Appendix B

Staff Report

Justification for Delisting Muir Beach for Indicator Bacteria Impairment
Marin County, California

STAFF REPORT

REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

April 1, 2014

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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1. PROJECT DEFINITION

1.1 Background

In 2006, the section of the Pacific Ocean adjacent to Muir Beach (Muir Beach) was added to California's Clean Water Act Section 303(d) List (303(d) list) of impaired water bodies due to impairment of the water contact recreation beneficial use caused by excessive levels of indicator bacteria. This listing was based on indicator bacteria data collected from April 2003 through October 2005.

Recreational use of waters with elevated indicator bacteria concentrations has long been associated with adverse public health effects. National epidemiological studies have demonstrated that there is a causal relationship between adverse health effects and recreational water quality as measured by indicator bacteria concentrations. The Beach and adjacent ocean waters lie within the jurisdiction of the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board).

1.2 Proposed Delisting

We are proposing to delist Muir Beach for indicator bacteria impairment. Data collected over the past eight years (i.e., from 2005 – 2013) at this location have shown a significant improvement in water quality conditions such that waters are no longer impaired by indicator bacteria. We have:

1. compiled and analyzed all existing indicator bacteria water quality data from Muir Beach, and
2. summarized recent actions in the Redwood Creek watershed, Muir Beach's main tributary watershed, that are likely to have resulted, and will continue to result, in improved water quality.

1.3 Analyses Supporting Delisting

To evaluate Muir Beach's current water quality status, we reviewed total coliform, fecal coliform, and enterococcus indicator bacteria data for the time period of April 2005 to June 2013. These data were collected as part of the routine beach water quality monitoring program conducted by the Marin County Environmental Health Department, on a weekly basis, from April through October of each year. Section 4 summarizes the results of these data analyses. Appendix A contains the raw indicator bacteria data.

Review of the available data (from April 2005 to June 2013) shows attainment of the indicator bacteria water quality objectives and the water contact recreational beneficial use is supported at Muir Beach. The Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (Listing Policy) (State Water Resources Control Board 2004) specifies the maximum allowable frequency of exceedance of applicable water quality objectives to make a determination that the water body may be delisted. Section 4.3 and Table 4.2 of the Listing Policy specify that for bacterial measurements, a water body may be delisted when numeric water quality objectives are exceeded in effectively fewer than or equal to approximately 10 percent of analyzed samples. The recent water quality data, from April 2005 to June 2013, showed bacteria levels well below the delisting water quality objective exceedance thresholds specified in the Listing Policy. The observed exceedance frequencies for total coliform, fecal coliform, and enterococcus indicator bacteria ranged from 0.0% to 1.7% over eight years. Therefore, we conclude that water quality conditions at Muir Beach have improved since the original 303(d) listing in 2006, and the water body is no longer impaired.

2. WATERSHED DESCRIPTION

2.1 Water Body Location and Land Use

Muir Beach is located 16.5 miles northwest of San Francisco in western Marin County (Figure 1). Muir Beach is about 1,000 feet long and 200 feet wide, with coarse sand and several large boulders. Muir Beach is used by visitors for a variety of water contact and non-water contact recreational activities, such as: swimming, picnicking, strolling, boogie boarding, surfing, and kayaking.

Muir Beach is flanked to the northwest by about 150 homes, which are perched on steep hills, and on the east side by the open space bluffs and hiking trails of the Golden Gate National Recreation Area (Figure 2). The population of the unincorporated community of Muir Beach was estimated at 310 at the 2010 census.

The main source of freshwater discharge to Muir Beach is Redwood Creek, which begins in the peaks of Mount Tamalpais and flows through the forests of Muir Woods, open expanses of grassland, chaparral, ephemeral wetlands, and niches of riparian woodland, until it finally reaches the Pacific Ocean at Muir Beach. Green Gulch is the largest tributary of the lower Redwood Creek area. Green Gulch and another tributary, often referred to as the Golden Gate Dairy tributary, join Redwood Creek less than half a mile upstream of the mouth of Redwood Creek. The area near the mouth of the Creek is known historically as Big Lagoon. Due to historical upstream logging and cattle grazing activities, the Lagoon has silted in and looks quite different than it did towards the middle of the 19th century. As a result, it has been the focus of extensive ecological restoration efforts in recent years.

The entire Redwood Creek watershed encompasses an area of less than nine square miles. According to the National Land Cover Database 2006 (MRLC 2006), the Redwood Creek watershed's land cover is comprised as 55% forest land; 38% grass land; 5% urban and built-up; 1% wetlands; and 1% agricultural land, and water (Figure 3).

The only commercial businesses of a significant size and potential to impact bacterial water quality at Muir Beach, in the Redwood Creek watershed, are the Pelican Inn, which consists of a small lodge and a restaurant, and the Golden Gate Dairy Stables horse boarding facility. Other land uses of note in the watershed are the Green Gulch Zen Center and Muir Woods National Monument.

Golden Gate Dairy Stables provides full time horse boarding by the day, week, or month during the dry months. They also board horses overnight for guests at the Pelican Inn. It does not, however, offer any rental trail rides.

The Green Gulch Zen Center is a Buddhist practice center that offers training in Zen meditation. In addition to the temple program of Zen and study, it includes an organic farm and garden, as well as a guest house and conference center.

About two miles inland from Muir Beach lies Muir Woods National Monument, a 550-acre park with some of the last remaining old growth Coast Redwoods in the San Francisco Bay Area. Muir Woods caters to pedestrians with various hiking trails. Picnicking, camping, and pets are not permitted in the park.

Figure 1. Location of Muir Beach and the Redwood Creek Watershed

Figure 2. Aerial photo of Muir Beach and its immediate land use, showing low density residential areas on the steep hills to the left and open space bluffs and trails to the right. Redwood Creek and the area near its mouth, the “Big Lagoon,” are seen immediately upstream of Muir Beach.

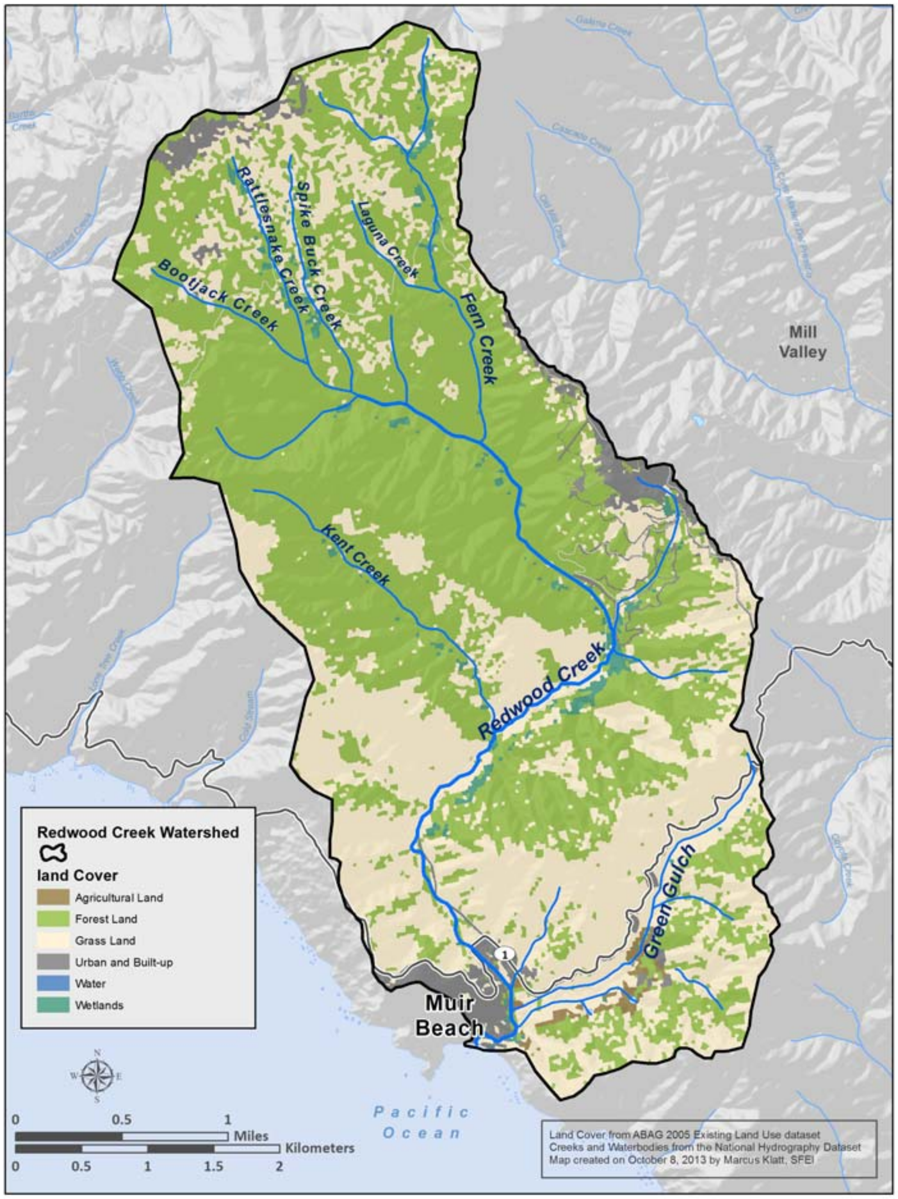

Figure 3. Redwood Creek Watershed Land Use

2.2 Potential Indicator Bacteria Sources

Indicator bacteria are delivered to water bodies by a wide variety of point and non-point sources. Point sources are those where the discharge to a water body is at a discrete physical location or "point." Some examples of point sources of bacteria are wastewater treatment facilities, sanitary sewer overflows, and animal feedlots. In contrast, non-point sources are diffused and spatially distributed in a catchment or watershed. Wildlife, livestock, pastures, domestic pets, and onsite wastewater treatment systems are a few examples of non-point sources of bacteria. The main sources of indicator bacteria in the Redwood Creek watershed likely are of the non-point source category.

While no bacterial source tracking study has been conducted in the watershed, based on our knowledge of the watershed, the key potential sources of indicator bacteria are likely to be:

- **Onsite wastewater treatment systems (OWTSs, septic systems)**. Septic systems that are poorly installed or maintained, faulty, improperly located, or are in close proximity to water bodies are potential sources of indicator bacteria to surface and ground waters.

  All residential buildings near the mouth of Redwood Creek are on septic systems. Local geology and topography can be challenging for septic systems, as the residential parcels are located on rocky land with steep slopes and limited suitable areas for leachfields. However, due to the recent Redwood Creek channel realignment (see section 2.3), these septic systems are not likely to cause bacterial exceedances at Muir Beach.

  The Green Gulch Zen Center, which is located on Green Gulch Creek, one of the main tributaries to Redwood Creek, is also on septic. Several Zen Center buildings are built near the culverted portion of the Green Gulch Creek and could be a potential source of bacteria to the Creek if there were leaks in sewer pipes. However, the Zen Center has a long-term capital improvement and restoration plan that would be likely to address any such impacts.

- **Public Restroom Facilities**. Until recently, there were several porta-potties at the Muir Beach parking lot in relatively close proximity to Redwood Creek. However, as of November 2013, these facilities have been replaced with vault toilets and, along with the parking lot, have been relocated to a site further away from the Creek bank. Sanitary waste from the Muir Woods restroom facilities is collected and piped out of the watershed. Therefore, these facilities are not believed to be a source of indicator bacteria to the nearby water bodies.

- **Horse facilities and riding trails**. There is one horse boarding facility and multiple riding trails within the Redwood Creek watershed. If horses and their waste are not properly managed at these sites, they could contribute indicator bacteria through direct deposit and/or surface runoff to nearby water bodies. However, staff does not believe potential bacteria contributions from these sites are significant.

- **Wildlife**. A variety of wildlife resides in the watershed. Directly-deposited or runoff-delivered wildlife waste can be a source of indicator bacteria to the receiving water bodies.

- **Stormwater runoff**. Stormwater runoff can be a significant source of indicator bacteria, delivering bacteria present in the waste of domestic pets, wildlife, livestock, litter, and spilled sewage to water bodies.

2.3 Changes in Observed Indicator Bacteria Concentrations

Since the original listing, contributions from the above sources to Muir Beach have changed. In recent years, the area near the mouth of Redwood Creek has been the focus of an extensive restoration project called the "Redwood Creek Restoration at Muir Beach." These restoration efforts have coincided with a substantial decrease in indicator bacteria discharges to the Creek and ultimately Muir Beach by:

- limiting human and animal (e.g., pets, wildlife, horses) access to the Creek,
- creating natural vegetated buffers along the Creek that act as bacteria filters, and
- relocating the creek channel away from residential areas with potentially faulty septic systems.

The following summarizes the restoration project and the key attendant changes, which are expected to help maintain and continue the improved water quality at Muir Beach into the future.

2.3.1 Redwood Creek Restoration at Muir Beach

Until recently, before reaching Muir Beach, Redwood Creek flowed through a highly modified lagoon. Years of farming and development at and near Muir Beach had caused habitat fragmentation, poor flow and sediment conveyance, flooding, fish stranding, and inadequate winter habitat for juvenile salmon and trout in Redwood Creek. In 2009, a multi-year, landscape-level coastal restoration project was undertaken by the National Park Service (NPS) to restore the ecological functions of the Creek, freshwater wetlands, intermittent tidal lagoon, and dunes over a 46-acre site at the mouth of this iconic Bay Area watershed (National Park Service 2013).

The recently-completed project reconnected the floodplain over the entire site and created habitat for threatened and endangered species like coho salmon, steelhead trout, and California red-legged frogs. Additionally, NPS has relocated the Creek away from the hills with residential development and its associated septic systems. The effect of this relocation has been to increase the upland buffer between the hillside septic systems and the Creek by an average of several hundred feet. The increased buffer is likely to have reduced, and will continue to reduce, any potential discharges from the septic systems to the Creek.

A new 225-linear foot pedestrian bridge, with a visitor gathering area, also now spans the creek and its floodplain, providing access to the Muir Beach while protecting these habitats and the plants and animals that live there. The bridge significantly reduces human and horse access to the Creek and Lagoon, and decreases the potential for bacteria discharges from these sources to reach the Creek and, ultimately, Muir Beach. About 500 linear feet of the Coastal Trail was also realigned in 2010 to allow a weedy, eroded ravine and hillside that drain into the Creek to be fully restored. This restoration effort is likely to have resulted in better filtration of bacteria discharges in stormwater runoff and, therefore, improved water quality at Muir Beach.

Lastly, the project permanently reconfigured and relocated the visitor parking lot away from the main creek channel and its floodplain and replaced the previous parking lot porta-potties with new vault toilets that are more secure and further away from the creek bank. These changes will result in a decrease in any bacteria contribution from the parking lot and restroom facilities to the Creek and Beach. Figures 4 and 5 show the pre- and post-project restoration elements, respectively.

Since some of the above changes are fairly recent, and thus not yet reflected in water quality monitoring data, we expect the observed improvement in Muir Beach’s water quality to continue in the future.

Figure 4. Redwood Creek Restoration Site at Muir Beach – Pre-Project

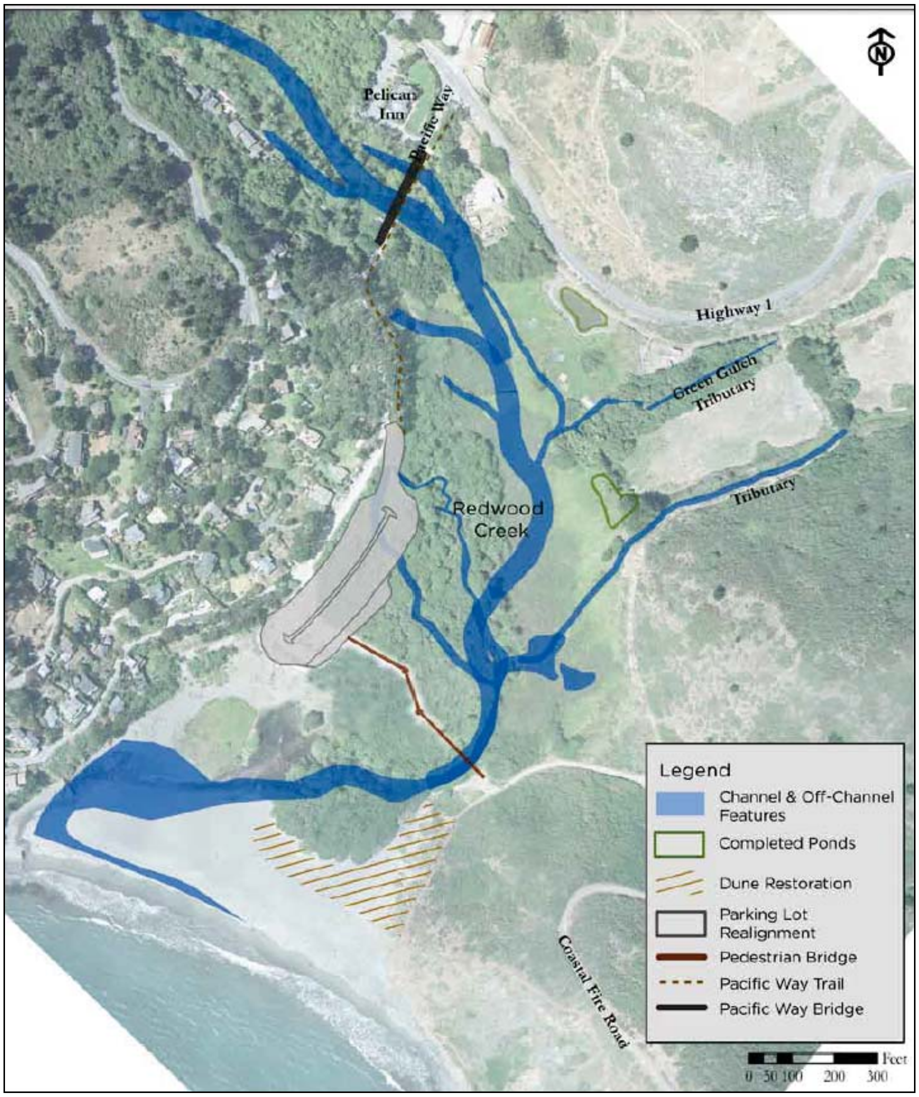

Figure 5. Redwood Creek Restoration Site at Muir Beach – Post-Project

3. WATER QUALITY OBJECTIVES

This section discusses the indicator bacteria used as indicators of waterborne pathogens and the water quality objectives based on those indicator bacteria that are applicable to Muir Beach.

3.1 Use of Indicator Bacteria as Indicators of Pathogens

More than 100 types of pathogenic microorganisms can occur in water polluted by fecal matter and cause outbreaks of waterborne disease (Havelaar 1993).

The detection and enumeration of all pathogens of concern is impractical in most circumstances. Many different pathogens can reside in a single water body, and organism-specific detection methods are costly and time consuming (U.S. EPA 2002). Therefore, indicator organisms are commonly used to assess microbial water quality for recreational uses. Several types of indicator bacteria colonize the intestinal tracts of warm-blooded animals and are routinely shed in their feces. These organisms are not necessarily pathogenic but are abundant in wastes from warm-blooded animals and are easily detected in the environment. The detection of indicator organisms indicates that the environment is contaminated with fecal waste and that pathogenic organisms may be present.

Commonly used bacterial indicators of fecal contamination include total coliform, fecal coliform, *E. coli,* and enterococcus:

- Total coliform include several genera of bacteria commonly found in the intestines of warm-blooded animals. However, many types of coliform bacteria grow naturally in the environment—that is, outside the bodies of warm-blooded animals.
- Fecal coliform are a subset of total coliform and are more specific than total coliform to wastes from warm-blooded animals but not necessarily to humans.
- *E. coli* are a subset of fecal coliform and are thought to be more closely related to the presence of human pathogens than fecal coliform (U.S. EPA 2002).
- Enterococcus represents a different bacterial group from coliform and is also regarded to be a good indicator of fecal contamination from warm-blooded animal sources, especially in salt water (*ibid.*).

3.2 Water Quality Standards

Under the authority of the federal Clean Water Act, the Water Board has established water quality standards for recreational uses. Water quality standards consist of: the beneficial uses of the water body in question, water quality objectives (WQOs) (numeric or narrative) to protect those beneficial uses, and the State of California’s antidegradation policy, which requires continued maintenance of existing high-quality waters.

3.2.1 Beneficial Uses

The beneficial use for which Muir Beach is listed as impaired by high levels of indicator bacteria is the water contact recreation use (REC-1) (Water Board 2013). This beneficial use is defined as: uses of water for recreational activities involving body contact with water such that ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs.

3.2.2 Water Quality Objectives

The State Water Resources Control Board (State Water Board) has established WQOs to protect REC-1 in ocean waters (e.g., Muir Beach) from bacterial contamination. These WQOs are contained in the State Water Board’s Water Quality Control Plan for Ocean Waters of California (Ocean Plan) and are summarized in Table 1 (State Water Board 2009).

Table 1. Water Quality Objectives for Water Contact Recreation in Ocean Waters

Objective Type	Indicator Bacteria	Standard
Single Sample Maximum[a]	Total Coliform	10,000 MPN[d]/100 mL
	Fecal Coliform	400 MPN/100 mL
	Enterococcus	104 MPN/100 mL
30-day Geometric Mean[b]	Total Coliform	1,000 MPN/100 mL
	Fecal Coliform	200 MPN/100 mL
	Enterococcus	35 MPN/100 mL
Value cannot be exceeded if ratio of fecal/total coliform is greater than 0.1[c]	Total Coliform	1,000 MPN/100 mL

a. The "single sample maximum" objective means that no sample can exceed the corresponding water quality standard value (e.g., 400 MPN/100 mL for fecal coliform).

b. The geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers. It is calculated by multiplying all the numbers in a data group, and taking the n^{th} root of the total. For the numeric objectives listed in this table, the geometric mean is calculated based on the five most recent samples from each site during a 30-day period.

c. If the ratio of the concentration of the fecal coliform sample to the concentration of the total coliform sample is higher than 0.1, then concentration of the total coliform sample must be no greater than 1000 MPN/100 mL.

d. Most Probable Number (MPN) is a statistical representation of the results of the standard bacteria test.

4. DATA ANALYSIS

4.1 Water Quality Data

Indicator bacteria data to characterize the condition of Muir Beach were collected from April 2005 to June 2013. These data were collected as part of the beach water quality monitoring program conducted by the Marin County Environmental Health Department, on a weekly basis, from April through October of each year, as required and specified by sections 115880, 115885, and 115915 of the Health and Safety Code relating to public beaches. This code states that for coastal beaches "testing shall be conducted on at least a weekly basis, from April 1 to October 31, inclusive, of each year…." This requirement is intended to protect beach water contact recreational users during the highest-use period of the year. Since this time period does not include the wetter months of the year (i.e., November through March), during which bacteria levels could be higher due to stormwater runoff, the Listing Policy requires a more conservative (protective) bacteria water quality objective exceedance threshold (i.e., 10%) for delisting a water body based on data generated from this type of monitoring, than it does when year-round data is used (i.e., 16%).

All the samples were collected by one entity and collection and analyses were based on the *Marin County's Public Health Laboratory's Standard Operating Procedures for Water Sample Collection at Beaches and Creeks*. These data meet the requirements for comparison to applicable water quality objectives (e.g., sufficient frequency, number of samples, time period, etc.) and are considered to be of consistent and high quality.

There are three separate water quality monitoring stations at Muir Beach that are less than 200 meters apart (i.e., the distance between the North and South stations is less than 200 meters) (Table 2 and Figure 6). Since the use patterns and indicator bacteria sources for all three stations at Muir Beach are similar, and since these stations are in close hydrologic and geographic connection to each other (i.e., they are spatially dependent), we determined that it was appropriate to consider samples collected at these stations as samples from the same station. Accordingly, the results from these three stations were averaged. The Listing Policy also supports this approach. Section 6.1.5.2 of the Listing Policy suggests that samples collected within 200 meters of each other should be considered samples from the same station or location.

Table 2. Inventory of Water Quality Monitoring Stations at Muir Beach

Station ID	County	Latitude	Longitude
Muir Beach, North	Marin	37.85993	-122.57728
Muir Beach, Central	Marin	37.85932	-122.57632
Muir Beach, South	Marin	37.85807	-122.57497

Figure 6: Muir Beach Sampling Stations

4.2 Data Analysis Summary

We analyzed all of the available data from April 2005 to June 2013 for both the single sample maximum and geometric mean indicator bacteria objectives and found they meet the delisting policy limits. Therefore, the water contact recreation beneficial use is not impaired by indicator bacteria levels at Muir Beach. Table 3 provides a summary of the results of the analyses conducted on the data. Figures 7 through 12 depict the single sample and geometric mean data for total coliform, fecal coliform, and enterococcus indicator bacteria from April through October of each year from April 2005 to June 2013.

Table 3. Muir Beach Indicator Bacteria Data Analyses Summary

Indicator Bacteria	Years of collection	Water Quality Objective (MPN/100 mL)	Type of Water Quality Objective	Number of Exceedances/ Number of Samples	Percent Exceedance
Total Coliform	2005-2013	10,000	Single Sample Maximum	1 / 234	0.4%
Total Coliform	2005-2013	1,000	Geometric Mean	0 / 171	0.0%
Fecal Coliform	2005-2013	400	Single Sample Maximum	2 / 234	0.9%
Fecal Coliform	2005-2013	200	Geometric Mean	0 / 171	0.0%
Enterococcus	2005-2013	104	Single Sample Maximum	4 / 234	1.7%
Enterococcus	2005-2013	35	Geometric Mean	1 / 171	0.6%

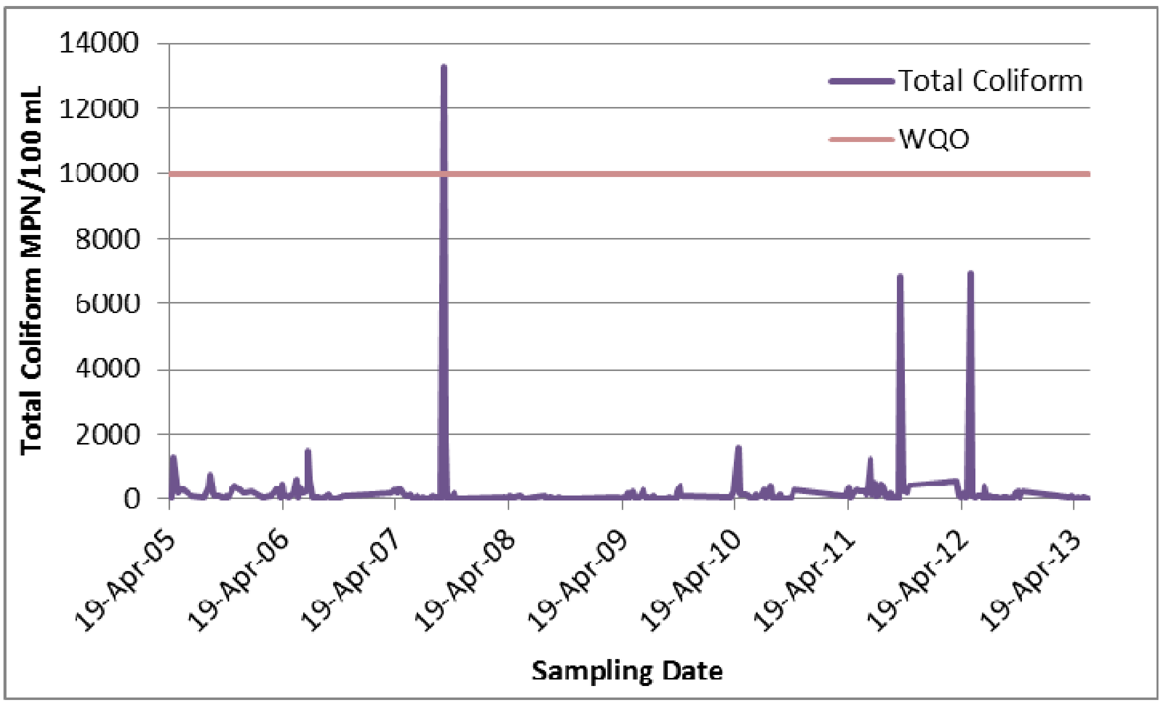

Figure 7. Single Sample Total Coliform Concentrations (from April through October of each year)

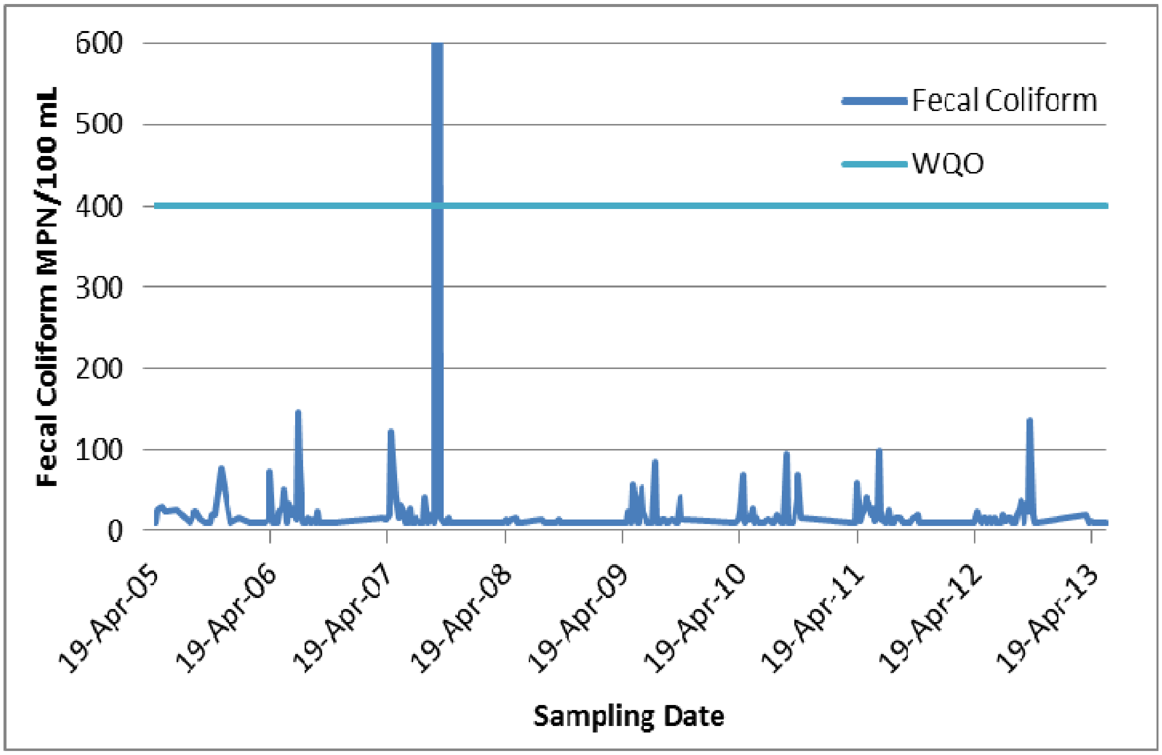

Figure 8. Single Sample Fecal Coliform Concentrations (from April through October of each year)

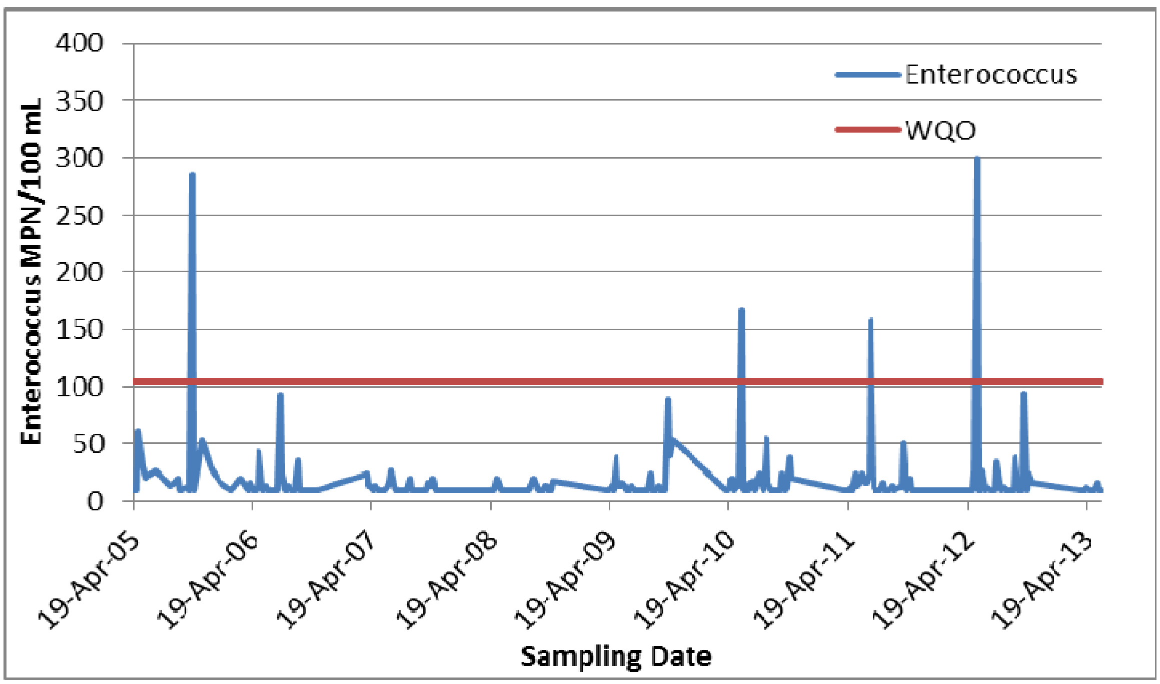

Figure 9. Single Sample Enterococcus Concentrations (from April through October of each year)

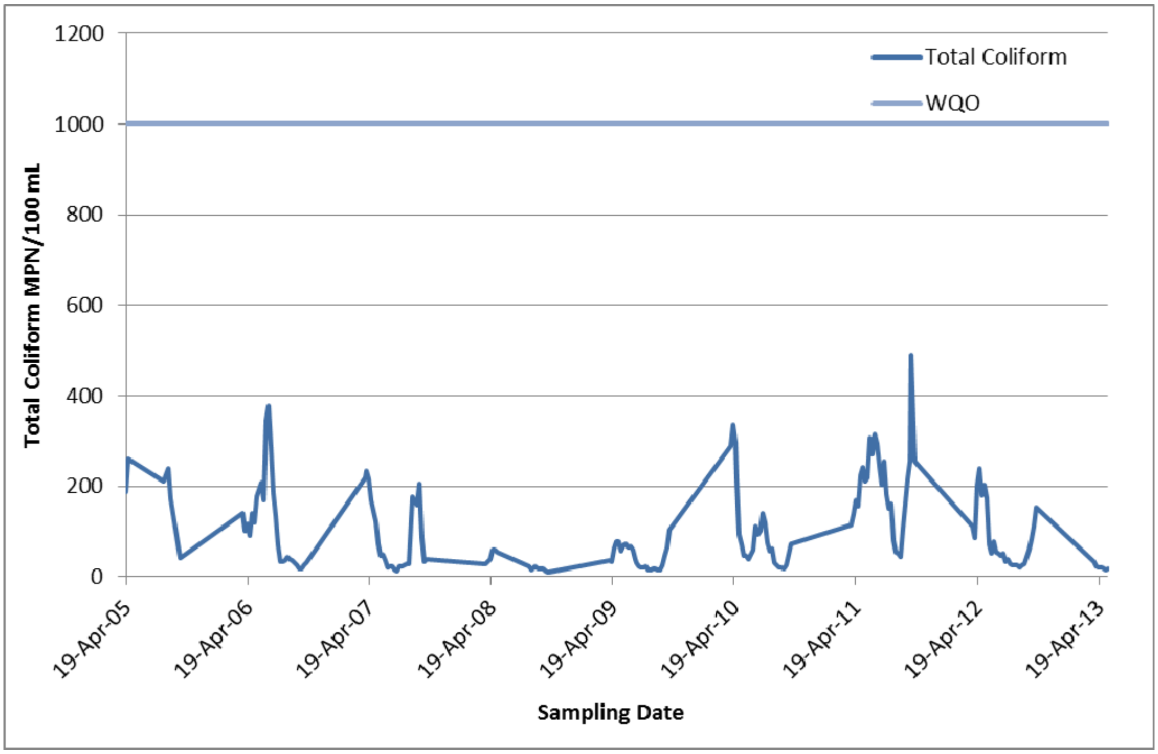

Figure 10. Geometric Mean of Total Coliform Concentrations (for each five consecutive samples; from April through October of each year)

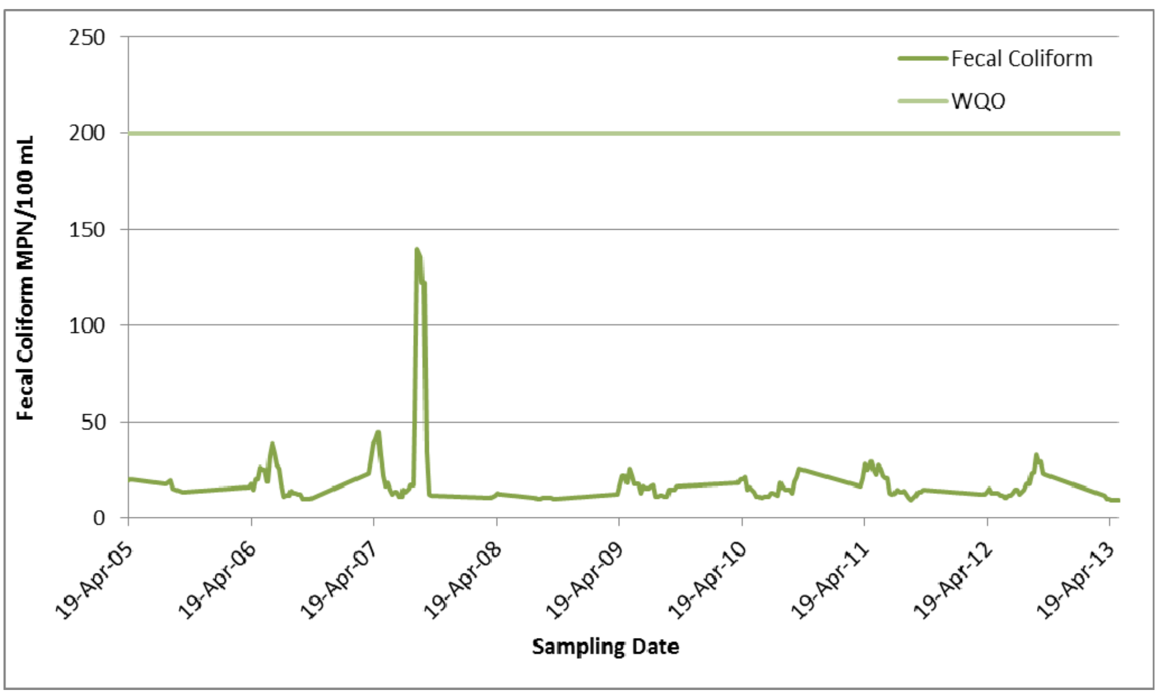

Figure 11. Geometric Mean of Fecal Coliform Concentrations (for each five consecutive samples; from April through October of each year)

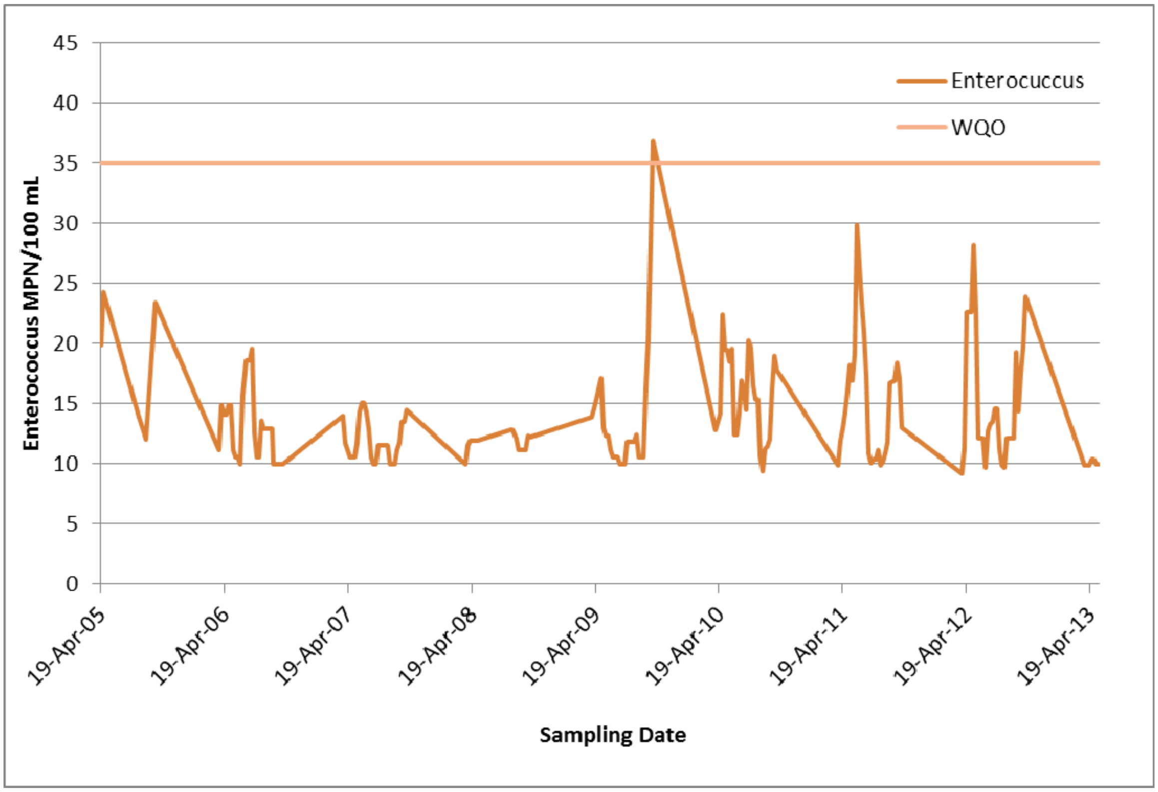

Figure 12. Geometric Mean of Enterococcus Concentrations (for each five consecutive samples; from April through October of each year)

5. RATIONALE FOR DELISTING

Water quality conditions in the Pacific Ocean at Muir Beach, as observed from April 2005 through June 2013, show attainment of the indicator bacteria water quality objectives, and the water contact recreation beneficial use is supported in this water body. The analysis of the recent water quality data showed they meet the delisting limits specified in the Listing Policy. Therefore, we conclude that water quality conditions at Muir Beach have improved since the original 303(d) listing in 2006 and that the water body is no longer impaired and should be removed from the 303(d) list as being impaired by indicator bacteria.

6. REFERENCES

1. California State Water Resources Control Board (State Water Board). 2004. *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (Listing Policy).* Sacramento, California.

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Appendix A

Bacteriological Water Quality Data

Note: All units are in MPN/100 mL

Date	TC-N	TC-C	TC-S	FC-N	FC-C	FC-S	EN-N	EN-C	EN-S
19-Apr-05	233	9	31	41	9	10	9	9	9
26-Apr-05	145	10	10	10	9	9	10	9	9
3-May-05	3448	292	10	52	20	9	41	10	135
17-May-05	528	52	10	63	20	10	75	9	9
24-May-05	906	86	20	52	9	9	41	10	9
28-Jun-05	243	10	10	63	9	9	63	9	9
9-Aug-05	135	10	41	10	9	9	10	9	20
23-Aug-05	908	41	10	52	10	9	30	9	9
30-Aug-05	2143	41	10	52	10	9	41	9	9
6-Sep-05	171	20	221	9	9	41	9	9	10
13-Sep-05	199	85	20	10	20	9	9	9	9
27-Sep-05	189	10	63	9	9	10	20	9	9
11-Oct-05	10	9	31	9	9	9	9	9	9
18-Oct-05	209	10	9	41	9	9	836	10	9
25-Oct-05	10	9	52	9	9	41	10	9	9
15-Nov-05	1210	10	20	203	10	20	134	20	9
13-Dec-05	504	52	10	10	10	10	63	10	10
10-Jan-06	529	110	10	31	10	10	20	20	10
14-Feb-06	31	10	146	10	10	10	10	10	10
14-Mar-06	275	41	31	10	10	10	41	10	10
4-Apr-06	836	62	41	10	10	10	10	10	10
11-Apr-06	119	31	41	20	10	10	30	10	10
18-Apr-06	1043	298	31	201	10	10	10	10	10
25-Apr-06	148	10	63	10	10	10	10	10	10
2-May-06	63	156	31	10	10	10	10	10	10
9-May-06	120	10	41	10	10	10	109	10	10
16-May-06	318	62	20	52	10	10	20	10	10
24-May-06	336	63	20	63	10	10	10	10	10
31-May-06	1785	63	10	134	10	10	20	10	10
6-Jun-06	97	10	10	10	10	10	10	10	10
13-Jun-06	1137	41	10	85	10	10	10	10	10
22-Jun-06	565	10	10	41	10	10	10	10	10
27-Jun-06	520	98	10	63	10	10	10	10	10
5-Jul-06	581	20	41	20	10	10	10	10	10
11-Jul-06	3441	862	10	345	85	10	109	160	10
18-Jul-06	1182	10	627	41	10	187	41	10	20
25-Jul-06	109	31	10	10	10	10	10	10	10
1-Aug-06	52	10	10	10	10	10	10	10	10
8-Aug-06	63	63	10	10	10	10	20	10	10
15-Aug-06	85	51	10	10	31	10	10	10	10
22-Aug-06	10	10	41	10	10	10	10	10	10
29-Aug-06	63	31	41	10	10	20	10	10	10
6-Sep-06	30	20	41	10	10	10	10	86	10
12-Sep-06	275	52	63	20	10	41	10	10	10
19-Sep-06	10	10	52	10	10	10	10	10	10
26-Sep-06	10	10	31	10	10	10	10	10	10
3-Oct-06	10	20	20	10	10	10	10	10	10

Date	TC-N	TC-C	TC-S	FC-N	FC-C	FC-S	EN-N	EN-C	EN-S
10-Oct-06	10	10	20	10	10	10	10	10	10
17-Oct-06	10	52	10	10	10	10	10	10	10
25-Oct-06	41	10	20	10	10	10	10	10	10
1-Nov-06	281	10	41	10	10	10	10	10	10
5-Apr-07	462	20	10	31	10	10	52	10	10
10-Apr-07	548	75	10	10	20	10	20	10	10
17-Apr-07	749	41	10	20	10	10	20	10	10
25-Apr-07	457	10	52	41	10	10	10	10	10
1-May-07	86	839	20	75	279	10	10	20	10
9-May-07	98	573	20	86	98	10	10	10	10
15-May-07	269	131	31	85	31	10	10	10	10
22-May-07	160	10	62	10	10	31	10	10	10
29-May-07	228	10	10	75	10	10	10	10	10
5-Jun-07	209	158	41	10	52	10	20	10	10
12-Jun-07	31	10	10	10	10	10	31	10	10
19-Jun-07	10	10	30	10	10	10	10	41	30
27-Jun-07	75	63	108	41	31	10	10	10	20
3-Jul-07	10	41	10	10	10	10	10	10	10
10-Jul-07	10	10	10	10	10	10	10	10	10
17-Jul-07	10	52	10	10	31	10	10	10	10
24-Jul-07	10	10	31	10	10	10	10	10	10
1-Aug-07	10	10	10	10	10	10	10	10	10
7-Aug-07	10	10	20	10	10	10	10	10	10
15-Aug-07	231	85	10	85	30	10	41	10	10
21-Aug-07	20	10	52	10	10	10	10	10	10
28-Aug-07	31	30	10	20	30	10	10	10	10
5-Sep-07	10	20	41	10	10	31	10	10	10
11-Sep-07	10	20	10	10	10	10	10	10	10
18-Sep-07	24192	15531	10	24192	4611	10	10	10	10
25-Sep-07	379	10	4884	345	10	4611	10	10	10
2-Oct-07	10	10	31	10	10	31	10	10	10
9-Oct-07	10	41	10	10	10	10	20	20	10
17-Oct-07	41	86	10	10	10	10	10	20	10
23-Oct-07	437	20	41	31	10	10	41	10	10
30-Oct-07	20	10	20	10	10	10	10	10	10
1-Apr-08	41	20	10	10	10	10	10	10	10
8-Apr-08	10	52	10	10	10	10	10	10	10
15-Apr-08	10	10	30	10	10	10	10	10	10
22-Apr-08	201	20	20	20	10	10	10	10	10
29-Apr-08	52	10	20	10	10	10	10	10	10
6-May-08	148	10	10	20	10	10	41	10	10
20-May-08	292	10	10	31	10	10	10	10	10
27-May-08	201	10	20	10	10	10	10	10	10
3-Jun-08	41	10	10	10	10	10	10	10	10
12-Aug-08	97	20	122	10	10	20	10	10	10
19-Aug-08	10	10	10	10	10	10	10	20	10
27-Aug-08	10	52	30	10	10	10	10	41	10
3-Sep-08	10	10	86	10	10	10	10	20	10
10-Sep-08	10	10	10	10	10	10	10	10	10

Date	TC-N	TC-C	TC-S	FC-N	FC-C	FC-S	EN-N	EN-C	EN-S
17-Sep-08	10	10	10	10	10	10	10	10	10
24-Sep-08	31	122	10	10	10	10	10	10	10
1-Oct-08	10	31	20	10	20	10	20	10	10
8-Oct-08	31	10	10	10	10	10	20	10	10
15-Oct-08	10	10	10	10	10	10	10	10	10
22-Oct-08	10	10	10	10	10	10	10	10	10
29-Oct-08	10	10	10	10	10	10	31	10	10
8-Apr-09	63	63	10	10	10	10	10	10	10
15-Apr-09	10	10	10	10	10	10	10	10	10
22-Apr-09	52	10	31	10	10	10	20	10	10
29-Apr-09	30	20	10	10	10	10	10	10	10
6-May-09	288	327	10	31	31	10	96	10	10
13-May-09	10	20	75	10	10	10	10	20	10
20-May-09	282	75	327	75	75	20	20	10	10
27-May-09	96	41	110	10	10	98	20	20	10
3-Jun-09	10	20	30	10	10	10	20	10	10
10-Jun-09	132	10	10	10	10	10	10	10	10
17-Jun-09	156	86	10	85	63	10	10	10	10
24-Jun-09	743	31	31	52	10	10	20	10	10
1-Jul-09	86	41	20	20	10	10	10	10	10
8-Jul-09	52	10	20	10	10	10	10	10	10
15-Jul-09	41	30	10	10	10	10	10	10	10
22-Jul-09	10	10	10	10	10	10	10	10	10
29-Jul-09	10	10	253	10	10	238	10	10	10
5-Aug-09	10	10	10	10	10	10	10	10	10
12-Aug-09	30	10	20	10	10	10	10	10	10
19-Aug-09	41	10	10	20	10	10	40	20	10
26-Aug-09	31	10	10	20	10	10	10	10	10
2-Sep-09	10	10	10	10	10	10	10	10	10
9-Sep-09	10	20	20	10	10	10	10	10	10
16-Sep-09	31	31	10	20	10	10	20	10	10
23-Sep-09	20	10	30	10	10	20	10	10	10
30-Sep-09	10	10	10	10	10	10	10	10	10
7-Oct-09	10	10	10	10	10	10	10	10	10
14-Oct-09	249	488	10	52	63	10	41	216	10
21-Oct-09	1017	109	97	20	10	10	97	10	10
28-Oct-09	250	31	52	20	10	10	10	120	30
7-Apr-10	145	10	10	10	10	10	10	10	10
15-Apr-10	504	97	86	10	20	10	10	10	10
21-Apr-10	2075	10	10	52	10	10	31	10	10
28-Apr-10	4611	85	41	185	10	10	41	10	10
5-May-10	285	63	85	10	10	10	10	10	10
12-May-10	307	41	10	31	10	10	20	10	10
19-May-10	323	31	10	20	10	10	20	10	10
26-May-10	384	41	10	63	10	10	460	31	10
2-Jun-10	10	52	10	10	10	10	10	10	10
9-Jun-10	109	10	10	31	10	10	10	10	10
16-Jun-10	10	10	20	10	10	10	10	10	10
23-Jun-10	355	10	10	10	10	10	30	10	10

Date	TC-N	TC-C	TC-S	FC-N	FC-C	FC-S	EN-N	EN-C	EN-S
30-Jun-10	121	52	10	10	10	10	31	10	10
7-Jul-10	209	10	10	10	10	10	10	10	10
14-Jul-10	256	52	20	20	10	10	41	10	10
21-Jul-10	144	31	631	20	10	10	10	20	41
28-Jul-10	134	10	10	10	10	10	20	10	10
4-Aug-10	132	110	30	10	10	10	10	10	10
11-Aug-10	1126	63	52	31	10	20	145	10	10
18-Aug-10	98	31	10	20	10	10	30	10	10
25-Aug-10	41	30	10	10	10	10	10	10	10
1-Sep-10	20	9	9	9	9	9	9	9	9
8-Sep-10	31	315	41	9	269	10	10	10	9
15-Sep-10	31	9	9	9	9	9	10	9	9
22-Sep-10	20	9	9	9	9	9	9	9	9
29-Sep-10	10	10	10	9	10	10	20	10	41
6-Oct-10	31	10	10	10	9	9	10	9	10
13-Oct-10	155	20	10	106	10	10	20	9	9
20-Oct-10	121	146	20	86	109	10	9	97	10
27-Oct-10	717	107	41	10	31	10	41	9	9
6-Apr-11	250	9	20	10	9	9	9	9	9
13-Apr-11	243	31	10	9	9	9	9	9	9
20-Apr-11	987	30	41	146	20	10	10	10	9
27-Apr-11	95	9	9	20	9	9	9	20	9
4-May-11	488	10	9	41	9	9	9	10	9
11-May-11	657	10	9	63	10	9	52	9	9
18-May-11	754	63	9	108	9	9	10	9	20
25-May-11	650	20	9	85	9	9	31	10	10
1-Jun-11	598	51	63	41	10	10	41	9	20
8-Jun-11	520	158	63	41	31	10	31	9	10
15-Jun-11	332	9	9	20	9	9	31	9	9
22-Jun-11	934	31	20	52	10	9	52	10	9
29-Jun-11	3,654	63	9	259	30	9	457	10	9
6-Jul-11	341	31	9	20	10	9	20	9	9
13-Jul-11	1,455	84	20	20	9	9	9	10	9
20-Jul-11	203	31	10	9	9	9	9	10	9
27-Jul-11	241	142	10	52	20	9	9	9	9
3-Aug-11	1,046	241	156	9	9	9	30	9	10
10-Aug-11	865	307	31	10	10	10	10	9	9
17-Aug-11	233	30	41	31	9	9	10	10	9
24-Aug-11	31	31	31	20	10	20	9	9	9
31-Aug-11	341	156	52	10	31	9	20	10	9
7-Sep-11	31	9	9	9	9	9	9	9	9
21-Sep-11	189	20	20	9	9	10	20	9	9
28-Sep-11	10	9	30	10	9	9	9	9	20
4-Oct-11	19,863	420	262	9	9	9	135	9	9
12-Oct-11	464	161	96	31	10	9	9	10	10
19-Oct-11	576	135	20	31	9	9	30	9	9
26-Oct-11	262	52	195	9	9	41	31	9	20
2-Nov-11	833	281	145	9	9	10	10	9	9
4-Apr-12	1076	309	327	10	9	10	10	10	9

Date	TC-N	TC-C	TC-S	FC-N	FC-C	FC-S	EN-N	EN-C	EN-S
11-Apr-12	275	9	10	9	9	10	9		9
18-Apr-12	75	10	9	9	9	9	9	9	9
25-Apr-12	602	10	20	52	9	9	9	9	9
2-May-12	121	9	9	31	9	9	10	9	9
8-May-12	496	9	9	10	9	9	63	9	9
16-May-12	19863	789	213	31	9	9	882	9	9
23-May-12	168	20	20	31	9	9	9	9	9
30-May-12	84	52	9	9	10	9	10	9	9
6-Jun-12	243	10	9	31	9	9	63	9	9
13-Jun-12	228	9	10	10	9	9	9	9	9
20-Jun-12	209	20	20	20	9	20	20	9	9
27-Jun-12	20	9	9	9	9	9	9	9	9
3-Jul-12	1071	96	52	10	9	9	10	9	9
11-Jul-12	20	10	9	10	9	9	9	9	9
18-Jul-12	199	9	9	41	9	9	85	10	10
25-Jul-12	121	9	9	20	9	9	31	9	9
1-Aug-12	31	30	10	20	20	10	10	10	10
8-Aug-12	74	31	31	10	10	31	20	9	9
15-Aug-12	31	31	9	9	10	9	9	9	9
22-Aug-12	20	20	10	9	9	9	9	9	9
29-Aug-12	9	9	52	9	9	41	9	9	10
5-Sep-12	9	63	10	9	63	10	9	9	9
12-Sep-12	10	63	75	9	52	52	9	97	10
19-Sep-12	10	9	9	9	9	9	9	9	9
26-Sep-12	9	31	110	9	20	75	9	9	10
3-Oct-12	63	31	9	52	10	9	9	9	9
10-Oct-12	279	134	213	148	74	187	135	62	86
17-Oct-12	31	313	305	20	31	10	9	9	9
24-Oct-12	75	85	9	10	10	9	41	20	10
31-Oct-12	323	148	171	10	10	9	30	9	9
2-Apr-13	120	20	20	30	10	20	10	9	9
9-Apr-13	161	20	31	9	9	10	9	9	9
16-Apr-13	171	9	10	20	9	9	20	9	9
23-Apr-13	9	9	9	9	9	9	9	9	9
29-Apr-13	10	41	20	9	9	9	10	9	10
7-May-13	9	9	9	9	9	9	9	9	9
14-May-13	63	9	10	9	9	9	10	9	9
21-May-13	97	52	10	9	9	9	31	9	9
28-May-13	9	9	9	9	9	9	9	9	9
4-Jun-13	9	9	9	9	9	9	9	9	10

TC: Total Coliform

FC: Fecal Coliform

EN: Enterococcus

N: Muir Beach-North

C: Muir Beach-Central

S: Muir Beach-South