

San Francisco Bay Beaches Pathogens TMDL

Project Definition



**SAN FRANCISCO BAY
REGIONAL WATER QUALITY CONTROL BOARD**

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Introduction

Several beaches located along San Francisco Bay are on the Clean Water Act (CWA) Section 303(d) list of impaired water bodies due to exceedances of bacteria objectives. This Project Definition report represents the first step in the process of developing a Total Maximum Daily Load (TMDL) for the 303(d)-listed beaches¹. This report outlines pertinent background information and presents an initial analysis of available bacteria data for each beach. In addition, the applicable bacteria objectives are stated and a strategy for developing the TMDL is proposed. This report represents the initial “snapshot”; all of these topics will be further analyzed and developed through subsequent steps of TMDL development.

Because the Bay area is highly urbanized, all of its beaches are expected to have similar potential sources of pathogens, such as urban runoff, sewer system leakage or overflows, pet waste, and wildlife sources. The San Francisco Bay beaches pathogen TMDL will accomplish two tasks:

1. Establish plans for achieving pathogen objectives for the Bay beaches currently listed as impaired by pathogens
2. Establish a framework for addressing future pathogen impairments at Bay beaches.

This strategy is similar to that contained in the 2005 Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL, which addresses new water bodies as are they are placed on the 303(d) list for pesticide-related toxicity impairments.

San Francisco Bay beaches at 13 park areas (Figure 1, Table 1) are regularly monitored for pathogens, as required by Assembly Bill (AB) 411 (codified at Health and Safety Code section 115880 et. seq.). AB411 regulations, developed by the State Department of Public Health, require the testing of all beaches which have more than 50,000 visitors annually and are near storm drains that flow in the summer. Samples must be tested for fecal indicator bacteria (FIB) including total coliform, fecal coliform, enterococci, and streptococci bacteria.

Monitoring data for six beaches, highlighted in Figure 1 and Table 1, indicate FIB exceed water quality objectives established to protect water-contact recreational beneficial uses, and these beaches are on the CWA 303(d) list of impaired water bodies. In the case of Marina Lagoon, the entire six-mile reach of the lagoon is listed as impaired.

Table 1. San Francisco Bay Beaches subject to AB411. Beaches in bold are included in the TMDL.

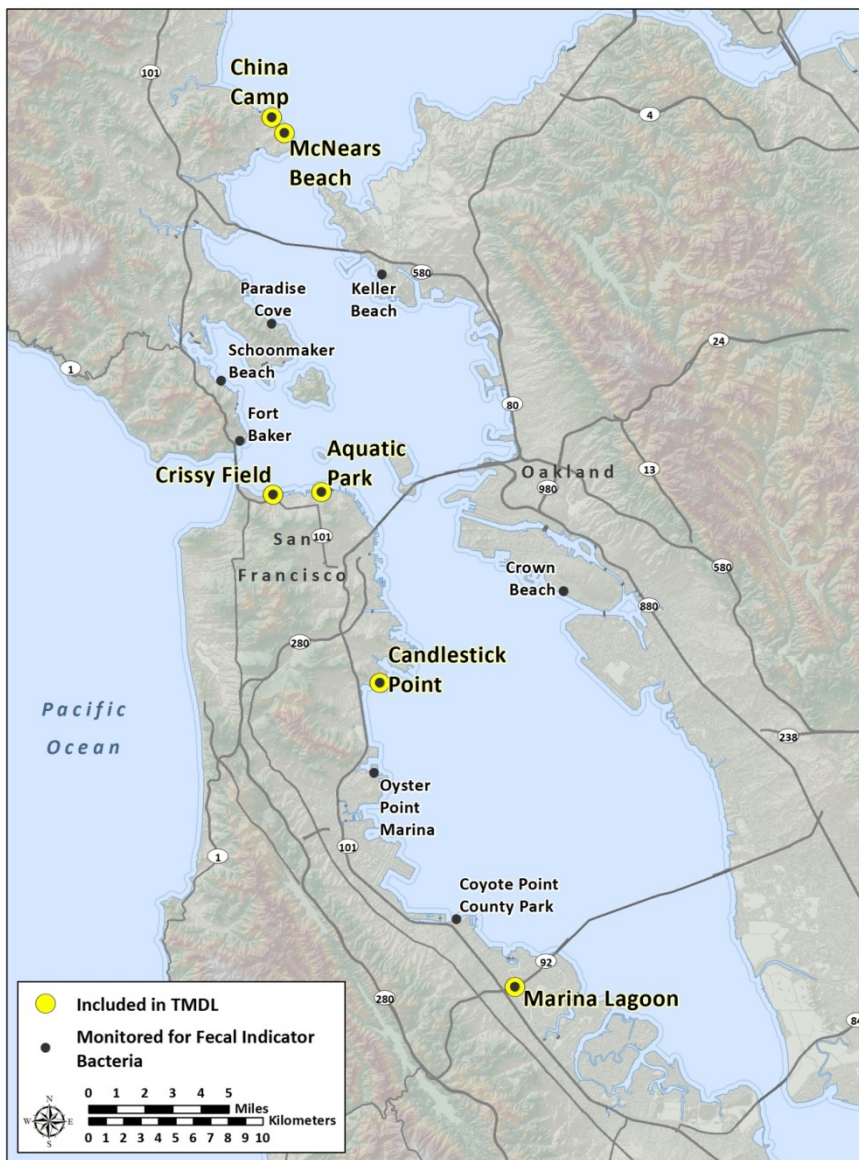
Beach	Nearest City	Sampling Agency	On 303(d) list?	# of Sample Locations
San Francisco				
Aquatic Park	San Francisco	SF Public Utilities Commission (SFPUC)	yes	2
Candlestick Point	San Francisco	SFPUC	yes	3
Crissy Field Beach	San Francisco	SFPUC	yes	2
Marin County				
China Camp	San Rafael	Marin Co Health	yes	1
McNears Beach	San Rafael	Marin Co Health	yes	1
Ft. Baker Horseshoe Cove	Sausalito	Marin Co Health	no	3

¹ This Problem Definition is based on the U.S. Environmental Protection Agency (USEPA) guidance document *Protocol for Development of Pathogen TMDLs* (2001) and the State Board’s *A Process for Addressing Impaired Waters in California – Draft* (2003).

Project Definition - San Francisco Bay Beaches Pathogen TMDL

Beach	Nearest City	Sampling Agency	On 303(d) list?	# of Sample Locations
Schoonmaker Beach	Sausalito	Marin Co Health	no	1
Paradise Cove	Tiburon	Marin Co Health	no	1
East Bay				
Crown Beach	Alameda	E. Bay Regional Parks District (EBRPD)	no	5
Keller Beach	Richmond	EBRPD	no	3
San Mateo County				
Oyster Point Marina	South SF	SM County Health	no	1
Coyote Point Park	Burlingame/ San Mateo	SM County Health	no	1
Marina Lagoon	San Mateo	SM County Health & City San Mateo	Yes	2

Figure 1. San Francisco Bay Beaches



Aquatic Park Beach

Aquatic Park Beach is located within the San Francisco Maritime National Historic Park. The beach lies within a horseshoe-shaped cove bounded by Hyde Street Pier on the east and the fishing pier on the west (Figure 2). Other features within this National Park include historic ships, such as the Balclutha on Hyde Street Pier and the Bathhouse building, which was built by the Works Progress Administration in the 1930s. After being used by troops in WWII, the Bathhouse building became home to the San Francisco Maritime Museum and the country's first Senior Center. The museum was operated by the San Francisco Maritime Association until it was transferred to the National Park Service in 1978 (National Park Service 2013).

Located between Fisherman's Wharf and Crissy Park, Aquatic Park is a highly popular location for strolling, sunning and swimming. In addition, the beach is used year-round by swimming and rowing clubs.



National Park Service

Basis of Listing

The U.S. Environmental Protection Agency (U.S. EPA) placed this beach on the 303(d) list in 2006 based on 15% of samples exceeding the single sample maximum (SSM) for fecal coliform; 18% exceeding the SSM for enterococci; and 37% exceeding the geometric mean for enterococci (U.S. EPA 2011). Data were collected August 2002 through October 2005.

Available Data

Ample data are available through the Beach Monitoring Program, which is administered jointly by the San Francisco Public Utilities Commission (SFPUC) and the San Francisco Department of Public Health (SFDPH). San Francisco beaches with significant water contact recreation use are sampled weekly for three FIB: total coliform, *Escherichia coli* (*E. coli*), and enterococcus. SFPUC does not analyze samples for fecal coliform. Samples are collected year-round at two locations at Aquatic Park Beach, off Hyde Street Pier and at Station 211 (Figure 2). The sample locations are at the east end of the beach because that is where most of the swimming occurs.

SFPUC does additional sampling following combined sewage discharges (CSD), when designated water contact recreation areas that could be affected by a CSD are monitored daily until monitoring confirms that FIB levels are below water contact recreation standards. Signs are posted when monitoring shows an exceedance of standards and a website is updated to show when a CSD or a FIB exceedance occurs. As a precautionary measure, Aquatic Park is posted whenever there are widespread CSDs from SFPUC’s northshore outfalls (Figure 2) (Chastain 2013a).

Table 2. Summary of Aquatic Park Beach Data: 1/2/2008 – 12/26/2012 (260 weeks)

	Location	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	Hyde St. Pier	282	10 (3.5%)	6 (2.2%)
	Station 211	313	30 (9.6%)	97 (31.4%)
Total Coliform	Hyde St. Pier	282	0 (0%)	16 (5.8%)
	Station 211	313	1 (0%)	0
E.coli ^b	Hyde St. Pier	282	4 (1.4%)	16 (5.8%)
	Station 211	313	1 (0.3%)	1 (0.3%)

^aGeomeans calculated using all data collected in rolling 30-day periods.

^bCompare to fecal coliform objective, because no marine E.coli objective exists.

Key Pollutant Sources

Aquatic Park Beach has few of the common potential sources of pathogens, as outlined below.

Urban stormwater: Due to San Francisco’s combined sewer system and the topography of the surrounding area, only a small catchment discharges to Aquatic Park Beach. The outfall for this catchment is at the western end of the beach (Figure 2). Stormwater runoff from the Maritime Museum building and grounds, including the green roof over the building, also discharges to Aquatic Park Beach. Stormwater runoff from the remainder of the catchment flows to the SFPUC’s combined sewer system. The nearest combined sewer overflow discharge points are:

- At the western end of Gas House Cove (Figure 2). According to SFPUC personnel, there is rarely a discharge at this point (Chastain 2013b).
- At Baker Street, over one mile west of Aquatic Park Beach, a deep-water pipe discharges CSOs 290 feet off-shore.
- Near Pier 39, approximately one-half mile east of Aquatic Park Beach (Figure 2).

Leaking sewer infrastructure: A sanitary sewer line, owned by the SFPUC, runs parallel to the beach. No information about the integrity of this line has been obtained to date. The National Park Service owns two public restroom structures, one at either end of the beach. Both were built in the mid-1930s and closed in about 2006 because the piping and pump stations needed frequent maintenance and operating these facilities was not cost-effective. There are no plans to renovate the rest rooms.

The Sea Scout structure at the west end of the beach does not contain a restroom. Temporary sanitation stations are rented when the structure is used for overnight events.

The Aquatic Park Bathhouse (also called the Maritime Museum) structure has been extensively renovated. Two pumps within the building pump wastewater to the SFPUC combined sewer system.

An operational public restroom facility is located on Hyde Street Pier. Port of San Francisco staff state they have checked below the Hyde Street Pier and found no leaking pipes (Alford 2013).

Pet waste: Dogs are not allowed on Aquatic Park Beach, but dogs do frequent the beach and pet waste is evident at times, according to National Park Service personnel groundskeepers. There is not a formal or informal campaign to enforce the “no dogs” rule.

Boat waste: Aquatic Park provides anchorage for non-motorized boats for short-term docking of one to five nights. For the period July 2011-June 2012, an average of nine boats anchored overnight per month. However, during the Fourth of July and Fleet Week holidays, up to 50 boats will anchor in Aquatic Park Cove (Morris 2013b).

Boaters either call the harbor master when they want to anchor or apply in advance for a permit. At that time, boaters are informed of the rules, including the rule that boat must have “zero discharge” of waste to the water. While National Park Service personnel cannot strictly enforce this rule, it is thought that only a minority of boaters may discharge waste in the harbor (Morris 2013a). It is thought that most boaters are aware of fact that the entire San Francisco Bay is a zero discharge area, and no dumping is allowed within several miles of the coast. Signs stating the rules are posted at Municipal Pier and at the U.S. Army Corps of Engineers breakwater.

Another 60 temporary berths are located on the east side of Hyde Street Pier, where Port of San Francisco staff provides information on proper management of marine sanitary devices.

Wildlife: Seals are commonly seen at Aquatic Park, frequently at the west end, and birds are present year-round. National Park Service personnel report that the presence of a barn owl near the cable car turn-around may keep the number of sea gulls in the vicinity relatively low.

Except for exceedances in June 2012 and July and September 2011, enterococcus exceedances at Aquatic Park Beach (station 211) occur primarily October through March, the wet part of the year. SFPUC personnel have determined that combined sewer overflows (CSO) are not likely responsible for FIB on Aquatic Park Beach, based on data comparing CSO dates to dates of enterococcus exceedances (Chastain 2013a). Thus, further investigation into the key FIB pollutant sources to Aquatic Park Beach is needed.

Analysis Strategy

Ample annual beach monitoring data are available for both dry and wet seasons. Further data collection, potentially using current pathogen source tracking methods, may be needed to better determine pathogen sources.

Management Techniques

Aquatic Park Beach is under the management of the National Park Service, while the sanitary sewer system is operated by the SFPUC. These entities could implement new or enhance existing management practices, such as complete integrity/leakage surveys for sanitary sewers; enhance street sweeping in catchments discharging to east Aquatic Beach; educate and conduct outreach to pet owners, visitors and residents/tenants; divert and treat storm runoff.

Contacts and Stakeholders

San Francisco Maritime National Park
San Francisco Public Utilities Commission
Port of San Francisco
Dolphin Club
South End Rowing Club

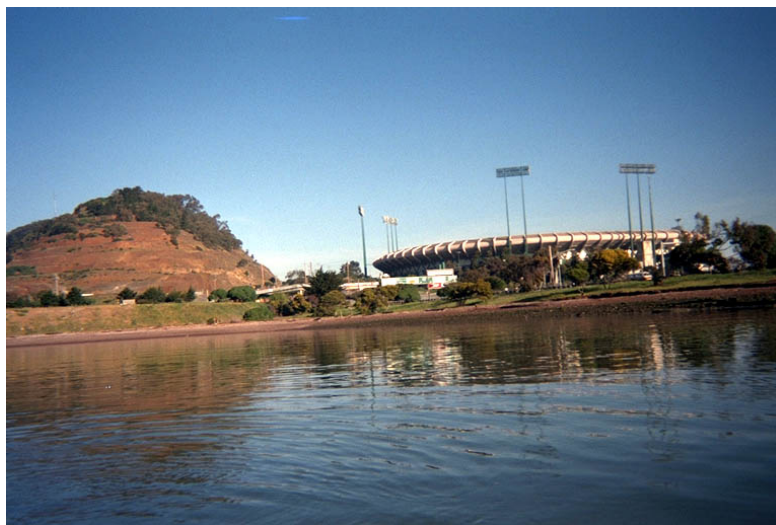
Aquatic Park Neighbors

Figure 2. Aquatic Park Beach, San Francisco



Candlestick Point Beaches

Candlestick Point State Recreation Area is located at the southeastern tip of San Francisco, adjacent to Candlestick Stadium (Figure 3). The State purchased the land in 1973 and soon after turned it into a state recreation area, making Candlestick Point Park the first urban State recreation area in California. The park contains two fishing piers and three beaches: Jackrabbit Beach, Windsurfer Circle, and Sunnydale Cove. Windsurfer Circle in particular is a popular area for windsurfing because of strong winds.



www.kayaker.net

As required by its NPDES permit for discharges of treated wastewater, SFPUC conducts recreational-use studies to quantify, to the extent possible, the number of people using areas near its outfalls for water contact recreation and non-contact recreation. Results of a study of Candlestick Point beaches conducted between October 2009 and September 2011, shown in Table 3, provide an idea of the recreational usage at the three beaches.

Table 3. Estimated Annual Recreational Users – Candlestick Point Beaches (SFPUC 2012)

Location	REC1 Users	REC2 Users	Total	Major Activities
Sunnydale Cove	210	261	471	Walking/jogging & fishing
Windsurfer Circle	5,698	529	6,227	Fishing at nearby pier accounted for 65% of all REC1; Site also had 87% of all windsurfers
Jackrabbit Beach	456	770	1,226	Walking/jogging followed by sitting/sunbathing; 75% of all wading observed during study

Basis of Listing

U.S. EPA placed Candlestick Point on the 303(d) list based on 28% of samples exceeding the geometric maximum for total coliform and 17% and 36% of samples exceeding the enterococcus SSM and geometric maxima, respectively. Fecal coliform exceedances during the sample timeframe (August 2002 to October 2005) were below 10% of the samples (USEPA 2011).

Available Data

Ample data are available through the SFPUC and SFDPH Beach Monitoring Program, which sample the three Candlestick beaches weekly for three FIB: total coliform, *Escherichia coli* (*E. coli*), and enterococcus. Samples are collected year-round and are not analyzed specifically for fecal coliform.

In addition to weekly sampling, following a CSD the beaches are monitored daily until monitoring confirms that FIB levels are below water contact recreation standards. Signs are posted when monitoring shows an exceedance of standards and a website is updated to show when a CSD or a FIB exceedance occurs. Sunnydale Cove, Windsurfer Circle, and Jackrabbit Beach are posted whenever there is a CSD from the South Basin, which includes the Yosemite Slough and Sunnydale outfalls (SFPUC 2012).

Table 4. Summary of Jackrabbit Beach Data, 1/2/2008 – 6/11/2012 (223 weeks)

	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	287	46 (16.0%)	65 (22.9%) REL method
Total Coliform	287	4 (1.4%)	11 (3.9%)
E.coli	287	21 (7.3%) ^b	14 (4.9%) ^b

Table 5. Summary of Sunnydale Cove Data, 1/2/2008 – 6/11/2012 (223 weeks)

	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	321	86 (26.8%)	163 (51.3%) REL method
Total Coliform	321	14 (4.3%)*	114 (36.0%)
E.coli	321	6 (1.9%) ^b	317 (1.9%) ^b

Table 6. Summary of Windsurfer Circle Data, 1/2/2008 – 6/11/2012 (223 weeks)

	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	379	144 (38%)	231 (61.4%) REL method
Total Coliform	379	53 (16.5%)*	254 (67.7%)
E.coli	379	67 (17.7%) ^b	101 (26.9%) ^b

^aGeomeans calculated using all data collected in rolling 30-day periods.

^bCompare to fecal coliform objectives, because no marine E.coli objective exists.

Analysis of the exceedances of the enterococcus geomean objective for Windsurfer Circle found that the exceedances nearly all occurred during the wet months of October through March. During the 4.5 year timeframe, there were no exceedances in June, July or August, and only one in September.

Key Pollutant Sources

Urban Stormwater: A large portion of the urban area abutting Candlestick Point includes Visitacion Valley, a 720-acre area served by SFPUC's 100+ year-old Sunnydale combined sewer. Historically, this system frequently discharged untreated combined wastewater during storm events, but construction of the Sunnydale Transport/Storage (T/S) Structure and Pump Station at Harney Way near Candlestick Park in 1991 has greatly reduced the number of such discharges. When this system does overflow, the discharge is first routed through the T/S structure, which allows solids to settle and removes floating debris. The Sunnydale T/S structure has four outfalls in the vicinity of Candlestick Point, as shown in Figure 3.

SFPUC analyzed the relationship between combined sewer discharges (CSD) and days in which one or more of the FIB water contact recreation objectives were exceeded. Results show that, for the years 2008-2011, from 0 to 4% of the exceedance days coincided with CSDs, as shown in Table 7. Note that there were five CSDs during this period.

Table 7. SFPUC Analysis of CSDs vs. FIB Objective Exceedances (SFPUC, 2012)

Year	Season	# Days with Exceedances	# Days with CSDs	% Exceedances Possibly Caused by CSDs
2008	Oct – April	56	2	4%
2009	May – Sept	4	0	0%
	Oct – April	82	2	2%
2010	May – Sept	3	0	0%
	Oct – April	68	1	1%
2011	May – Sept	12	0	0%
	Oct – April	39	0	0%
2012	May – Sept	12	0	0%
TOTAL	May – Sept	245	5	2%
	Oct – April	31	0	0%

Candlestick Stadium also is served by SFPUC’s combined sewer system. Stormwater from Candlestick Stadium is pumped to SFPUC’s combined sewer system via two pumps. When the pumps are overwhelmed, a significant portion of the south end of the stadium parking lot drains through a pipe that runs under the Hunters Point Expressway and discharges to the Bay at Windsurfer Circle. There are preliminary indications that a relatively small storm event, such as a 5-year rainfall, can result in an overflow to the Bay (Ilejay 2013). This discharge has been shown to be a source of pathogens, especially when rain events coincided with 49er football games. Photo evidence shows portable toilets knocked over and large amounts of trash present in flooded areas of the Stadium parking lot (Ilejay 2009). Candlestick Stadium is managed by the San Francisco Recreation and Parks Department.

Currently, dirt lots surrounding Candlestick Stadium are owned and managed by the National Park Service, and rented out to private parking operators. These lots have been used during San Francisco 49er football games and other public events at Candlestick Stadium. Stormwater discharges from these lots via overland flow to the Bay. While the dirt lots do not have portable toilets, they have been heavily littered with trash following public events (Ilejay 2013).

The 2013-2014 season is slated to be the final football season for Candlestick Stadium. At present, it appears possible that the arena will continue to be used for concerts and other large events for some years. Alternately, the arena may be demolished in the near future to make way for other development.

Leaking Sewer Infrastructure: As stated above, a large portion of the urban area abutting Candlestick Point is served by SFPUC’s 100+ year-old Sunnydale combined sewer, a potential source of FIB.

In addition, Candlestick State Park contains seven restroom facilities (Figure 3). All the restrooms were built when the park was created in the mid-1970s and are plumbed to the SFPUC combined sewer system. Park personnel describe the restroom facilities as follows (Moises 2013):

1. A non-public restroom is located at the kiosk at main gate (also called the Boat Lounge area), which is used on game/event days. A pump was replaced in 2012.
2. Public restrooms at Jackrabbit Beach are in working order.
3. Public restrooms at Windsurfer Circle are in working order.

4. One of two pumps and the electrical system at the public restrooms located at the Big Meadow picnic area were replaced in 2013.
5. For the last six months, the electrical system of the public restrooms at Sunrise Point has been out of order, so the tanks are pumped out once a day, and checked each morning.
6. Public restrooms at the Last Port location (near condominiums) are gravity fed to the SFPUC sewer system.
7. The restrooms at main office at 1150 Carroll Avenue are not directly connected to the SFPUC sewer system. The holding tank is pumped out once/month.

Pets: Pets are allowed at the park but must be on a leash.

Boats: There is no boat ramp at the park. Due to its location on the Bay, it is unlikely that dumping from boats would be a specific source of pathogens at these beaches.

Wildlife: Various park personnel have described squirrels and blackbirds as the primary wildlife in the Park, not seagulls or other wildfowl often associated with marine beaches. Seagulls are prevalent during football games and other events at Candlestick Stadium.

In summary, potential sources of pathogens to the Candlestick Point beaches include the urban runoff not collected by, or potentially leaking from, SFPUC's combined sewer, including runoff from Candlestick Stadium and surrounding properties. Leaking piping from aging sewer infrastructure and/or restroom facilities is another potential source. Wildlife is a potential source, but appears to be less so than at most beaches. In addition, the beaches are shallow and the possibility that bacteria may persist in the sediments should be examined.

Analysis Strategy

Ample annual beach monitoring data are available for both dry and wet seasons. Further spreadsheet analyses may be performed as more information about potential sources and management actions is obtained, in order to assess water quality impacts from the sources and water quality improvements from management actions. For example, exceedances may be analyzed in relation to game days at Candlestick Stadium.

Changes in land use must be considered to the extent possible during the timeframe of TMDL development. In addition to changes in the physical structure and/or uses of Candlestick Arena, a new General Plan for Candlestick State Park was approved in 2013; the plan provides for reconfiguration of the park and potential land exchanges, which could change the stormwater runoff patterns to the beaches over the long term.

Management Techniques

Sewerage system improvements and improved management and/or treatment of runoff from Candlestick Stadium and surrounding parking lots are potential management techniques.

Contacts and Stakeholders

Candlestick Point State Recreation Area
San Francisco Public Utilities Commission
San Francisco Recreation and Parks Department
Windsurfers

Figure 3. Candlestick Beaches



China Camp Beach

China Camp Beach is located within China Camp State Park, on the southwest shore of San Pablo Bay (Figure 4). A Chinese shrimp-fishing village thrived on this site in the 1880s, populated by nearly 500 people from Canton, China. In its heyday, there were three general stores, a marine supply store and a barber shop. A museum at China Camp Beach tells the story of these fisher-people.

The beach offers year-round wading, swimming, kayaking, and boating, with the greatest usage during the warmer months.



www.parks.ca.gov

Water Board staff photo

Basis of Listing

U.S. EPA placed this beach on the 303(d) list in 2006 based on 26% of samples exceeding the geomean for total coliform (Final CA 2010 Integrated Report (U.S. EPA 2011)). Only 5 of 90 samples exceeded the SSM for enterococci, and 5 of 91 exceeded the SSM for total coliform. The sample timeframe was the summers of 2003 through 2005.

Available Data

Seasonal data are available through the Marin County Health Department, which collects a single sample from China Camp Beach weekly during the months of April through October. These data indicate that the number of exceedances of the geomean for total coliform have decreased since the 2003-2005 timeframe that formed the basis for listing China Camp Beach on the 303(d) list. Further data analyses are needed to determine whether this beach is a candidate for delisting, i.e., removal from the 303(d) list.

Table 8. Summary of China Camp Beach Data: 1/2/2008 – 6/11/2012 (223 weeks)

	Location	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	China Camp	151	2 (1.3%)	0
Total Coliform	China Camp	151	5 (3.3%)	13 (9.8%)
E.coli ^b	China Camp	151	2 (1.3%)	0

^aGeomeans calculated using all data collected in rolling 30-day periods.

^bCompare to fecal coliform objective, because no marine E.coli objective exists.

Key Pollutant Sources

China Camp Beach has few of the common potential sources of pathogens, as outlined below.

Urban stormwater: China Camp State Park has no urbanized land use. The China Camp Beach catchment, likewise, is not urbanized. With the exception of one resident, who is the last surviving Chinese fisherman of China Camp Village, the structures on the beach are largely historic and unoccupied. A small café and a public restroom structure are also located on the beach. Urban stormwater is not expected to be a significant source or transport mechanism for pathogens.

Leaking sewer infrastructure: Wastewater from public restrooms at the beach and the upper parking area, café, and residence are pumped to San Rafael Sanitary District sewer lines. China Camp State Park's Maintenance department is reviewing information and interviewing Park staff to determine whether physical changes to the infrastructure or changes in practices (such as enforcement of best pet or litter clean-up practices) in the last decade may correlate with the reduction in total coliform objective exceedances.

Pet waste: Pets are allowed on the beach, provided they are on a leash.

Boat waste: During the warmer months, sailboats may anchor offshore of the beach. At a busy time, but not commonly, up to 15 boats may be anchored. Less frequently a houseboat has anchored offshore for a longer period of time. These are county waters, and the Marin County or San Rafael police boat patrol deal with the anchored boats, or the U.S. Coast Guard will do so. There are no records kept of when houseboats or large groups of sailboats have anchored off China Camp Beach, so it is not possible to determine whether such activities have been correlated with increased pathogens (Goering 2013).

Wildlife: Approximately a mile north of the beach is a marsh that extends northward for several miles. The marsh is heavily used by wildfowl. China Camp Beach itself is not noted for wildfowl or other wildlife populations.

Litter: According to State Park personnel, China Camp Beach is well maintained by its visitors, and there is not a lot of litter. Once a year, on Earth Day, a litter pick up event will yield less than one dumpster load of litter (Goering 2013).

Analysis Strategy

Seasonal beach monitoring data are available for the dry season. Available data will be further analyzed to determine if this water body is a candidate for delisting. Further spreadsheet analyses may be performed as more information about potential sources and management actions is obtained, in order to assess water quality impacts from the sources and water quality improvements from management actions.

Management Techniques

Should further reductions in FIB be necessary to achieve bacteria water quality standards, China Camp Beach and its watershed are under the management of the California State Parks Department, which could implement new or enhance existing management practices, such as complete integrity/leakage surveys for sanitary sewer system components; educate and conduct outreach to pet owners and visitors; or divert and treat storm runoff.

Contacts and Stakeholders

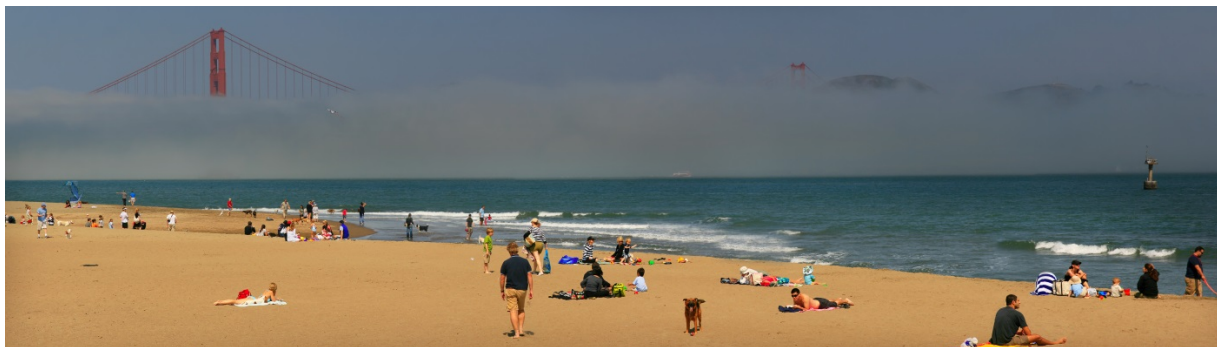
China Camp State Park
Marin County Parks Department
Marin County Health Department
Friends of China Camp

Figure 4. China Camp Beach



Crissy Field Beach

Crissy Field Beach (Crissy Beach) is located within the Golden Gate National Recreation Area and within the Presidio (Figure 5). Boardsailing is a common water activity. General swimming and wading occur, but are limited by cold water temperatures and strong tidal currents. This two-mile beach includes two locations from which samples are collected to measure bacteria water quality. Sample results have shown that contact recreation uses of waters at Crissy Beach are impaired by pathogens, particularly the data from the eastern sample location.



commons.wikimedia.org

Basis of Listing

U.S. EPA placed this beach on the 303(d) list based on 15% of samples exceeding the SSM for enterococci, and 32% exceeding the maximum geomean for enterococci (U.S. EPA 2011). The Line of Evidence lists only the geomean exceedances, not the single sample maximum exceedances. Total and fecal coliform exceedances during the sample timeframe of August 2002 to October 2005 were low, in the zero to 7.6% range.

Available Data

Ample data are available through the Beach Monitoring Program, which is administered jointly by the SFPUC and the San Francisco Department of Public Health. San Francisco beaches with significant water contact recreation use are sampled weekly for three FIB: total coliform, *Escherichia coli* (*E. coli*), and enterococcus. Samples are not analyzed specifically for fecal coliform. Samples are collected year-round at two locations at Crissy Beach.

Of the two sample locations used for the 303(d) listing, only the east location, which exhibited the exceedances, remains in use today. What was once called the west (trees) location is now referred to as the “mid-beach” sample location, and SFPUC no longer collects samples there. Instead, SFPUC samples the far west end of Crissy Beach, near Torpedo Wharf, and this is now the “west” sampling station. Pathogen objective exceedances are infrequent at the west sample location, as evidenced in Table 9.

SFPUC does additional sampling following CSDs, when designated water contact recreation areas that could be affected by a CSD are monitored daily until monitoring confirms that FIB levels are below water contact recreation standards. Signs are posted when monitoring shows an exceedance of standards and a website is updated to show when a CSD or a FIB exceedance occurs. As a precautionary measure, Crissy Field is posted whenever there are widespread CSDs from the Northshore outfalls, even though the nearest CSD outfall (Baker Street outfall) is approximately 290 feet offshore (Chastain 2013a).

Table 9. Summary of Crissy Beach Data: 1/2/2008 – 6/11/2012 (223 weeks)

	Location	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	Crissy E.	282	41 (14.5%)	47 (16.9%)
	Crissy W.	239	11 (4.6%)	14 (5.9%)
Total Coliform	Crissy E.	282	2 (0.7%)	0
	Crissy W.	239	6 (2.5%)	2 (0.9%)
E.coli ^b	Crissy E.	282	13 (4.6%)	2 (0.7%)
	Crissy W.	239	7 (2.9%)	1 (0.5%)

^aGeomeans calculated using all data collected in rolling 30-day periods.

^bCompare to fecal coliform objective, because no marine E.coli objective exists.

Key Pollutant Sources

In the 1990s, first the U.S. Army (1992-95) and then the Presidio Trust (1997-present) began systematically upgrading the sanitary infrastructure at the Presidio. This work continues in the present day, with the repair of interconnections, rehabilitation of manholes, and similar activities. Presidio personnel have suggested they will prepare a map of the locations where sewer infrastructure has been videoed and/or repaired as time allows (Hurley 2013a).

With the ongoing realignment work on Doyle Drive through the Presidio, a homeless encampment has been removed. As Doyle Drive is realigned, the topography of a significant portion of the upper Presidio area is being altered, so that stormwater runoff patterns will change. In addition, the affected stormwater and waste water piping is being replaced (Hurley 2013a).

Despite the work to upgrade certain sanitary infrastructure, enterococcus water quality objective exceedences continued in 2011 and 2012. Enterococcus exceedences have consistently occurred primarily in November through March, the wet part of the year. At present a significant portion of the Presidio drains into Crissy Marsh. National Park Service personnel have sampled Crissy Marsh and found that the Marsh does not exceed pathogen objectives where it discharges to Crissy Beach, although pathogens are elevated in mid-Marsh near stormwater discharge locations (Ward 2013a).

Thus, key FIB pollutant sources to Crissy Beach could include localized urban runoff, municipal sewer leakage, pets and wildlife.

Analysis Strategy

Ample annual beach monitoring data are available for both dry and wet seasons. Further spreadsheet analyses may be performed as more information about potential sources and management actions is obtained, in order to assess water quality impacts from the sources and water quality improvements from management actions.

Management Techniques

Crissy Beach and its watershed are under the management of the Presidio Trust and the National Park Service, who could implement new or enhance existing management practices, such as complete integrity/leakage surveys for sanitary sewers; enhance street sweeping in catchments discharging to east Crissy Beach; educate and conduct outreach to pet owners, visitors and residents/tenants; require owners to clean up after pets; and divert and treat storm runoff.

Contacts and Stakeholders

Presidio and Golden Gate National Recreation Area
San Francisco Public Utilities Commission
South End Rowing Club
Ocean Beach Dog Owners Group

Figure 5. Crissy Field Beach and Sample Locations



Marina Lagoon

Marina Lagoon is a tidal slough that has been diked and dredged. It now serves as a flood control basin, recreation area (boating, waterskiing, wakeboarding, swimming), and aesthetic amenity, and is managed by the City of San Mateo. The lagoon covers approximately 169 acres. It flows in a northerly direction from its inlet at the Belmont city limits, where a concrete slide gate structure controls inflow from O'Neill Slough, to its outlet into Seal Slough, a distance of about four miles (City of San Mateo 2013). It is not uncommon to see the entire distance of Marina Lagoon labeled as Seal Slough on maps. More than 300 private residences, most of which have boat docks, border the Lagoon (City of San Mateo 2012).

Two beaches are located on the Lagoon (Figure 6). Lakeshore Park, located at 1500 Marina Court, has beach access to the Lagoon as well as picnic areas, a playground, basketball courts, and a baseball diamond. Parkside Aquatic Park, with a sandy beach for swimming, is located at the end of Seal Street. This park offers kayaks, sailboats and stand up paddle surfboards for rent, as well as a boat ramp.

Note that Parkside Aquatic Park beach currently is not on the 303(d) list of impaired water bodies, but it is being proposed as a separate 303(d) listing. Because it will inevitably be listed as impaired by bacteria and due to its similarities to Lakeshore Park beach co-located on Marina Lagoon, Parkside Aquatic Park beach is included in the San Francisco Bay Beaches TMDL.



Water Board staff photos

Basis of Listing

Marina Lagoon was proposed for 303(d) listing by the San Francisco Bay Water Board in 2002, based on a series of samples collected over 30 days at ten sites on Marina Lagoon by Surfrider members who were trained to collect the samples (SFBRWQCB 2001). The 303(d) listing for Marina Lagoon was final in 2006, and was based on electronic data from the San Mateo County Environmental Health Department.

Since 1998, the San Mateo County Health System (its current name) has collected samples at two sites on Marina Lagoon, Parkside Aquatic Park and Lakeshore Park. Prior to 2007, they collected additional samples at Lakeshore Park along the rocks south of the Recreation Center, but sampling at this location was discontinued because swimmers do not use this rocky area (Smith 2012). As funding levels have fluctuated, the City of San Mateo has taken responsibility for some of this sampling.

The 303(d) list is in the process of being updated, and as part of this process, Parkside Aquatic Park on Marina Lagoon may be added as a “stand-alone” listing. Under this San Francisco Bay Beaches TMDL, the Parkside Aquatic Park beach is considered part of the Marina Lagoon water body and thus is addressed as part of the TMDL.

Available Data

Because the City of San Mateo and the San Mateo County Health System have sampled the two public beaches on Marina Lagoon for over a decade, ample data are available. The two beach areas are sampled year-round on a weekly basis for three FIB: total coliform, fecal coliform, and enterococcus.

Table 10. Summary of Parkside Aquatic Park Data, 9/8/2004 – 6/11/2012* (355 weeks)

	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	325	78 (24.0%)	134 (44%)
Total Coliform	354	65 (18.4%)	176 (63.8%)
Fecal Coliform	355	107 (30.1%)	102 (36.7%)

*Enterococcus collected 12/5/2005-12/31/2012 (324 weeks)

^aGeomeans calculated using all data collected in rolling 30-day periods.

Table 11. Summary of Lakeside Recreation Center Data, 1/30/2006 – 12/31/2012 (315 weeks)

	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	314	77 (24.5%)	132 (45.2%)
Total Coliform	315	60 (19.0%)	168 (68.6%)
Fecal Coliform	315	77 (24.4%)	71 (28.4%)

^aGeomeans calculated using all data collected in rolling 30-day periods.

Key Pollutant Sources

A ten-square mile watershed, originating in the western hills of San Mateo and Belmont, drains into Marina Lagoon. This drainage area contains four subwatersheds, including 16th Avenue, 19th Avenue, Laurel Creek, and direct Marina Lagoon drainage, all located in the southern two-thirds of San Mateo. Peak storm flows from the hills to the west are controlled by three dams on Laurel Creek. The watershed is almost entirely urbanized with the exception of Sugarloaf Mountain (City of San Mateo 2009). There are no houseboat moorages on the Lagoon, but pleasure boating is a common activity.

According to City of San Mateo Environmental Services Division personnel, approximately 75% of sewer pipes in the City are clay or concrete pipes that are more than 70 years old. The City is conducting a program to improve the aging sewer infrastructure in the Los Prados neighborhood (Figure 6) (Parrish 2012). The City recently replaced 250 laterals, which were identified as leaky through video inspections. In San Mateo, the property owner is responsible for all lateral maintenance. The City is working to expand its program to further replace sewer laterals, maintain the collection system, and potentially construct two equalization basins; a related study is scheduled to be completed by June 2014 (Patterson 2013). In addition, the City conducts an ongoing program to video-inspect sewer mains.

In summary, potential pathogen sources to Marina Lagoon include sanitary sewer leaks and overflows, urban runoff (including pet waste and litter associated with urban runoff), boat waste and litter associated with recreation on Marina Lagoon, and direct deposit by wildfowl.

Analysis Strategy

Ample year-round beach monitoring data are available for both dry and wet seasons for two beaches along San Mateo Lagoon. Further spreadsheet analyses may be performed as more information about potential sources and management actions is obtained, in order to assess water quality impacts from the sources and water quality improvements from management actions.

Physical Considerations & Current Lagoon Management Operations

The lagoon ranges from 300 to 400 feet wide, and averages a depth of 6 feet at mid-channel during the summer. Its primary water source is tidal flow from San Francisco Bay through O'Neill Slough, at a rate of approximately 52 million gallons per day annualized. Bay water is augmented by perennial low volume fresh water inflow from Laurel Creek and lesser drainage sub-basins within a ten square mile watershed, which comprises only about 0.3 percent of total annual inflow. During the wet season, stormwater runoff can comprise a larger proportion of inflow over the short-term (City of San Mateo 2013a).

The Corps of Engineers has deferred administrative oversight of this waterway to the City through a renewable 5-yr permit (City of San Mateo 2012).

Management Techniques

The City of San Mateo is one of the municipalities covered by the Municipal Regional Stormwater Permit (MRP), Order No. R2-2009-0074. The MRP requires the City to conduct a number of activities that could address pathogens in stormwater runoff, such as street sweeping, trash control, and implementation of the Lagoon Management Performance Standards. The City's Department of Public Works carries out many of the MRP requirements as well as operation and maintenance of the Lagoon, including the pumping stations and other infrastructure, weed and algae control, debris and litter clearing, water quality management and monitoring, and oversight of private dock construction and maintenance.

Routine tasks outlined in the Lagoon Management Performance Standards are (City of San Mateo 2013b):

- Protect all beneficial uses of the lagoon, including habitat for fish and waterfowl, water contact recreation, aesthetics, and flood control
- Manage in-water and shoreline construction activities
- Monitor and protect lagoon water quality
- Employ integrated pest management techniques for control of weeds and algae
- Follow all applicable laws and regulations with respect to use of aquatic herbicides
- Control litter and debris
- Train staff involved in lagoon management and share information with managers of neighboring lagoons
- Educate the public about water pollution prevention.

In addition, City of San Mateo Parks and Recreation Department rangers patrol the Lagoon seven days a week, from 6:00am to one half hour after sunset. Rangers' duties include handling dog issues. As appropriate, some of the tasks outlined above, or other tasks conducted in compliance with MRP requirements, such as trash collection, could be enhanced to address the pathogen impairment.

To further address leaky sewer infrastructure in San Mateo, a private lateral ordinance, similar to that enacted in Pacifica, may be necessary. Repair and replacement of aging sewer infrastructure must continue, likely on a larger scale. Other potential management techniques

could include diverting and treating storm runoff; enhanced education and outreach for pet owners, visitors and residents/tenants; and requiring owners to clean up after pets.

Contacts and Stakeholders

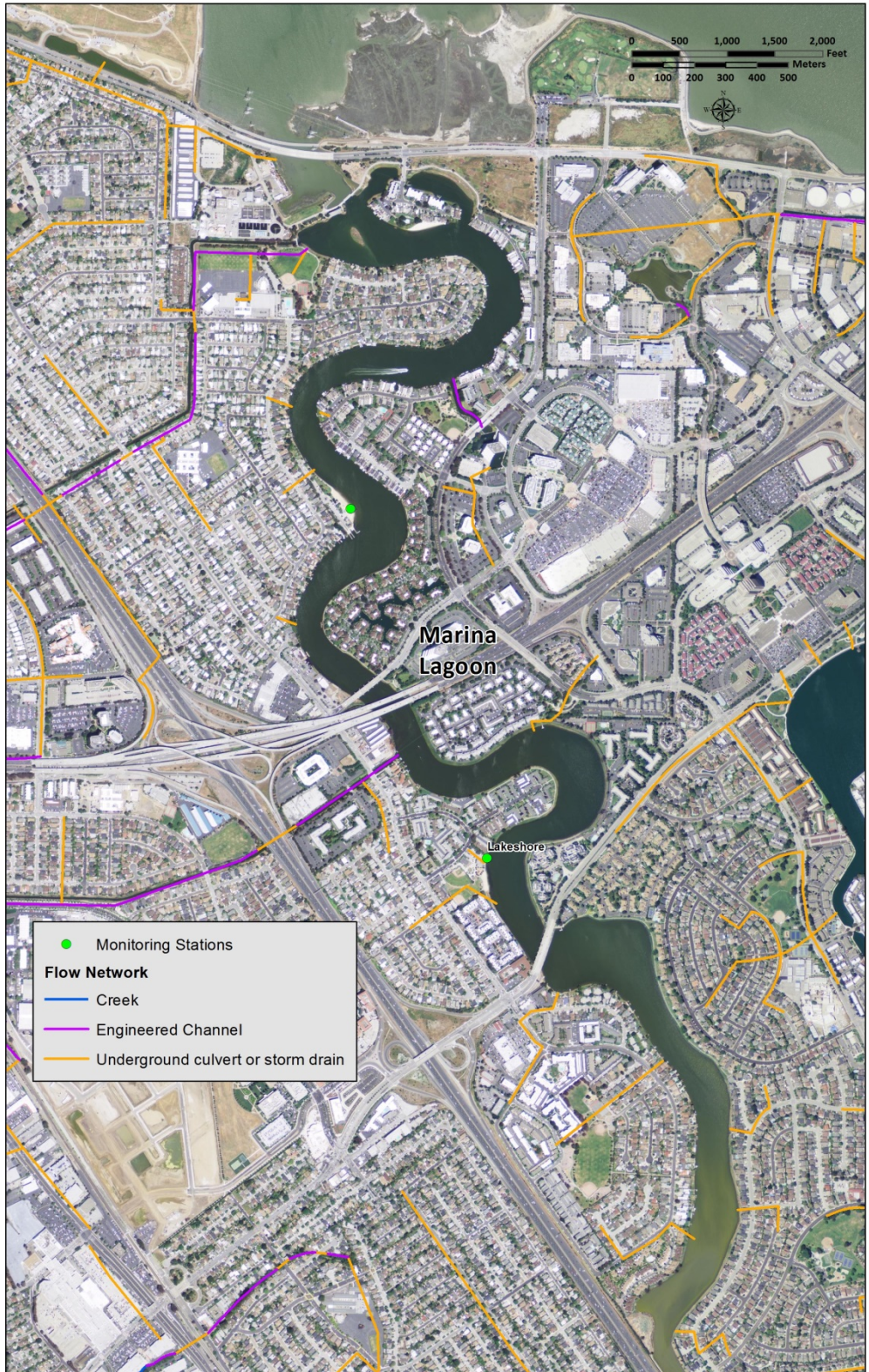
City of San Mateo

San Mateo County Environmental Health

San Mateo Water Ski Club

Marina Lagoon Action Committee

Figure 6. Marina Lagoon
Show neighborhood names (use City San Mateo diagrams), dog park, pump station, tide gates



McNears Beach

McNears Beach is located on San Pablo Bay within the 55-acre McNears Beach Park, a popular park operated by Marin County Parks (Figure 7). The one-mile long beach is used for swimming, wading, and fishing, and by kayaks and canoes. The surrounding park offers adult and toddler swimming pools, tennis courts, grassy play areas, and a fishing pier, as well as shower/changing rooms and restrooms. Dogs are not permitted in McNears Beach Park.



Water Board staff photos

Basis of Listing

The U.S. EPA placed McNears Beach on the Clean Water Act 303(d) list in 2006, based on 15% of samples exceeding the geomean for total coliform (U.S. EPA 2011). Seven percent of samples exceeded the SSM for enterococci. The sampling timeframe was the summers of 2003 through 2005 (Table 12).

Available Data

No recent data were available for McNears Beach as this report was prepared. The Marin County Health Department ceased sampling the beach in 2009 due to funding issues, but sampling was restarted in July, 2013.

Table 12. Summary of McNears Beach Data, 5/13/2003 – 4/13/2009* (180 weeks)

	Data pts	# samples exceeding Single Sample Max (%)	# samples exceeding Geometric Mean ^a (%)
Enterococcus	124	9 (7.3%)	3 (2.9%)
Total Coliform	181	3 (1.7%)	27 (16.9%)
Fecal Coliform	181	2 (1.1%)	1 (0.6%)

*Enterococcus collected 12/5/2005-12/31/2012 (324 weeks)

^aGeomeans calculated using all data collected in rolling 30-day periods.

Key Pollutant Sources

McNears Beach has few of the common potential sources of pathogens, as outlined below.

Urban stormwater: Like nearby China Camp Beach, the stormwater catchment area for McNears Beach is relatively small, and urban stormwater is not expected to be a significant source or transport mechanism for pathogens.

McNears Beach Park itself is heavily used throughout much of the year, and park users leave behind large volumes of litter, especially on weekends and holidays. Stormwater runoff from the park discharges to the beach at four locations. In addition, McNears Beach is positioned

geographically so that litter from the Delta and Napa River lands on the beach. Park personnel report that they remove plastic and other debris from the beach on a daily basis (Sauter 2013).

Leaking sewer infrastructure: The park contains a public swimming pool, showers, restrooms, a small café, park ranger headquarters, and a residence. A sewer main running the length of the park and two pump stations are owned by the San Rafael Sanitation District, which conducts checks on the pump stations three times per week (Sauter 2013).

Pet waste: Pets are not allowed in McNears Beach Park. One or more Marin County Park rangers work at the park on a daily basis, providing for good enforcement of the “no pets” policy.

Boat waste: McNears Beach does not have a boat launch area. However, similarly to nearby China Camp Beach, day boats and yachts will anchor offshore for varying lengths of time. On at least one occasion, a boat was anchored offshore for a period of several weeks or months (Sauter 2013). Boat waste could be an occasional source of pathogens to the beach; however, this cannot be fully investigated due to lack of data.

Wildlife: Geese are attracted to the green lawn at the park, and goose droppings are a nuisance for park-goers. Deer inhabit the park as well.

Analysis Strategy

Marin County Health personnel ceased sampling McNears Beach in 2009, so no recent data exist. Sampling resumed in July 2013.

Management Techniques

McNears Beach Park is under the management of the Marin County Parks Department, which could implement new or enhance existing management practices; educate and conduct outreach regarding litter; or divert and treat storm runoff. The San Rafael Sanitation District could conduct integrity/leakage testing of its sewage pumps and lines, which are within close proximity to the beach.

Contacts and Stakeholders

Marin County Parks Department
San Rafael Sanitation District
Marin County Health Department
City of San Rafael

Figure 7. McNears Beach



Applicable Standards

Federal Clean Water Act regulations and the San Francisco Bay Basin Water Quality Control Plan (Basin Plan) contain water quality standards that identify the beneficial use of San Francisco Bay Basin water bodies, numeric and narrative water quality objectives to protect those uses, and provisions to enhance and protect existing water quality. All the beaches included in this TMDL have water contact recreational uses, and the TMDL's goal is to protect those uses. While shellfish harvesting is a beneficial use of the entire San Francisco Bay, there is no information that shellfish harvesting is occurring at any of these beaches, and it will not be addressed in the TMDL. The Basin Plan's bacteria Water Quality Objectives for protection of water contact recreation in estuarine waters are shown in Table 13.

Table 13. Basin Plan Objectives for Bacteria in Waters with Recreational Beneficial Uses

Beneficial Use	Fecal Coliform (MPN ^a /100 mL)	Total Coliform (MPN/100 mL)	Enterococcus (MPN/100mL) ^b
Water Contact Recreation (REC-1)	Geometric Mean ^c < 200 90 th percentile < 400	Median < 240 No sample > 10,000	Geometric Mean ^c < 35 No sample > 104
Non-contact Water Recreation (REC-2)	Mean < 2000 90 th percentile < 4000	Not Available	Not Available

a. Most Probable Number (MPN) is a statistical representation of the results of the standard coliform test.
 b. Applicable to marine and estuarine waters only.
 c. Based on a minimum of five consecutive samples equally spaced over a 30-day period.

While Table 13 shows the applicable standards for the development of this TMDL, it is relevant to point out the standards used for beach closures as well. These standards are contained in the State's Public Health Regulations for Ocean Beaches and Ocean Water-Contact Sports Areas, pursuant to Assembly Bill 411. These regulations require local health officers to conduct weekly bacterial testing between April 1 and October 31 of waters adjacent to public beaches which have more than 50,000 visitors annually and are near storm drains that flow in the summer. Local health officers are required to test for three indicator organisms: total coliform, fecal coliform, and enterococci. If any one of these indicator organisms exceeds the standards established in the Health and Safety Code, the county health officer is required to post warning signs at the beach and to make a determination whether to close that beach in the case of extended exceedances. The California Department of Public Health bacteriological standards for beaches and recreational waters are shown in Table 14.

Table 14. California Health & Safety Code Bacteriological Standards for Ocean Beaches & Recreational Waters

Sample Type	Indicator	Standards ¹
Single	Total Coliform ²	1000
	Total Coliform	10,000
	Fecal Coliform	400
	Enterococci	104
30-day Log Mean	Total Coliform	1,000
	Fecal Coliform	200
	Enterococci	35

¹ Number of organisms or colonies forming per 100 ml of water.

² If the ratio of fecal to total coliform exceeds 0.1.

Strategy for Developing the TMDL

The goal of this project is to develop a TMDL that will address impairment of water contact uses at San Francisco Bay beaches. After analyzing the sources of pathogens to the beaches, developing numeric targets is the next step in the TMDL process. Recent pathogen TMDLs for California coastal water bodies have used a “reference beach” approach to develop numeric targets, which have been expressed as the number of allowable exceedances of the bacteria objectives. Because the watershed draining to the reference beach is overwhelmingly nonurban, and thus wildlife is the predominate source of bacteria to the beach, the reference beach is used to determine the number of exceedances caused by the uncontrollable source, wildlife. An example of such a TMDL in the San Francisco Bay region is the San Pedro Creek & Pacifica Beach TMDL.

The reference beach approach is applicable to beaches with watersheds that have a significant portion of nonurban open space, where wildlife would be expected to contribute a significant portion of the bacteria impairment. San Francisco Bay has no beaches that fit that profile, and thus no suitable reference beach exists for Bay beaches.

Because the reference beach approach is not suitable, other strategies will be explored for developing a TMDL for the Bay beaches. To provide background information, approaches used in other Bay area pathogen TMDLs are summarized in Table 15.

Table 15. Summary of Non-reference beach approaches to SF Bay Area Pathogen TMDLs

TMDL Element	Tamales Bay TMDL	Napa River & Sonoma Creek TMDLs	Richardson Bay TMDL
Numeric targets	Same as Basin Plan (BP) Objectives, yr-round, ≤10% of samples exceed in 30-day period; no discharge of untreated human waste; 30 days/yr shellfish harvest closures	Same as BP Objectives, yr-round, ≤10% of samples exceed in 30-day period; no discharge of untreated human waste	Same as BP Objectives
TMDL	Same as BP Objectives for shellfish harvesting	Same as numeric targets	Same as BP Objectives for shellfish harvesting
Margin of safety	10% margin of safety reflected in of the allocation of numeric target. See “Other” row below	Due to uncertainty in estimating loading from nonpoint sources and municipal runoff, allocations have a 10% margin of safety	Implicitly part of the numeric target
Allocations	Grazing, dairies, equestrian facilities, urban runoff, open space-wildlife, in-bay-wildlife each must meet Objectives	Allocated all but 10% of load to each: muni run-off, grazing, confined animal facilities, wildlife. POTWs must meet Objectives	Urban stormwater & wildlife sources each allocated the Objectives
Wildlife	Open space & Bay wildlife are recognized as potential source areas; not believed a significant source & considered natural background; no management measures required	Wildlife not believed a significant source and their contribution is considered natural background; no management measures required	Wildlife not a readily controllable source; no management measures required

Project Definition - San Francisco Bay Beaches Pathogen TMDL

TMDL Element	Tamales Bay TMDL	Napa River & Sonoma Creek TMDLs	Richardson Bay TMDL
Implementation elements	Grazing land Waste Discharge Requirements; reduce boat discharges; education; monitoring	County evaluate septic systems; sanitary systems seek permits; grazing lands waiver; Confined feeding operations submit Record of Waste Discharge; urban stormwater & POTWs comply with permits	County evaluate houseboats & vessels, owners repair/upgrade; urban stormwater & POTWs comply with permits
Other	Separate targets for Bay (shellfish) & tributaries (recreation). Each of 2 tributaries are allocated geomean = 95 fecal coliform (WQO = 200)		

San Francisco area pathogen TMDLs have generally established TMDL targets consistent with applicable Basin Plan Water Quality Objectives for bacteria, and allow 10% of samples to exceed the target; this is consistent to the 303(d) listing policy. For the San Francisco Bay beaches TMDL, we will start with the concept of allowing 10% of samples to exceed Water Quality Objectives, and investigate whether information, precedent, or regulatory mandate exists upon which to establish an alternate (either higher or lower) allowable rate of exceedance for the beaches included in this TMDL.

Water Board staff will work with stakeholders throughout the TMDL development process, which will include implementation actions specific to each beach. In addition, the TMDL will propose a conceptual model and framework by which the numeric targets, allocations, and implementation actions may be applied to other Bay beaches, should any other beaches be placed on the Clean Water Act 303(d) list. This framework could potentially allow the implementing agency(s) to identify the sources of bacteria to their beach from those shown in the conceptual model, and to develop a plan for implementing the corrective/best management actions associated with those sources in the TMDL implementation framework.

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