

Draft Guidance for Fresh Water Beaches  
[Health Warnings!]

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Glossary

**Closure:** The placement of signs at an area of a public beach that informs the public that the area is closed to swimming and water contact. These signs should indicate the nature of the public health concern (e.g., sewage spill), and should, by nature of their language, color, and design, enable the recreating public to differentiate from advisories provided by posting. Closure is envisioned to occur when health risks are considered greater than those associated with posting, as with sewage spills or at

areas at which monitoring results show that multiple indicator organism standards are exceeded, for both single sample and 30-day average values.

**Posting:** The placement of a sign or signs at an area of a public beach that informs the public of contamination of recreational water and the risk of possible illness, and advises against swimming and/or water contact (see Section 8.2). The placement of signs may be temporary, as a result of monitoring that indicates a single microbiological indicator standard is exceeded (e.g., or more permanent, where monitoring indicates regular or sporadic contamination (e.g., a storm drain, or a water body with poor water circulation), or where sources of contamination are identifiable and can be explained (e.g., storm drain water, or residential wild or domestic animal populations).

**Storm drain:** A conveyance through which water flows onto or adjacent to a public beach, and includes rivers, creeks, and streams, whether in natural or in man-made channels. The presence of a storm drain that flows in the summer is one criterion that identifies a coastal public beach as being subject to certain regulatory requirements.

## 1.0 Introduction

The purpose of this document is to provide guidance for local health agencies with regard to the sanitation and healthfulness of recreational waters and beaches. It includes guidance for developing a protocol for recreational waters, a discussion of recommended levels of contamination for public notification and beach closure, levels for reopening closed beaches, and suggested language for public notification. It also includes other recommendations related to beach cleanliness.

The appendices to this guidance include a review of current standards and guidance for ocean and fresh water recreation, as well as other related material. Appendices A, B, and C present state statutes and regulations, federal guidance, and local guidance and ordinances, respectively. Appendix D discusses the microbiological indicator organisms in standards and guidance. Appendix E provides a brief review of epidemiological studies associated with ocean and fresh water recreation.

### 1.1 Sources of Microbiological Contamination of Recreational Waters

Microbiological contamination of recreational waters is generally associated human sewage or non-human wastes. So long as recreational areas are isolated from those wastes, contamination by disease-causing microorganisms is unlikely. However, there are a number of pathways by which such contamination may occur.

**Sewage—**Potential sources of microbiological contamination of recreational waters may be associated with system failures in human sewage treatment facilities, leaking sewer lines, or with rainfall and resulting surface water runoff.

When excessive rainfall occurs and sewage systems are not able to process the volume of water that enters them it, flooding may occur and releases of untreated sewage may occur.

Treatment processes that include secondary treatment followed by filtration and disinfection will be more protective of public health than those that do not include the latter steps.

**Other Sources of Sewage—**Other sewage retaining systems that are specific for recreational areas may be a potential source of microbiological contamination of recreational waters if they are poorly

maintained or if their contents are otherwise released through accident, error, or deliberate action. Sources of possible contamination include releases from boat and recreational vehicle holding tanks, pumping stations, sewer line leaks, and portable toilets.

**Septic Systems**—Leachate from septic systems may be a potential source of microbiological contamination of recreational waters, particularly from septic systems that are poorly maintained, or during flooding. Although a single home septic system alone may pose a small risk of environmental contamination, in areas where septic systems predominate, shabby maintenance and flooding may be more significant.

**Animal Wastes**—Animal wastes may also contribute to microbiological contamination of recreational waters, though it is generally assumed that such contamination represents a less substantial human risk than contamination by human sewage. To the extent that animals may be allowed on beaches or other recreational properties, such as equestrian trails, their wastes may add to the microbiological burden of recreational waters.

Even the practice of "curbing" one's dog may result in an added microbiological burden during times of surface runoff that ultimately reaches a recreational water body.

Feedlots, dairy farms, pasture land, forests and other "natural" areas, and urban surfaces may be sources of microbiological contamination. Animals, both wild and domestic, may also serve as vectors for microbiological parasites of public health concern, such as *Giardia* and *Cryptosporidium*.

**Sewage Sludge**—The distribution of treated sewage sludge, provided that treatment adequately destroys any microbiological components that may be present, should not pose a potential for microbiological contamination of recreational waters. Organisms in inadequately treated sewage sludge, which should not be disposed of on land, may be present in runoff associated with rainfall or with landscape or agricultural irrigation practices.

**Surface Water Runoff**—As mentioned previously, surface water runoff can contribute significantly to the census of microbes in a recreational body of water, particularly in times of heavy rains, in which street gutters and storm drain systems that often contain decaying organic matter are flushed out by large volumes of water.

In addition, sanitary sewers systems and septic systems may be overwhelmed by stormwater that may enter them. In situations with common storm drains and sewer drains, or leaking sewer drains, heavy rains are obvious problems.

Dry weather urban runoff may also contain high levels of indicator organisms.

In addition to urban runoff, surface runoff from other land surfaces may also contain microbes, and land on which wildlife or domestic animals are in dense populations may contribute to high microbial densities in runoff.

**Swimmer-to-Swimmer Contamination**—Another source of microbiological contamination of marine recreational waters are the individuals who are using those waters for recreation. Constituents of residual fecal matter may be washed off the body on contact with water, with most of it washed off within a relatively short time after submersion. Hence, swimmers, bathers, waders, surfers, the fishing

population, and others who may come into full- or most-body contact may all contribute to contamination to which they are exposed.

Infants and young children, and other individuals may also contribute significantly to microbiological contamination by accidental fecal releases. Others may cause contamination by intentional fecal releases, because of a lack of proper sanitary facilities at or near the recreational area, or because such facilities, though present, are not used.

Recreational users at beaches with limited water circulation will likely be subject to a greater swimmer-to-swimmer contamination than those at beaches where water circulation is greater.

## 2.0 Protocol Development

Protocols should be developed for the following:

- Sanitary survey
- Sewage spills
- Stormwater runoff
- Sampling and analysis
- Beach posting, closure and reopening procedures

### 2.1 Sanitary Survey

A sanitary survey should be performed that identifies actual or potential sources of microbiological contamination of the recreational waters and beach areas. Information that is collected for purposes of the Drinking Water Source Assessment and Protection (DWSAP) Program or other watershed-related activities could contribute to a sanitary survey. The DWSAP Program document contains a checklist of possible contaminating activities for surface water sources that may be helpful in this regard.

Sources of contamination near recreational areas may indicate a need for increased monitoring of microbiological indicator organisms.

For recreational area with poor water circulation, the sanitary survey should include a discussion of the impact of bather load on recreational areas. Because of the poor water circulation, heavy bather loads can cause significant elevation in bacterial counts for total and fecal coliform and enterococcus bacteria.

High use areas with poor water circulation may also indicate a need for increased monitoring of microbiological indicator organisms.

### 2.2 Sewage Spills

A protocol should be developed that sets forth procedures for closing recreational waters and beach areas in the event of a sewage spill, including language that is used in public notification and signage, and monitoring requirements for reopening the recreational waters and beach areas (e.g., consecutive sampling indicates that standards are being met and area can be reopened for recreational use). The protocol should also indicate the extent of beach closure in terms of distance, based on the amount of sewage estimated to be discharged or spilled.

### 2.3 Stormwater Runoff

A protocol should be developed that sets forth procedures for public notification about beach contamination whenever significant amounts of rainfall result in urban runoff that enters recreational waters and beach areas.

The public notification should include press releases and updates of a telephone hotline that is accessible to the public. Other means of public access may also be utilized. The notification should inform the public that body contact with stormwater runoff should be avoided for a minimum of 72 hours following significant rainfall because of microbiological contamination. The 72-hour period should be adequate to dissipate microbiological contamination.

The protocol should include the language that is used in public notification and the means by which the information is distributed.

### 2.4 Sampling and Analysis Plan

A plan should be developed that includes location of sampling sites, frequency of sampling, duration of sampling period, and depth of sampling. The plan should also include other pertinent information, such as containers for sampling, packaging samples for transport, references for analytic methods, reporting of data, requirements for repeat sampling. The plan should be developed in conjunction with the local Public Health Laboratory.

**Location of Sampling Sites**—Sampling sites should include areas used for water contact sports. In addition, areas known to be regularly or chronically contaminated should be included in the sampling plan.

**Frequency of Sampling**—Sampling no less frequently than weekly is recommended. However, a minimum frequency of sampling should be established locally, based upon historical records, usage, current situations, and the potential of health hazards.

When samples are above standards or guidance levels, more frequent or daily sampling is appropriate, to determine whether the area should be closed to recreational use.

Subsequent sampling is also needed to determine when to reopen the recreational area.

**Time of Sampling**—Sampling should occur at each location at generally the same time of day.

For crowded beaches at which bather-to-bather contamination may be a significant route of microbiological exposure, sampling when recreational use is highest may be appropriate (e.g., mid-afternoon).

**Duration of Sampling Period**—The sampling period should cover the period of recreational use, for example, April through October.

**Depth of Sampling**—Samples should be taken from just below the water surface, in ankle- to knee-depth water, approximately 12 to 24 inches deep.

Sampling from boats is inadequate for beach monitoring, since water depths would exceed those common to beach-related recreational water sports activities occur, especially for young children.

**Indicator Organisms** —Indicator organisms should include total coliform bacteria and fecal coliform bacteria, and either enterococcus bacteria or *Escherichia coli*.

## 2.5 Laboratories and Laboratory Analyses

All samples are to be submitted for analyses to a laboratory certified by the Department of Health Services' Environmental Laboratory Accreditation Program (ELAP), pursuant to Health and Safety Code Section 100825, in microbiology for methods appropriate for the analysis of the sample type.

Transportation conditions, holding time limits, and analysis of samples shall be in accordance with those methods that appear on the certificate listing for microbiology of ELAP.

Analyses should be completed expeditiously after they are received in the laboratory. Preliminary results should be available from the laboratory as soon as possible, and, if they exceed the standards for microbiological indicator organism, the laboratory should telephone the appropriate local agency. Written results should be provided within one week after sampling.

**Use of *Escherichia coli* as a surrogate for fecal coliforms**—When a test method measures *E. coli* to be used as a surrogate for fecal coliforms, laboratories should split samples between such a method and either the multiple tube fermentation or membrane filtration method with standard confirmation steps, and run the two tests in parallel, to identify an appropriate correction factor to apply to the *E. coli*-derived values (e.g.,  $E. coli$  per 100 ml  $\times$  1.2 = fecal coliforms per 100 ml). Such parallel testing should include enough samples to develop a scientifically credible correlation between the two methods. It should occur at least once per year (for example, early summer) or twice each year (for example, early spring and late summer), and ideally should be done for each type of water source that is subject to the sampling program (for example, lake beach and river beach). The most recently derived correction factor should be applied to the *E. coli* values to determine compliance with the fecal coliform standard. Laboratories should retain the results of the parallel testing in their files, consistent with their record retention procedures.

**Data Reporting**—The sampling and analysis plan should indicate how data are to be reported, particularly if they are outside the reporting range. For example, samples below the testing range for the most probable number (MPN), e.g., <20 MPN, should be reported as "<20 MPN" and not as "zero."

The sampling and analysis plan should also indicate how data outside the testing range are used in the calculation of 30-day averages. For example, a sample that is <20 MPN may appropriately be designated "10 MPN" (half the upper range for the sample) for purposes of assigning a numeric value that can be used for determining the monthly values.

## 2.6 Posting, Closure and Reopening Procedure

The protocol should include procedures for posting and/or closing beaches and recreational areas, public notification, and procedures for determining whether posting and/or closure should continue.

## 3.0 Corrective Action

When recreational waters fail to meet guidance levels, the local health officer may choose to take corrective action. Such actions may include, after taking into consideration the causes for the elevation of microbiological indicators, posting the beach with warning signs, closing the beach or otherwise restricting its use until corrective action has been taken and guidance levels are met.

#### 4.0 Sewage Spills and Closing Recreational Beaches

Immediate beach closure is the appropriate corrective action whenever sewage releases or spills occur. The closure should continue until after the spill or release has been stopped, and until monitoring indicates that the contamination levels meet appropriate guidance levels (see Section 5.0)

#### 5.0 Indicator Organism Levels and Posting/Closure

Appendices A and B present existing state and federal numeric standards and guidance for indicator organisms. Appendix C presents a brief summary of local guidance and ordinances.

Decisions about posting and closing beaches should be based upon the most recent single samples. Thirty-day averages allow determinations to be made of the natural fluctuations of the numbers of those organisms. Longer term evaluations also provide an understanding of the presence of indicator organisms, in terms of their association with rainfall, stormwater runoff, dry urban runoff, recreational use, or other conditions specific to a particular beach or recreational area.

Areas that are highly or consistently contaminated require special attention. For example, portions of beaches that are associated with areas that fail to meet standards more often than not, because of local conditions, may be appropriate for posting and/or closing on a long-term basis. Creeks, streams, and rivers, whether natural or in man-made channels, may contain elevated levels of indicator organisms, particularly if their flow is influenced by stormwater or dry weather urban runoff.

#### 5.1 Single Sample Values

Beach posting is recommended when indicator organisms exceed any of the following levels:

- \* Total coliforms: 10,000 per 100 ml
- \* Fecal coliforms: 400 per 100 ml
- \* Either Enterococcus: 61 per 100 ml, or E. coli: 235 per 100 ml

#### 5.2 Thirty-Day Average Values

Additional sanitary surveys and other related evaluations, including more frequent sampling if levels appear to be on an increasing trend, are recommended when indicator organisms exceed any of the following, based on the log mean of at least 5 equally spaced samples in a 30-day period:

- \* Total coliforms: 1,000 per 100 ml
- \* Fecal coliforms: 200 per 100 ml
- \* Either Enterococcus: 33 per 100 ml, or E. coli: 126 per 100 ml

#### 6.0 Reopening Closed Beaches

The levels of Section 5.0 should be used to determine the appropriateness of continuing to post or close beaches or recreational areas, or portions thereof.

## 7.0 Prohibition of Diapers from Beaches and Recreational Waters

Because of the likelihood of contamination of recreational waters by fecal matter, diaper-wearing infants should be prohibited from water contact.

Public notification may be used to inform parents and others about the prohibition of individuals wearing diapers from water contact. Methods of public notification may include, but are not limited to, signs, notices, or flyers.

## 8.0 Public Notification

Notification may be provided to the public by signs, press releases, and electronic access.

Appropriate language for signs and their placement along a beach is best determined by local experience.

### 8.1 Signs

Signs should be present near the portion of the recreational area at which water contact will occur, and elsewhere (e.g., along walkways to the beach, park entrances) where they are likely to be read. Signs should be large enough to be clearly seen and legible. They should be posted in English and other language(s) as appropriate.

Other signage than those examples given below may be appropriate, as determined by local agencies. A variation of the international sign, with a graphic depiction of a swimmer in a red circle with a diagonal hash mark, may be useful in some locations. Signs in a second language may be appropriate if a large percentage of recreational water users only speak that language.

**Signs for Beach Posting Associated with Storm Drains**—If a storm drain at a recreational area is chronically contaminated, the area affected by the storm drain should be posted with language similar to the following:

**WARNING! STORM DRAIN WATER  
MAY CAUSE ILLNESS.  
NO SWIMMING IN STORM DRAIN WATER**

or

**WARNING!  
CONTAMINATED STORM DRAIN WATER.  
NO SWIMMING IN STORM DRAIN WATER**

**Signs for Beach Posting Not Associated with Storm Drains**—If a beach or recreational area is contaminated, the area should be posted with language similar to the following:

**WARNING!**



**CONTAMINATED WATER  
SWIMMING NOT ADVISED**

Signs for Beach Posting Associated with Contamination by Populations of Animals—If a beach or recreational area is contaminated animal waste, the area should be posted with language similar to the following:

**WARNING!  
WATER CONTAMINATED BY WILDLIFE  
SWIMMING NOT ADVISED**

or

**WARNING!  
CONTAMINATED WATER BY ANIMALS  
SWIMMING NOT ADVISED**

or

**WARNING!  
CONTAMINATED WATER BY BIRDS  
SWIMMING NOT ADVISED**

Signs Indicating Beach Closure—If a beach or recreational area is closed because of a sewage spill or other similar contamination, signs should be used to indicate the closure. Signs for closure should be easily recognized (by virtue of their color, shape, wording, symbols) as of different from those used for posting. Language should be similar to the following:

**WARNING!  
UNTREATED SEWAGE SPILL  
BEACH CLOSED**

or

**WARNING! CLOSED TO SWIMMING.  
BEACH/SWIMMING AREA IS CONTAMINATED  
AND MAY CAUSE ILLNESS**

## 8.2 Press Releases

Notification of beach postings or closures because of rainfall and urban runoff, sewage spills, or other public health concerns by print and electronic media is appropriate. Such notification should be considered supplemental to posting of warning or and closure signs, if those activities are required.

All press releases should come from the health authority.

## 8.3 Electronic Access

Notification of beach postings or closures because of rainfall and urban runoff, sewage spills, or other public health concerns by means of recorded messages accessible by a telephone hotline is recommended. Additional public information may be provided by electronic bulletin boards, the Internet, and local radio and television.

#### 8.4 Other Information

To minimize person-to-person microbiological contamination, local health agencies may provide visitor education programs and present information on sanitary practices, consisting of notices posted at the beach/park entrances and flyers given to individuals.

An example of such information is alerting the public that children should not be allowed to wear diapers in recreational waters.

Because of the likelihood of microbiological contamination of recreational waters by the recreating public themselves, a public education campaign (postings, brochures, public service announcements) might be implemented. Such a program could encourage good hygiene practices, avoidance of swimming while ill, control (where feasible) of accidental fecal releases among infants and young children, (including recommendations for no diaper wearing in recreational waters, as discussed in Section 7.0). It could also discuss the increased probability of sharing pathogenic organisms when large numbers of people share recreational waters.

#### 8.5 Notification Associated with a Rainfall Event

In the event of rainfall that occurs during recreational months, local health officers may choose to utilize a combination of posted warnings and/or closure signs, telephone hotline information, and press releases that advise against water contact for 72 hours after rainfall ceases (see Section 2.3).

#### 8.6 Notification of Drinking Water Systems

When a beach posting, closure or other restriction or public notification occurs because guidance levels for microbiological indicators are not met in a freshwater body that is used as a source of drinking water by a public water system, the public water system should be notified by the local health officer.

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## Appendices — Draft Guidance for Salt- and Fresh Water Beaches

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### Appendices

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### **References**

#### **Appendix A. STATE REGULATION OF BEACHES AND RECREATIONAL WATERS**

##### **A.1. OCEAN BEACHES AND OCEAN WATER-CONTACT SPORTS AREAS**

###### **A.1.1. Statutory Authority**

Health and Safety Code Sections 100275, 115880, 116075, and 116080 authorize the Department of Health Services to adopt regulations pertaining to beach safety.

###### **A.1.1.1 Statutes Related to Beaches**

The following sections from the Health and Safety Code address beaches and water contact sports areas.

115875. "Public beach," as used in Sections 115875 to 115895, inclusive, means any beach as used by the public for recreational purpose that is owned, operated, or controlled by the state, any state agency, any local agency, or any private person in this state.

115880. (a) The department shall by regulation, in consultation with local health officers and the public, establish minimum standards for the sanitation of public beaches, including, but not limited to, the removal of refuse, as it determines are reasonably necessary for the protection of the public health and safety.

(b) Prior to final adoption by the department, the regulations and standards required by this section shall undergo an external comprehensive review process similar to the process set forth in Section 57004 of the Health and Safety Code.

(c) The regulations shall, at a minimum, do all of the following, by December 31, 1998:

(1) Require the testing of the waters adjacent to all public beaches for microbiological contaminants, including, but not limited to, total coliform, fecal coliform, and enterococci bacteria. The department may require the testing of waters adjacent to all public beaches for microbiological indicators other than those set forth in this paragraph, or a subset of those set forth in this paragraph, if the department affirmatively establishes, based on the best available scientific studies and the weight of the evidence, that the alternative indicators are as protective of the public health.

(2) Establish protective minimum standards for total coliform, fecal coliform, and enterococci bacteria, or for other microbiological indicators that the department determines are appropriate for testing pursuant to paragraph (1).

(3) Establish protocols for all of the following:

(A) Determining monitoring site locations and monitoring frequency based on risks to public health.

(B) Making decisions regarding public notification of health hazards, including, but not limited to the posting, closing, and reopening of public beaches.

(4) Require that the waters adjacent to public beaches be tested for total coliform, fecal coliform and enterococci bacteria, or for other microbiological indicators that the department determines are appropriate for testing pursuant to paragraph (1). Except as set forth in paragraph (5), testing shall be conducted on at least a weekly basis, from April 1 to October 31, inclusive, of each year, beginning in 1999, if all of the following apply:

(A) The beach is visited by more than 50,000 people annually.

(B) The beach is located on an area adjacent to a storm drain that flows in the summer.

(5) The monitoring frequency and locations established pursuant to this subdivision and related regulations may only be reduced or altered after the testing required pursuant to paragraph (4) reveals levels of microbiological contaminants that do not exceed for a period of two years the minimum protective standards established pursuant to paragraph (2).

(d) The local health officer shall be responsible for testing the waters adjacent to, and coordinating the testing of, all public beaches within his or her jurisdiction.

(e) The local health officer may meet the testing requirements of this section by utilizing test results from other agencies conducting microbiological contamination testing of the waters under his or her jurisdiction.

(f) Any city or county may adopt standards for the sanitation of public beaches within its jurisdiction that are stricter than the standards adopted by the state department pursuant to this

section.

(g) For purposes of this section, "public beach" means any public beach located within the coastal zone, as defined in Section 30103 of the Public Resources Code.

(h) Any duty imposed upon a local public officer or agency pursuant to this section shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with the performance of these duties. The State Director of Health Services shall annually, within 15 days after enactment of Budget Act, file a written statement with the Secretary of the Senate and with the Chief Clerk of the Assembly memorializing whether sufficient funds have been appropriated.

115885. The health officer having jurisdiction over the area in which a public beach is created shall:

(a) Inspect the public beach to determine whether the standards established pursuant to Section 115880 are being complied with. If the health officer finds any violation of the standards, he or she may restrict the use of, or close, the public beach or portion thereof in which the violation occurs until the standard is complied with.

(b) Investigate any complaint of a person of a violation of any standard established by the department pursuant to Section 115880. If the health officer finds any violation of the standard prescribed by the department, he or she may restrict the use of, or close, the public beach or portion thereof until the standard is complied with. If the person who made the complaint is not satisfied with the action taken by the health officer, he or she may report the violation to the department. The department shall investigate the reported violation, and, if it finds that the violation exists, it may restrict the use of or close the public beach or portion thereof until the standard violated is complied with.

(c) (1) Whenever a beach is posted, closed, or otherwise restricted in accordance with Section 115915, the health officer shall inform the agency responsible for the operation and maintenance of the public beach within 24 hours of the posting, closure, or restriction.

(2) The health officer shall establish a telephone hotline to inform the public of all beaches currently closed, posted, or otherwise restricted. The hotline shall be updated as needed in order to convey changes in public health risks.

(d) Report any violation of the standards established pursuant to Section 115880 to the district attorney, or if the violation occurred in a city and, pursuant to Section 41803.5 of the Government Code, the city attorney is authorized to prosecute misdemeanors, to the city attorney.

(e) In the event of a known untreated sewage release, the local health officer shall immediately test the waters adjacent to the public beach and to take action pursuant to regulations established under Section 115880.

(f) Notwithstanding any other provision of law, in the event of an untreated sewage release that is known to have reached recreational waters adjacent to a public beach, the local health officer shall immediately close those waters until it has been determined by the local health officer that the waters are in compliance with the standards established pursuant to Section 115880.

(g) Any duty imposed upon a local public officer or agency pursuant to this section shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with the performance of these duties. The State Director of Health Services shall annually, within 15 days after enactment of Budget Act, file a written statement with the Secretary of the Senate and with the Chief Clerk of the Assembly memorializing whether sufficient funds have been appropriated.

115890. Prior to restricting the use of or closing a public beach or portion thereof alleged to be violation of standards, the health officer, or the department as the case may be, shall give reasonable notice of the violation to the owner of, or person or agency in charge of, the beach.

115895. Any private person who violates any regulation adopted by the state department pursuant to Section 115880 is guilty of a misdemeanor.

115900. For the purposes of Sections 115900 to 115915, inclusive, the following definitions apply:

(a) "Beach" means any public beach of the ocean waters and bays of the state where water-contact sports are engaged in by the public.

(b) "Board" means the State Water Resources Control Board.

(c) "Health officer" means the legally appointed health officer or director of environmental health of the county or city having jurisdiction of the area in which a public saltwater beach is located.

115905. The Legislature finds and declares all of the following:

(a) California's world-famous beaches are an invaluable economic, environmental, and recreational resource that must be protected for present and future generations. Millions of residents and visitors alike visit the state's beaches annually.

(b) Pollution from toxic spills, untreated municipal sewage, and agricultural and urban runoff threatens this critical resource.

(c) During 1989 through 1991 alone, at least 400 of the state's beaches had to be posted "off-limits" due to dangerous levels of bacterial and toxic contamination.

(d) Due to this pollution, local health officials were forced to close one or more beaches between San Diego and Mendocino Counties for all but 18 days in 1991.

(e) This contamination of our beaches poses serious threats to the public's health, increasing the risk that persons who use the beaches will suffer from hepatitis, gastroenteritis, and other dangerous illnesses.

(f) Notwithstanding the importance and potential severity of this problem, the state has never conducted a statewide survey to document annual beach closings.

(g) The state does not have uniform testing protocols that must be followed to ensure that the public is never exposed to dangerous contamination at the state's beaches.

(h) The state does not have uniform standards requiring beach postings when California Ocean Plan bathing water standards, as adopted by the board pursuant to Section 13170.2 of the Water Code, are exceeded.

(i) The state does not have uniform requirements mandating the frequency with which beach waters must be tested to ensure public safety. Beach water sampling currently varies greatly from county to county. For example, Los Angeles County tests its beaches every week of the year while other coastal counties test much less frequently.

(j) More accurate and centralized record keeping on the relative contributions of pollutant sources to beach closures would enable more effective targeting of corrective actions to keep our beaches safe and our coastal areas economically strong.

115910. (a) On or before the 15th day of each month, each health officer shall submit to the board a survey documenting all beach postings and closures resulting from implementation of Section 115915 that occurred during the preceding month. The survey shall, at a minimum,

include the following information:

(1) Identification of the beaches in each county subject to testing conducted pursuant to Section 115885 and the amount and types of monitoring conducted at each beach.

(2) Identification of the geographic location, areal extent, and type of action taken for each incident of posting or closure conducted pursuant to Section 115915. Geographic location and areal extent shall be noted in sufficient detail to determine on a common map, or by latitude and longitude, the approximate boundaries of the affected beaches.

(3) Identification of the standards exceeded and the causes and sources of the pollution, if known. Exceeded standards shall be identified with sufficient particularity to determine which types of tests and biological indicators were used to determine that an exceeded standard exists. Causes of pollution shall be identified with sufficient particularity to determine what substances, in addition to any water carrying the substances, were responsible for the exceeded standard. Sources shall be identified with sufficient particularity to determine the most specific geographic origin of the pollution sources available to the health officer at the time of the posting or closure.

(b) Surveys conducted pursuant to subdivision (a) shall be in a specific format established by the board on or before February 1, 2001. The board shall make the format easily accessible to the health officer through means that will enable the health officer to most effectively carry out the requirements of this section and enable the board to develop consistent, statewide data concerning the effect and status of beach postings and closures in a particular calendar year.

(c) On or before the 30th day of each month, the board shall make available to the public the information provided by the health officers. Based upon the data provided pursuant to subdivision (a), the report shall, at a minimum, include the location and duration of each beach closure and the suspected sources of the contamination that caused the closure, if known.

(d) On or before July 30 of each year, the board shall publish a statewide report documenting beach posting and closure data provided to the board by the health officers for the preceding calendar year. Based upon the data provided pursuant to subdivision (a), the report shall, at a minimum, include the location and duration of each beach closure and the suspected sources of the contamination that caused the closure, if known.

(e) Within 30 days of publication of the annual report, the board shall distribute copies of the report to the Governor, the Legislature, and major media organizations, and copies of the report shall be made available to the public by a variety of means typically available to the board.

115915. (a) Whenever any beach fails to meet the bacteriological standards established pursuant to subdivision (b) of Section 115880, the health officer shall, at a minimum, post the beach with conspicuous warning signs to inform the public of the nature of the problem and the possibility of risk to public health.

(b) A warning sign shall be visible from each legal primary beach access point, as identified in the coastal access inventory prepared and updated pursuant to Section 30531 of the Public Resources Code, and any additional access points identified by the health officer.

(c) Any duty imposed upon a local public officer or agency pursuant to this section shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with the performance of these duties. The State Director of Health Services shall annually, within 15 days after enactment of the Budget Act, file a written statement with the Secretary of the Senate and with the Chief Clerk of the Assembly memorializing whether sufficient funds have been appropriated.

116070. As used in this article, water-contact sport means any sport in which the body of a person comes into physical contact with water, including but not limited to swimming, surfboarding, paddleboarding, skin diving, and water-skiing. It does not include boating or

fishing.

116075. The department has supervision of sanitation, healthfulness, and safety of the public beaches and public water-contact sport areas of the ocean waters and bays of the state and, except as provided in Section 18930, the department may make and enforce regulations pertaining thereto as it deems proper.

116080. Regulations made pursuant to this article shall include suitable standards of safe bacteria count for water-contact sports areas specified by the State Water Pollution Control Board or regional water pollution control boards, which standards shall be applied to all public water-contact sport areas of the ocean waters and bays of the state.

116085. Every person who violates any rule or regulation adopted pursuant to this article is guilty of a misdemeanor.

116090. Nothing contained in this article shall be construed to give the department the authority to fix the areas wherein water-contact sports may be engaged in or to affect the authority of the State Water Pollution Control Board or regional water pollution control boards to fix appropriate areas for various uses.

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**A.1.2 Regulations**

**A.1.2.1 Department of Health Services [Also see DHS' Guidance for Salt Water Beaches]**

Regulations for recreational use of ocean waters are published in Title 17 of the California Code of Regulations, in Group 10. Sanitation, Healthfulness and Safety of Ocean Water-Contact Sports Areas.

**Title 17 of the California Code of Regulations**

**Group 10. Sanitation, Healthfulness and Safety of Ocean Water-Contact Sports Areas**

**Article 2. Definitions**

**7952. Public Water-Contact Sports Area Defined.**

Public water-contact sports area means any area so designated (1) by a regional water pollution control board, or (2) by any other authorized and responsible public agency.

**7956. Storm Drain.**

"Storm drain" means a conveyance through which water flows onto or adjacent to a public beach and includes rivers, creeks, and streams, whether in natural or in man-made channels.

**Article 4. Healthfulness**

**7957. Physical Standard.**

No sewage, sludge, grease, or other physical evidence of sewage discharge shall be visible at any time on any public beaches or water-contact sports areas.

**7958. Bacteriological Standards.**

(a) The minimum protective bacteriological standards for waters adjacent to public beaches



and public water-contact sports areas shall be as follows:

(1) Based on a single sample, the density of bacteria in water from each sampling station at a public beach or public water contact sports area shall not exceed:

- (A) 1,000 total coliform bacteria per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1; or
- (B) 10,000 total coliform bacteria per 100 milliliters; or
- (C) 400 fecal coliform bacteria per 100 milliliters; or
- (D) 104 enterococcus bacteria per 100 milliliters.

(2) Based on the mean of the logarithms of the results of at least five weekly samples during any 30-day sampling period, the density of bacteria in water from any sampling station at a public beach or public water contact sports area, shall not exceed:

- (A) 1,000 total coliform bacteria per 100 milliliters; or
- (B) 200 fecal coliform bacteria per 100 milliliters; or
- (C) 35 enterococcus bacteria per 100 milliliters.

(b) Water samples shall be submitted for bacteriological analyses to a laboratory certified by the Environmental Laboratory Accreditation Program, California Department of Health Services in microbiology for methods for the analysis of the sample type.

#### **7959. Bacteriological Sampling.**

(a) In order to determine that the bacteriological standards specified in Section 7958 above are being met in a water-contact sports area designated by a Regional Water Quality Control Board in waters affected by a waste discharge, water samples shall be collected at such sampling stations and at such frequencies as may be specified by said board in its waste discharge requirements.

(b) In waters of a public beach or water-contact sports area that has not been so designated by a Regional Water Quality Control Board, water samples shall be collected at such frequencies as may be determined by the local health officer or Department. Local health officers shall be responsible for the proper collection and analysis of water sample in such areas.

#### **7960. Corrective Action.**

(a) When a public beach or public-water-contact sports area fails to meet any of the standards as set forth in Section 7957 or 7958 above, the local health officer-or the Department, after taking into consideration the causes therefor, may at his or its discretion close, post with warning signs, or otherwise restrict use of said public beach or public water-contact sports area, until such time as corrective action has been taken and the standards as set forth in 7957 and 7958 above are met.

#### **7961. Public Beaches Visited by More than 50,000 People Annually and Adjacent Storm Drains.**

(a) Waters adjacent to a public beach shall be tested for bacteria identified in Section 7957 on at least a weekly basis from April 1 to October 31, inclusive, if the beach is

- (1) Visited by more than 50,000 people annually, and
- (2) Located adjacent to a storm drain that flows in the summer.

(b) Water samples shall be taken from locations that include areas affected by storm drains. Samples shall be taken in ankle- to knee-deep water, approximately 4 to 24 inches below the water surface.

(c) When testing reveals that the waters adjacent to a public beach fail to meet any of the standards set forth in Section 7958(a)(1), the local health officer shall post the beach pursuant to Health and Safety Code Section 115915, and shall use the standards of Sections 7958(a)(1) and (2) in determining the necessity to restrict the use of or close the public beach or portion thereof.

(d) In the event of a known release of untreated sewage into waters adjacent to a public beach, the local health officer shall:

(1) Immediately post and close the beach or a portion thereof, or otherwise restrict its use until the source of the sewage release is eliminated;

(2) Sample the affected waters; and

(3) Continue closure or restriction of the beach or a portion thereof and posting the beach until testing results establish that the standards of Sections 7958(a)(1) are satisfied.

#### **7962. Duties Imposed on a Local Public Officer or Agency.**

(a) Pursuant to Health and Safety Code Sections 115880(h), 115885(g), and 115915(c), any duty imposed upon a local public officer or agency by Section 7961 shall be mandated only during a fiscal year in which the Legislature has appropriated sufficient funds, as determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with performance of the duties.

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Regulations for the sanitation of public beaches are published in Title 17 of the California Code Regulations, in Group 10.1

#### **Group 10.1 Sanitation of Public Beaches**

#### **Article 2. Definitions and Exemptions**

#### **7972. Saltwater Body.**

Saltwater Body means the ocean, a marine bay, estuary or lagoon.

#### **7973. Freshwater Body.**

Freshwater Body means a natural or artificial lake, river, reservoir, stream or canal.

#### **7974. Refuse.**

Refuse means domestic or industrial garbage, rubbish, or other debris adversely affecting public health and safety as specified by the Health Officer.

#### **7975. Sanitation.**

Sanitation means the maintenance of a safe and healthful environment by means of removal of refuse; provision of sanitary toilet and handwashing facilities; disposal of sewage and liquid wastes; protection of bathing water quality; provision of pure, wholesome and potable drinking water; and control of harmful insects, rodents and animals.

**7976. Recreational Purposes.**

Recreational purposes include but are not limited to, swimming, camping, scenic enjoyment, fishing, shellfish gathering, surfing, scuba or snorkel diving, boating, equestrianism, use of recreational vehicles, jogging, walking, and beachcombing.

**7977. Public Health and Safety.**

Public health and safety means the maintenance of an environment that contributes to human well being, and in which there is an absence of human disease, ill health or injury

**7978. Health Officer.**

Health Officer means the legally appointed Health Officer of the county or city having jurisdiction of the area in which a public beach is located.

**7979. Exemption.**

Sections 7981 through 7991 of Title 17 shall not apply when the Health Officer determines that the beach is maintained primarily as an open space. The criteria, among others, that may be evidence of open space is lack of developed access, lack of parking facilities, lack of lifeguard services, or where casual use normally does not exceed 50 people per mile of shoreline.

**7980. Review by Health Officer.**

No persons shall begin construction, reconstruction or alteration of any public beach sanitation facility without first submitting plans, specifications and other such information as may be required, to the Health Officer for his review and written approval. If no action is taken within fifteen (15) days of submission of plans, the project shall be deemed approved. If the Health Officer disapproves, the reason shall be so stated in writing.

**Article 3. Day Use Beaches****7981. Application.**

The provisions of this article shall be applicable to public beaches where overnight camping is not permitted.

**7982. Toilets.**

Toilets shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code. Portable toilets may be substituted for plumbed toilets.

**7983. Water Supply.**

Water when provided for drinking, showers, or handwashing shall be from a source approved by the Health Officer.

**7984. Maintenance.**

Toilets shall be available to the public at all times the beach is officially open for use. All facilities must be maintained in a clean and sanitary condition at all times.

**7985. Refuse Handling.**

(a) Refuse containers approved by the Health Officer shall be provided at all public beaches.

(b) All refuse shall be stored in the container in a manner which will not create a nuisance.

(c) Containers shall be emptied at frequencies sufficient to prevent overflow and to be maintained in a sanitary condition.

(d) Every public beach shall be maintained in a clean condition free of refuse.

#### **7985.1 Animals.**

No person shall bring onto or allow any animal, except guide dogs used by the blind, to remain on any beach which has been designated a public swimming beach by the state, any city, county, or city and county and where life guards are provided, except that horses may be ridden on designated equestrian trails and areas.

This regulation is not intended to prohibit or supersede any local ordinance not in effect which may be enacted.

### **Article 4. Beaches Allowing Overnight Camping**

#### **7987. Application.**

The provisions of this article shall be applicable to public beaches used for overnight camping.

#### **7988. Refuse Handling.**

(a) Refuse containers approved by the Health Officer shall be provided in every camping area.

(b) All refuse shall be stored and removed in a manner which will not create a nuisance.

(c) Beach areas and areas set aside for camping shall, at all times, be maintained in a clean condition free of refuse.

#### **7988.1 Animals.**

No person shall bring onto or allow any animal, except guide dogs used by the blind, to remain on any beach which has been designated a public swimming beach by the state, any city, county, or city and county and where life guards are provided, except that horses may be ridden on designated equestrian trails and areas.

This regulation is not intended to prohibit or supersede any local ordinance not in effect which may be enacted.

#### **7989. Campsites.**

(a) No travel trailer, camp car, recreational vehicle or tent shall be located closer than six feet from any building or travel trailer, camp car, recreational vehicle or tent on an adjacent lot or campsite.

(b) Each vehicular lot or campsite in a camping area shall have direct access.

#### **7990. Sanitary Facilities.**

(a) Toilets shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code.

(b) Shower baths or other bathing facilities are not required; however, when provided, they shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code.

#### **7991. Maintenance.**

All sanitary facilities shall be maintained in a clean and safe condition.

**7992. Disposal of Sewage Wastes.**

(a) Wastewater or material from plumbing fixtures shall not be permitted to be deposited upon the ground.

(b) Campsites not provided with a drain inlet shall not be occupied by a travel trailer, car, or recreational vehicle equipped with plumbing unless the drain outlet of the vehicle is capped or as otherwise provided by part (c) of this section. Each campsite for use by vehicles equipped with toilets, unless self-contained shall be provided with a three-inch drain inlet.

(c) Other means of disposing of liquid wastes, not including human wastes, may be approved by the Health Officer.

(d) Trailer sanitation stations approved by the Health Officer and designed to receive the discharge of sewage holding tanks of self-contained vehicles shall be installed or available in an accessible location to every public beach campground area in which there are campsites not provided with drain inlets designed to receive the discharge of sewage wastes. Trailer sanitation stations shall be provided on the basis of one station for each 100 such campsites or portion thereof.

(e) Trailer sanitation stations shall be designed and constructed as required by Sections 5570 through 5580, Title 25, California Administrative Code.

**7993. Laundry Facilities.**

Laundry facilities are not required; however, when provided they shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code.

**7994. Water Supply.**

When provided, potable water shall be from a source approved by the Health Officer and obtainable from faucets installed not more than 400 feet from each campsite. Potable water shall be adequate for all the requirements of the camping area.

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**A.1.2.2 State Water Resources Control Board (SWRCB)**

The SWRCB's Ocean Plan (SWRCB, 1997) establishes the following Water Quality Objectives for microbiological contamination (the sections dealing with kelp beds and shellfish harvesting are not included):

**II. Water Quality Standards****A. Bacterial Characteristics****1. Water Contact Standards**

Within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline, and in areas outside this zone used for water contact sports, as determined by the Regional Board, but including all kelp beds the following bacterial objectives shall be maintained throughout the water column:

a. Samples of water from each sampling station shall have a density of total coliform organisms less than 1,000 per 100 ml (10 per ml); provided that not more than 20 percent of the sample of any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 per ml), and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 (100 per ml).

b. The fecal coliform density based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10 percent of the total samples during any 60-day period exceed 400 per 100 ml.

## **B. Bacterial Assessment and Remedial Action Requirements**

The requirements listed below shall be used to 1) determine the occurrence and extent of any impairment of a beneficial use due to bacterial contamination; 2) generate information which can be used in the development of an enterococcus standard; and 3) provide the basis for remedial actions necessary to minimize or eliminate any impairment of a beneficial use.

Measurement of enterococcus density shall be conducted at all stations where measurement of total and fecal coliforms are required. In addition to the requirements of Section II.A.I, if a station consistently exceeds a coliform objective or exceeds a geometric mean enterococcus density of 24 organisms per 100 ml for a 30-day period or 12 organisms per 100 ml for a six-month period, the Regional Board shall require the appropriate agency to conduct a survey to determine if that agency's discharge is the source of the contamination. The geometric mean shall be a moving average based on no less than five samples per month, spaced evenly over the time interval. When a sanitary survey identifies a controllable source of indicator organisms associated with a discharge of sewage, the Regional Board shall take action to control the source.

Waste discharge requirements shall require the discharger to conduct sanitary surveys when so directed by the Regional Board. Waste discharge requirements shall contain provisions requiring the discharger to control any controllable discharges identified in a sanitary survey.

The Ocean Plan's Standard Monitoring Procedures (Appendix II) provide guidance on monitoring.

### **Chapter II. A. Bacterial Standards:**

For all bacterial analyses, sample dilutions should be performed so the range of values extends from 2 to 16,000. The detection methods used for each analysis shall be reported with the rest of the analysis.

Detection methods used for coliforms (total and fecal) shall be those presented in the most recent edition of *Standard Methods for the Examination of Water and Wastewater* or any improved method determined by the Regional Board (and approved by EPA) to be appropriate.

Detection methods used for enterococcus shall be those presented in EPA publication EPA 600/4-85/076, *Test Methods for Escherichia coli and Enterococci in Water by Membrane Filter Procedure* or any improved method determined by the Regional Board to be appropriate.

#### **A.2 FRESH WATER BEACHES**

##### **A.2.1 Department of Health Services [Also, see DHS' non-regulatory Guidance for Fresh Water Beaches.]**

Regulations for public beaches are published in Title 17 of the California Code of Regulations, Group 10.1 Sanitation of Public Beaches, beginning with Section 7972. They provide definitions, terms, and address the provision of water supply, toilets and sanitary facilities, maintenance, refuse handling, campsites and animals. These regulations are presented above.

##### **A.2.2 State Water Resources Control Board**

The SWRCB's Inland Waters Plan (SWRCB, 1993) and the Enclosed Bays and Estuaries Plan (SWRCB, 1995b) do not address microbiological contamination.

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## Appendix B. US EPA GUIDANCE FOR RECREATIONAL WATERS AND BEACHES

This section provides guidance from the United States Environmental Protection Agency, which released a planning document for beaches and recreational waters, ***Action Plan for Beaches and Recreational Waters*** (US EPA, 1999). US EPA also held regional conferences in 1999 on beach programs, and published the ***conference proceedings*** (US EPA, 2000).

### B.1 THE FEDERAL WATER QUALITY CRITERION FOR RECREATIONAL WATERS

The federal water quality criterion for recreational waters was established in 1968 by the Department of the Interior's National Technical Advisory Committee (NTAC, 1968). This criterion was recommended again by the US EPA in 1976 and 1986 (EPA, 1976, 1986). This criterion is follows:

Fecal coliforms should be used as the indicator organism for evaluating the microbiologic suitability of recreation waters. As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content of primary contact recreation water shall not exceed a log mean of 200 per 100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400 per 100 ml.

The value of 400 fecal coliforms per 100 ml was derived from a concentration of 2300 total coliforms per 100 ml, which corresponded to the density at which a statistically significant increase in swimming-associated gastrointestinal illness was observed. Fecal coliforms comprise about 18 percent of the total coliforms.

### B.2 MARINE WATERS

The US EPA evaluated health effects of microbiological contamination on recreational use of marine waters (Cabelli, 1983). Subsequently it published guidance on water quality for recreational use in *Ambient Water Quality Criteria for Bacteria - 1986* (US EPA, 1986).

EPA's guidance for marine recreational waters is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 19 cases/1000 swimmers. Its steady state geometric mean indicator density at the acceptable rate is 35 enterococci per 100 ml. The rate of 19 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml.

EPA's criterion (US EPA, 1986) for bathing (full body contact) recreational waters for marine water is as follows:

Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed 35 per 100 ml.

No sample should exceed a one-sided confidence limit (CL), using the following as guidance:

Designated bathing beach area	upper 75% CL
Moderate full body contact recreation	upper 82% CL
Lightly used full body contact recreation	upper 90% CL
Infrequently used full body contact recreation	upper 95% CL

based on a site-specific log standard deviation, or if site data are insufficient to establish log standard deviation, then using 0.7 as the log standard deviation.

From the EPA's guidance document, single sample limits (in enterococci per 100 ml.) are:

Designated bathing beach area	= 104 enterococci per 100 ml.
Moderate full body contact recreation	= 124 enterococci per 100 ml.
Lightly used full body contact recreation	= 276 enterococci per 100 ml.
Infrequently used full body contact recreation	= 500 enterococci per 100 ml.

The above recommendations notwithstanding, the US EPA did not recommend a change in the stringency of its bacterial criteria for recreational waters, finding that such a change did not appear warranted until more information on the new indicators was accumulated.

### B.3 FRESH WATER

The US EPA evaluated health effects of microbiological contamination on recreational use of fresh waters (Dufour, 1984). Subsequently it published guidance on water quality for fresh water recreational use (US EPA, 1986).

EPA's guidance for fresh recreational waters is based upon an "Acceptable Swimming Associate Gastroenteritis Rate" of 8 cases/1000 swimmers at a steady state geometric mean indicator density of 33 enterococci per 100 ml or 126 *E. coli* per 100 ml. The rate of 8 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml.

EPA's criterion for bathing (full body contact) recreational waters for fresh water is as follows (EPA, 1986):

Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed one or the other of the following (Note that only one indicator should be used. The regulatory agency should select the appropriate indicator for its conditions.):

*E. coli*, at a concentration of 126 per 100 ml., or  
enterococci, at a concentration of 33 per 100 ml.

No sample should exceed a one-sided confidence limit (CL), using the following as guidance:

Designated bathing beach area	upper 75% CL
Moderate full body contact recreation	upper 82% CL
Lightly used full body contact recreation	upper 90% CL
Infrequently used full body contact recreation	upper 95% CL

based on a site-specific log standard deviation, or if site data are insufficient to establish log standard deviation, then using 0.4 as the log standard deviation.



From the EPA's guidance document, the single sample limits (in *E. coli* per 100 ml., or in enterococci per 100 ml.) are:

Designated bathing beach area	= 235 <i>E. coli</i> per 100 ml., or 61 enterococci per 100 ml.
Moderate full body contact recreation	= 298 <i>E. coli</i> per 100 ml., or 89 enterococci per 100 ml.
Lightly used full body contact recreation	= 406 <i>E. coli</i> per 100 ml., or 108 enterococci per 100 ml.
Infrequently used full body contact recreation	= 576 <i>E. coli</i> per 100 ml., or 151 enterococci per 100 ml.

As mentioned above, the US EPA did not recommend a change in the stringency of its bacterial criteria for recreational waters, finding that such a change did not appear warranted until more information on the new indicators was accumulated.

### **B.3.1 Specific Standards Set by US EPA for Colville Indian Reservation, Washington.**

The US EPA (40 Code of Federal Regulations 131.35) has established fresh (surface) water quality criteria for several classes of water, as follows:

**Class I (Extraordinary)**, including these designated uses: Water supply (domestic, industrial, agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, salmonids and other fish; wildlife habitat; ceremonial and religious water use; recreation (**primary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class I water the bacteriological criteria are: The geometric mean of the enterococci bacteria densities in samples taken over a 30-day period shall not exceed 8 per 100 ml, nor shall any single sample exceed an enterococci density of 35 per 100 milliliters. This limits are calculated the geometric mean of the collected samples approximately equally spaced over a 30-day period.

**Class II (Excellent)**, including these designated uses: Water supply (domestic, industrial, agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, salmonids and other fish, and crayfish rearing, spawning and harvesting; wildlife habitat; ceremonial and religious water use; recreation (**primary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class II water the bacteriological criteria are: The geometric mean of the enterococci bacteria densities in samples taken over a 30-day period shall not exceed 16 per 100 ml, nor shall any single sample exceed an enterococci density of 75 per 100 milliliters. This limits are calculated the geometric mean of the collected samples approximately equally spaced over a 30-day period.

**Class III (Good)**, including these designated uses: Water supply (industrial, agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, of salmonids and other fish, and crayfish rearing, spawning and harvesting; wildlife habitat; recreation (**secondary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class III water the bacteriological criteria are: The geometric mean of the enterococci bacteria densities in samples taken over a 30-day period shall not exceed 33 per 100 ml, nor shall any single sample exceed an enterococci density of 150 per 100 milliliters. This limits are calculated as the geometric mean of the collected samples approximately equally spaced over a 30-day period.

30-day period.

**Class IV (Fair)**, including these designated uses: Water supply (Industrial); stock watering; fish migration of salmonids and other fish; recreation (**secondary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class IV water no bacteriological criteria are identified. No streams are identified as Class I.

**Lake Class**, including these designated uses: Water supply (domestic, industrial, agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, of salmonids and other fish, and crayfish rearing, spawning, and harvesting; wildlife habitat; ceremonial and religious water use; recreation (**primary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Lake Class water the bacteriological criteria are: The geometric mean of the enterococci bacteria densities in samples taken over a 30-day period shall not exceed 33 per 100 ml, nor shall any single sample exceed an enterococci density of 150 per 100 milliliters. This limits are calculated as the geometric mean of the collected samples approximately equally spaced over a 30-day period.

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### **Appendix C. LOCAL GUIDANCE AND ORDINANCES**

DHS polled local environmental health departments about the status of their recreational water programs. The following summarizes the responses DHS received, as of May 1997, for counties that utilize specific numeric levels for monitoring and corrective action. Those who are interested in the current status of local programs should contact the local environmental health programs directly.

**C.1 OCEAN BEACHES** [Certain beaches are subject to **monitoring and posting requirements from April 1 through October 31** of each year. The statutory and regulatory requirements are in **Appendix A**]

#### **C.1.1 Los Angeles County**

Los Angeles County has a comprehensive ocean water contact sports area regulatory program. County's policy directs the health officer to close affected portions of a beach and post "Beach Closed" signs "when there is a known incident of sewage pollution or chemical contamination, and ... a health risk exists to persons engaging in water contact activities."

Beaches that are affected by sewage shall be closed for a minimum of 48 hours. Guidelines for closure, in terms of gallons of sewage spilled or discharged, are:

Less than 1,000 gallons	= 1/4 mile each side of discharge
1,000 - 10,000 gallons	= 1/2 mile each side of discharge
10,000 - 100,000 gallons	= 1 mile each side of discharge
100,000 - 1 million gallons	= 3 miles each side of discharge
1 million - 2 million gallons	= 5 miles each side of discharge
More than 2 million gallons	= 10 miles or more on each side of discharge

Subsequent sampling will be done at locations to be determined on the basis of the reported volume of the spill, prevailing winds and currents, location of the discharge, and extent of the closure. The Protocol includes sampling points in relation to the size of the sewage spill (e.g., a spill less than 1,000 gallons would be sampled at three locations: at the spill and 1/4 mile on either side of the spill). Beaches will be reopened when data from bacteriological analyses indicate bacteria counts are within acceptable health levels.

The following bacterial standards are used in the LA County protocol:

1. California total coliform standard (Title 17, California Code of Regulations, Section 7958): No single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 cfu per 100 ml., nor shall more than 20 percent of the samples within a 30-day period at any sampling station exceed 1,000 cfu per 100 ml.
2. US EPA recommendation for enterococcus: No single sample shall exceed 104 colony forming units (cfu) per 100 ml., nor shall the log mean of five or more samples taken over a 30-day period exceed 35 cfu per 100 ml.
3. Santa Monica Bay Epidemiology Study: No single sample with a total coliform level that exceed 5,000 cfu per 100 ml shall have a total coliform to fecal coliform ratio of 5 or less (See Haile *et al.*, 1996).

Bacterial levels are considered to be elevated when two consecutive samples reveal the following:

1. Total coliform exceeds 10,000 cfu per 100 ml.
2. Enterococcus exceeds 104 cfu per 100 ml. in combination with total coliform that exceeds 1,000 cfu per 100 ml.
3. Total coliform exceeds 5,000 cfu per 100 ml. in combination with total coliform to fecal coliform ratio of 5 or less.

An evaluation is to be conducted to determine the cause that includes, but is not limited to, an evaluation of the bacteriological data, an on-site field investigations and consultation with monitoring personnel.

LA County also has a public notification process that issues public advisories to wire services whenever a significant beach area is closed to the public. Public advisories are also issued when a significant rain storm is predicted or occurs, explaining that storm drain flows may cause elevated bacterial counts for approximately 72 hours and ocean water contact, especially in areas adjacent to storm drain flows, should be avoided.

### **C.1.2 Mendocino County**

Mendocino County reopens beaches following sewage spills when total coliforms are less than 1000 per 100 ml, fecal coliforms are less than 200 per 100 ml, and enterococci are less than 3 per 100 ml.

### **C.1.3 Orange County**

Orange County samples from many regular sampling stations, samples are taken from water ankle-deep in the surf zone, waist-deep or deeper in harbors. Samples are taken 6-12 inches below the water surface. The county issues beach advisory press releases after 0.2 inches of rain and posts warning signs at creek or drain mouths due to fluctuating coliform values. It closes beaches after sewage spills or when total 20 percent of coliforms exceed 1000 per 100 ml., and reopens beaches when two consecutive sampling days show levels "well below" 1000 total coliforms per 100 ml.

### **C.1.4 Monterey County**

Monterey County posts warnings on ocean beaches when fecal coliforms meet or exceed 200 per 100 ml., or total coliforms meet or exceed 1000 per 100 ml. Beaches are closed when the standard is exceeded, with visual presence of chemicals or human waste.

#### **C.1.5 San Diego County**

San Diego County samples approximately monthly, for total and fecal coliforms. Levels for posting warnings, beach closure, and reopening beaches are 1000 total coliforms and 200 fecal coliforms per 100 ml.

#### **C.1.6 San Francisco**

San Francisco samples regularly from shoreline sampling stations at high use areas, and areas adjacent to outfalls. Analyzes for total and fecal coliforms, enterococci, and *E. coli*. Follows 17 CCR §7958 for posting, closure and reopening beaches.

#### **C.1.7 San Luis Obispo County**

San Luis Obispo County samples as needed, generally during the rainy season, during heavy rainfall periods. Sampling is also done if a major sewage spill occurs in the watershed supplyin stream sources that reach the ocean beach areas. . Analyzes for total and *E. coli*. Follows 17 CCR §7957 for posting, closure and reopening beaches.

#### **C.1.8 San Mateo County**

San Mateo samples year round along coastal area under the influence of water treatment plants. Beaches are closed when total coliforms exceed 1000 per 100 ml, or when fecal coliforms exceed 200 per 100 ml.

#### **C.1.9 Santa Cruz County**

Santa Cruz County samples one/week or one/month, according to location, some stations all year, some May-September. The county has one regular sampling station per beach, and samples water at ankle depth. Analysis is for fecal coliforms, and there is also extensive parallel testing for total, enterococci, *E. coli* and fecal streptococcus. Warnings are issued when two consecutive samples of fecal coliforms are over 200 MPN per 100 ml. Beach closure occurs with a significant raw sewage spill. Reopening occurs when samples return to 200 MPN per 100 ml for fecal coliforms.

### **C.2 INLAND SALT WATER BEACHES (Salton Sea)**

#### **C.2.1 Imperial County**

Imperial County samples monthly, two samples per beach, from regular sampling stations, taken from waist-deep water. Sampling is from areas most frequented by people, or from sampling grids. Analyzes for total and fecal coliforms. For posting warnings, the county uses regional water board criteria, coupled with evidence of source of human pollution. It has no guidance for closure/reopening. Uses board authority of health officer to post warnings, in the absence of inland water standards.

#### **C.2.2 Riverside County**

Riverside County samples weekly, about four samples per beach, from regular sampling stations chosen because they represent heavy use areas. Samples are taken from 6 inches below water surface, and analyzed for total and fecal coliforms. Levels for posting warnings and closing beaches are 200 fecal coliforms per 100 ml two weeks in a row. Beaches are reopened with samples lower than 200 per 100 ml.

### **C.3 FRESH WATER BEACHES**

### **C.1 Kern County**

Kern County samples its lakes and reservoirs twice per month, from May through August, three samples per beach/recreational area, from regular sampling stations. Samples are analyzed for total and fecal coliforms. Posting warnings, beach closure, and reopening beaches are based on total coliform level of 1000 per 100 ml.

### **C.2 Los Angeles County**

For freshwater recreational areas, Los Angeles County's Code uses the following:

- (1) Total coliform: No single sample shall exceed 10,000 cfu per 100 ml. Not more than 10 percent of the samples tested shall exceed 1,000 cfu per 100 ml. Of all samples collected over 30 day period, the mean shall not exceed 500 cfu per 100 ml.
- (2) Total coliform/fecal coliform ratio: No single sample with a total coliform level of 5,000 cfu per 100 ml. or greater shall have a total coliform/fecal coliform ratio of 5 or less.
- (3) Enterococci: No single sample shall exceed 61 cfu per 100 ml. A minimum of 5 samples equally spaced over a 30-day period shall not exceed a log mean of 33 cfu per 100 ml.

### **C.3 Riverside County**

Riverside County samples weekly, about four samples per beach, from regular sampling station chosen because they represent heavy use areas. Samples are taken from 6 inches below water surface, and analyzed for total and fecal coliforms. Levels for posting warnings and closing beaches are 200 fecal coliforms per 100 ml two weeks in a row. Beaches are reopened with samples lower than 200 per 100 ml.

### **C.4 San Bernardino County**

Santa Bernardino County has an ordinance that applies to all water contact recreation resorts (WCRR), where the definition of an WCRR includes all public water contact recreation facilities which direct or indirect fee is charged for the use of the facility. WCRRs include water theme parks, swim or wave lagoons, natural and man-made lakes and water courses, and similar public water contact recreational places (Ordinance No. 3020). Microbiological quality, which is regulated by the county Department of Environmental Health Services (DEHS) is addressed in section 31.054(b). The regulation calls for routine sampling and analysis at a frequency, and from representative locations, as determined by the DEHS. The fecal coliform density from any consecutive sets of samples collected within any thirty (30) days shall not exceed an arithmetic mean of two hundred (200) organisms per one hundred (100) ml. When fecal coliform density any sample collected exceeds one thousand (1,000) per one hundred ml, the DEHS shall order the closure of the water contact area and follow-up daily sampling shall be immediately commenced with waters analyzed for fecal coliform for at least two (2) consecutive days. If any follow-up daily sample exceeds one thousand (1,000) per one hundred (100) ml., the water contact area shall remain closed, and with the appropriate signs posted and maintained by the owner/operator, and shall not reopen without prior written approval being obtained from the DEHS. The DEHS may also direct sampling for specific pathogens. WCRRs that utilize an approved filtration and disinfection system may, upon approval by the DEHS, maintain a daily log of disinfectant and pH test reading in lieu of microbiological sampling. Fecal coliform sampling shall be conducted prior to the commencement of each season's use and as requested by the DEHS. Routine water samples shall be obtained from representative portions of the swim area at a depth of two (2) feet.

### **C.5 San Joaquin County**

San Joaquin County samples its lakes/reservoirs and rivers once per week May through September, one sample per beach from regular sampling stations. Samples are taken from

waist-deep water, and analyzed for total and fecal coliforms. Levels for beach closure: one sample exceeding 400 fecal coliform/ per 100 ml or five consecutive samples taken within a 30-day period exceeding a mean of 200 fecal coliforms per 100 ml.

### **C.6 Santa Cruz County**

Santa Cruz County's county ordinance (Ord 1472, 11/25/69) establishes Section 7.72.0030 as the bacteriological standard for freshwater contact sports areas: Samples of water from each sampling station at such a freshwater contact sports area shall have a count of fecal coliform organisms less than 200 organisms per 100 milliliters, provided that not more than 20 percent the samples at any sampling station, in any 30-day period, may exceed 200 per 100 milliliters

### **C.7 Solano County**

Solano County samples as needed for complaints during May-September, and routinely analyses for shistosoma complaints only.

### **C.8 Tuolumne County**

Tuolumne County's lakes/reservoirs, rivers, and artificial impoundments are sampled on a volunteer basis, at about 10 organized beaches. Sampling is once per month, one to three samples per beach from regular sampling stations, April through September. Samples are take six inches deep one foot away from structures/shore, and analyzed for total and fecal coliforms. Warnings and closures occur in response to sewage spills. Beaches are reopened when fecal an total coliforms are back to background levels. The county uses an advisory level for discontinui water contact of 1200 MPN fecal coliforms per 100 ml., in the absence of sewage contaminatio

### **C.9 Yolo County**

Yolo County's rivers and creeks are sampled only when there is a complaint or when an incident of pollution occurs. For warning and closure, the county uses a standard of not to exceed a daily average of 2400 coliforms per 100 ml. Repeated testing at least on two consecutive days is required to establish a warning/closure action, and the same procedure is required for removal such order.

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### **Appendix D. MICROBIOLOGICAL INDICATOR ORGANISMS IN STANDARDS AND GUIDANCE**

To protect the recreating public from exposure to microorganisms associated with the presence sewage in at beaches and in recreational waters, health agencies use microorganisms such as total coliform bacteria, fecal coliform bacteria, enterococci, or *E. coli* as indicators of water quality. Though they are not considered disease-causing agents, their presence above certain numeric levels is suggestive of the presence of other, difficult to detect and quantify pathogeni microorganisms that can cause health effects. The use of the general indicators is an inexpensive, effective way of monitoring the overall well-being of recreational waters.

The use of indicator organisms is public health protective. However, using surrogates as monitoring endpoints makes quantitative risk assessments difficult, and does not enable development of dose/effect relationships, traditional risk assessments (as used in the regulatio of chemical contaminants, for example), and predictions of actual risk from disease-causing organisms in recreational waters. The difficulty arises from:

- determining exposure to the disease-causing microbes (the "dose"), which requires quantitation of the specific organism under actual recreating circumstances, which, even possible analytically, is expensive. For example, monitoring for specific pathogens such a *Giardia* or *Cryptosporidium* is costly and appears not to yield predictable, reliable results.

- determining the risk of illness (the "effect"), which requires epidemiological studies of the recreating public in parallel with water analyses for specific. Epidemiological studies of recreational bathers that have been done generally use indicator organisms, though case-histories of specific disease outbreaks are more specific (see **Appendix E**).

**D.1 Microbiological Indicator Organisms**

**D.1.1. Total Coliform Bacteria**

The term total coliform bacteria refers to a number of bacteria including *Escherichia*, *Klebsiella*, *Citrobacter* and *Enterobacter*. They are able to grow at 35° C and ferment lactose. These are a gram negative asporogenous rods and have been associated with feces of warm-blooded animals. They are also present in soil.

**D.1.2 Fecal Coliform Bacteria**

Fecal coliform bacteria are a subgroup of the total coliform group. They are able to grow at 44. C and ferment lactose. These bacteria have found use as indicators of fecal contamination, because they are restricted to the intestinal tract of warm-blooded animals. Their use enables separation of bacteria of soil and fecal origin.

Among the fecal coliform group, *E. coli*, an indicator of fresh fecal pollution, has also found use as an indicator organism (US EPA, 1986).

**D.1.3 Streptococcus Bacteria (and Enterococcus Group)**

The table below indicates the *Streptococcus* species and subspecies that are used as indicators of fecal contamination.

Indicator organism	Enterococcus group*	Streptococcus group
Group D antigen		
<i>Streptococcus faecalis</i> **	X	X
<i>S. faecalis</i> subsp. <i>liquefaciens</i>	X	X
<i>S. faecalis</i> subsp. <i>zymogenes</i>	X	X
<i>S. faecium</i> **	X	X
<i>S. bovis</i>		X
<i>S. equinus</i>		X
Group Q antigen		
<i>S. avium</i>		X

- 
- \* excludes *S. bovis*, *S. equinus*, and Group Q organisms.
  - \*\*also includes some Group Q antigen reactive types that occur in humans, dogs, and pigs.

The normal habitat of fecal streptococci is the intestines of humans and animals; therefore the microorganisms are indicators of fecal pollution. (*Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, 1985). The enterococcus group is a subgroup that is considered more indicative of pollution associated with human sewage. The streptococcus group, when there is a predominance of *S. bovis* and *S. equinus*, is considered to be related to the excreta of nonhuman, warm-blooded animals, as might be related to meat-processing plants, dairy wastes, and feedlot and farmland runoff. *S. faecalis* subsp. *liquefaciens*, besides being associated with mammalian feces, is also associated with vegetation, insects, and certain soils, and may predominate when counts are low (less than 100 per 100 ml).

#### D.1.4 Other Indicators

A number of possible indicator organisms other than those presented above have been evaluated for marine waters. As summarized by US EPA (1986), other microorganisms that were evaluated for their correlation with swimming-associated gastroenteritis included *Klebsiella*, *Enterobacter/Citrobacter*, *Clostridium perfringens*, *Pseudomonas aeruginosa*, *Aeromonas hydrophila*, *Vibrio parahaemolyticus*, and Staphylococci. Because of poor correlation, none of the was considered helpful as an indicator organism.

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### Appendix E. EPIDEMIOLOGICAL AND OTHER STUDIES RELATED TO OCEAN WATER AND FRESH WATER RECREATION

#### E.1 OCEAN WATER

This section presents a brief overview of epidemiological studies of swimmers and other studies of ocean water and fresh water.

##### Cabelli, 1983

This study evaluated health effects of microbiological contamination on recreational use of marine waters and developed US EPA criteria, based on the mathematical relationship of the swimming-associated rate of gastrointestinal symptoms among bathers to the quality of their water. Enterococci were used as a fecal indicator.

The data, based on 26,686 subjects who responded to follow-up interviews, were collected in an epidemiological research program of the US EPA from beaches in three areas: (1) New York City, New York, in 1972, 1973 and 1974, 15,882 respondents; (2) Lake Pontchartrain, New Orleans, Louisiana, in 1977 and 1978, 6,751 respondents; and (3) Boston Harbor, Massachusetts, in 1974, 4,053 respondents. Water samples were collected from chest-high depths.

The recommended health effects criterion for marine recreation waters was described by the equation

$$\log X = 0.0456Y + 0.677 \quad \text{[Equation 1]}$$

where:

X is the mean enterococcus density per 100 ml., and  
Y is the swimming-associated rate per 1000 people for gastroenteritis (highly credible gastrointestinal symptoms).



Subsequent to the Cabelli study, US EPA developed guidance (US EPA, 1986) for marine recreational waters. This guidance is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 19 cases/1000 swimmers, developed from the Cabelli study. The rate of 19 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml. Its steady state geometric mean indicator density at the acceptable rate is 35 enterococci per 100 ml. An acceptable one-time exposure is 104 enterococci per 100 ml.

#### **Cheung et al., 1993**

This study of bathers in Hong Kong found *E. coli* to be the best indicator of illness.

#### **Corbett et al., 1993**

This study found fecal coliforms to be the best indicator of health effects among Australian swimmers, better than fecal streptococci.

#### **Fleisher et al., 1993**

These authors found no difference in health effects between British bathers and non-bathers at fecal streptococci densities less than 40 per 100 ml.

#### **Kay et al., 1994**

In a randomized experimental epidemiological study in which British swimmers were assigned to exposed or unexposed groups, fecal streptococci were the best predictor of gastroenteritis effects. The threshold for GI effects was 33 fecal streptococci per 100 ml.

#### **Fleisher et al., 1996**

This study of British swimmers found thresholds for febrile respiratory effects and ear effects at 60 and 100 fecal streptococci per 100 ml., respectively.

#### **Haile et al., 1996**

This study evaluated health effects of microbiological contamination on recreational use of beaches at Santa Monica Bay in southern California, with attention to proximity of swimmers to large drains that empty onto the beaches. Total coliform, fecal coliform, enterococci, and *E. coli* were used as indicator organisms. The data, collected in 1995 and based on 13,278 subjects who responded to follow-up interviews, were collected at various distances from beach drains: 0, 100 yards downcoast, 100 yards upcoast, and 400 yards upcoast in three different areas: (1) Santa Monica Beach near Ashland Avenue, Will Rogers Beach at Santa Monica Canyon, and Surfrider Beach near Malibu Creek, respondents. Water samples were collected from ankle-high depths.

The authors concluded that swimming in (or near) storm drains resulted in a higher risk of gastrointestinal and respiratory illness, compared to swimming at a distance (~ 400 meters) from those drains. These authors considered the best predictor of swimming-related illness to be the ratio of total coliform organisms/fecal coliform organisms when this ratio was less than 5, when the total coliform level was greater than 5000 per 100 ml. Subsequent analyses (Haile and Witte, undated) showed increased illness when the ratio was lower (e.g., as low as 10 to 18), and when the total coliform level was greater than 1,000 per 100 ml.

#### **Prüss, 1998**

This evaluation of health risks associated with poor microbiological quality of recreational water reviews 22 epidemiological investigations, including 15 studies of marine waters and one study of fresh and marine waters.

#### **Spear et al., 1996**

The SWRCB (1995a) identified the choice of indicator organism (*i.e.*, coliform vs. enterococcus for the water-contact bacterial standard and increased stringency of the water-contact fecal coliform standard as an issue to be addressed in its triennial review of the Ocean Plan. The SWRCB in 1990 required dischargers, if ordered by Regional Water Quality Control Boards (RWQCBs) to: (1) monitor for both coliform and enterococcus organisms, and (2) conduct sanitary surveys when either the coliform standards or a specified enterococcus level was exceeded. This approach, it was thought, would provide information on which organism was best for use in California. However, this was a controversial approach, so in 1992, the SWRCB convened an independent technical group, the Microbiological Advisory Committee (MAC), to provide advice on how to investigate the issue. Subsequently, a study was done under contract with the University of California, Berkeley to investigate the presence of each indicator organism at monitoring stations from two major ocean dischargers (City of San Diego and City and County of San Francisco). Those investigators found good correlation between enterococcus and coliform monitoring, and recommended no change from the total and fecal coliform monitoring, (Spear *et al.*, 1996).

## E.2 FRESH WATER

### Dufour, 1984

This study evaluated health effects of microbiological contamination on recreational use of freshwaters and developed US EPA criteria. These criteria were based on the mathematical relationship of the swimming-associated rate of gastrointestinal symptoms among bathers to the quality of their water. Enterococci and *Escherichia coli* were used as fecal indicators.

The data, based on 34,598 subjects who responded to follow-up interviews, were collected in an epidemiological research program of from beaches in two areas: (1) Lake Erie, Erie, Pennsylvania, in 1979, 1980 and 1982, 18,299 respondents; (2) Keystone Lake, near Tulsa, Oklahoma, in 1979 and 1980, 16,299 respondents.

The recommended health effects criteria for fresh recreation waters were described by the following equations:

$$\log Y = 1.464 + 0.0687 X \quad \text{[Equation 2]}$$

where

X is the swimming-associated rate per 1000 people for gastroenteritis (highly credible gastrointestinal symptoms), and

Y is the mean *E. coli* density per 100 ml.

$$\log Y = 0.938 + 0.059 X \quad \text{[Equation 3]}$$

where

X is the swimming-associated rate per 1000 people for gastroenteritis (highly credible gastrointestinal symptoms), and

Y is the mean enterococcus density per 100 ml.

Subsequent to the Dufour study, US EPA developed guidance (US EPA, 1986) for fresh recreational waters. EPA's guidance for fresh recreational waters is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 8 cases/1000 swimmers. The rate of 8 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml. Its steady state geometric mean indicator density at the acceptable rate is 33 enterococci per 100 ml. An acceptable one-time exposure is 65 enterococci per 100 ml.

**Calderon et al., 1991**

In this study of recreational swimmers using a pond (Calderon et al., 1991) found a greater correlation between infectious disease and the number of other swimmers/bathers than it did between infectious disease and various microbiological indicators.

**Fresno County Community Health Department, 1996**

A cryptosporidiosis outbreak at a water park in Fresno County was attributed to the ingestion of pool water that may have been contaminated by *Cryptosporidium* oocysts from fecal accidents of infected individuals(s) or from the rinsing off of water from an untreated pond adjacent to the pool area (Fresno County Community Health Department, 1996).

**Kramer et al., 1996**

The Centers for Disease Control (Kramer et al., 1996) reported 14 outbreaks of gastroenteritis in the US in 1993-1994, 10 of which were attributable to protozoan parasites in recreational water (e.g., *Cryptosporidium parvum* or *Giardia lamblia*) and the rest to *Shigella* spp., or *E. coli* O157:H7). Seven of these outbreaks occurred in lakes, one in a river, and six in pools.

**Levy et al., 1998**

The Centers for Disease Control (Levy et al., 1998) reported 37 outbreaks in the US in 1995-1996. Of these, 22 were gastroenteritis outbreaks; causes included *Cryptosporidium parvum* (6), *Giardia* (1), *E. coli* O157:H7 (6), *Shigella sonnei* (3), and *Salmonella* serotype Jave (1). Thirteen of the 22 gastroenteritis outbreaks were associated with lake water, eight with swimming or wading pools, and one with a hot spring. There were nine dermatitis outbreaks, of which two were lake-associated (swimmer's itch caused by *Schistosoma* species) and seven were hot tub-associated (*Pseudomonas*). The final six were single cases of primary amebic meningoencephalitis (all fatal, five in Texas and one in Florida, associated with a shallow lake, river, pond, or canal), caused by *Naegleria fowleri*.

Human feces appeared to be related to outbreaks associated with several lake-associated outbreaks.

**Prüss, 1998**

This evaluation of health risks associated with poor microbiological quality of recreational water reviews 22 epidemiological investigations, including six studies of fresh waters and one of fresh and marine waters.

**Warrner et al., 1996**

This outbreak, associated with *E. coli* O157:H7, involved 12 individuals who had visited an Illinois state park with a lake swimming beach.

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California  
Department of  
*Health  
Services*

## Appendices — Draft Guidance for Salt- and Fresh Water Beaches

Last Update: July 27, 2000  
Initial Draft: November 1997

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### **References**

#### **Appendix A. STATE REGULATION OF BEACHES AND RECREATIONAL WATERS**

##### **A.1. OCEAN BEACHES AND OCEAN WATER-CONTACT SPORTS AREAS**

###### **A.1.1. Statutory Authority**

Health and Safety Code Sections 100275, 115880, 116075, and 116080 authorize the Department of Health Services to adopt regulations pertaining to beach safety.

###### **A.1.1.1 Statutes Related to Beaches**

The following sections from the Health and Safety Code address beaches and water contact sports areas.

115875. "Public beach," as used in Sections 115875 to 115895, inclusive, means any beach used by the public for recreational purpose that is owned, operated, or controlled by the state, any state agency, any local agency, or any private person in this state.

115880. (a) The department shall by regulation, in consultation with local health officers and the public, establish minimum standards for the sanitation of public beaches, including, but not limited to, the removal of refuse, as it determines are reasonably necessary for the protection of the public health and safety.

(b) Prior to final adoption by the department, the regulations and standards required by this section shall undergo an external comprehensive review process similar to the process set forth in Section 57004 of the Health and Safety Code.

(c) The regulations shall, at a minimum, do all of the following, by December 31, 1998:

(1) Require the testing of the waters adjacent to all public beaches for microbiological contaminants, including, but not limited to, total coliform, fecal coliform, and enterococci bacteria. The department may require the testing of waters adjacent to all public beaches for microbiological indicators other than those set forth in this paragraph, or a subset of those set forth in this paragraph, if the department affirmatively establishes, based on the best available scientific studies and the weight of the evidence, that the alternative indicators are as protective of the public health.

(2) Establish protective minimum standards for total coliform, fecal coliform, and enterococci bacteria, or for other microbiological indicators that the department determines are appropriate for testing pursuant to paragraph (1).

(3) Establish protocols for all of the following:

(A) Determining monitoring site locations and monitoring frequency based on risks to public health.

(B) Making decisions regarding public notification of health hazards, including, but not limited to the posting, closing, and reopening of public beaches.

(4) Require that the waters adjacent to public beaches be tested for total coliform, fecal coliform and enterococci bacteria, or for other microbiological indicators that the department determines are appropriate for testing pursuant to paragraph (1). Except as set forth in paragraph (5), testing shall be conducted on at least a weekly basis, from April 1 to October 31, inclusive, of each year, beginning in 1999, if all of the following apply:

(A) The beach is visited by more than 50,000 people annually.

(B) The beach is located on an area adjacent to a storm drain that flows in the summer.

(5) The monitoring frequency and locations established pursuant to this subdivision and related regulations may only be reduced or altered after the testing required pursuant to paragraph (4) reveals levels of microbiological contaminants that do not exceed for a period of two years the minimum protective standards established pursuant to paragraph (2).

(d) The local health officer shall be responsible for testing the waters adjacent to, and coordinating the testing of, all public beaches within his or her jurisdiction.

(e) The local health officer may meet the testing requirements of this section by utilizing test results from other agencies conducting microbiological contamination testing of the waters under his or her jurisdiction.

(f) Any city or county may adopt standards for the sanitation of public beaches within its jurisdiction that are stricter than the standards adopted by the state department pursuant to this



section.

(g) For purposes of this section, "public beach" means any public beach located within the coastal zone, as defined in Section 30103 of the Public Resources Code.

(h) Any duty imposed upon a local public officer or agency pursuant to this section shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with the performance of these duties. The State Director of Health Services shall annually, within 15 days after enactment of Budget Act, file a written statement with the Secretary of the Senate and with the Chief Clerk of the Assembly memorializing whether sufficient funds have been appropriated.

**115885.** The health officer having jurisdiction over the area in which a public beach is created shall:

(a) Inspect the public beach to determine whether the standards established pursuant to Section 115880 are being complied with. If the health officer finds any violation of the standards, he or she may restrict the use of, or close, the public beach or portion thereof in which the violation occurs until the standard is complied with.

(b) Investigate any complaint of a person of a violation of any standard established by the department pursuant to Section 115880. If the health officer finds any violation of the standard prescribed by the department, he or she may restrict the use of, or close, the public beach or portion thereof until the standard is complied with. If the person who made the complaint is not satisfied with the action taken by the health officer, he or she may report the violation to the department. The department shall investigate the reported violation, and, if it finds that the violation exists, it may restrict the use of or close the public beach or portion thereof until the standard violated is complied with.

(c) (1) Whenever a beach is posted, closed, or otherwise restricted in accordance with Section 115915, the health officer shall inform the agency responsible for the operation and maintenance of the public beach within 24 hours of the posting, closure, or restriction.

(2) The health officer shall establish a telephone hotline to inform the public of all beaches currently closed, posted, or otherwise restricted. The hotline shall be updated as needed in order to convey changes in public health risks.

(d) Report any violation of the standards established pursuant to Section 115880 to the district attorney, or if the violation occurred in a city and, pursuant to Section 41803.5 of the Government Code, the city attorney is authorized to prosecute misdemeanors, to the city attorney.

(e) In the event of a known untreated sewage release, the local health officer shall immediately test the waters adjacent to the public beach and to take action pursuant to regulations established under Section 115880.

(f) Notwithstanding any other provision of law, in the event of an untreated sewage release that is known to have reached recreational waters adjacent to a public beach, the local health officer shall immediately close those waters until it has been determined by the local health officer that the waters are in compliance with the standards established pursuant to Section 115880.

(g) Any duty imposed upon a local public officer or agency pursuant to this section shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with the performance of these duties. The State Director of Health Services shall annually, within 15 days after enactment of Budget Act, file a written statement with the Secretary of the Senate and with the Chief Clerk of the Assembly memorializing whether sufficient funds have been appropriated.

115890. Prior to restricting the use of or closing a public beach or portion thereof alleged to be violation of standards, the health officer, or the department as the case may be, shall give reasonable notice of the violation to the owner of, or person or agency in charge of, the beach.

115895. Any private person who violates any regulation adopted by the state department pursuant to Section 115880 is guilty of a misdemeanor.

115900. For the purposes of Sections 115900 to 115915, inclusive, the following definitions apply:

(a) "Beach" means any public beach of the ocean waters and bays of the state where water-contact sports are engaged in by the public.

(b) "Board" means the State Water Resources Control Board.

(c) "Health officer" means the legally appointed health officer or director of environmental health of the county or city having jurisdiction of the area in which a public saltwater beach is located

115905. The Legislature finds and declares all of the following:

(a) California's world-famous beaches are an invaluable economic, environmental, and recreational resource that must be protected for present and future generations. Millions of residents and visitors alike visit the state's beaches annually.

(b) Pollution from toxic spills, untreated municipal sewage, and agricultural and urban runoff threatens this critical resource.

(c) During 1989 through 1991 alone, at least 400 of the state's beaches had to be posted "off-limits" due to dangerous levels of bacterial and toxic contamination.

(d) Due to this pollution, local health officials were forced to close one or more beaches between San Diego and Mendocino Counties for all but 18 days in 1991.

(e) This contamination of our beaches poses serious threats to the public's health, increasing the risk that persons who use the beaches will suffer from hepatitis, gastroenteritis, and other dangerous illnesses.

(f) Notwithstanding the importance and potential severity of this problem, the state has never conducted a statewide survey to document annual beach closings.

(g) The state does not have uniform testing protocols that must be followed to ensure that the public is never exposed to dangerous contamination at the state's beaches.

(h) The state does not have uniform standards requiring beach postings when California Ocean Plan bathing water standards, as adopted by the board pursuant to Section 13170.2 of the Water Code, are exceeded.

(i) The state does not have uniform requirements mandating the frequency with which beach waters must be tested to ensure public safety. Beach water sampling currently varies greatly from county to county. For example, Los Angeles County tests its beaches every week of the year while other coastal counties test much less frequently.

(j) More accurate and centralized record keeping on the relative contributions of pollutant sources to beach closures would enable more effective targeting of corrective actions to keep our beaches safe and our coastal areas economically strong.

115910. (a) On or before the 15th day of each month, each health officer shall submit to the board a survey documenting all beach postings and closures resulting from implementation of Section 115915 that occurred during the preceding month. The survey shall, at a minimum,

include the following information:

(1) Identification of the beaches in each county subject to testing conducted pursuant to Section 115885 and the amount and types of monitoring conducted at each beach.

(2) Identification of the geographic location, areal extent, and type of action taken for each incident of posting or closure conducted pursuant to Section 115915. Geographic location and areal extent shall be noted in sufficient detail to determine on a common map, or by latitude and longitude, the approximate boundaries of the affected beaches.

(3) Identification of the standards exceeded and the causes and sources of the pollution, if known. Exceeded standards shall be identified with sufficient particularity to determine which types of tests and biological indicators were used to determine that an exceeded standard exists. Causes of pollution shall be identified with sufficient particularity to determine what substances, in addition to any water carrying the substances, were responsible for the exceeded standard. Sources shall be identified with sufficient particularity to determine the most specific geographic origin of the pollution sources available to the health officer at the time of the posting or closure.

(b) Surveys conducted pursuant to subdivision (a) shall be in a specific format established by the board on or before February 1, 2001. The board shall make the format easily accessible to the health officer through means that will enable the health officer to most effectively carry out the requirements of this section and enable the board to develop consistent, statewide data concerning the effect and status of beach postings and closures in a particular calendar year.

(c) On or before the 30th day of each month, the board shall make available to the public the information provided by the health officers. Based upon the data provided pursuant to subdivision (a), the report shall, at a minimum, include the location and duration of each beach closure and the suspected sources of the contamination that caused the closure, if known.

(d) On or before July 30 of each year, the board shall publish a statewide report documenting beach posting and closure data provided to the board by the health officers for the preceding calendar year. Based upon the data provided pursuant to subdivision (a), the report shall, at a minimum, include the location and duration of each beach closure and the suspected sources of the contamination that caused the closure, if known.

(e) Within 30 days of publication of the annual report, the board shall distribute copies of the report to the Governor, the Legislature, and major media organizations, and copies of the report shall be made available to the public by a variety of means typically available to the board.

115915. (a) Whenever any beach fails to meet the bacteriological standards established pursuant to subdivision (b) of Section 115880, the health officer shall, at a minimum, post the beach with conspicuous warning signs to inform the public of the nature of the problem and the possibility of risk to public health.

(b) A warning sign shall be visible from each legal primary beach access point, as identified in the coastal access inventory prepared and updated pursuant to Section 30531 of the Public Resources Code, and any additional access points identified by the health officer.

(c) Any duty imposed upon a local public officer or agency pursuant to this section shall be mandatory only during a fiscal year in which the Legislature has appropriated sufficient funds, determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with the performance of these duties. The State Director of Health Services shall annually, within 15 days after enactment of the Budget Act, file a written statement with the Secretary of the Senate and with the Chief Clerk of the Assembly memorializing whether sufficient funds have been appropriated.

116070. As used in this article, water-contact sport means any sport in which the body of a person comes into physical contact with water, including but not limited to swimming, surfboarding, paddleboarding, skin diving, and water-skiing. It does not include boating or

fishing.

116075. The department has supervision of sanitation, healthfulness, and safety of the public beaches and public water-contact sport areas of the ocean waters and bays of the state and, except as provided in Section 18930, the department may make and enforce regulations pertaining thereto as it deems proper.

116080. Regulations made pursuant to this article shall include suitable standards of safe bacteria count for water-contact sports areas specified by the State Water Pollution Control Board or regional water pollution control boards, which standards shall be applied to all public water-contact sport areas of the ocean waters and bays of the state.

116085. Every person who violates any rule or regulation adopted pursuant to this article is guilty of a misdemeanor.

116090. Nothing contained in this article shall be construed to give the department the authority to fix the areas wherein water-contact sports may be engaged in or to affect the authority of the State Water Pollution Control Board or regional water pollution control boards to fix appropriate areas for various uses.

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### **A.1.2 Regulations**

#### **A.1.2.1 Department of Health Services [Also see **DHS' Guidance for Salt Water Beaches**]**

Regulations for recreational use of ocean waters are published in Title 17 of the California Code of Regulations, in Group 10. Sanitation, Healthfulness and Safety of Ocean Water-Contact Sports Areas.

#### **Title 17 of the California Code of Regulations**

#### **Group 10. Sanitation, Healthfulness and Safety of Ocean Water-Contact Sports Areas**

#### **Article 2. Definitions**

##### **7952. Public Water-Contact Sports Area Defined.**

Public water-contact sports area means any area so designated (1) by a regional water pollution control board, or (2) by any other authorized and responsible public agency.

##### **7956. Storm Drain.**

"Storm drain" means a conveyance through which water flows onto or adjacent to a public beach and includes rivers, creeks, and streams, whether in natural or in man-made channels.

#### **Article 4. Healthfulness**

##### **7957. Physical Standard.**

No sewage, sludge, grease, or other physical evidence of sewage discharge shall be visible at any time on any public beaches or water-contact sports areas.

##### **7958. Bacteriological Standards.**

(a) The minimum protective bacteriological standards for waters adjacent to public beach

and public water-contact sports areas shall be as follows:

(1) Based on a single sample, the density of bacteria in water from each sampling station at a public beach or public water contact sports area shall not exceed:

- (A) 1,000 total coliform bacteria per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1; or
- (B) 10,000 total coliform bacteria per 100 milliliters; or
- (C) 400 fecal coliform bacteria per 100 milliliters; or
- (D) 104 enterococcus bacteria per 100 milliliters.

(2) Based on the mean of the logarithms of the results of at least five weekly samples during any 30-day sampling period, the density of bacteria in water from any sampling station at a public beach or public water contact sports area, shall not exceed:

- (A) 1,000 total coliform bacteria per 100 milliliters; or
- (B) 200 fecal coliform bacteria per 100 milliliters; or
- (C) 35 enterococcus bacteria per 100 milliliters.

(b) Water samples shall be submitted for bacteriological analyses to a laboratory certified by the Environmental Laboratory Accreditation Program, California Department of Health Services in microbiology for methods for the analysis of the sample type.

#### **7959. Bacteriological Sampling.**

(a) In order to determine that the bacteriological standards specified in Section 7958 above are being met in a water-contact sports area designated by a Regional Water Quality Control Board in waters affected by a waste discharge, water samples shall be collected at such sampling stations and at such frequencies as may be specified by said board in its waste discharge requirements.

(b) In waters of a public beach or water-contact sports area that has not been so designated by a Regional Water Quality Control Board, water samples shall be collected at such frequencies as may be determined by the local health officer or Department. Local health officers shall be responsible for the proper collection and analysis of water samples in such areas.

#### **7960. Corrective Action.**

(a) When a public beach or public-water-contact sports area fails to meet any of the standards as set forth in Section 7957 or 7958 above, the local health officer or the Department, after taking into consideration the causes therefor, may at his or its discretion close, post with warning signs, or otherwise restrict use of said public beach or public water-contact sports area, until such time as corrective action has been taken and the standards as set forth in 7957 and 7958 above are met.

#### **7961. Public Beaches Visited by More than 50,000 People Annually and Adjacent Storm Drains.**

(a) Waters adjacent to a public beach shall be tested for bacteria identified in Section 7957 on at least a weekly basis from April 1 to October 31, inclusive, if the beach is

- (1) Visited by more than 50,000 people annually, and
- (2) Located adjacent to a storm drain that flows in the summer.

(b) Water samples shall be taken from locations that include areas affected by storm drains. Samples shall be taken in ankle- to knee-deep water, approximately 4 to 24 inches below the water surface.

(c) When testing reveals that the waters adjacent to a public beach fail to meet any of the standards set forth in Section 7958(a)(1), the local health officer shall post the beach pursuant to Health and Safety Code Section 115915, and shall use the standards of Sections 7958(a)(1) and (2) in determining the necessity to restrict the use of or close the public beach or portion thereof.

(d) In the event of a known release of untreated sewage into waters adjacent to a public beach, the local health officer shall:

(1) Immediately post and close the beach or a portion thereof, or otherwise restrict its use until the source of the sewage release is eliminated;

(2) Sample the affected waters; and

(3) Continue closure or restriction of the beach or a portion thereof and posting the beach until testing results establish that the standards of Sections 7958(a)(1) are satisfied.

#### **7962. Duties Imposed on a Local Public Officer or Agency.**

(a) Pursuant to Health and Safety Code Sections 115880(h), 115885(g), and 115915(c), any duty imposed upon a local public officer or agency by Section 7961 shall be mandated only during a fiscal year in which the Legislature has appropriated sufficient funds, as determined by the State Director of Health Services, in the annual Budget Act or otherwise for local agencies to cover the costs to those agencies associated with performance of the duties.

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Regulations for the sanitation of public beaches are published in Title 17 of the California Code Regulations, in Group 10.1

#### **Group 10.1 Sanitation of Public Beaches**

#### **Article 2. Definitions and Exemptions**

##### **7972. Saltwater Body.**

Saltwater Body means the ocean, a marine bay, estuary or lagoon.

##### **7973. Freshwater Body.**

Freshwater Body means a natural or artificial lake, river, reservoir, stream or canal.

##### **7974. Refuse.**

Refuse means domestic or industrial garbage, rubbish, or other debris adversely affecting public health and safety as specified by the Health Officer.

##### **7975. Sanitation.**

Sanitation means the maintenance of a safe and healthful environment by means of removal of refuse; provision of sanitary toilet and handwashing facilities; disposal of sewage and liquid wastes; protection of bathing water quality; provision of pure, wholesome and potable drinking water; and control of harmful insects, rodents and animals.

**7976. Recreational Purposes.**

Recreational purposes include but are not limited to, swimming, camping, scenic enjoyment, fishing, shellfish gathering, surfing, scuba or snorkel diving, boating, equestrianism, use of recreational vehicles, jogging, walking, and beachcombing.

**7977. Public Health and Safety.**

Public health and safety means the maintenance of an environment that contributes to human well being, and in which there is an absence of human disease, ill health or injury.

**7978. Health Officer.**

Health Officer means the legally appointed Health Officer of the county or city having jurisdiction of the area in which a public beach is located.

**7979. Exemption.**

Sections 7981 through 7991 of Title 17 shall not apply when the Health Officer determines that the beach is maintained primarily as an open space. The criteria, among others, that may be evidence of open space is lack of developed access, lack of parking facilities, lack of lifeguard services, or where casual use normally does not exceed 50 people per mile of shoreline.

**7980. Review by Health Officer.**

No persons shall begin construction, reconstruction or alteration of any public beach sanitation facility without first submitting plans, specifications and other such information as may be required, to the Health Officer for his review and written approval. If no action is taken within fifteen (15) days of submission of plans, the project shall be deemed approved. If the Health Officer disapproves, the reason shall be so stated in writing.

**Article 3. Day Use Beaches****7981. Application.**

The provisions of this article shall be applicable to public beaches where overnight camping is not permitted.

**7982. Toilets.**

Toilets shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code. Portable toilets may be substituted for plumbed toilets.

**7983. Water Supply.**

Water when provided for drinking, showers, or handwashing shall be from a source approved by the Health Officer.

**7984. Maintenance.**

Toilets shall be available to the public at all times the beach is officially open for use. All facilities must be maintained in a clean and sanitary condition at all times.

**7985. Refuse Handling.**

(a) Refuse containers approved by the Health Officer shall be provided at all public beaches.

(b) All refuse shall be stored in the container in a manner which will not create a nuisance.

(c) Containers shall be emptied at frequencies sufficient to prevent overflow and to be maintained in a sanitary condition.

(d) Every public beach shall be maintained in a clean condition free of refuse.

#### **7985.1 Animals.**

No person shall bring onto or allow any animal, except guide dogs used by the blind, to remain on any beach which has been designated a public swimming beach by the state, any city, county, or city and county and where life guards are provided, except that horses may be ridden on designated equestrian trails and areas.

This regulation is not intended to prohibit or supersede any local ordinance not in effect which may be enacted.

### **Article 4. Beaches Allowing Overnight Camping**

#### **7987. Application.**

The provisions of this article shall be applicable to public beaches used for overnight camping.

#### **7988. Refuse Handling.**

(a) Refuse containers approved by the Health Officer shall be provided in every camping area.

(b) All refuse shall be stored and removed in a manner which will not create a nuisance.

(c) Beach areas and areas set aside for camping shall, at all times, be maintained in a clean condition free of refuse.

#### **7988.1 Animals.**

No person shall bring onto or allow any animal, except guide dogs used by the blind, to remain on any beach which has been designated a public swimming beach by the state, any city, county, or city and county and where life guards are provided, except that horses may be ridden on designated equestrian trails and areas.

This regulation is not intended to prohibit or supersede any local ordinance not in effect which may be enacted.

#### **7989. Campsites.**

(a) No travel trailer, camp car, recreational vehicle or tent shall be located closer than six feet from any building or travel trailer, camp car, recreational vehicle or tent on an adjacent lot or campsite.

(b) Each vehicular lot or campsite in a camping area shall have direct access.

#### **7990. Sanitary Facilities.**

(a) Toilets shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code.

(b) Shower baths or other bathing facilities are not required; however, when provided, they shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code.

#### **7991. Maintenance.**

All sanitary facilities shall be maintained in a clean and safe condition.



**7992. Disposal of Sewage Wastes.**

(a) Wastewater or material from plumbing fixtures shall not be permitted to be deposited upon the ground.

(b) Campsites not provided with a drain inlet shall not be occupied by a travel trailer, car, or recreational vehicle equipped with plumbing unless the drain outlet of the vehicle is capped or as otherwise provided by part (c) of this section. Each campsite for use by vehicles equipped with toilets, unless self-contained shall be provided with a three-inch drain inlet.

(c) Other means of disposing of liquid wastes, not including human wastes, may be approved by the Health Officer.

(d) Trailer sanitation stations approved by the Health Officer and designed to receive the discharge of sewage holding tanks of self-contained vehicles shall be installed or available in an accessible location to every public beach campground area in which there are campsites not provided with drain inlets designed to receive the discharge of sewage wastes. Trailer sanitation stations shall be provided on the basis of one station for each 100 such campsites or portion thereof.

(e) Trailer sanitation stations shall be designed and constructed as required by Sections 5570 through 5580, Title 25, California Administrative Code.

**7993. Laundry Facilities.**

Laundry facilities are not required; however, when provided they shall conform to the State Plumbing Code, Part 5, Title 24, California Administrative Code.

**7994. Water Supply.**

When provided, potable water shall be from a source approved by the Health Officer and obtainable from faucets installed not more than 400 feet from each campsite. Potable water shall be adequate for all the requirements of the camping area.

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The SWRCB's Ocean Plan (SWRCB, 1997) establishes the following Water Quality Objectives for microbiological contamination (the sections dealing with kelp beds and shellfish harvesting are have not been included):

**II. Water Quality Standards****A. Bacterial Characteristics****1. Water Contact Standards**

Within a zone bounded by the shoreline and a distance of 1,000 feet from the shoreline or the 30-foot depth contour, whichever is further from the shoreline, and in areas outside this zone used for water contact sports, as determined by the Regional Board, but including all kelp beds the following bacterial objectives shall be maintained throughout the water column:

a. Samples of water from each sampling station shall have a density of total coliform organism less than 1,000 per 100 ml (10 per ml); provided that not more than 20 percent of the sample of any sampling station, in any 30-day period, may exceed 1,000 per 100 ml (10 per ml), and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 (100 per ml).

b. The fecal coliform density based on a minimum of not less than five samples for any 30-day period, shall not exceed a geometric mean of 200 per 100 ml nor shall more than 10 percent of the total samples during any 60-day period exceed 400 per 100 ml.

### **B. Bacterial Assessment and Remedial Action Requirements**

The requirements listed below shall be used to 1) determine the occurrence and extent of any impairment of a beneficial use due to bacterial contamination; 2) generate information which can be used in the development of an enterococcus standard; and 3) provide the basis for remedial actions necessary to minimize or eliminate any impairment of a beneficial use.

Measurement of enterococcus density shall be conducted at all stations where measurement of total and fecal coliforms are required. In addition to the requirements of Section II.A.I, if a station consistently exceeds a coliform objective or exceeds a geometric mean enterococcus density of 24 organisms per 100 ml for a 30-day period or 12 organisms per 100 ml for a six-month period, the Regional Board shall require the appropriate agency to conduct a survey to determine if that agency's discharge is the source of the contamination. The geometric mean shall be a moving average based on no less than five samples per month, spaced evenly over the time interval. When a sanitary survey identifies a controllable source of indicator organisms associated with a discharge of sewage, the Regional Board shall take action to control the source.

Waste discharge requirements shall require the discharger to conduct sanitary surveys when so directed by the Regional Board. Waste discharge requirements shall contain provisions requiring the discharger to control any controllable discharges identified in a sanitary survey.

The Ocean Plan's Standard Monitoring Procedures (Appendix II) provide guidance on monitoring.

### **Chapter II. A. Bacterial Standards:**

For all bacterial analyses, sample dilutions should be performed so the range of values extends from 2 to 16,000. The detection methods used for each analysis shall be reported with the rest of the analysis.

Detection methods used for coliforms (total and fecal) shall be those presented in the most recent edition of *Standard Methods for the Examination of Water and Wastewater* or any improved method determined by the Regional Board (and approved by EPA) to be appropriate.

Detection methods used for enterococcus shall be those presented in EPA publication EPA 600/4-85/076, *Test Methods for Escherichia coli and Enterococci in Water by Membrane Filter Procedure* or any improved method determined by the Regional Board to be appropriate.

### **A.2 FRESH WATER BEACHES**

#### **A.2.1 Department of Health Services [Also, see DHS' non-regulatory Guidance for Fresh Water Beaches.]**

Regulations for public beaches are published in Title 17 of the California Code of Regulations, Group 10.1 Sanitation of Public Beaches, beginning with Section 7972. They provide definitions, terms, and address the provision of water supply, toilets and sanitary facilities, maintenance, refuse handling, campsites and animals. These regulations are presented above.

#### **A.2.2 State Water Resources Control Board**

The SWRCB's Inland Waters Plan (SWRCB, 1993) and the Enclosed Bays and Estuaries Plan (SWRCB, 1995b) do not address microbiological contamination.

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## Appendix B. US EPA GUIDANCE FOR RECREATIONAL WATERS AND BEACHES

This section provides guidance from the United States Environmental Protection Agency, which released a planning document for beaches and recreational waters, **Action Plan for Beaches and Recreational Waters** (US EPA, 1999). US EPA also held regional conferences in 1999 on beach programs, and published the **conference proceedings** (US EPA, 2000).

### B.1 THE FEDERAL WATER QUALITY CRITERION FOR RECREATIONAL WATERS

The federal water quality criterion for recreational waters was established in 1968 by the Department of the Interior's National Technical Advisory Committee (NTAC, 1968). This criterion was recommended again by the US EPA in 1976 and 1986 (EPA, 1976, 1986). This criterion is follows:

Fecal coliforms should be used as the indicator organism for evaluating the microbiologic suitability of recreation waters. As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples taken over not more than a 30-day period, the fecal coliform content of primary contact recreation water shall not exceed a log mean of 200 per 100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400 per 100 ml.

The value of 400 fecal coliforms per 100 ml was derived from a concentration of 2300 total coliforms per 100 ml, which corresponded to the density at which a statistically significant increase in swimming-associated gastrointestinal illness was observed. Fecal coliforms comprise about 18 percent of the total coliforms.

### B.2 MARINE WATERS

The US EPA evaluated health effects of microbiological contamination on recreational use of marine waters (Cabelli, 1983). Subsequently it published guidance on water quality for recreational use in *Ambient Water Quality Criteria for Bacteria - 1986* (US EPA, 1986).

EPA's guidance for marine recreational waters is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 19 cases/1000 swimmers. Its steady state geometric mean indicator density at the acceptable rate is 35 enterococci per 100 ml. The rate of 19 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml.

EPA's criterion (US EPA, 1986) for bathing (full body contact) recreational waters for marine water is as follows:

Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed 35 per 100 ml.

No sample should exceed a one-sided confidence limit (CL), using the following as guidance:

Designated bathing beach area	upper 75% CL
Moderate full body contact recreation	upper 82% CL
Lightly used full body contact recreation	upper 90% CL
Infrequently used full body contact recreation	upper 95% CL

based on a site-specific log standard deviation, or if site data are insufficient to establish log standard deviation, then using 0.7 as the log standard deviation.

From the EPA's guidance document, single sample limits (in enterococci per 100 ml.) are:

Designated bathing beach area	= 104 enterococci per 100 ml.
Moderate full body contact recreation	= 124 enterococci per 100 ml.
Lightly used full body contact recreation	= 276 enterococci per 100 ml.
Infrequently used full body contact recreation	= 500 enterococci per 100 ml.

The above recommendations notwithstanding, the US EPA did not recommend a change in the stringency of its bacterial criteria for recreational waters, finding that such a change did not appear warranted until more information on the new indicators was accumulated.

### B.3 FRESH WATER

The US EPA evaluated health effects of microbiological contamination on recreational use of fresh waters (Dufour, 1984). Subsequently it published guidance on water quality for fresh water recreational use (US EPA, 1986).

EPA's guidance for fresh recreational waters is based upon an "Acceptable Swimming Associate Gastroenteritis Rate" of 8 cases/1000 swimmers at a steady state geometric mean indicator density of 33 enterococci per 100 ml or 126 *E. coli* per 100 ml. The rate of 8 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml.

EPA's criterion for bathing (full body contact) recreational waters for fresh water is as follows (US EPA, 1986):

Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed one or the other of the following (Note that only one indicator should be used. The regulatory agency should select the appropriate indicator for its conditions.):

*E. coli*, at a concentration of 126 per 100 ml., or  
enterococci, at a concentration of 33 per 100 ml.

No sample should exceed a one-sided confidence limit (CL), using the following as guidance:

Designated bathing beach area	upper 75% CL
Moderate full body contact recreation	upper 82% CL
Lightly used full body contact recreation	upper 90% CL
Infrequently used full body contact recreation	upper 95% CL

based on a site-specific log standard deviation, or if site data are insufficient to establish log standard deviation, then using 0.4 as the log standard deviation.

From the EPA's guidance document, the single sample limits (in *E. coli* per 100 ml., or in enterococci per 100 ml.) are:

Designated bathing beach area	= 235 <i>E. coli</i> per 100 ml., or 61 enterococci per 100 ml.
Moderate full body contact recreation	= 298 <i>E. coli</i> per 100 ml., or 89 enterococci per 100 ml.
Lightly used full body contact recreation	= 406 <i>E. coli</i> per 100 ml., or 108 enterococci per 100 ml.
Infrequently used full body contact recreation	= 576 <i>E. coli</i> per 100 ml., or 151 enterococci per 100 ml.

As mentioned above, the US EPA did not recommend a change in the stringency of its bacterial criteria for recreational waters, finding that such a change did not appear warranted until more information on the new indicators was accumulated.

### **B.3.1 Specific Standards Set by US EPA for Colville Indian Reservation, Washington.**

The US EPA (40 Code of Federal Regulations 131.35) has established fresh (surface) water quality criteria for several classes of water, as follows:

**Class I (Extraordinary)**, including these designated uses: Water supply (domestic, industrial agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, salmonids and other fish; wildlife habitat; ceremonial and religious water use; recreation (**primary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class I water the bacteriological criteria are: The geometric mean of the enterococci bacter densities in samples taken over a 30-day period shall not exceed 8 per 100 ml, nor shall any single sample exceed an enterococci density of 35 per 100 milliliters. This limits are calculated the geometric mean of the collected samples approximately equally spaced over a 30-day period.

**Class II (Excellent)**, including these designated uses: Water supply (domestic, industrial, agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, salmonids and other fish, and crayfish rearing, spawning and harvesting; wildlife habitat; ceremonial and religious water use; recreation (**primary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class II water the bacteriological criteria are: The geometric mean of the enterococci bacter densities in samples taken over a 30-day period shall not exceed 16 per 100 ml, nor shall any single sample exceed an enterococci density of 75 per 100 milliliters. This limits are calculated the geometric mean of the collected samples approximately equally spaced over a 30-day period.

**Class III (Good)**, including these designated uses: Water supply (Industrial, agricultural); stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, of salmonids and other fish, and crayfish rearing, spawning and harvesting; wildlife habitat; recreation (**secondary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class III water the bacteriological criteria are: The geometric mean of the enterococci bacteria densities in samples taken over a 30-day period shall not exceed 33 per 100 ml, nor shall any single sample exceed an enterococci density of 150 per 100 milliliters. This limits are calculated as the geometric mean of the collected samples approximately equally spaced over a 30-day period.

30-day period.

**Class IV (Fair)**, including these designated uses: Water supply (industrial); stock watering; fish migration of salmonids and other fish; recreation (**secondary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Class IV water no bacteriological criteria are identified. No streams are identified as Class I

**Lake Class**, including these designated uses: Water supply (domestic, industrial, agricultural), stock watering; fish and shellfish—migration, rearing, spawning, and harvesting, of salmonids and other fish, and crayfish rearing, spawning, and harvesting; wildlife habitat; ceremonial and religious water use; recreation (**primary contact recreation**, sport fishing, boating and aesthetic enjoyment); and commerce and navigation.

For Lake Class water the bacteriological criteria are: The geometric mean of the enterococci bacteria densities in samples taken over a 30-day period shall not exceed 33 per 100 ml, nor shall any single sample exceed an enterococci density of 150 per 100 milliliters. This limits are calculated as the geometric mean of the collected samples approximately equally spaced over a 30-day period.

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**Appendix C. LOCAL GUIDANCE AND ORDINANCES**

DHS polled local environmental health departments about the status of their recreational water programs. The following summarizes the responses DHS received, as of May 1997, for counties that utilize specific numeric levels for monitoring and corrective action. Those who are interested in the current status of local programs should contact the local environmental health programs directly.

**C.1 OCEAN BEACHES** [Certain beaches are subject to **monitoring and posting requirements from April 1 through October 31** of each year. The statutory and regulatory requirements are in **Appendix A**]

**C.1.1 Los Angeles County**

Los Angeles County has a comprehensive ocean water contact sports area regulatory program. County's policy directs the health officer to close affected portions of a beach and post "Beach Closed" signs "when there is a known incident of sewage pollution or chemical contamination, and ... a health risk exists to persons engaging in water contact activities."

Beaches that are affected by sewage shall be closed for a minimum of 48 hours. Guidelines for closure, in terms of gallons of sewage spilled or discharged, are:

Less than 1,000 gallons	= 1/4 mile each side of discharge
1,000 - 10,000 gallons	= 1/2 mile each side of discharge
10,000 - 100,000 gallons	= 1 mile each side of discharge
100,000 - 1 million gallons	= 3 miles each side of discharge
1 million - 2 million gallons	= 5 miles each side of discharge
More than 2 million gallons	= 10 miles or more on each side of discharge

Subsequent sampling will be done at locations to be determined on the basis of the reported volume of the spill, prevailing winds and currents, location of the discharge, and extent of the closure. The Protocol includes sampling points in relation to the size of the sewage spill (e.g., a spill less than 1,000 gallons would be sampled at three locations: at the spill and 1/4 mile on either side of the spill). Beaches will be reopened when data from bacteriological analyses indicate bacteria counts are within acceptable health levels.

The following bacterial standards are used in the LA County protocol:

1. California total coliform standard (Title 17, California Code of Regulations, Section 7958): No single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 cfu per 100 ml., nor shall more than 20 percent of the samples within a 30-day period at any sampling station exceed 1,000 cfu per 100 ml.
2. US EPA recommendation for enterococcus: No single sample shall exceed 104 colony forming units (cfu) per 100 ml., nor shall the log mean of five or more samples taken over a 30-day period exceed 35 cfu per 100 ml.
3. Santa Monica Bay Epidemiology Study: No single sample with a total coliform level that exceed 5,000 cfu per 100 ml shall have a total coliform to fecal coliform ratio of 5 or less (See Haile *et al.*, 1996).

Bacterial levels are considered to be elevated when two consecutive samples reveal the following:

1. Total coliform exceeds 10,000 cfu per 100 ml.
2. Enterococcus exceeds 104 cfu per 100 ml. in combination with total coliform that exceeds 1,000 cfu per 100 ml.
3. Total coliform exceeds 5,000 cfu per 100 ml. in combination with total coliform to fecal coliform ratio of 5 or less.

An evaluation is to be conducted to determine the cause that includes, but is not limited to, an evaluation of the bacteriological data, an on-site field investigations and consultation with monitoring personnel.

LA County also has a public notification process that issues public advisories to wire services whenever a significant beach area is closed to the public. Public advisories are also issued when a significant rain storm is predicted or occurs, explaining that storm drain flows may cause elevated bacterial counts for approximately 72 hours and ocean water contact, especially in areas adjacent to storm drain flows, should be avoided.

### **C.1.2 Mendocino County**

Mendocino County reopens beaches following sewage spills when total coliforms are less than 1000 per 100 ml, fecal coliforms are less than 200 per 100 ml, and enterococci are less than 3 per 100 ml.

### **C.1.3 Orange County**

Orange County samples from many regular sampling stations, samples are taken from water ankle-deep in the surf zone, waist-deep or deeper in harbors. Samples are taken 6-12 inches below the water surface. The county issues beach advisory press releases after 0.2 inches of rain and posts warning signs at creek or drain mouths due to fluctuating coliform values. It closes beaches after sewage spills or when total 20 percent of coliforms exceed 1000 per 100 ml., and reopens beaches when two consecutive sampling days show levels "well below" 1000 total coliforms per 100 ml.

### **C.1.4 Monterey County**

Monterey County posts warnings on ocean beaches when fecal coliforms meet or exceed 200 per 100 ml., or total coliforms meet or exceed 1000 per 100 ml. Beaches are closed when the standard is exceeded, with visual presence of chemicals or human waste.

#### **C.1.5 San Diego County**

San Diego County samples approximately monthly, for total and fecal coliforms. Levels for posting warnings, beach closure, and reopening beaches are 1000 total coliforms and 200 fecal coliforms per 100 ml.

#### **C.1.6 San Francisco**

San Francisco samples regularly from shoreline sampling stations at high use areas, and areas adjacent to outfalls. Analyzes for total and fecal coliforms, enterococci, and *E. coli*. Follows 17 CCR §7958 for posting, closure and reopening beaches.

#### **C.1.7 San Luis Obispo County**

San Luis Obispo County samples as needed, generally during the rainy season, during heavy rainfall periods. Sampling is also done if a major sewage spill occurs in the watershed supplying stream sources that reach the ocean beach areas. Analyzes for total and *E. coli*. Follows 17 CCR §7957 for posting, closure and reopening beaches.

#### **C.1.8 San Mateo County**

San Mateo samples year round along coastal area under the influence of water treatment plants. Beaches are closed when total coliforms exceed 1000 per 100 ml, or when fecal coliforms exceed 200 per 100 ml.

#### **C.1.9 Santa Cruz County**

Santa Cruz County samples one/week or one/month, according to location, some stations all year, some May-September. The county has one regular sampling station per beach, and samples water at ankle depth. Analysis is for fecal coliforms, and there is also extensive parallel testing for total, enterococci, *E. coli* and fecal streptococcus. Warnings are issued when two consecutive samples of fecal coliforms are over 200 MPN per 100 ml. Beach closure occurs with a significant raw sewage spill. Reopening occurs when samples return to 200 MPN per 100 ml for fecal coliforms.

### **C.2 INLAND SALT WATER BEACHES (Salton Sea)**

#### **C.2.1 Imperial County**

Imperial County samples monthly, two samples per beach, from regular sampling stations, taken from waist-deep water. Sampling is from areas most frequented by people, or from sampling grids. Analyzes for total and fecal coliforms. For posting warnings, the county uses regional water board criteria, coupled with evidence of source of human pollution. It has no guidance for closure/reopening. Uses board authority of health officer to post warnings, in the absence of inland water standards.

#### **C.2.2 Riverside County**

Riverside County samples weekly, about four samples per beach, from regular sampling stations chosen because they represent heavy use areas. Samples are taken from 6 inches below water surface, and analyzed for total and fecal coliforms. Levels for posting warnings and closing beaches are 200 fecal coliforms per 100 ml two weeks in a row. Beaches are reopened with samples lower than 200 per 100 ml.

### **C.3 FRESH WATER BEACHES**



### **C.1 Kern County**

Kern County samples its lakes and reservoirs twice per month, from May through August, three samples per beach/recreational area, from regular sampling stations. Samples are analyzed for total and fecal coliforms. Posting warnings, beach closure, and reopening beaches are based on total coliform level of 1000 per 100 ml.

### **C.2 Los Angeles County**

For freshwater recreational areas, Los Angeles County's Code uses the following:

- (1) Total coliform: No single sample shall exceed 10,000 cfu per 100 ml. Not more than 10 percent of the samples tested shall exceed 1,000 cfu per 100 ml. Of all samples collected over 30 day period, the mean shall not exceed 500 cfu per 100 ml.
- (2) Total coliform/fecal coliform ratio: No single sample with a total coliform level of 5,000 cfu per 100 ml. or greater shall have a total coliform/fecal coliform ratio of 5 or less.
- (3) Enterococci: No single sample shall exceed 61 cfu per 100 ml. A minimum of 5 samples equally spaced over a 30-day period shall not exceed a log mean of 33 cfu per 100 ml.

### **C.3 Riverside County**

Riverside County samples weekly, about four samples per beach, from regular sampling station chosen because they represent heavy use areas. Samples are taken from 6 inches below water surface, and analyzed for total and fecal coliforms. Levels for posting warnings and closing beaches are 200 fecal coliforms per 100 ml two weeks in a row. Beaches are reopened with samples lower than 200 per 100 ml.

### **C.4 San Bernardino County**

Santa Bernardino County has an ordinance that applies to all water contact recreation resorts (WCRR), where the definition of an WCRR includes all public water contact recreation facilities which direct or indirect fee is charged for the use of the facility. WCRRs include water theme parks, swim or wave lagoons, natural and man-made lakes and water courses, and similar public water contact recreational places (Ordinance No. 3020). Microbiological quality, which is regulated by the county Department of Environmental Health Services (DEHS) is addressed in section 31.054(b). The regulation calls for routine sampling and analysis at a frequency, and from representative locations, as determined by the DEHS. The fecal coliform density from any consecutive sets of samples collected within any thirty (30) days shall not exceed an arithmetic mean of two hundred (200) organisms per one hundred (100) ml. When fecal coliform density any sample collected exceeds one thousand (1,000) per one hundred ml, the DEHS shall order the closure of the water contact area and follow-up daily sampling shall be immediately commenced with waters analyzed for fecal coliform for at least two (2) consecutive days. If any follow-up daily sample exceeds one thousand (1,000) per one hundred (100) ml., the water contact area shall remain closed, and with the appropriate signs posted and maintained by the owner/operator, and shall not reopen without prior written approval being obtained from the DEHS. The DEHS may also direct sampling for specific pathogens. WCRRs that utilize an approved filtration and disinfection system may, upon approval by the DEHS, maintain a daily log of disinfectant and pH test reading in lieu of microbiological sampling. Fecal coliform sampling shall be conducted prior to the commencement of each season's use and as requested by the DEHS. Routine water samples shall be obtained from representative portions of the swim area at a depth of two (2) feet.

### **C.5 San Joaquin County**

San Joaquin County samples its lakes/reservoirs and rivers once per week May through September, one sample per beach from regular sampling stations. Samples are taken from

waist-deep water, and analyzed for total and fecal coliforms. Levels for beach closure: one sample exceeding 400 fecal coliform/ per 100 ml or five consecutive samples taken within a 30-day period exceeding a mean of 200 fecal coliforms per 100 ml.

### **C.6 Santa Cruz County**

Santa Cruz County's county ordinance (Ord 1472, 11/25/69) establishes Section 7.72.0030 as the bacteriological standard for freshwater contact sports areas: Samples of water from each sampling station at such a freshwater contact sports area shall have a count of fecal coliform organisms less than 200 organisms per 100 milliliters, provided that not more than 20 percent the samples at any sampling station, in any 30-day period, may exceed 200 per 100 milliliters

### **C.7 Solano County**

Solano County samples as needed for complaints during May-September, and routinely analyzes for shistosoma complaints only.

### **C.8 Tuolumne County**

Tuolumne County's lakes/reservoirs, rivers, and artificial impoundments are sampled on a volunteer basis, at about 10 organized beaches. Sampling is once per month, one to three samples per beach from regular sampling stations, April through September. Samples are taken six inches deep one foot away from structures/shore, and analyzed for total and fecal coliforms. Warnings and closures occur in response to sewage spills. Beaches are reopened when fecal coliforms are back to background levels. The county uses an advisory level for discontinuing water contact of 1200 MPN fecal coliforms per 100 ml., in the absence of sewage contamination.

### **C.9 Yolo County**

Yolo County's rivers and creeks are sampled only when there is a complaint or when an incident of pollution occurs. For warning and closure, the county uses a standard of not to exceed a daily average of 2400 coliforms per 100 ml. Repeated testing at least on two consecutive days is required to establish a warning/closure action, and the same procedure is required for removal of such order.

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### **Appendix D. MICROBIOLOGICAL INDICATOR ORGANISMS IN STANDARDS AND GUIDANCE**

To protect the recreating public from exposure to microorganisms associated with the presence of sewage in at beaches and in recreational waters, health agencies use microorganisms such as total coliform bacteria, fecal coliform bacteria, enterococci, or *E. coli* as indicators of water quality. Though they are not considered disease-causing agents, their presence above certain numeric levels is suggestive of the presence of other, difficult to detect and quantify pathogenic microorganisms that can cause health effects. The use of the general indicators is an inexpensive, effective way of monitoring the overall well-being of recreational waters.

The use of indicator organisms is public health protective. However, using surrogates as monitoring endpoints makes quantitative risk assessments difficult, and does not enable development of dose/effect relationships, traditional risk assessments (as used in the regulation of chemical contaminants, for example), and predictions of actual risk from disease-causing organisms in recreational waters. The difficulty arises from:

- determining exposure to the disease-causing microbes (the "dose"), which requires quantitation of the specific organism under actual recreating circumstances, which, even possible analytically, is expensive. For example, monitoring for specific pathogens such as *Giardia* or *Cryptosporidium* is costly and appears not to yield predictable, reliable results.

- determining the risk of illness (the "effect"), which requires epidemiological studies of the recreating public in parallel with water analyses for specific. Epidemiological studies of recreational bathers that have been done generally use indicator organisms, though case-histories of specific disease outbreaks are more specific (see **Appendix E**).

**D.1 Microbiological Indicator Organisms**

**D.1.1. Total Coliform Bacteria**

The term total coliform bacteria refers to a number of bacteria including *Escherichia*, *Klebsiella*, *Citrobacter* and *Enterobacter*. They are able to grow at 35° C and ferment lactose. These are a gram negative asporogenous rods and have been associated with feces of warm-blooded animals. They are also present in soil.

**D.1.2 Fecal Coliform Bacteria**

Fecal coliform bacteria are a subgroup of the total coliform group. They are able to grow at 44. C and ferment lactose. These bacteria have found use as indicators of fecal contamination, because they are restricted to the intestinal tract of warm-blooded animals. Their use enables separation of bacteria of soil and fecal origin.

Among the fecal coliform group, *E. coli*, an indicator of fresh fecal pollution, has also found some use as an indicator organism (US EPA, 1986).

**D.1.3 Streptococcus Bacteria (and Enterococcus Group)**

The table below indicates the *Streptococcus* species and subspecies that are used as indicators of fecal contamination.

Indicator organism	Enterococcus group*	Streptococcus group
Group D antigen		
<i>Streptococcus faecalis</i> **	X	X
<i>S. faecalis</i> subsp. <i>liquefaciens</i>	X	X
<i>S. faecalis</i> subsp. <i>zymogenes</i>	X	X
<i>S. faecium</i> **	X	X
<i>S. bovis</i>		X
<i>S. equinus</i>		X
Group Q antigen		
<i>S. avium</i>		X

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\* excludes *S. bovis*, *S. equinus*, and Group Q organisms.

\*\*also includes some Group Q antigen reactive types that occur in humans, dogs, and pigs.

The normal habitat of fecal streptococci is the intestines of humans and animals; therefore the microorganisms are indicators of fecal pollution. (*Standard Methods for the Examination of Water and Wastewater*, American Public Health Association, 1985). The enterococcus group is a subgroup that is considered more indicative of pollution associated with human sewage. The streptococcus group, when there is a predominance of *S. bovis* and *S. equinus*, is considered to be related to the excreta of nonhuman, warm-blooded animals, as might be related to meat-processing plants, dairy wastes, and feedlot and farmland runoff. *S. faecalis* subsp. *liquefaciens*, besides being associated with mammalian feces, is also associated with vegetation, insects, and certain soils, and may predominate when counts are low (less than 100 per 100 ml).

#### **D.1.4 Other Indicators**

A number of possible indicator organisms other than those presented above have been evaluated for marine waters. As summarized by US EPA (1986), other microorganisms that were evaluated for their correlation with swimming-associated gastroenteritis included *Klebsiella*, *Enterobacter/Citrobacter*, *Clostridium perfringens*, *Pseudomonas aeruginosa*, *Aeromonas hydrophila*, *Vibrio parahaemolyticus*, and Staphylococci. Because of poor correlation, none of the was considered helpful as an indicator organism.

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### **Appendix E. EPIDEMIOLOGICAL AND OTHER STUDIES RELATED TO OCEAN WATER AND FRESH WATER RECREATION**

#### **E.1 OCEAN WATER**

This section presents a brief overview of epidemiological studies of swimmers and other studies of ocean water and fresh water.

#### **Cabelli, 1983**

This study evaluated health effects of microbiological contamination on recreational use of marine waters and developed US EPA criteria, based on the mathematical relationship of the swimming-associated rate of gastrointestinal symptoms among bathers to the quality of their water. Enterococci were used as a fecal indicator.

The data, based on 26,686 subjects who responded to follow-up interviews, were collected in an epidemiological research program of the US EPA from beaches in three areas: (1) New York City, New York, in 1972, 1973 and 1974, 15,882 respondents; (2) Lake Pontchartrain, New Orleans, Louisiana, in 1977 and 1978, 6,751 respondents; and (3) Boston Harbor, Massachusetts, in 1974, 4,053 respondents. Water samples were collected from chest-high depths.

The recommended health effects criterion for marine recreation waters was described by the equation

$$\log X = 0.0456Y + 0.677 \quad \text{[Equation 1]}$$

where:

X is the mean enterococcus density per 100 ml., and  
Y is the swimming-associated rate per 1000 people for gastroenteritis (highly credible gastrointestinal symptoms).

Subsequent to the Cabelli study, US EPA developed guidance (US EPA, 1986) for marine recreational waters. This guidance is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 19 cases/1000 swimmers, developed from the Cabelli study. The rate of 19 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml. Its steady state geometric mean indicator density at the acceptable rate is 35 enterococci per 100 ml. An acceptable one-time exposure is 104 enterococci per 100 ml.

### **Cheung et al., 1993**

This study of bathers in Hong Kong found *E. coli* to be the best indicator of illness.

### **Corbett et al., 1993**

This study found fecal coliforms to be the best indicator of health effects among Australian swimmers, better than fecal streptococci.

### **Fleisher et al., 1993**

These authors found no difference in health effects between British bathers and non-bathers at fecal streptococci densities less than 40 per 100 ml.

### **Kay et al., 1994**

In a randomized experimental epidemiological study in which British swimmers were assigned to exposed or unexposed groups, fecal streptococci were the best predictor of gastroenteritis effects. The threshold for GI effects was 33 fecal streptococci per 100 ml.

### **Fleisher et al., 1996**

This study of British swimmers found thresholds for febrile respiratory effects and ear effects at 60 and 100 fecal streptococci per 100 ml., respectively.

### **Haile et al., 1996**

This study evaluated health effects of microbiological contamination on recreational use of beaches at Santa Monica Bay in southern California, with attention to proximity of swimmers to large drains that empty onto the beaches. Total coliform, fecal coliform, enterococci, and *E. coli* were used as indicator organisms. The data, collected in 1995 and based on 13,278 subjects who responded to follow-up interviews, were collected at various distances from beach drains: 0, 10, 100 yards downcoast, 100 yards upcoast, and 400 yards upcoast in three different areas: (1) Santa Monica Beach near Ashland Avenue, Will Rogers Beach at Santa Monica Canyon, and Surfrider Beach near Malibu Creek, respondents. Water samples were collected from ankle-high depths.

The authors concluded that swimming in (or near) storm drains resulted in a higher risk of gastrointestinal and respiratory illness, compared to swimming at a distance (~ 400 meters) from those drains. These authors considered the best predictor of swimming-related illness to be the ratio of total coliform organisms/fecal coliform organisms when this ratio was less than 5, when the total coliform level was greater than 5000 per 100 ml. Subsequent analyses (Haile and Witte, undated) showed increased illness when the ratio was lower (e.g., as low as 10 to 18), and when the total coliform level was greater than 1,000 per 100 ml.

### **Prüss, 1998**

This evaluation of health risks associated with poor microbiological quality of recreational water reviews 22 epidemiological investigations, including 15 studies of marine waters and one study of fresh and marine waters.

### **Spear et al., 1996**

The SWRCB (1995a) identified the choice of indicator organism (*i.e.*, coliform vs. enterococcus for the water-contact bacterial standard and increased stringency of the water-contact fecal coliform standard as an issue to be addressed in its triennial review of the Ocean Plan. The SWRCB in 1990 required dischargers, if ordered by Regional Water Quality Control Boards (RWQCBs) to: (1) monitor for both coliform and enterococcus organisms, and (2) conduct sanitary surveys when either the coliform standards or a specified enterococcus level was exceeded. This approach, it was thought, would provide information on which organism was to be used for use in California. However, this was a controversial approach, so in 1992, the SWRCB convened an independent technical group, the Microbiological Advisory Committee (MAC), to provide advice on how to investigate the issue. Subsequently, a study was done under contract with the University of California, Berkeley to investigate the presence of each indicator organism at monitoring stations from two major ocean dischargers (City of San Diego and City and County of San Francisco). Those investigators found good correlation between enterococcus and coliform monitoring, and recommended no change from the total and fecal coliform monitoring, (Spear *et al.*, 1996).

## E.2 FRESH WATER

### Dufour, 1984

This study evaluated health effects of microbiological contamination on recreational use of freshwaters and developed US EPA criteria. These criteria were based on the mathematical relationship of the swimming-associated rate of gastrointestinal symptoms among bathers to the quality of their water. Enterococci and *Escherichia coli* were used as fecal indicators.

The data, based on 34,598 subjects who responded to follow-up interviews, were collected in an epidemiological research program of from beaches in two areas: (1) Lake Erie, Erie, Pennsylvania, in 1979, 1980 and 1982, 18,299 respondents; (2) Keystone Lake, near Tulsa, Oklahoma, in 1979 and 1980, 16,299 respondents.

The recommended health effects criteria for fresh recreation waters were described by the following equations:

$$\log Y = 1.464 + 0.0687 X \quad \text{[Equation 2]}$$

where

X is the swimming-associated rate per 1000 people for gastroenteritis (highly credible gastrointestinal symptoms), and

Y is the mean *E. coli* density per 100 ml.

$$\log Y = 0.938 + 0.059 X \quad \text{[Equation 3]}$$

where

X is the swimming-associated rate per 1000 people for gastroenteritis (highly credible gastrointestinal symptoms), and

Y is the mean enterococcus density per 100 ml.

Subsequent to the Dufour study, US EPA developed guidance (US EPA, 1986) for fresh recreational waters. EPA's guidance for fresh recreational waters is based upon an "Acceptable Swimming Associated Gastroenteritis Rate" of 8 cases/1000 swimmers. The rate of 8 cases of illness per 1000 swimmers is estimated to result from exposures to waters containing bacteria using the fecal coliform indicator group at the maximum geometric mean of 200 per 100 ml. Its steady state geometric mean indicator density at the acceptable rate is 33 enterococci per 100 ml. An acceptable one-time exposure is 65 enterococci per 100 ml.

**Calderon et al., 1991**

In this study of recreational swimmers using a pond (Calderon *et al.*, 1991) found a greater correlation between infectious disease and the number of other swimmers/bathers than it did between infectious disease and various microbiological indicators.

**Fresno County Community Health Department, 1996**

A cryptosporidiosis outbreak at a water park in Fresno County was attributed to the ingestion of pool water that may have been contaminated by *Cryptosporidium* oocysts from fecal accidents of infected individuals(s) or from the rinsing off of water from an untreated pond adjacent to the pool area (Fresno County Community Health Department, 1996).

**Kramer et al., 1996**

The Centers for Disease Control (Kramer *et al.*, 1996) reported 14 outbreaks of gastroenteritis in the US in 1993-1994, 10 of which were attributable to protozoan parasites in recreational water (e.g., *Cryptosporidium parvum* or *Giardia lamblia*) and the rest to *Shigella* spp., or *E. coli* O157:H7). Seven of these outbreaks occurred in lakes, one in a river, and six in pools.

**Levy et al., 1998**

The Centers for Disease Control (Levy *et al.*, 1998) reported 37 outbreaks in the US in 1995-1996. Of these, 22 were gastroenteritis outbreaks; causes included *Cryptosporidium parvum* (6), *Giardia* (1), *E. coli* O157:H7 (6), *Shigella sonnei*(3), and *Salmonella* serotype Java (1). Thirteen of the 22 gastroenteritis outbreaks were associated with lake water, eight with swimming or wading pools, and one with a hot spring. There were nine dermatitis outbreaks, of which two were lake-associated (swimmer's itch caused by *Schistosoma* species) and seven were hot tub-associated (*Pseudomonas*). The final six were single cases of primary amebic meningoencephalitis (all fatal, five in Texas and one in Florida, associated with a shallow lake, river, pond, or canal), caused by *Naegleria fowleri*.

Human feces appeared to be related to outbreaks associated with several lake-associated outbreaks.

**Prüss, 1998**

This evaluation of health risks associated with poor microbiological quality of recreational water reviews 22 epidemiological investigations, including six studies of fresh waters and one of fresh and marine waters.

**Warrner et al., 1996**

This outbreak, associated with *E. coli* O157:H7, involved 12 individuals who had visited an Illinois state park with a lake swimming beach.

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