

**USEPA REGION 9 LABORATORY  
RICHMOND, CALIFORNIA**

**STANDARD OPERATING PROCEDURE # 1106**

**STANDARD OPERATING PROCEDURE FOR  
VOLUNTEER MONITORING OF  
SURFACE WATERS FOR BACTERIA**

Revision 5  
Effective Date: 7/1/2009

Signature & Title

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**1. PURPOSE AND APPLICABILITY:**

This SOP defines procedures for volunteer collection of surface water samples to be analyzed for bacteria. These procedures are primarily intended for use by volunteer monitors. Prior to sampling, volunteer monitors should fill out the Volunteer Monitoring Information Form (Attachment A) and provide a copy to Amy Wagner, Volunteer Monitoring Coordinator, EPA Region 9 Laboratory, 1337 S. 46<sup>th</sup> Street, Bldg. 201, Richmond, CA 94804 (fax 510-412-2304). The form will assist in organizing sampling efforts and objectives.

These procedures address only routine sampling for a maximum of 10 water samples per day. If a project involves a larger number of samples, the matter should be referred to the EPA Region 9 Quality Assurance Manager to determine whether the procedures outlined in this SOP are appropriate. Samples collected by non-EPA employees are specifically not intended to be used in EPA enforcement proceedings.

Data Quality Objectives: The objective of sampling efforts under this SOP is to determine the presence and measure the concentrations of bacteria including total coliforms, *E. coli* and enterococcus in fresh and marine surface waters. The data produced will be suitable for comparison with EPA’s Ambient Water Quality Criteria for Bacteria - 1986 (EPA 440/5-84-002) for Bathing (Full Body Contact) Recreational Waters, listed below, and for comparison with State standards for other water uses:

EPA Ambient Water Quality Criteria  
 for Bathing (Full Body Contact) Recreational Waters

	<u>Fresh Water</u>	<u>Salt Water</u>
	<u><i>E. coli</i></u>	<u>Enterococci</u>
Geometric Mean * per 100 ml (All waters)	126	33
Maximum per 100 ml at:		
- designated beaches	235	61
- moderately used areas	298	89
- lightly used areas	406	108
- infrequently used areas	576	151

\* Geometric mean of five samples per month.

California lists the 1986 EPA criteria as a supplement to the 1995 California Water Quality Control Plan limits listed below. These limits are based on a minimum of five consecutive samples equally spaced over a 30-day period. In addition to contact recreational (bathing) limits, they also contain non-contact recreation and shellfish harvesting limits. Bacterial results for shallow streams may be compared with the non-contact recreation limits.

California Water Quality Objectives for Coliform Bacteria

<u>Beneficial Use</u>	<u>Fecal Coliform per 100 ml</u>	<u>Total Coliform per 100 ml</u>
Water Contact Recreation	Geometric mean < 200 90 <sup>th</sup> percentile < 400	median < 240 maximum 10,000
Non-contact Water Recreation	mean < 2000 90 <sup>th</sup> percentile < 4000	
Shellfish Harvesting	median < 14 90 <sup>th</sup> percentile < 43	median < 70 90 <sup>th</sup> percentile < 230

When reviewing results, it should be noted that *E. coli* is likely the major type of fecal coliform bacteria. *E. coli* results which are higher than a California fecal coliform standard indicate an exceedence of that standard. *E. coli* results which are lower than the California standard do not necessarily mean that the standard is achieved, although *E. coli* has been used interchangeably with fecal coliform and found to correlate very well in a major Southern California recreational monitoring study.

Water Quality Criteria developed in the late 1960's recommended total and fecal coliform limits in waters used for recreation, based on a minimum of five consecutive samples over a 30-day period. These were adopted into many state water quality standards, including California's Water Quality Objectives. Coliform bacteria, including the subset which respond to the fecal coliform tests can have both animal and plant origins. EPA's revised criteria, listed above, are based on *E. coli* and enterococci. These bacteria are produced only in the digestive tracts of warm-blooded animals and humans, and are therefore more specific indicators of fecal contamination. Epidemiological studies also demonstrated that these bacteria, while not necessarily pathogenic themselves, correlate well with gastrointestinal illness in swimmers, while total and fecal coliforms do not. Based on these studies, EPA advised states to revise their recreational water quality standards to limit *E. coli* and/or enterococci rather than total and fecal coliforms.

## **2. PROCEDURES:**

The equipment required for sampling includes an insulated cooler, ice, sterile sampling bottles with labels, zip-loc bags and rubber gloves. Sterile bottles, labels and chain-of-custody forms will be supplied by EPA. Coolers, ice, zip-loc bags, and rubber gloves are available at supermarkets and other general stores.

The number of samples and the analyses requested will be determined by the samplers. Generally larger numbers of samples provide more context for interpreting results. Bacterial levels in streams often increase from headwaters to receiving waters. Samples running along the length of a stream may allow monitors to determine where levels increase and potentially isolate sources. Suspected sources should be bracketed by upstream and downstream samples. Similarly, monitoring separate branches of a stream will provide information on their contributions to overall stream bacterial levels. Designated bathing beaches or other heavily used recreational areas are also common locations for bacterial monitoring. Both EPA and California criteria recommend a minimum of five sets of weekly samples.

Either total coliforms/ *E. coli* or enterococcus may be analyzed in each freshwater sample. Samples will be analyzed by the EPA Regional Laboratory using the Colilert and Enterolert methods. The total coliform/*E. coli* analysis is generally preferable for freshwater since it provides two endpoints and the results may be compared to both the EPA Water Quality Criteria for bathing waters and the California Water Quality Objectives for contact and non-contact waters. Enterococcus is recommended for marine waters. Marine samples must be clearly labeled with the word marine or seawater since the lab must dilute marine samples prior to analysis. Marine samples include ocean, bay and brackish samples. When in doubt, samples should be labeled brackish.

One sterile 120 ml bottle will be used per sample. The bottles have clear seals over their caps. Discard any sample bottle if its seal is broken. To sample, remove the seal and cap being careful not to touch the inside of the cap or bottle. It is not necessary to rinse out the sample bottle. Fill the bottle to the 100ml line, leaving the space above the line empty. If the sample bottle is overfilled pour the excess out. If the cap becomes contaminated use a new bottle. Cap the bottle tightly and label it using indelible ink with the sampler's name, the sample number, and the date and time. If the label is missing, you can write on the bottle or cap with permanent marker. Be sure to label the bottle and place it on ice before taking the next sample.

In streams, samples can be most easily taken from cascades. Sample the water stream and avoid touching rocks or other solid objects with the sample bottle. In deep water take samples by holding the bottle near the base and plunging it, neck downward, below the surface. Turn the bottle until it points slightly upward and is directed toward the current. If there is no current, as in the case of a reservoir or the ocean, create a current artificially by pushing the bottle forward horizontally in a direction away from the hand. For shallow waters attempt to sample the water without touching any solids.

Each sampler should keep a field notebook to record their sampling efforts and note any difficulties encountered when sampling which might affect the results (e.g., sample bottle touched stream bottom or sewage odors present). Other information that may assist in the interpretation of results, such as weather conditions, should also be recorded. Detailed descriptions or sketches of sites may also be useful to help relocate sample locations.

### **3. QUALITY ASSURANCE AND QUALITY CONTROL SAMPLES:**

For each sampling day, one duplicate sample will be collected for quality assurance and quality control. The duplicate sample will be a second sample collected at any location. The second sample should be collected as soon as possible and in the same manner as the first sample, and have the same sample number followed by a 'D.' Any problems encountered when collecting the duplicate sample should be noted. The results for duplicate samples should be similar. Although some variation in bacterial counts in consecutively collected samples is expected, a large difference (e.g. more than a factor of two) may indicate errors or contamination during field sampling or laboratory analysis. If duplicate samples exceed this criterion it may be prudent to resample.

Only dedicated pre-sterilized sample bottles will be used so there will be no field blank analyses performed. Samples are to be chilled with ice immediately after collection and during storage and transportation to the laboratory. Temperatures will be recorded upon arrival at the Regional Laboratory using an infrared thermometer; therefore no temperature blank is required.

### **4. HEALTH AND SAFETY:**

Samplers should never drink stream water and should wash their hands before and after sampling and before eating. Rubber gloves should be worn when sampling to help prevent contamination of the samples and to protect the sampler if pollution is suspected. Samplers must obtain permission before entering or sampling on private property. Additional health and safety tips are listed in the EPA methods manuals listed in the references section.

## **5. SAMPLE LABELS AND CHAIN-OF-CUSTODY FORM:**

All samples must be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have unique numbers. At a minimum, the sample labels will contain the following information:

- Sampler's name
- Sample number
- Sample location
- Date and time of collection
- Analysis: Either Colilert (for total coliforms and *E. coli*) or Enterolert (for enterococcus). Only one can be selected per sample bottle.
- Marine or brackish samples must be clearly marked.

The label information will also be recorded on an EPA chain-of-custody form which will be used to document sample collection and transportation to the laboratory. The sample location on the chain-of-custody form should be sufficiently descriptive so that another person could resample the same location. Global coordinates or routine identifiers, such as permanent sample station numbers, should be recorded if available. All samples will be 'grabs.' Write the analyses requested (Colilert or Enterolert) in the diagonal spaces at the top right of the form, and put an X in the appropriate box below for each sample. Use the Remarks column to record information such as the type of water (e.g., marine), and any problems encountered sampling.

When you are finished sampling be sure that all samples are recorded on the chain-of-custody form and that the sample numbers, times, and analyses requested on the form match those on the sample bottles. The sampler's name, address and phone number should also be written on the form.

## **6. SAMPLE DELIVERY:**

Amy Wagner, Volunteer Monitoring Coordinator (510-412-2329) should be notified as far in advance as possible of scheduled sampling by filling out the Volunteer Monitoring Information Form (Attachment A) and faxing it to 510-412-2304 or mailing it to:

Amy Wagner, Volunteer Monitoring Coordinator  
EPA Region 9 Laboratory  
1337 S. 46<sup>th</sup> Street, Bldg. 201  
Richmond, CA 94804

All sample containers must be placed in a cooler with ice for transport to the Regional Laboratory. Place ice in the cooler before collecting the first sample. Make sure all of the lids on the sample bottles are tight. Place the sample bottles upright in the cooler underneath the ice.

Samples must be hand-delivered to the EPA Regional Laboratory in Richmond California (1337 S. 46th Street, Building 201, Richmond, CA 94804) between 8 am and 4 pm, Monday through Thursday. Samples should be delivered as soon as possible on the day of sampling, but in no case more than 24 hours after collection of the first sample. Upon delivery, the sampler will sign the chain-of-custody record in the "relinquished by" box and note date and time. The Regional Laboratory Sample Custodian will sign the form and return the pink copy to the sampler.

**Please call the Sample Custodian (510-412-2377) if there are any changes or if scheduled samples will not be delivered.**

**7. DATA REPORTING:** Results for all analyses will be reported in writing from the Regional Laboratory to the sampler within 35 days after the end of the sampling event.

**8. REFERENCES:**

USEPA, Volunteer Lake Monitoring: A Methods Manual, EPA 440-4-91-002, 1991.

USEPA, Volunteer Estuary Monitoring: A Methods Manual, EPA 842-B-93-004, December, 1993.

USEPA, Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003, November, 1997.

**Attachment A**

Volunteer Monitoring Information

Organization:

Water body interested in sampling:

Expected sampling dates:

Sampling Objectives (what we hope to learn):

What we foresee as the use for the data:

Volunteer sampler's names:

On the back of this page sketch a map showing the water body to be sampled and the expected sampling locations.