CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, SAN DIEGO REGION

INVESTIGATION ORDER NO. R9-2006-076

OWNERS AND OPERATORS OF MUNICIPAL SEPARATE STORM SEWER SYSTEMS, CALIFORNIA DEPARTMENT OF TRANSPORTATION, HALE AVENUE RESOURCE RECOVERY FACILITY, AND NORTH COUNTY TRANSIT DISTRICT RESPONSIBLE FOR THE DISCHARGE OF BACTERIA, NUTRIENTS, SEDIMENT, AND TOTAL DISSOLVED SOLIDS INTO IMPAIRED LAGOONS, ADJACENT BEACHES, AND AGUA HEDIONDA CREEK

TECHNICAL REPORT

July 19, 2006

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To request copies of Investigation Order No. R9-2006-076, '*Owners and Operators of Municipal Separate Storm Sewer Systems, California Department of Transportation, Owners and Operators of Wastewater Treatment Plants, and a Dewatering Operation Responsible for the Discharge of Bacteria, Nutrients, Sediment and Total Dissolved Solids into Impaired Lagoons, Adjacent Beaches, and Agua Hedionda Creek,*' please contact Ms. Cynthia Gorham-Test at (858) 467-2957 or ctest@waterboards.ca.gov.

Documents also are available at: http://www.waterboards.ca.gov/sandiego.

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California Regional Water Quality Control Board
San Diego Region
on July 19, 2006

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INTRODUCTION

The purpose of this Technical Report is to summarize information and technical analyses upon which the California Regional Water Quality Control Board, San Diego Region (San Diego Water Board) relied to develop the findings and directives in Investigation Order No. R9-2006-0076 (Order). The information in the reports required by the Order is needed by the San Diego Water Board for its investigation of the quality of certain waters of the State for which Total Maximum Daily Loads (TMDLs) are being developed.

The eleven waterbodies addressed by the Order were placed on the Clean Water Act (CWA) section 303(d) List of Water Quality Limited Segments (List) within the San Diego Region. Waterbodies included in this Order were placed on the 1998 List for exceedances of one or more of the following pollutants/stressors: indicator bacteria, sedimentation/siltation, and eutrophication/nutrients (See Table 1). One waterbody, Agua Hedionda Creek, was placed on the 2002 List for impairment due to total dissolved solids (TDS).

Lagoon is defined as a shallow basin that is semi-isolated from coastal oceanic water by barrier beaches (Kennish, 1986). For this Monitoring Order the term "lagoon" is used to refer to waterbodies with the names lagoons, sloughs, and creek mouths.

To examine the impairments identified in these listings, the San Diego Water Board needs water quality and hydrodynamic data to parameterize, calibrate and verify watershed and lagoon models of each impaired lagoon system. The lagoon and watershed models will be used to estimate existing pollutant loading, develop TMDLs, and conduct a source analysis for the waterbodies. This technical report provides information to support the findings and justify the requirements of Investigation Order No. R9-2006-076 issued pursuant to Water Code sections 13267 and 13383. This Order requires the California Department of Transportation, owners and operators of municipal separate sewer systems (MS4s), Wastewater Treatment Plants, and a dewatering operation that discharge impairing pollutants into the listed waterbodies to submit a monitoring program workplan, Quality Assurance Program Plan (QAPP), and monitoring data reports needed to address excessive 1) nutrients/eutrophication, 2) sediment, and 3) indicator bacteria in the listed waterbodies. Three waterbodies will be sampled for bacteria impairments only, two for nutrient impairments only, one for TDS impairment only, and the others for some combination of these impairments.

Waterbodies placed on the List for bacteria include: Loma Alta Slough and ocean shoreline, Buena Vista Lagoon and ocean shoreline, Agua Hedionda Lagoon, and San Elijo Lagoon and ocean shoreline (see Table 1). Bacteria impaired waters require sampling for fecal coliform, total coliform, and *Enterococcus* to meet minimal data needs.

Waterbodies placed on the List for sedimentation/siltation include: Buena Vista Lagoon, Agua Hedionda Lagoon, San Elijo Lagoon, and Los Penasquitos Lagoon (see Table 1). The lower portion of Agua Hedionda Creek also is impaired for TDS. To meet minimal data needs for sedimentation/siltation and TDS impaired waters, sampling for total suspended solids, turbidity, and flow rate, or total dissolved solids and flow rate are required.

Waterbodies placed on the List for nutrients/eutrophication include: Santa Margarita Lagoon, Loma Alta Slough, Buena Vista Lagoon, San Elijo Lagoon, and Famosa Slough and Channel (see Table 1). To meet minimal data needs for nutrients/ eutrophication impaired waters, sampling for various forms of nitrogen and phosphorus, and flow rate are required, as well as chlorophyll a, and biochemical oxygen demand are required in sections 4 and 5.

Table 1. List of Water Quality Limited Segments addressed in TMDLs for Lagoons, Adjacent Beaches and Agua Hedionda Creek.

Hydrologic Descriptor	Water Quality Limited Segment	Nutrients/ Eutrophication	Sedimentation/ Siltation	TDS	Bacteria
Lower Ysidora HSA (902.11)	Santa Margarita Lagoon	**Yes**			
Loma Alta HA (904.10)	Loma Alta Slough	**Yes**			**Yes**
Loma Alta HA (904.10)	Pacific Ocean Shoreline at Creek				**Yes**
El Salto HSA (904.21)	Buena Vista Lagoon	**Yes**	**Yes**		**Yes**
Buena Vista Creek HA (904.20)	Pacific Ocean Shoreline at Creek				**Yes**
Los Monos HSA (904.31)	Agua Hedionda Lagoon		**Yes**		**Yes**
Los Monos HSA (904.31)	Lower Agua Hedionda Creek			**Yes**	
San Elijo HSA (904.61)	San Elijo Lagoon	**Yes**	**Yes**		**Yes**
Escondido Creek HA (904.60)	Pacific Ocean Shoreline at Lagoon				**Yes**
Miramar Reservoir HA (906.10)	Los Penasquitos Lagoon		**Yes**		
Mission San Diego HSA (907.11)	Famosa Slough & Channel	**Yes**			

The basis for the findings and directives included in the Order are provided in the following sections. The finding or directive is first stated in italics followed by a discussion of the San Diego Water Board's basis for the finding or directive.

FINDINGS

Finding 1. Condition of Impairment

The Clean Water Act (CWA) section 303(d) requires states to develop a list of waterbodies that do not or are not expected to meet water quality standards after implementing technology-based controls. The waterbodies in Table 1 have been listed by the State Water Resources Control Board as water quality limited segments for which TMDLs must be developed pursuant to section 303(d). The purpose of a TMDL is to attain water quality objectives and restore the waterbody's beneficial uses.

The eleven water quality limited segments are comprised of lagoons (in this Order "lagoons" refers to lagoons, sloughs, and creek mouths), adjacent beaches, and Agua Hedionda Creek. These waterbodies are impaired due to one or more of the following: indicator bacteria, nutrients, sediment/siltation, total dissolved solids (TDS), and/or eutrophic conditions. In order to meet water quality objectives and restore beneficial uses the San Diego Water Board is initiating development of TMDLs to address these water quality limited segments.

Discussion: Fact Sheets (1998 and 2002 Water Quality Assessment Files, File No. 77-0118) prepared for the 11 waterbodies summarize the data and analysis used to designate the waterbodies as water quality limited segments. The areal/linear extent of the impairments for each waterbody is dependent upon the size of the watershed, the size of the waterbody, and whether the tidal channel is opened or closed, or if maintenance dredging occurs (see Table 2).

Table 2. Extent of Impairment for Each Water Quality Limited Segment

	Waterbody	***Water Quality Limited Segment***	***Pollutant/ Stressor***	***Tidal Channel***	***Extent of Impairment***
1	*Santa Margarita Lagoon*	*Entire lagoon*	*Eutrophic*	*Open/closed*	*1 acre*
2a	*Loma Alta Slough*	*Entire slough*	*Eutrophic*	*Usually closed*	*8.2 acres*
2b		*Entire slough*	*Indicator Bacteria*	*Usually closed*	*8.2 acres*
3	*Pacific Ocean Shoreline*	*At Loma Alta creek mouth*	*Indicator Bacteria*	*Ocean*	*1.1 miles*
4a	*Buena Vista Lagoon*	*Upper and lower portion of lagoon*	*Sedimentation / Siltation*	*Closed*	*202 acres*
4b		*Upper portion of lagoon*	*Nutrients*	*Closed*	*150 acres*
4c		*Upper and lower portion of lagoon*	*Indicator Bacteria*	*Closed*	*202 acres*
5	*Pacific Ocean Shoreline*	*At Buena Vista Creek*	*Indicator Bacteria*	*Ocean*	*1.2 miles*

	Waterbody	Water Quality Limited Segment	Pollutant/ Stressor	Tidal Channel	Extent of Impairment
6a	Agua Hedionda Lagoon	Upper and lower portion of lagoon	Sedimentation / Siltation	Open	6.8 acres
6b		Upper and lower portion of lagoon	Indicator Bacteria	Open	6.8 acres
7	Agua Hedionda Creek	Lower portion	Total Dissolved Solids	Freshwater	7 miles
8a	San Elijo Lagoon	Upper and lower portion of lagoon	Eutrophic	Usually closed / maint. dredging	330 acres
8b		Upper and lower portion of lagoon	Sedimentation / Siltation	Usually closed / maint. dredging	150 acres
8c		Upper and lower portion of lagoon	Indicator Bacteria	Usually closed / maint. dredging	150 acres
9	Pacific Ocean Shoreline	At San Elijo Lagoon	Indicator Bacteria	Ocean	0.44 mile
10	Los Penasquitos Lagoon	Entire Lagoon	Sedimentation / Siltation	Usually closed / maint. dredging	469 acres
11	Famosa Slough & Channel	Entire Lagoon	Eutrophic	Open	32 acres

Finding 2. Discharge of Waste

Sediment, nutrients, TDS, and bacteria enter these water quality limited segments from point and nonpoint sources. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels from urban runoff discharges. Nonpoint sources are diffused sources that reach receiving waters from different routes of entry and originate from multiple land uses. A significant portion of sources (point and nonpoint) is discharged through municipal separate storm sewer systems (MS4s), which include State highways and military facilities into the water quality limited segments. Other significant pollutant sources include wastewater treatment plants and dewatering operation discharges into the water quality limited segments.

Discussion: Bacteria sources may include pet waste, homeless encampments, sewer line breaks, leaking septic systems, agricultural activities, animal feeding operations, decaying soil matter, and wildlife. Bacteria impairments adversely impact the Water Contact Recreation (REC-1), Non-Contact Recreation (REC-2), Commercial and Sport Fishing (COMM), and Shellfish Harvesting (SHELL) beneficial uses of these waterbodies.

Nutrient sources include agricultural, home, park, golf course, other landscaped area fertilizer applications, imported water supplies, wastewater treatment plants, leaking septic systems, and animal waste. Nutrient impairments adversely impact the Warm Freshwater Habitat (WARM), Estuarine Habitat (EST), Marine

Habitat (MAR), Wildlife Habitat (WILD) beneficial uses of these waterbodies. Nutrient sources also contribute to algae growth, which can impair the aesthetic qualities of a waterbody creating a nuisance condition.

Sediment sources include non-vegetated soils, construction or landscaping activities, wastewater, dredge and fill activities. Impairments due to sedimentation have resulted in increased turbidity, possible decrease in primary productivity, loss of capacity, loss of tidal influence by shoaling of the tidal channel, and loss of habitat within these waterbodies. These conditions can adversely impact several beneficial uses for these waterbodies through loss of habitat, or loss of a corridor including: Warm Freshwater Habitat (WARM), Estuarine Habitat (EST), Marine Habitat (MAR), Wildlife Habitat (WILD), Rare, Threatened, or Endangered Species Habitat (RARE), Migration of Aquatic Organisms (MIGR), Commercial and Sport Fishing (COMM), and Shellfish Harvesting (SHELL). Recreational beneficial uses can be indirectly impacted by discharges of sediment/silt, which can exacerbate shoaling of the tidal passes. Closure or restriction of the tidal passes will inhibit flushing of bacteria, nutrients and other pollutants from the lagoon.

Exceedance of total TDS WQOs in lower Agua Hedionda Creek may be caused by agricultural activities, lawn watering, washing sidewalks and streets, landscaping activities, and/or return flows of imported water supplies. This increase can adversely impact the Municipal and Domestic Supply (MUN), Agriculture (AGR), Industrial Service Supply (IND), Warm Freshwater Habitat (WARM), and Wildlife Habitat (WILD) beneficial uses for this waterbody.

When urban runoff encounters these sources, it picks up bacteria, nutrients, suspended solids (sediment), and total dissolved solids (TDS), among many other pollutants. These pollutants are conveyed and discharged to receiving waters via MS4 systems. Pollutants also infiltrate MS4 systems through breaks or joints in underground pipes. While the sources of the contaminants are diffuse, the MS4s are considered a point source, with cities, counties, military facilities, and Caltrans bearing the responsibility for ensuring that discharges from MS4s do not cause or contribute to a violation of a water quality standard.

Water Code section 13050(d) defines waste as “sewage and any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation, including waste placed within containers of whatever nature prior to, and for purposes of, disposal.”

Federal regulation [40 CFR 122.2] defines a “point source” as “any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term

does not include return flows from irrigated agriculture or agricultural storm water runoff." This regulation defines "discharge of a pollutant" as "Any addition of any 'pollutant' or combination of pollutants to 'waters of the United States' from any point source."

Urban runoff discharges from the San Diego Region MS4's are regulated under NPDES requirements prescribed by the Regional Board pursuant to Clean Water Act section 402 and Water Code section 13376. The MS4 owners/operators must adhere to the Municipal Storm Water requirements for either San Diego County (Order No. R9-2001-01 and subsequent revisions), or Riverside County (Order No. R9-2004-001 and subsequent revisions). In addition, facilities with small MS4s, in this case military facilities, must adhere to Order No. 2003-0005-DWQ. Because the water quality limited segments receive pollutant loads from the MS4 discharges, more stringent WDRs are likely needed to ensure that WQOs are met in the receiving water and beneficial uses are protected.

Effluent monitoring reports show that discharges from waste treatment plants typically contain loads of bacteria and nutrients. Groundwater discharges contribute nutrient loads to surface streams when the nutrient concentrations are elevated in the groundwater body.

Finding 3. Persons Responsible for the Discharge

The California Department of Transportation (Caltrans)[1] and MS4 owners and operators in San Diego County,[2] Riverside County[3], Camp Pendleton and Fallbrook Naval Weapons Station (see Attachment 1) are responsible for these discharges. MS4 discharges from the non-military agencies are regulated under the terms and conditions of the Waste Discharge Requirements in the orders listed in footnotes 1 through 3. Camp Pendleton and Fallbrook Naval Weapons Station are designated as small MS4s pursuant to Order No. 2003-0005-DWQ[4] but have not yet been regulated by the San Diego Water Board under that order.

The City of Escondido Hale Avenue Resource Recovery Facility (Order No. 98-10), regulated by NPDES requirements, discharges nutrients into

[1] Order No. 99-06-DWQ, NPDES No. CAS000003, '*National Pollutant Discharge Elimination System (NPDES) Permit Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans).'*

[2] Order No. R9-2001-0001, NPDES No CAS0108758, '*Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer System (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District.'*

[3] *Order No. R9-2004-001 (NPDES Permit No. CAS0108766), 'Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the County of Riverside, the City of Murrieta, the City of Temecula and the Riverside County Flood Control and Water Conservation District within the San Diego Region.'*

[4] *Order No. 2003-0005-DWQ (State General Permit No. CA000004). "Waste Discharge Requirements (WDRs) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems".*

the Escondido Creek. The North County Transit District is responsible for nutrient discharges to the Santa Margarita River from the dewatering of its Stuart Mesa Maintenance Facility.

Discussion:

MS4s:

Water Code section 13267 authorizes the San Diego Water Board to require monitoring program reports from persons who are discharging waste within the Region that could affect the quality of waters within the Region. Water Code section 13383 authorizes the San Diego Water Board to establish monitoring and record keeping requirements for discharges regulated under NPDES requirements. Table 3 provides a list of persons within the watersheds of each impaired waterbody who are discharging bacteria, nutrients, sediment, and/or TDS into the water quality limited segments or their tributaries.

Table 3. Dischargers Within Each Watershed of a Water Quality Limited Segment.

Water Quality Limited Segments	HUC	Municipalities	Counties, State Agencies, and Other Facilities
Santa Margarita Lagoon	902.1	Camp Pendleton Fallbrook Naval Weapons Station Murrieta Temecula	1. San Diego County 2. Riverside County Flood Control and Water Conservation District 3. Caltrans 4. North County Transit District
Loma Alta Slough and Ocean Shoreline	904.1	Oceanside Vista	1. San Diego County 2. Caltrans
Buena Vista Lagoon and Ocean Shoreline	904.2	Carlsbad Oceanside Vista San Marcos	1. San Diego County 2. Caltrans
Agua Hedionda Lagoon and lower Agua Hedionda Creek	904.3	Carlsbad Oceanside San Marcos Vista	1. San Diego County 2. Caltrans
San Elijo Lagoon and Ocean Shoreline	904.6	Encinitas Escondido San Marcos Solana Beach	1. San Diego County 2. Caltrans 3. City of Escondido Hale Avenue Resource Recovery Facility
Los Penasquitos	906.1	Del Mar Poway San Diego	1. San Diego County 2. Caltrans
Famosa Slough and Channel	907.1	San Diego	1. Caltrans

Monitoring data and land use information indicate that the pollutant sources described above are present in the areas drained by MS4s within the watersheds of concern in this Order. Therefore, the San Diego Water Board has the authority under Water Code sections 13267 and 13383 to require submission of monitoring program reports from the MS4 owner/operators that discharge into these watersheds.

Responsible Dischargers for the Famosa Slough Watershed:
Famosa Slough is located on the south side of the San Diego River Floodway Channel (River Channel) within the tidal reaches of the River. Water from the River Channel can enter Famosa Slough via pipes installed on the south bank of the San Diego River Channel. Flap gates are installed at the opening of the pipes. When the gates are open, water can enter the Slough during high tides or storm events. However, the gates are usually closed during storm events to prevent water from entering Famosa Slough from the River Channel.

During low tides or high storm flows, San Diego River water, along with water from Mission Bay, exits the Floodway Channel into the ocean. Most of this freshwater mass will mix with the ocean water, significantly dispersing the nutrient load carried by the River. During high tides, ocean water enters the floodway channel, with the possibility of some inflow to Famosa Slough. At this point, the nutrient concentration of the ocean water will be much lower than the nutrient concentration of the River water, and thereby possibly provide a minor net gain of nutrients to Famosa Slough.

An assumption of the modeling for the Lagoons TMDLs is that the area beyond the tidal channel of each estuary is a sink, not a source of pollutants. Monitoring to consider the ocean (and in this case the Floodway Channel) beyond the tidal channel of each estuary would be required to effectively model any input from beyond the tidal channel. The San Diego Regional Board is not planning to add this component to the monitoring and modeling of each of the estuarine systems (lagoons, sloughs, creek mouths) listed in the Order.

Because there is not substantial evidence that the ocean water entering Famosa Slough is a source of nutrients to the slough, the San Diego Water Board will not require the Cities of Santee, La Mesa, El Cajon, and the Padre Dam Municipal Water District (all are located within the San Diego River Watershed) to submit the monitoring program reports required by the Order.

Caltrans:
Caltrans is responsible for any discharge from its roadways, right-of-ways, and landscaped areas as required under CWA section 402 and the Caltrans Statewide Stormwater Requirements (Order No. 99-06-DWQ and subsequent revisions). Discharges from roadways may include any or all of the pollutants addressed in the monitoring order (see Findings #2 and #3). Therefore, the San

Diego Water Board has the authority under Water Code sections 13267 and 13383 to require submission of monitoring program reports from Caltrans.

Other sources from areas outside of MS4 drained areas may be contributing pollutant loads to the water quality limited segments. These sources include agricultural, nursery, and livestock operations subject to NPDES requirements, Waste Discharge Requirments (WDRs), or the Basin Plan Waiver Policy (Waiver Policy), [5] and landfills, septic systems, or other facilities subject to WDRs or the Waiver Policy. The Waiver Policy is located on the San Diego Water Board website at http://www.waterboards.ca.gov/sandiego/programs/basinplan_amendments.html.

Other Dischargers:
Nursery and livestock operations are not required to submit monitoring program reports pursuant to this Order because WDRs and/or the Waiver Policy requirements prohibit irrigation discharges from nurseries, and stormwater and wastewater discharges from livestock operations to waters of the United States. If violations are found, the appropriate action for the San Diego Water Board would be to enforce the provisions of the WDRs, or in the case of non-compliance with a waiver, require the discharger to cease the discharge and/or submit a Report of Waste Discharge.

The WDR Waiver Policy requires owners/operators of animal feeding operations to implement management measures to conform with State requirements [CCR Title 27 Division 2, sections 22562 to 22565], or to prevent stormwater contact with animals, animal waste and composting areas. Section 22562 requires retention of all facility wastewater, including precipitation on, and drainage through, manured areas during a 25-year, 24-hour storm. Sections 22563 through 22565 address manure application rates, surface runoff, percolation, and infiltration from application fields. If a discharge, whether in compliance or in violation of the Waiver Policy, is found to occur for an operation under the Animal Feeding Operations sections of the Waiver Policy, then it can be added to the Order.

The Nursery Irrigation Return Water waiver requires owners/operators of nurseries to implement best management practices as required in the Plan for California's Non-point Source Control Program to prevent all waste from discharging to waters of the United States (including man-made ditches). San Diego County has conducted inspections of nurseries in the unincorporated county for compliance with the nursery waiver. The San Diego Water Board is in the process securing copies of the nursery inspection reports from the county to assess compliance with the Nursery Irrigation Return Water waiver.

[5]Resolution No. R9-2003-0060. Waste Discharge Requirements Waiver Policy. *Amendment to the Water Quality Control Plan for the San Diego Region (9) to Incorporate a Waste Discharge Requirement Waiver Policy for Certain Specific Types of Discharges.*

The Waiver Policy does not prohibit agricultural irrigation return water discharges to waters of the United States. The Agricultural Irrigation Return Water waiver requires that agricultural irrigation operations with return water implement best management practices as described in the "Plan for California's Nonpoint Source Pollution Control Program." Information on the NPSC program can be found at http://www.waterboards.ca.gov/nps/protecting.html. The San Diego Water Board has no evidence of specific irrigation return water discharges into the impaired lagoons and tributaries. However, with credible evidence of such discharges, the San Diego Water Board has the authority under Water Code section 13267 to amend the Order and require that agricultural facilities that discharge irrigation return water submit monitoring program reports.

The San Diego Water Board intends to begin evaluating potential changes to the Waiver Policy in the fall of 2006. Such changes could include requiring facilities regulated under the Waiver Policy to enroll with the San Diego Water Board. This will help the San Diego Water Board identify potential agricultural, nursery, and livestock facilities in the watersheds of water quality limited segments. Additionally, the San Diego Water Board could require facilities regulated under the Waiver Policy to conduct monitoring and submit reports. Such reports could simply be an accounting of BMPs undertaken to comply with a waiver, or could require effluent and/or receiving water monitoring.

Individual septic systems are either regulated under the Waiver Policy or WDRs. Septic systems regulated under the Waiver Policy must meet the requirements and are subject to the conditions set forth in Chapter 4 of the Basin Plan wherein the San Diego Water Board defers the authority to regulate the discharge of domestic waste to the appropriate county health officer. Individual septic systems not meeting criteria for regulation under the Waiver Policy are regulated with WDRs. If an individual septic system is found to contribute nutrients or bacteria to an impaired lagoon or tributary due to ponding of wastewater on the surface, the appropriate action for the San Diego Water Board would be to enforce the provisions of the WDRs and Waiver Policy which prohibit such discharges. If nutrients are transmitted from septic systems to waters of the United States via groundwater, the San Diego Water Board has the authority under Water Code section 13267 to amend the Order to require septic system owners/operators to submit monitoring program reports.

Most of the municipal waste treatment facilities in the San Diego Region discharge to ocean outfalls, or dispose of their discharge through land application. However, the City of Escondido Hale Ave. Resource Recovery Facility, discharges nutrients and bacteria into Escondido Creek. Therefore, the San Diego Water Board has the authority under Water Code sections 13267 and 13383 to require submission of monitoring program reports from the owners of these facilities. Industrial facilities are not required to submit monitoring program reports because they discharge directly into the municipal storm sewer system or the sanitary sewer, usually after pretreatment.

The North County Transit District Stuart Mesa Maintenance Facility discharges pumped groundwater to the Santa Margarita River. This discharge is not currently regulated and is being investigated by the San Diego Water Board. Monitoring data submitted to the San Diego Water Board indicates that nutrient concentrations exceed water quality objectives for the Santa Margarita River. Therefore, the San Diego Water Board has the authority under Water Code section 13267 to require submission of monitoring program reports from North County Transit District.

Finding 4. Need for Monitoring Data
Water Quality monitoring data are needed to develop TMDLs, and load and waste load allocations and reductions for the waterbodies for each impairing pollutant. The San Diego Water Board intends to develop TMDLs, allocations, and reductions through modeling studies of the watersheds and lagoons. Hydrodynamic and water quality data for the lagoons, flow and water quality data for the major tributaries, and flow and water quality data for storm drains discharging directly into lagoons are needed to calibrate and verify the lagoon models, and to verify the watershed models in order to develop TMDLs and allocations.

Discussion: A report titled "Impaired Lagoons and Adjacent Beaches and Creeks TMDL, San Diego Region" prepared by TetraTech, Inc. (Carter, 2005) assessed the data needs for the models to be used to develop TMDLs for the water quality limited segments. TetraTech is known throughout the U.S. for its work on TMDL related-studies. For many years, TetraTech has been a contractor for the U.S. Environmental Protection Agency to review, design, and develop modeling and assessment tools for application to complex water resources projects, including TMDLs. TetraTech has worked on several TMDL-associated projects resulting in Implementation Plans in Southern California, and is familiar with issues relevant to development of technically sound and defensible models for the public review process, as well as policy considerations that are important for development of water quality regulatory and management frameworks.

TetraTech has prepared a report on the extensive data search it completed for Loma Alta Slough and ocean shoreline, Buena Vista Lagoon and ocean shoreline, Agua Hedionda Lagoon and Creek, San Elijo Lagoon and ocean shoreline impaired waterbodies (Carter, 2005). This report summarizes the assessment results, including a review and data gap identification of the following hydrologic, water quality, and physical parameters:

- Stream flow data for watersheds
- Bacteria data for watersheds, lagoons and adjacent beaches
- Bathymetric and hydraulic information for lagoons

- Sediment data for watersheds and lagoons
- Nutrient data for watersheds and lagoons
- Other miscellaneous data including waterfowl census, feces dropping rates and concentrations

This report concludes that insufficient data are available to develop a model for determining existing loads and necessary load reductions for these waterbodies. While some data have been collected near storm drains, it cannot be used for the modeling effort because it would overestimate the bacteria, nutrients, and/or sediment loading from the watershed. Data for the modeling effort must be collected farther away from storm drains, beyond the mixing zone, to more precisely determine the effect that loading from each watershed is having upon each lagoon. In addition, data must be collected at the lower-end of the watershed, but above the tidal prism, during significant storm events. At least eight samples should be collected per storm event in order to characterize the bacteria/nutrients/suspended solids concentrations at different times during each storm event (onset of event, first flush, peak flow, etc.,). These data will be used to calibrate the computer model for each watershed. The watershed data that have been collected at various points in each watershed in the past cannot be used to *calibrate* (or set-up) the model because the low frequency of samples collected over a short time span within a storm event are not adequate, however, the past data may be used to *validate* (verify model output with actual data) the model results in the watershed. Any mass loading station data within one of these watersheds will be used for validation of the model.

Watershed data must be collected during two significant storm events for each waterbody placed on the 303(d) list for bacteria, nutrients, and/or sediments for up to three different waterbody types: watersheds, lagoons, and beaches. Hydrology and loading are measured at different flow intervals in each of three storm events to document some of the variability that occurs with regard to storm intensity, storm duration, and antecedent dry period. The larger sample size improves statistical accuracy and precision, thereby increasing the probability of producing an assessment that characterizes the true condition of the waterbody. While regulatory-based stormwater monitoring may include many more data points than required for this limited monitoring program, most programs do not require sample collection before peak flows are reached in a storm event. This is problematic because most of the pollutant loading occurs during the “first flush,” which can occur as much as eight hours before the peak flows of a storm event. Hence, the pollutant load can be greatly underestimated.

Although the historical wet-weather data analysis indicates that many of the creeks are ephemeral in nature during dry periods, some of these streams do have sustained low flows. These dry-weather flows can be attributed to various urban practices, including runoff from lawns and other landscaping, car washing, street cleaning, etc. The watershed model for storm events does not simulate the low flows caused by these urban processes well; therefore, dry flows need to

be addressed separately. To understand the dry-weather characteristics, monitoring data are required.

The following is a description of the data needs as outlined by TetraTech (Carter, 2005):

> "Data gaps prohibited more detailed analyses of hydrology, bacteria, sediment, and nutrients associated with the lagoons. There are several specific data elements that would be useful to better understand the hydrology, hydraulics, and water quality of the lagoons and their adjacent beaches. These data include, but are not limited to, the following:
>
> - Continuous flow data during wet and dry weather for Agua Hedionda Creek, Escondido Creek, Buena Vista Creek, and Loma Alta Creek
> - Bathymetric data for Loma Alta Slough
> - Rating curves that can be used to relate lagoon outflows to the ocean for the Buena Vista Lagoon, and Loma Alta Slough
> - Wet-weather and dry-weather watershed bacteria data for Loma Alta and Buena Vista Creeks
> - In-lagoon ambient bacteria data for all lagoons (very limited information are currently available for San Elijo Lagoon)
> - In-lagoon sediment data for San Elijo Lagoon, Agua Hedionda Lagoon, and Buena Vista Lagoon
> - Wet- and dry-weather watershed nutrients data for Loma Alta Creek and Buena Vista Creek
> - In-lagoon nutrients data for Loma Alta Slough, Buena Vista Lagoon and San Elijo Lagoon
> - Local estimates of bird densities and their estimated bacteria loadings
>
> Without the identification or collection of additional data, confirming existing impairments and TMDL development using hydrologic, hydrodynamic, and/or water quality models (or even simpler methods) will not be possible. The data gaps identified above should be prioritized and incorporated into an overall monitoring strategy for the lagoons, with an emphasis on obtaining data to confirm impairments and subsequently develop TMDLs for the impaired waterbodies."

Data availability analyses for Famosa Slough and Channel, Los Penasquitos Lagoon, and Santa Margarita Lagoon were not conducted. However, based on the lack of appropriate data available in the other watersheds, the data needed to model and calculate TMDLs for these watersheds are unlikely to exist. Nonetheless, the San Diego Water Board will assess data availability in these watersheds as soon as possible. If adequate data are available for TMDL development, the directives of the order can be amended with respect to these three impaired waterbodies.

Finding 5. Regulatory Authority and Necessity

Water Code section 13267 authorizes the San Diego Water Board to require the submission of monitoring program reports from any person discharging pollutants into waters of the State. The monitoring data reports will allow the San Diego Water Board to assess the conditions of pollution due to sedimentation, nutrients, bacteria, and TDS contributing to impairment in the lagoons, adjacent beaches, and creek. These actions will result in the restoration and protection of water quality necessary to support the designated beneficial uses of these waterbodies. The costs to produce the monitoring program reports were estimated by the Dischargers to range between $300,000 to $500,000 per lagoon and up to $6.5 million region-wide, which included the cost of the special studies listed in Directive A8. The associated costs bear a reasonable relationship to the need for the actions, specifically the protection of water quality and beneficial uses.

Water Code section 13383 authorizes the San Diego Water Board to establish monitoring and reporting requirements for discharges regulated under NPDES requirements.

Discussion: According to W.C. section 13267 (b)(1): "In conducting an investigation, the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires."

According to W.C. section 13383: "The state board or a regional board may establish monitoring, inspection, entry, reporting, and recordkeeping requirements, as authorized by Sections 13160, 13376, or 13377 or by subdivisions (b) and (c) of this section, for any person who discharges, or proposes to discharge, to navigable waters, any person who introduces pollutants into a publicly owned treatment works, any person who owns or operates, or proposes to own or operate, a publicly owned treatment works or other treatment works treating domestic sewage, or any person who uses or disposes, or proposes to use or dispose, of sewage sludge."

W.C. sections 13267 and 13383 Investigative Orders are considered as enforcement. These Orders are neither "regulations" nor "policies" as those terms are used and defined in the Health and Safety Code (W.C. section 57004). In addition, the Administration Procedurese Act does not apply to W.C. sections 13267 and 13383 because these Investigative Orders are not associated with rulemaking. In addition, neither a cost/benefit analysis nor economic considerations are required for issuance of W.C. 13267 Investigative Orders.

The benefits of meeting water quality standards to achieve the express, national policy of the CWA are in proportion to the costs of the monitoring reports because meeting the water quality objectives established for these waterbodies will ensure that beneficial uses for these waterbodies are attained.

Meeting water quality standards and the express national policy of the CWA is a benefit to the people of the State because of their paramount interest in the conservation, control, and utilization of the water resources of the State for use and enjoyment (Water Code section 13000). Furthermore, the health, safety and welfare of the people of the State requires that the State be prepared to exercise its full power and jurisdiction to protect the quality of waters from degradation.

Beneficial uses of water are necessary for the survival and well being of people, plants, and animals. Recreational, shellfish harvesting, aquatic life, municipal, agricultural, and industrial process beneficial uses of water, and aesthetic quality of water serve to promote the tangible and intangible economic, social, and environmental goals of the people of the San Diego Region. Coastal waters are used extensively in the San Diego Region for recreation, commercial and sport fishing. These waters are vital links in the Pacific flyway and support important aquatic life habitats. The lagoons and adjacent beaches are therefore key to the economic vitality and social and environmental well being of the region.

The estimated cost for the monitoring required in the order includes the special studies outlined in Directive A8. The Southern California Coastal Water Research Project (SCCWRP) has submitted a grant proposal, *Creating Tools for Numeric Nutrient Criteria and TMDL Development in San Diego Coastal Lagoons (PIN# 9275)*, to the State Water Resources Control Board for a Coastal Nonpoint Source Grant. Should SCCWRP receive funding from this grant, and conduct the special studies, the requirements of Directive A8 will be fulfilled.

Finding 6: California Environmental Quality Act:

This action is an order to enforce the laws and regulations administered by the San Diego Water Board. As such, this action is categorically exempt from the provisions of the California Environmental Quality Act pursuant to section 15306 of the California Public Resources Code.

***IT IS HEREBY ORDERED**, pursuant to Water Code sections 13267 and 13383, that the Dischargers identified in Attachment 1 to this Order shall furnish the following reports required by the San Diego Water Board in its investigation of the quality of waters of the State within the area of the discharge described in the above findings*:

DIRECTIVES

A.1. MONITORING PROGRAM WORKPLANS

The Dischargers shall develop and submit to the San Diego Water Board no later than August 1, 2007, one Monitoring Program Workplan for each watershed containing one or more water quality limited segments, or one Monitoring Program Workplan for each water quality limited segment, as shown in Table 1. If, within 30 days after submittal of the workplans, no comments have been received from the San Diego Water Board, the Dischargers shall implement the Monitoring Program Workplans according to the schedules in the workplans. Workplans shall not be implemented until an adequate Quality Assurance Project Plan has been submitted the San Diego Water Board as required in Directive A9 of this Order.

The Workplans must be adequate to guide the collection of monitoring data needed to characterize dry weather flow and storm flow influenced water quality in the segments listed in Table 1 in order to complete development of TMDLs, and load and waste load allocations and reductions. The workplan study design must address the following questions, or provide data necessary to calibrate/validate the computer models used to assist in answering the following questions:

a) What are the concentrations of bacteria, nutrients, and/or sediments at the base of each watershed before it enters an impaired lagoon/slough/creek mouth, in accordance with the impairments specified in the 303(d) list? What is the TDS concentration in Agua Hedionda Creek?

b1) What are the concentrations of bacteria, nutrients, and/or sediments in each impaired lagoon/slough/creek mouth, in accordance with the impairments specified in the 303(d) list? Do they exceed Water Quality Objectives?

b2) What are the dissolved oxygen concentrations in lagoons/sloughs/creek mouths impaired for nutrients/eutrophication?

c) What are the total annual (and daily) mass loads of bacteria, nutrients, and/or sediments from each watershed to each impaired lagoon/slough/creek mouth, in accordance with the impairments specified in the 303(d) list? What is the total annual (and daily) mass load of TDS to Agua Hedionda Creek?

d) What are the measured values and fluctuations for the physical factors that contribute to the concentrations of impairing pollutant within each lagoon/slough/creek mouth, in accordance with the impairments specified in the 303(d) list? Physical factors can

include: condition of tidal channels (width, depth), stream flow velocities and volumes, bathymetry, seasonality, light availability, temperature, rainfall, etc.

d1) Under what inflow conditions (flow velocities, flow volumes) are the major loads deposited within each lagoon/slough/creek mouth, in accordance with the impairments specified in the 303(d) list?

d2) What percentage of the annual load from each constituent is deposited within the lagoons/sloughs/creek mouths, in accordance with the impairments specified in the 303(d) list, versus exiting the tidal channels?

e) For waterbodies impaired by nutrients/eutrophication additional questions are required to model the nutrient dynamics of each system. These factors will affect not only the nutrient concentrations found in the water column, but also the response of plants/algae to these concentrations.

e1) What are the sediment flux rates for nutrients in these waterbodies?

e2) What is the sediment oxygen demand in these waterbodies?

e3) What are the standing crop totals and primary productivity rates for plant/macroalgae biomass in these waterbodies?

f) What are the relative contributions for impairing pollutant(s) from each land use type or from permitted industrial/municipal facilities?

g) What is the total annual load reduction of nutrients needed so that beneficial uses and water quality objectives associated with eutrophication/ low dissolved oxygen and nuisance algae growth are met?

h1) What is the total annual load reduction of bacteria needed so that recreational beneficial uses and water quality objectives are met?

h2) What is the total annual load reduction of sediment needed so that sedimentation/ siltation is reduced to meet water quality objectives and to prevent lagoon mouth closings, loss of lagoon depth, and loss of important habitats?

h3) What is the total annual load reduction of TDS needed in Agua Hedionda Creek so that MUN beneficial uses and water quality objectives are met?

Lagoons/watersheds shall be monitored for the constituents that correspond to the pollutants/stressors indicated for the segments listed in Table 1.

Discussion: The performance standards contained in this directive were developed to guide the dischargers in setting the scope of the monitoring program workplans and are justified by the discussion of Finding 4, Need for Monitoring Data. These questions are designed to address data needs for determining present conditions (including verifying or refuting waterbody impairment), and provide calibration and verification data for computer model development. The models will provide loading estimates under present conditions and under different management scenarios. One management scenario will be chosen to develop load allocations for the TMDL for each waterbody and its designated impairment(s).

The Stormwater Monitoring Coalition developed the following core management questions for the stormwater program (Model Monitoring Program for MS4s in Southern California, Technical Report #419, August 2004).

1.) Are conditions in receiving waters protective, or likely to be protective, of beneficial uses?
2.) What is the extent and magnitude of the current or potential receiving water problem(s)?
3.) What is the relative urban runoff contribution to the receiving water problem(s)?

Management Question No. 1 is addressed in the Basin Plan and Water Quality Objectives, and through monitoring with respect to documenting ambient conditions in the waterbody. Many of the study questions developed in this Order can be placed under Management Question No. 2, and indirectly under Management Question No. 3. Other questions regarding the impacts of other environmental factors upon constituent loading and concentrations (including nutrient dynamics and physical factors) are not directly addressed in the Management Questions, but nevertheless are important to consider in developing the TMDL load and allocation for each waterbody and impairing constituent.

Discussion Regarding Model Development: Wet-weather and dry-weather flows will be modeled separately for these TMDL studies, because the pollutant loading response during these different types of flow is dissimilar.

A majority of pollutant loading from the watershed is delivered to estuaries through streams and stormwater collection systems. Often, watershed-based pollutant sources can be linked to specific land use types that have higher relative accumulation rates of pollutants. To assess the link between sources of the pollutant and the impaired waters, a modeling system may be utilized that simulates the build-up and wash-off of pollutants and the hydrologic processes

that deliver these pollutants to the waterbody of concern. Understanding and modeling these processes provides the necessary decision support for TMDL development, which includes determining point and non-point source load allocations (Carter, 2005).

Wet-weather TMDL calculations will be based on watershed models of the basins draining to the impaired waterbodies. USEPA's Loading Simulation Program C++ (LSPC) model was selected to simulate the hydrologic processes and pollutant loading to these waterbodies (Shen et al., 2004; USEPA, 2003a). Configuration of the wet-weather watershed models involves consideration of four major components: meteorological data, land use representation, hydrologic and pollutant representation, and waterbody representation. These components provided the basis for the models' ability to estimate flow and pollutant loadings.

Much of the dry weather flow in Southern California is generated by nuisance flows such as irrigation, washing cars, and rinsing sidewalks. Dry weather flows may carry a multitude of pollutants, such as nutrients and bacteria, but generally do not carry much of a sediment load. Therefore, sediment loading from dry weather flow will not be modeled for waterbodies requiring sediment TMDLs.

The dry weather flow modeling approach will be based on regression equations developed from dry-weather data, and steady-state flow assumptions. Pollutant concentrations in each waterbody segment, are calculated using water quality data, basic channel geometry, and flow. Bacteria first order die-off rates are included for bacteria modeling. Bacteria die-off rates can be attributed to solar radiation, temperature, and other environmental conditions.

The estuaries (lagoons/sloughs/creek mouths) will be modeled separately using the Environmental Fluid Dynamics Code (EFDC) model. EFDC is a capable of simulating hydrodynamics, salinity, temperature, suspended sediment, water quality, and the fate of toxic metals. EFDC is a widely accepted model (particularly by U.S. EPA) and is capable of simulating 21 water quality parameters, including dissolved oxygen, suspended algae, various components of carbon, nitrogen, phosphorus, and bacteria."

This model simulates circulation patterns in the estuary to determine whether the loading to the estuary from the watershed remains in the estuary or is taken away from the estuary by the current, through tidal passes. It also estimates the concentration of the pollutant of concern within the estuary based on the amount of loading, the initial concentration of the pollutant in the estuary, and water circulation.

> *A2. IN SITU DATA COLLECTION (FIELD MEASUREMENTS)*
> *The Monitoring Program Workplan shall include, at a minimum, the constituents, sampling locations, and frequency and duration of sampling as indicated below for water temperature, specific conductivity, dissolved*

oxygen, pH, and velocity measurements needed to calibrate and verify the models to be used to calculate TMDLs in the water quality limited segments. Site-specific changes to this sampling specification may be proposed to the San Diego Water Board along with the scientific rationale for the changes. Any proposed changes may not be implemented until incorporated into this Order by amendment.

Hourly field measurements are required to document the influence of tides and/or daily fluctuations of dissolved oxygen. The daily fluctuations of dissolved oxygen are amplified in waterbodies with nutrient/ eutrophic impairments. All the lagoons listed in this Order are subject to tidal influence and/or impaired for nutrients/eutrophication (which can lead to low dissolved oxygen concentrations). Therefore all lagoons must have the following data collected:

i. Constituents
- *Specific conductivity*
- *Water Temperature*
- *Surface water depth (if no bathymetry data exist)*
- *Velocity (optional)*
- *Dissolved oxygen (DO) and pH (only required in lagoons impaired for eutrophic conditions/nutrients)*

ii. Location
A minimum of one sample site in each segment or portion of a segment shall be selected. The sampling site shall represent ambient water conditions and shall not be influenced by storm drains or other effluent discharges.

iii. Frequency/Duration
Two two-week periods of hourly monitoring for the constituents listed above.

One two-week period shall be selected between October 1, 2007, through April 30, 2008 and another two-week period between May 1, 2008, through September 30, 2008.

Discussion: The data collection required in the monitoring order is needed to validate the computer model used to determine the pollution load for each impaired waterbody. This same model will predict the reduced load needed to meet water quality objectives. In addition to the pollutant concentrations/mass data required, data of the bathymetry and physical conditions of these waters (temperature, conductivity, water elevation, velocity) are needed as well to model the hydrodynamics of the lagoon systems. Dissolved oxygen data are needed to characterize the relationship between nutrient loading, limited tidal exchange, and dissolved oxygen concentration in the lagoons.

Waterbodies can be separated into segments, according to differences within each waterbody due to factors such as freshwater/saltwater conditions caused by presence/absence of tidal action, natural or man-made constrictions separating portions of the waterbody, differing bathymetry or geology, etc. These differences can affect water quality among segments, so that a sample collected within one segment is not representative of a sample within another segment of the same waterbody.

Intensive field measurement data of two two-week periods outlined in Section A2 is required for monitoring of lagoons/sloughs/creek mouths that are tidally influenced and/or with nutrient/eutrophication designated impairment to characterize water quality over multiple tidal cycles. The intensive monitoring of water temperature, conductivity (salinity), and dissolved oxygen is required so that 1) the water mass exchanges occurring due to the tidal cycle will be captured, 2) the nutrient fluctuations in the water that occur due to nutrient loading, uptake and release by plants and animals, denitrification in the sediments, nitrification at the air/water interface, and exchanges due to tidal action, and 3) the dissolved oxygen fluctuations that occur due to tidal action, daily cycles of photosynthesis and respiration effects, and biomass uptake and decomposition will be documented.

These lagoon/slough/creek mouth systems that have some connection to the ocean are transitional systems. Many of these experience a daily high tide and low tide. Due to the tidal action, significantly different masses of water can occur in these waterbodies with a water mass that is closer to marine conditions during high tide, and a water mass that is closer to freshwater conditions during low tide. The characteristics of these water masses are influenced by tide stage and strength, condition of the tidal pass, and amount of freshwater inflow, among others.

For TMDLs, a waterbody segment refers to the area that was determined to be impaired according to the data that was collected at sampling stations. These segments are determined according to the physiography (depth, width to the waterbody as well as the magnitude of exceedence of water quality objectives at specific sites. This determination is coupled with the known hydrodynamics of the waterbody to estimate the extent of exceedences beyond the sampling locations. The segment represents the known extent of impairment. The segment designation provides guidance for establishing the TMDL process for each waterbody. The entire waterbody is examined during TMDL development to determine whether a more intensive analysis reveals that the waterbody is impaired, and the extent of impairment, or that the waterbody is meeting water quality objectives.

Intensive monitoring of field measurements will occur for a two-week period in the wet season and a two-week period in the dry season. It is necessary to document the differences that occur in the wet vs. dry seasons because of

differences in water temperature or sunlight available affecting 1) dissolved oxygen solubility in water, 2) metabolic rates of organisms, 3) plant growth and dormancy, and 4) decomposition. It is necessary to collect hourly measurements to use for model validation because the model runs on an hourly time step.

In order to determine present loads and loads needed to meet numeric targets for the TMDL, the following synopsis of data required for section A2: Hourly electronic sensor data shall be collected away from storm drains, beyond the mixing zone, for water temperature, specific conductance, and water depth or elevation for tidally influence lagoons and sloughs, and those impaired for nutrients/eutrophication. Dissolved oxygen shall be collected as well for lagoons impaired for nutrients/ eutrophication. One sample site per waterbody is needed.

A3. WATERSHED POLLUTAGRAPHS AND LAGOON WATER QUALITY (STORM EVENT)

The Monitoring Program Workplan shall include, at a minimum, the constituents, sampling locations, and frequency and duration of sampling as indicated below for generation of two separate storm pollutagraphs. When planning for monitoring, forecasted storm events of 0.2 or more inches of rainfall should be considered. Site-specific changes to this sampling specification may be proposed to the San Diego Water Board along with the scientific rationale for the changes. Any proposed changes may not be implemented until incorporated into this Order by amendment.

When water depth is sufficient to submerge a probe, field measurements of water temperature, pH, conductivity, and dissolved oxygen shall be collected when water quality samples listed below are collected.

i. Constituents

Waters impaired due to Indicator Bacteria (Loma Alta Slough, Buena Vista Lagoon, Agua Hedionda Lagoon, San Elijo Lagoon)

- *Fecal coliform*
- *Total coliform*
- *Enterococcus*
- *Flow rate*

Waters impaired due to Sedimentation/Siltation (Buena Vista Lagoon, Agua Hedionda Lagoon, San Elijo Lagoon, Los Penasquitos Lagoon)

- *Total suspended solids*
- *Turbidity*
- Flow rate

Waters impaired due to TDS (Agua Hedionda Creek)

- *Total dissolved solids*
- *Flow rate*

Waters impaired due to Eutrophic Conditions/Nutrients
(Santa Margarita Lagoon, Loma Alta Slough, Buena Vista Lagoon, San Elijo Lagoon, Famosa Slough and Channel)

- *Total nitrogen*
- *Total phosphorus*
- *Flow rate*

ii. Location
Watersheds:
A minimum of one sample site shall be selected in the main tributary to the water quality limited segment, upstream of the tidal prism. (For Famosa Slough the major contributing storm drain will be representative of the main tributary). The sampling site shall represent ambient water conditions and shall not be directly influenced by storm drains (except for Famosa Slough) and other effluent discharges. If a tributary has an established mass loading station, this site should be used for the pollutagraph monitoring.

Lagoons:
A minimum of one sample site in each lagoon segment or portion of a segment shall be selected. The sampling site shall represent ambient water conditions and shall not be influenced by storm drain flow or other effluent discharges.

iii. Frequency/Duration
Watersheds:
Hourly grab samples shall be collected during the storm event. From those hourly samples collected, a minimum of eight grab samples representative of the storm event shall be analyzed. Any remaining samples may be disposed. The samples shall be collected to represent at least the first flush and peak flow to the extent that is practicable.

At a minimum, sampling shall occur during two storm events, between October 1, 2007 and April 30, 2008. Sampling of at least one early season storm is preferred.

Lagoons:
A minimum of one grab sample shall be collected in each lagoon segment during each storm event corresponding to the storm events described above for Watershed Frequency/Duration in this section. Samples should be collected as close to the peak flow of the storm event as practicable.

Discussion: Coliform and *Enterococcus* bacteria are the indicator bacteria used to determine waterbody impairment for pathogens. Bacteria and flow rate data

are needed to verify the impairment and to calculate bacteria concentration/load to the waterbody. Total suspended solids (TSS), turbidity, and flow rate data are needed to calculate sediment loading into sediment-impaired or nutrient impaired lagoons. TSS is the constituent used to measure the sediment load from the watershed (when multiplied by flow volume). TDS and flow rate measurements are needed to determine whether TDS exceed water quality objectives and loading into Agua Hedionda Creek.

Total nitrogen, total phosphorus, and flow rate data are needed to determine whether concentrations exceed numeric water quality objectives, to determine whether concentrations will promote algae and macrophyte growth leading to eutrophic conditions, and to determine loading of these nutrients to the impaired waterbody. Note that, other forms of nitrogen and phosphorus are measured in sections 4 and 5, but only total nitrogen and total phosphorus are measured in section 3 (for nutrient/eutrophic impaired estuaries). To lower monitoring costs, the other forms of nitrogen and phosphorus are not required to be measured in section 3, where the monitoring is needed to determine total load of these nutrients to each estuary. In sections 4 and 5 the various forms of nutrients are measured to address the nutrient dynamics involved in each estuary.

The watershed sampling location should be located above the tidal prism, but as near the tidal prism as practicable for efficient collection, to effectively determine the total mass load of each pollutant in question discharging from the entire watershed for each river/creek entering the impaired waterbody. Water below the tidal prism will be influenced by the tides and mixing with water from the ocean, which would not be representative of total load originating from the watershed.

The tidal prism is defined as the area within an estuary where variation of salinity occurs due to the mixture of seawater with freshwater. The tidal prism extends to the uppermost region of an estuary where there is tidal influence (measured by salinity or reverse streamflow caused by high tides), which can cause salinities to exceed 0.5 ppt at least occasionally.

The impairing pollutants will be measured in the lagoons to determine the total reservoir of pollutants in the waterbody and to develop a relationship between the total load in the estuary, the total loss, from the tidal passes and the concentration in the water column (or sediment deposited).

The lagoons can be separated into segments, according to differences within each waterbody due to factors such as freshwater/saltwater conditions caused by presence/absence of tidal action, natural or man-made constrictions separating portions of the waterbody, differing bathymetry or geology, etc. These differences can affect water quality among segments, so that a sample collected within one segment is not representative of a sample within another segment of the same waterbody.

The eight grab samples chosen to represent the storm event will be used to calibrate the model for loading that occurs during a storm event. Studies by SCCWRP and others have reported that the majority of the pollutant loading occurs during the portion of the storm event known as the peak flow and the first flush (Stein, et al., 2006). It is therefore, important to understand how pollutant concentrations change throughout a storm event in response to flow rate, duration of flow, and flow volume. Assuming a constant concentration throughout a storm event can vastly underestimate or overestimate loading results depending upon when the grab sample was collected.

Water Quality Pollutagraph Sampling Synopsis: For waterbodies impaired by eutrophication/ nutrients, and/or bacteria, and/or sedimentation/ siltation or TDS: Grab samples shall be collected for two separate storm events (for the appropriate combination of these constituents and for flow) located above the tidal prism in the watershed, and beyond the mixing zone in the lagoon. At least eight samples shall be collected per storm event at the watershed site. One sample shall be collected per storm event at the lagoon site.

A4. WATERSHED MODEL (DRY WEATHER)

The Monitoring Program Workplans shall include a study to conduct a one-day survey during each two-week period of hourly sensor data collection to measure the flow rate and water quality of all storm drain discharges of visible flow into a lagoon. At a minimum, the constituents, sampling locations, and frequency and duration of sampling as indicated below for the pollutants impairing a water quality limited segment shall be included in the Workplan. Site-specific changes to this sampling specification may be proposed to the San Diego Water Board along with the scientific rationale for the changes. Any proposed changes may not be implemented until incorporated into this Order by amendment.

i. Constituents

When water depth is sufficient to submerge a probe to collect a measurement at the storm drain outfall, field measurements of water temperature, pH, conductivity, and dissolved oxygen shall be collected when water quality samples listed below are collected. If water depths in the lagoon/slough/creek mouth are sufficient to collect field measurements, but not at the storm drain outfall, then a measurement may be collected in the lagoon/slough/creek mouth near the storm drain.

Waters impaired due to Indicator Bacteria

- *Fecal coliform*
- *Total coliform*
- *Enterococcus*

- *Storm drain flow rate*

Waters impaired due to Eutrophic Conditions/Nutrients

- *Ammonia as N*
- *Total Kjeldahl nitrogen*
- *Nitrite as N*
- *Nitrate as N*
- *Total nitrogen*
- *Ortho phosphate as P*
- *Total phosphorus*
- *Chlorophyll a*
- *Biochemical oxygen demand (BOD5)*
- *Storm drain flow rate*

ii. Location
All storm drain flow, as it exits the outfall, discharging within the confines of each lagoon or estuary.

iii. Frequency/Duration
Time-composite samples shall be collected once during the two-week period of hourly sensor data collection from all storm drain outfalls with visible flow that directly discharges into a lagoon. A time composite sample consists of one sample taken every 15 minutes at the same location (at 0 min., 15 min. and 30 min.)*. These three samples will then be combined into one sample that will be taken to the lab for analysis*.

Discussion: Monitoring outlined in Section A4 addresses dry weather loading of pollutants. While flows may be very low at this time, significant loading of nutrients and/or bacteria can occur due to nuisance flows. Samples will be collected at storm drains that directly discharge into lagoon/slough/creek mouth waters.

Coliform and *Enterococcus* bacteria are the indicator bacteria used to determine waterbody impairment for pathogens. Bacteria and flow rate data are needed to verify the impairment and to calculate bacteria concentration/load to the waterbody. TSS, turbidity, and flow rate data are needed to calculate sediment loading into sediment-impaired or nutrient impaired lagoons. TSS (total suspended solids) is the constituent used to measure the sediment load from the watershed (when multiplied by flow volume). TDS and flow rate measurements are needed to determine whether total dissolved solids exceed water quality objectives and loading into Agua Hedionda Creek.

The various forms of nitrogen and phosphorus, chlorophyll a, BOD_5, and flow rate data are needed to determine whether concentrations exceed numeric water quality objectives, to determine whether concentrations will promote algae and

macrophyte growth leading to eutrophic conditions, and to determine loading of these nutrients to the impaired waterbody. The excessive growth can cause stressful conditions for other organisms living in the lagoon, such as low dissolved oxygen concentrations. Nutrient cycling from sediments can increase the amount of nutrients in the water column significantly when low dissolved oxygen concentrations occur. Only certain forms of nutrients are available for use by algae and plants, the other forms must be converted to a useable form. Organic forms of nutrients can take the longest time to convert to a useable form. Therefore, understanding what forms of nutrients occur, and their dynamics, in an estuary is important.

Chlorophyll a is a surrogate measure of planktonic algae biomass in the water column. It is a simple measurement that can be used in the model to represent primary producer biomass in the waterbody, and is helpful to determine a relationship between nutrient concentrations/loads and biomass produced. Where macroalgae and other macrophytes occur, it should not be the only measure of primary producer biomass used.

Biochemical Oxygen Demand (BOD_5) is a measure of oxygen required for biochemical degradation of organic material and the oxygen used to oxidize inorganic material such as sulfides and ferrous iron. (It also may measure the oxygen used to oxidize reduced forms of nitrogen unless an inhibitor is used to prevent their oxidation.) Since organisms' respiration and decomposition can require significant amounts of oxygen, and the aquatic environment can be oxygen-limited, consideration of this factor is important when modeling a waterbody for excessive nutrients and eutrophication.

The requirement for samples collected at all storm drains with visible discharge directly to the lagoon includes all storm drains that are located below the watershed sampling station (the station that is located above the tidal prism). Storm drains are a significant source of pollutants from urban runoff. In the dry season, most of the flow and pollutant load can be delivered to an estuary via the storm drains.

Time composite samples will consist of three samples taken every 15 minutes at the same location (at 0 min., 15 min. and 30 min.). These three samples will then be combined into one sample that will be taken to the lab for analysis. The purpose of a time composite sample is to ensure that a representative sample is taken of the waterbody at that location.

The constituents will be measured in the lagoons to determine the total reservoir of pollutants in the waterbody and to develop a relationship between the total load in the estuary, the total loss, from the tidal passes and the concentration in the water column (or sediment deposited).

The lagoons can be separated into segments, according to differences within each waterbody due to factors such as freshwater/saltwater conditions caused by presence/absence of tidal action, natural or man-made constrictions separating portions of the waterbody, differing bathymetry or geology, etc. These differences can affect water quality among segments, so that a sample collected within one segment is not representative of a sample within another segment of the same waterbody.

A5. LAGOON WATER QUALITY AND TRIBUTARY FLOW AND WATER QUALITY MONITORING FOR TWO-WEEK PERIODS.

The Monitoring Program Workplans shall include at a minimum the constituents, sampling locations, and frequency and duration of sampling as indicated below for the pollutants impairing a water quality limited segment. Site-specific changes to this sampling specification may be proposed to the San Diego Water Board along with the scientific rationale for the changes. Any proposed changes may not be implemented until incorporated into this Order by amendment.

i. Constituents

Field measurements of water temperature, pH, conductivity, and dissolved oxygen shall be collected when water quality samples listed below are collected.

Waters impaired due to Indicator Bacteria *(Loma Alta Slough, Buena Vista Lagoon, Agua Hedionda Lagoon, San Elijo Lagoon)*

- *Fecal coliform*
- *Total coliform*
- *Enterococcus*
- *Tributary flow rate*

Waters impaired due to Sediment/Siltation and TDS (Buena Vista Lagoon, Agua Hedionda Lagoon, Agua Hedionda Creek, San Elijo Lagoon, Los Penasquitos Lagoon)

- *Turbidity*
- *Total suspended solids*
- *Tributary flow rate*

Waters impaired due to Sediment/Siltation and TDS (Agua Hedionda Creek)

- *Total dissolved solids*
- Tributary flow rate

Waters impaired due to Eutrophic Conditions/Nutrients (Santa Margarita Lagoon, Loma Alta Slough, Buena Vista Lagoon, San Elijo Lagoon, Famosa Slough and Channel)

- *Ammonia as N*
- *Total Kjeldahl nitrogen*
- *Nitrite as N*
- *Nitrate as N*
- *Total nitrogen*
- *Ortho phosphate as P*
- *Total phosphorus*
- *Chlorophyll a*
- *Biochemical oxygen demand (BOD5)*
- *Tributary flow rate*

ii. Location
Lagoons:
A minimum of one sample site in each segment or portion of a segment shall be selected. The sampling site shall represent ambient water conditions and shall not be influenced by storm drain flow or other effluent discharges.

Tributaries:
A minimum of one sample site shall be selected in the tributary to the water quality limited segment, upstream of the tidal prism. The sampling site shall represent ambient water conditions and shall not be influenced by storm drain flow or other effluent discharges.

iii. Frequency/Duration
Time composite samples will consist of one samples taken every 15 minutes at the same location (at 0 min., 15 min., and 30 min.). These three samples will then be combined into one sample that will be taken to the lab for analysis.

Lagoons:
For tidally influenced lagoons, at a minimum, time composite samples shall be collected twice daily for two two-week periods corresponding to the two-week periods of hourly sensor data collection. One sample shall be collected during high tide, the other sample during low tide.

Tidally influenced lagoons include Santa Margarita Lagoon, Loma Alta Slough, Agua Hedionda Lagoon, San Elijo Lagoon, Los Penasquitos Lagoon, and Famosa Slough & Channel. The mouth opening can be maintained by dredging and still be considered a tidally influenced lagoon.

For non-tidally influenced lagoons, at a minimum, time composite samples shall be collected once daily for two two-week periods.

Tributaries:
For tributaries (and non-tidal lagoons), at a minimum, time composite samples shall be collected once daily for two two-week periods corresponding to the two-week periods of hourly sensor data collection.

Discussion: Coliform and *Enterococcus* bacteria are the indicator bacteria used to determine waterbody impairment for pathogens. Bacteria and flow rate data are needed to verify the impairment and to calculate bacteria concentration/load to the waterbody. TSS, turbidity, and flow rate data are needed to calculate sediment loading into sediment-impaired or nutrient impaired lagoons. TSS is the constituent used to measure the sediment load from the watershed (when multiplied by flow volume). TDS and flow rate measurements are needed to determine whether total dissolved solids exceed water quality objectives and loading into Agua Hedionda Creek.

The various forms of nitrogen and phosphorus, chlorophyll a, BOD_5, and flow rate data are needed to determine whether concentrations exceed numeric water quality objectives, to determine whether concentrations will promote algae and macrophyte growth leading to eutrophic conditions, and to determine loading of these nutrients to the impaired waterbody. The excessive growth can cause stressful conditions for other organisms living in the lagoon, such as low dissolved oxygen concentrations. Nutrient cycling from sediments can increase the amount of nutrients in the water column significantly when low dissolved oxygen concentrations occur. Only certain forms of nutrients are available for use by algae and plants, the other forms must be converted to a useable form. Organic forms of nutrients can take the longest time to convert to a useable form. Therefore, understanding what forms of nutrients occur, and their dynamics, in an estuary is important.

The tributary sampling location should be located above the tidal prism, but as near the tidal prism as practicable for efficient collection, to effectively determine the total mass load of each pollutant in question discharging from the entire watershed for each river/creek entering the impaired waterbody. Water below the tidal prism will be influenced by the tides and mixing with water from the ocean, which would not be representative of total load originating from the watershed.

The constituents will be measured in the lagoons to determine the total reservoir of pollutants in the waterbody and to develop a relationship between the total load in the estuary, the total loss from the tidal passes and the concentration in the water column (or sediment deposited).

The lagoons can be separated into segments, according to differences within each waterbody due to factors such as freshwater/saltwater conditions caused by presence/absence of tidal action, natural or man-made constrictions separating

portions of the waterbody, differing bathymetry or geology, etc. These differences can affect water quality among segments, so that a sample collected within one segment is not representative of a sample within another segment of the same waterbody.

These lagoon/slough/creek mouth systems that have some connection to the ocean are transitional systems. Many of these experience a daily high tide and low tide. Due to the tidal action, significantly different masses of water can occur in these waterbodies with a water mass that is closer to marine conditions during high tide, and a water mass that is closer to freshwater conditions during low tide. The characteristics of these water masses are influenced by tide stage and strength, condition of the tidal pass, and amount of freshwater inflow, among other factors.

Daily water quality monitoring will occur for a two-week period in the wet season and a two-week period in the dry season. It is necessary to document the differences that occur in the wet vs. dry seasons because of differences in water temperature or sunlight available affecting 1) metabolic rates of organisms, 2) plant growth and dormancy, and 3) decomposition. Tidally influenced lagoons will be sampled twice daily (once at high tide and once at low tide) to account for tidal influence. Non-tidal lagoons will be sampled once per day, since they are not affected by the tides.

A6. RAINFALL DATA REPRESENTATIVE OF THE WATERSHED

The Monitoring Program Workplans shall include precipitation monitoring and describe at a minimum the rainfall sampling device to be used, location of the gage, and frequency and duration of sampling as indicated below for the watersheds with impaired water quality limited segments. If an established and ongoing rainfall gage can be identified that is representative of the watershed, then the data from that gage may be used in place of a newly established gage specific to this project. If the rain monitoring equipment becomes inoperative, it must be repaired or replaced within 7 days. The San Diego Water Board must be notified within 24 hours of the failure of any of the rain monitoring equipment. If an established gage is used, the Workplan must specify who is responsible for maintaining and collecting data from this gage. The gage shall collect the following information:

i. Constituents

Rainfall measured in 1/100th inches per hour.

ii. Location

The rainfall gage shall be placed in a location that is representative of each watershed with an impaired waterbody.

iii. Frequency/Duration

The rainfall gage shall be operational to collect measurements continuously during every rainfall event, throughout the entire sampling program associated with this Order.

A7. LAGOON SEDIMENT SAMPLES

The Monitoring Program Workplans shall include at a minimum the constituents, sampling locations, and frequency and duration of sediment sampling as indicated below for the pollutants impairing a water quality limited segment. Site-specific changes to this sampling specification may be proposed to the San Diego Water Board along with the scientific rationale for the changes. Any proposed changes may not be implemented until incorporated into this Order by amendment.

i. Constituent
All lagoons impaired for nutrients/eutrophication and/or sedimentation/siltation:
Grain size distribution

ii. Location
A minimum of one sample site in each lagoon segment or portion of a segment shall be selected.

iii. Frequency/Duration
- *A minimum of one sample shall be collected using surficial sampling tubes during each two-week period of hourly sensor data collection.*
- *A minimum of one sample shall be collected within 72 hours after each storm event monitored for pollutagraph data described in Section 3.*

Discussion: The sediment grain size can be separated into many fractions, but a separation of sediments into simply sand, silt, and clay will indicate whether pollutants are likely to be associated with the sediment. Smaller grain sizes of sediment (silt and clay) can have pollutants (including nutrients) attached to them, whereas, sand usually has negligible amounts of pollutants associated with them.

Sediment containing pollutants are deposited in estuaries during storm events. This sediment can be suspended in the water column and measured as TSS. Knowing how much new sediment is being deposited during a storm event and how much is washed out of the estuary during high flows is important. Also, it is important to know if the storm event deposits sand, or silt/clay that may contain pollutants.

Suspended solids with nutrients adhering to them can provide a significant load of nutrients to a waterbody. A large reservoir of nutrients can be stored in the sediments of a waterbody and remain there until conditions allow them to enter the water column. These cycling processes occur for both nitrogen and phosphorus, although they occur through different mechanisms. It is important to understand these processes and measure the total loads or storage they may provide to a waterbody that may experience eutrophic conditions.

A8. SPECIAL STUDIES

The Monitoring Program Workplans shall include, at a minimum, the following one-time surveys of waters impaired for eutrophic conditions/nutrients:

- *Macrophyte and periphyton (estimation of biomass)*
- *Sediment oxygen demand*
- *Nutrient flux from sediments*

Discussion: These special studies are needed to provide data for determining lagoon-specific nutrient numeric targets to be used in nitrogen and phosphorus TMDL calculations, and to better understand the fate and transport of nutrients in the lagoon systems. The special studies will provide the lagoon-specific data and analysis needed to link nutrient loading to dissolved oxygen and algal biomass response endpoints.

The Southern California Coastal Water Research Project (SCCWRP) has submitted a grant proposal, *Creating Tools for Numeric Nutrient Criteria and TMDL Development in San Diego Coastal Lagoons*, to the State Water Resources Control Board for a Coastal Nonpoint Source Grant. Should SCCWRP receive funding from this grant, and conduct the special studies, the requirements of Directive A8 will be fulfilled.

A9. QUALITY ASSURANCE PROJECT PLAN AND IMPLEMENTATION OF MONITORING PROGRAM

*The Dischargers shall submit an adequate Quality Assurance Project Plan (QAPP) for field and laboratory operations by **September 1, 2007**, as described below. If, within 30 days after submittal of the QAPP, no comments have been received from the San Diego Water Board, the Dischargers shall begin implementing the QAPP Workplans.*

a. The QAPP for field operations shall include, at a minimum, the following:

- *Quality assurance objectives;*
- *Sample container preparation, labeling and storage;*

- *Chain-of-custody tracking;*
- *Field setup;*
- *Sampler equipment check and setup;*
- *Sample collection;*
- *Use of field blanks to assess field contamination;*
- *Use of field duplicate samples;*
- *Transportation to the laboratory;*
- *Training of field personnel; and*
- *Evaluation and enhancement if needed of the QA/QC plan.*

b. The QAPP for laboratory operations shall include, at a minimum, the following:

- *Quality assurance objectives;*
- *Organization of laboratory personnel, their education, experience, and duties;*
- *Sample procedures;*
- *Sample custody;*
- *Calibration procedures and frequency;*
- *Analytical procedures;*
- *Data reduction, validation, and reporting;*
- *Internal quality control procedures;*
- *Performance and system audits;*
- *Preventive maintenance;*
- *Assessment of accuracy and precision;*
- *Correction actions; and a*
- *Quality assurance report.*

Furthermore, the QAPP plan shall meet the standards as set forth in the Quality Assurance Project Plan for the State of California's Surface Water Ambient Monitoring Program (SWAMP). The SWAMP QAPP can be found on the World Wide Web at: http://www.swrcb.ca.gov/swamp/index.html.

Discussion: A SWAMP compatible QAPP is needed to ensure the reliability and comparability of all data collected and reported pursuant to this Order. Preparing and adhering to a SWAMP compatible QAPP will also increase the long-term utility of the data for future studies and analysis.

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Appendix A: DATA COLLECTION SCHEDULE

A2. In Situ data

Lagoons tidally influenced and/or impaired for nutrients/eutrophication – two two-week periods one in wet season, one in dry season. This includes all estuaries in this Order.

A3. Watershed Model – Pollutagraphs – wet season storm events
watershed – two storm events in wet season
estuaries – same two storm events in wet season as in watershed

A4. Watershed Model – dry weather

Water quality samples collected one time during each two-week period of hourly sensor data collection. Samples will be collected at all storm drains. Sensor data will be collected at the grab sample sites where water is deep enough for the probes.

A5. Lagoon & Tributary Water Quality collected during each two-week period when continuous sensor data is collected.

- Lagoons tidally influenced – twice daily time composite samples for each two-week period (one high tide, one low tide)
- Lagoons non-tidal – once daily for the two two-week periods.
- Tributaries – once daily for the two two-week periods.

A6. Rainfall Data collected at one gage in each watershed with an impaired waterbody. Measurements shall be taken at $1/100^{th}$ of an inch in hourly increments.

A7. Lagoon Sediments

One sample collected during each two-week period of sensor data collection.

One sample collected within 72-hours each storm event monitored for pollutagraph data.

Appendix B: Definitions

Lagoon – A shallow basin that is semi-isolated from coastal oceanic water by barrier beaches (Ecology of Estuaries, 1986). For this Monitoring Order the term "lagoon" is used to refer to waterbodies with the names lagoons, sloughs, and creek mouths.

Segment – The waterbody segment refers to the area that was determined to be impaired according to the data that was collected at sampling stations. These segments are determined according to the physiography (depth, width to the waterbody as well as the magnitude of exceedence of water quality objectives at specific sites. This determination is coupled with the known hydrodynamics of the waterbody to estimate the extent of exceedences beyond the sampling locations. The segment represents the known extent of impairment. The segment designation provides guidance for establishing the TMDL process for each waterbody.

Tidal prism – The tidal prism is found in the area within an estuary where variation of salinity occurs due to the mixture of seawater with freshwater. The tidal prism extends to the uppermost region of an estuary where there is tidal influence, which can cause salinities to exceed 0.5 ppt at least occasionally.