm event at each outfall, chronic toxicity was measured using bivalve embryos. For the 2015-2016 storm season, core discharge monitoring was performed at outfalls ASBS-016 and ASBS-028. Both of these outfalls are linked with an ocean receiving water site and therefore were analyzed for the full suite of chemical constituents. The toxicity testing requirement for outfalls ASBS-016 and ASBS-028 had been met during the 2012-2013 storm season, therefore, no toxicity testing was performed at these outfall stations during the 2015-2016 storm season.

The Ocean Receiving Water Monitoring Program was designed to compare conditions in the ASBS near major discharges to “natural” or reference conditions, both prior to and immediately following a storm event. Reference sites located at the mouths of streams in un-urbanized watersheds along the Southern California coast were used to define “natural water quality” based on criteria identified in the Regional ASBS Work Plan. The conditions monitored in this program included water chemistry, water toxicity, and biological integrity. For the 2015-2016 storm season, ocean receiving water monitoring was performed at stations ASBS-SO1 and ASBS-SO2 both prior to, and during, each monitored storm event. Ocean receiving water was analyzed for the same constituent list as the core discharge sites: oil and grease, TSS, total metals, PAHs, pyrethroids, OP pesticides, ammonia, nitrate as N, and total phosphorus prior to (pre-storm) and during or immediately following each storm event (post-storm). Post-storm samples must be collected while runoff from the outfall is flowing to the receiving water; therefore they may be collected while it is raining or after it has stopped raining, provided discharge from the outfall is still flowing into the receiving water. Additionally, chronic toxicity to bivalve embryos, echinoderms, and kelp was measured from post-storm samples collected during each storm event.

Table 2-1 details the characteristics of the stations that were monitored during the 2015-2016 storm season. The core discharge station ASBS-016 and its linked ocean receiving water station

ASBS-SO1 were monitored for two storm events while the core discharge stations ASBS-028 and its linked ocean receiving water station ASBS-SO2 were monitored for one storm event.

Table 2-1. Monitoring Program Stations, Outfall Dimensions, Ownership, and Required Analyses for the 2015-2016 Wet Weather Season

Monitoring Type	Beach Location	Site Name	LACDPW Storm Drain Tag	Pipe Diameter	Ownership		Chemical Analyses and Number of Storms to Be Tested	Toxicity Testing** and Number of Storms to Be Tested
					Flood Control District	LA County		
Core Monitoring	Zuma Beach	ASBS-016	Zuma Open Channel	60		x	Full List* 2 storms	None
	Escondido Beach	ASBS-028	MTD 622 Line 4	36	x		Full List* 1 storm	None
Receiving Water Monitoring	Zuma Beach	ASBS-SO1	Linked to Zuma Open Channel	NA			Full List* 2 storms	3 species 2 storms
	Escondido Beach	ASBS-SO2	Linked to MTD 622 Line 4	NA			Full List* 1 storm	3 species 1 storm

*Full constituent list comprises TSS, total metals, PAHs, pyrethroids, OP pesticides, ammonia, nitrate, and total phosphorus.
**Toxicity species includes bivalves, giant kelp and sea urchins.

2.1.1 Sampling Locations

The location of Zuma Beach outfall ASBS-016 and its receiving water ASBS-SO1 is shown in Figure 2-1 and Figure 2-2, whereas the location of Escondido Beach outfall ASBS-028 and its receiving water ASBS-SO2 is shown in Figure 2-3 and Figure 2-4. A brief description of the two storm drain outfall pipes and their respective ocean receiving water stations is presented below.

- **Outfall ASBS-016 South Zuma Beach—** ASBS-016 is located west of the Pacific Coast Highway (approximately 100 meter [m] south of Morning View Drive) along the Zuma Beach Access Road. The watershed draining to ASBS-016 is 115 acres and comprises the following mix of land uses: 33 percent (%) public facilities, 25% rural residential, 19% vacant, 13% residential, 8% transportation, and 2% open space and recreation. Storm runoff to this outfall follows a more or less natural drainage path to the beach. Just before reaching the beach, the flow enters a road culvert under PCH and travels an additional 20 m across an open channel where it splits into three pipes that discharge onto the sand at Zuma Beach (Figure 2-1). During the summer, the outfall pipes along South Zuma Beach are buried for safety purposes and then excavated prior to the storm season to ensure storm water flows are not impeded. Once the pipes are excavated, however, the elevation of the surrounding sand berm can be as high as 3 m above the outfall pipe. For this reason Beaches and Harbors re-excavates the sand berm immediately in front of the ASBS-016 outfall before large storm events. Receiving water samples were collected at ASBS-SO1 in the ASBS mixing zone in approximately 1 m of water, directly in front of the Zuma Beach outfall of ASBS-016.

Figure 2-1. Box Culvert (A); Zuma Beach Outfall of ASBS-016 (B); and Ocean Receiving Water of ASBS-SO1(C)

Figure 2-2. Core Discharge and Ocean Receiving Water Monitoring Locations along Zuma Beach

- **Outfall ASBS-028 Escondido Beach —** ASBS-028 is located west of Malibu Cove Colony Drive on Escondido Beach beneath an elevated house. The watershed draining to ASBS-028 is 36 acres and comprises the following mix of land uses: 44% rural residential, 33% vacant, 9% residential, 8% agriculture, and 6% transportation. As a result of its proximity to the ocean, this monitoring station is generally not accessible during tides greater than 3 ft (Figure 2-4). There is no sand berm associated with this outfall, and as a result of the narrow beach, flow typically reaches the receiving water during even minor storm events (less than 0.25" of rainfall). Receiving water samples were collected at ASBS-SO2 in the ASBS mixing zone in approximately 1 m of water directly in front of outfall ASBS-028.

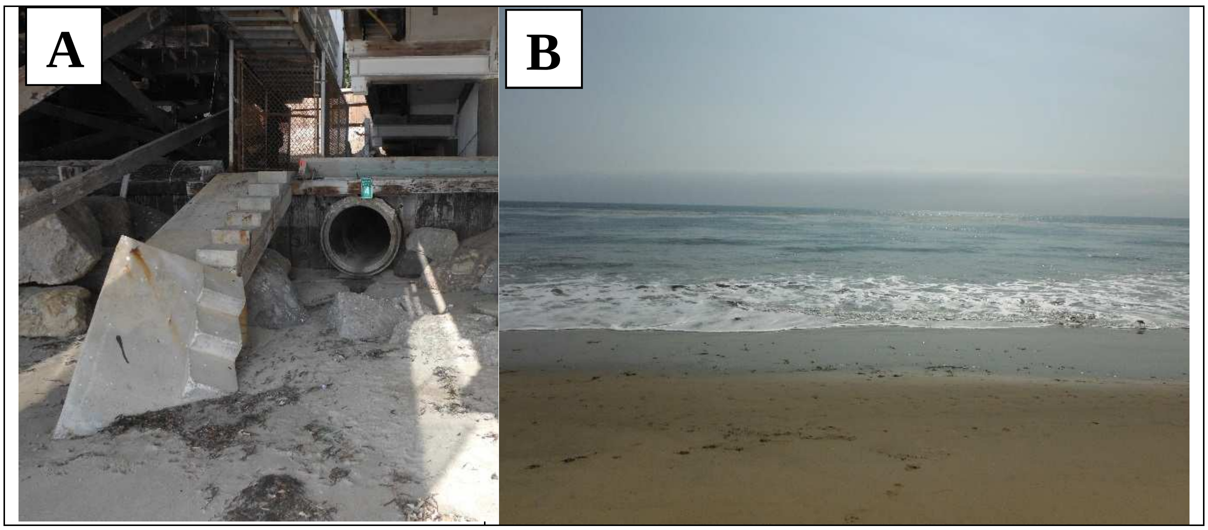


Figure 2-3. ASBS-028 Escondido Beach Outfall (A) and Ocean Receiving Water site ASBS-SO2 (B)

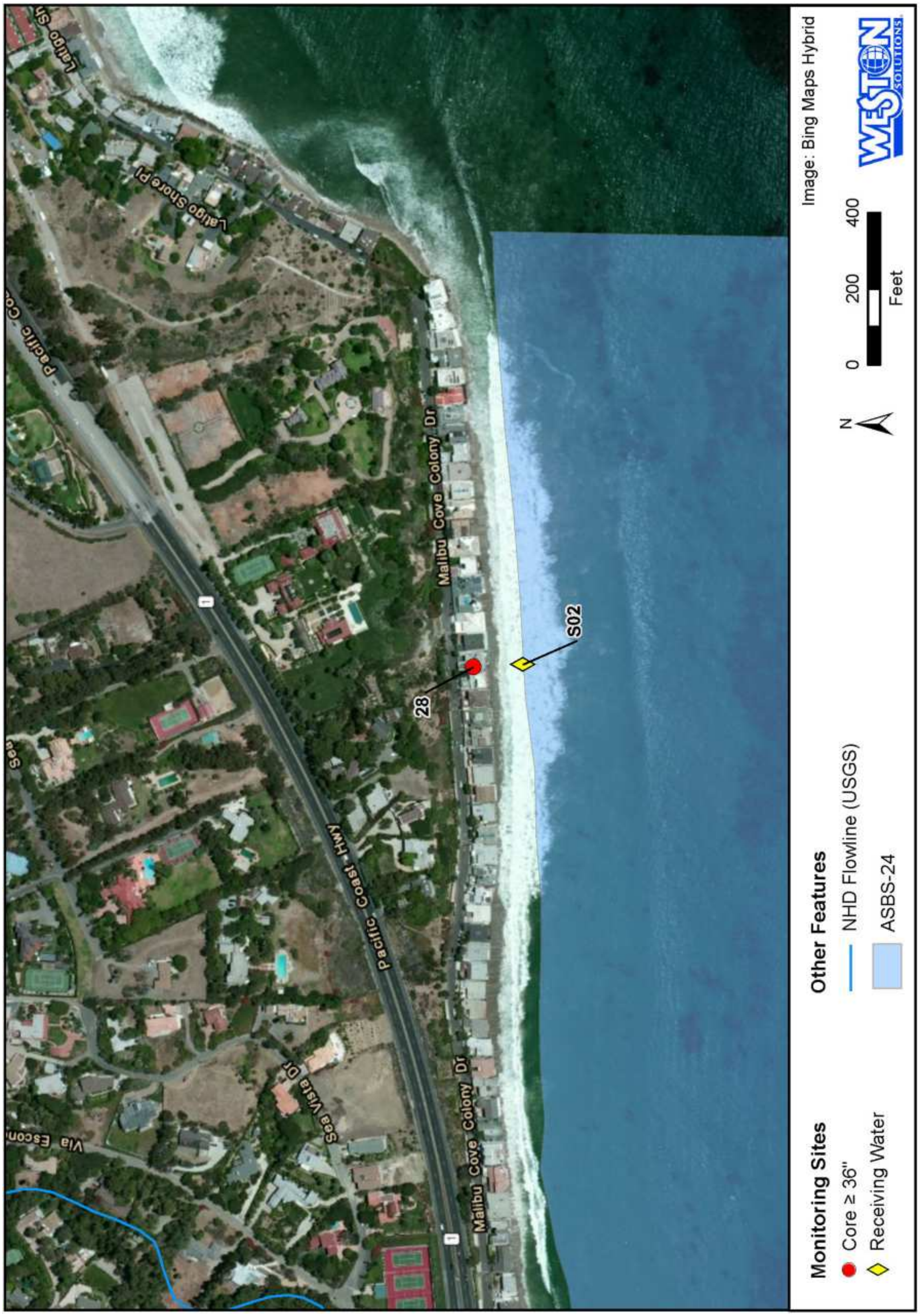


Figure 2-4. Core Discharge and Ocean Receiving Water Monitoring Locations along Escondido Beach

2.2 Sampling Methods

2.2.1 Water Collection

Core discharge samples were collected at the base of each outfall. Samples were collected in certified clean laboratory bottles appropriate for the analyses to be conducted. Following sampling, samples were placed on ice in a cooler and delivered within the required holding times to Physis Environmental Laboratories, Inc.

Sampling of ocean receiving water was performed prior to each storm's arrival (within 48 hours) and again during, or immediately following, the storm while storm water runoff was flowing to the receiving water. Ocean receiving water samples were collected in the ocean directly in front of the storm drain outfall by submerging a clean 4 liter (L) glass container just below the surface of the water in the mixing zone. Water from the glass sampling container was then evenly distributed to each of seven certified clean, pre-labeled laboratory bottles as well as to plastic cubitainers used for toxicity analysis. Each laboratory bottle was filled to approximately 25% of capacity before the glass sampling container was then refilled in the same manner as previously described and the collected water re-distributed to each of the laboratory bottles and cubitainers. This process continued until all containers were filled. The water depth was approximately 1 m at the sample collection point. Samples were collected in bottles appropriate for the analysis to be conducted. After retrieval, the samples were placed on ice in a cooler and delivered within the required holding times for analysis to Physis Environmental Laboratories, Inc. for chemical testing. Cubitainers for toxicity testing were kept on ice in coolers and shipped the following day for overnight delivery to Aquatic Bioassay and Consulting Laboratories, Inc. (ABC Labs.) for toxicity testing.

2.2.2 Field Water Quality

During each sampling event, several water quality parameters were measured in the ocean receiving water with a handheld YSI multi-probe water quality meter (Model 650MDS). The meter was submerged in the surf zone at the receiving water monitoring site. The following parameters were measured and recorded on field data sheets: water temperature, salinity, pH, conductivity, turbidity, and dissolved oxygen (DO). In addition, the following observations were recorded on the field data sheets: weather and ocean conditions, beach characteristics, and runoff characteristics. Photographs were taken and are provided in this report where appropriate.

2.2.3 Chain of Custody

Chain-of-custody forms were completed for each sample and accompanied the samples to the appropriate laboratories. Samples were considered to be in custody if they were:

- In the custodian's possession or view,
- Retained in a secured place (under lock) with restricted access, or
- Placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal.

Chain-of-custody procedures were used for all samples throughout the collection, transport, and analytical process and were initiated during sample collection.

Documentation of sample handling and custody included the following:

- Sample identifier
- Sample collection date and time
- Any special notations on sample characteristics or analysis
- Initials of the person collecting the sample
- Date the sample was sent to the analytical laboratory
- Shipping company and waybill information.

Completed Chain-of-custody forms were be placed in a plastic envelope and kept inside the cooler containing the samples. Once delivered to the analytical laboratory, the person receiving the samples signed the Chain-of-custody form.

2.2.4 Sample Analyses - Water

After collection, core discharge and ocean receiving water samples were submitted to Physis Environmental Laboratories, Inc. for analyses. Chemical and biological analysis methods, detection limits, and reporting limits for constituents that were measured in the 2015–2016 Ocean Receiving Water Sampling are listed in Table 2-2.

Table 2-2. List of Constituents Analyzed for the 2015-2016 Core Discharge and Ocean Receiving Water Sampling Programs

Constituent	Method	MDL[1]	RL[2]	Units
General Chemistry				
Total suspended solids (TSS)*	SM 2540-D		5	mg/L
Nitrate as N	SM4500-NO3 E		0.05	mg/L
Ammonia	SM4500-NH3D		0.06	mg/L
Oil and grease*	USEPA[3] 1664A		5	mg/L
Total orthophosphate as P	SM4500-P E		0.02	mg/L
Total and Dissolved Trace Metals				
Aluminum (Al)	USEPA[3] 200.8(m)		8.25	µg/L
Antimony (Sb)			0.015	µg/L
Arsenic (As)			0.045	µg/L
Beryllium (Be)			0.1	µg/L
Cadmium (Cd)			0.010	µg/L
Chromium (Cr)			0.25	µg/L
Copper (Cu)			0.05	µg/L
Lead (Pb)			0.05	µg/L
Manganese (Mn)			0.45	
Mercury (Hg)			0.1	µg/L
Molybdenum (Mo)			0.1	
Nickel (Ni)			0.1	µg/L
Selenium (Se)			0.25	µg/L
Silver (Ag)			0.15	µg/L
Thallium (Tl)			0.05	
Zinc (Zn)			0.01	µg/L
Organophosphorus Pesticides				
Bolstar (sulprofos)	USEPA[3] 625		4	ng/L

Constituent	Method	MDL[1]	RL[2]	Units
Chlorpyrifos			2	ng/L
Demeton			2	ng/L
Diazinon			4	ng/L
Dichlorvos			6	ng/L
Disulfoton			2	ng/L
Ethoprop (ethoprofos)			2	ng/L
Fenchlorophos (eonnel)			4	ng/L
Fensulfothion			2	ng/L
Fenthion			4	ng/L
Malathion			6	ng/L
Methyl parathion			2	ng/L
Mevinphos (phosdrin)			16	ng/L
Phorate			12	ng/L
Tetrachlorvinphos (stirofos)			4	ng/L
Tokuthion			6	ng/L
Trichloronate			2	ng/L
Polynuclear Aromatic Hydrocarbons (PAHs)				
1-Methylnaphthalene	USEPA[3] 625		5	ng/L
1-Methylphenanthrene			5	ng/L
2,3,5-Trimethylnaphthalene			5	ng/L
2,6-Dimethylnaphthalene			5	ng/L
2-Methylnaphthalene			5	ng/L
Acenaphthene			5	ng/L
Acenaphthylene			5	ng/L
Anthracene			5	ng/L
Benz[a]anthracene			5	ng/L
Benzo[a]pyrene			5	ng/L
Benzo[b]fluoranthene			5	ng/L
Benzo[e]pyrene			5	ng/L
Benzo[g,h,i]perylene			5	ng/L
Benzo[k]fluoranthene			5	ng/L
Biphenyl			5	ng/L
Chrysene			5	ng/L
Dibenz[a,h]anthracene			5	ng/L
Dibenzothiophene			5	ng/L
Fluoranthene			5	ng/L
Fluorene			5	ng/L
Indeno[1,2,3-c,d]pyrene			5	ng/L
Naphthalene			5	ng/L
Perylene			5	ng/L
Phenanthrene			5	ng/L
Pyrene			5	ng/L
Allethrin	USEPA[3] 625 NCI		2	ng/L
Bifenthrin			2	ng/L
Cyfluthrin			2	ng/L
Cypermethrin			2	ng/L
Danitol (Fenpropathrin)			2	ng/L
Deltamethrin/Tralomethrin			2	ng/L
Esfenvalerate			2	ng/L
Fenvalerate			2	ng/L
Fluvalinate			2	ng/L
L-Cyhalothrin			2	ng/L
Permethrin			25	ng/L
Prallethrin			2	ng/L
Resmethrin			25	ng/L

*Core discharge outfalls less than 36” in diameter were analyzed only for TSS and oil and grease. Outfalls greater than or equal to 36” in diameter, and ocean receiving water samples were analyzed for all constituents listed in Table 2-3.
[1]MDL = method detection limit.
[2]RL = reporting limit.
[3]USEPA = United States Environmental Protection Agency.

Details of analytical chemistry methods used for Malibu ASBS Special Protections Monitoring are provided in Appendix C.

2.2.5 Sample Analyses - Toxicity

Toxicity testing of three different marine species was performed during each monitored storm event for ocean receiving waters. Toxicity testing was performed using the marine bivalve, *Mytilus galloprovincialis*, the purple sea urchin, *Strongylocentrotus purpuratus*, and the kelp, *Macrocystis pyrifera*. Toxicity test methods that were used included the following: chronic 48-hour bivalve development test, chronic 40-minute echinoderm fertilization test, and chronic 48-hour kelp germination and growth test. The marine bivalve test was performed using a modified method based on EPA 600/R-15-136 that was used for the Bight ’08 program, whereas the purple sea urchin and kelp tests were performed using EPA 600/R-15/136. Each of these methods is approved by the United States Environmental Protection Agency (USEPA) for testing toxicity in marine and estuarine waters of the United States. Details of toxicity test protocols used for Malibu ASBS Special Protections Monitoring are provided in Appendix D.

3.0 2015-2016 MONITORING RESULTS

Core Discharge Monitoring and Ocean Receiving Water Monitoring were conducted over two storm events during the 2015-2016 Storm Season. The first storm occurred on January 6, 2016 and the second storm occurred on March 6, 2016. Monitoring was successfully completed at both outfalls and receiving water locations. The analyses performed at each sampling location are listed in Table 3-1.

Table 3-1. Summary of Core Discharge and Ocean Receiving Water Sample Collection

Event	Sampling Location	Outfall or Receiving Water	Storm Event			
			January 6, 2016		March 6, 2016	
			Chem	Tox	Chem	Tox
Pre-Storm	ASBS-SO1	Receiving Water	x		x	
	ASBS-SO2	Receiving Water	x			
Storm	ASBS-016	Outfall	x		x	
	ASBS-SO1	Receiving Water	x	x	x	x
	ASBS-028	Outfall	x			
	ASBS-SO2	Receiving Water	x	x		

Storm Event: January 6, 2016

Pre-storm ocean receiving water samples were collected on January 3, 2016 at 11:40 at ASBS-SO2 and 12:10 from ASBS-SO1 during a low tide. The forecast storm arrived on January 5, 2016 and continued into January 7, 2016, with sampling beginning at 16:30 on January 6, 2016 and continuing until 17:15 that day. A total of 1.7 inches of rainfall were recorded at the Leo Carrillo beach rain gauge: (https://www.wunderground.com/personal-weather-station/dashboard?ID=MLCBC1) over the course of the storm, whereas 1.58 inches of rainfall were recorded at the Point Dume rain gauge: (https://www.wunderground.com/personal-weather-station/dashboard?ID=KCAMALIB6). Effluent from both ASBS-016 and ASBS-028 outfalls was flowing into the ocean receiving water while samples were being collected.

Storm Event: March 6, 2016

The pre-storm ocean receiving water sample at ASBS-SO1 was collected on March 4, 2016 at 13:30. The forecast storm arrived on the night of March 5, 2016 and continued into the early morning on March 6, 2016. A small amount of additional rain also occurred on March 7, 2016. Sampling began at 21:50 on March 7, 2016 and continued until 01:53 on March 8, 2016. A storm total of 1.45 inches of rainfall were recorded at a rain gauge located just south of Leo Carrillo Beach: (https://www.wunderground.com/personal-weather-station/dashboard?ID=KCAMALIB610), whereas 1.23 inches of rainfall were recorded at the Point Dume rain gauge. Effluent from the ASBS-016 outfall was flowing into the ocean receiving water while the receiving water samples were being collected.

3.1 Core Discharge Monitoring

Core discharge samples were collected manually using clean laboratory-certified containers supplied by the analytical laboratory. Grab samples were collected as the storm water effluent flowed from the pipe onto the sand, or in the case of ASBS-016, from the box culvert onto the natural channel that flowed to Zuma Beach. Constituent concentrations from core discharge samples are presented in Table 3-2. In the summary table, only analytes that were measured above detection limits are listed under the categories organophosphorus pesticides, and synthetic pyrethroids. For results of individual OP pesticides, PAHs, and synthetic pyrethroids, refer to Appendix C which provides the full chemistry reports for each monitoring date. Total OP pesticides, total PAHs, and total pyrethroid pesticides were calculated in accordance with SCCWRP's method for establishing the 85th percentile reference threshold, and a value of one-half of the method detection limit was used for non-detect and estimated (J-flag) values. In the calculation of the total OP pesticides concentration, a subset of eight OP pesticides were totaled. In the calculation of the total PAHs concentration, 25 individual PAHs were totaled with a value of 0.5 ng/L for each PAH that was non-detect or estimated. Thus, a total PAH value of 12.5 ng/L indicates that no PAHs were detected. For total pyrethroid pesticides concentration, a subset of ten pyrethroid pesticides were totaled.

January 6, 2016 Storm Event

In general, the effluent from outfalls ASBS-016 and ASBS-028 was similar in concentration for most metals. General chemistry constituents varied somewhat, however, as the nitrate concentration at ASBS-016 was approximately six times higher than at ASBS-028, and the TSS and oil and grease concentrations were substantially higher at ASBS-028 than at ASBS-016. No OP pesticides were detected at either outfall. Total PAHs were approximately ten times higher at ASBS-028 (2,161 ng/L) than at ASBS-016 (223 ng/l). No synthetic pyrethroid pesticides were detected at ASBS-016, whereas five different pyrethroids were detected at ASBS-028. Bifenthrin comprised 92% of the pyrethroid concentration at ASBS-028.

March 6, 2016 Storm Event

General chemistry concentrations at ASBS-016 during the March 6, 2016 storm event were similar to those measured during the January 6, 2016 storm event. Only the ammonia concentration (0.17 in March 2016 vs. 0.51 mg/L in January 2016) varied by more than 2-fold. Metals concentrations at ASBS-016 were all lower during the March 6, 2016 storm event than during the January 6, 2016 storm event, with cadmium, lead, mercury, and silver decreasing by the greatest percentages. Similar to the January 6, 2016 storm event, no OP pesticides or synthetic pyrethroid pesticides were detected at ASBS-016. The total PAH concentrations measured during both storm events were nearly identical (223 ng/L in January 2016 vs. 227 ng/L in March 2016).

Table 3-2. Summary of Core Discharge Results from Monitored Storm Events during the 2015-2016 Storm Season

Analyte	Units	Outfall	Outfall	Outfall
		ASBS-016 Post-Storm	ASBS-028 Post-Storm	ASBS-016 Post-Storm
		1/6/2016	1/6/2016	3/6/2016
General Chemistry				
Ammonia as N	mg/L	0.51	0.42	0.17
Nitrate as N	mg/L	1.98	0.34	1.08
Oil & Grease	mg/L	<1	4.8	1J
Total Orthophosphate as P	mg/L	0.39	0.21	0.57
Total Suspended Solids	mg/L	284	1040	510
Total Metals				
Arsenic (As)	µg/L	4.141	7.243	2.483
Cadmium (Cd)	µg/L	9.210	8.325	0.897
Chromium (Cr)	µg/L	35.18	36.70	33.39
Copper (Cu)	µg/L	73.10	71.40	26.03
Lead (Pb)	µg/L	34.80	33.54	6.49
Mercury (Hg)	µg/L	0.439	0.560	0.063
Nickel (Ni)	µg/L	72.04	69.79	36.09
Selenium (Se)	µg/L	0.965	1.482	0.12
Silver (Ag)	µg/L	0.08	0.01J	<0.01
Zinc (Zn)	µg/L	446.5	413.4	102.7
Organophosphorus Pesticides				
Total OP Pesticides	ng/L	6	6	6
Polynuclear Aromatic Hydrocarbons				
Total PAHs	ng/L	223.3	2161.2	226.9
Synthetic Pyrethroid Pesticides				
Bifenthrin	ng/L	<0.5	164.2	<0.5
Cyhalothrin, Total Lambda	ng/L	<0.5	3.9	<0.5
Esfenvalerate	ng/L	<0.5	3.3	<0.5
Esfenvalerate/Fenvalerate	ng/L	<0.5	4.4	<0.5
Fenvalerate	ng/L	<0.5	1.1J	<0.5
Total Pyrethroids	ng/L	6.75	177.9	6.75

3.2 Ocean Receiving Water

Ocean receiving water samples were collected at ASBS-SO1 in front of ASBS-016 and at ASBS-SO2 in front of ASBS-028 within 48 hours prior to, and during or immediately following, the storm while effluent runoff was still flowing into the receiving water. Two storm events were monitored at ASBS-SO1 while one storm event was monitored at ASBS-SO2. The monitored storm events for the ocean receiving water stations coincided with the monitored storm at core discharge stations (outfalls). Constituent concentrations from ocean receiving water samples were compared to reference threshold concentrations. Reference threshold concentrations are defined as the 85th percentile of sample concentrations taken from reference sites in Southern California. Estimated values (J-flagged values) measured above the detection limit but below the reporting limit were not considered to be in exceedance of reference thresholds. Complete chemistry and toxicity reports for each storm event are provided in Appendices C and D, respectively. A summary of chemistry results is provided in Table 3-3, and is described in the following text.

3.2.1 Field Water Quality

January 6, 2016 Storm Event

Field parameter measurements at Ocean Receiving Water stations are provided in Table 3-4. Pre-storm measurements of temperature, salinity, conductivity, turbidity and DO were similar at ASBS-SO1 and ASBS-SO2 prior to the January 6, 2016 storm event. Pre-storm pH differed somewhat among the two sites however, measuring 8.26 pH units at ASBS-SO1 and 7.97 pH units at ASBS-SO2. Water temperature dropped slightly during the January storm event at both ASBS-SO1 and ASBS-SO2. Salinity, conductivity, and pH also decreased slightly during the storm event as fresh water entered the receiving water. Turbidity increased only slightly during the storm event from pre-storm conditions.

March 6, 2016 Storm Event

Salinity and conductivity were substantially lower during the storm (14.7 ppt) than before the storm (33.3 ppt). Since the ocean receiving water sample was collected in the mixing zone immediately out from where the effluent entered the receiving water, a drop in salinity and conductivity during the storm event is to be expected. Temperature was approximately two degrees lower and DO was approximately 1.3 mg/L higher during the storm event than before the storm event. Turbidity increased during the storm event, likely as a result of increased wave activity and turbid runoff entering the receiving water. pH was relatively unchanged by the storm event, decreasing less than 0.2 pH units from the pre-storm level.

Table 3-3. Summary of Ocean Receiving Water Results from Monitored Storm Events during the 2015-2016 Storm Season

Analyte	Units	Natural Water Quality	ASBS-SO1 Pre-Storm	ASBS-SO1 Post-Storm	ASBS-SO2 Pre-Storm	ASBS-SO2 Post-Storm	ASBS-SO1 Pre-Storm	ASBS-SO1 Post-Storm
		85th Percentile	1/3/2016	1/6/2016	1/3/2016	1/6/2016	3/4/2016	3/6/2016
General Chemistry								
Ammonia as N	mg/L	0.015	<0.02	0.15	<0.02	0.04J	<0.02	0.04J
Nitrate as N	mg/L	0.34	0.02J	0.04J	0.02J	0.03J	<0.01	0.08
Oil & Grease	mg/L	0.5	<1	<1	<1	<1	<1	1.1
Total Orthophosphate as P	mg/L	0.1	0.03	0.03	0.03	0.04	0.04	0.15
Total Suspended Solids	mg/L	48	57.6	10.7	4.5	35.2	5.6	52.7
Trace Metals								
Arsenic (As)	µg/L	1.8	1.525	1.551	1.437	1.592	1.414	2.061
Cadmium (Cd)	µg/L	0.15	0.036	0.028	0.028	0.108	0.052	0.091
Chromium (Cr)	µg/L	1.9	0.32	0.90	0.27	1.96	0.62	5.07
Copper (Cu)	µg/L	1.5	0.40	0.56	0.25	2.00	0.35	2.35
Lead (Pb)	µg/L	0.5	0.32	0.17	0.06	0.65	0.19	0.66
Mercury (Hg)	µg/L	0.0006	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
Nickel (Ni)	µg/L	1.3	0.98	0.81	0.33	1.95	0.46	3.51
Selenium (Se)	µg/L	0.0025	0.02	0.012J	0.015	0.076	0.023	0.042
Silver (Ag)	µg/L	0.08	0.08	0.09	0.08	0.09	0.02	0.02
Zinc (Zn)	µg/L	18.6	0.4	1.1	1.5	5.3	1.0	10.4
Organophosphorus Pesticides								
Total OP Pesticides	ng/L	6	6	6	6	6	6	6
Polynuclear Aromatic Hydrocarbons								
Total PAHs	ng/L	12.5	12.5	12.5	12.5	35.2	12.5	18.8
Pyrethroids								
Bifenthrin	ng/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyhalothrin, Total Lambda	ng/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Esfenvalerate	ng/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Esfenvalerate/Fenvalerate	ng/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fenvalerate	ng/L		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Pyrethroids	ng/L	6.75	6.75	6.75	6.75	6.75	6.75	6.75

< - results less than the method detection limit.

J-Analyte was detected at a concentration below the reporting limit and above the method detection limit. Reported value is estimated.

Table 3-4. Field Parameter Measurements at Ocean Receiving Water Stations

Parameter	ASBS-SO1		ASBS-SO2		ASBS-SO1	
	Pre-storm	Post-storm	Pre-storm	Post-storm	Pre-storm	Post-storm
	1/3/2016	1/6/2016	1/3/2016	1/6/2016	3/4/2016	3/6/2016
	12:10	17:15	11:40	16:30	13:30	4:30
Temp (^{o}C)	14.97	12.6	14.8	13.71	17.45	15.27
Salinity (ppt)	33.24	32	32.62	32.1	33.28	14.74
Conductivity (µS)	50,665	49,120	49,842	49,140	50,685	24,211
pH (pH units)	8.26	7.82	7.97	7.88	8.04	7.87
Turbidity (NTU)	-0.5	2.0	0.2	3.6	2.7	41.3
DO (mg/L)	8.31	8.63	8.18	8.53	8.21	9.5

^{o}C = degrees Celsius, ppt = parts per thousand, µS = micro Siemens, NTU = Nephelometric turbidity units, mg/L = milligrams per Liter

3.2.2 General Chemistry

January 6, 2016 Storm Event

General chemistry constituents included ammonia as N, nitrate as N, oil and grease, total orthophosphate as P, and TSS. Post-storm ammonia concentrations at both ASBS-SO1 and ASBS-SO2 were above the 85th percentile reference threshold. Pre-storm samples were less than 0.02 mg/L at both ocean receiving water stations. However, because the ammonia concentration at ASBS-SO2 was an estimated value (J-flagged), it was not considered to be in exceedance of the 85th percentile reference threshold.

Pre-storm nitrate concentrations were estimated (J-flagged) at 0.02 mg/L for both ASBS-SO1 and ASBS-SO2 and increased only slightly to estimated values of 0.04 mg/L and 0.03 mg/L at ASBS-SO1 and ASBS-SO2, respectively, during the storm event. No oil and grease was detected in pre-storm or post-storm samples at either receiving water location. Total orthophosphate remained unchanged at ASBS-SO1 and increased only slightly from 0.03 mg/L to 0.04 mg/L at ASBS-SO2 during the storm event. The pre-storm TSS concentration was above the reference threshold at ASBS-SO1; however the post-storm TSS concentration was below the reference threshold. Although TSS increased during the storm event at ASBS-SO2 from the pre-storm concentration, it remained below the 85th percentile reference threshold value of 48 mg/L.

March 6, 2016 Storm Event

Post-storm concentrations of ammonia, oil and grease, total orthophosphate, and TSS were measured above 85th percentile reference threshold values at ASBS-SO1. However, because the ammonia concentration was an estimated value (J-flagged), it was not considered to be in exceedance of the 85th percentile reference threshold. Each of the general chemistry constituents had higher post-storm concentrations than pre-storm concentrations. The post-storm measurements of oil and grease and total orthophosphate were 1.1 mg/L and 0.15 mg/L, respectively, which were slightly above the oil and grease and total orthophosphate reference thresholds of 0.5 mg/L and 0.1 mg/L, respectively. TSS was measured at 52.7 mg/L during the storm event, which slightly exceeded the 85th percentile reference threshold value of 48 mg/L.

3.2.3 Total Metals

January 6, 2016 Storm Event

In general, post-storm metals concentrations in ocean receiving water samples at ASBS-SO1 were either below the 85th percentile reference threshold values or were below pre-storm concentrations. Silver, which was the only metal that exceeded both criteria, had a pre-storm concentration of 0.08 µg/L and a post-storm concentration of 0.09 µg/L which was slightly above the threshold of 0.08 µg/L. While the post-storm selenium concentration was measured above the reference threshold, it was below the pre-storm concentration, and therefore not considered as an exceedance of natural water quality. At ASBS-SO2, concentrations of chromium, copper, lead, nickel, selenium, and silver were above 85th percentile reference threshold values.

March 6, 2016 Storm Event

During the March 6, 2016 storm event, concentrations of arsenic, chromium, copper, lead, nickel, and selenium at ASBS-SO1 were above 85th percentile reference threshold values. The pre-storm concentrations of selenium also exceeded 85th percentile reference threshold value at ASBS-SO1. Post-storm concentrations of arsenic, chromium, copper, lead, and nickel were 1.1, 2.7, 1.6, 1.3, and 2.7 times higher, respectively, than 85th percentile reference threshold values, while selenium had a post-storm concentration 16.8 times higher than the reference threshold value.

3.2.4 Polynuclear Aromatic Hydrocarbons

January 6, 2016 Storm Event

PAH concentrations were below the detection limit of 1 ng/L for 20 out of 25 analyzed PAHs during the January 6, 2016 storm event at ASBS-SO1. Eighteen PAHs (out of 25 that were analyzed) were detected in the post-storm sample from ASBS-SO2, but only five of these were above the reporting limit (5 ng/L) (Table 3-3). Low concentrations of PAHs were detected in pre-storm samples from both ocean receiving water locations but none of the concentrations were above reporting limits. The post-storm concentration of total PAHs at ASBS-SO2 (35.2 ng/L) was slightly above the 85th percentile reference threshold of 12.5 ng/L. The California Ocean Plan does not provide a total PAHs WQO for the protection of marine aquatic life. It should be noted that detected values that were below the reporting limit were summed as half the detection limit for comparison against the 85th percentile reference threshold. Individual PAH concentrations can be found in the chemistry reports provided in Appendix C.

March 6, 2016 Storm Event

Benzo(b)fluoranthene was the only PAH which was measured above the reporting limit in the post-storm sample collected from ASBS-SO1 on March 6, 2016. As a result, the total PAH concentration of 18.8 ng/L was slightly above the 85th percentile reference threshold value of 12.5 ng/L.

3.2.5 Organophosphorus Pesticides

January 6, 2016 Storm Event and March 6, 2016 Storm Event

Pre-storm and post-storm concentrations of OP pesticides were below detection limits during both of the monitored storm events. The 85th percentile reference threshold value for total OP pesticides (6.0 ng/L) was not exceeded at either ASBS-SO1 or ASBS-SO2 during the monitored storm events.

3.2.6 Synthetic Pyrethroids

January 6, 2016 Storm Event and March 6, 2016 Storm Event

Pre-storm and post-storm concentrations of synthetic pyrethroid pesticides were below detection limits during each of the monitored storm events. The 85th percentile reference threshold value for total pyrethroids (6.75 ng/L) was not exceeded at either ASBS-SO1 or ASBS-SO2 during the January 6, 2016 storm event or at ASBS-SO1 during the March 6th storm event.

In the calculation of the total pyrethroid pesticides concentration, a subset of ten pyrethroid pesticides were totaled (in accordance with SCCWRP's method for establishing the 85th percentile reference threshold). A value of one-half of the method detection limit was used for non-detect values.

3.2.7 Toxicity

Toxicity samples were collected during each storm event from ocean receiving water locations while runoff from the outfall pipe was still flowing into the receiving water. Toxicity testing of ocean receiving water consisted of the following tests: *M. galloprovincialis* (bivalve) development, *S. purpuratus* (sea urchin) fertilization, and *M. pyrifera* (giant kelp) germination and growth. A summary of the toxicity results from these bioassay tests is presented in Table 3-5. The full toxicity reports for each storm event are provided in Appendix D.

January 6, 2016 Storm Event

Results indicate that there was no toxicity observed to *M. galloprovincialis* development, *S. purpuratus* fertilization, or *M. pyrifera* germination or growth in exposures to ocean receiving water from ASBS-SO1 and ASBS-SO2 during the Jaunary 6, 2016 storm event. This is supported by no observed effect concentration (NOEC) values of 100% and lowest observed effect concentration (LOEC) values of greater than 100% for each of the bioassay tests.

March 6, 2016 Storm Event

Results indicate that there was no toxicity observed to *M. galloprovincialis* development, *S. purpuratus* fertilization, or *M. pyrifera* germination or growth was observed in exposures to ocean receiving water from ASBS-SO1 during the March 6, 2016 storm event. This is supported by NOEC values of 100% and LOEC values of greater than 100% for each of the bioassay tests.

Table 3-5. Summary of Ocean Receiving Water Monitoring Toxicity Results for Post-Storm Samples

Outfall	Storm Date	Toxicity Test	NOEC (%)	LOEC (%)	EC_{25} (%)	EC_{50} (%)	TU_c
ASBS-SO1	(January 6, 2016)	Bivalve development	100	>100	>100	>100	1
		Sea Urchin Fertilization	100	>100	>100	>100	1
		Kelp Germination	100	>100	>100	>100	1
		Kelp Growth	100	>100	>100	>100	1
	(March 6, 2016)	Bivalve development	100	>100	>100	>100	1
		Sea Urchin Fertilization	100	>100	>100	>100	1
		Kelp Germination	100	>100	>100	>100	1
		Kelp Growth	100	>100	>100	>100	1
ASBS-SO2	(January 6, 2016)	Bivalve development	100	>100	>100	>100	1
		Sea Urchin Fertilization	100	>100	>100	>100	1
		Kelp Germination	100	>100	>100	>100	1
		Kelp Growth	100	>100	>100	>100	1

> = greater than.
NOEC = no observed effect concentration.
LOEC = lowest observed effect concentration.
EC_{25} = concentration producing a 25% response.
EC_{50} = concentration producing a 50% response, or median effective concentration.
TUc = toxic units chronic.

3.3 Flow Modeling and Pollutant Load Calculations

Flow modeling was performed previously for each monitored outfall during the 2012-2013 and 2013-2014 storm seasons. Modeled flows were verified by correlating actual flows measured in outfall pipes ASBS-016 and ASBS-028 to modeled flows. Because flow equipment was removed from the outfalls following the 2013-2014 storm season, no additional flow modeling or pollutant loading was performed for events monitored during the 2015-2016 storm season.

3.4 Determination of Compliance with Natural Water Quality

Compliance with natural water quality was assessed by comparing post-storm ocean receiving water data from wet weather monitoring in ASBS 24 to the pre-storm data from the same site and to the 85^{th} percentile threshold of reference sample concentrations measured during Bight 2008 and Bight 2013. Compliance with natural water quality requires lower values of post-storm receiving water concentrations relative to the 85^{th} percentile reference threshold and the pre-storm concentrations. The Bight data from 2013 were combined with previously collected data during Bight '08 to determine the current 85^{th} percentile constituent thresholds for natural water quality.

Concentrations of pollutants in post-storm receiving water were compared to those in pre-storm receiving water and to the 85^{th} percentile threshold of reference sample concentrations. When post-storm receiving water concentrations are greater than the 85th percentile threshold and are greater than pre-storm concentrations for two or more consecutive storm events, they are considered to be in exceedance of natural water quality in accordance with Special Protections. Since the monitoring performed in 2015-2016 was an addendum to the previous monitoring program from 2012-2013 and 2013-2014, the ocean receiving water stations were examined sequentially to determine compliance with Special Protections. Table 3-6 presents the results showing which analytes were in exceedance of the 85th percentile reference threshold for each monitored storm event since the 2012-2013 storm season.

During Storm 1 (2/19/2013), selenium and total PAHs concentrations at ASBS-SO2 were above the 85th percentile reference threshold and were also above the pre-storm concentration (Table 3-6). For Storm 2 (3/8/2013), concentrations of nitrate, chromium, copper, lead, nickel, selenium, zinc, and total PAHs at ASBS-SO2 were above the 85th percentile reference threshold and were also above the pre-storm concentrations. There was no data from ASBS-SO1 for these initial two storm events since no flow entered the receiving water from the linked storm drain outfall ASBS-016. During Storm 3 (2/28/2014), concentrations of TSS, total orthophosphate, mercury, selenium, silver, total pyrethroids, and total PAHs were above the natural water quality criteria at ASBS-SO2, and mercury, silver, and zinc concentrations were above the natural water quality criteria at ASBS-SO1. The storm on January 6, 2016 (Storm 4) resulted in concentrations of ammonia and silver that were in exceedance of the 85th percentile reference threshold values at ASBS-SO1 and concentrations of chromium, copper, lead, nickel, selenium, silver, and total PAHs that were in exceedance of reference threshold values at ASBS-SO2. During the storm on March 6, 2016 (Storm 5), oil and grease, total orthophosphate, TSS, arsenic, chromium, copper, lead, nickel, selenium, and total PAHs were above the 85th percentile reference threshold values at ASBS-SO1 (Storm 5 was not monitored for ASBS-SO2). It should be noted that while the ammonia concentration (0.04 mg/L) was technically measured above the 0.015 mg/L reference threshold value at ASBS-SO1 during Storm 5 and at ASBS-SO2 during Storm 4, these results were estimated values and therefore were not considered to be in exceedance of the 85th percentile reference threshold.

Thus, at ASBS-SO1 silver was the only analyte which exceeded the reference threshold during consecutive storm events (Storm 3 and 4). However, since silver did not exceed the reference threshold during Storm 5 at ASBS-SO1, it may be inferred that silver is not a chronic threat to the water quality of the ASBS at this location.

At ASBS-SO2, selenium, silver, and total PAHs exceeded the reference threshold during consecutive storm events. Selenium and total PAHs were in exceedance of the reference threshold at ASBS-SO2 during four consecutive storm events, whereas silver was in exceedance of the reference threshold during two consecutive storm events. It should be noted that although selenium and silver exceeded the value assigned to natural water quality based on reference site monitoring, the selenium concentration in the ocean receiving water was over three orders of magnitude below the COP Imax.

Table 3-6. Constituents that Exceeded the 85th Percentile Reference Threshold

SO1						SO2			
Storm 1	**Storm 2**	**Storm 3**	**Storm 4**	**Storm 5**		**Storm 1**	**Storm 2**	**Storm 3**	**Storm 4**
2/19/2013	**3/8/2013**	**2/28/2014**	**1/6/2016**	**3/6/2016**		**2/19/2013**	**3/8/2013**	**2/28/2014**	**1/6/2016**
No Flow	**No Flow**		Ammonia						
				Oil and grease				TSS	
				Total orthophosphate			Nitrate		
				TSS			Chromium		Chromium
				Arsenic			Copper		Copper
				Chromium			Lead		Lead
				Copper				Mercury	
				Lead			Nickel		Nickel
		Mercury				Selenium	Selenium	Selenium	Selenium
				Nickel				Silver	Silver
				Selenium			Zinc		
		Silver	Silver			Total PAHs	Total PAHs	Total PAHs	Total PAHs
		Zinc						Total pyrethroids	
				Total PAHs				Total orthophosphate	

Shaded cells indicate analytes that exceeded the 85th percentile reference threshold for two consecutive storm events including the most recent storm events.

4.0 SUMMARY AND DISCUSSION

Special Protections Monitoring for ASBS 24 during the 2015-2016 storm season consisted of monitoring two outfalls and their linked ocean receiving water stations. Monitoring was comprised of chemical analyses of PAHs, pyrethroids, metals, OP pesticides, ammonia, nitrate, oil and grease, TSS, and total orthophosphate for each of the outfalls and the two ocean receiving water stations. Toxicity testing was also performed on ocean receiving water samples (three species during each storm event). Results from the two monitoring events are discussed below.

Ocean Receiving Water Monitoring

Ocean receiving water samples were collected from ASBS-SO1 during two storm events and from ASBS-SO2 during one storm event. Ocean receiving water post-storm chemistry results revealed that ammonia and silver were above the 85th percentile reference threshold at ASBS-SO1 during the January 6, 2016 storm event and oil and grease, total orthophosphate, TSS, total PAHs, and six metals (arsenic, chromium, copper, lead, nickel, and selenium) were above the 85th percentile reference threshold at ASBS-SO1 during the March 6, 2016 storm event. At ASBS-SO2, six metals (chromium, copper, lead, nickel, selenium, and silver) and total PAHs were above the 85th percentile reference threshold in post-storm samples from the January 6, 2016 storm event. Several constituents, such as TSS, selenium and silver had pre-storm concentrations that exceeded or equaled the 85th percentile reference threshold at one or both stations. Of these, concentrations of TSS and selenium from the January 6, 2016 storm event at ASBS-SO1 were higher in the pre-storm sample than in the post-storm sample.

Toxicity results from ocean receiving water collected at the receiving water sites ASBS-SO1 (associated with outfall ASBS-016) and ASBS-SO2 (associated with outfall ASBS-028) indicate that no toxicity was observed in any of the three test species from receiving water collected during the January 6, 2016 storm event. Similarly, no toxicty was observed in any of the three test species to receiving water collected from ASBS-SO1 during the March 6, 2016 storm event.

Core Discharge Monitoring

Core discharge water samples were collected from ASBS-016 during two storm events and from ASBS-028 during one storm event. During the January 6, 2016 storm event, the effluent from outfalls ASBS-016 and ASBS-028 was generally similar in concentration for most metals while constituents such as nitrate, TSS, and oil and grease varied somewhat between the two sites. No OP pesticides or synthetic pyrethroids were detected at ASBS-016, and no OP pesticides were detected at ASBS-028. Five different pyrethroids, were detected at ASBS-028, and were comprised predominantly by bifenthrin. Total PAHs were approximately ten times higher at ASBS-028 than at ASBS-016.

During the March 6, 2016 storm event, general chemistry concentrations at ASBS-016 were similar to those measured during the January 6, 2016 storm event. Metals concentrations, however, were all lower at ASBS-016 during the March 2016 storm event than during the January 6, 2016 storm event. Similar to the January 6, 2016 storm event, no OP pesticides or synthetic pyrethroid pesticides were detected at ASBS-016 during the March 6, 2016 storm event, and total PAHs were nearly identical in concentration (223 ng/L in January 2016 vs. 227 ng/L in March 2016).

Link between Outfall Concentrations and Receiving Water Concentrations

The link between the concentrations measured at outfalls ASBS-016 and ASBS-028 to concentrations measured at their respective ocean receiving water stations was explored. As previously mentioned, selenium, silver, and total PAHs at ASBS-SO2 were the only recurring constituents in the ocean receiving water that were elevated above background concentrations (pre-storm concentrations) and were above the 85^{th} percentile reference threshold for two or more consecutive storm events.

ASBS-028 and ASBS-SO2

Table 4-1 presents the list of constituents which had either pre-storm or post-storm exceedances of 85^{th} percentile reference threshold values at ASBS-SO2 for the storm event monitored on January 6, 2016. Table 4-1 also includes information used to determine whether effluent from outfall ASBS-028 may have contributed to these exceedances.

Total PAHs

During the January 6, 2016 storm event, the post-storm concentration of total PAHs was measured slightly above the 85^{th} percentile reference threshold at ASBS-SO2. Although the outfall total PAH concentration at ASBS-028 was substantially higher than the pre-storm ocean receiving water total PAH concentration, there is not a COP Imax value established for total PAHs for the protection of marine aquatic life. Because of this, it is difficult to quantify the level of management actions that would need to be undertaken.

PAHs can occur naturally from forest and grass fires, oil seeps, volcanic eruptions, and chlorophyllus plants, fungi, and bacteria. Anthropogenic sources of PAHs include the incomplete combustion of organic matter from manufacturing facilities, as well as from petroleum processing, power generation, waste incineration, home heating, lubricating materials, tar and asphalt. Internal combustion engines used in automobiles, railways, ships, and aircraft are also leading sources of PAH emissions in the environment (ATSDR 1995). The PAH sources in the watershed of ASBS-028 in the ocean receiving water would include some combination of motor oil, automobile exhaust emissions, ash from recent forest fires, tar and asphalt, and construction activities. Observed on-going construction on Malibu Cove Colony Drive has the potential to contribute to PAH contamination in the receiving water via oil leaks from contractor trucks and generators.

Selenium

Both the pre-storm and post-storm concentrations of selenium were measured above the 85^{th} percentile reference threshold value at ASBS-SO2 for the January 6, 2016 storm event. Although the outfall total selenium concentration at ASBS-028 was higher than the pre-storm ocean receiving water concentration, it remained over three orders of magnitude below the COP Imax value established for the protection of marine aquatic life.

Selenium occurs naturally in the environment, often found in association with sulfide ores of copper, iron, zinc, and in natural coal deposits. (http://www.clw.csiro.au/publications/waterforahealthycountry/2010/wfhc-contaminants-domestic-wastewater.pdf). Selenium is widely used in the electronics industry, as well as in the manufacture of ceramics, semiconductors, glass and pigments, alloys, catalysts, personal hygiene products, and animal feeds. The selenium sources in the ASBS-028 watershed and in the ocean receiving water may include some combination of naturally occurring selenium in the soil that has been exposed through construction activity or natural erosion and anthropogenic sources.

Silver

Silver was measured above the 85th percentile reference threshold during the January 6, 2016 storm event. During this event, the effluent concentration in outfall ASBS-028 was estimated to be 0.01 μg/L (J-flagged) and the ocean receiving water concentration at ASBS-SO2 was 0.09 μg/L. Since the ocean receiving water concentration was greater than the outfall concentration, and was only slightly greater than the pre-storm ocean receiving water concentration (0.08 μg/L), it seems unlikely that the effluent from ASBS-028 contributed to the ocean receiving water concentration at ASBS-SO2. The incremental difference of 0.01 ug/L between the pre-storm and post-storm ocean receiving water concentration can likely be explained by normal grab sample variability and suggests that the source of the detected silver measured in the Escondido Beach receiving water originates outside of the ASBS-028 watershed. It should be noted that similar silver concentrations in the ocean receiving water were also detected in pre-storm samples collected at ASBS-SO1 along Zuma Beach.

Silver is a rare but naturally occurring element that is most commonly found in its pure form in ores or as a compound in the form of silver sulfide. In industry, silver is used in the manufacture of silver nitrate, silver bromide and other photographic chemicals, water distillation equipment, mirrors, silver plating equipment, special batteries, table cutlery, jewelry, dental medical and scientific equipment including amalgams (Smith and Carson 1977). Silver is tightly bound by sewage sludge, and elevated silver concentrations in sediments are often characteristic of areas near sewage outfalls. Silver in oxidized sediments is closely associated with oxides of iron and with humic substances (Bryan & Langston, 1992).

Table 4-1. Comparison of ASBS-028 Outfall Concentrations to Pre-storm and Post-storm Ocean Receiving Water Concentrations for ASBS-SO2

Parameter	Units	COP IMAX	Natural Water Quality 85th Percentile	Outfall ASBS-028	Ocean Receiving Water ASBS-SO2	
				Outfall (1-6-16)	Pre-storm (1-3-16)	Post-storm (1-6-16)
Total PAHs	ng/L		12.5	2161.2	12.5	35.2
Selenium	μg/L	150	0.0025	1.48	0.015	0.076
Silver	μg/L	7	0.08	0.01J	0.08	0.09

J- Analyte was detected at a concentration below the reporting limit and above the method detection limit. Reported value is estimated.

Compliance with Natural Water Quality

Compliance with natural water quality was determined by comparing post-storm receiving water data from wet weather monitoring conducted since the 2012-2013 storm season for ASBS 24 to pre-storm receiving water data and to the 85th percentile threshold of reference sample concentrations calculated from data collected during Bight 2008 and Bight 2013.

Based on the results of five storm events and four storm events that were monitored at ASBS-SO1 and ASBS-SO2, respectively, since 2012-2013 storm season, no analytes were in exceedance of the 85th percentile reference threshold at ASBS-SO1 and three analytes were in exceedance of the reference threshold at ASBS-SO2. The three analytes that exceeded 85th percentile reference threshold at SO2 were total PAHs, selenium, and silver. Total PAHs and selenium concentrations were above the reference threshold in four consecutive storm events whereas silver was above the reference threshold in the two most recent storm events.

4.1 Recommendations

As previously discussed, there were three constituents which had concentrations that were outside of established compliance parameters for natural water quality in the receiving water at ASBS-SO2: selenium, silver, and total PAHs.

- An evaluation of the potential load reduction required for selenium to be in compliance with the Special Protections document is provided in Area of Special Biological Significance 24 Compliance Plan for the County of Los Angeles and the City of Malibu (Weston, 2014).
- The most recent monitoring data supports no action to be taken regarding reducing the silver concentration in storm drain effluent from ASBS-028. This is based upon the measured outfall concentrations of the two most recent storm events being substantially lower than the measured ocean receiving water concentrations.
- Total PAHs has no established COP Imax value to determine necessary management actions. As a result, no additional BMP recommendation is provided other than those actions provided in the ASBS Compliance Plan.

5.0 LITERATURE CITED

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