SECTION C-3

PLAN DEVELOPMENT

PROGRAM EFFECTIVENESS ASSESSMENT
2006-07

C-3.0 Plan Development

C-3.1 Introduction (LIP Section A-3.1)

This Section provides information on the approach taken by the County in developing its Local Implementation Plan (LIP). This section also discusses a number of studies that the County is participating in that will assist in future revision and improvement of the overall stormwater compliance program.

C-3.2 Plan Development (LIP Section A-3.2)

The complexity of the Third Term Permits has necessitated the development of the LIP in order to provide a County-specific plan within the broader policy and program framework of the 2003 DAMP. The LIP focuses predominantly on the jurisdictional implementation of the model pollution prevention-oriented programs detailed in the 2003 DAMP. The County LIP is a dynamic document that is evaluated on a continuing basis by the County and an annual basis or as directed by the Regional Board.

As implementation of pollution prevention programs has taken place and evolved, so too has the LIP. The County's stormwater program management has worked closely with all departments to ensure that the goals of the program are met in concert with the County's overall mission of providing and maintaining valuable resources and services to its residents. As County departments have used stormwater inspection forms, implemented model maintenance procedures and BMPs, completed environmental performance reports, etc., they have provided important feedback which has allowed program management to adjust the plan to refine parts of the program that may not be working optimally while continuing forward with elements that are effective.

C-3.3 BMP Effectiveness Investigations (LIP Section A-3.3)

An important element of the County's LIP is the implementation of additional/enhanced BMPs and/or the refinement of BMPs within the DAMP programs. The tables that follow list the BMP projects and BMP investigations implemented since the issuance of the Third Term Permits.

Summary of County BMP Projects and Investigations

	Initiated in Reporting Period	Completed in Reporting Period	Projected completion in Reporting Period	Watershed
Structural BMPs				
Ocean Institute BMP	2001-02	2002-03	*Completed*	Dana Point Coastal Streams
J01P28 Clear Creek System	2001-02	2003-04	*Completed*	Aliso Creek
J01P01 Munger Media Filter	2001-02	2006-07	*Completed*	Aliso Creek
Channel Diversion Facilities	2002-03	2002-03	*Completed*	Santa Ana River
Poche Beach UV Disinfection	2002-03	2003-04	*Completed*	San Clemente Coastal Streams
Warner Channel – Wetland Vegetated Channel	2003-04	2005-06	*Completed*	Newport Bay
Selenium Removal Quick Start BMP	2004-05	2004-05	*Completed*	Newport Bay
Baby Beach Storm Drain to Sanitary Sewer Diversion and First Flush Filtration System	2004-05	2005-06	*Completed*	Dana Point Coastal Streams
Bird Exclusion Fencing Baby Beach Public Pier	2004-05	2005-06	*Completed*	Dana Point Coastal Streams
Sediment removal from San Diego Creek Sediment Basin #2	2004-05	2005-06	*Completed*	Newport Bay
Narco Channel Restoration	2005-06	*N/A*	2006-07	Aliso Creek
Litter Control BMPs	See discussion of Drainage Facilities and Infrastructure Maintenance in **Section C-5.A.3**			
Non-Structural BMPs				
Countywide Area Spill Control (CASC) Program	2001-02	*N/A*	Ongoing Project	Multiple Watersheds
Beach Sweeping at Baby Beach – Bird Feces Control	2006-07	*N/A*	2007-08	Dana Point Coastal Streams

Summary of BMP Effectiveness Investigations

Project	Type of BMP	Manufacturer (if applicable)	Type of Analysis	Report Completed
J01P28 Clear Creek System	Media filter; UV disinfection	Clear Creek	Bacterial Monitoring	Yes ☒ No ☐
Ocean Institute BMP	Infiltrative swale; In-line separator	Stormceptor®	Runoff Monitoring	Yes ☒ No ☐
Poche Beach UV Disinfection	Sediment basin; UV disinfection	Suntec Environmental	Bacterial Monitoring	Yes ☒ No ☐
Warner Channel – Wetland Vegetated Channel	Wetland Vegetated Channel	N/A	Nutrients, Selenium, and Flow Monitoring	Yes ☒ No ☐
J01P01 Munger Media Filter	Media Filter	N/A	Bacteria, Solids, Nutrients, Metals Monitoring	Yes ☒ No ☐
Selenium Removal BMP	Multiple (Physical, chemical, biological)	N/A	Selenium Monitoring	Yes ☒ No ☐

BMP Project Updates in the Santa Ana Region:

Newport Bay Watershed

Nitrogen and Selenium Management Program (NSMP)

Selenium and Nitrogen BMP Evaluation

In December 2004, the Santa Ana Regional Water Quality Control Board issued a General NPDES Permit regulating certain groundwater-related discharges in the Newport Bay watershed. To comply with the terms of the permit, a Working Group of 21 public agencies and private entities is funding and implementing a work plan over the next five years to evaluate BMPs and treatment technologies for selenium and nitrogen.

One of the work plan tasks is to evaluate BMPs for removal of selenium and nitrogen from surface water and groundwater discharges in the Newport Bay watershed. The focus of this task is to develop and apply a treatment technology, or series of technologies, in targeted areas in the watershed in order to maintain beneficial uses. The technologies that currently exist are primarily geared towards agricultural and mining practices. However, the Newport Bay

watershed is a highly dense, urbanized environment, rendering many of those technologies infeasible for application. During 2005-06, a survey of existing and developing technologies was compiled and an initial assessment of applicability to the Newport Bay watershed was conducted. The summary list of existing technologies was further evaluated and five BMPs were selected for further testing in the watershed. Those technologies were:

- Reverse Osmosis (RO) (physical treatment)
- Katchall Filtration Systems Heavy Metals Removal (HMR) Media (physical treatment)
- Anaerobic Bacterial Removal (biological treatment)
- Constructed Wetlands (biological treatment)
- Ferrous Hydroxide (chemical treatment)

The field scale pilot testing of these technologies and the final report was completed during the 2006-07 reporting period. The summary report of selenium and nitrogen removal BMPs can be found at www.ocnsmp.com. During the 2006-07 reporting period the information gained will be used to develop a BMP implementation plan.

Multiple Watersheds (Anaheim Bay/Huntington Harbor, Newport Bay & Santa Ana River)

Countywide Area Spill Control (CASC) Program

Orange County, California has over 33,000 acres of parkland and open space and over 100 miles of coastal and bay beaches. Many of these recreational areas are highly valued due to their scenic attractiveness and direct ties or proximity to a water resource (creek, bay, harbor or beach). Although these recreational areas are vital to Orange County, many of the inland, coastal waters, and/or bays and harbors are listed on the 2006 303(d) list due to elevated concentrations of pathogens, fecal coliform, total coliform, and/or enterococcus.

The northern and central Orange County 303(d) listed water bodies include:

- Seal Beach (Coastal Shorelines/Beaches, .53 miles)
- Huntington Beach State Park (Coastal Shorelines/Beaches, 5.8 miles)
- Huntington Harbor (Bay, 221 acres)
- San Diego Creek (Reach 1, 7.8 miles)
- Buck Gully Creek (.3 miles)
- Los Trancos Creek (.19 miles); and,
- Silverado Creek (11 miles)

Upper Newport Bay, and Lower Newport Bay are also included on the 2006 303(d) List of Water Quality Limited Segments Being Addressed by USEPA Approved Total Maximum Daily Loads (TMDLs).

Although Orange County has experienced ocean and bay closures as well as postings and advisories due to elevated bacteria concentrations, almost all of the closures have been attributed to sanitary sewer overflows (SSOs or overflows) that reached, or threatened to reach, ocean waters. The primary wastewater and stormwater agencies in northern and central Orange County are the Orange County Sanitation District (OCSD) and the County of Orange (County), respectively. Both OCSD and the County are regulated under National Pollutant Discharge Elimination System (NPDES) permits and are required to develop and implement management programs that, among other things, effectively prohibit the discharge of pollutants to surface waters, including the discharges of raw or untreated sewage.

Even though OCSD and the County had similar goals and objectives and were both regulated under NPDES permits, multi-agency coordination to address sewage spills was generally reactive instead of proactive. However, with growing concerns over bacteriological contamination and increasing regulatory and public pressure to improve water quality, OCSD and the County began to meet to discuss how they might cooperatively minimize and/or prevent the impacts caused by SSOs. The agencies initiated a pilot project in late 2000 titled "Tustin Area Spill Control Demonstration Project (TASC)". The project progressed for several years and the initial project report, which documented the achievements, was prepared in November 2003 and entitled "*Tustin Area Spill Control (TASC) Demonstration Project – Initial Case Study Report*".

Progress reports for the TASC project have been prepared annually and provided to the Santa Ana and San Diego Regional Water Quality Control Boards (Regional Water Boards) as an Appendix to the Annual Stormwater Program Effectiveness Assessment. Annual Progress Reports submitted to date include:

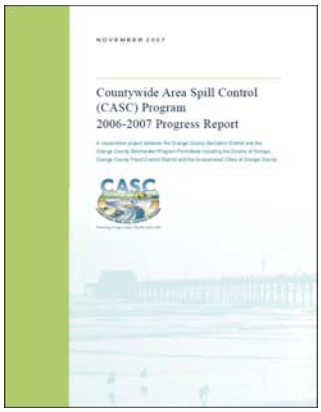
- "*Tustin Area Spill Control (TASC) Demonstration Project – 2003-2004 Progress Report*";
- "*Tustin Area Spill Control (TASC) Demonstration Project – 2004-2005 Progress Report*"; and
- "*Tustin Area Spill Control (TASC) Demonstration Project – 2005-2006 Progress Report*"

In 2007 the project evolved in several ways and was, therefore, renamed the "*Countywide Area Spill Control (CASC)*" Program. The renaming was done to reflect the fact that 1) the project evolved from a demonstration project to a permanent program; and 2) the program will be expanded throughout the county area over the next few years. The overall objectives of the CASC program are to:

- Create broader awareness regarding the causes of SSOs and measures that can be implemented in order to prevent them;
- Improve the interagency coordination when responding to SSOs;
- Identify the resources needed when responding and mitigating impacts;
- Develop predictive tools for identifying potential impacts;
- Protect the beneficial uses of the local water bodies; and
- Expand the program throughout the entire county area over the next few years.

The CASC Program is comprised of: program and coordination, planning and implementation elements. During this reporting period, the following tasks were completed for the CASC Program elements:

- Conducted the second field-based exercise with both contractors;
- Transitioned the TASC project into the CASC Program;
- Development of program expansion guidelines;
- Expansion of the CASC Program area outside of North Tustin area;
- Completed a draft MOU between OCSD, County and participating Cities;
- Developed Countywide Area Spill Control Program Logo and Tagline;
- Developed Expansion Criteria Guidance Document;
- Conducted Public Education and Outreach Activities;
- Initiated implementation of CASC Program Expansion for the cities of Orange and Villa Park; and,
- Prepared objectives and task list for 2007-2008



The CASC 2006-07 Progress Report has been prepared to summarize the work that has been completed and identifies activities that may be undertaken during the upcoming reporting period. This report is being submitted as an attachment to the 2006-07 Unified Report, and will be included in **Appendix E** of the DAMP.

Channel Diversion Facilities

The County has constructed and now operates diversion facilities at Huntington Beach pump station, Talbert Channel, Greenville Banning Channel, and the Lower Santa Ana River. Sampling and analysis of diverted runoff for pesticides and heavy metals was conducted on a semiannual basis at all facilities and results submitted to Orange County Sanitation District (OCSD) as a condition of the County's sanitary discharge permit. Diverted runoff was in compliance with OCSD maximum allowable concentrations for the reporting period, such that it would not disrupt the biological treatment process or materially affect OCSD's own outfall discharge permit. During the 2006-07 reporting period over 342 million gallons were diverted and treated by these four projects, a 5 percent increase over the prior period.

BMP Project Updates in the San Diego Region:

Aliso Creek Watershed

J01P28 Clear Creek Treatment System

The management measure employed in this project is to apply a proprietary package system to treat Pipe J01P28 low-flow prior to its discharge to Aliso Creek. The Clear Creek Treatment System at J01P28 treats urban runoff by filtering then exposing the water to ultraviolet radiation, and then returning the treated water to Aliso Creek. The system is designed to remove suspended solids, bacteria, and associated pollutants at a maximum rate of 300,000 gallons/day. Construction for the project was completed in June 2003. Operation of the system began in July 2003. The total cost of the project was approximately $500,000.

The Clear Creek System operated from April 2004 through September 2004, and then was shut down in October 2004 until the end of the storm season. Operation recommenced in June 2005 due to the extended storm season; however, operation was suspended in August 2005 due to excessive backwash frequency and premature clogging of the filter media. In February 2006 a heavy equipment pad was constructed adjacent to the facility to improve maintenance access, and in March accumulated sediment was removed from the energy dissipation basin which serves as the intake reservoir for the treatment system.

The County is presently preparing plans for structural modifications to the dissipation basin that would provide pre-treatment of runoff before entry to the Clear Creek system, which would be expected to improve the operational efficiency and life of the treatment facility. However, in the interim, the County replaced filtration media in the filter columns in August 2007 and has resumed operation of the treatment facility in September 2007.

Bacteriological monitoring at the influent and effluent of the system had shown a 99.8% reduction in fecal coliform levels from July – September 2004. The fecal coliform levels a distance downstream of the Clear Creek System were also measured and were found to be significantly higher than the effluent immediately after treatment. Since there are no inputs to the channel between the treatment plant and its confluence with Aliso Creek, this indicates that bacterial indicator regrowth may be occurring, reducing the effectiveness of the treatment system on bacterial levels in Aliso Creek.

Since Clear Creek system operation was suspended in August 2005, bacteria counts have been correspondingly high in the outflow from the J01P28 discharge to Aliso Creek. Specific water quality information is presented in the County's quarterly reports for the Aliso Creek 13225 Directive, which are available on the County's website at www.ocwatersheds.com.

J01P01 Munger Storm Drain Sand/Media Filter

This sand filter is intended to treat dry season runoff from the Munger Storm Drain (J01P01) prior to its discharge to Aliso Creek. The system is comprised of a pre-sedimentation vault, pump station/wet well and sand filter vault, with gravity discharge to the creek. The system is expected to provide meaningful removal of suspended solids, bacteria, and other pollutants.

The project was designed in 2003, and then redesigned in 2004 in order to relocate the filter vault out of the stream course onto the top of the streambank. System construction was completed in December 2005 with funds from a State Water Resources Control Board Proposition 13 grant. However, the system was unable to accommodate design flow rates, so system operation was suspended while recommendations were developed to modify the

system. Recommendations included the conversion of pump operation from cycled to continuous operation, and valve metering of inflow to the filter. The modifications will allow the system to safely and effectively treat inflow, albeit at a lower flow rate.

The modifications were implemented in the summer of 2006, and the system was finally started up in September 2006. The filter underwent a four month water quality performance evaluation period from October 2006 – January 2007. The filter provided 90% removal of all three fecal indicator bacteria, favorable (75 – 86%) removal of suspended solids and turbidity, and modest removals of particulate nutrients and metals. Results affirmed the effectiveness of the sand filter treatment technology for application to dry weather urban runoff flows. However, the relatively small volume of urban runoff treated by the BMP resulted in little or no meaningful improvement in Aliso Creek quality. The County is presently deliberating on the future disposition of the system.

The total cost of the project is estimated at $1,000,000. Updates to the project can be found in the County's quarterly reports for the Aliso Creek 13225 Directive, which are available on the County's website at www.ocwatersheds.com.

Narco Channel Restoration in Laguna Niguel Regional Park

Narco Channel was a 40-foot wide by 20-foot deep earthen channel which was completely devoid of vegetation due to its vertical earthen slopes and stagnant water in its invert. In 2007, the channel was widened about 50 feet into Laguna Niguel Regional Park and the channel slope was laid back. The project is complete with the exception of the planting of native vegetation. The planting of the native vegetation was placed on hold during the hot summer months. The planting is being scheduled to commence in October 2007 and be complete by mid November 2007. The purpose of the project is to promote nutrient uptake with the new native vegetation and associated bacteria reduction. The city of Laguna Niguel received a $1.4 million grant from the State Water Resources Control Board for the project and the County entered into an agreement with the City of Laguna Niguel. Bid opening for the project occurred on August 23, 2006. The construction is anticipated to be completed in November 2007 and the contracted plant establishment period will end by March 31, 2008.

Dana Point Coastal Streams Watershed

Ocean Institute Stormwater Treatment System

The County received a State Clean Beach Initiative grant to construct and evaluate the performance of stormwater treatment features at the Ocean Institute in Dana Point Harbor (Part of the Dana Point Coastal Streams Watershed) as an element of facility redevelopment. Stormwater treatment features consist of two parking area infiltrative swales with underdrains leading to a Stormceptor® suspended solids separator. Site reconstruction was completed in the fall of 2002, whereupon the County initiated a two year performance evaluation of the system. While three storm events were monitored in 2002-03, problems with automated sampling equipment resulted in limited data generation. Adjustments were made in sampling equipment

configuration over the dry season, and three additional storm events were successfully captured in the 2003-04 wet season.

The final report was submitted in March 2006 to the CBI grant officer. Findings suggested that relatively minor pollutant removals were achieved by the system. The limited performance was attributable in large part to the backwater influence of tidal fluctuations on the Stormceptor unit, and the apparent poor performance of the infiltrative swales. Design modifications were recommended to potentially improve performance.

Baby Beach BMPs

Urban Runoff to Sanitary Sewer Diversion

The County received a Proposition 40 Phase II Clean Beaches Initiative grant from the State Water Resources Control Board to construct a storm drain to sanitary sewer diversion project just upstream of where the storm drain enters Dana Point Harbor at Baby Beach. The 24-inch diameter concrete storm drain contains urban runoff from three restaurants, eight residential homes, two large strip malls, one hotel, and several city streets with adjacent landscaping. The sanitary diversion facility was installed in June 2005. The diversion is operational during the summer and turned off during the winter.

First Flush Filtration

A storm water first flush filtration system was installed in the Baby Beach public parking lot near the pier. The storm water filtration system consists of two 11-foot by 26-foot concrete vaults containing 154 filter media cartridges manufactured by Contech, Inc. (formerly Stormwater 360). A 6-foot by 12-foot vault containing storm screens manufactured by Contech, Inc. was installed upstream of the stormwater filters.

Bird Exclusion Fencing

The County received a Proposition 40 Phase II Clean Beaches Initiative grant from the State Water Resources Control Board to place anti-bird netting under the Baby Beach public pier. The existing bird netting had disintegrated and pigeons had begun to roost under the pier. The bird exclusion fencing consisted of vinyl coated chain link fencing. The work was completed in September of 2005 for $47,500.

Stormdrain Flap Gate

The 24 inch stormdrain pipe outfall in the harbor sea wall approximately 20 feet north of the Baby Beach pier is typically submerged at medium to high tide. In order to prevent intrusion of seawater into this stormdrain pipe and thus potential growth of bacteria, a stainless steel flap gate was installed near the sea wall. Installation was completed in November of 2005.

Beach Sweeping

In January 2007 the County initiated a beach sweeping demonstration program at Baby Beach. Beach sweeping removes shorebird feces from the exposed intertidal area of the beach before

they are re-suspended into the surf zone by the incoming tide. Preliminary indications are that the beach sweeping practice may be contributing to what have been very low bacteria counts and correspondingly few water quality advisory postings for the beach during the year to date. The demonstration program will extend through the 2007 calendar year, whereupon a water quality comparative evaluation of the practice will be performed.

San Clemente Coastal Streams Watershed

Poche Beach Ultraviolet Bacteria Disinfection System

In 2001, The County received a Proposition 13 Clean Beaches Initiative grant from the State Water Resources Control Board to construct an ultraviolet bacteria disinfection system at the Prima Deshecha storm channel that outlets at Poche Beach in the San Clemente Coastal Streams Watershed. Poche Beach is chronically posted for exceeding AB 411 limits for bacteria in the surf zone.

The Poche Beach disinfection system was designed as a gravity-flow-through type of ultraviolet disinfection system that was placed inside the Prima Deshecha storm channel. The urban runoff flowed through the disinfection system, killing bacteria before the urban runoff reached the beach. The system was operated during the summer season, with the system being installed in the channel in the spring and removed for the winter.

The system was designed and fabricated during the 2002-03 reporting period, and installed in the channel in October 2003 for a brief functional evaluation before being withdrawn in early November 2003. The system was installed again for the entire summer of 2004. The system removed approximately 70 percent of the bacteria. However, the system experienced major operational issues and never operated at full capacity for more than a few days.

The County has since received a second CBI grant for the Poche UV bacteria disinfection project. This project will move the treatment system to railroad right of way adjacent to the channel and pump the water through the treatment system before releasing it into the surf zone. Plans have been completed and regulatory permits have been applied for. The plans include complete media filtration. The pre-construction meeting was held on August 7, 2007. Construction should commence by September 15, 2007. The city of San Clemente and the County share O&M costs. The South Coast Water District has offered to operate and maintain the system via an Agreement with the County due to the proximity of their O&M personnel to the project site.

As a separate action, the County hired MEC Analytical/Weston Solutions to perform a source tracking investigation within the watershed to determine the sources of the bacteria. Bacteria concentrations were measured at each of the side drains entering the main channel. The findings of this study were unexpected. Bacteria concentrations start very high at the first side inlet and reduce slightly as the flow moves downstream. One side inlet into the main channel, just downstream of the landfill near the top of the watershed, was found to contribute 90 percent of the bacteria load in the watershed. Groundwater samples at the landfill were non-detect for indicator bacteria. The apparent source of the problem, according to the study is over-irrigation in the reach between the Prima Deshecha Landfill and the Shorecliffs Golf Course. A

significant number of DNA analyses were performed on the bacteria and none contained any human tracers. The final report from this study has been submitted.

C-3.4 Improvements in Stormwater Science (LIP Section A-3.4)

The County as Principal Permittee continues to conduct and sponsor investigations and special studies that will better characterize the sources of pollutants in urban and stormwater runoff, and the impacts these pollutants exert on beneficial uses in receiving waters. During the reporting period the County participated in the following studies:

Urban Nutrient Runoff Characterization

The County received a State Proposition 13 grant to characterize nutrient loading from dry weather urban runoff in order to help meet Total Maximum Daily Load (TMDL) nutrient requirements for Upper Newport Bay. The characterization was intended to determine the nature and magnitude of nutrient (nitrogen and phosphorus) loading from four representative urban commercial and residential areas within the watershed. The characterization included 24-hour composite sampling and flow monitoring of the entire drainage stream from a study area, as well as "curbside" sampling of specific urban runoff generation activities. Findings are expected to provide a better understanding of the extent to which urban activities contribute to nutrient loading to the Bay, and identify those urban activities which should be targeted for control efforts for the most effective load reductions.

Project flow and water quality field monitoring was performed during the summer and fall of 2004. The final source characterization report was completed in April 2006. Findings included the development of specific annual urban nutrient loading rates for the Newport Bay watershed. Measured loadings were substantially lower than the literature-based loadings used in the development of the Newport Bay Nutrient TMDL baseline allocation for urban areas. In one study area it was conclusively demonstrated that shallow groundwater infiltration into the storm drain system contributed 27% of dry weather pipe discharge and a disproportionately high 84% of the nitrate nitrogen load of what was ostensibly urban runoff from the area.

Curbside samples were evaluated by watershed activity category. Irrigation overspray and resultant lawn drainage was the most frequent runoff-generating activity observed, constituting over 70% of curbside events encountered. Furthermore, it represented the highest collective amount of runoff volume (49%). Car washing and hose wash down activities appeared to be in a second tier in both frequency and runoff volume. From a water quality perspective, there was no single category which was identified as requiring priority management attention; instead, field investigations indicated a small number of egregious, inadvertent, or irresponsible incidents within each activity category.

The project generated annual dry weather unit area loading rates for runoff, nitrogen and phosphorus which are representative of semi-arid urban areas. The information was made available to the wider professional community through paper presentation and publication at the WEF 2007 TMDL Conference.

Regional Bight '03 Characterization

Bight '03 is a collaborative effort of more than 50 organizations to conduct a regional survey to assess the environmental health of coastal waters in the Southern California Bight (the coastal area from Point Conception to the Mexican border). This survey is the third regional survey of its kind, preceded by a Pilot Project in 1994 and Bight '98. Bight '03 consists of three planning committees (Microbiology, Coastal Ecology, and Water Quality), each of which are developing unique study designs. A Steering Committee oversees the efforts of the three planning committees, ensuring that synergy occurs throughout the entire Bight '03 study. A major focus of Bight '03 activities will be the characterization of the extent to which storm flows from major river systems along the Bight influence the quality of adjacent coastal waters.

As Principal Permittee, the County has taken an active role in the development of each of the three planning committee study designs, and serves on the Steering Committee. The County on behalf of the Orange County Stormwater Program has also made a monetary contribution of $25,000 to Bight '03. In addition, The County is co-sponsoring researchers from the University of California Irvine in a stormwater characterization study of the Santa Ana River watershed that will complement efforts by the Water Quality Committee to define stormwater plumes through remote sensing satellite imagery and efforts by the Microbiology Committee to assess the influence of stormwater flows on the shoreline and surfzone. One peer reviewed journal article was published on the joint efforts of the UCI research team and the Bight '03 Water Quality Committee:

Ahn, JH, Grant, SB, Surbeck, CQ, DiGiacomo, PM, Nezlin, NP, Jiang, S (2005). "Coastal water quality impact of stormwater runoff from an urban watershed in southern California." Environmental Science and Technology, 39:5940-5953.

During the 2006-07 reporting period, Bight '03 activities have continued to consist primarily of data evaluation and draft reporting efforts. The planning committees have met periodically to review data sets and to outline and begin drafting report chapters. Draft and potentially final reports were completed and planning for Bight '08 will commence in the 2007-08 reporting period.

Regional Research Monitoring Program (Stormwater Monitoring Coalition)

The County continues to participate in a leadership role in this collaborative effort by southern California Phase I municipal stormwater NPDES Principal permittees, NPDES regulatory agencies and SCCWRP. The goal of this working group is to identify region-specific research needs to better understand stormwater mechanisms and impacts, and to collectively sponsor the development of assessment techniques and methodologies that will enable more informed and consistent stormwater management decision-making across the region. The Stormwater Monitoring Coalition (SMC) relationship was formalized in an agreement signed in 2000. The SMC has been so successful that member agencies have renewed their letter of agreement and four new member agencies have signed on. The member agencies are:

- California Regional Water Quality Control Board, Los Angeles Region
- California Regional Water Quality Control Board, San Diego Region
- California Regional Water Quality Control Board, Santa Ana Region
- City of Long Beach
- County of Orange, RDMD
- County of San Diego Stormwater Management Program
- Los Angeles County Department of Public Works (LACDPW)
- Riverside County Flood Control and Water Conservation District
- San Bernardino County Flood Control District
- Ventura County Watershed Protection District
- Southern California Coastal Water Research Project (SCCWRP)
- Caltrans
- City of Los Angeles
- State Water Resources Control Board
- US Environmental Protection Agency

The multi-agency collaboration has demonstrated its effectiveness in working together to identify common needs and to efficiently use public funds in coordinating regional stormwater research efforts. In its first year of formation (2001-02), the SMC assembled a panel of nationally recognized experts in relevant technical discipline areas to assist them in the development of a five-year priority research agenda which would serve as the basis for activities by the SMC in the foreseeable future. The report is entitled "Stormwater Research Needs in Southern California", and can be found online at ftp://ftp.sccwrp.org/pub/download/PDFs/358_stormwater_workplan.pdf

The SMC has initiated nine of the 15 research projects identified in the research agenda. A summary of project accomplishments during the 2006-07 reporting period are as follows:

Building a Regionally Consistent and Integrated Freshwater Stream Bioassessment Monitoring Program
Status: 95% complete

Assessment of freshwater biological communities represents a potentially powerful tool for evaluating the effects of discharges in southern California creeks and streams. Bioassessments integrate the effects of multiple stressors, including chemical pollutants and physical alterations in receiving waters. The value of biological assessments is that they are closer to many of the defined beneficial uses of receiving waters (i.e. aquatic life, warm water habitat, cold water habitat) than chemically-derived water quality objectives.

The goal of this study is to build a regionally consistent bioassessment monitoring program. This project will be completed in three phases including: 1) building a monitoring infrastructure; 2) calibrating and validating a regional assessment tool; and 3) designing an integrated, coordinated regional monitoring program. The first phase focuses on creating a monitoring infrastructure so that multiple agencies are properly trained, data are collected in comparable manners, and data can be efficiently shared. The second phase focuses on developing an assessment tool that is robust enough to be used by all agencies across the region. This will enable a consistent approach for evaluating the status of freshwater biological communities and provide the answers regarding community impacts to managers in meaningful and understandable terms. The third phase focuses on creating a study design that most efficiently answers specific questions of interest at large regional scales. Addressing some questions at regional scales can provide cost efficiency for addressing reference condition, cumulative impacts, and when nested within a local sampling design, provides unparalleled information for providing context to local monitoring data.

Our main collaborator on this project is the California Department of Fish and Game (CDF&G). The project is 50% funded by the SWRCB, whose main desire is to ensure integration with the Surface Water Ambient Monitoring Program (SWAMP). This will provide further value to SMC member agencies. To help accomplish this project, an SMC Technical Subcommittee has been formed.

All three phases have been implemented by the SMC. The first goal towards monitoring infrastructure is complete. SMC member agencies have used training, workshops, field audits, enhanced laboratory quality assurance activities, and written or collated information management and field protocol documents. Of particular note, SMC member agencies have helped to create an important network of laboratory taxonomists called the Southwestern Association of Freshwater Invertebrate Taxonomists that will be important in standardizing and ensuring the quality of laboratory identifications. The second task to evaluate an assessment tool is nearing completion. The southern California index of biological integrity (SC IBI) was being tested in 15 low gradient streams of varying levels of impact. It was clear from this study that the IBI is not the best assessment tool for describing impact in these habitats. The low gradient project was so successful that the Working Group helped SCCWRP and CDFG to prepare a State Consolidated Grant proposal to test the SC IBI in another important habitat; non-perennial streams. Finally, the Working Group has designed an integrated, collaborative Regional Watershed Monitoring program. The goal of the Regional Watershed Monitoring program is to increase the effectiveness of existing NPDES monitoring programs by integrating among permittees and SWAMP to achieve a large-scale assessment of watershed condition. The cost of implementing this program would be negligible because the Working Group identified significant redundancies and inefficiencies in existing monitoring programs that could be reprogrammed towards a regional design. Finally, the Working Group has found additional partners to help contribute to the regional monitoring program including the Wetland Recovery Project (WRP), other RWQCBs, and other NPDES permittees.

This project is in its final phases. The written workplan should be completed within the next quarter and a regional watershed monitoring program could be implemented as soon as 2008.

Laboratory Intercalibration Study
Status: 35% complete

One goal of the southern California Stormwater Monitoring Coalition (SMC) is to compile monitoring data from separate monitoring programs to make regionwide assessments. The SMC has begun integrating their monitoring programs by agreeing on goals, objectives, and study designs as part of their development of a southern California Model Monitoring Program ftp://ftp.sccwrp.org/pub/download/PDFs/419_smc_mm.pdf . As part of the model monitoring program, 11 analytical laboratories that perform chemical analysis of runoff samples for SMC member agencies conducted an intercalibration study to assess interlaboratory variability and enhance comparability.

The laboratory intercalibration study quantified the range of variability both within and among laboratories that SMC member agencies can expect when examining their own data, or combining data with other agencies. It was successful because the laboratories worked together to minimize interlaboratory variability through the use of performance-based limits for accuracy, precision, and sensitivity. The intercalibration study also defined a series of protocols for specific analytical techniques where performance-based guidelines needed to be enhanced with methodological consistency to ensure comparability. Finally, the intercalibration and resulting guidelines/protocols were documented in a Laboratory Guidance Manual for SMC member agency laboratories
<ftp://ftp.sccwrp.org/pub/download/PDFs/420_smc_chem.pdf>.

The laboratory Guidance Manual and intercalibration effort, however, was incomplete in three areas. The first area was the need to repeat the intercalibration periodically as new laboratories, or new personnel at existing laboratories, come along. The second area was the need to intercalibrate on additional constituents. The original laboratory calibration focused on suspended solids (TSS), nutrients, and trace metals. Organic constituents such as chlorinated hydrocarbons (CHC), organophosphorus pesticides (OP), and polycyclic aromatic hydrocarbons (PAH) were not included. Third, the integration of the laboratory performance-based guidelines were insufficiently integrated into monitoring programs. While the Laboratory Manual could be used as citation for monitoring agencies or regulatory compliance, no specific permitting or contractual language was provided for SMC member agencies.

The goal of this project is to complete the three areas of missing information to make the Laboratory Guidance Manual an ongoing and effective document. It will involve three steps: 1) repeat the laboratory intercalibration for TSS, nutrients, and trace metals; 2) initiate an intercalibration for organic constituents and toxicity; and 3) create draft contract language for integration into stormwater monitoring programs. A technical Working Group consisting mostly of laboratory managers has been formed to assist in the study.

The SMC has successfully finished the first task of the study. The intercalibration of TSS, nutrients, and trace metals was based on customized certified reference materials just for our project and runoff samples from different land use types. Gratifyingly, most of the laboratories that participated previously successfully completed the second iteration. An objective

laboratory scoring system, which consists of letter scores for each analyte, has been developed and is being used for the contract language in task 3.

Pending formal agreement signatures, the working group is prepared to implement the toxicity testing element of the intercalibration.

Bacterial Reference Watershed Study
Status: 90% complete

High fecal indicator bacteria levels are one of the most common surface water impairments in southern California. Frequent exceedences of bacterial water quality standards have resulted in development of Total Maximum Daily Loads (TMDL) as a regulatory mechanism to address bacterial contamination in several southern California watersheds.

Current water quality standards for freshwater use fecal coliforms or E. coli as an indicator of fecal contamination because their presence is well correlated with the many waterborne disease-causing organisms or pathogens. However, fecal coliforms and E. coli are naturally present in the intestines of warm-blooded. Consequently, fecal contamination of surface waters can result from numerous sources of fecal pollution, including human sewage, manure from livestock operations, indigenous wildlife and urban runoff. In undeveloped areas wildlife, such as small and large mammals and birds, have the potential to be a significant source of fecal bacteria to surface waters.

In recognition of the potential for natural sources to affect bacteria levels in surface waters, several TMDLs either allow or require development of numeric targets that account for natural bacteria levels. For example, the Malibu Creek Bacteria TMDL requires responsible jurisdictions to monitor unimpaired streams in the local watershed during dry weather, dry winter weather, and wet weather for at least one full year in order to develop a representative numeric target for allowable bacteria exceedence days. Several similar studies are currently being considered or proposed in Ventura, Los Angeles, Orange, and San Diego counties; however, there is currently no coordination between these proposed studies.

The objective of this project is to assess natural bacteria levels in numerous streams throughout southern California in order to provide a regional characterization of background bacteria concentrations. Bacterial indicators were measured from unimpaired streams in 12 southern California watersheds weekly for one full year. These data were used to investigate background levels, frequency of exceedences of relevant water quality standards, and spatial and temporal patterns.

This project is a partnership of numerous SMC agencies who are participating via in-kind contributions. Three regional water quality control boards, six storm water agencies, and several cities cooperated on field data collection and laboratory analysis. Following laboratory and field intercalibration, samples were collected weekly between May 2006 and May 2007. Overall, the 30-day geometric mean exceedences of freshwater standards were 2% for E. coli and 14% for enterococci. There were clear seasonal patterns with exceedences being most

common during July and August. Data collection and analysis for this project is complete, with a project report expected in December 2007.

Hydromodification Study
Status: 10% complete

The process of urbanization has the potential to affect stream courses by altering watershed hydrology. Development and redevelopment can increase the amount of impervious surfaces on formerly undeveloped landscapes. This reduces the capacity of remaining pervious surfaces to capture and infiltrate rainfall and, as a result, a larger percentage of rainfall becomes runoff during any given storm. In addition, runoff reaches the stream channel much more efficiently, so peak discharge rates postdevelopment are higher compared to predevelopment for an equivalent rainfall event. This process has been termed hydromodification.

Hydromodification can result in adverse effects to stream habitat, surface water quality, and water supply. The stream erosion that results from the increased peak flow can threaten infrastructure, homes, and businesses. Intermittent and ephemeral streams that possess riparian and wetland habitat are at particular risk from effects of hydromodification. Streams in semi-arid regions are especially vulnerable to urbanization due to a prevalence of sand bed channels, lack of vegetative reinforcement, and relatively large net changes in water and sediment supply associated with stormwater runoff. Recent studies by the SMC have indicated that intermittent and ephemeral streams in southern California degrade at lower levels of watershed urbanization than streams in the eastern US.

In response to the effects of hydromodification, state and local agencies are developing standards and management approaches to control and/or mitigate the effects of hydromodification on natural and semi-natural stream courses. Successful implementation of these regulatory programs requires development of tools to better assess hydromodification effects and develop appropriate mitigation and management strategies.

The goal of this project is to develop a series of tools supporting implementation of hydromodification management measures that could be used to better protect the physical, chemical, and biological integrity of streams and their associated beneficial uses. This project will provide tools to answer the following questions: 1) Which streams are at the greatest risk from the effects of hydromodification? 2) What are the anticipated effects in terms of increased erosion, sedimentation, or habitat loss, associated with increases in impervious cover? 3) What are some potential management measures that could be implemented to offset hydromodification effects and how effective are they likely to be?

This project is being conducted in collaboration with researchers from Colorado State University, Fort Collins. In May 2007, we held an initial Technical Advisory Committee meeting for the project, which was attended by over 30 scientists and managers. Based on the results of this meeting, we refined our scope of work and produced the Project Work Plan and Quality Assurance Project Plan (QAPP). Field reconnaissance of sampling sites was completed during the summer of 2007, resulting in the identification of 18 sites where model calibration data will be collected, and an additional 15 sites where data will be collected for development of

the screening tools. Field data collection will occur in Fall 2007. Finally, we have continued to coordinate this project with similar efforts being conducted by several county stormwater programs, CASQA, and the Water and Land Use Partnership (WALUP).

Low Impact Development Study
Status: 10% complete

The Low Impact Development Guidance (LID) Study is being conducted with funding from the State Water Resource Control Board's Consolidated Grants Program, under the Urban Runoff Program of Proposition 40. A proposal was submitted by the County of San Bernardino on behalf of the SMC for the LID Project known as "LID Guidance and Training for Southern California."

The LID Project will develop a comprehensive program to incorporate LID strategies and techniques into the planning and design of public and private sector projects. The LID Project will develop a model program for localities in California that are interested in adopting LID strategies and techniques. This will include determining the key technical and institutional issues that must be addressed for successful implementation, pilot projects that demonstrate the effectiveness of LID, and training and outreach to help solidify an implementation strategy to ensure large-scale and long-term success.

The grant funded portion of the project must be completed by September 2008. This will require a two-year work effort that is organized into the following funding areas:

1. Pilot Project Planning and Design. Establish design criteria and site selection
2. Monitoring. Implementation and demonstration of technology
3. Outreach and Training. Reporting and facilitation of wide-spread programmatic implementation

The SMC will provide the required 25% matching funds ($200,000) for the grant funded tasks. These tasks include preparing a literature review, conducting a series of training workshops, and developing a field monitoring program for LID features. The Literature Review has been completed and the final report will be made available through the California Stormwater Quality Association Website and the SMC website when operational.

A Technical Advisory Committee has been established and they reviewed the Literature Review and provided guidance on the initial tasks for the project. The TAC will meet as needed to advise the project as it proceeds.

Training workshops are in preparation. Several potential field monitoring sites have been identified, and Stantec Consulting has been hired to develop the monitoring program and select monitoring sites.

Once the grant-funded tasks are completed, the SMC will continue to fund (approximately $200,000) and manage the project for three additional years that will primarily require field monitoring and analysis of LID features.

Newport Bay Dissolved Oxygen and Algae Distribution Study

In Newport Bay, the spatial and temporal extent of hypoxic/anoxic events and their relationship to macroalgal blooms is unknown. Previous data collection efforts were limited to depths less than 1 foot below the surface or were instantaneously collected. As a result, there is not a continuous record of dissolved oxygen (DO) in bottom waters of Upper Newport Bay. In April 2005 The County received a Proposition 13 grant from the State Water Resources Control Board to collect the continuous dissolved oxygen data and macroalgae cover estimates needed to assess the spatial and temporal extent of hypoxia/anoxia in the Bay, which is essential in determining whether or not designated beneficial uses are protected.

From June 15 to December 28, 2005, water column DO, temperature, conductivity, salinity, depth and pH data were collected at 30 minute intervals in surface and bottom waters at 3 sites in Upper Newport Bay. Intertidal macroalgal distribution was surveyed with high-resolution false color infrared (CIR) aerial photography during daytime low tides on three occasions during in-situ water quality measurements: July 26, September 17, and October 31, 2005.

The relationships between water quality parameters and macroalgal extent were investigated through a series of statistical analyses. The results and conclusions of these analyses were presented in a final project report submitted on October 31, 2006. The study resulted in the following general conclusions:

1. Color infrared photography provided a good tool for evaluation of macroalgal abundance on exposed, intertidal mudflats.

Remote sensing by CIR aerial photography was a successful technique for mapping intertidal macroalgal distribution in UNB. Two classes of macroalgae were distinguishable based on the image analysis: *Ceramium* spp. and *Ulva* spp. The overall accuracy of classification (i.e., the percentage of pixels classified correctly) was very high (~97% on July 26, ~91% on September 17, and ~97% on October 31, 2005), and estimates of algal cover from both ground-based measures and aerial photo-interpretation were comparable. However, aerial image analysis tended to detect a greater proportion of areas not covered by macroalgal mats than ground surveys did. There were probably two reasons for this: a limited number of end members used in image classification; and irregular distribution of macroalgae within the intertidal zone, with most of the macroalgae concentrated along the water's edge where ground samples were collected, resulting in a data set that did not accurately represent the true distribution of macroalgae and bare substrate within the system. Data extrapolated from the ground surveys likely overestimates macroalgal abundance, while estimates from aerial imagery are likely conservative. Aerial photo-interpretation was not able to provide any information on the thickness of macroalgal mats and, therefore, is not appropriate for estimating biomass.

2. Overall algal extent was high and exhibited clear spatial and temporal patterns.

The area of UNB covered by macroalgae significantly increased from July to September and decreased in October. Based on aerial image analysis, the overall portion of the intertidal zone covered by *Ceramium* spp. and/or *Ulva* spp. was 45% in July, 91% in September, and 70% in

October. In general, there was a longitudinal gradient in macroalgal abundance with more algae near the head of the estuary and less in downstream areas. Macroalgal composition of the seaward regions was dominated by *Ceramium* spp. until October, when *Ulva* spp. replaced *Ceramium* spp. in the lower estuary. In contrast, *Ulva* spp. was the dominant algae at the head of the estuary throughout the study period.

3. Hypoxic events primarily occurred in late summer-early fall, following algal blooms, and were associated with particular physical conditions.

Results of the time series analysis support an emerging conceptual model of bottom water hypoxia resulting from a combination of increased primary productivity (and subsequent oxygen demand associated with macroalgal blooms) and vertical stratification of the water column (i.e. increased residence time of bottom waters). Specific instances of hypoxia tended to occur during nighttime low tides in the late summer-early fall, particularly during neap tidal series. Temperature and salinity data indicate that there was vertical stratification at these times as well. The long-term trends of DO concentration were especially pronounced in the bottom layer and were also correlated with water column stratification resulting from solar heating of surface waters and freshwater discharge decreasing surface salinity. There was a time lag between initial observations of macroalgal proliferation and the onset of hypoxia. This was likely associated with the time required for macroalgae to senesce and sink to the bottom. This contribution of organic material from macroalgae to sediments increased sediment oxygen demand through both biological and oxygen-consuming biogeochemical pathways. Thus, macroalgae seen growing in the intertidal zone in June and July may have contributed to bottom water hypoxia several months later.

4. Macroalgal abundance was not quantitatively related to the frequency of hypoxia.

The abundance of *Ceramium* and *Ulva* spp. as determined from aerial photography explained very little of the variability in surface and bottom water hypoxia (based on a threshold of 3.0 mg/l), though the frequency of bottom water hypoxia was generally correlated with *Ulva* spp. abundance. DO values < 3.0 mg/L were considered hypoxic for the purposes of this report; this value was chosen based on a review of scientific literature (Kamer and Stein 2003). However, individual species may have higher DO requirements. A DO threshold of 5.0 mg/L may be adopted for regulatory purposes to protect designated beneficial uses in UNB. Therefore, at the request of the Regional Board, DO values were compared to a 5.0 mg/L threshold as well. There were stronger relationships between macroalgal abundance and the frequency of DO measurements <5.0 mg/L. Together, *Ceramium* and *Ulva* spp. explained roughly 50% of the variability in the frequency of DO values < 5.0 mg/L in surface and bottom waters. *Ulva* spp. alone explained 75% of the variability in the frequency of DO measurements <5.0 mg/L in bottom waters and 57% of the variability; however, these relationships should be used with caution in surface waters. UNB is a relatively shallow system (average depth <1 m) with relatively short (~7 d) residence time and significant tidal range (~2 m maximum). Wind driven mixing and tidal mixing may limit the occurrence of hypoxia, even during macroalgal bloom events.

Next Steps

Although this study provides valuable insight into the mechanisms that influence hypoxia in UNB, additional work is necessary to develop predictive tools relating physical factors and biological factors (e.g. macroalgal blooms) to hypoxia. Specifically, a more complete understanding of nutrient cycling and budgets should be developed for UNB. The relative roles of biological and sediment oxygen demand over inter- and intra-annual cycles should be investigated. Finally, a dynamic simulation model for nutrients should be developed for UNB. This model would allow investigation of the role hydrodynamics (e.g. freshwater input, stratification, and tidal cycles) and biogeochemistry (e.g. nutrient cycling, sediment oxygen demand) on hypoxia. Such a model could also be used to evaluate the anticipated effect of potential management actions on endpoints such as hypoxia and macroalgal blooms.

Remote sensing holds promise as a management tool for assessment of coastal estuaries and lagoons. The approach developed in this study should be applied to other southern California coastal wetlands to determine how robust the methodology is between systems and to help further refine the algorithms used to translate the image analysis to macroalgal abundance. In addition to the color infrared imaging we used, hyperspectral imaging and high resolution satellite imagery should also be explored in the future with the following considerations in mind: spatial resolution, ability to resolve macroalgal mat thickness, ability to target tidal phase, and cost.

Newport Bay Fecal Coliform TMDL Source Identification and Management Plan

The fecal coliform TMDL was adopted in 1999 to improve bacterial quality, reduce public health risks and improve water contact recreational activities in the Bay. Beach advisory and closure postings based on bacterial levels have increased over the past few years. The development of a Source Management Plan, as required by the fecal coliform TMDL, is made difficult by the many different urban and natural sources of fecal indicator bacteria in the Bay, the apparently episodic and diffuse nature of these sources, and the fact that bacteria are intrinsically non-conservative (i.e., they die-off and grow in the environment). In February 2005, the County received a Proposition 13 grant from the State Water Resources Control Board to identify and quantify the contribution of urban and natural sources of fecal indicator bacterial impairment in Newport Bay to define the relative contribution of FIB and viruses to water quality impairment of the Bay, and to prepare a Fecal Coliform TMDL Source Management Plan evaluating and prioritizing sources of fecal coliform bacteria and BMPs to address the sources.

Data collection was initiated in December 2005 and continued through February 2007. Data collection efforts included:

- 46 Bay-to-Ocean (BTO) transects were completed and an intensive survey of the upper basin of Upper Newport Bay (BTO4) was conducted to assess the impact of a large macroalgae bloom on FIB concentrations.
- Inventory of storms drains with the City of Newport Beach has been completed. Dry weather sampling of irrigation water run-off at curbside on the PCH side of the Bay, Balboa Peninsula, Balboa Island and Lido Island, as well as sampling of water from beach trenches

was conducted in the early morning hours on November 16, 2006. Twenty-one drains were surveyed and 5 trenches were sampled. The wet weather storm drain survey was conducted on January 31, 2007, where the same twenty one drains were sampled from the dry weather study. Drains were sampled at the end of the pipe at low tide. In addition, irrigation water from the curbside was collected at street-level for each of the storm drains during both dry and wet weather.

- Two synoptic studies of water quality along the perimeter of the Lower Newport Bay at most of the storm drain outlets (those that could be identified from the bay side) were conducted in August. Measurements of FIB, pH and salinity were taken at each storm drain outfall and 50-100 feet away from the outfalls at low-tide and high tide in the night-time hours when FIB concentrations would be highest. These results were used to generate a map of FIB exceedances from storm drain outfalls in LNB.
- Four diurnal intertidal sediment studies (wet season and dry) were completed. Wet weather surveys occurred during storms on March 1-2 and March 18-19, 2006. The dry weather studies were completed on October 19 and October 26, 2006.
- Microcosm studies have been conducted assessing the die-off and re-growth of FIB from runoff in Newport Bay waters, bird feces, macroalgae, sediment, and runoff. In total 70 separate microcosms have been conducted:
  - 28 microcosm studies have been conducted assessing the die-off and/or re-growth of FIB associated with macroalgae and bird feces;
  - 14 microcosm studies have been conducted assessing the die-off and/or re-growth of FIB associated with sediments of various grain sizes;
  - 27 microcosm studies have been conducted assessing the die-off and/or re-growth over a range of salinities, creek sources and bay sources;
  - 4 microcosms were conducted to assess the influence of wrack line debris;
  - 3 microcosms were conducted to assess FIB in runoff.
- E. coli and enterococcus isolates were obtained from the Newport Bay BTO study and the microcosom studies. Biochemical identification for both Enterococcus and E. coli was conducted. Approximately 200 Enterococcus isolates were identified and approximately 200 E. coli isolates were characterized by API 20 test. E. coli gene expression patterns were analyzed to distinguish environmental adapted strains from those of fecal origin.

Preliminary data results were presented to the Newport Bay Fecal Coliform TMDL Technical Advisory Committee on July 21, 2006 and April 13, 2007. Reports documenting the identification and quantification of urban and natural sources of FIB in Newport Bay are under development. A source management plan will be developed in the 2007-08 reporting period based on the information presented in the final investigation reports.

Development of California Sustainable Watershed/Wetland Information Manager (CalSWIM) – Prototype Database

In response to a commitment to develop a prototype watershed database for cumulative impact assessment, the County on behalf of the Orange County Stormwater Program has joined with the University of California, Irvine (UCI) in developing and implementing a prototype database called the California Sustainable Watershed/Wetland Information Manager (CalSWIM). CalSWIM will be a web-based expert system and database focused, initially, on Newport Bay and the Newport Bay watershed. CalSWIM will be designed with a user friendly and instruction-rich interface to facilitate its use by individuals from a wide spectrum of educational backgrounds and technical expertise. The technical objective of CalSWIM is to provide an interactive platform for coastal wetland and watershed managers, planners, and engineers to explore alternative wetland and watershed management strategies. By exploring the (often unintended) consequences of management decisions in a virtual environment *before* implementation, CalSWIM should promote cost-effective and scientifically justifiable decisions regarding the monitoring, management, and alternation of coastal urban wetlands and their associated watersheds. While the focus is on providing a decision making platform for coastal managers, the "SimCity" character of CalSWIM's design may also lead to its use by other user groups, including educators, environmentalists, and the lay public.

A highly interdisciplinary team of researchers from four universities (UCSD-Scripps Institution of Oceanography, UCI, UCLA, and Caltech-JPL) participated in the development of the CalSWIM concept. From this concept, a formal research proposal was developed and submitted to NOAA's 2004 call for "Ecological Forecasting" proposals. The CalSWIM proposal was designated by the review panel as "fundable", and scored in the top four of all proposals submitted to the program. Unfortunately, due to funding reductions in the Ecological Forecasting program, NOAA could fund only the top two proposals.

In the interim, the County funded a small subset of the original research team (a computer scientist and environmental engineer) to construct a prototype CalSWIM web site that will focus on two components: 1) the assimilation of data and information on Newport Bay and the Newport Bay watershed; 2) the integration of a subset of the data for fecal indicator bacteria impairment with a forecasting model developed by UCI. During this reporting period, a prototype web site was completed (www.calswim.org). The web page provides information on the San Diego Creek/Newport Bay watershed to visitors through four tools:

1. Explore – Through this portal visitors can explore the watershed through an interactive map, view its creeks and tributaries, land uses, and monitoring stations. Geo-referenced photos, reports, and monitoring data are also available through this portal;

2. Simulate – Users are able to evaluate the behavior of the watershed in Upper Newport Bay using an advanced model of pollutant concentration developed at UCI;

3. Analysis – Monitoring data for specific constituents and time periods can be displayed graphically; and,

4. Data Query - Monitoring data and reports are made available through direct queries to monitoring program databases.

During 2006-07 UCI applied for and received a major grant from the National Science Foundation which will support development of CalSWIM in two main arenas: 1) development of a Wiki based information system; and 2) improved methods of data integrity.

C-3.5 Regulatory Directives

13225 Directive for Aliso Creek

On March 2, 2001 the San Diego Board issued a written directive pursuant to California Water Code Section 13225 to the County of Orange, Orange County Flood Control District and the Aliso Creek watershed cities (Watershed Permittees). The directive found that the Watershed Permittees may be discharging waste with high bacteria levels from municipal storm drain outfalls into Aliso Creek and its tributaries. As a result the Watershed Permittees were directed to conduct an evaluation of the relative contribution of the urban stormwater discharges to the impairment of beneficial uses or the exceedances of water quality objectives and, where necessary, take appropriate measures to eliminate the sources of pollution.

The Directive required the Watershed Permittees to submit an initial report by April 30, 2001 and submit quarterly progress reports by July 31, October 31, January 31, and April 30 of each year until the San Diego Board determines that the nuisance discharges have been prevented to the Maximum Extent Possible (MEP). The County on behalf of the Watershed Permittees submitted the initial report on April 30, 2001, and has submitted progress reports quarterly from 2001 through September 2005. Detailed information on the Permittees' efforts to identify, evaluate, and reduce or eliminate sources of bacterial contamination, including the County's efforts described below, may be found in these quarterly progress reports which are available on the Watershed and Coastal Resources Division website at www.ocwatersheds.com.

The County is responsible for implementing elements of its LIP in unincorporated areas of the County. The County's unincorporated areas within the Aliso Creek watershed contain one storm drain outfall that meets the minimum size criteria of 39 inches, but otherwise does not contain drainage areas with significant urban land use. Therefore, the County's main responsibilities pursuant to the Regional Board's Directive include coordinating the Watershed Permittees' activities, conducting the monitoring program, and compiling Watershed Permittee information and monitoring data necessary to prepare the quarterly progress reports, and developing prototype bacteria BMP projects (see prior discussion on J01P28 Clear Creek System and J01P01 Munger Storm Drain Sand/Media Filter).

Through 2004-05, the County continued to implement the Aliso Creek Bacteria Monitoring Program and quarterly reports were submitted utilizing the simplified quarterly reporting for the Directive template form and letter. The County also worked with the Watershed Permittees and Regional Board staff to revise the Aliso Creek Watershed Action Plan (Formerly Watershed Chapter) to incorporate the requirements of the Directive and to provide information on planned activities and progress made in reducing bacteria loads to Aliso Creek. A revised

monitoring program to provide more focus on source identification and local evaluation of the effectiveness of the Watershed Permittees' activities to reduce bacteria levels was approved by the Regional Board at the October 2005 board meeting and implemented in June 2006.

The revised program focuses monitoring efforts on a group of status and trends sites near the bottom of the watershed and a second set of BMP evaluation sites at high-priority drains throughout the watershed. Monitoring occurs at a higher frequency than in the original program, but only during the two-month period in late summer when bacteria levels are highest. Analyses of the available monitoring data show that this design will sufficiently track compliance with REC1 standards in the area of highest recreational use in the lower watershed and document the effectiveness of BMPs implemented at the high-priority drains.

Data and results of the revised monitoring program will be submitted on an annual basis on November 15th of each year (See **Section C-11** of the Unified Annual PEA). Analysis of the bacteria water quality data indicates trend lines over time at each station vary widely but do not demonstrate a visible upward or downward trend. This variability is typical of bacterial indicators. The revised monitoring program for Aliso Creek is designed to track certain levels of change over a 10 year period of time. Based on the data, while the BMP efforts taking place in the Aliso Creek watershed to reduce bacteria loads may not yet be yielding significant improvements in receiving waters, they may be limiting further degradation of receiving waters. As the program continues and the municipalities implement additional BMP's, it is likely that we will see improvements in receiving water quality.

C-3.6 Plan Development Modifications

There were no modifications to the Plan Development section of the County's LIP (**Section A-3**) during the reporting period.