Pillar Point Harbor Source Identification Project

Clean Beaches Grant Program, Proposition 50

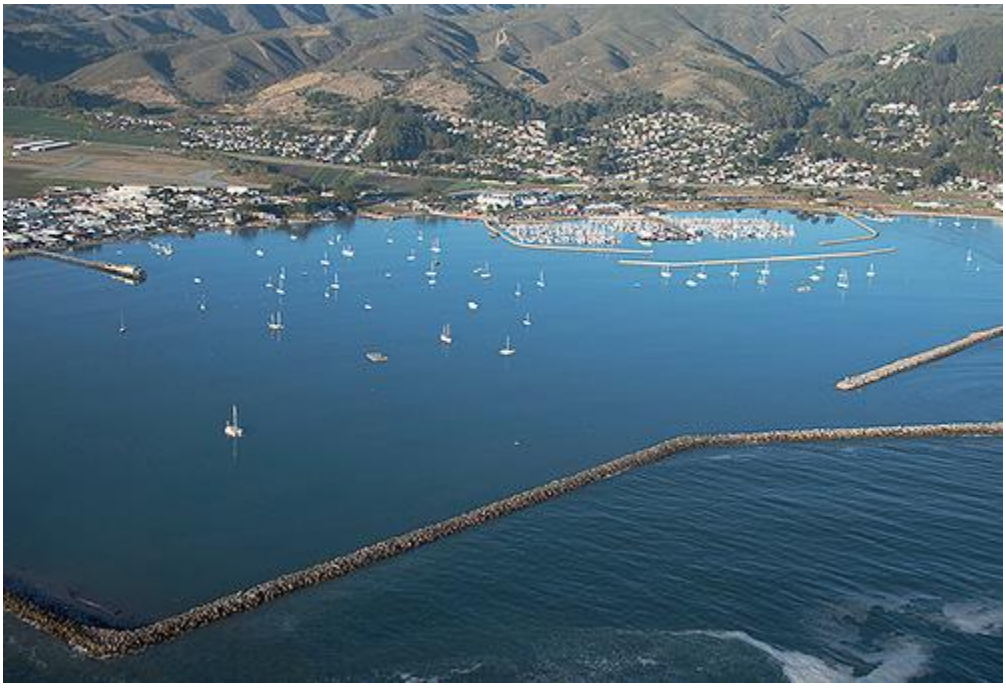
FINAL PROJECT REPORT

Agreement 07-574-550-2

Between the State Water Resources Control Board

and

San Mateo County Resource Conservation District



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January 2014

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PROJECT SUMMARY

This final report summarizes the monitoring and other data collection efforts as well as findings and recommendations of the Pillar Point Harbor (PPH) Source Identification Project. This summary includes references to previously completed deliverables as well as additional work done for this project by the San Mateo County Resource Conservation District (RCD) and University of California, Davis (UCD).

Project Purpose, Scope and Goals

The main objectives of this project were:

1) To provide information about the primary sources of fecal contamination at PPH
2) To recommend remediation strategies to reduce fecal pollution based on findings of the project

The primary focus of this project is Capistrano Beach, which has well-documented, chronically high levels of fecal indicator bacteria. The secondary focus is the five other beaches and live-aboard boats in the harbor.

Water quality at Capistrano Beach is poor based on fecal indicator bacteria (FIB) levels and the State Water Resources Control Board (SWRCB) has listed the location as impaired by coliform bacteria on the 303(d) list submitted to the United States Environmental Protection Agency (USEPA).

Specific recommendations of water quality remediation projects were developed based on research and analysis. This report identifies constraints, impediments, opportunities, and priorities to remediate water quality on the beaches in PPH and cost-effective, feasible water quality improvement projects. A timeline for implementing the proposed mitigation strategies to achieve water quality objectives was also developed. This report identifies the parties responsible for implementing recommended measures and proposes monitoring and performance measures to track implementation of projects.

Monitoring, data analysis and the resulting prioritized recommendations are essential for a second phase to implement projects to improve water quality at public beaches in PPH. Local stakeholders are committed to a second phase in which they pursue implementation of these recommendations and recognize that this first phase was an essential step toward that end.

How the Project Addressed the Stated Goals

In order to provide information about the primary sources of fecal contamination at PPH, a microbial source tracking (MST) study was initiated concurrent with fecal indicator bacteria (FIB) monitoring and investigations of terrestrial hydrology within and surrounding the PPH.

MST monitoring was conducted by University of California, Davis in 2008 and 2011-12 to estimate relative contributions of fecal pollution originating from human, bovine, dog, horse and avian sources. The RCD monitored FIB, including total coliform, *E. coli* and *Enterococcus*, regularly and concurrently with MST sampling events to evaluate microbial water quality in the area. Balance Hydrologics was also contracted to investigate hydrology, including coordinating a circulation study (see Appendix B, *Pillar Point Harbor Circulation Study Final Report*) as well as stream gaging of freshwater inflows and collection of total suspended solids samples during high-flow events. A total of 514 water samples were collected for FIB analysis, and a total of 225 samples from water, sediment, and biofilm matrices were collected for genetic analysis.

In order to select and prioritize recommendations for remediation strategies, the RCD consulted with the project Technical Advisory Committee (TAC), and community members. The RCD also considered MST study results (2012 by the same UCD Lead Researcher) and water quality data from storm drain demonstration projects being implemented concurrently within the James V. Fitzgerald Area of Special Biological Significance (ASBS), which is located just north of the PPH study area (see Appendix E, *Fitzgerald Marine Reserve Pollution Reduction Program Monitoring Report*).

Roles and Responsibilities

The RCD is a non-regulatory public benefit district to help people protect, conserve, and restore natural resources through information, education, and technical assistance programs. For this project, the RCD was responsible for administration, project management, and outreach. This included hiring consultants for technical expertise in hydrology, geology, microbial source tracking, and laboratory work.

A TAC, including a Lead Researcher from UCD, guided and contributed expertise to all aspects of the project. The TAC met several times per year as a group, while subgroups and individuals contributed expertise to the project as needed and when opportunities arose. The Lead Researcher provided oversight for the design of the research components of the project as well as monitoring and data analysis done by UCD. The TAC established appropriate methodology to identify the sources of fecal pollution and made recommendations based on monitoring findings. Expertise on the TAC included harbor function and infrastructure, wastewater treatment function and infrastructure, abatement of fecal indicator bacteria, hydrology and geology, microbiology, public health, microbial source tracking, and water quality (see Appendix C, *Pillar Point Harbor Source Identification Study Project Description*).

Background and Discussion

In 2008 the RCD received funding under the Proposition 50 Clean Beaches Initiative Grant Program for multi-year monitoring in PPH, which had impaired water quality based on the presence of fecal indicator bacteria.

PPH is a popular recreational area and home to a vital commercial fishing industry located on the northern side of Half Moon Bay and adjacent to the small town of Princeton along the central California coast in San Mateo County. The PPH study area is enclosed by an outer and inner harbor and contains several beaches – Capistrano Beach, Marsh Beach, Mavericks Beach, Beach House Beach, Inner Harbor Beach, and Yacht Club Beach. PPH receives complex drainage inputs from freshwater creeks, storm drains, outflow pipes, and large, mixed-use areas including an airport, agricultural, commercial and residential sections. The harbor area domiciles various commercial ventures such as restaurants, hotels, recreational shops, commercial fish buyers, a fertilizer plant, and a Naval Station situated on the western bluff. Outside the Outer Harbor, but within the project area, there are residential areas, conference facilities, and additional commercial ventures as well as a pump station for the Sewer Authority Mid-Coastside. The project area is also within the boundaries of the James V. Fitzgerald Marine Reserve Critical Coastal Area. The Reserve, located along the coastline immediately to the north of PPH, is a designated Area of Special Biological Significance and a biologically significant habitat for diverse species as well as a popular recreational area.

PPH water quality has chronically been so poor that the SWRCB has listed the location as impaired by coliform bacteria on the 303(d) list submitted to the USEPA. Capistrano Beach had elevated levels of fecal indicator bacteria, such as *E. coli* and *Enterococcus*. This beach has been ranked for several years by the Heal the Bay's Report Card as a "Beach Bummer," meaning that it is in the top ten most polluted

beaches in California in dry weather conditions. In 2005/2006, Capistrano Beach ranked sixth on the "Beach Bummer" list. It was the worst ranked beach in Northern California and is a Clean Beaches Task Force Priority Beach with regard to fecal pollution.

In 2005 and 2006, San Mateo County Department of Environmental Health (County) repeatedly posted beaches in the Harbor as potential health hazards. Capistrano Beach was posted most frequently, approximately 50 weeks in each year. Marsh Beach was posted over 20 weeks in each year, 42% to 51% of sampling events. Mavericks Beach was posted approximately 15 weeks each year, approximately 30% of sampling events. The County terminated sampling for Capistrano Beach and permanently posted the beach as a potential health hazard in March of 2006.

The public health impact of the impaired waters may impact commercial ventures, harbor activities, tourism, recreation, ecological habitat, and sources of drinking water for municipal utilities in the watershed. The harbor area has approximately 100,000 visitors annually and is heavily used recreationally by boating enthusiasts, kayakers, windsurfers, campers, hikers, dog walkers, bird watchers, swimmers, waders, families, clam diggers, surfers, and thousands of spectators for the world famous Mavericks big wave surf break.

Within the local community there are numerous opinions as to the primary sources of fecal pollution impacting the harbor, including human contamination from leaking sewer lines, avian contamination from resident and migratory bird populations including large flocks of gulls and other birds, and lack of flushing in the harbor due to the presence of two breakwalls. Although much effort had been expended on studying the locations of fecal pollution impacting the harbor, including water sampling and fecal indicator enumeration studies, data on identification of primary sources and their relative contributions to the overall magnitude of the pollution problem were lacking. There was an urgent need for a comprehensive study to determine possible sources of pollution in this watershed and to understand flow interaction within the confines of the enclosed Harbor.

The MST and FIB sampling sites were selected on the basis of historical FIB data and major freshwater inputs to PPH. To investigate the sources of fecal pollution and their relative contributions to beaches, 10 primary locations were selected as sampling sites. In 2012, 7 upstream sampling sites were added, based on GIS land-use analysis and site accessibility, to estimate fecal loadings in the waterways within the urban area upstream of PPH. These sites were selected for accessibility during all weather conditions and for representativeness of the upland area watershed. Because there has been significant hydromodification of the watersheds draining to the Harbor, only certain sites were available – St. Augustine Creek, for example, flows underground in the storm drainage system all the way from our most upstream site to its terminus at the PPH-2 storm drain outlet.

MST samples were collected during the wet and dry season as well as first flush events. For wet season and first flush sampling events, the water samples were collected in three phases based on precipitation conditions, as pre-, during, and post-rain samples. MST water samples were taken at all 10 sampling sites including 4 freshwater inflows and 6 beaches at PPH in 2008 and 2011. In 2012, the Lead Researcher with input from the RCD focused MST sampling on Capistrano Beach and the 4 inflow sites on the basis of 2-yr FIB and MST monitoring results from 2008 and 2011. Additionally, samples close to live-aboard boat locations were collected once in 2011 and 2012. Based on FIB weekly monitoring in 2012, upstream MST sampling events were conducted at selected locations in 2012. Sediment and biofilm samples were collected during the dry and wet season. Either one or two biofilm samples (submerged aquatic vegetation) were also obtained at the sites. A probabilistic model developed at UCD was applied to all MST samples to estimate the true concentration of host-associated *Bacteroidales*. FIB

samples were taken bi-weekly at Capistrano Beach and its inflow sites in 2008 and 2011. In 2012, FIB samples were obtained (bi)weekly at Capistrano Beach and the 4 inflow sites as well as 5 upstream locations.

There was site-specific FIB variation among the 10 primary sampling locations. All 4 inflow sites including Capistrano Outfall Pipe, Bathhouse Outfall Pipe, Denniston Creek and Deer Creek Outlet frequently exceeded the FIB criteria. FIB counts were usually low at all beaches at PPH except for Capistrano Beach. FIB spatial and seasonal analysis revealed that the Bathhouse Outfall Pipe and Deer Creek Outlet had significantly increased *E. coli* levels during the dry season, while *Enterococcus* levels at Capistrano Beach were higher during the wet season. FIB monitoring upstream of Capistrano Beach showed fecal loading into the waterway from the urban area.

Human-associated *Bacteroidales* (BacHum) were not commonly detected at any of the sites using two independent assays; the few positive samples yielded mostly low marker concentrations, which are considered a minor source. Predictive analysis of live-aboard boat site monitoring data suggests that the contribution of potential human feces from live-aboard boats to the water quality of Capistrano Beach is not significant. Dog-associated *Bacteroidales* (BacCan) were frequently detected at Capistrano Beach. While the dog marker was also often found at Mavericks Beach, the spatial distribution of BacCan in nearby beaches indicates that the presence of dog marker at Capistrano Beach was more likely introduced from freshwater inflows rather than from Mavericks Beach. Bovine-associated *Bacteroidales* were frequently found at Deer Creek Outlet throughout the MST monitoring period, and bovine was considered as a predominant source of fecal pollution at this site especially in the dry season. Upstream MST monitoring revealed that dog feces introduced into the waterway reaches Capistrano Outfall Pipe and Deer Creek Outlet after passing through the urban area located between PPH and the upper watershed. Given the geographical setting upstream wildlife is likely to be the predominant source of fecal pollution at Denniston Creek. There was little evidence of fecal pollution derived from gulls or horses based on assays indicative of gull-associated *Catellicoccus* and horse-associated *Bacteroidales*. During sediment and biofilm MST monitoring, high levels of the universal *Bacteroidales* marker, BacUni, were detected in both sediments and biofilm even when the levels in water were not high. This indicates that previously introduced microbial populations accumulate more and persist longer when associated with sediments and biofilm. The gradual decrease of BacUni in sediments and biofilms during the wet season suggests that sediment re-suspension occurs via natural turbulence. Therefore, sediments and biofilm are considered to play an important role for water quality in PPH. For additional detailed information about the project methods and findings, please see Appendix D, *Pillar Point Harbor Source Identification Final Report (UC Davis)*.

This monitoring study provided significant insights into fecal contamination in PPH.

- Human fecal sources exist but do not account for the majority of fecal indicator bacteria found at Capistrano Beach or elsewhere in the harbor.
- Dogs represent a significant, but not the main, fecal source at Capistrano Beach.
- Resident fecal populations in sediments and biofilms are periodically re-suspended during events of turbulence and can lead to temporal increases in FIB levels.
- The main fecal source at Deer Creek is bovine followed by canine.
- The study eliminated other beaches in PPH as areas of concern and pin-pointed the freshwater inflows as the vectors for bacteria entering the Harbor.

Although there were uncharacterized fecal sources not attributable to the host-associated genetic markers used, this study provides useful information to select appropriate management practices to reduce fecal pollution. Equally important, it provided strong evidence that humans, gulls and horses are not significant sources of contamination. Marine mammals were also ruled out as a significant source through PhyloChip analysis. This is valuable information to prevent the expenditure of significant resources on efforts that would not have reduced contamination.

COMPLETED PROJECT TASKS

All grant tasks were completed between 2007 and 2013. Most of the project tasks were completed within the first year of the project, including the project monitoring plan, QAPP and PAEP. Most of the work done between 2008 and 2013 was the actual data collection and analysis of existing data. The final project tasks were reporting findings in the final project report, making recommendations for remediation based on findings, and to hold a public meeting to discuss findings and recommendations with the local community.

Table One: Completed Project Tasks

Item	DESCRIPTION	DATE SUBMITTED
A.	PLANS AND COMPLIANCE REQUIREMENTS	
1.	GPS information for Project site and monitoring locations	2007
2.	Project Assessment and Evaluation Plan (PAEP)	2007
3.	Monitoring Plan (MP)	2007
4.	Quality Assurance Project Plan (QAPP)	2007
5.	Copy of final CEQA/NEPA Documentation	N/A
6.	Land Owner Agreement(s)	N/A
7.	Applicable Permits	N/A
B.	WORK TO BE PERFORMED BY GRANTEE	
1.	Project Management and Administration	2007-2013
1.1	List of Technical Advisory Committee Members	2007, 2013
2.	Project Implementation	2007-2013
2.1	Analysis of Existing Data	2007
2.3	Public Notices and Meeting Attendance information	6/14/2013
A.	INVOICING	Quarterly
E	REPORTS	
1.	Grant Summary Form	6/14/2013
2.	Progress Reports by the twentieth (20^{th}) of the month following the end of the calendar quarter (March, June, September, and December)	2007-2013
3.	Natural Resource Projects Inventory (NRPI) Project Survey Form	9/13/2013
4.	Draft Project Report	6/14/2013
5.	Final Project Report	01/28/2014

PROJECT MONITORING

Numerous types of inflows and drainages exist at PPH and its watersheds, including outflows from creeks, outfall pipes, storm drains, runoff from pavements and other impervious surfaces, agricultural and commercial operations. The MST and FIB sampling sites were selected on the basis of historical FIB data and major freshwater inputs to PPH. To investigate the sources of fecal pollution and their relative contributions to beaches, 10 primary locations were selected as sampling sites. Among the 10 sites, PPH-1, 2, 4, and 8 are freshwater inflows and others are marine water beaches (Table 2 and Figure 2).

In an effort to estimate possible fecal loadings caused by live-aboard boats at PPH, MST and FIB samples were collected at 3 boat docks located at the western side of Inner Harbor, one pump station where live-aboard boats empty their onboard tanks, and at 3 locations near live-aboard boats anchored in Outer Harbor (Table 3 and Figure 3).

Upstream FIB and MST monitoring was conducted in 2012 to estimate spatial distribution of fecal loadings in the waterways of 4 primary inflows draining to PPH and to find areas of fecal inputs within the urbanized area. Seven upstream sampling sites were added based on GIS land-use analysis and site accessibility (Table 4 and Figure 4). One to three upstream sites were chosen per inflow site.

Table 2 - Latitude and longitude of primary MST and FIB sampling sites

Site ID	Type	Site name	Latitude	Longitude
PPH-1	Inflow	Capistrano Beach	37º 30’13’’N	122º 29’08’’W
PPH-2	Inflow	Bathhouse Outfall Pipe	37º 30’11’’N	122º 29’06’’W
PPH-3	Beach	Capistrano Beach	37º 30’12’’N	122º 29’07’’W
PPH-4	Inflow	Denniston Creek	37º 30’14’’N	122º 29’13’’W
PPH-5	Beach	Marsh Beach	37º 30’04’’N	122º 29’38’’W
PPH-6	Beach	Mavericks Beach	37º 29’55’’N	122º 29’45’’W
PPH-7	Beach	Beach House Beach	37º 30’08’’N	122º 28’37’’W
PPH-8	Inflow	Deer Creek Outlet	37º 30’08’’N	122º 28’38’’W
PPH-9	Beach	Inner Harbor Beach	37º 30’11’’N	122º 28’52’’W
PPH-10	Beach	Yacht Club Beach	37º 30’09’’N	122º 29’27’’W

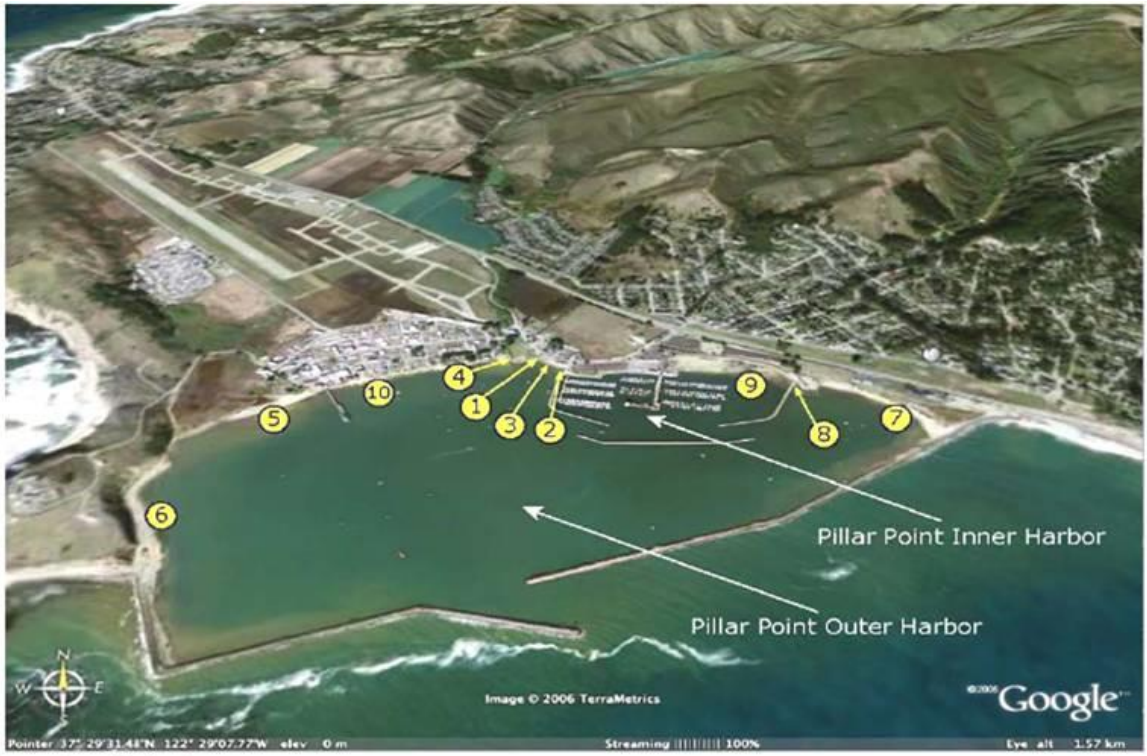
Table 3 - Latitude and longitude of live-aboard boat sampling sites

Site ID	Site description	Latitude	Longitude
Dock A	Inner Harbor Dock	37º 30’13’’N	122º 29’04’’W
Dock B	Inner Harbor Dock	37º 30’10’’N	122º 29’05’’W
Dock C	Inner Harbor Dock	37º 30’07’’N	122º 29’04’’W
Pump	Sanitary pumping station	37º 30’07’’N	122º 28’92’’W
OH 1	Outer Harbor	37º 30’07’’N	122º 28’67’’W
OH 2	Outer Harbor	37º 29’93’’N	122º 29’03’’W
OH 3	Outer Harbor	37º 30’08’’N	122º 29’17’’W

Table 4 - Latitude and longitude of upstream MST and FIB sampling sites

Site ID	Site description	Latitude	Longitude
PPH-1B	Upstream of Capistrano Outfall Pipe	37º 30’19’’N	122º 29’07’’W
PPH-2B	Upstream of Bathhouse Outfall Pipe	37º 30’35’’N	122º 28’40’’W
PPH-DN2	Upstream of Denniston Creek	37º 30’23’’N	122º 29’14’’W
PPH-DN3	Upstream of Denniston Creek	37º 30’35’’N	122º 29’17’’W
PPH-DN4	Upstream of Denniston Creek	37º 30’57’’N	122º 29’20’’W
PPH-DR4	Upstream of Deer Creek Outlet	37º 30’22’’N	122º 28’34’’W
PPH-DR6	Upstream of Deer Creek Outlet	37º 30’33’’N	122º 28’14’’W

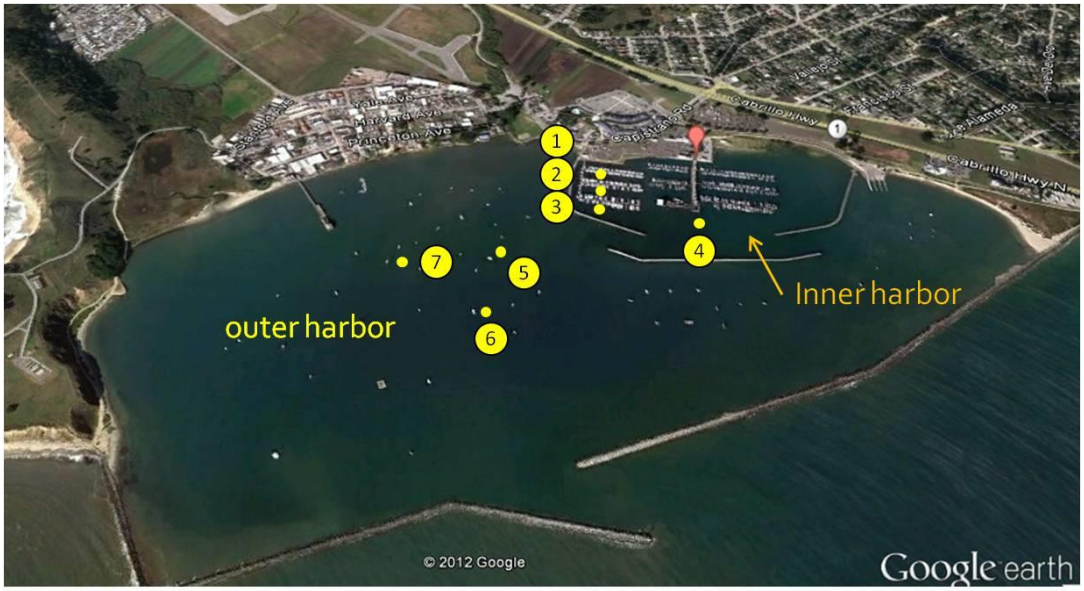
Figure 2 - Aerial view of the 10 primary sampling sites at PPH



Locations (Yellow):

1. Capistrano Outfall Pipe
2. Bathhouse Outfall Pipe
3. Capistrano Beach
4. Denniston Creek
5. Pillar Point Marsh Beach
6. Mavericks Beach
7. Beach House Beach
8. Deer Creek Outlet
9. Inner Harbor Beach
10. Yacht Club Beach

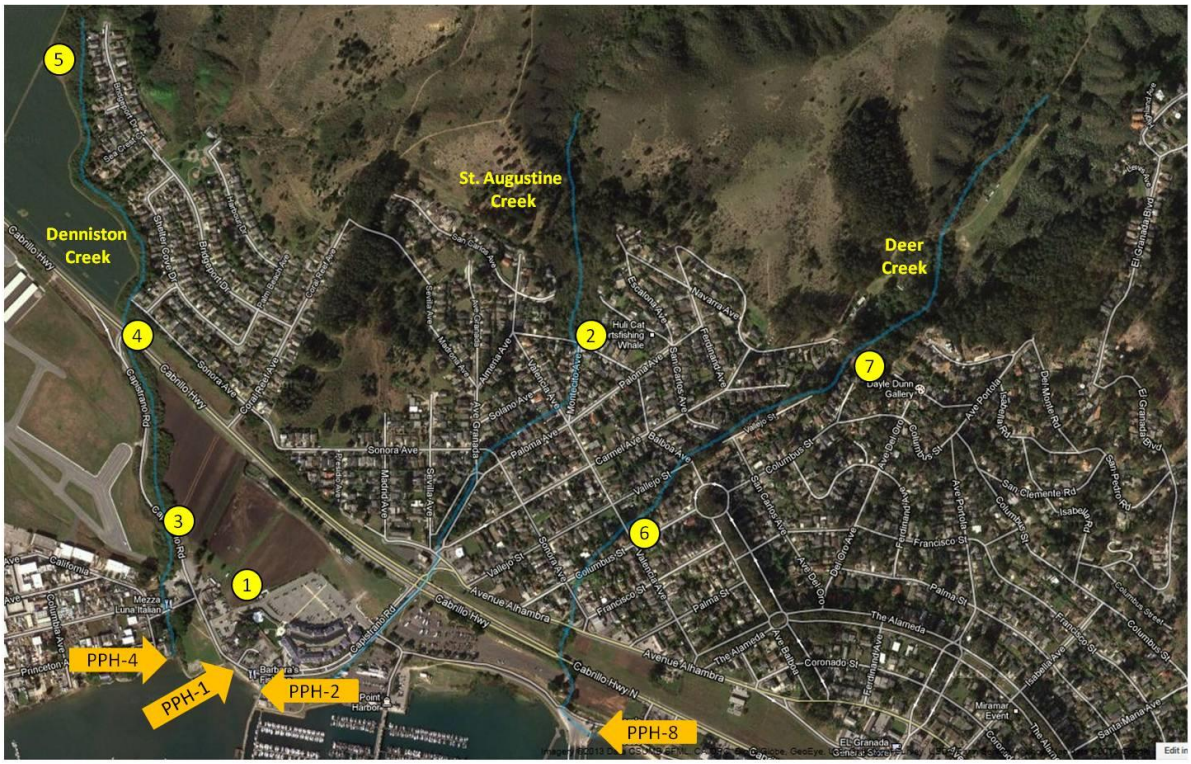
Figure 3 - Aerial view of live-aboard boat sampling sites



Locations (Yellow):

1. Dock A, Inner Harbor
2. Dock B, Inner Harbor
3. Dock C, Inner Harbor
4. Sanitary pumping station
5. OH1, Outer Harbor
6. OH2, Outer Harbor
7. OH3, Outer Harbor

Figure 4 - Aerial view of upstream sampling sites - arrows indicate inflow sampling sites, and numbers in a circle denote upstream sampling sites of each inflow.



Locations (Yellow):

1. PPH-1B (upstream of PPH-1)
2. PPH-2B (upstream of PPH-2)
3. PPH-DN2 (upstream of PPH-4)
4. PPH-DN3 (upstream of PPH-4)
5. PPH-DN4 (upstream of PPH-4)
6. PPH-DR4 (upstream of PPH-8)
7. PPH-DR6 (upstream of PPH-8)

PROJECT COSTS

Funding for this project was provided in part by the SWRCB and came from Proposition 50: the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002. This project was funded by the SWRCB in January 2008, but in December 2008 the State budget freeze occurred causing all bond-funded projects to cease work. When bond funds were un-frozen in 2010 the RCD revised the original project budget to account for the additional costs required to do a re-start of the project (because monitoring had been ceased mid-season, at least two full years of data collection were needed). The RCD requested these funds from the SWRCB and received them. In the meantime, the San Mateo County Harbor District provided funds for the completion of a report summarizing the findings of a circulation study, which was finalized in 2011. These funds from the Harbor District are the only additional funds provided for this project.

The total project cost was $924,338.45.

- The total amount awarded through the SWRCB Proposition 50 Nonpoint Source Grant was $1,048,294, and the amount spent was $909,338.45.
- The total amount awarded and spent through the San Mateo County Harbor District was $15,000 to complete the circulation study report.

PUBLIC OUTREACH

The RCD's approach to public outreach was strategic and multi-pronged. In addition multiple project updates given to the local media, the RCD conducted extensive volunteer recruitment for and public outreach about the project circulation study. Multiple presentations of study status and findings thus far were made at publicly noticed RCD Board of Directors, San Mateo County Harbor Commission and San Mateo County Board of Supervisors meetings between 2008 and 2012 as well as at many other meetings (see Outreach Activities below). TAC meetings also served as public outreach in a fashion because the TAC members represent significant stakeholder constituencies. In June 2013 the RCD held a public meeting for the local community to present the final findings of the project and to get public feedback on recommendations for remediation. This meeting was announced to the RCD project contacts list including many local agencies, publicly elected officials, organizations and individuals. In addition, the meeting was advertised in local media via local newspapers, online news websites and local online event calendars.

Outreach Activities

Presentations of project status and/or preliminary findings:

Bay Area Open Space Council: January 7, 2010

Fishnet 4-C (a five-county effort to restore salmonids): April 22, 2010

Golden Gate National Recreation Area: August 8, 2011

Gulf of the Farallones Marine Sanctuary Advisory Council: October 11, 2012

Half Moon Bay High School: October 9, 2008

National Beach Conference, April 20-22, 2009 (UC Davis presented a poster at this conference in Huntington Beach, CA)

Native Sons of the Golden West Steelhead Festival: August 9, 2011

Pescadero High School: March 17, 2010

Pescadero Municipal Advisory Council: April 10, 2012

San Francisco Bay Coastal Training Program Workshop, "Fecal Pollution in San Francisco Bay: New Predictive Tools for Decision Makers": February 13, 2009

San Mateo County Resource Conservation District Board of Directors: updated Board of Directors on project status and/or presented data collected up to that point at nearly every monthly Board of Directors meeting, 2008 to present (June, 2013)

San Mateo County Board of Supervisors: January 27, 2009, April 13, 2010, December 13, 2011, January 16, 2013,

San Mateo County Environmental Health Division: January 15, 2008

San Mateo County Harbor Commission: September 5, 2007, August 4, 2010, November 2, 2011, October 17, 2012

Skyline College: March 17, 2010

Sustainable Conservation: June 10, 2012

Presentation of final project findings and initial recommendations for remediation at public meeting:

San Mateo County Resource Conservation District, Public Meeting (hosted by the Half Moon Bay Yacht Club): June 8, 2013 – see Appendix F for presentation

PROJECT PERFORMANCE

This project was evaluated for its final performance using the Project Assessment and Evaluation Plan (PAEP), see the table below. The PAEP was developed at the beginning of the project and was approved by the grant manager to determine if the project had met certain goals, such as stakeholder/TAC participation, development of recommendations for remediation and attendance of public meetings to discuss findings. Detailed discussion of how each Project Goal was met is below, following the PAEP table.

PROJECT PERFORMANCE: Project Assessment and Evaluation Plan

Project Goals	Desired Outcomes	Output Indicators	Outcome Indicators	Measurement Tools and Methods	Targets
1. Investigate sources of fecal contamination impacting Pillar Point Harbor in order to develop strategies for remediation.	1. Assessment and analysis of existing data. 2. Creation of Technical Advisory Committee. 3. Investigation of sources of fecal contamination.	1. Written report summarizing assessment and analysis of existing data. 2. Regular meetings of TAC. 3. Draft report of sources of fecal contamination. 4. Public workshop to share information.	1. Participation and input of TAC. 2. Ability to develop and prioritize strategies for remediation of fecal contamination. 3. Attendance and local interest in public workshop.	1. Attendance of participants in TAC meetings. 2. Surface Water Ambient Monitoring Program 3. Targeted sampling protocol.	1. Identification of causes of contamination sufficient to develop strategies to remediate.
2. Develop and prioritize strategies to remediate fecal contamination in Pillar Point Harbor.	1. Recommended strategies to remediate fecal contamination.	1. Regular meetings of TAC. 2. Milestones and timeline for implementing remediation activities. 3. Identification of parties who may implement recommendations. 4. Draft monitoring plan and performance measures to track implementation of projects. 5. Public workshop to share information.	1. Participation and input of TAC. 2. Attendance and local interest in public workshop.	Non-point source pollution management measures as identified in the *California Non-Point Source Encyclopedia* and by the US EPA.	1. Written recommended goals and strategies by May 2013.

PAEP

Item 1

The first goal listed in the PAEP and the main purpose of this project was to "investigate sources of fecal contamination impacting Pillar Point Harbor in order to develop strategies for remediation".

The desired outcomes for this first goal were to complete an assessment and analysis of all accessible existing data about Harbor water quality, to create a TAC to advise and guide the project and finally to investigate sources of fecal contamination through monitoring.

The output indicators for these outcomes were: a written report summarizing and analyzing existing data (see Appendix G, *Pillar Point Harbor Source Identification Project Literature Review*), regular meetings of the TAC, a draft report on findings of the investigation of fecal sources and finally a public workshop where findings would be presented.

This project has succeeded in identifying some significant sources of fecal contamination at the Harbor and in ruling out certain sources such as horses or gulls as significant sources of FIB. This was accomplished both through compilation and assessment of existing monitoring data as well as through multiple years of water quality monitoring for FIB counts as well as Microbial Source Tracking through two lines of evidence – *Bacteroidales* host-specific genetic markers and analysis of samples using the PhyloChip technology. Although the project did not identify a "smoking gun" as the main source of bacteria at the sites of most concern, the monitoring data did indicate that the source of most of the FIB in the Harbor was coming from storm drains and creeks flowing into the Harbor at the beaches. This allowed for the development of recommendations for strategies to reduce fecal inputs from the upland area (see Recommendations section below), therefore meeting the target, "Identification of causes of contamination sufficient to develop strategies to remediate."

Item 2

The second goal listed in the PAEP was to "develop and prioritize strategies to remediate fecal contamination in Pillar Point Harbor".

The desired outcome for this second goal was to recommend remediation strategies that would reduce bacteria counts at Capistrano Beach, the site of most concern.

The output indicators for this desired outcome were: regular meetings of the TAC, milestones and timeline for implementing remediation activities, identification of parties who may implement recommendations, draft monitoring plan and performance measures to track implementation of projects, public workshop to share information.

This project has succeeded in identifying and prioritizing recommended strategies for remediation in the upland area. There are three highest priority recommendations that have been developed based on project findings. The first is for the continued outreach to upland land owners to help make the connection between the upland area and PPH as well as to encourage proper disposal of dog feces. The second recommendation is to perform additional GIS analysis of land-use to identify locations for implementation of Best Management Practices (BMPs) on private and public land to decrease FIB loads entering the storm drain system. The final recommendation is to pursue implementation of BMPs in the upland areas surrounding PPH and to monitor their efficacy. A concurrent County project also funded by the SWRCB is currently implementing BMPs within the storm drain system and on private properties and

public lands in the watersheds draining to the James V. Fitzgerald ASBS. The RCD recommends adapting the County's previously developed work plan and monitoring plan as appropriate to select and implement BMPs in the upland areas and monitor their success at filtering FIB, particularly during wet weather.

Although the final report including these and other recommendations was not completed by the target date of May, 2013, the project has succeeded in developing and prioritizing recommendations for remediation as well as goals and strategies for their implementation.

LESSONS LEARNED

- Urban Inputs: The key lesson learned from this project is that the high FIB counts at Capistrano Beach are ***a landscape-level issue, not based at or in the Harbor itself but rather in the upland urban area.***

- Pre-emptive Public Outreach: Extensive, up-front outreach regarding the circulation study, particularly the release of dye into the Harbor, resulted in minimal public concern or outcry about the impact of the dye on the harbor, boats, fish, crabs, etc...

- Oral History: Compiling an oral history and a myriad of public opinions about the high bacteria counts in PPH was key for this type of project. It allowed all stakeholders to share what they knew or suspected and informed the RCD of what monitoring and work had already been done to try to address the high counts.

- Adaptive Management: Adjusting the monitoring strategy during the study to increase data resolution at sites of most interest was crucial for the success of this project. Adaptive management during the project in real time allowed us to focus where we needed the most information and introduce new technologies to the project, such as additional marker assays and Phylochip.

- Pros and Cons of Different Approaches: There were limitations to each of the technologies used in the study. The addition of the Phylochip analysis was critical to this project – it gave us three lines of evidence to use and allowed us to confirm the initial MST findings.

- Landowner Outreach: Doing outreach to upstream landowners before final findings were released allowed us access to give technical assistance for BMPs. This also had the benefit of enabling us to see if there was a response in the monitoring data.

- Budget Freeze: The State budget freeze and stop work order had pros and cons – it jeopardized community confidence in the project and State and local agencies and made the project term very long, caused staff turnover, interrupted data collection and increased costs. However there is a silver lining, which is that the technology advanced in the meantime, increasing the usability of the data and therefore improving our data analysis and findings.

- Operational Knowledge: We found great value in integrating scientific knowledge and operational expertise on the project TAC. We consistently got helpful information and advice from Harbor staff and managers – they provided advice on where to do the dye releases during the circulation study, assisted with site selection for live-aboard boat monitoring, and assisted with sampling at the Harbor.

- Making Data Public: It was challenging to manage community demand for information before the study was complete. We found that there was a delicate balance between being transparent and accessible without releasing incomplete or misleading datasets, and packaging information by beach or monitoring site instead of by analyte was important.

- Recommendations: We anticipated that recommendations would prioritize controlling direct inputs of bacteria to the Harbor, such as from leaking pipes. We did not anticipate that we would make such strong recommendations to manage input from the upstream urban areas.

RECOMMENDATIONS AND NEXT STEPS

Tier 1 Priorities

1) **Continue conducting outreach to upland property owners.** We recommend development of a public outreach strategy that helps upland property owners make the connection between the landscape, stormwater runoff and the Harbor. The primary focus would be outreach targeted at reducing inputs from dog waste. A secondary focus would be increased outreach to reduce inputs from other pets, confined animals and livestock. The RCD has conducted outreach in other local watersheds to address confined animal sources of feces resulting in voluntary implementation of BMPs to reduce runoff of pathogens and nutrients. Another approach that serves both as a potential FIB load reduction and an outreach opportunity would be a "doggy clean-up" event where volunteers are organized to clean up dog feces and do outreach in target areas. An event like this could be sponsored by local rescue groups and pet-related businesses.

    - **Constraints:** availability of funding for staff time for outreach and event coordination, the ability of individual property/dog owners to make a connection between pet waste and impacts on "distant" waters, convincing property/dog owners that individual actions can make a difference, being able to reach a broad enough audience to make a difference
    - **Impediments:** current political environment of dog advocacy and restricted dog access
    - **Opportunities:** collaborate with local dog-owner and dog-walker groups
    - **Potential responsible parties:** RCD, local property owners and dog groups
    - **Project monitoring:** continued FIB monitoring at established inflow and upstream locations, particularly during storm events
    - **Performance measures:** volunteer turn-out to events, reductions in FIB counts at established inflow sites, particularly during storm events, direct measurements of weight of collected feces

2) **Conduct additional GIS analysis of land uses.** We recommend conducting additional GIS analysis of the land use and drainage features in the watersheds draining to PPH. The focus of this analysis would be to identify and prioritize locations for

implementation of stormwater filtering/catchment on private and public lands based on criteria such as but not limited to: proximity to stormwater catchment basins, sufficient space to implement BMPs such as planted filter areas, accessibility, property ownership and characterization of drainage area to that point (land use and area). Doing this analysis could serve as the first step to select, implement and evaluate the effectiveness of upland BMPs.

- **Constraints:** availability of funding to pay for staff time to do analysis, quality and availability of relevant GIS data
- **Impediments:** none
- **Opportunities:** collaborate with local agencies and organizations to compile GIS data from various sources
- **Potential responsible parties:** RCD
- **Project monitoring:** none
- **Performance measures:** (if BMPs are implemented) reductions in FIB counts from upstream to downstream of BMP implementation sites

3) **Pursue stormwater filtering BMPs.** We recommend implementation of appropriate BMPs in the upland area to filter stormwater. BMPs would be selected based on land use, location and potential to reduce transport of FIB to storm drains and local creeks. Some specific BMPs that may have the best potential to reduce pollutant runoff such as rainwater catchment, vegetated filter areas and infiltration areas would be specifically targeted. Use of vegetated filter areas have been found to be successful at significantly decreasing pollutant loads in storm water in other studies, including the afore-mentioned project in the James V. Fitzgerald ASBS (see Appendix E). The RCD will attempt to develop a proposal for funds to investigate, implement and evaluate effectiveness of these BMPs in the areas draining to PPH. This approach would also require collaboration and partnership with local private and public property owners and managers and potentially the County also, which the RCD is well-situated to do.

    - **Constraints:** availability of funding, availability of appropriate locations with sufficient size and spacing for BMP installation
    - **Impediments:** land ownership, permitting
    - **Opportunities:** lessons learned and leverage with SMC's Prop 84 ASBS demonstration sites and other RCD implementation sites
    - **Potential responsible parties:** RCD in partnership with private and public property owners (and possibly the County and other local and State agencies as needed)
    - **Project monitoring:** RCD recommends the monitoring approach used by the County, see Appendix E.
    - **Performance measures:** reductions in FIB counts from upstream to downstream of implemented BMPs and/or reductions in FIB counts at stormwater/creek outfall monitoring sites

Tier 2 Priorities

1) **Continue upstream bovine best management practices.** We recommend that the RCD continues to provide technical assistance in implementing BMPs on a property where there are cattle in the Deer Creek watershed. One should note that while the MST study did seem to indicate a "smoking gun" bovine source of bacteria in Deer Creek, it did not rule out wildlife. With outreach and technical assistance from the RCD and NRCS based on early findings of the project, the property owner began early implementation of BMPs to decrease the delivery of feces to the creek and eventually the Harbor.
    - **Constraints:** landowner willingness to continue BMP implementation
    - **Impediments:** none
    - **Opportunities:** could include funding from Farm Bill and other sources for riparian exclusionary fencing
    - **Potential responsible parties:** property owner, RCD, NRCS
    - **Project monitoring:** continued FIB monitoring at established inflow and upstream locations
    - **Performance measures:** reduction in FIB counts at established inflow and especially upstream monitoring locations

2) **Further investigate FIB contributions from sediment and biofilm in stormwater drainage system near outfalls.** The RCD recommends further investigation of the potential of sediment and biofilms in the tidally-influenced portion of the storm drainage system to affect FIB counts at Capistrano Beach with a qualified researcher, such as UCD. The potential load of FIB from re-suspended sediment must be determined in order to decide whether options for management of sediment and biofilms in the tidally-influenced portions of storm drains should be pursued. In addition to calculating potential FIB load, the RCD recommends investigating what other stormwater agencies have already done regarding sediment and biofilms. Whether or not sediment and biofilm management is a viable or effective option for decreasing the delivery of FIB to Capistrano Beach will depend on what others have discovered about the efficacy of approaches to decrease sediment and biofilms.

    - **Constraints:** availability of funding, availability/past use of appropriate approaches, usefulness of study data to do this kind of calculation
    - **Impediments:** none
    - **Opportunities:** possible technical assistance from SWRCB, possible County resources and knowledge, collaboration with other agencies/researchers also investigating sediment and biofilms
    - **Potential responsible parties:** RCD in partnership with UCD or other qualified researcher
    - **Project monitoring:** FIB monitoring in water, sediment and biofilms at outfall and upstream storm drain sites as accessible
    - **Performance measures:** completion of calculations of potential FIB load

Tier 3 Priorities

1) **Further investigate fecal sources from wildlife in the stormwater drainage system.** This is not a high priority recommendation because it is unlikely that identifying areas of heavy wildlife use would lead to recommendations for remediation. While this approach may help characterize the upstream inputs from wildlife not detected in the MST analysis, there are not likely to be any reasonable ways to prevent wildlife from entering the storm drainage system. Also, this approach would require additional time and money for doing the investigation.
    - **Constraints:** access to heavy-use areas, availability of funding for staff time to do field reconnaissance and report on findings, availability of funding for additional monitoring, limited cost-effective and feasible ways to restrict wildlife access, public objection to animal control
    - **Impediments:** none
    - **Opportunities:** none
    - **Potential responsible parties:** San Mateo County, RCD, open space landowners
    - **Project monitoring:** continued FIB monitoring at established inflow and upstream sites
    - **Performance measures:** none

2) **Pursue a Quantitative Microbial Risk Assessment and further investigate fecal sources from sewer inputs into the stormwater drainage system.** This project has created an opportunity to inform stakeholders of what the quantified health risk from the different fecal sources may be. Also, even though the data collected do not indicate that human sources are a significant part of understanding the human health risk may include doing additional investigation of the potential for sanitary systems to be a source of FIB. We recommend pursuing funding to complete a Quantitative Microbial Risk Assessment using data from this project and previously collected data as applicable, and to do further analysis of the local sewer system conditions and potential for delivery into the stormwater system. This approach may include monitoring if a problem area is indicated. This is not a high priority recommendation because the findings of this project did not indicate a significant source from humans and this approach would require additional time and money with little certainty that we would be able to make substantive recommendations based on the findings. It is also quite possible that the recommendations would remain the same as Tier 1 priorities. However, the risk assessment and additional information about the sewer system would be worthwhile information to report to stakeholders and possibly even the public.
    - **Constraints:** funding for Wuertz lab or others to perform Quantitative Microbial Risk Assessment, ability to find and access areas of possible sewer cross-over, funding for staff time to do GIS and field reconnaissance and report on findings, funding for additional monitoring
    - **Impediments:** none
    - **Opportunities:** potential in-kind contribution from local sanitary districts to scope sewer lines

- **Potential responsible parties:** San Mateo County, RCD, local sanitary districts
- **Project monitoring:** continued FIB and/or MST monitoring at established inflow and upstream sites
- **Performance measures:** none

Timeline for Implementation of Recommendations

Note: the following timelines were prepared in May 2013 and have not been updated to show current plans/timelines, although the approaches and activities are similar.

Tier 1 Priorities

1) The following anticipated timeline for this recommendation is contingent on funding and is an estimate only. The RCD will seek funding from local organizations, associations, businesses and other sources and will approach local property owners and dog owner/walker groups to collaborate on outreach strategies to the dog community in the areas surrounding PPH. The focus of the outreach will be on helping property owners and dog owners make the connection between the landscape and the Harbor, as well as trying to achieve some reduction in potential FIB through clean-up events at targeted heavy-use areas. The monitoring plan for these practices would likely be continuing the FIB monitoring during storm events at the established inflow sites. If these outreach activities happen concurrently with other projects, such as the practices mentioned above, then the monitoring for those projects may capture any changes in FIB concentrations during runoff events.

   June – July 2013: Seek funding to develop an outreach plan in collaboration with local dog groups. *(RCD)*

   August 2013: Conduct outreach events and "doggy clean-up" events as funding is available. Do direct measurements of weight of feces collected in order to estimate load reduction during rain events. *(RCD and partners)*

   September – October 2013: Conduct First Flush water quality monitoring at established Harbor inflow sites to determine bacteria concentrations. *(RCD)*

   October – December 2013: Share findings of monitoring and outreach activities with local dog and community groups as funding allows. *(RCD)*

2) The RCD plans to apply to future funding opportunities to perform the recommended GIS analysis, select priority sites and implement BMPs. Partnerships with local universities to have the GIS analysis done by graduate students may also be pursued, depending on timing and interest from students. The RCD will partner with private and public property owners as well as the County and other local and State agencies as appropriate depending on the locations where BMPs are recommended. The grant proposal may also include calculation of potential FIB load from sediments in the storm drain system as described above. The monitoring plan for these recommendations would be adapted from the County's previous monitoring plan for the James V. Fitzgerald Marine Reserve Pollution Reduction Program.

June – July 2013: Develop and complete proposal for Prop 50 funds. (*RCD)*

August 2013: Submit proposal to Prop 50 Clean Beaches Initiative Grant Program. *(RCD)*

January – August 2014: Complete GIS analysis. Select highest priority implementation sites for BMPs. Approach property owners/managers to partner on implementation of BMPs. Complete implementation at selected sites. *(RCD, private property owners, possibly the County, Caltrans or others)*

September 2014– March 2015: Conduct water quality monitoring before, during and after at least 3 storm events upstream and downstream of implemented practices to determine reduction in FIB concentration and concentrations of sediment. *(RCD)*

April – July 2015: Write report summarizing findings of monitoring and describing the efficacy of the implemented practices. If the practices are demonstrated to be highly successful at reducing FIB then additional funding to do more implementation may be pursued. *(RCD)*

Tier 2 Priorities

1) The following anticipated timeline is contingent on the willingness of the property owner in question to work with RCD and to implement BMPs to reduce fecal delivery to Deer Creek and the Harbor. Monitoring of the success of these practices is also contingent on funding, although if other monitoring efforts are underway concurrently this may provide a cost savings and still detect any changes in FIB concentrations.

   July – August 2013: Conduct additional outreach and offer technical assistance and possibly cost-share funds to Deer Creek watershed property owner to reduce bovine fecal inputs. *(RCD, NRCS, property owner)*

   August – September 2013: Implement additional recommended practices. *(property owner)*

   August – November 2013: Conduct water quality monitoring at established inflow and upstream monitoring locations to determine if there was a reduction in FIB. Report findings of monitoring to property owner. *(RCD)*

2) The following anticipated timeline for this recommendation is contingent on funding and is an estimate only. The RCD will attempt to pursue funding and partnerships with UCD or other appropriate researchers to do the recommended analysis and calculation of potential FIB load from sediment and biofilms. This work may be included in the afore-mentioned Prop 50 grant proposal, depending on the fit with the stated goals of the funding and availability of a researcher to do the work.

   June – August 2013: Investigate similar analyses and projects addressing sediment and biofilms. Determine whether an appropriate researcher from UCD or other group can do the load calculations. Develop a Prop 50 proposal for funding if deemed appropriate for the funding source. *(RCD, possibly in partnership with County)*

   August 2013: Submit proposal to Prop 50 Clean Beaches Initiative Grant Program. *(RCD and County)*

January – August 2014: Complete load calculations and compilation of information on sediment and biofilm management from other groups/agencies. *(RCD, County, researcher)*

September 2014– December 2014: Write report summarizing findings of load calculation and review of existing information on sediment and biofilm management. If the load calculations and compilation of existing information reveals that a substantial load reduction of FIB could be achieved from implementing some kind of sediment /biofilm management then additional funding to do more implementation may be pursued. *(RCD and County)*

Tier 3 Priorities

The following anticipated timeline is for both Tier 3 priority recommendations and is contingent on funding and willingness of partners to do the proposed work. Implementation of these recommendations may help identify sources of FIB that were not detected by the MST analysis, but is unlikely to result in additional recommendations that will substantively reduce counts of bacteria at Capistrano Beach. Water quality monitoring during the estimated timeline below would be solely to characterize FIB counts during the investigation period, not to determine efficacy.

July – August 2013: Approach and collaborate with SMC, local sanitary districts and open space property owners to do investigations of wildlife use of stormwater system and to identify areas in the sanitary system that are most likely to either leak or overflow into the stormwater system. *(RCD, SMC, sanitary districts, open space property owners)*

September – November 2013: Conduct wildlife surveys of storm drainage system. Conduct scoping of targeted areas of the sanitary system. Conduct water quality monitoring for ambient conditions and runoff events at established inflow and upstream sites. *(RCD, SMC, sanitary districts)*

December 2013: Report findings of wildlife surveys, sewer line scoping and water quality monitoring to all project partners. Develop strategies for remediation of problems discovered. *(RCD, SMC, sanitary districts)*